HOME-BUILT MARINE DIRECTION FINDER

RADIO & TV NEWS

JUNE
1957
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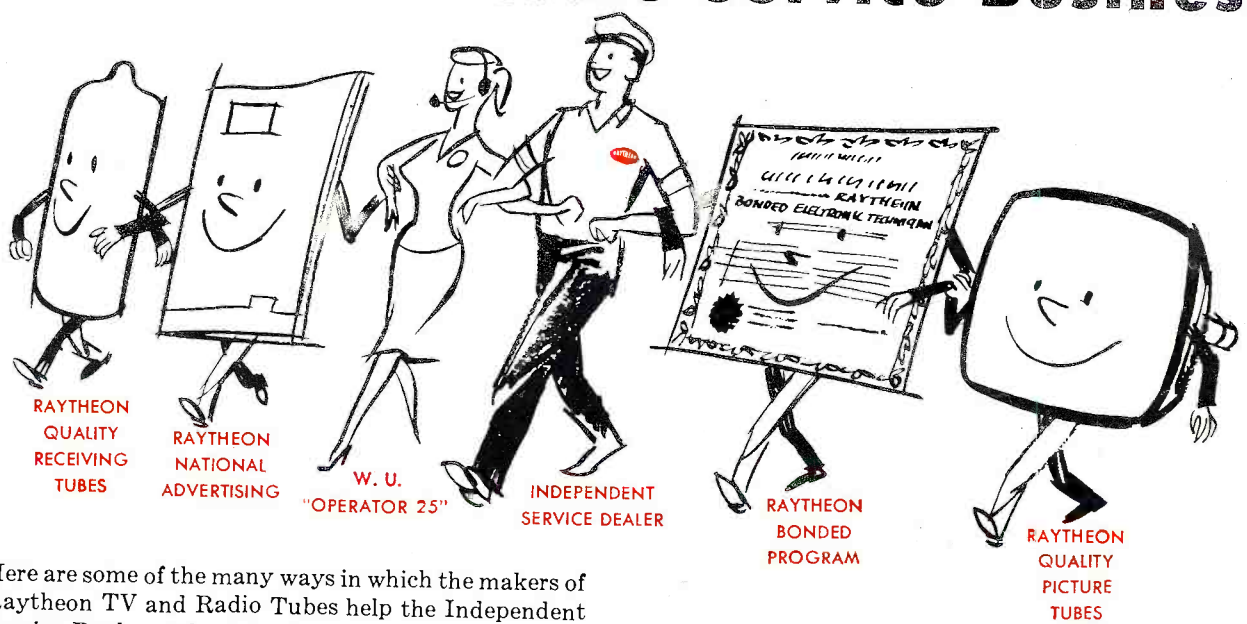
MAINTAIN & REPAIR YOUR OWN SWEEP GENERATOR

BATTERIES FOR TRANSISTOR RADIOS

A TRANSISTORIZED MARINE DIRECTION FINDER
(See Page 42)

How RAYTHEON Help

Independent Service Dealers with their TV-Radio Service Business



Here are some of the many ways in which the makers of Raytheon TV and Radio Tubes help the Independent Service Dealer with his business.

1 For nearly *12 years* Raytheon has offered the Raytheon Bonded Electronic Technician program to Independent Service Dealers. Dealers who qualify have their service and parts guarantee backed by a bond issued through Continental Casualty Company, one of the country's largest insurance companies. It gives them real prestige in the eyes of the customer.

2 Raytheon provides "Western Union Operator 25" service for Bonded Dealers in 23,000 cities and towns. In answer to phoned requests for fast, dependable, *bonded* TV-Radio service, "Operator 25" sends customers to Bonded Dealers.

3 Raytheon consistently runs national advertising, presenting Independent Service Dealers as the best in the business.

4 Raytheon has a network of *independent* distributors with well trained personnel who are eager to help *independent* dealers.

5 Raytheon makes a complete line of TV and Radio Tubes that are tops for replacement work — Raytheon All-Set Tubes — designed to help the versatile service dealer who repairs all makes and models.

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J. E. SMITH, FOUNDER

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RADIO & TV NEWS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), 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: one year U. S. and possessions, and Canada $4.00; Pan American Union Countries $4.50; all other foreign countries $5.00.

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COVER PHOTO: Bill Harvey, who handles the "Glaspar Mariner" and operates the Bay Shore Small Boat Center, Newport Beach, Calif., navigates with the tiny direction finder described in this month's issue, page 42. (Ektachrome by Peter J. Samerjan)

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JUNE, 1957

DEPARTMENTS

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC

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WILLIAM B. ZIFF (1898-1953) FOUNDER
Executive Office: 366 Madison Ave.
New York 17, N. Y. MU 7-8080
Editorial Office: 1 Park Ave.
New York 16, N. Y. MU 5-6367
VOLUME 57 • NUMBER 6

ABC Member Audit Bureau of Circulations

SUBSCRIPTION SERVICE. All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should allow at least four weeks for change of address. Include your old address as well as new—enclosing, if possible, an address label from a recent issue of this magazine.

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George D. Crouch, California, was a retail store clerk. He took the DeVry Program, and today is in the servicing field for himself.

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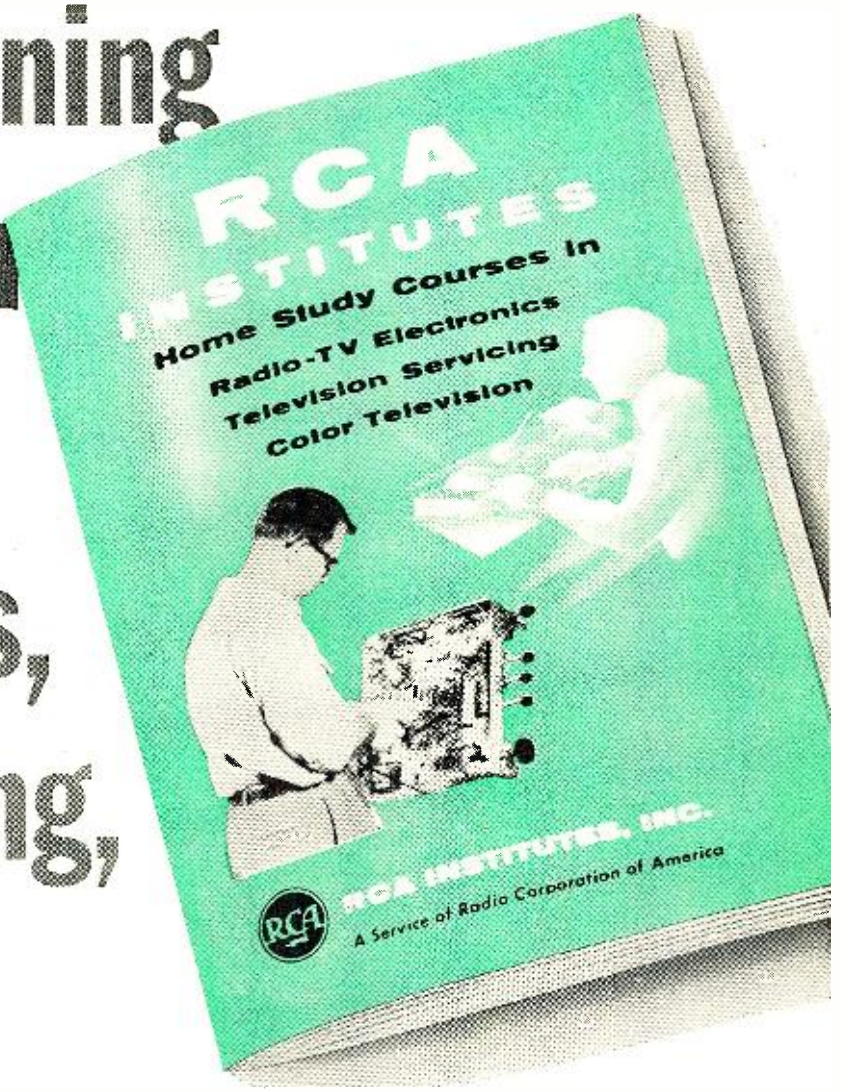

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For the RECORD

THE NEW GENERATION OF VIKINGS

AN INTERESTING and relatively quiet "revolution" has been under way in this country during the last ten years—one that indirectly affects many of us in the electronic industry.

We are, of course, speaking of the emergence of boating as the new and popular "family hobby." According to the National Association of Engine and Boat Manufacturers, Inc., the industry's trade association, there are some 5,971,000 craft of all types bobbing around on rivers, ponds, creeks, lakes, inland waterways, canals, off-shore waters, etc. This means that *one out of every twenty-eight persons* in the United States owned some sort of pleasure craft at the end of 1956!

The time-worn jokes about being an Admiral in the "Nebraska Navy" are no longer valid since with the many vast dam and waterway projects being undertaken by the federal government, man-made lakes are providing a readily accessible playground to those who formerly lived in what were popularly known as "land locked" areas.

Last year enthusiasts spent $1,250,000,000 (one and one-fourth billion dollars) on new and used boats, accessories, safety equipment, fuel, insurance, docking, maintenance, etc. This is big business with a vengeance and the interesting thing about this hobby is the way its tentacles reach out into so many diverse fields. The oil companies, textile firms, and electronic equipment manufacturers have all received a share in this bonanza. Marinas, waterfront docking, launching facilities, and other service businesses all command an impressive portion of the total amount of the boating check.

While the electronics industry has not, as yet, been as vitally affected as other segments, some slight idea of the growth of marine electronics can be obtained by noting that the Federal Communications Commission now lists 55,000 marine radiotelephones (at the end of 1956) as compared with a mere 8204 in 1947. Serious yachtsmen who operate in coastal waters are buying and installing more and more elaborate gear to insure the safety of their passengers and craft and add to the operating convenience of their vessels when the boats are cruising at a distance from shore. Small boat radars, two-way radio gear, depth finders, modified sonars for spotting obstructions, direction finders, and other gear which was formerly associated only with ocean-going vessels of commercial tonnage have been scaled down in size, complexity, and price and are finding their way into the modest size weekend pleasure craft.

The original dollar outlay for such equipment makes a pleasant tinkle in the cash registers of the dealers who handle the sale and installation of such marine electronic gear. This pleasant sound becomes an ear-soothing jangle to the service technicians who keep the equipment in top-notch condition! The reason is simple and has an interesting psychological twist. The customer who could "be heard in the next county" if presented with a $5.00 service bill for repairing his a.c.-d.c. table model radio receiver is an altogether different individual when it comes to settling up for work done on his marine gear.

Just as the domestic tyrant who protests the purchase of a new broom becomes a veritable spendthrift when the bill arrives for his new fishing gear, so the avid boatsman considers any outlay which will make his hobby more fun, cash well spent.

From the technician's point of view, this type of service holds an additional charm in that it is not a field where he has to battle competition from the "boy next door who just loves to fiddle with radios." This is a field for the "men"—the "boys" learn to grow up or get out.

The very nature of the equipment used on boats is such that only "professionals" can handle the work. Those who work on radiotelephone gear or any other signal-producing equipment must hold pertinent FCC licenses and maintain the highest standards of competence. This fact and because of the nature of the equipment itself, most boat owners have a healthy respect for the men to whom they entrust their service business. The relationship is that of the expert or "pro" rather than a service operation.

Handling such business entails certain sacrifices on the part of the technician in the way of additional schooling, preparation for FCC license exams (2nd class radiotelephone ticket or better) and the purchase of several nonstandard service shop test equipment items, but the rewards are commensurate. The pay is good, the work is interesting, and the future looks as rosy as the sun over the mainmast. It is a field well worth the consideration of the would-be technician as well as the old hand who is a bit disenchanted with his routine radio and TV service work. . . . . O. R.

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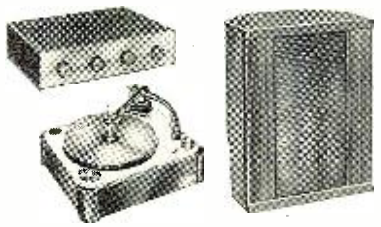

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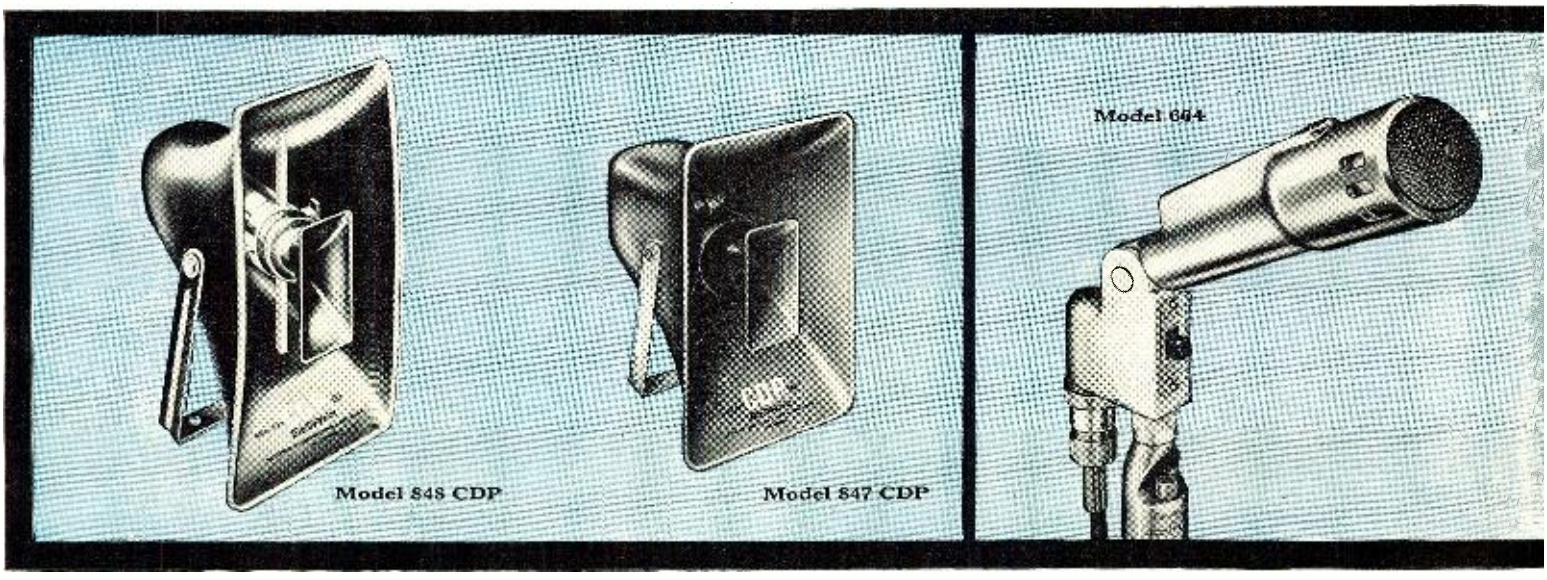

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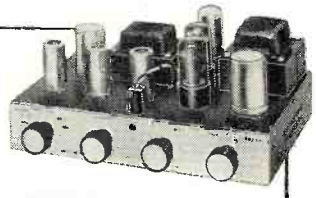

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The new Philco Universal Color and Dot Bar Generator, like all Philco Test Equipment, was designed by expert engineers who know service work best. Built by trained technicians to rigid and high quality standards for more dependable, more accurate, faster work on the job.

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- Regulated power supply.
- Separate R.F. and video attenuators.
- Positive and negative video signals for localizing trouble.
- Complete with R.F. and video cables.
- Tube complement of 14 tubes: 7-12AT7, 1-12AU7, 2-6CS7, 1-6CL6, 1-513, 2-OD3.

For Sure Success in Color Servicing

Philco Test Equipment is designed to help your profits grow by being faster and more accurate in solving every service problem. This latest Philco Universal Color Bar and Dot Bar Generator combining both services in one compact, lightweight case eliminates the nuisance of using separate instruments. Improved convergence signals are provided and a "white-raster" display is included to speed up accurate "color-purity" adjustments.

Now, it's no longer necessary to disable the set by removing a tube or changing circuit to obtain the "quiet", snow-free raster required. Halves the work time and eliminates old-fashioned methods requiring you to handle hot tubes. Front panel of etched aluminum with black knobs and easy-to-read etched markings. 18 lbs. light. Dimensions: 13⅜" wide, 11⅛" high, 9¾" deep.

Get the full story on how the Philco Universal Color Bar and Dot Bar Generator can streamline color servicing.

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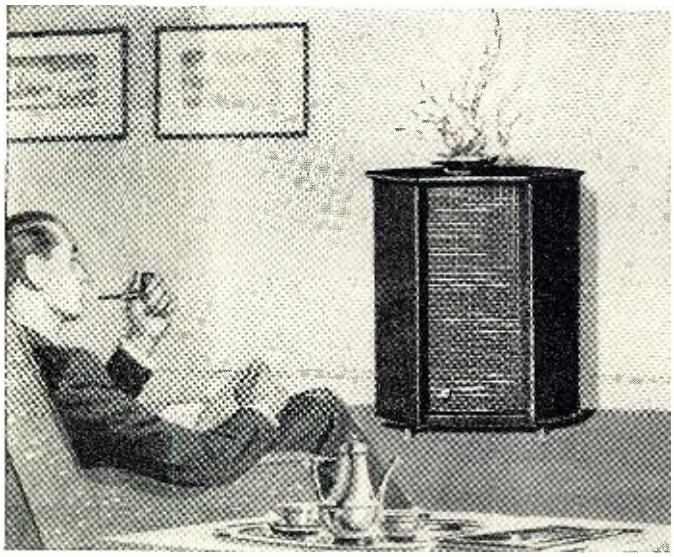

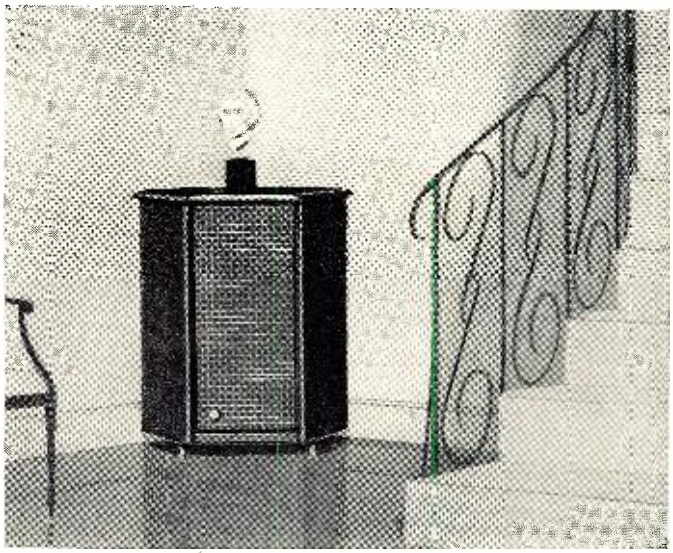

RCA 501S1 Biaxial Speaker—compares with models two or three times the price! Features 14.5 ounce Alnico-V magnet and 8-ohm voice coil. Its 12-inch woofer employs

Olson-developed foam damping ring; 3-inch tweeter is mounted off-axis to minimize crossover interference; high frequency response extends beyond 18,000 cps.

Suggested User Price (optional) $33.50

RCA 502S1 Direct Radiator Speaker—outstandingly smooth, unsurpassed in its frequency range to 16,000 cps. Features same construction as 501S1 and incorporates

medium-weight curved cone for smoothness, range, damping, and sensitivity to equal sound pressure of higher power speakers using double the power input.

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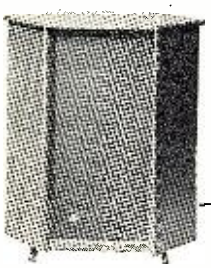
RCA Enclosures—Beauty in cherry or blonde cabinetry, the *solid Honduras Mahogany* will enhance room decor with the expensive look and feel of fine woods. Built for a lifetime of use, RCA enclosures feature mortise-and-tenon joints, glue-block



reinforcements and wood-screw clamping. For 12-inch speakers.

Suggested User Price (optional) 300W1 Cherry **$69.95**
301W1 Blonde **$74.50**

301X1 Adapter Panel—converts 12-inch enclosures for use with 8-inch speakers.
Suggested User Price (optional) $2.45

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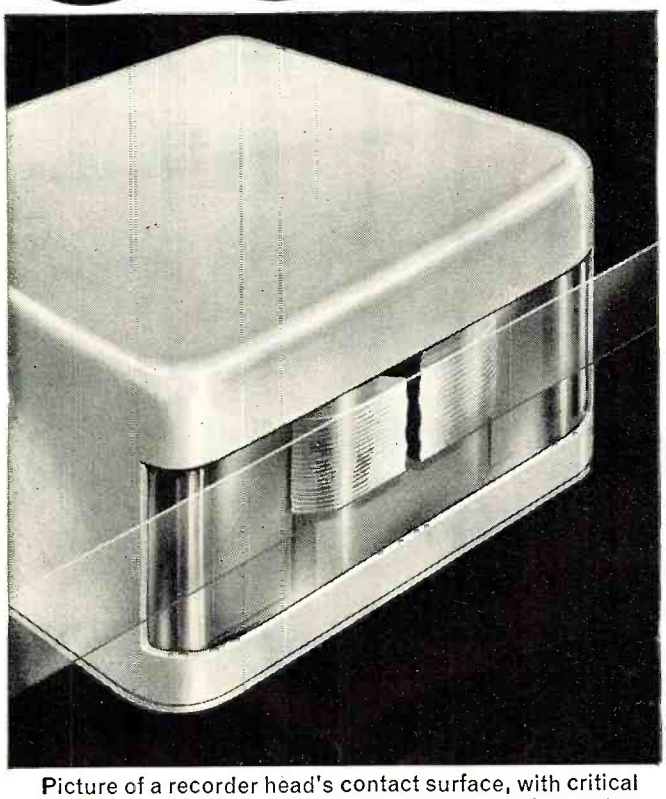
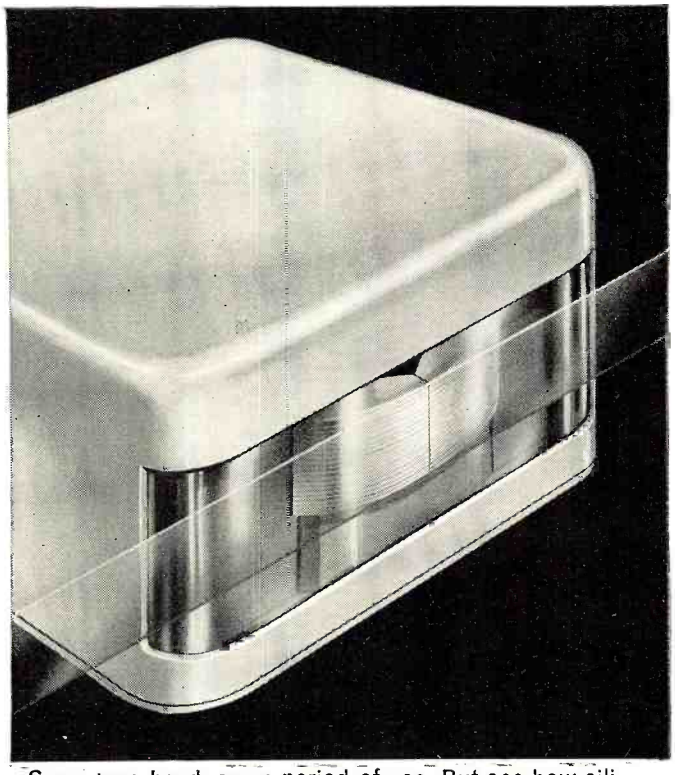


Picture of a recorder head's contact surface, with critical center gap eroded and enlarged by the wearing action of conventional magnetic tape.



Same type head, same period of use. But see how silicone lubricated "Scotch" Brand Magnetic Tape has saved the head from wear—assuring perfect response!

Read how "Scotch" Brand's built-in dry lubrication reduces recorder abrasion

Know what's the most vulnerable part of your recorder? It's the sensitive magnetic head—the tiny, precision-made part where lack of proper lubrication can cause annoying wow, flutter and harmful friction.

Compare the two magnetic heads magnified above. See for yourself what lack of proper lubrication can do. Like the heads in your recorder, each head is made with an almost invisible quarter mil gap over which tape passes. At left, abrasive action by conventional tape has worn down the head .0025 of an inch. (Small, yes, but enough to cause a frequency drop of a full octave!) Now, look how "Scotch" Brand Magnetic Tape has saved the head on the right. No wear. . . so no loss of sound.

Only "Scotch" Brand Magnetic Tapes perform this critical lubricating job for you. Exclusive silicone lubrication process (dry lubrication) lets tape glide smoothly, safely over the magnetic heads. And this famous safety feature lasts the life of the tape. Treat your machine to a reel soon.

Free Tape Tips—write Dept. **PF-67.**

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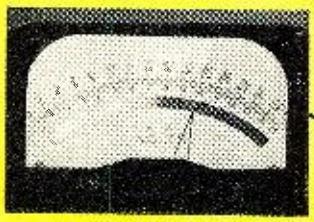
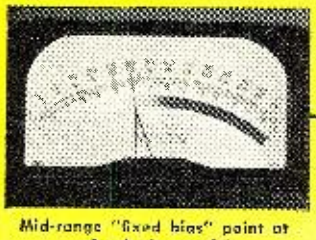
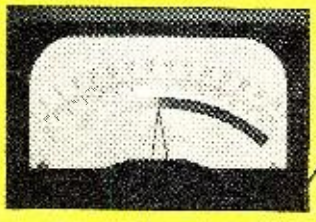


Low "fixed bias" point at —1 volt (bottom scale)



Mid-range "fixed bias" point at —3 volts (top scale)



High "fixed bias" point at —7.5 volts (bottom scale)

In determining the plate current (I_b) and Transconductance curves, grid bias is fixed at three points. These points, representing conditions of weak, average, and strong signals establish the nature of the plate current characteristic curve. The "fixed bias" points selected vary according to tube type.

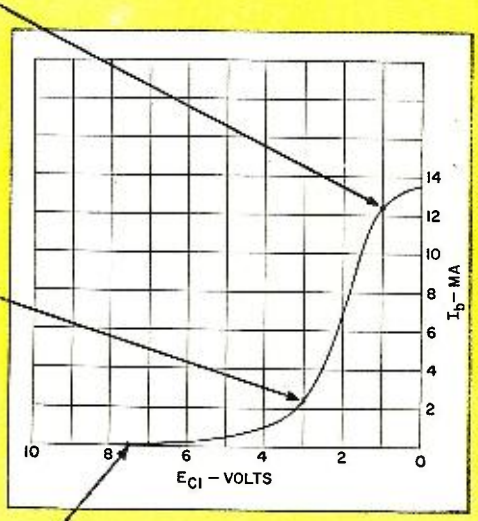
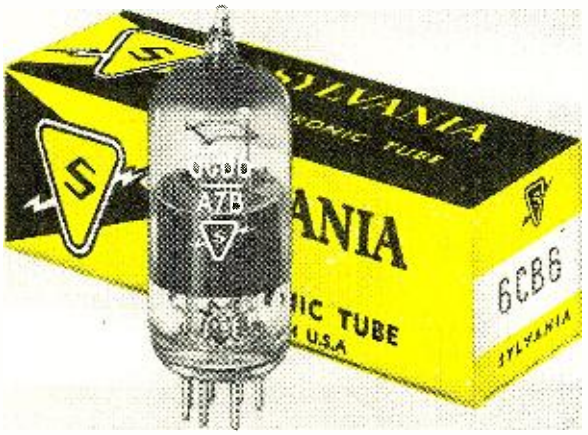


Plate current characteristics, shown on this typical test curve, are carefully controlled by the "fixed bias" test, assuring good performance and stable AGC functioning over a wide range of TV signal conditions.

Dynamic TV set conditions are set up in these test bridges making the "fixed bias" test a true measure of how the tube will perform in TV sets encountered by you in the field.



for stable performance and service dependability

It has always been Sylvania's policy to search for new and better ways to test tubes under dynamic conditions for closer control over performance. The "fixed bias" test is typical of these techniques. It places a more stringent, realistic measure on the tube's ability to perform under varying circuit conditions.

By controlling the plate current characteristics and transconductance of IF amplifier tubes, the "fixed bias" test gives the serviceman an extra measure of dependability regardless of make, model, or age of the TV set serviced.

The range of stable operation is controlled, too, for smooth AGC action over wide variations in signal strength.

These are the same reasons that Sylvania IF types are the choice of leading TV set manufacturers, attested by the wide assortment of Sylvania original types listed among IF tubes now in popular use.

In addition to the "fixed bias" test many other electrical tests are performed on Sylvania IF amplifier types including stability during life. During life tests, close controls are placed on interelectrode leakage.

In every way, Sylvania IF amplifier types offer you maximum assurance of trouble-free service based on sound, newly developed testing methods. Specify Sylvania IF amplifier tubes in the new yellow and black carton.

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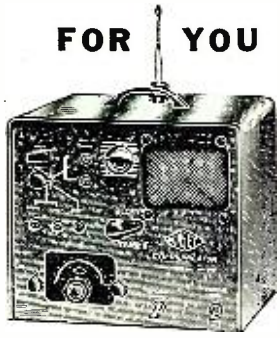

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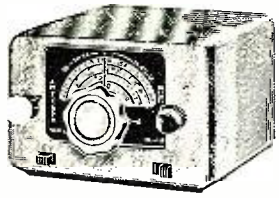

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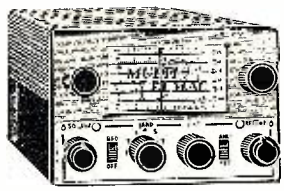

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He'll do a better job for you because he wants to. He's your neighbor. He pays taxes in your town. He has the same common interests and problems. He cares what *you* think of him and the service he gives you . . . because it's important to *his* business success.

So when your radio or TV needs repairs, call the man who cares. Call your independent service-dealer . . . the skilled technician who is trained and equipped to service promptly *all* makes of radio and TV sets at fair prices.

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Help us help you. Join with other independent service-dealers . . . your independent parts distributor . . . and CBS Tubes to make independent service strong.

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Remember.
The more you say, "I want CBS Tubes!", the greater support you give to your independent service-dealer campaign. Keep saying it. It will keep paying you business dividends.

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WASHINGTON EDITOR

FEDERAL OPERATION of the airway systems across the country, that has been sharply criticized by Congress and a number of civic groups, will soon have a "new look" that is expected to satisfy even the harshest complainant. The new look will take the form of a multi-million dollar network of electronic-communication centers from coast-to-coast that will supplement the present setup of 214 stations.

Commenting on the size of the program, CAA's director of the technical development center in Indianapolis, Don Stuart, said that the total plant investment in the Federal Airways system prior to June, 1956, was $172,000,000. In the fiscal-year 1957, $75,000,000 was appropriated for the establishment of air-navigation facilities, and the fiscal-year 1958 budget for the same activity is $175 million. The fiscal '58-dollar investment in air navigation, if all goes well, Stuart added, will be greater than the total plant investment over the past 30 years, or since the passage of the Air Commerce Act of 1926.

During the next five years, the CAA expert reported, radar control will be extended to additional terminal areas, to high-density routes, and to high-altitude area control. Longer range primary radar and secondary (beacon) radar will extend the advantages of radar-control methods beyond the present approach and departure areas, it was emphasized; it will expand the safe capacity of the air-traffic control system through better utilization of air space, simplification of the control function, and extension of control of traffic to an area basis.

In addition, Stuart said, airport surface detection equipment will permit improved control of traffic on the surface of major airports under poor visibility conditions. And by means of additional peripheral ground station facilities, improved contact for direct controller-pilot communications will be possible.

A DYNAMIC ILLUSTRATION of how the streamlined program of CAA is being carried out appeared recently in an announcement on contract awards.

It was disclosed that the air agency had ordered over $3-million worth of microwave-link installations that will be used to remote radar information from antenna sites into CAA air-route traffic-control centers. This will be done where, because of critical siting

NEW TELEVISION STATION GRANTS

An additional listing of new construction permits and changes that have been made in station call letters. List continued next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Florida	Jacksonville	WETJ	7	174-180	16.4
Montana	Glendive	.....	5	76-82	4.62
Texas	San Angelo	.....	3	60-66	3.02

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Arizona	Tucson	KGUN-TV (Formerly KDWI-TV)	9	186-192
California	Eureka	KHUM-TV	13	210-216
"	San Francisco	KPRT	26	542-548
Massachusetts	North Adams	WCDC (Formerly WMGT)	19	500-506
Montana	Helena	KABL-TV	10	192-198
Texas	Big Spring	KEDY-TV (Formerly KBST-TV)	4	66-72
Washington	Walla Walla	KRTV (Formerly KWAR)	8	180-186

* ERP = (effective radiated power, kw.)

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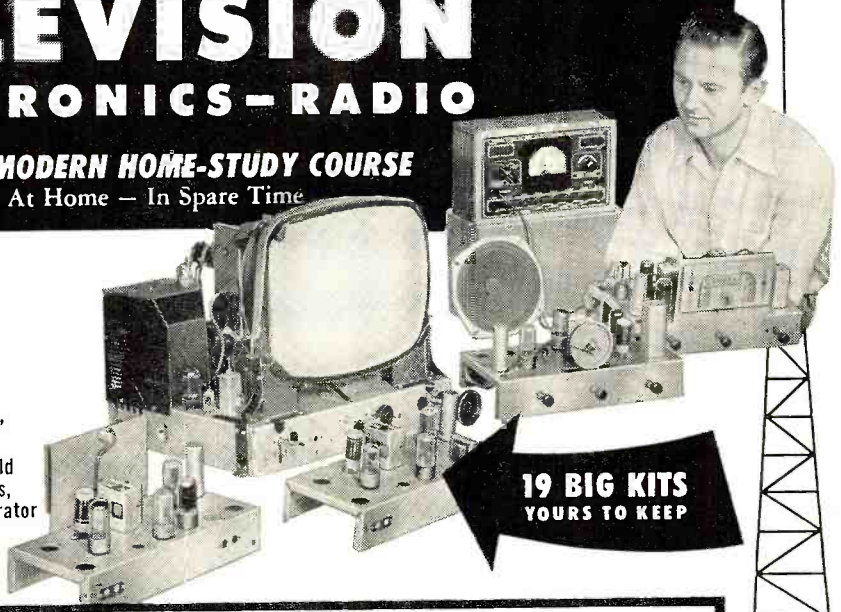

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problems, the antenna is placed more than two miles from the control center, or where radar coverage is required over congested areas many miles away from the control center.

The equipment, which operates at 7000 megacycles, breaks down the radar information at the antenna site and transmits it to the traffic-control center, where it is re-assembled before it reaches the radar scope as a display. The newly ordered equipment operates on line-of-sight and will require relay towers to carry information over long distances, because of the curvature of the earth's surface.

The longest distance to be covered by the links will be between Houston and the air-route traffic-control center at San Antonio, Texas, a distance of approximately 200 miles. This will require six of the sixteen relay towers provided for in the contract. Another link will be established between the Air Defense Command radar installation at Lackland Air Force Base into the San Antonio center. The area around Atlantic City, N. J., will have radar coverage from a Navy installation there, which will be remoted into the New York center by link with the help of a pair of relay towers.

Other locations where the new equipment will be used to carry information to air-route traffic-control centers will be: Boston, Pittsburgh, Cleveland, Atlanta, El Paso, Fort Worth, Miami, New Orleans, with one relay for each area; Detroit, Kansas City, one relay; St. Louis, one relay; Denver, one relay; Los Angeles and Oakland, two relays; Phoenix, where a new center is to be established; Salt Lake City, one relay; Seattle and Spokane, one relay.

In addition to those locations where the information will be remoted into an air-route traffic-control center, a link will be used at Benson, North Carolina, where a radar will be established and operated on the spot as a purely local operation to handle approach-control functions for Raleigh-Durham, Fayetteville Municipal, Pope Field at Fort Bragg near Fayetteville, and Seymour Johnson Air Force Base at Goldsboro, North Carolina, and for low-altitude tower control in the congested triangle covered by these installations.

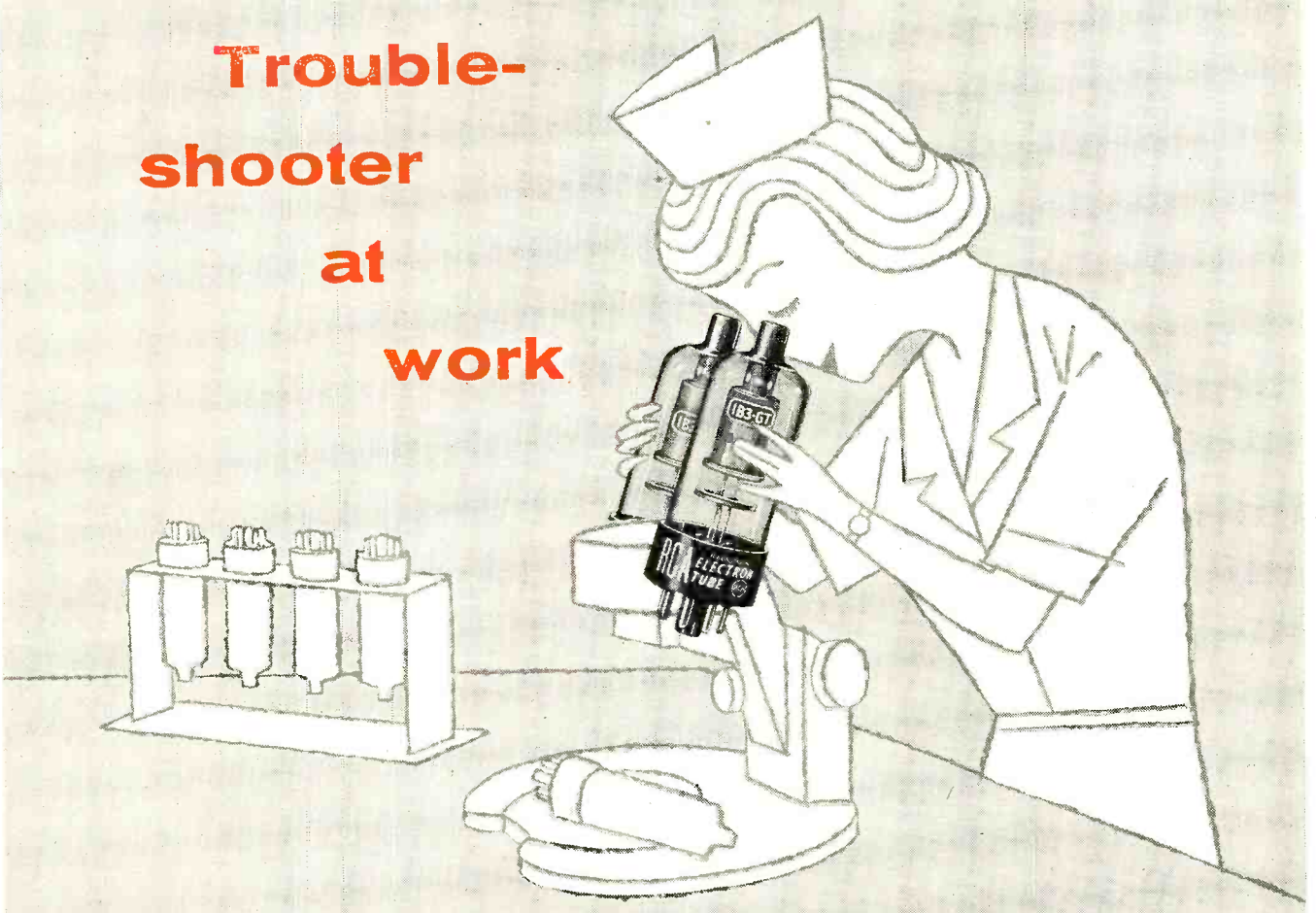
The microwave link order, covering 22 installations, was the second largest purchase of electronic equipment in the history of the CAA, exceeded only by a $9-million contract for long-range radar issued last November.

THE AIR FORCE, also concerned with the growth of air traffic, not only nationally, but world-wide, has decided to explore ways to revamp its communications system.

Today, it was pointed out, it is necessary to adopt many of the commercial practices in the high-quality radio relay, multiplex and long-distance switching systems developed for 4000-mile communication-system operation and adapt these to 10,000 to 15,000-

QUIET

Trouble-shooter at work



Here's how Microscopic Inspection by RCA helps reduce costly callbacks...

A bad tube, or a potential trouble-maker—can it get by this gal? Not likely. She's part of the specially trained RCA group of inspectors whose important job it is to find trouble and help prevent it from happening *to you*.

RCA Quality-Control Procedures include MICROSCOPIC INSPECTION OF POPULAR TV RECEIVING TYPES! These types are closely examined for possible poor welds, weld splatter, bad crimps, damaged stems, improper assembly, and many other factors that can affect top quality, long-term performance. Though the tubes may pass all electrical tests, such defects could slip by and mean the difference between a profitable service call and a costly callback.

You gain valuable assurances from this *extra* care: (1) that popular TV receiving types shipped to RCA Tube Distributors have had the *extra* benefit of the MICROSCOPIC INSPECTION PROGRAM and (2) that you can always service your customers with the confidence that RCA TV Receiving Types are top quality replacement tubes.

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RECEIVING TUBES

RADIO CORPORATION OF AMERICA

Tube Division, Harrison, N. J.

mile systems over large water areas as well as land masses. In this adaptation, one must remember that the capabilities of a civilian communications system must be used for normal as well as wartime operations. It has been found that it is too costly to duplicate such civilian systems with large military systems; and in addition there would be an impossible drain on technical manpower for engineering, installation, and operation in such a duplicate system.

The problem could be resolved, Air Force experts believed, through a system that would establish a standard for everyone.

In such a setup, now under investigation, there would be a modular multiplex system of 4-kilocycle channels with a basic 12-channel group and a 60-channel super group designed as a maximum 600-channel system. The plan would also provide radio relays with amplifiers for knife-edge diffraction and tropospheric scatter applications for transmission over large land areas and adjacent islands.

The complete operation, it was noted, would have to be engineered for universal application so that it could be used for voice, teletype, facsimile, telephoto, or data transmissions.

NOT ONLY ARE THE AIR FORCE and the CAA worried about airlane control, but the FCC is also beset by many problems. With more than 1¼-million transmitters in operation and the radio services expanding and multiplying, the scarcity of frequencies in many portions of the spectrum presents a serious situation.

Currently, three conservation techniques are offering aid in relieving heavily congested bands. They are known as offset carrier, single-sideband, and split-channel.

In TV broadcasting, as an example, a station may be required to operate with its carrier frequency offset 10 kilocycles above or below the normal carrier frequency. The channel assigned to such a station is, in consequence, designated plus or minus, as the case may be. Through careful planning, the application of this offset-carrier technique has resulted in less mutual interference between stations, making it possible to assign more channels.

Single-sideband has been used for many years on international radio-telephone circuits and, to some extent, for ship-to-shore communication. However, the percentage of stations using this type of transmission is very small, and most stations continue to transmit two sidebands, one slightly above and one slightly below the carrier signal. Since each of the two sidebands contains all of the information transmitted, technically there is a duplication of effort, and more frequency space is used than is actually required. By eliminating either of the sidebands, a narrower channel may be used and assignments

(*Continued on page* 161)

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only complete line of

TV and COMMUNICATION TOWERS

proven in Profits *and* Customer Satisfaction

look at these ROHN exclusives

- **HOT DIPPED GALVANIZED**
  The finest, most durable finish is available for ROHN Towers and accessories . . . all done entirely on the ROHN premises under careful ROHN supervision.
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  ROHN is the only design that has stood up over the years. ROHN has been first and foremost . . . and always the *leader* in new products to meet the changing demands.
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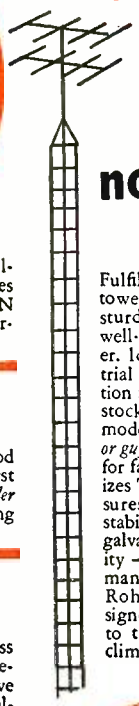
  ROHN was the first to utilize mass production techniques to build a superior tower at the most competitive prices. This means no sacrifice in quality yet far greater profits for you.
- **UNIVERSAL CUSTOMER ACCEPTANCE**
  Thousands and thousands of installations prove the ROHN line first in customer satisfaction.
- **PIONEER MANUFACTURERS**
  Pioneers in tower manufacturing—and today one of the world's largest manufacturers of this type equipment. The ROHN Company was built on satisfaction on the part of distributor, dealer and customer alike.
- **COMPLETE LINE**
  Only ROHN offers a full line—*one* dependable one-stop source for all TV installation equipment. Save headaches, save shipping costs, save time . . . use ROHN unequalled service *exclusively*.

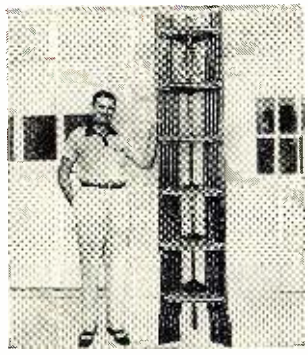
HIGHLIGHTS OF THE ROHN LINE



no. 6 tower

"All-Purpose" tower

Fulfills 75% of your general tower needs—is structurally as sturdy—yet *costs less* than the well-known Rohn No. 10 Tower. Ideal for home and industrial installations, communication requirements . . . eliminates stocking many different tower models. *Self-supporting to 50 ft. or guyed to 120 ft.!* Easy to climb for fast, efficient servicing. Utilizes *"Magic Triangle"* which insures *far* greater strength and stability. Permanent hot-dipped galvanized coating. Dependability — a feature customers demand — is assured with the Rohn No. 6 Tower . . . designed to "stand up" for years to the rigors of weather and climatic conditions.



Package Tower*

"Space Saver"— cuts storage space 300% or more!

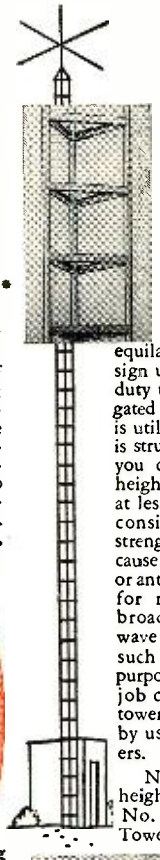
Popular PT-48 has almost 50′ of sturdy tower within a compact 8′ x 20″ package! "Magic Triangle" design is adapted to a pyramid shape using a wide 19″ base with progressively decreasing size upward. Decreases your overhead . . . easy to transport and assemble — cuts shipping costs. Galvanized throughout. Available in heights of 24, 32, 40, 48, 56 and 64 feet!

Both Towers Feature **THE ROHN MAGIC TRIANGLE***

For structural superiority, famed wrap-around "magic triangle" design is featured in these all-steel towers. Towers have full 2⅜" wide corrugated cross-bracing welded to tubular steel legs. The exclusive design assures dependable strength and permanence.

* pat. pending

COMMUNICATIONS TOWER



For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized. The No. 40 is structurally sound so you can install it for heights up to 300′; or at lesser heights when considerably greater strength is required because of excessive wind or antenna loading. Use for radio telephone, broadcasting, microwave relay and all other such communication purposes. If a particular job calls for this type tower, save real money by using ROHN towers.

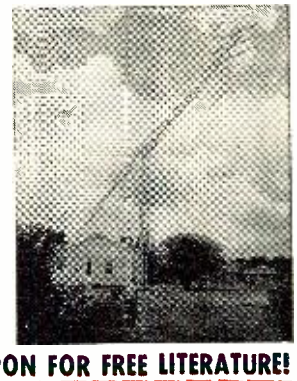
Note: For lesser heights, use the Rohn No. 20 or No. 30 Tower.

Telescoping Masts

Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. *Quick installation* . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives mast stability that can't be beat. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.

ROHN FOLD-OVER TOWERS

These unique fold-over towers are perfect for experimentation, TV service departments, amateur use, and special purposes. Uses regular ROHN tower sections with kit. Now available in standard No. 10 tower to 50′, and in ROHN No. 30 & No. 40 towers for heavy-duty use.



ALSO a full line of ROHN ACCESSORIES

Rotor posts, house brackets, eave brackets, peak and flat roof mounts, instant drive-in bases, hinged base sections, telescoping mast bases, guying brackets, UHF antenna mounts, erection fixtures, variety of mounts and supports for masts or tubing, tower installation accessories, TV service tables, mast and TV hot-dipped galvanized tubing, guy rings, "twister-anchors", rubber tower grommets, insulator sections, hinged rotor platform, accessory shelf and platform and dozens of other items. Get the complete catalog TODAY!

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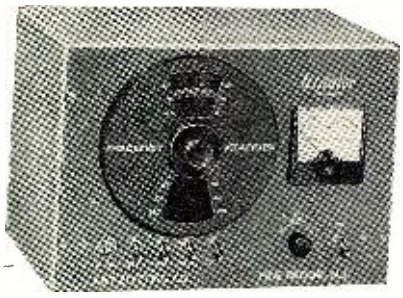
New Low-Cost, Precision Instruments for Service Calls or Shop Work

from KAY ELECTRIC



NEW KAY

Utilator

Portable, Compact Utility Oscillator

FEATURES

- AGC'd for Flatness
- Metered Output 0.7 V rms into 75 ohms
- Broad-Band 4.5 to 220 mc
- Direct Reading Dial
- High Quality—Low Price

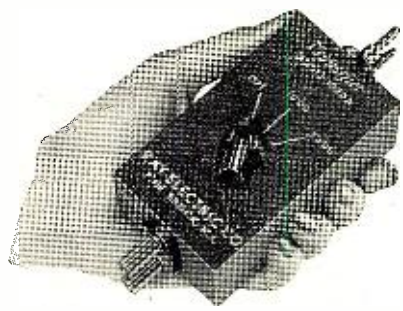
A small, compact utility oscillator designed for bench or field service, the new Kay *Utilator* covers the 4.5 to 220 megacycle range. The unit is completely self-contained with attenuators, power supply and output meter. The *Utilator* provides a high level RF output AGC'd for flatness over the range, and a direct-reading frequency dial accurate to ±1%.

SPECIFICATIONS

Frequency Range: 4.5 to 220 mc, in six switched bands, fundamental frequency
RF Output: 0.7 volts rms into nominal 75 ohms, metered; AGC'd
Flatness: ±0.5 db over the range
Frequency Calibration: Direct reading frequency dial calibrated to within ±1%
Attenuators: Switched steps of 20 db, 20 db, 10 db and 6 db, plus continuously variable 6 db
Dimensions: Width 11", Depth 6½", Height 8½"
Weight: 19 lbs.
Price: $295.00 F.O.B. Pine Brook, New Jersey

For Literature

on the Complete Line of Kay Transistorized Instruments, Write:



NEW KAY

Transifier

All-Transistorized, Plug-In Wide-Band Video Amplifier

FEATURES

- Broad-Band Response to 15 mc
- Completely Transistorized—Small, Self-Contained, Compact Portable Unit
- Signal Gain Controlled By Overall Feedback—Built-In Stabilization
- No Hum
- Long Stable Life—Powered By Two Penlight or Mercury Cells
- Units May Be Cascaded to Provide Additional Gain

The Kay **Transifier** is a **true** modular unit, completely transistorized, with built-in feedback circuit for stabilized signal gain. The unit is self-contained in a cast-aluminum housing with standard banana plug input and output.

The **Transifier** may also be used as a low level pulse amplifier or as a pre-amplifier for video and audio instruments, vacuum tube voltmeters, cathode ray oscilloscopes, tape recorders and microphones. Other uses include, use as a humless Audio Amplifier and as a Modular in control circuitry, and all types of Audio-Video Electronic devices.

SPECIFICATIONS

Frequency Response: 10 db Position: 3 db down at 20 cycles and 15 mc
20 db Position: 3 db down at 20 cycles and 10 mc
Gain: 10 db and 20 db switchable
Input Impedance: Capacitance 15 mmf—Resistive Component—20,000 ohms at 1 mc to 15,000 ohms at 10 mc
Output Impedance: 500 ohms, approximately
Maximum Output Voltage: 0.15 volts 10 db position
0.30 volts 20 db position
Price: $85.00 F.O.B. Pine Brook, New Jersey

See us at the Armed Forces Communications & Electronics Convention May 20-22, Washington, D. C., Booth 46

KAY ELECTRIC COMPANY

Dept. RT-6 **14 Maple Ave., Pine Brook, N. J.** **CAldwell 6-4000**

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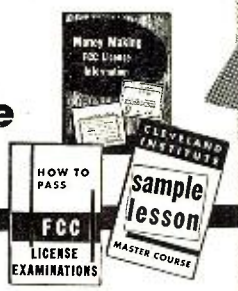

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We guarantee

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If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training, without additional cost of any kind, until you successfully obtain your Commercial license.

Employers Make Offers Like These To Our Trainees Every Month!

Radio Operators & Technicians — American Airlines has openings for radio operators and radio mechanics. Operators start at $334.53 per month. Radio mechanic's salary up to $1.99 per hour. Periodic increases with opportunity for advancement. Many company benefits.

Electronic Technicians — Convair Electronics Department: Radio and Radar Mechanics, Electronics Technicians, and Junior Engineers are wanted for a special program on fire control development and installation. Beginning rate: $365 and up.

Here's Proof:

Name and Address	License	Time
John H. Johnson, Boise City, Okla.	1st	20 weeks
Prentice Harrison, Lewes, Delaware	1st	27 weeks
Francis W. Bartley, Danbury, Conn.	2nd	15 weeks
Herbert W. Clay, Phoenix, Ariz.	2nd	22 weeks
Thomas J. Bingham, Finley, N. Dak.	2nd	9 weeks

(Names and addresses of trainees in your area sent on request)

We can provide names in your area on request

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OUR AMAZINGLY EFFECTIVE JOB-FINDING SERVICE Helps CIRE Trainees Get Better Jobs . . . Here are some recent examples:

Chief Engineer—"Since enrolling with Cleveland Institute I have received my 1st class license, served as a transmitter engineer and am now Chief Engineer of Station WAIN. I also have a Motorola 2-Way Service Station. Thanks to the Institute for making this possible."

Lewis M. Owens, Columbia, Ky.

Airlines—In a year and a half, he received his first class FCC License. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience.

Bob Thompson, Nashville 14, Tennessee

Test Engineer—"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."

Boyd Daugherty, Falls Church, Va.

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Cleveland Institute of Radio Electronics

Desk RN-6, 4900 Euclid Ave., Cleveland 3, O.

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

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- ☐ Radio-TV Servicing
- ☐ Home Experimenting
- ☐ Manufacturing
- ☐ Telephone Company
- ☐ Amateur Radio
- ☐ Other _____

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

Special Tuition Rates to Members of Armed Forces

Within the Industry

THOMAS E. DAVIS has been named national sales manager of the instrumentation division, *Ampex Corporation.*

Associated until last September with the electronics division of *Bing Crosby Enterprises,* Mr. Davis has been active in company sales since 1948. His earlier experience includes two years in charge of the Naval Air Transport Service Radar Lab. at Oakland Airport in California.

An electrical engineering graduate of the University of California at Los Angeles, he holds memberships in the Institute of Radio Engineers, Instrument Society of America, and American Institute of Electrical Engineers.

* * *

VICTOR H. POMPER has been elected vice-president of *Hermon Hosmer Scott, Inc.,* manufacturers of electronic instruments and high-fidelity amplifiers, tuners, and turntables. He will continue as a director of the corporation and will be responsible for over-all marketing, manufacturing, and personnel activities.

Mr. Pomper joined the company in 1950 as sales engineer, and successively was sales manager and assistant general manager. He received his bachelor and master degrees in electrical engineering from the Massachusetts Institute of Technology, where he was elected to Tau Beta Pi and Eta Kappa Nu, honorary engineering fraternities.

A registered professional engineer in Massachusetts, he is a Senior Member of the Institute of Radio Engineers, a member of the Acoustical Society of America, and belongs to several other national organizations in the field.

* * *

R. K. BURNS has been appointed to the position of distributor sales manager of *Gramer-Halldorson Transformer Corporation,* according to an announcement by the president of the firm.

Mr. Burns is no newcomer to the electronics parts field. Prior to his joining this organization, he had a background of 19 years with *Belden Manufacturing Company,* calling on distributors as district manager in major territories in the United States.

* * *

PACO ELECTRONICS COMPANY, INC., a newly formed division of the *Precision Apparatus Company,* has launched a new line of electronic test instruments in kit form.

These kits are expected to find wide application in radio and TV servicing, hi-fi custom building and service, electronic hobbies and amateur radio, science education and technical schools, as well as industrial testing and quality control.

In designing, engineering, packaging, and market researching the new kit line, the company has drawn heavily on the parent organization's 25 years of experience in the manufacture of test instruments and meters. Particular attention has been paid to ruggedness, ease of operation, simplicity of assembly and wiring, as well as appearance.

* * *

R. H. G. MATHEWS has been named manager of a newly formed high-fidelity radio-phonograph department of the television-radio division of *Westinghouse Electric Corporation.*

Mr. Mathews comes to the firm from the *Magnavox Company,* with which he had been associated for the past three and one-half years in the capacities of director of the high-fidelity division, and assistant to the vice-president and general manager, television-radio-phonograph division.

Having spent practically all of his adult life in radio and electronics, he brings to his new position a strong background of engineering, sales management, sales promotion, advertising, and administration in this field.

* * *

ASSOCIATION OF ELECTRONIC PARTS AND EQUIPMENT MANUFACTURERS, INC. has elected its officers to new positions at the group's first meeting as a not-for-profit corporation.

A. N. (Bud) Haas, *Bud Radio,* was named president. Helen Staniland Quam, *Quam Nichols Co.,* was elected first vice-president. Ken Hathaway, *Ward Leonard,* was re-elected treasurer, and Kenneth C. Prince was renamed executive secretary. Gail Carter, *Merit Coil & Transformer,* was elected to the new position of second vice-president.

Karl Jensen, *Jensen Industries,* was named to serve from August, 1957 to August, 1959 as one of two EP&EM representatives on the Electronic Industry Show Corporation, sponsors of the annual Electronic Parts Distributors Show.

In addition, nine directors also were chosen. They are: Wilfred Larson,

Build 20 Useful Transistor Sets from this NEW RCA BOOKLET...

Just Out!

24 exciting pages of up-to-the-minute information are contained in this brand new booklet—*RCA Transistors and Semiconductor Diodes*—one of the newest members of the RCA family of authoritative publications.

Whether you are a student, service technician, experimenter, radio amateur, or design engineer—you're sure to profit from the wealth of knowledge in the sections on *Characteristics* and *Theory*. Of special interest, too, is the *Transistor Interchangeability Directory*, which lists more than 500 types produced by 27 different manufacturers. There is valuable experience to be gained in building your own transistor sets. And 20 of the latest tried-and-tested circuits with *all parts values*, including coil and transformer details, are given in this RCA booklet.

For your next transistor project, remember that RCA *superior-quality* TRANSISTORS are now available through your RCA distributor.

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THESE 20 CIRCUITS!

- Code-Practice Oscillator
- Hearing Aid
- Grid-Dip Meter
- Phonograph Amplifier
- Phonograph Preamplifier
- 2-Transistor Receiver
- High-Gain Low-Distortion Low-Drain Audio Amplifier
- Portable Low-Drain High-Voltage Power Supply
- Sensitive Relay
- High-Gain Transformerless Signal-Tracing Probe
- 2-Stage Unneutralized 455-kc IF Amplifier
- 1-Stage Neutralized 455-kc IF Amplifier
- 4-Transistor Receiver
- Telephone-Pickup Amp.
- 6-Transistor Receiver
- Three-Tube, Two-Transistor Receiver
- 2-Stage 10.7-mc IF Amp.
- IF and Broadcast-Band Signal Tracer
- Microphone Preamplifier
- RF and Mixer-Oscillator Stages for 3-Band Receiver

HANDY TABLE OF POPULAR RCA TRANSISTORS

Class A AF amplifier	2N77, 2N104, 2N105, 2N206, 2N215
Class A Low-noise AF amplifier	2N175, 2N220
Push-pull Class B AF amplifier	2N109, 2N217, 2N270
Class A 455-Kc IF amplifier	2N139, 2N218
Converter in 540-to-1640-Kc band	2N140, 2N219
Class A RF amplifier	2N247
Push-pull Class B Power amplifier	2N301, 2N301-A

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I am enclosing 25 cents in coin. Please rush my copy of the new 24-page booklet "RCA Transistors & Semiconductor Diodes", Form SCD-108.

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

Switchcraft; Ted Rossman, *Pentron Corp.;* Robert Svoboda, *Amphenol;* Roy Laird, *Ohmite;* Les Thayer, *Belden Mfg.;* Earl Templeton, *P. R. Mallory;* Karl Jensen, *Jensen Industries;* Ralph Hill, *Grayhill;* and Norman Ackerman, *Perma-Power.*

* * *

E. A. LINK, founder and chairman of *Link Aviation, Inc.,* has been elected to the newly created post of vice-chairman of the board. He has also been appointed to the executive committee of *General Precision Equipment Corporation,* parent organization of the firm, according to the announcement.

Mr. Link is the originator of aerial trainers and simulators, and received the United States Air Force's highest civilian award, the Exceptional Service Award, in 1954.

* * *

RADIO-ELECTRONICS-TELEVISION MANUFACTURERS ASSOCIATION has proposed that its name be changed in recognition of industry trends.

The board of directors, upon the recommendation of the set, military products, and technical products divisions, referred to the organization committee a proposal that the present name be changed by substituting "Electronics" for the present "Radio-Electronics-Television" in the interest of simplicity, and in keeping with the growing diversity of the products of the entire industry.

The organization committee was asked to consider the proposals and make its recommendations to the board of directors at its next meeting. Among the new names suggested were "Electronic Industry Association" and "Electronic Manufacturers Association." If a name change is approved by the board, it will be submitted to the membership before being adopted.

* * *

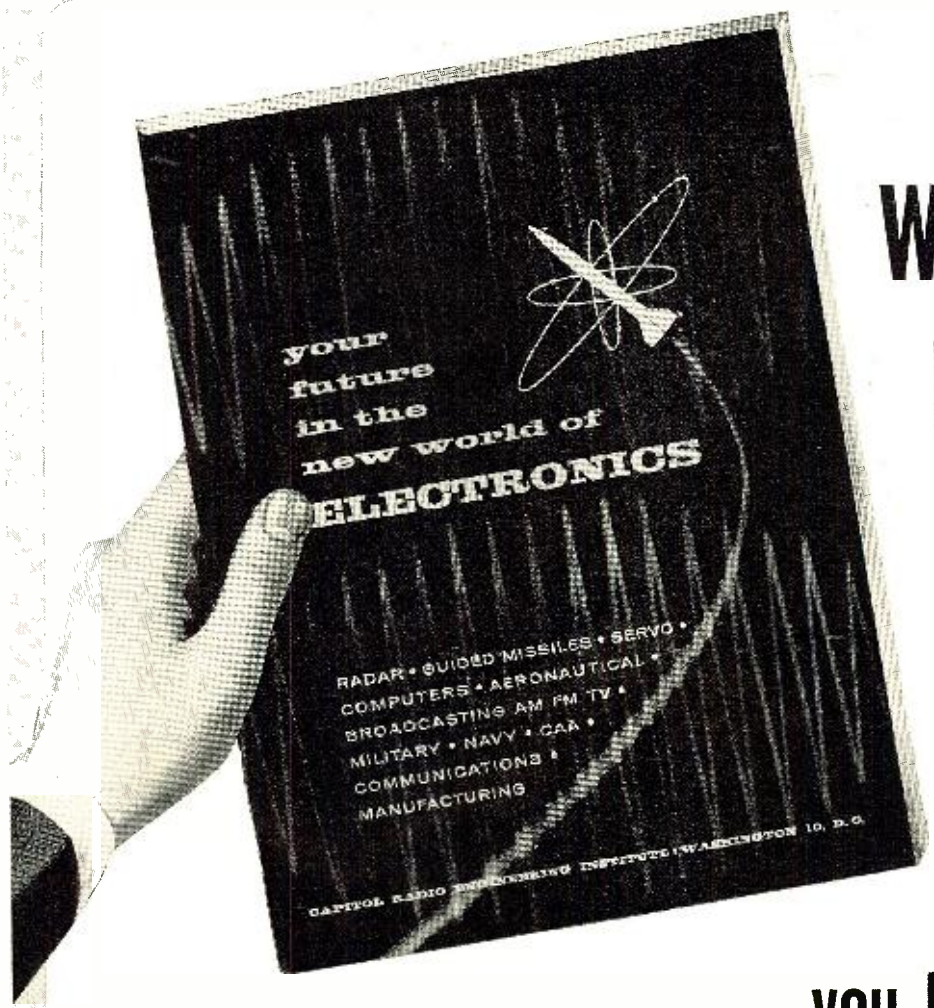
LAMOTTE T. COHU, president of *Kay Lab.,* was elected head of the newly formed *Cohu Electronics, Inc.*

Mr. Cohu said that the new corporation was formed to provide financial and business management for electronics manufacturing and development firms.

He has headed the senior firm for approximately two years. Prior to his joining the company, he was a former president of *American Airlines, TWA, Convair,* and *Northrop Aircraft.*

* * *

NATIONAL ELECTRONIC DISTRIBUTORS ASSOCIATION has moved to 343 South Dearborn Street, Chicago 4, Ill. . . . The Mincom Division of **MINNESOTA MINING & MANUFACTURING CO.** moved into new quarters at 11701 Mississippi Avenue, West Los Angeles, Calif. . . . A new 25,000 square foot plant for



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Please send me your course outline and **FREE** Illustrated Booklet "Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Practical Electronics Engineering Technology.

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- ☐ Broadcast (AM, FM, TV) Engineering Technology
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To help us answer your request intelligently, please give the following information:

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TYPE OF PRESENT WORK.....

SCHOOL BACKGROUND.....

ELECTRONICS EXPERIENCE.....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?.....

REK-O-KUT is scheduled to go into operation soon. The plant will be at 108th St. and 39th Avenue in Queens, N.Y. . . . **JERROLD ELECTRONICS CORPORATION** has formed an instruments and test equipment division . . . The electronic systems division of **SYLVANIA ELECTRIC PRODUCTS INC.** announces the establishment of a new reconnaissance systems laboratory at Mountain View, Calif. . . . **GENERAL TRANSISTOR CORP.** purchased a 20,000 square foot building, and the adjoining 20,000 square feet of ground at 91-27 138th Place, Jamaica, N.Y. The firm's executive and administrative offices are now being moved into the new quarters . . . **BLONDER-TONGUE LABORATORIES** consolidated its engineering, manufacturing, and administrative operations at 9-25 Alling Street, Newark, N.J. . . . **SPERRY RAND CORPORATION** announces plans for the construction of a new 150,000 square foot plant near Bristol, Tenn. . . . **RAYTHEON MANUFACTURING COMPANY** announces that construction is under way on its 42,000 square foot electronic laboratory at Santa Barbara, Calif. . . . Expansion plans for **THE BABCOCK & WILCOX COMPANY'S** research center are in the offing . . . Establishment of the **PACKARD BELL COMPUTER CORPORATION,** an affiliate of **PACKARD-BELL ELECTRONICS CORPORATION,** has been announced. The new facility is located at 11766 West Pico Blvd., West Los Angeles, Calif. . . . **DIAMONITE PRODUCTS MANUFACTURING COMPANY** has opened research laboratory, product development, and pilot production facilities in connection with its recently occupied manufacturing plant. Coincident with the opening of the research laboratories, general offices of the company have moved to larger quarters at 1232 Cleveland Avenue, N. W., Canton 3, Ohio . . . **CBS-HYTRON,** tube and semiconductor manufacturing division of **COLUMBIA BROADCASTING SYSTEM, INC.,** announces a consolidation of all packing, shipping, testing, and warehousing operations of its receiving tube plants in Salem, Danvers, and Newburyport, Mass. in a modern warehouse on Parker Street in Newburyport . . . **BECKMAN INSTRUMENTS, INC.** is now located at 325 North Muller Avenue, Anaheim, Calif.

* * *

THE DATICS CORPORATION, serving government, science, and industry in data reduction, research, and development in the computing, data reduction, and data processing fields, scientific computation, data processing, and consulting services has been formed. The firm is located at 6000 Camp Bowie Blvd., Fort Worth, Texas . . . **AMPEX CORPORATION** has finalized plans for the formation of a completely integrated subsidiary company devoted exclusively to products designed for the consumer retail market. The new firm is known as **AMPEX AUDIO, INCORPORATED,** and is located at Sunnyvale, Calif. Phillip L. Gundy, who is a vice-president of the parent company, is the president . . . **EL-TRONICS, INC.**

(*Continued on page* 134)

NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

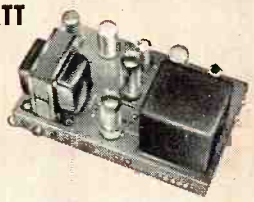
with Preamplifier, Equalizer & Control Section

KIT $34.95 WIRED $57.95

Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist: 20 cps:** 2% @ 4.2 w; ½% @ 2.5 w; **30 cps:** 2% @ 11 w; ½% @ 6.3 w; **40 cps:** 1% @ 12 w; ½% @ 9.3 w; **2000 cps:** ½% @ 12 w; **10 kc:** 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 3⅝" x 12" x 8¼". 13 lbs.

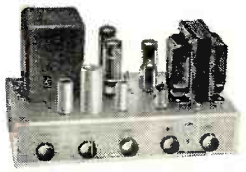
COMING SOON

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER



HF50 KIT $57.95 WIRED $87.95

Like the HF60 shown below, the HF50 features **virtually absolute stability**, flawless transient response under either resistive or reactive (speaker) load, & **no bounce or flutter** under pulsed conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.:** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps –60 kc; ±0.1 db 15 cps –30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching Cover **E-2 $4.50.**



NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52

with Preamplifier, Equalizer & Control Section

KIT $69.95 WIRED $109.95

Combines a power amplifier section **essentially identical** to the **HF50 power amplifier** with a **preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output).

Matching Cover **E-1 $4.50.**

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NEW

HIGH FIDELITY PREAMPLIFIER

#HF61A KIT $24.95, WIRED $37.95

With Power Supply: #HF61 KIT $29.95, WIRED $44.95

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Senior "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) & **3 low-level inputs** (separate **front panel low-level input selector** permits concurrent use of changer & turntable). **Proper pick-up loading & atenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 8-100,000 cps; ±0.3 db 12-50,000 cps. **Extremely sensitive. Negligible** hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.

NEW

60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

KIT $72.95 WIRED $99.95

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: ±0.5 db 5 cps –100 kc; ±0.1 db 15 cps to 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 3 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both bias and DC — balance adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 $4.50.**

NEW

COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

KIT $49.95 WIRED $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; 2 **low-level inputs** for proper loading with all cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs.

Matching cover **Model E-1. $4.50.**

NEW **COMPLETE with FACTORY-BUILT CABINET— 2-WAY HI-FI SPEAKER SYSTEM #HFS1 $39.95**

Genuine 2-way book-shelf size speaker system **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (**not** a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input —**Woofer:** ±4 db 80-1800 cps; **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. **Power-handling capacity:** 25 watts. Size: 23" x 11" x 9". 25 lbs. **Wiring Time:** 15 min.

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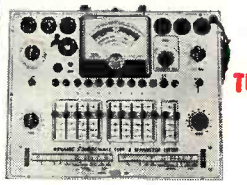


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

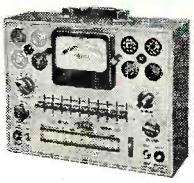
KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication** of Gm, Gp & peak emission. **Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95

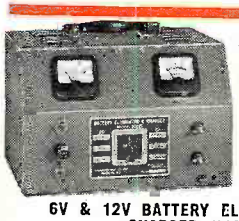
7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50



TUBE TESTER #625
KIT $34.95
Wired $49.95

- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50

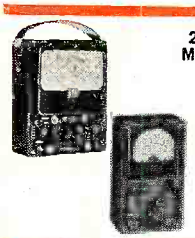


Sep. volt-meter & ammeter
KIT $29.95
Wired $38.95

6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95

DELUXE MULTI-SIGNAL TRACER #147



20,000 Ohms/Volt MULTIMETER #565
KIT 24.95
Wired $29.95

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

Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.
KIT $19.95
Wired $29.95

R-C BRIDGE & R-C-L COMPARATOR #950B

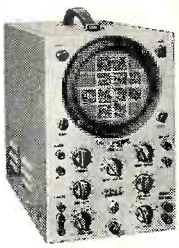
VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1	$6.95	
High Voltage Probe-2	$4.95	
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **incereductor** for excellent linearity. **Extremely flat** RF output: **new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **3 fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460



KIT $79.95 WIRED $129.50

- **Features DC Amplifiers!**

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V&H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

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

NEW! PEAK-to-PEAK VTM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

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

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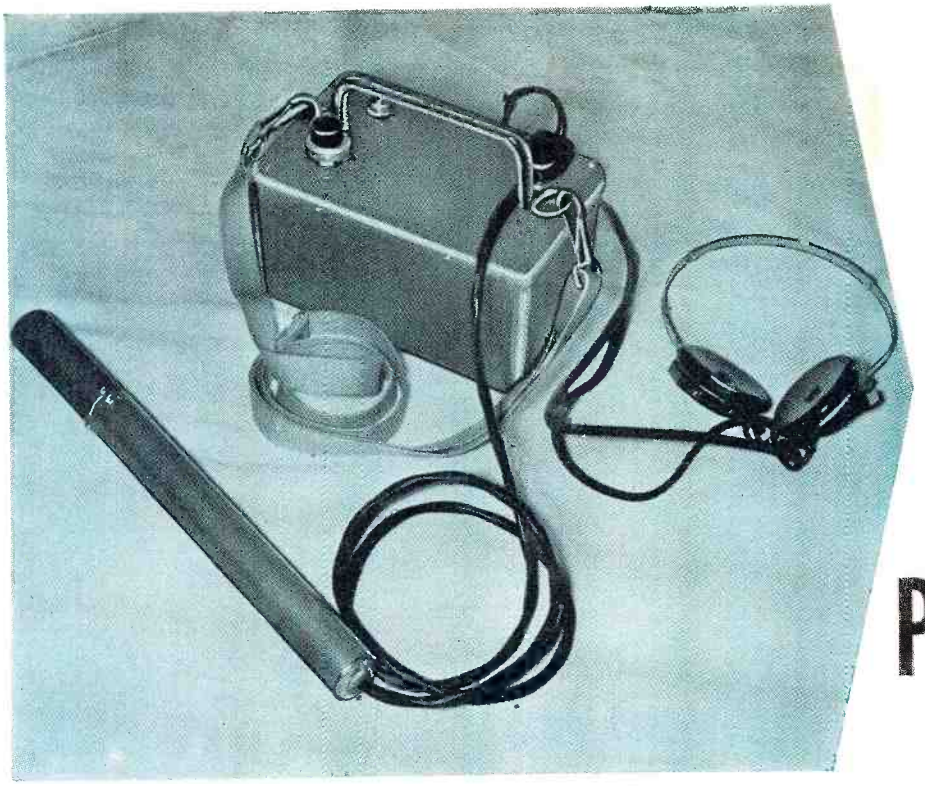


Geiger Counter with Transistor Power Supply

By J. E. PUGH, JR.

Simple unit for summer prospecting uses transistor oscillator supply and features long battery life.

SIX desirable features which a geiger counter power supply should have are: 1. small size, 2. light weight, 3. small initial cost, 4. economical operation, 5. long and trouble-free life, and 6. easily obtained batteries.

A comparison of the various types of power supplies (high-voltage battery, vibrator type, vacuum-tube oscillator type, and transistor oscillator type) shows that the transistorized power supply is superior to any of the other types except that the initial cost is slightly greater. Because of the low battery drain, low maintenance costs, and use of inexpensive batteries, the operating cost of the transistorized type is so much lower that this disadvantage is minor.

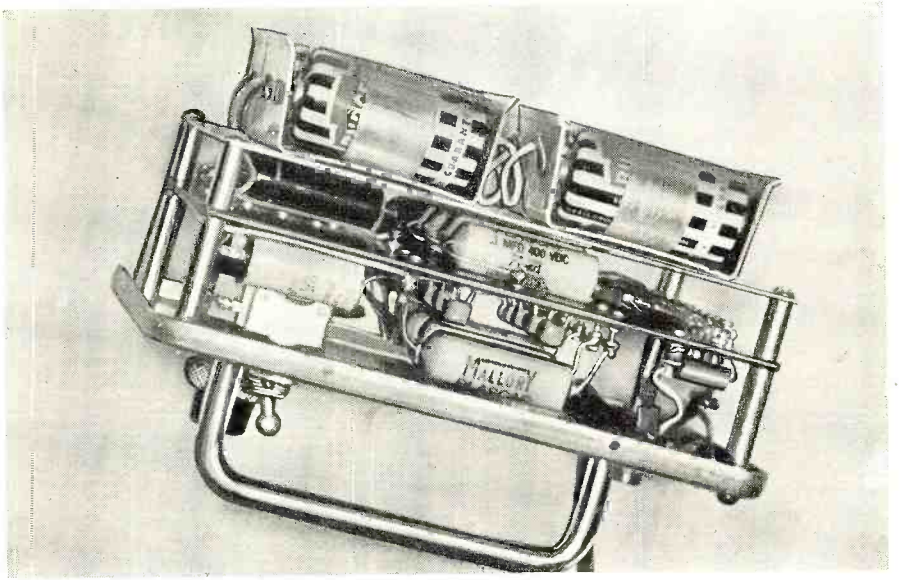
The geiger counter to be described is built around an efficient transistorized power supply designed to reduce the battery drain to a minimum. All parts, except the shoulder strap, are standard easy-to-get items and are operated well below their ratings to insure long trouble-free operation. The shoulder strap shown above is a special item and is not available at any of the regular suppliers but could be improvised or substituted.

Circuit Description

As can be seen in the schematic of Fig. 3, the transistor (V_1) is in a conventional class C Hartley oscillator circuit operating between 30 to 100 cycles-per-second. The potentiometer, R_2, controls the output voltage level by controlling the oscillator frequency. Resistor R_1 sets a limit on the minimum resistance in the transistor base circuit, and thus sets a limit on the maximum collector current. The actual value of R_1 was selected so as to limit the collector current to about 10 ma. maximum when $B_1 = 9$ volts, and at the same time to permit the full V_2 anode voltage of 900 volts to be obtained when the battery voltage drops to 6 volts.

The a.c. voltage developed across the primary of T_1 is approximately equal to the battery voltage since the oscillator operates class C. This voltage is stepped up about 16 to 1 in the secondary of T_1 and is then fed to the rectifier circuit. The rectifier is of the voltage-multiplier type giving a multiplication of 10, thus the total voltage multiplication of the entire circuit is about 160. The rectifier circuit is such that the voltage across each of the associated capacitors, C_1 to C_{13}, is one-fifth of the output voltage. This permits capacitors with a lower voltage rating to be used. In addition, the peak inverse voltage across each of the rectifiers is well below the maximum permissible value to insure long component life. This also keeps the input power low because the losses in each rectifier go up rapidly as the voltage across it increases.

Fig. 1. Side view of completed unit shown with case removed.



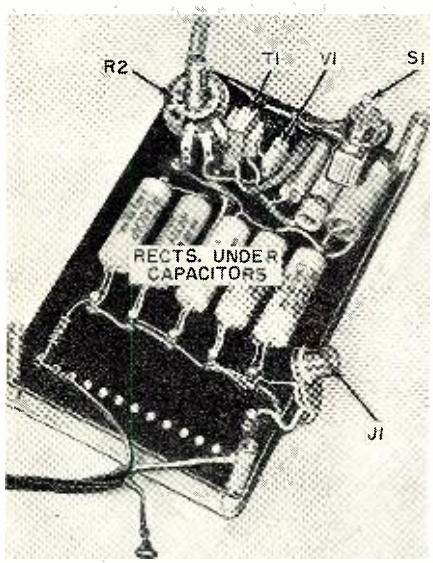


Fig. 2. Top view of unit's subpanel.

The d.c. output from the rectifier circuit is filtered by R_3 and C_{14} and is then fed to V_2, the geiger counter tube. This filter reduces the a.c. ripple to less than 1%. When measured across the headphones, this ripple is more than 60 db below the level of the geiger tube output pulse at which point it is just audible.

The string of neon lamps, PL_1 to PL_{12}, limits the voltage across V_2 to approximately 900 volts. This voltage can be made greater or smaller in 75 volt steps by increasing or decreasing the number of neon lamps. Thus if a 300 volt geiger tube were used, four neon lamps would be required. The operation of this circuit is very simple. Potentiometer R_2 is adjusted until the voltage across the string of neon lamps is *just below* the value needed to fire the lamps. At this point the V_2 anode voltage is at the pre-determined level, and since the lamps are not firing, the current through them is zero, which means that they do not put a drain on the battery during normal operation. Compared with the conventional voltage regulator, this limiter has several advantages—and one disadvantage. The disadvantage is that it does not have automatic control over the high voltage level while the voltage regulator does—over a limited range. This lack of automatic control means that under normal operating conditions R_2 will need a slight adjustment about every 80 to 100 hours of use to compensate for the normal drop-off in battery voltage. In contrast the voltage limiter costs less to build, less to operate, and does not require a meter for adjusting to the optimum operating point.

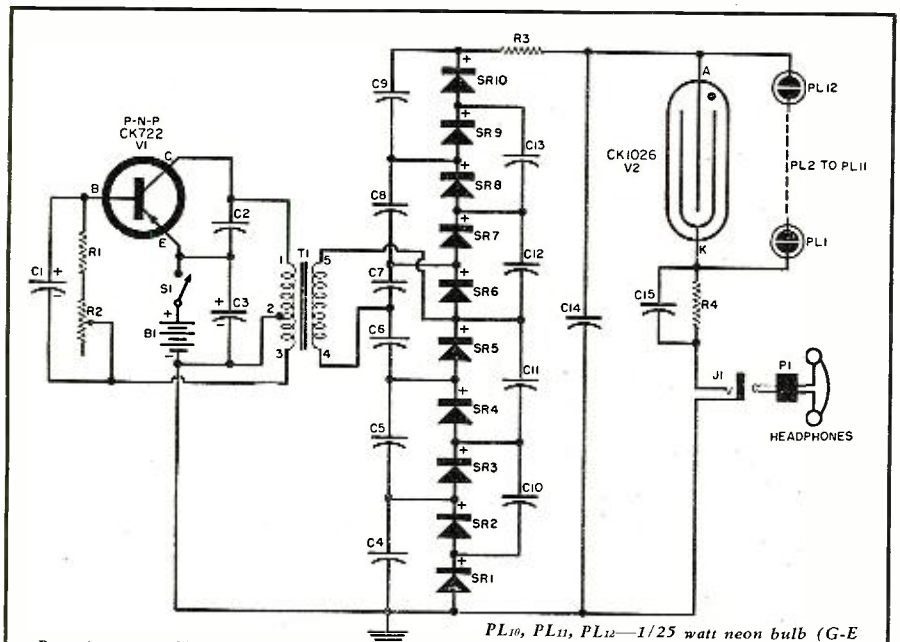
The *RC* network, R_4 and C_{15}, is used to minimize the current through the neon lamps when they fire. This results in a more easily made and a more precise, output voltage setting than would be possible if the neon lamps were permitted to load the high voltage circuit excessively when they fire, and at the same time it keeps the V_2 output pulse, as would be developed across the headphones, at a high level.

The geiger tube is a low-cost halogen-quenched type. It will have a very long life since it is not affected by the number of counts nor by accidental over-voltage as it can go into continuous discharge without being damaged. The output pulse is of sufficient amplitude that an amplifier is not needed for headphone monitoring. If the builder wishes, one of the very small speakers now available can be used instead of the headphones by adding a stage of amplification.

It will be noticed that the amplitude of the geiger tube pulse decreases slightly with an increase in the count rate. This is a normal condition in this tube and has been minimized by making R_4 large.

Six small flashlight cells (size C) are used to supply the transistor with 9 volts. This voltage was selected so as to keep the collector current at a low value—normally less than 6 ma.—thereby keeping the battery drain low. When the battery has dropped to 6 volts this current is less than 10 ma. for the full 900-volt V_2 anode voltage. Tests show that the battery life will exceed 600 hours when used 40 hours per week. A considerable reduction in size is possible by using size Z penlite cells, one set of which should last through a prospecting season.

Fig. 3. Complete schematic diagram of the transistorized geiger counter unit.



R_1—4700 ohm, ½ w. res.
R_2—100,000 ohm pot
R_3—220,000 ohm, ½ w. res.
R_4—4.7 megohm, ½ w. res.
C_1—10 µfd., 25 v. elec. capacitor (Sprague TVA-1204)
C_2—.5 µfd., 200 v. capacitor (Aerovox P82Z)
C_3—100 µfd., 12 v. elec. capacitor (Aerovox SRE Bantam)
C_4, C_5, C_6, C_7, C_8, C_9, C_{10}, C_{11}, C_{12}, C_{13}—.1 µfd., 400 v. capacitor (Mallory PT-401 Plascap)
C_{14}—.035 µfd., 1000 v. elec. capacitor (Sprague 10TM-S35)
C_{15}—500 µµfd., 600 v. ceramic capacitor
PL_1, PL_2, PL_3, PL_4, PL_5, PL_6, PL_7, PL_8, PL_9, PL_{10}, PL_{11}, PL_{12}—1/25 watt neon bulb (G-E Type NE-2)
J_1—Phone jack
P_1—Phone plug (Switchcraft right-angle Type 220)
SR_1, SR_2, SR_3, SR_4, SR_5, SR_6, SR_7, SR_8, SR_9, SR_{10}—20 ma. selenium rectifier (Federal 1159 or International 5U1, see text)
S_1—S.p.s.t. toggle switch
B_1—9 volt battery (six size C flashlight cells)
Headphones—24,000 ohm headphones (Trimm "Featherweight")
T_1—Transformer (A Triad uncased miniature audio unit, Type T-2 or T-2X, was used)
V_1—"p-n-p" transistor (Raytheon CK722)
V_2—Geiger counter tube (Raytheon CK1026)

Construction

The smallest standard parts obtainable are used. Special high-priced subminiature parts are not used, but if the builder wishes, a considerable reduction in size is possible by using such parts.

The case is a deep drawn aluminum box with matching cover. It is available in various sizes at a reasonable cost direct from the manufacturer—*The Zero Manufacturing Company*, Burbank, California. The bottom and sides are fabricated from the same sheet of aluminum without any openings which simplifies the problem of moisture- and dirt-proofing. One of the ordinary boxes available at most radio parts suppliers can be used but will not be quite as satisfactory in this respect.

Most of the parts are mounted on a base made of a good grade of insulation material using turret-type terminal lugs. See Figs. 1, 2, and 5. The insulation material used is XXXP-26 but any other type with a high insulation resistance, low moisture absorption, and moderate mechanical strength will do. Most of the thin sheets of Bakelite available at radio parts suppliers will be satisfactory.

The terminal lugs are *USECO* turret lugs and are available at *Newark Electric Company*, Chicago, *Burstein-*

Applebee, Kansas City, Missouri, and *The Radio Shack,* Boston. Four types of these lugs were used to obtain the neatest construction. These are: a single lug (Type 1350), a double lug (1300), a small feedthrough (1290), and a large feedthrough (1320). Swaging tools (available at these same suppliers) are used to fasten these lugs, but if the builder wishes to eliminate this investment in swaging tools, the 1300T lug can be used. This lug is fastened with a 4-40 nut, and for the most compact arrangement this nut should be 3/16" across the flats (*Walsco* 4-40 hex nuts, Item #8804-N). The first mentioned group of lugs is available for use with different thicknesses of panel while the 1300T is made in one length only. It can be used on panels up to 1/8" thick.

The battery boxes are mounted on a sheet of thin aluminum which is fastened to the chassis with 5/8" threaded spacers. This assembly is mounted to the box cover with 1 1/4" spacers or two 5/8" spacers arranged in series.

The layout used permits the geiger tube to be used in a probe as shown or to be located inside the case. The probe is very easy to construct and the details are shown in Fig. 4 above. It consists of an aluminum tubing handle with an end cap, a female coax receptacle used as the geiger tube anode connector, a helical #16 bus wire cathode connector, and a plastic cover for the geiger tube. The inner conductor of the coax connector will need to be enlarged slightly to provide a better fit for the V_2 anode pin. If available, a #68 drill can be used for this job, otherwise a short length of an ordinary paper clip can be used. Simply cut off a short straight length of the paper clip with a pair of diagonal pliers and use the cut end for reaming. After the reaming job is completed, bend the contact fingers together slightly with a sharp pointed tool. The outer shell of the coax connector has a 1/4-28 threaded portion which is mounted in the section of 7/8" polystyrene rod as is shown in detail in Fig. 4.

If a 1/4-28 tap is not available, simply drill a 15/64" diameter hole and screw the coax connector in. It will cut its own thread.

If the counter tube is mounted inside the case, a Type 45 *Fahnestock* clip can be mounted on the base (in the middle of the space occupied by R_3) for use as the anode connector. The same type helix of #16 bus used in the probe can be used for the cathode connector.

The builder can choose either of two suitable rectifiers. The *Federal* Type 1159 costs less but it is cardboard encased and *must* be moisture-proofed. This can be done by first baking the rectifier in an oven set to 150°F for about 1 hour. Next the rectifier is coated thoroughly with paraffin, beeswax, or polystyrene coil dope. The *International Rectifier* Type 5U1 (available at *Burstein-Applebee Company,* Kansas City, Missouri) is more expensive but it is smaller and does not need to be moisture-proofed since it is plastic encased. The losses in these units are very low and this may cause the oscillator frequency to be very low, resulting in a very slow charging rate for capacitors C_4 to C_{13}. If the initial charging rate is too slow it can be corrected by connecting about 220 megohms (ten 22 megohm resistors in series) across the string of rectifiers.

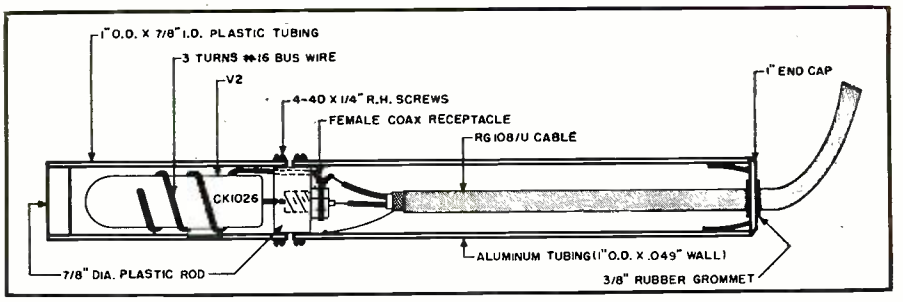


Fig. 4. Details on the construction of the geiger counter probe.

A #6 solder lug can be used to connect the negative terminal of the battery to the aluminum mounting plate at one of the corner posts. This will provide a convenient point for monitoring the transistor current when construction is completed. This current should be approximately 8 to 10 ma. when the switch is first closed. It should then drop fairly rapidly to 5 or 6 ma. if the 1159 rectifier is used and to 2 or 3 ma. if the Type 5U1 is used.

Adjustment

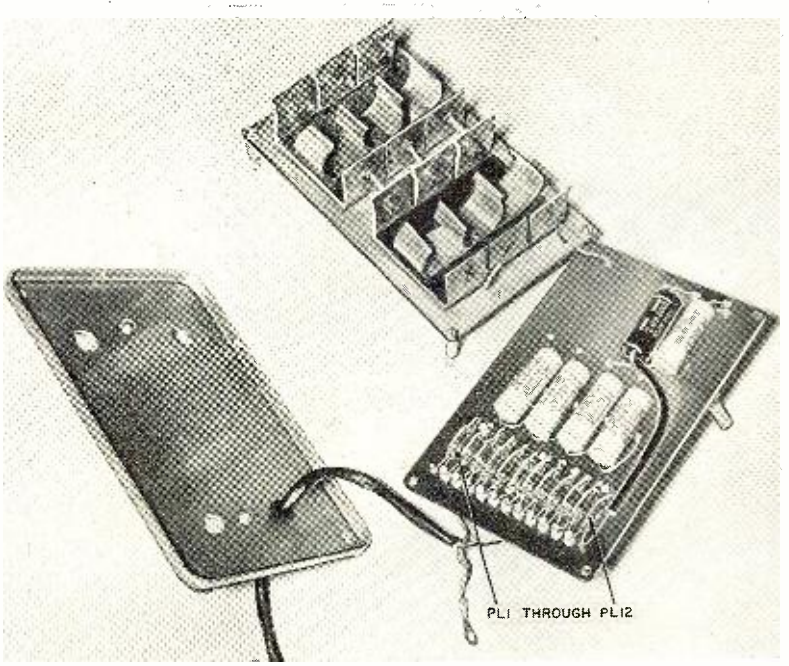
1. Loosen the knurled shaft lock and turn the control maximum counterclockwise.
2. Throw the switch to "on."
3. Wait about 30 seconds.
4. Rotate the control knob clockwise until loud regular clicks are heard in the headphones. These clicks are caused by firing of the neon lamps and are louder than the geiger tube clicks. The counter tube clicks are easily identified and no confusion should result.
5. Back the control off slowly until these loud clicks are no longer heard.
6. Tighten the knurled lock nut and start looking for uranium.

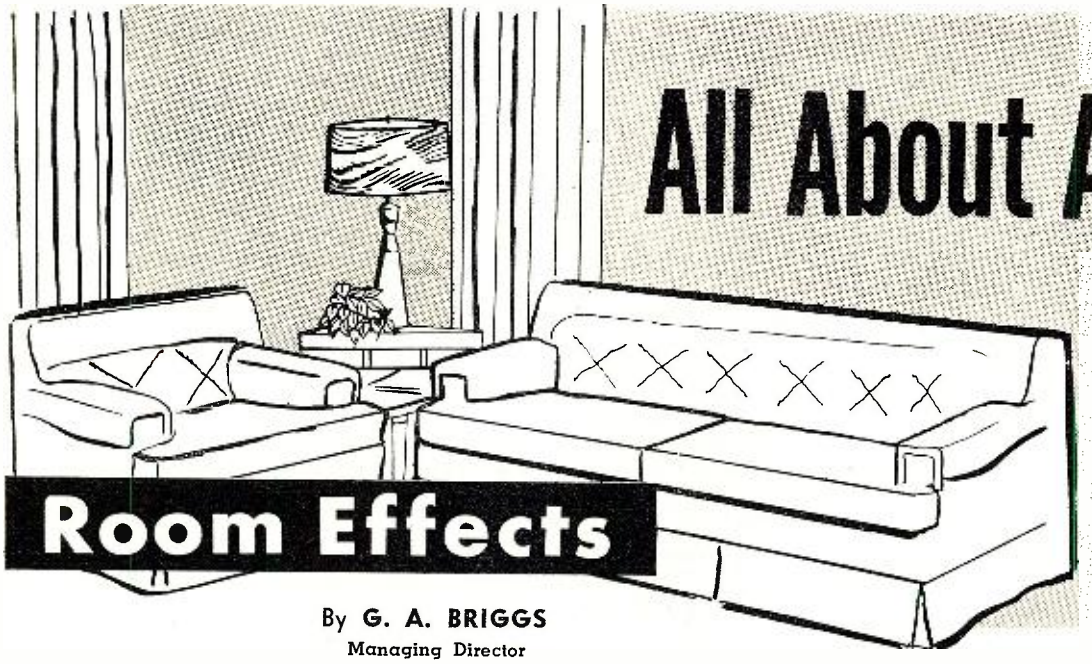
After the anode voltage of V_2 has reached 900 volts it will usually continue to rise very slowly for several minutes. This is a normal condition and seems to be caused by a slight change in transistor gain due to internal heating. All that is required is to back the control off slightly—just enough to stop the neon lamps from firing.

After 80 to 100 hours of use the control should be rotated clockwise by a very small amount to compensate for the normal loss in battery voltage.

When the batteries are renewed, repeat the outlined adjustment procedure, making sure that the control has been backed off (counterclockwise) before throwing the switch to "on." This will keep the battery drain at a minimum and will also reduce the strain on some of the other components. —30—

Fig. 5. Bottom view of unit's subpanel showing the line-up of 12 neon bulbs. Note also the construction of the battery clips.





All About Audio and Hi-Fi

Room Effects

By **G. A. BRIGGS**
Managing Director
Wharfedale Wireless Works Ltd.

Part 2. Experiments with speaker placement show that listening room has considerable effect on reproduction.

HAVING dealt in a non-medical and non-technical way with the human ear, we naturally arrive at the room in which the ear is normally used for listening to reproduced music. Tonal discrimination must clearly involve an appreciation of what the room is doing to the sound.

Much has been written on room acoustics, but I still believe that the effects are greater than most people realize.

As the questions of room treatment, reverberation, and absorption were fully covered by Mr. H. A. Hartley in the May and June 1956 issues of this magazine, there would be no point in going over the same ground again; I will therefore endeavor to describe what actually happens in certain specified rooms in the hope that readers may be able to pick up a few useful hints.

Size of Room

Some textbooks state that to reproduce a low-frequency sound the room must be at least as long as the wavelength you wish to reproduce, which means that a 50-cycle note requires a room nearly 24 feet long. The minimum usually advocated is half a wavelength, which means a 12-foot room for good bass down to 50 cycles, and I agree with this, but I do not agree that even smaller rooms are adequate.

As a matter of fact, a room about 11 feet long will have a main resonance at 50 cycles (with harmonics at 100 and 150 cps) and would tend to emphasize power-line hum from a noisy amplifier working into a good woofer. This, of course, refers to British power lines. At the 60-cycle power line frequency prevalent in the U. S. the equivalent room dimension would be 9 feet. It is clear that large rooms are better than small ones because the room resonances are lower in frequency and help to build up the bass in a region where it is often deficient. Nobody says that a sound is inaudible if the room length is less than half the wavelength. It is simply not so well reproduced.

Concert Halls

The obvious way to avoid small room effects is to move into a good concert hall, where it is possible to hear what a loudspeaker is doing *before* it is affected by reflections from walls, and where the room (hall) resonances occur at much lower frequencies where they are less harmful. I know of no quicker or better way of assessing speaker performance, and I am unable to understand why nobody else advocates this technique; my voice is still like one crying in the wilderness.

It is not suggested that the final choice of one speaker for domestic use—out of say half a dozen samples—should be made in a concert hall, where conditions are different (and superior), but it is claimed that the reliable information so obtained can be applied to good purpose. I remember testing a speaker system with a new foam suspension to the cones, compared with a similar system with different cone surrounds, in St. George's Hall, Bradford, and in Carnegie Hall, New York, when everybody present immediately heard and appreciated the difference.

In short, a decision to adopt a new type of construction—cone, suspension, centering device, or a different cabinet, baffle, or horn, or even a change to electrostatic units—can often be made in a few minutes instead of hours or days. This is achieved simply by improving the listening conditions.

Many of the effects to be observed cannot be produced by response curves taken in anechoic chambers or the open air.

Readers who do not own concert halls may wonder how all this affects them, and I agree it appears to be of rather doubtful value to amateurs. But there are thousands of halls which are used only a few hours a week, and serious investigators of sound reproduction could arrange tests without abnormal difficulty or expense. They would at least learn by comparison something of what a normal living room actually does to sound waves.

Ordinary Rooms

To get back to earth (before the Editor starts using his blue pencil), a general outline of my own listening room at home is given in Fig. 7. Apart from the fact that it is usually cluttered up with equipment and numerous loudspeakers (my wife is case-hardened), the furnishings, carpets, and curtains are normal.

The room measures 20 x 14 x 11 feet, so the main resonances occur at about 28, 40, and 50 cycles, but the odd shape at one end helps to break up the horizontal modes.

At *A* there is a permanent 3-speaker corner installation, which gives better results than any speaker ever tested in any other position in the room—in spite of the rude things often said about corners and room resonance. At *B, C, D,* and *E* we do *not* find four more speakers, but simply one speaker tested in four positions. This is a 3-speaker sand filled baffle, measuring 34″ x 31″ with 12″ sides, with 12″ and

10" units facing forward, and a 3" tweeter mounted on a separate small baffle facing upward. The speakers radiate from both sides of the cones, and the main baffle therefore performs as a doublet at low frequencies (Fig. 6). (As the tweeter also radiates from two sides in a vertical direction, I suppose the whole system could be described as a "Quadlet," but I doubt if the Acoustical Society of America or if the A. E. S. will ever accept this new term!)

A speaker which radiates in one direction only, say from a reflex cabinet, is known as a simple radiator (not a "Singlet") and appears to be less susceptible to room effects than a doublet. I have therefore selected the open baffle, stand-anywhere model as the basis of this test, because results were easier to observe. Although a simple radiator does not behave in the same way as a doublet, many of the room deductions would still apply.

The first and most important lesson to be learned is that strong directional effects in middle and upper registers must be avoided like the plague. With a simple radiator this can often be done by facing the speaker into a corner or at an angle of 45° towards a hard wall, so that the sound is splashed into the room and thus loses some of its "loudspeaker" quality. In a good concert hall, undue directional effects give an even more unnatural result.

To revert to Fig. 7, the general conclusions are as follows, but it will be understood that other rooms, other speakers, other ears would give different results. It is equally important to remember that results vary according to the type of record or radio transmission being used. Large choral and orchestral works often contain a good deal of studio coloration or ambience which might clash with the room resonance. A rather dry, crisp recording is essential. Solo voice is an excellent test, but a good, clean piano record is hard to beat, as the frequency range covers seven octaves and any "boxiness" in reproduction is easily noticed. It is worthy of note here that the type of recording which sounds "right" in a good concert hall, and is therefore free from excessive recorded ambience, is ideal for these tests as it will not lead the ear astray.

Here are the findings for the various positions:

Position A: This has already been awarded pride of place. The 3-speaker system in use here is not movable, in common with many reflex cabinets and back loading horns designed to give optimum results from a corner. In short, the speaker objects to being pushed around, so it cannot conveniently take part in the tests under consideration. Room resonance may or may not be prominent, but can easily be countered by the use of an extra speaker, which may be comparatively small, suitably placed in the room. Experiments on these lines will be described in Part 3 of this series.

Position B runs very close to *A*, without exciting the full room resonance. Any speaker with a pronounced enclosure resonance around 50 cycles might sound better here than at *A*. Suits dance bands.

Position C: A nice combination of medium bass and good reflection of rear sound waves. Suits most types of music.

Position D: Ideal for those who prefer completely nondirectional effects. (There is no reason why the loudspeaker should always look the listener straight in the eye, or ear.) Very good on guitar and similar instruments. Room resonance well masked.

Position E: This position gives the impression that the music is being played in the room rather than through a hole in the wall, and is liked by some listeners.

A-B Testing

Some readers may suspect that the effects of speaker placing are being exaggerated, but an *A-B* test of two similar speakers often proves its importance. For instance, if speaker *A* happens to be standing in a better position, acoustically, than *B*, a preference for *A* might be transferred to *B* simply by transposing the speakers. This is another reason why large hall tests are safer: a difference of two or three feet in position is of no consequence, but in a small room this may be serious.

Load Matching: Connecting an extra speaker in parallel with one already in use obviously halves the impedance, assuming that both speakers are the same. With modern negative-feedback amplifiers the output resistance is low and the damping factor is high, so a mismatch to the speaker load does not cause distortion—it merely reduces the available distortion-free power. Assuming your amplifier will give 20 watts clean output, connecting a (perfect) 16-ohm speaker to a 16-ohm output circuit would make available the full 20 watts. If you then add another 16-ohm speaker in parallel, and halve the impedance of the load, the available power is also approximately halved. If you are not using more than 10 watts at any time, there is nothing to worry about; but if you are likely to exceed 10 watts, it is desirable to change to an 8-ohm output tap or thereabouts for better results.

"Perfect" matching never comes our way, because speaker impedance varies with frequency, so it is only necessary to come reasonably near. For instance, an output circuit rated at 8 ohms is quite satisfactory with nominal speaker loads between 6 and 10 ohms impedance.

If two or more speakers are to be added in parallel it would be advisable to work on a low output impedance, say 3-5 ohms, so that more power becomes available as the extra power-handling capacity is increased by connecting the extra speakers.

I hope these comments will encourage readers to try various experiments where room and furniture will permit. Even results from an ordinary radio set can often be improved enormously by removing the back and placing the cabinet across a corner at a suitable distance from the wall.

In Part 3 the use of two or more speaker systems in a room with single and/or two-channel input will be considered.

(To be continued)

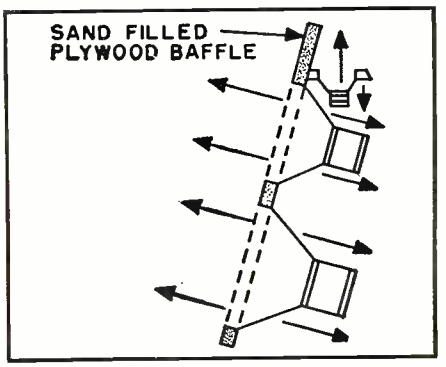


Fig. 6. Doublet speaker system used.

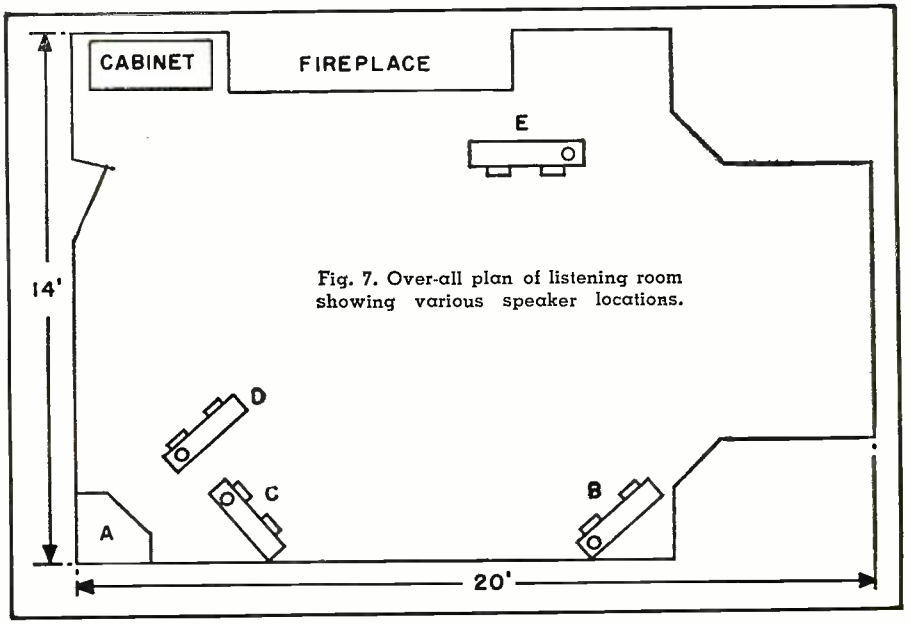


Fig. 7. Over-all plan of listening room showing various speaker locations.

Batteries for Transistor Radios

Fig. 1. The batteries shown here are only three of the many types, sizes, and shapes found in current transistor sets.

Tubeless radios have increased the potential for batteries, but also introduced confusion.

IN 1956, about 31 per-cent of all portable radios sold used transistors. In 1957, predicts J. A. McIlnay, vice-president for sales of the *Ray-O-Vac Company,* transistorized units will probably account for close to 60 per-cent of all portable sales. In step with this trend, McIlnay expects the present annual retail sales volume in batteries of about $50 million to swing to the $200-million mark by 1965.

Whatever the exact figures will be, there is little doubt that the average service establishment will be devoting more attention to replacement battery sales than in the past; or that both technician and consumer will be seeking answers to questions pertaining to the types of batteries that are used, their differences from previously existing types, availability of replacements, initial cost, cost per hour of operation, storage life, and life in use, among others.

To find the answers, RADIO & TV NEWS has polled the battery industry. Information on which this article is based has been provided by *Burgess Battery Co., National Carbon Co. (Eveready), P. R. Mallory & Co., Radio Corp. of America,* and *Ray-O-Vac Company.* The general impression is that the trend is too young to permit final answers to all questions. However, it is certainly not too early, even in the unsettled areas, to observe the possible alternate trends and to engage in well-informed speculation.

Tubes versus Transistors

Whatever type of construction is used, the battery for the transistorized radio is asked to provide a much lower voltage than its cousin employed in tube radios. The latter may range up to 90 volts or more for "B" supply. An "A" battery, with up to 9 volts, is also required for tube portables, except in those cases where a single multiple unit —which effectively combines both batteries in a single container—is used.

The transistorized portable generally relies on a single-voltage source, which may be as low as 3 volts but sometimes edges beyond 20. Most sets now available fall into the 6-to-12-volt category, with the most usual value being 9 volts. This voltage may be provided by a single battery or by an arrangement of series or series-parallel 1.5-volt cells. Some of the receiver manufacturers provide optional mounting arrangements for either the single unit or the multi-cell string—an indication of uncertainty as to what long-range public preference will be.

Current Drain

Battery current drain is approximately the same on low transistor voltage as it is on high battery voltage. There is doubtless some confusion on this score, since it is generally recognized that the lower-voltage transistor radios enjoy an appreciable advantage with respect to *power* consumed. Nevertheless, *Ray-O-Vac* engineers, having sampled models of all types, report that tube radios require from 8 to 14 ma. "B" supply, while transistor receivers draw between 5 and 20 ma. Although the average runs about the same, one reason for the greater range in transistor sets is that these units are relatively sensitive to volume-control settings, whereas the current pulled by tube sets is varied only slightly when the volume level is changed. Of course, with transistor receivers still in the infant stage, forthcoming developments may reduce current requirements substantially.

Dry Battery Types

Still the most common type of dry cell for radio use is the LeClanche cell, the zinc-carbon unit that is the basis for the familiar flashlight battery. Also enjoying considerable popularity is the mercury cell, which provides longer life in smaller size. *Mallory* markets a full line of these, but *RCA* and *Eveready* also have some available.

There is much talk of the development of special types, such as "sun" batteries, alkaline cells, "atomic" batteries, and metallic-oxide cells, but only some of these are now available. Some alkaline cells have already reached the market, but present production costs for most other types of "super" batteries prohibit their commercialization.

Some segments of the battery industry tend toward the opinion that the special types will eventually obsolete the zinc-carbon standby. More conservative elements point out that the zinc-carbon system has yet to touch its potential limits. Presently available LeClanche batteries have capacities up to 50 per-cent greater than their prewar forebears, and the end is not yet in sight.

Design Features

In physical appearance, one would be pressed to distinguish between, say, a carbon-zinc battery and a mercury unit except that, *for a given capacity,* the mercury energizers are much smaller. Shapes range from the cylindrical (as in the pen-light and flashlight types), through the slim, flat types, and through the various cubic configurations. Some popular shapes are shown in Fig. 1. Sizes range from the pen-light size to some as large as the smaller "B" batteries for tube radios. Connectors range from the simple contacts of the flashlight cell to the snap-in and snap-on fasteners. They do not vary greatly from connectors used on other battery radios, if at all.

More interesting are the differences that may exist between units of the same type, nominally, as offered by different manufacturers. The venerable carbon-zinc LeClanche cell provides a good illustration of this point.

When these batteries deteriorate, the contents swell and eventually burst the container, as many an owner of a ruined flashlight knows. The corrosive chemicals thus released present a more serious threat to the interior of an expensive transistor radio than they do to a simple flashlight. Ingenious manufacturers have devised various ways of preventing this action, and many now offer firm guarantees against such action. Earliest of the "leakproof" types is the *Ray-O-Vac* metal-clad "sealed-in-steel" battery.

Another limitation on life, both on the shelf or in use, has been the drying out of the electrolyte in the carbon-zinc batteries. It may take no more than a thimbleful of water added to the mix used in this type to put it in business, but without this amount the energizer is useless. The metal-clad construction is one method that keeps the water from evaporating. *Burgess* and other manufacturers use such techniques as special wafer-cell construction or Mylar and Pliofilm moisture barriers. Other life-prolonging measures include the addition of small quantities of compounds to the electrolyte of the LeClanche units that were unheard of for this purpose 15 years ago. Over that same period, the rated life of these batteries has gone up 50 per-cent, and even better, where most recent know-how is used.

Life Characteristics

The shelf or storage life of carbon-zinc batteries is in the range of 8 to 12 months, when they are stored in a "cool, dry place." Recommended storage temperatures are in the range of 65 to 70 degrees F. Under the same conditions, mercury batteries can be stored for 2 years or more.

As for life in use, Fig. 2 tells us how the familiar "D" size flashlight cell fares in transistor-radio use. The conditions of use are for three rates of drain, turned on for 4 hours a day, every day, at a room temperature of 70 degrees. At the average rate of drain imposed by a transistor radio, such a cell will have a useful life of about 500 hours, or about 4 months.

In another test, two 1.5-volt cells, one carbon-zinc and the other mercury, were operated under the same drain-and-temperature conditions. As shown in Fig. 3, the mercury type yielded useful output for five times as long a period.

Operating Costs

At present, the cost of operating a transistor radio is estimated to be about one-tenth the cost of operating a tube radio, where both use carbon-zinc batteries. One set of batteries for a tubeless set will cost about half as much and last about five times as long as the complement for a tube radio.

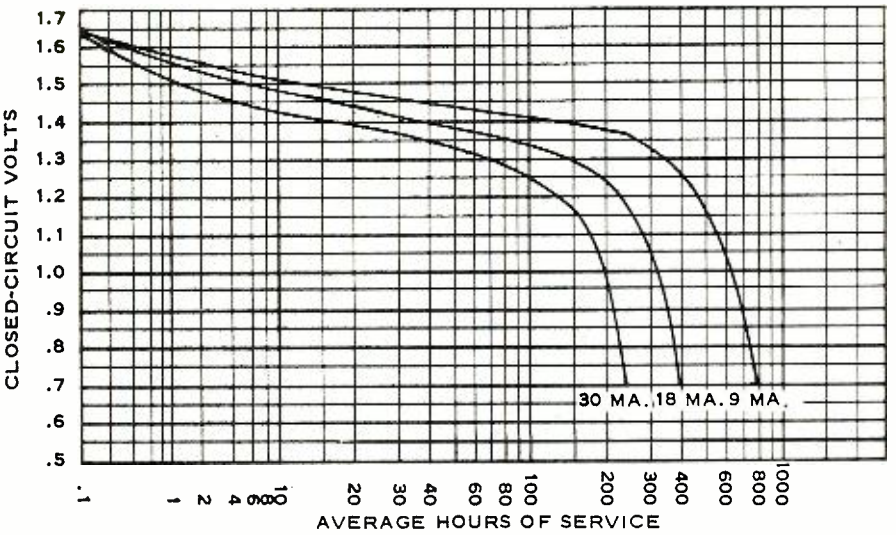


Fig. 2. Voltage-output life of a Ray-O-Vac "D" cell. See text for use conditions.

This puts the operating cost of the transistorized receivers in the same class with tube radios operated on house current, and has led to the prediction that the cordless house radio, safer, more adaptable to movement and room placement, and more attractive due to the absence of the unsightly cord, attached to present home receivers, is on its way.

Although there are no exact figures, even proponents of the LeClanche cell do not deny that the initially more expensive mercury batteries provide still more favorable cost-per-hour ratios. They feel that this does not put their product to serious disadvantage because people will prefer the small single outlay of cash for a complete carbon-zinc complement, and also that the standardization in size and type of these power packs will simplify replacement problems.

Replacement Problems

Physical and electrical characteristics of batteries used in tube radios have become so standardized that it has been possible for the National Electronic Distributors Association to promulgate a standard list, assigning type numbers to cover all variations as to voltage output, physical dimensions, and connections, and to cross-reference existing corresponding types of all manufacturers.

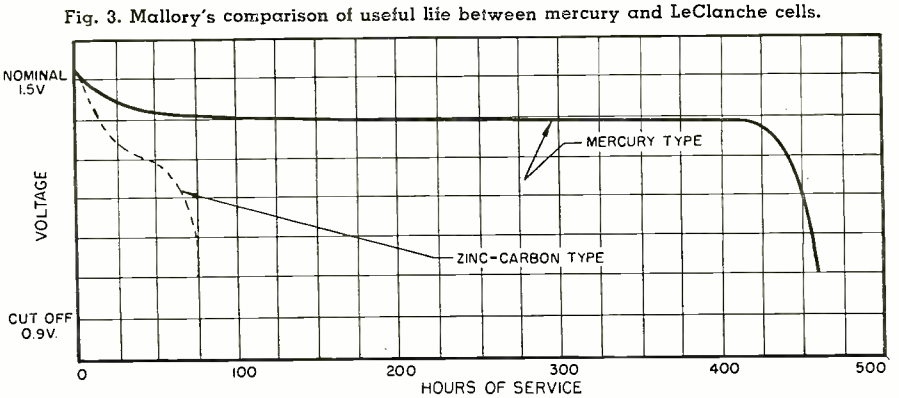
This publication has attempted a like project with respect to transistor-radio batteries, but it appears to be too early to organize in an area where development is still under way. In soliciting manufacturers for lists of most popular replacement types, for example, it is found that one source will list as popular types units that do not yet have equivalents in other manufacturers' lines! NEDA has attempted to assign numbers to transistor types, but battery manufacturers have units that do not conform to these designations.

Ray-O-Vac, which has generally adapted the NEDA system, has not been able to apply it to transistor units. *Mallory* attempts to list equivalents (on the jacket of each of its batteries) in the lines of other manufacturers.

Furthermore, it has not been possible to recommend battery types according to receiver manufacturers, as the same manufacturer will design different models for different batteries. The best bet is to obtain the replacement guide from the battery manufacturer—all of them have such lists available—which give the units in his line that can be used in the various radios of all set makers.

The one bright spot for dealers who must be concerned with stocking replacements is the large number of transistor radios that can be operated with the familiar flashlight cells. —30—

Fig. 3. Mallory's comparison of useful life between mercury and LeClanche cells.



A Transistorized Marine Direction Finder

By
OLIVER READ
Publisher, RADIO & TV NEWS and POPULAR ELECTRONICS

Compact, portable unit operates from self-contained battery. Provides sensitive and accurate bearings.

ONE of the fastest moving hobbies is that of boating. It is estimated that more than 200,000 new boat owners join the ranks each year. The greatest number comprise the "small boat" owner who is limited both in time and money necessary to pursue this hobby.

Until recent years, many electronic safety devices were not within financial reach of these boatsmen. Small boats, generally, have not been equipped with any form of power supply which would permit the owner to utilize essential marine navigational or communications devices. In our own case, a real need was found for a portable, compact direction finder which could be carried aboard a small boat which is operated in waters often blanketed by fog. The compact d.f. herein described is the result of that need. This tiny d.f. is housed in an aluminum box measuring 7" x 5" x 3" and utilizes a standard transistor superheterodyne circuit. It is self-contained and operates from its own battery.

The behavior of the transistor in r.f. circuits seemed to offer several possibilities for the inclusion of a "null indicator." Reference to the schematic shows the point chosen for insertion of the meter. A variation of approximately .8 ma. in the emitter circuit between a "no signal" and "maximum signal" condition is almost ideal for the purpose of indicating field strength. We used a conventional 0-1 milliammeter, which may be either mounted as shown in Fig. 1, or inverted 180° with the indicator pointing down. As shown, resonance (maximum signal) results in a sharp dip when the station signal is properly tuned. The null point (minimum signal) is indicated by a maxi-

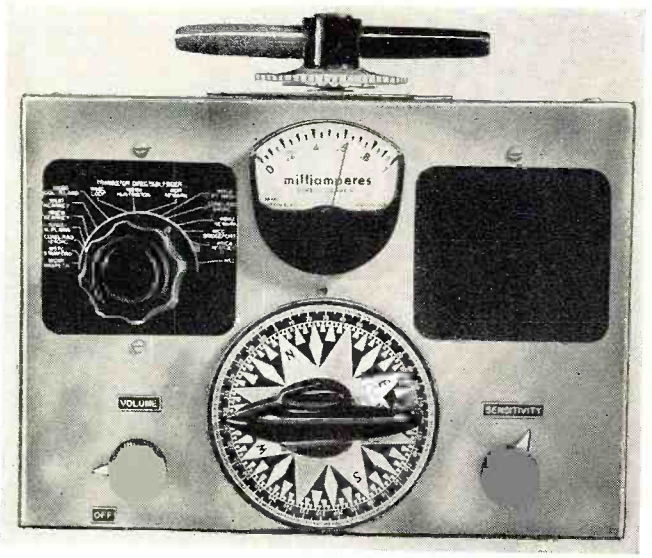
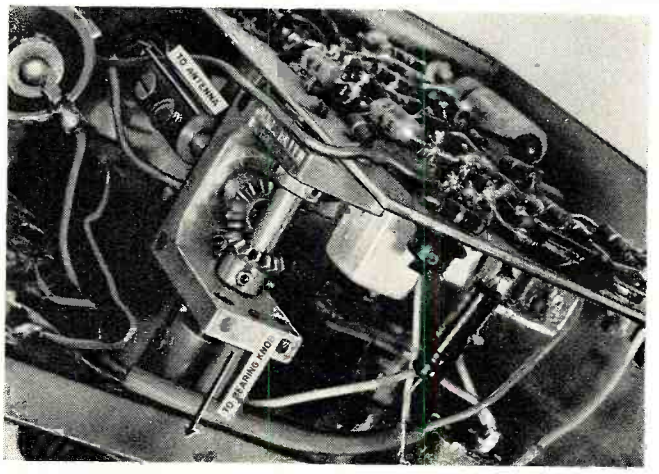


Fig. 1. Front view of d.f. showing operating controls.

Fig. 2. Inside view of unit showing details of gear drive.



mum current swing of the meter. This is just the opposite from the usual nulling instrument found on the expensive direction finders. The meter may be inverted to obtain conventional action.

Construction of the circuitry may be done either on an aluminum chassis or on one of the perforated board chassis supplied by the kit makers. Wiring is not critical and there is no hum problem. In addition, none of the component values is critical except that the various transformers and coils must be of design for transistorized circuitry. Most of the parts needed were found in the *Lafayette* KT-119 transistor receiver kit. We modified the chassis to fit our design.

A right-angle drive, a *Millen* 10012, permits the loop to be rotated from a line-of-sight position in front of the pilot or operator. This was found to be almost mandatory for the small outboard skipper who is in a sitting position and should be able to accurately read either the nulling or to follow his compass course without standing. Spacers were used to provide shaft clearance behind the meter, Fig. 2.

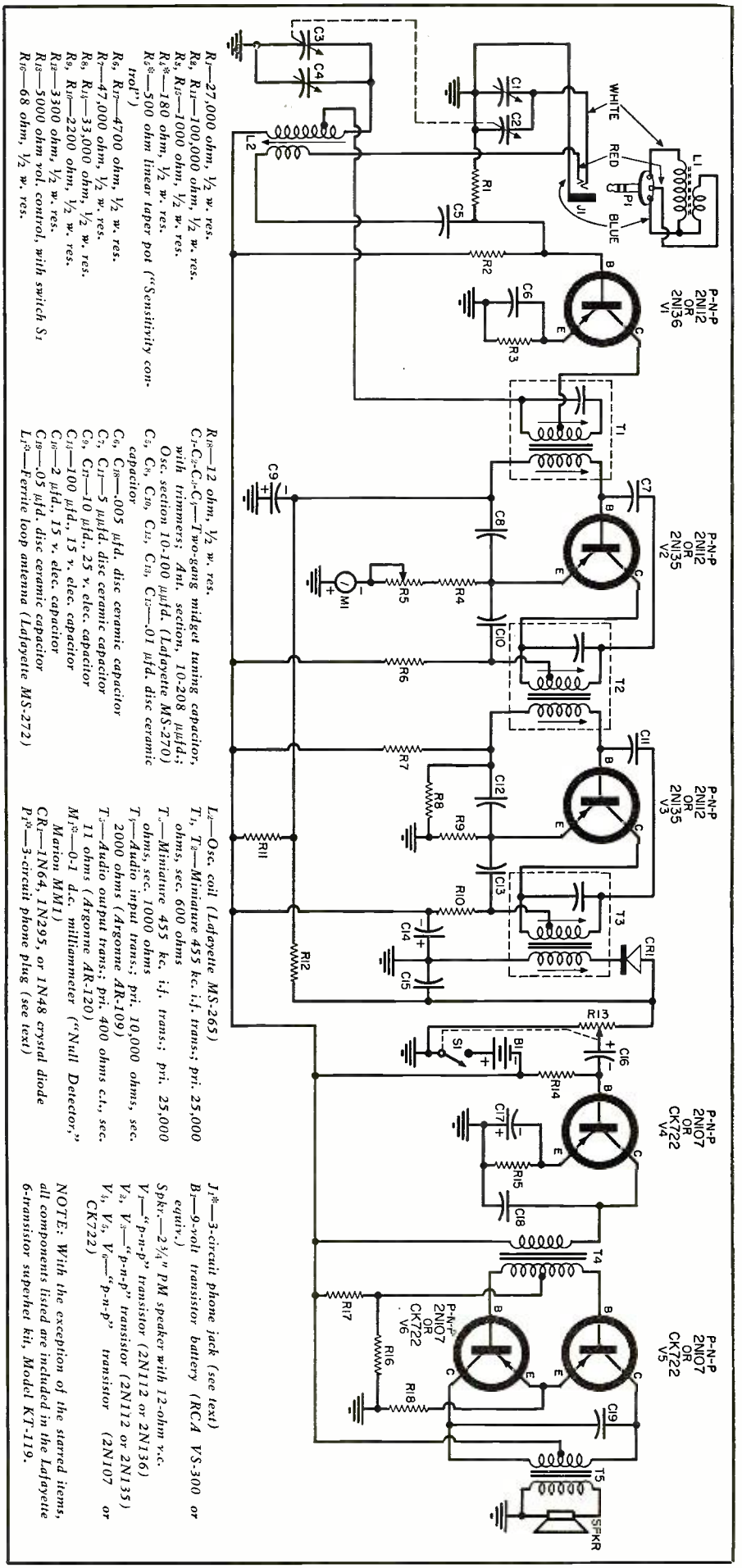
There are two compass roses provided—both independent of the mechanical coupling between the right-angle drive shaft and the loop assembly. The compass rose mounted beneath the loop is useful in boats where the pilot is standing and looking down on the d.f. From the null position of the loop, he is able to set the rose to a relative compass heading very simply.

It was decided, for maximum utility, that the dial on the tuning capacitor be marked for known transmitting station towers in the area in which the d.f. was to be used. In our case, this was Long Island Sound. The exact location of transmitting towers is easily obtained by calling the station and then plotting the point on the marine chart, as well as marking it directly on the tuning dial of the d.f. Conelrad frequencies are also plotted on the dial so that the d.f. can be used as a monitor on boats equipped with radiotelephone.

A small PM loudspeaker serves for checking the station or for general reception.

Headphones were not incorporated as it is not necessary to hear the signal over engine noise for navigational purposes. As a matter of fact, any contacts such as in a phone jack were eliminated in the design as insurance against failures due to salt air or water corrosion. Following final test the entire circuitry was sprayed with several coats of clear *Krylon* plastic to keep out moisture.

The construction of the loop designed by the author is optional. We utilized a conventional three-circuit phone or microphone jack and modified a conventional three-circuit plug which provided us with a simple means for obtaining wiping contacts for the loop circuits to the transistor mixer. This is shown in Fig. 3. We added a metal



Complete schematic diagram and parts list for the transistorized marine direction finder described in the above text.

R—27,000 ohm, ½ w. res.
R$_2$, *R*$_{12}$—100,000 ohm, ½ w. res.
R$_3$, *R*$_{15}$—1000 ohm, ½ w. res.
R$_4$*—180 ohm, ½ w. res.
R$_5$*—500 ohm linear taper pot ("Sensitivity control")
R$_6$, *R*$_{17}$—4700 ohm, ½ w. res.
R$_7$—47,000 ohm, ½ w. res.
R$_8$, *R*$_{14}$—33,000 ohm, ½ w. res.
R$_9$, *R*$_{16}$—2200 ohm, ½ w. res.
R$_{13}$—3300 ohm, ½ w. res.
R$_{15}$—5000 ohm vol. control, with switch *S*$_1$
R$_{16}$—68 ohm, ½ w. res.
R$_{18}$—12 ohm, ½ w. res.
C$_1$-*C*$_2$-*C*$_3$-*C*$_4$—Two-gang midget tuning capacitor, with trimmers; Ant. section, 10-208 μμfd.; Osc. section 10-100 μμfd. (Lafayette MS-270)
C$_5$, *C*$_9$, *C*$_{10}$, *C*$_{12}$, *C*$_{13}$, *C*$_{15}$—.01 μfd. disc ceramic capacitor
C$_6$, *C*$_{18}$—.005 μfd. disc ceramic capacitor
C$_7$, *C*$_{11}$—5 μμfd. disc ceramic capacitor
C$_8$, *C*$_{17}$—10 μfd., 25 v. elec. capacitor
C$_{14}$—100 μfd., 15 v. elec. capacitor
C$_{16}$—2 μfd., 15 v. elec. capacitor
C$_{19}$—.05 μfd. disc ceramic capacitor
L$_3$*—Ferrite loop antenna (Lafayette MS-272)
L$_2$—Osc. coil (Lafayette MS-265)
T$_1$, *T*$_2$—Miniature 455 kc. i.f. trans.; pri. 25,000 ohms, sec. 600 ohms
T$_3$—Miniature 455 kc. i.f. trans.; pri. 25,000 ohms, sec. 1000 ohms
T$_4$—Audio input trans.; pri. 10,000 ohms, sec. 2000 ohms (Argonne AR-109)
T$_5$—Audio output trans.; pri. 400 ohms c.t., sec. 11 ohms (Argonne AR-120)
M$_1$*—0-1 d.c. milliammeter ("Null Detector," Marion MM1)
CR$_1$—1N64, 1N295, or 1N48 crystal diode
P$_1$*—3-circuit phone plug (see text)
J$_1$*—3-circuit phone jack (see text)
B$_1$—9-volt transistor battery (RCA VS-300 or equiv.)
Spkr—2¾" PM speaker with 12-ohm v.c.
V—"p-n-p" transistor (2N112 or 2N136)
V$_2$, *V*$_3$—"p-n-p" transistor (2N112 or 2N135)
V$_4$, *V*$_5$, *V*$_6$—"p-n-p" transistor (2N107 or CK722)
NOTE: With the exception of the starred items, all components listed are included in the Lafayette 6-transistor superhet kit, Model KT-119.

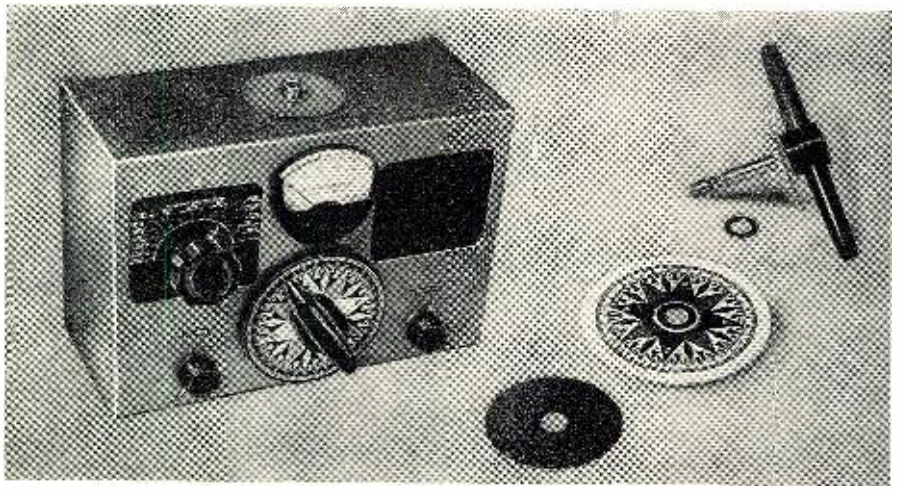


Fig. 3. The d.f. loop and its compass rose have been removed in this view.

spacer on the tip end of the plug and substituted a very small threaded bolt to secure it so that a shaft coupling could be mounted. The vertical right-angle shaft from the drive unit connects to the other end of the coupling. This provided means for uninterrupted (360°) rotation of the loop.

The average builder of this device can eliminate this somewhat complicated utility and simply provide a hollow shaft to the loop through which the leads may pass from the ferrite antenna to the tuning capacitor. This simplified technique should have means for limiting the rotation of the loop to 180 degrees. This will prevent damage to the leads as a result of twisting.

The ferrite antenna is ¼ inch in diameter and 3½ inches in length. Long flexible leads are provided by the manufacturer. Holding-tape is removed from one end and the leads are shifted to the center of the rod. For loop protection, the author utilized the plastic barrels from a ball-point pen. The cap of the phone plug was cut off and a slot provided so that the cap could hold the loop with a generous application of household cement. This, in turn, was cemented to the phone plug.

A handy selection of small aluminum dial plates was found in our junk box and these were utilized to mount the compass roses, as well as to provide spacers so that the compass rose can be rotated without engaging the shaft. A bit of ingenuity will be required if the builder prefers this refinement.

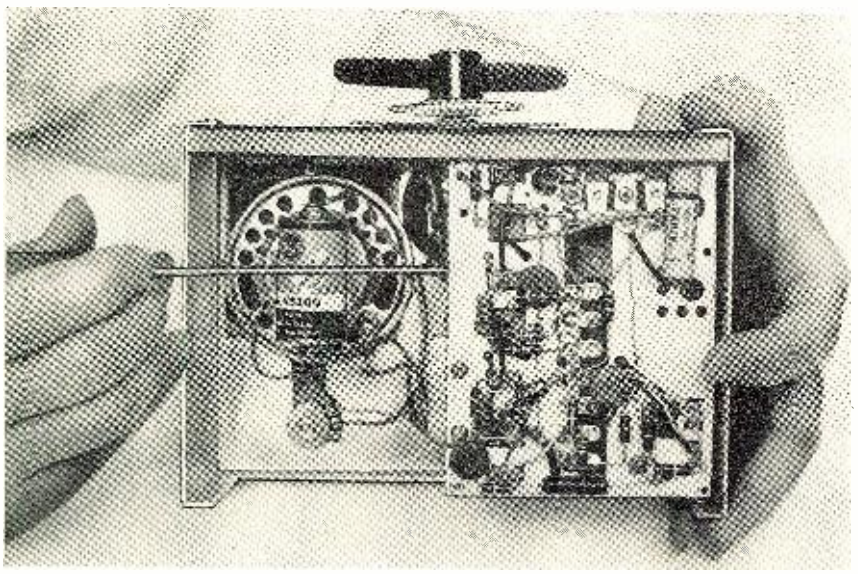
It is important to observe the polarity of the various electrolytic capacitors. The positive side of the battery connects through a switch to ground. A precaution should be taken to color-code the connecting leads to the battery as a protection to the transistors.

As mentioned previously, the layout for the components is not critical. However, it is recommended that the oscillator coil be located on one end of the chassis so that leads from the loop may be as short as possible. It is also important that access to the trimmers, located at the rear of the tuning capacitors, be provided, Fig. 4, as well as to keep wiring clear from the eyelets seen on the bottom of the i.f. transformers. The trimmers for the i.f.'s are reached through these eyelets by a small non-metallic screwdriver for peaking.

The chassis should not be mounted in the metal box until its performance is known and after all the transistors have proven to be functioning. It is a good idea to operate the receiver continuously for 24 hours as pre-insurance, after which a generous coating of *Krylon* should be applied. We mounted our chassis directly to the drive assembly and allowed enough clearance so that the rear cover would fit snugly, but without interference.

The only component that may be difficult to duplicate would be the compass rose. We were not successful in locating one printed on plastic or other stiff material, so we photographed a conventional rose (found in many boating books) and had a reduction made, one as a positive and the other as a negative. These were carefully cemented to aluminum dials and trimmed with a razor blade after drying.

Fig. 4. Rear view of transistorized d.f. is shown with its back cover off.



Operation

Maximum signal from a broadcast transmitter tower will be at right angles to the ferrite antenna. When the ferrite antenna points directly at the source, the loop will show its lowest sensitivity. The use of such an antenna is therefore almost ideal for nulling simply because the assembly will actually point to the station in the same manner as sighting a rifle. The d.f. should be mounted on the boat at right angles to the "lubber line" or keel. When the boat is heading directly toward a signal, then the antenna will also point directly at the signal. The compass rose should be rotated until an imaginary line drawn through 360 degrees and 180 degrees is parallel to the keel of the boat with 360 degrees pointing dead ahead. All d.f. bearings will then be relative to the boat's heading. Boat owners will find much information in "The Light List" obtainable from the Superintendent of Documents, Washington, D. C., and from information contained in text books devoted to seamanship.

The above mentioned booklets also provide the boat owner with essential information as to the proper use of marine navigational aids and are recommended reading.

After you have built your transistorized direction finder and are satisfied with its operation, we suggest that you make continuous use of the unit in your boat under good weather conditions so that you have confidence in the instrument under storm conditions, in darkness, and during periods of heavy fog.

Two or more bearings should be taken on stations of known location and your position plotted on your chart. With experience, you can take three- and four-point bearings with this gear which has an accuracy of plus or minus two degrees—which should keep you out of trouble.

We have just learned at press time that a complete kit, based on this mechanical design, will soon be available from Heath. This is welcome news and will simplify construction and provide the compass roses and loop assembly as finished components. —30—

Temperature Tests in Radio-TV Troubleshooting

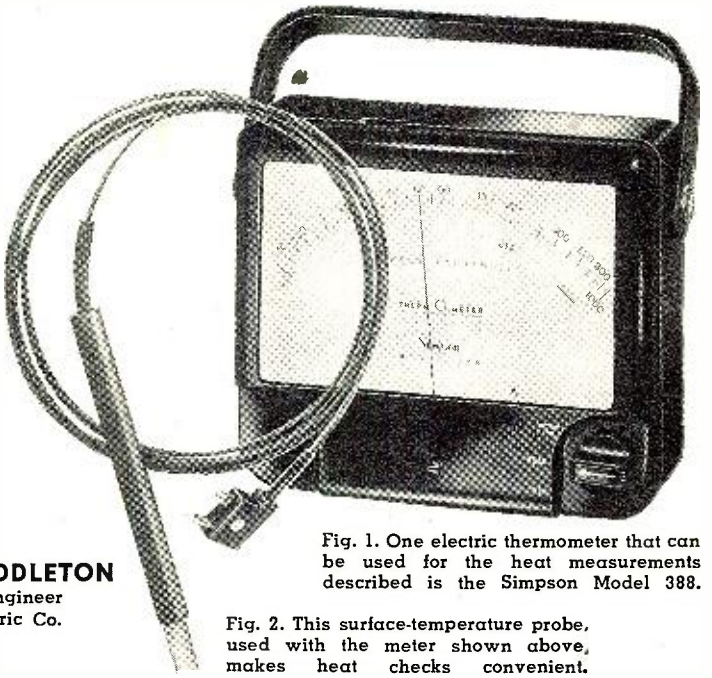


Fig. 1. One electric thermometer that can be used for the heat measurements described is the Simpson Model 388.

Fig. 2. This surface-temperature probe, used with the meter shown above, makes heat checks convenient.

An electric thermometer can pay its own way by turning many "dogs" into routine repairs.

By
ROBERT G. MIDDLETON
Chief Field Engineer
Simpson Electric Co.

THE USE of heat tests in trouble-shooting, a procedure that is not new, is often effective in handling circuit faults that have escaped detection by other methods. There are two general approaches that may be useful.

The first of these approaches—also the more familiar—involves the use of a lamp or other heat-producing device to apply heat to circuit components. In the second method, an electric thermometer is used to measure the operating temperatures of various components.

As an illustration of the first method, consider a service job in which the receiver operates in a satisfactory manner until it is warmed up; then appear such trouble symptoms as raster-shrinking, sync pulling, or intermittent reception. These are typical thermal troubles.

By applying a heat lamp over various portions of the under-chassis area, the thermal trouble may be aggravated. In this way, the general area in which the troublesome component lies is localized. Next, a soldering iron may be brought close to (but not touching) individual components within this area, to help identify the particular capacitor, resistor, or other component that is thermally responsive. While practical experience shows that capacitors are the most frequent offenders with this type of fault and that resistors run second, it is also possible for transformers to develop leakage or shorts when their operating temperature is raised slightly.

This test method is fairly well known and is, in fact, put to use on occasion by large numbers of experienced technicians. Less well known, but equally useful, is the second method mentioned. In this technique, a faulty component is localized, not by artificially elevating its temperature to cause breakdown, but by measuring operating temperature in the presence of faulty operation.

The basis for the test is not an innovation: actually, we are putting this same principle to work whenever we inspect resistors for charring, or whenever we touch various other components to determine whether they are running "hot." However, the test becomes more accurate—and considerably more useful—when an electric thermometer is used. One such instrument, the *Simpson* Model 388 "Therm-O-Meter," is shown in Fig. 1.

An instrument of this type has the wide range (over 1000 degrees Fahrenheit) that is required for practical test work. Thermometers with more limited indicating ranges may become damaged if accidentally applied to very hot spots on a chassis.

Another important feature of the instrument is the surface temperature probe, shown in Fig. 2, which permits heat to be applied effectively and conveniently to the meter by way of the temperature-sensing element in the probe.

For the purpose of using temperature testing as a troubleshooting technique, it is important to know what heat readings to anticipate with various types of components. Capacitors normally run quite cool: they are practically at the ambient temperature in their chassis area. However, if a capacitor is leaking, there is a voltage and power drop across it. This will cause its operating temperature to exceed the temperature of other capacitors in the circuit nearby. Comparative tests, then, will often put a leaking capacitor on the spot when the electronic thermometer is used.

The question may arise here of whether determination of defectiveness in a case like this one could not be made without the heat-sensitive device, using a simple "touch" or "finger" test. However, a rise in temperature that can be noted unequivocally on the instrument may yet be too small to show up on body contact.

As for resistors, it is normal for them to operate above ambient temperature. For this reason, comparative tests against the operating temperatures of resistors in similar configurations take on greater importance in ferreting out circuit faults. The following is one example of how such a check would be made in one circuit. It is suspected that the screen-dropping resistor in the second stage of a three-stage amplifier is running hot. Its temperature is checked and compared to the temperatures of the screen resistors in the first and third stages. If it is found to be running considerably hotter than the other two, immediate investigation is obviously in order.

Likewise, if a decoupling resistor is running substantially hotter in one stage than similarly functioning resistors in nearby similar stages, additional checks in the related circuit would be called for.

The method can be carried further, if necessary, by making comparative checks of the operating temperatures of tubes, too, in similar receivers. Let us suppose, for example, that the horizontal-output or damper tube in a defective receiver is appreciably hotter than the same tube or tubes in a reference receiver. Trouble is indicated in the associated circuit. The converse of this proposition also holds true: if the tube in the first receiver is *cooler* than its counterpart in a reference receiver, trouble is also indicated.

No argument is being made in behalf of heat measurement as a panacea for all troubles. However, the technique is advanced as one more useful approach that can turn certain types of "dogs" into fairly simple repair jobs often enough to make the investment in an additional piece of equipment well worth while. —30—

Motorola Color TV Receivers

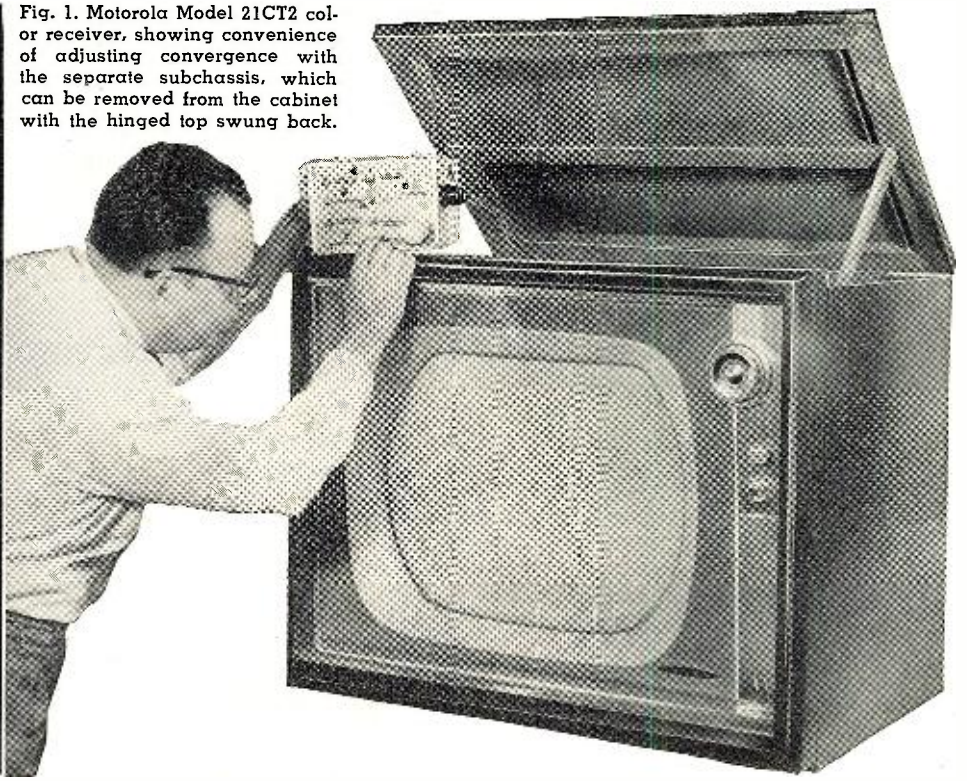


Fig. 1. Motorola Model 21CT2 color receiver, showing convenience of adjusting convergence with the separate subchassis, which can be removed from the cabinet with the hinged top swung back.

By **ROBERT GARY**

New tubes, new circuits, and an improved method for obtaining convergence adjustment are noted.

COLOR TV sets are being offered by more and more of the large-volume manufacturers. In 1956, many TV firms felt that they could still make money on black-and-white sets as long as they used small-size picture tubes and sold them at low prices. Now it becomes increasingly evident that this philosophy will not keep the receiver market booming indefinitely. With color sets, on the other hand, there has been no appreciable slump, although sales are still modest. *RCA* managed to sell practically everything it made in color. As our readers will know from recent articles, *G-E, Sylvania, Hoffman,* and other manufacturers have joined *RCA* in the color TV field. Now *Motorola* may be counted in.

It may be remembered that, two years ago, *Motorola* started to offer a 19-inch color model, but that, after a short time, this set was discontinued. The new 1957 *Motorola* color TV receiver is, in many respects, similar to other recent color sets, but there are some distinctive features. The color decoder circuits are unique, and *Motorola* has done considerable development work on a more precise system for adjusting purity and convergence. These new circuits, additional adjustment procedures not used on other color sets, as well as the mechanical features of the new *Motorola* Models 21CT2 and 21CK3 are of definite interest to those who wish to keep up with color.

At the time of writing, only two cabinet styles have been announced. One, the Model 21CT2, shown in Fig. 1, is a compact consolette available in sienna mahogany and Swedish oak. The second, Model 21CK3, is a modern-style console, available in the same type of finishes and featuring tapered legs with self-leveling glides. Both cabinet styles house the same chassis and have the same service arrangements. The only controls openly available are the channel tuning, a push-button type "on-off" switch, and a dual control for volume and contrast. All other controls are either located under the subpanel, the rear of the chassis, or on a separate subchassis which can be removed for convergence and purity alignment. The consolette has a small loudspeaker mounted at the side of the cabinet while the Model 21CK3 has the speaker below the screen.

The set uses conventional wiring and parts; no attempt has been made to employ modules, printed circuits, or any other novel assembly method. Instead, both the mechanical and electrical design features of this receiver show that *Motorola's* engineers have emphasized reliability and circuit performance. Since servicing will always be required to some extent, accessibility of all adjustments and an ample number of test points have been provided. Technicians will find this receiver easier to handle than some earlier models.

A total of 29 tubes plus the picture tube is used. As in most color sets, a great many of the tubes are multiple-purpose types incorporating several tubes in a single envelope. Latest tube types used here are the 6BV8 (a triode and dual diode), 6AU8 (a pentode-triode), and the 6BH8 (a pentode-triode), each contained in a nine-pin miniature glass envelope. Most of the other tubes used are in the usual color set complement. The power supply consists of a conventional power transformer with two 5U4 rectifiers followed by a pi filter network.

The tuner is a cascode type with u.h.f. attachment optional. Four i.f. stages are used, followed by separate video and audio detectors. The 4.5-mc. intercarrier sound section as well as the "Y" channel are conventional.

Vertical and horizontal sweep, h.v., and the color-sync section are also very similar to those previously described in this publication for other sets. A crystal-stabilized 3.58-mc. oscillator furnishes the demodulating signal to the novel color demodulators. The chroma amplifier and the color-killer circuit controlling it are also well known, but the color demodulating section is worthy of some detailed discussion. As shown in the circuit of Fig. 2, the last bandpass amplifier acts as a cathode follower and drives two sets of diode demodulators, which provide the red and blue color-difference signals to the following video amplifiers.

The principles of operation of this type of circuit are identical to those used in the phase-detector circuit

found in horizontal and some color-sync sections. Consider first the signals applied through C_3 and C_4 in Fig. 2. Due to the arrangement of L_1, these two signals are of equal amplitude but are 180° out-of-phase. At the common junction of the opposite diode sections, the locally generated 3.58-mc. color-sync signal is applied. The phase of this latter signal is that of the reference signal as sent out by the TV station.

If there were no phase difference between this and the chroma signal, no voltage would appear at the junction of R_2 and R_3. Actually, the difference in phase determines the polarity and amplitude of the "error" voltage, except that in this case the "error" voltage is the desired color video signal. In horizontal-sync circuits, the voltage developed at the junction of R_3 and R_2 would control the horizontal-oscillator frequency. The two series coils, L_2 and L_3, are self-resonant at 3.58 mc., and act as filters to keep the color-sync signal out of the video section.

As in many other receivers, the third color-difference signal is obtained by mixing the output of the red and blue amplifiers and feeding it into a third video amplifier, which then feeds the green color-difference signal to its particular grid in the color picture tube. While the 3.58-mc. oscillator is not shown in Fig. 2, its output network consists of L_1 and L_5, which must be set to give the proper phase relationships at the demodulators. Over-all phase is varied by the color-phase control potentiometer, located under the subpanel on the front of the receiver.

Another novel circuit feature in the *Motorola* set is the addition of three new adjustments in the deflection and convergence section. Fig. 4 shows the top view of the receiver with the top panel tilted upward. Just above the deflection yoke, a small box is visible, its hinged top opened. Inside are the horizontal-yoke balancing coil and the vertical-yoke balancing pot. A lead is visible going to the round, black cardboard-enclosed blue lateral-size switch. This switch is also visible in the photograph of Fig. 6, the rear view of the chassis in the cabinet.

From the circuit of Fig. 3, the operation of these controls can be examined. The horizontal yoke-balancing coil permits adjustment of the current flowing through either of the yoke coils. It should be noted here that the deflection coils are connected in parallel while, in most previously described sets, they have been connected in series. As the horizontal balance adjusts the relative linearity of the horizontal deflection coils, so does the vertical control permit balancing the vertical coils. Again a parallel connection is used. The diagram of Fig. 3 shows only the simplified circuit with the centering controls and their bypass capacitors omitted, for the sake of clarity.

All color sets reviewed to date have used a permanent-magnet blue lateral-position magnet. This magnet is required to position the blue electron beam laterally with respect to the other two colors, an adjustment made for good static convergence after the convergence magnets have been set up correctly. To permit a more accurate adjustment, *Motorola* uses an additional tapped coil and a switch which permits variation of the magnetic field without moving the magnet assembly physically. As apparent from Fig. 3, in addition to the d.c., there is also a small 15-kc. saw-tooth component acting on the lateral magnet which will improve the convergence of the blue beam at the edges of the screen.

At the right side of the deflection yoke in Fig. 6, two small tabs are visible which permit the adjustment of the top and bottom keystone-corrector magnets. In addition to these novel linearity adjustments, the receiver also

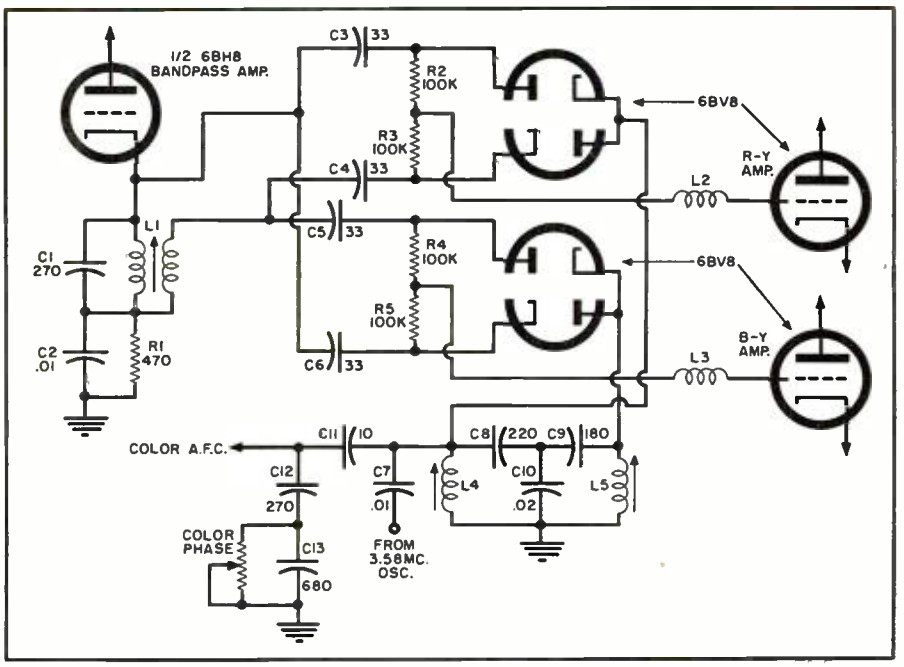


Fig. 2. A cathode-follower bandpass amplifier drives two sets of demodulators.

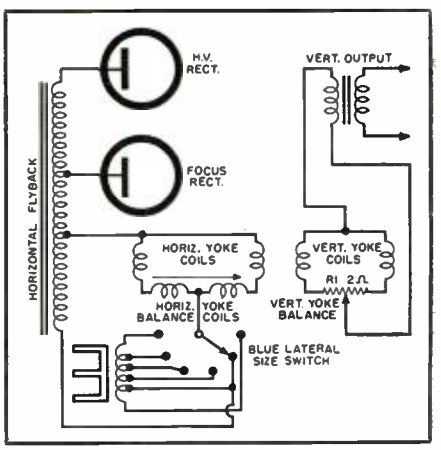
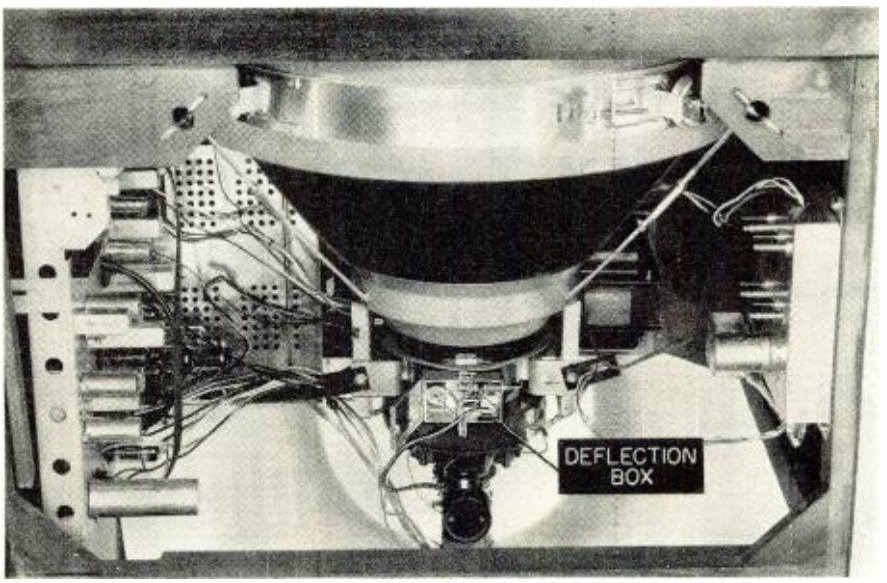


Fig. 3. Vertical and horizontal yoke coils are parallel-connected. The horizontal balancing coil and vertical balancing potentiometer are shown.

Fig. 4. The deflection box, viewed from above with hinged top open, houses the yoke balancing controls. One lead goes to the blue lateral-size switch.



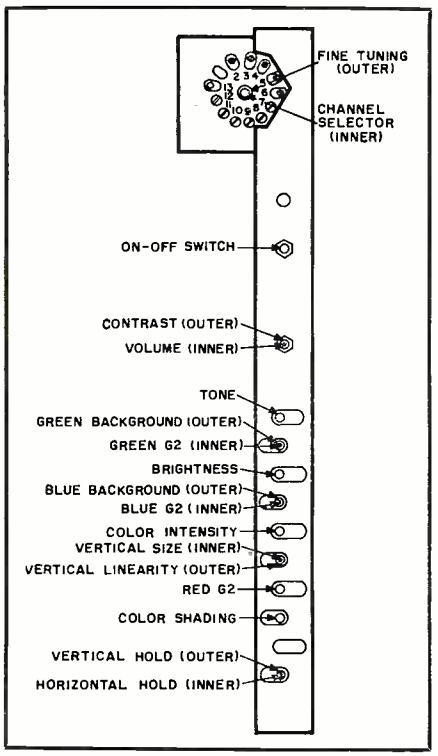


Fig. 5. Controls on the front subpanel.

has the purity, convergence, and neutralizing-magnet adjustments, found in all other color TV sets. The remaining color controls, such as the gray-background, gray-scale, and chroma-gain controls, are very similar to previously described circuits.

Color Adjustment

As mentioned in the beginning of this article, all service controls are concentrated in three areas: the subpanel on the front, the rear of the main chassis, and a separate subchassis which can be removed for servicing. Fig. 5 shows the location of these controls on the front subpanel. Fig. 1 shows how, by lifting the cover, the convergence subchassis can be removed and adjustments made from the front of the set. Since the adjustment of the customer-operated controls has been described many times before, we shall concentrate here on the unusual procedures required for the *Motorola* set and also cover those service adjustments which are made in connection with the novel circuitry already noted.

First adjust the vertical and horizontal controls for the correct monochrome picture stability. Adjustment of these controls will have some effect on the convergence system; for that reason, they should not need further setting after the initial setup. The horizontal-sync circuit is especially subject to marginal adjustment, and should be checked on all channels. Both centering controls will also affect convergence, and should therefore be set accurately on the monochrome pictures of various channels.

Next, adjusting the high-voltage, contrast, and three screen-voltage controls for a proper shade of gray with correct brightness and contrast is in order. To remove the convergence subchassis, open the hinged cabinet top and loosen the subchassis mounting screws. The rear panel of the cabinet must be removed in order to get to the two locking bars at the inside of the cabinet which hold the hinged top in place.

Once these bars have been retracted, the top cover can be raised from the front and propped open by the small wooden brace provided for this purpose. The subchassis can be slipped out without unscrewing the screws and there is sufficient cable length, as shown in Fig. 1, to permit operating the receiver with the convergence subchassis held in front of the screen. For d.c. convergence, which is the first step, the dynamic-convergence circuitry can be disabled by disconnecting the octal plug from the subchassis.

The manufacturer suggests that, for red-purity adjustment, the blue and green grid leads be removed from their plugs on the main chassis and plugged into adjacent grounded jacks. Without any station being received and with rather low brightness setting, the red-screen control is set for a red background. Then the purity magnet is adjusted for the largest possible purely red area. Moving the deflection yoke forward or backward will show the best position for red purity around the edges of the raster. Neutralizing magnets are adjusted in the usual manner for best over-all purity. Next the procedure is repeated individually for the green and blue fields, and any necessary compromises and re-adjustments are made until a satisfactory gray raster is obtained.

A cross-hatch pattern can be used for adjusting the d.c. convergence by means of the three permanent magnets on the convergence assembly and by positioning the blue lateral-correction magnet. Set the switch on top of this magnet for zero current, which is the second position as indicated on the circuit diagram in Fig. 3.

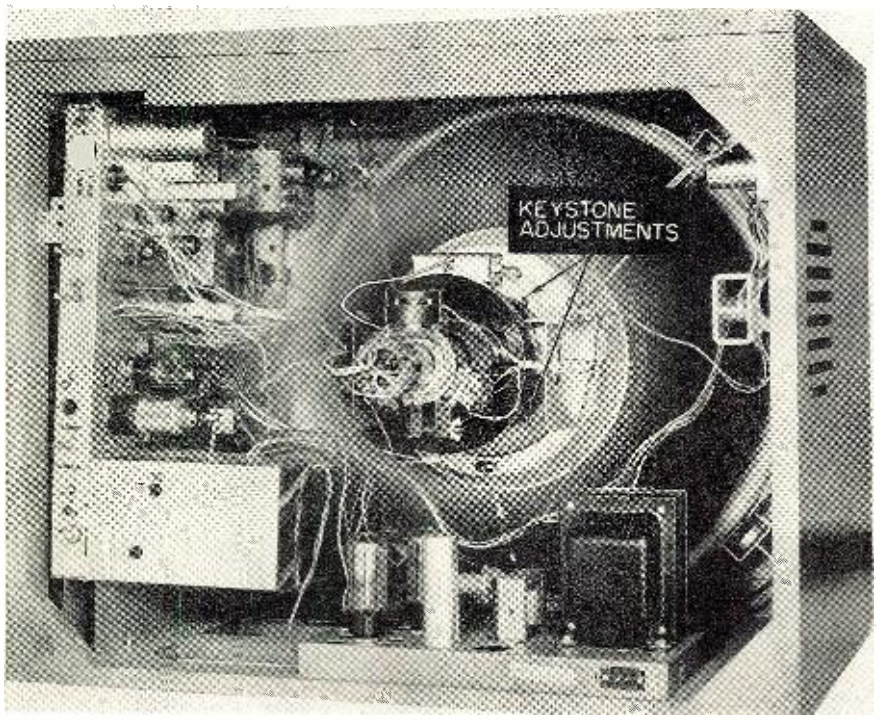
Observe the red and green horizontal lines at the center of the screen and adjust the tuning slug of the horizontal yoke balance coil until these lines are parallel to each other across the entire center of the screen. This coil is located in the little box over the deflection yoke, but the adjustment handle protrudes over the side of the yoke housing. The top keystone corrector magnet is adjusted until the green and red horizontal lines at the top of the raster are parallel across the screen. Similarly, the bottom keystone magnet is set for parallel green and red lines at the bottom of the screen.

The purpose of the vertical yoke balance adjustment is to give equal deflection over the upper and lower halves of the screen. To check this, observe the relative position of a green and red horizontal pattern line at the top and at the bottom of the screen. If, at the top, the *red* line is above the *green,* while at the bottom the *green* line is above the *red,* the vertical yoke needs better balancing. The correct setting of the potentiometer on the yoke housing is achieved when the red and green lines are in the same relative position at the top and bottom.

With the cross-hatch pattern still on the screen, the blue horizontal-size switch is varied until, at the left and right edges of the raster, the blue vertical lines fall *in between* the red and green vertical lines. Once all these adjustments are made, the convergence subchassis is connected again, and the

(*Continued on page* 141)

Fig. 6. Rear view of receiver, with keystone adjusting tabs highlighted.



The "SR-200" Hi-Fi Control Amplifier

Shown on the table are the control amplifier (left) and matching AM-FM tuner unit.

By
L. W. RAYMENT

Sargent-Rayment's new control amplifier has unique styling and unusual variable rumble, scratch filters.

TO THE casual observer, the problems of high-fidelity reproduction of sound would appear to have been pretty well solved—at least insofar as the purely electronic aspects of the reproducing chain are concerned. Time and again one reads that our electronic problems are over, and that now we must go to work and make the transducer elements (loudspeakers and pickups) the equal of amplifiers.

One would certainly be naive to think that the electronic elements of the high-fidelity reproducing chain are not far and away superior to the transducer elements, at least as far as distortion, frequency response, transient response, etc., are concerned. But it is because of this very fact, *i.e.*, relatively high distortion in the non-electronic elements, that it has been felt here that much could be done to improve the over-all quality of the *whole* reproducing chain by incorporating some electronic innovations. These innovations were designed to compensate for the inadequacies of the transducer elements.

To do this, it was first decided that a survey should be made in order to determine what sound-system problems are encountered by the average high-fidelity fan. It was thus hoped that by designing an amplifier around these particular problems it would be possible to come up with a new amplifier that would contribute to the listening enjoyment of the average audiophile. It was found, as one might suspect, that when conditions were ideal throughout the reproducing chain the sound was very good indeed. But it was also found that conditions were rarely, if ever, ideal.

To the surprise of some, it was evident quite early in the survey that high power was *not* one of the main problems (more on this later). Similarly, frequency response, important as it is, was not found to be a burning issue (probably because frequency response is so good in most present-day amplifiers). Instead, a somewhat insignificant factor was found to be the biggest obstacle to pleasant, high-fidelity reproduction: *worn records!* To the purist (and rich) this is only a matter of always playing new or nearly new records; but the average individual with a reasonably good system finds that after he has played a record a dozen or two times he no longer plays it because of the fuzzy sound that has begun to appear. Tape, of course, offers a wonderful solution to this problem of rapid record wear, but there are still a very small number of tape selections available, particularly when compared to the LP catalogue. The obvious practical solution to this worn record problem seems to be some sort of high-frequency filter.

Several step-type designs were tried, but all had only limited use in that they either cut off too much of the highs or too little. Also, many of them tended to peak just before the cut-off frequency, thus giving the resultant sound a harshness that is unpleasant. By designing a *continuously* variable, non-peaking filter it was found that precise rejection of the worn record "buzz" could be effected, and without eliminating any of the usable frequencies. This circuit employs no unusual parts, nor is it tricky or unstable. Further, it contributes practically no distortion to the signal. It is incorporated in the diagram of Fig. 1 as the "Scratch Filter" section, shown in heavy lines at left of circuit. Using a standard 365 $\mu\mu$fd.-per-section, three-gang AM tuning capacitor as the variable factor, the filter achieves the 18 db-per-octave cut-off, and is continuously variable from 2000 to 20,000 cycles, thus giving a very large number of cut-off frequencies and the most efficient possible filtering action. It is quite amazing how much better even slightly worn records sound when played with this filter in the amplifier circuit. As can be seen from Fig. 2 with the bass and treble controls set "flat," the cut-off is quite sharp, preventing the control from being used as a tone compensator by the uninitiated. Also, there is no audible peaking just before cut-off.

Second among the annoying problems that were discovered was one of low-frequency noise, whether it be hum or turntable rumble. Speakers reproduce so well in the low end that, except for the most expensive, almost all turntables (and changers, more so)

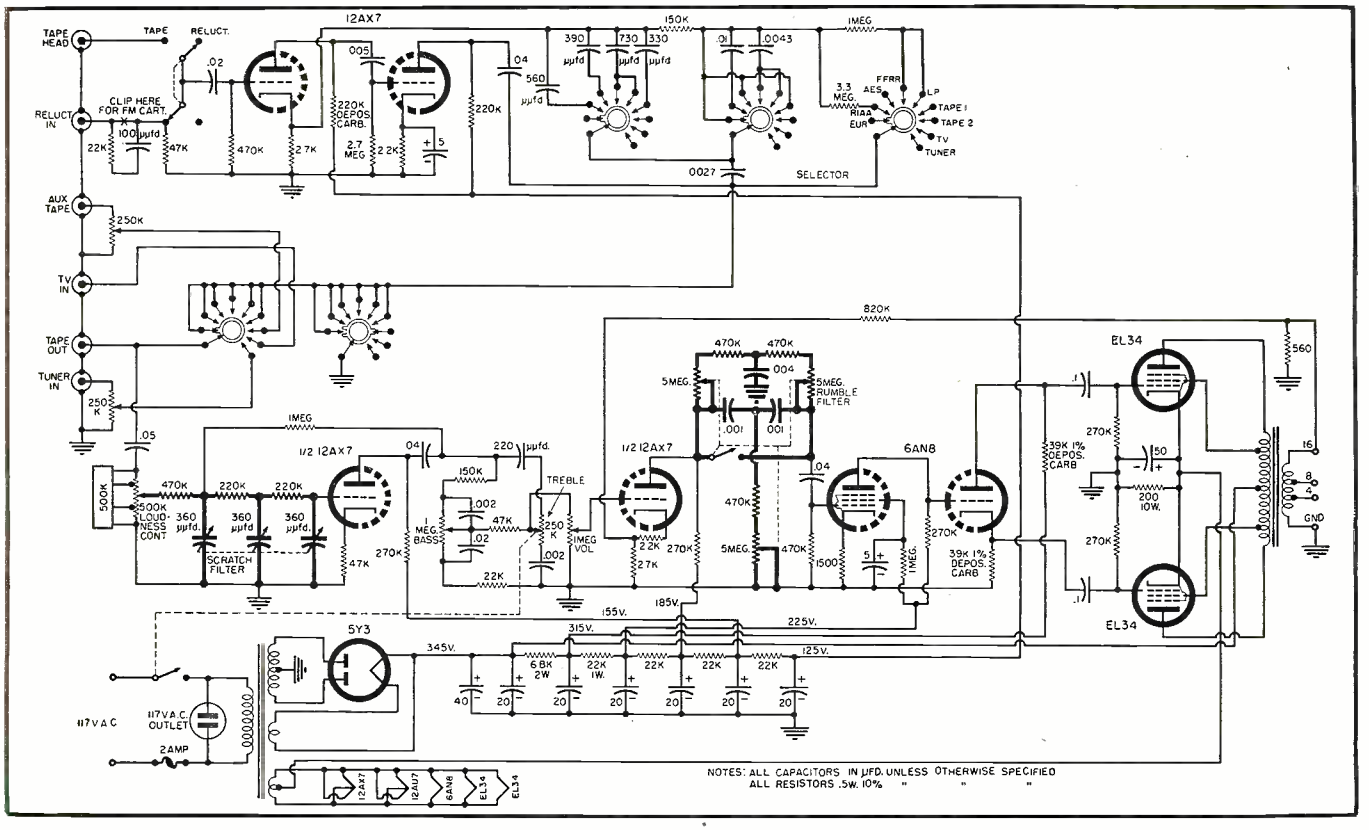


Fig. 1. Complete schematic diagram of the SR-200 control amplifier unit with the scratch and rumble filters shown bold.

contribute a great deal of noise to the over-all signal. Not only does this sound bad, but often it drives the amplifier and speaker much too hard, and into a high distortion range. While many of the turntables were found to rumble around 30 cycles or so, several others were found to have a noise component at a higher frequency, often as high as 100 cycles.

To solve this problem, a sharp cut-off, low-frequency chop was considered. But when used to decrease the 100-cycle type of noise, the amount of music that would be lost was considered to be excessive. Thus it appeared that what was needed to accommodate all types of turntables (and changers) was a continuously variable filter (to allow for the variations of frequency at which noise occurs both within one make and differing makes of turntables); and a filter that did not cut out too much of the music was considered essential. Clearly, the high-pass type, of conventional design, would simply not do the job.

So a variable "notched" type of filter was chosen as the best answer, as this type would allow a particular *band* of frequencies to be chopped out, but would leave the rest untouched. The only problem was one of design! After considerable calculation and experimentation, a design evolved that had the characteristics shown in Fig. 3. Two typical curves are shown here. One is with the filter adjusted to reject 30 cycles, the other 100 cycles. These curves were made with the tone controls in "flat" position. Variable from 19 to 122 cycles, this filter is capable of zero attenuation to 54 db attenuation in one octave. Forty db of this attenuation is within a plus or minus 5-cycle notch thus eliminating only the undesired frequency. In short it is a *tunable* low-frequency filter! A switch is provided to cut the filter out of the amplifier circuit if desired. Again no peaking is experienced near the cut-off points: thus just about any low-frequency noise problem can be eliminated, and with no appreciable loss of music, whether above or below the offending frequencies!

To the average audiophile this control should prove extremely useful; on the "super-high-quality," $500.00 and up turntables used in broadcast studios the control would not be very valuable, but it was found that even in some so-called "professional" type turntables manufactured for audiophile consumption there were objectionable amounts of noise when used with a good speaker system. This is not meant to be an indictment of turntable manufacturers, as they do a wonderful job within the limits imposed on them by the market. Another use for this filter is in the elimination of 60-cycle hum coming from the pick-up cartridge—a factor sometimes encountered with certain cartridges.

As can be seen from the circuit diagram of the SR-200 control amplifier (Fig. 1), this low-frequency, notched, tunable cut-off is essentially a parallel-T type network with three, ganged 5-megohm potentiometers to provide the necessary variation. Except at the suppressed frequencies, the loss in the network is negligible, hence no additional gain is required in the amplifier. The sharpness with which the filter cuts (usually circuits of this general type affect several octaves) is, in large part, due to the fact that it is included within the over-all feedback loop, which has a total of 20 db fed back from the secondary of the output transformer.

A problem of somewhat more subtle proportions that was found to plague audiophiles was what we call "balance." All of the equipment of a system can be of first-rate quality, all working perfectly, but in one room it will sound very poor, while in another room it will sound very good. Often the first room in which it is tried is the hi-fi shop, while the second is the consumer's living room. As is well known, room acoustics account for a great deal of this often-noticed change in sound quality, and also the volume level at which the equipment is played accounts for changes in apparent quality.

Some sort of compensation to eliminate as much of this variation as possible was needed. Conventional loudness or contour controls of the stepped type help a great deal (even though designed primarily for low to high level listening changes), but it was found more likely than not that one position would give too much compensation, while another position would give too little, *i.e.,* the reproduction would be too "thick" sounding in the first instance, and too "thin" in the second. So a continuously variable control was chosen again as the best possible answer to the problem. Such a control will allow for exact balance in almost any room.

Fletcher-Munson curves were the

basis for the circuits used in the SR-200, but more extreme equalization was found necessary in some rooms than is provided for in ordinary Fletcher-Munson compensation. Hence a very wide range of compensation is provided in the final design. Obviously, someone will ask why ordinary tone controls would not do the same job. The answer is that tone controls give an entirely different type of result from that of a properly designed balance control. The reason lies in that the *point* of boost or cut in tone controls is usually fixed, while in the balance control the point *and* amount of control can be varied with different settings, the shape of the resultant curve having been determined beforehand by the specific function the control is to perform. Accordingly, a pleasing balance is possible in any room, using this very widely variable control.

Another extremely important problem that the average audiophile encounters is that of his wife refusing to allow the amplifier in the living room unless it is cabineted in a large, expensive piece of furniture. In designing the SR-200 cabinet the industrial designer was instructed not only to make the unit appealing to the eye, but also functional. Thus, as can be seen from the photo the controls can all be clearly seen whether one is standing *or* seated in a chair near the amplifier. Further the knobs are mounted on a cantilevered section which makes for easy gripping of the knobs, and avoids hand cramping positions. The slide-rule-type dial indicates all of the phonograph equalization positions as well as the various inputs that are provided. This makes for easy identification of all functions, and further pleases the "better half" in that an engineer is not required to determine what is going on. The dial is edge-lighted, and the pointer is cabled through a detent, making each position discrete.

While it was not the engineer's desire to neglect the fundamentals of good amplifier design (low distortion, good power capabilities, etc.) the more unusual features have been discussed first. As stated earlier the problems of frequency response, distortion, etc., have been solved quite well before. In the SR-200 a high-quality circuit is used, based on a fairly straightforward screen-tap-type output stage driven by a cathodyne phase inverter. The advantages of triode operation are thereby achieved, but with considerably greater power handling capabilities than would occur in straight triode operation.

Power handling capabilities exceed 20 watts over the entire rated frequency range. While we do not wish to become involved in the amplifier-power argument that is currently raging, we have tested with the most inefficient cloth-surround speaker we could find; and in a cabinet that is essentially acoustically dead (not a horn or reflex which allows some of the rear radiation to be used). In a room of considerable size (20 x 32 x 9 feet), and at a volume level even the deafest of audiophiles considered earsplitting, it was found that even on the most extravagant peaks the power used never exceeded 12 watts[2]; so it was felt that 25 watts should suffice for home use! Further, an *A-B* test was set up using a high power amplifier (50-60 watts) along with a 14-watt job.

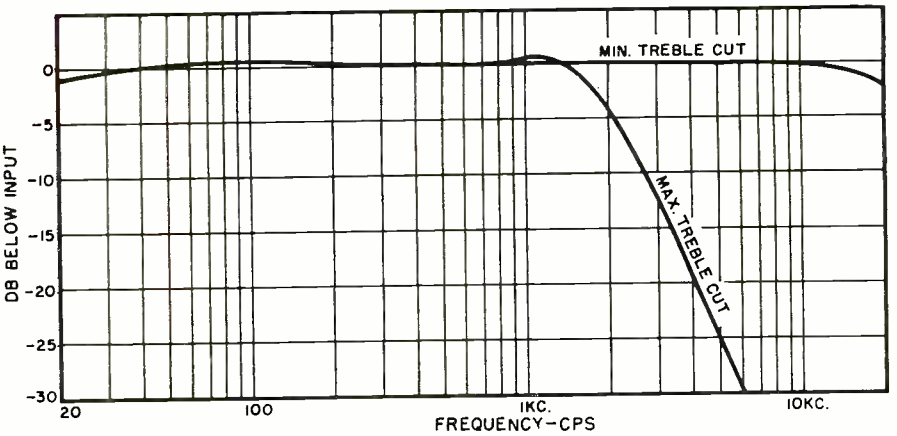


Fig. 2. Operation of variable scratch filter is shown by these response curves.

Several persons with highly trained ears, *i.e.*, musicians, audio consultants, etc., were asked to listen to each and to indicate which had the lower distortion. Even at very high levels and with the same inefficient speaker system, not one of the panel of experts was able to distinguish between the two amplifiers. Of course, on peaks or "tone bursts," an amplifier capable of 15 watts can well reach 30 to 40 watts. Honest ratings were confirmed before these tests. In any event, with true ratings the *two* amplifiers *sounded* the same. And with the more usual type of speaker that is more efficient, it could probably be shown that considerably less power output from the amplifier would produce the same results.

As is almost commonplace these days, total harmonic distortion at midrange is under .3 of one per-cent, while at the extremes it rises to only 1% at 22 watts output. IM distortion is below 1.5% at 18 watts. Although 20 db of feedback is used to lower the distortion even more, the amplifier has no tendency to oscillate at supersonic frequencies, and the more-than-adequate power supply filtering and care in maintaining proper time constants has prevented any low-frequency instability. As is usual in this sort of circuit, feedback is carried from the secondary of the output stage back to the first post-tone-control voltage amplifier cathode. Balancing of the power amplifier is achieved through the use of special, 1% tolerance, precision resistors, rather than through the use of potentiometers. It was found that even though balancing potentiometers are properly set at the factory and later at the time of sale, components tend to change value as they age, thus throwing the amplifier out of balance. Also someone often seems to unwittingly change the balancing potentiometer setting, also resulting in unbalance. Precision resistors of the type used in the SR-200 allow extremely close balance to be maintained throughout the life of the amplifier without any adjustments whatever by the user.

The output transformer has a tap at 4 ohms as well as 8 and 16 ohms, in recognition of the increasing use of 4 ohm speakers. Damping controls were avoided, as it was found that most damping control circuits that are *audibly* effective are, in reality, nothing more than post-amplifier bass boosting circuits. Those that do not make an appreciable audible change were found to present a problem not entirely un-

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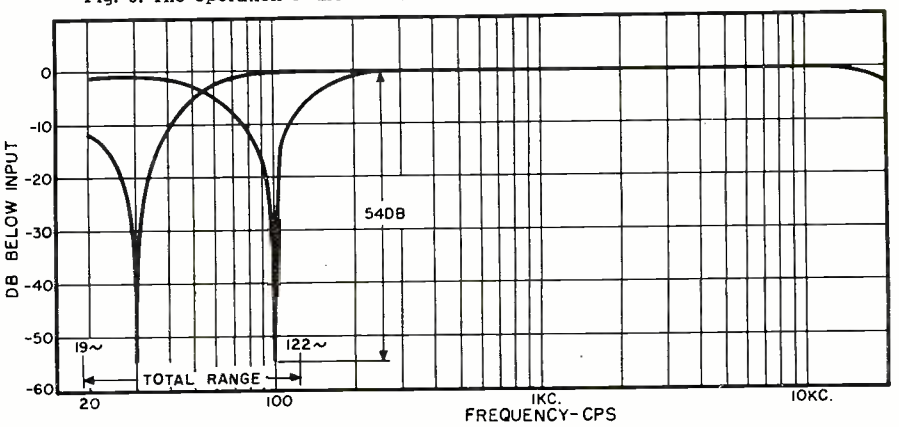
Fig. 3. The operation of the twin-T variable rumble filter may be seen here.



MAY

JUNE

JULY

AUG.

SEPT.

OCT.

NOV.

DEC.

By **WILLIAM LEONARD**

All business is more or less "seasonal". Try these business stimulators to level out the "valleys".

EVERY four years, the electronic service industry enjoys a six-month business boom that tends to breed a feeling of complacency about the future. The succession of events starting with the quadrennial national political conventions and continuing on through the fall and winter months generates a lot of TV service calls. Business is so good that, during its peak, most service dealers bemoan the fact they cannot get enough technicians to handle the requests for service.

The rude awakening that the business is still highly seasonal starts with the first warm days of spring when indoor entertainment starts to play second fiddle to yards and parks and the open highway. The volume of service calls dips sharply. As business starts its sharp slide the average service dealer begins to wonder where he will find the money to meet his operating expenses and pay his bills during the summer months ahead.

Every business that caters to the general public has similar seasonal business problems. Some types of businesses have adopted industry-wide sales programs to cushion these drops in volume. A good percentage of the public will buy "out of season" when they are offered what appears to be a bargain. People who understand the "merchandising" of products to the general public prepare their most aggressive promotional programs for the known off-seasons for their merchandise.

Service can be merchandised like any tangible product. Without reducing rates or income, bargain packages of service can be offered during the normal off-seasons that will inspire many people to have work done that they otherwise would put off until fall.

July and August have always been the roughest months in the electronic service business. One of the old, reliable stand-bys in selling radio service during the summer months is to offer a bargain package. This is an offer to service any five- or six-tube table model radio for a nominal charge, like three dollars for labor plus parts. In several instances shops that aggressively promoted a package of this kind had to set up a repair production line to handle all of the sets that came in. Similar summer-time service specials on TV sets have been equally effective in producing business when it was most needed.

To be effective, service specials must be promoted vigorously and intensively. They require a series of promotions. A single card, letter, or flyer will not do it. Striking postcards or handbills must be made up and distributed at regular intervals during the period of the promotion. Each piece in a well-planned campaign has a cumulative value in getting customer attention and action.

The most important factor involved in putting on a business-creating service-selling program is the planning of the campaign in all of its details. In addition to the planning of the cards or flyers that are to be used, attention should be given to the possibilities of the telephone and the ways technicians can generate the interest of neighbors of their TV service customers.

Since July and August normally are the worst months of the year for a TV service business, promotions to stimulate business should be focused on the period from the middle of July until the end of August. Early in June a study should be made of the trade area in which the promotion is to be carried out. The purpose of this study should be to determine the type of special service offer that will be made and the method or methods to be used in conducting the campaign effectively and economically. The dealer should estimate the number of homes he must reach with his promotion material to supply the volume of business he needs. His survey should tell him about the size of the residential area he will have to cover to reach his objective. Finally, the amount of money that can be allocated to finance the program will be the determining factor in the type of media that can be used.

In the normal service area of the average shop, it is possible to cover from fifteen hundred to three thousand homes with cards or flyers distributed house-to-house. Most high schools have a student employment bureau that welcomes all job opportunities for students who register for off-hours work. Students who are placed on jobs by the school bureaus usually are diligent in carrying out the work assigned to them. They are reliable in distributing material to the homes.

The general plan for the campaign should be determined no later than the middle of June. This will allow ample time to get the printed material that is to be used in the promotion. If several pieces are to be distributed in the same area, copy should be prepared for all of the pieces with the advertising messages focused on the "service special."

The most economical way to have special promotion material printed is by the photo-offset process of printing. Striking cards and flyers can be made up by combining copy from manufacturers' consumer advertising pieces. The printer will help to make up the circulars or cards so that they are both professional in appearance and effective in getting the "service special" idea across to the reader.

If all of the printing and planning details are completed before the campaign starts, the dealer can concentrate his attention on carrying out the program. After a dealer has put on one long-range program of this kind the experience he gains is invaluable in planning all of his future business promotional activities.

There are times when some dealer dreams up an ingenious "one-shot" promotion that results in the stimulation of business over a long period of time. This type of promotion is usually developed around some type of "gimmick." A program of this type

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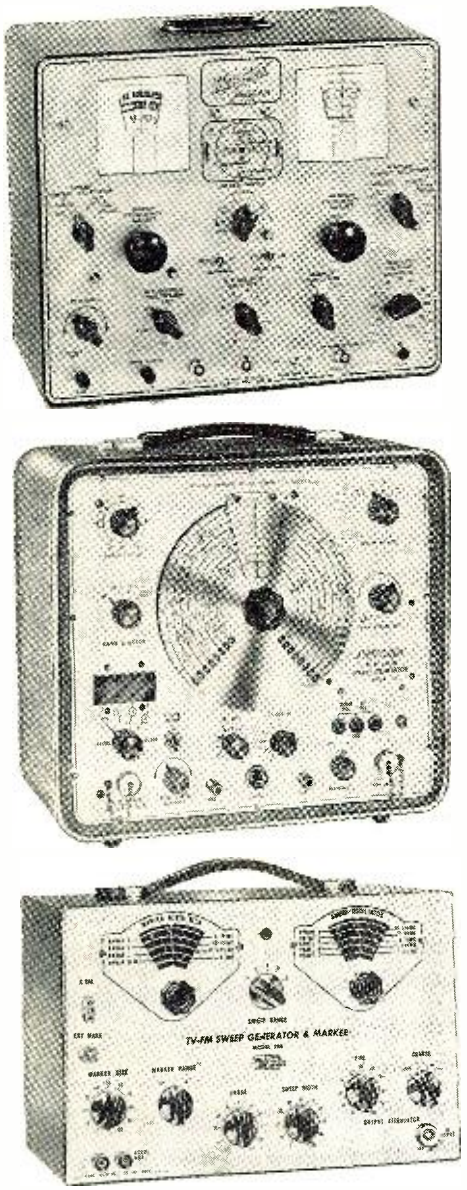


Typical sweep generators for use in service shops include units by Hickok (top), Precision (center), and EICO (bottom).

Maintain and Repair Your Own Sweep Generator

By **WALTER H. BUCHSBAUM**
Television Consultant, RADIO & TV NEWS

Don't lose the use of this instrument because it is out for repair. You can learn to recognize and correct many common troubles on your own.

THE OLD saying about a craftsman being no better than his tools still applies to such an advanced technical field as TV servicing. A service technician is limited in his work by the tools and instruments he has available. If half of his instruments are out of order, his efficiency suffers and in the end he is reduced to the level of the screwdriver mechanic.

Most test equipment is designed for years of service and should require little attention. Nevertheless, whenever tubes are used, for example, a certain amount of aging must be expected, as well as outright failures. In some types of test gear, the sensitivity of the unit will decline as the tubes grow gradually weaker. Unless occasional calibration checks are made, erroneous readings can be obtained. Some marginal TV receiver troubles, which seem so difficult to locate because they give only slightly wrong readings, can be complicated by poorly calibrated test equipment.

Readers are surely familiar with the need to recalibrate an ohmmeter frequently because of the aging of the batteries. Less well recognized is the need for calibrating and adjusting the v.t.v.m., oscilloscope, sweep generator, marker generator, and others. Yet insufficient output from the latter two instruments will often result in unnecessary troubleshooting and even wrong diagnoses.

Before dealing with the specific problems of test equipment maintenance and repair, a few words of caution must be offered concerning the extent to which test equipment *should* be repaired by the service technician. Whenever a warranty is still in effect, the owner will naturally want to have the manufacturer repair his product. If it appears obvious that a tube substitution will cure the trouble, this is often simpler than shipping a piece of equipment back. If, however, extensive troubleshooting is required or special parts must be replaced, it is wiser to utilize the warranty and return the unit. Certain types of very critical calibrations require voltage or frequency standards which the service shop does not usually have. For that reason, either the manufacturer or some specialist must be contacted. This applies especially to meter movements, r.f. field-strength indicators, frequency meters, and the like.

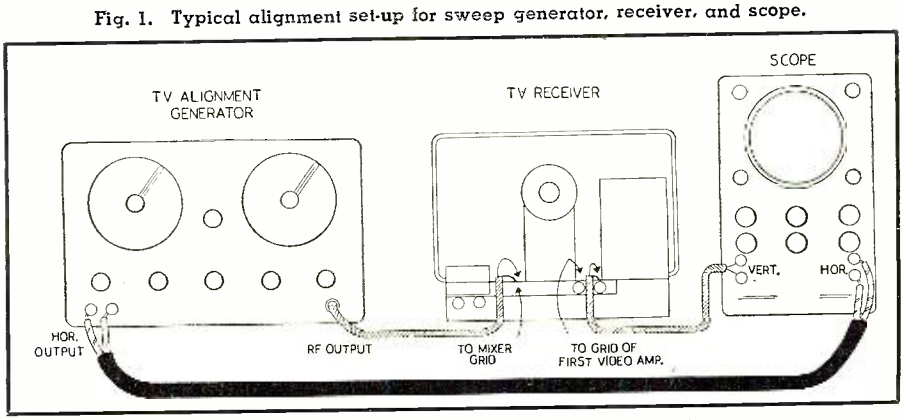
The immediate interest of this article is the maintenance and repair of TV sweep generators.

The one thing common to every sweep generator is the nature of the output signal. This signal is at the frequency of some TV channel, but varies rapidly back and forth within a certain band. For example, when a generator is set for channel 6, the r.f. output signal will usually change from 80 to 90 mc. at a rate of 60 times each second. The effect is the same as if some very rapid operator were to twirl the dial of an oscillator back and forth.

Sweep Generator Principles

Electrically the frequency sweeping action is performed either by some mechanical device, like a vibrator or motor-driven capacitor, or else this is done electronically by modulating a frequency-sensitive circuit with a 60-cycle signal from the power line. When the sweep signal thus produced is applied to the TV set, each frequency is amplified according to the frequency characteristic of the receiver. At the second detector (usually) the higher frequencies are removed and the remaining envelope corresponds to the frequency-response curve of the receiver circuits through which the signal has passed. To view this curve on the oscilloscope it is only necessary that the horizontal-deflection circuits of the latter instrument operate in synchronism with the frequency-sweeping mechanism of the sweep generator. This synchronism is assured by feeding the horizontal-sweep signal directly from the generator to the oscilloscope.

Fig. 1. Typical alignment set-up for sweep generator, receiver, and scope.



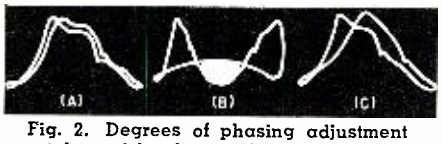


Fig. 2. Degrees of phasing adjustment without blanking of return trace.

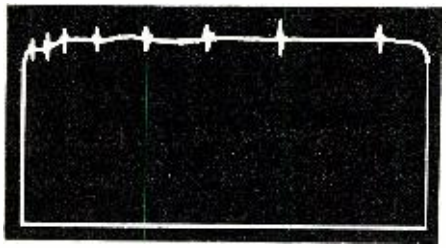


Fig. 3. Frequency markers 1 mc. apart expose frequency nonlinearity in sweep.

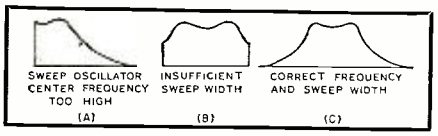


Fig. 4. Response curves may be distorted by incorrect generator adjustments.

A typical sweep-generator set-up is shown in Fig. 1. This is the one recommended by the *Heath Company* for its alignment generator. To avoid the usual double trace due to slight phase shifting in the oscilloscope leads and amplifiers, most sweep generators cut the oscillator off during one half of its cycle. To insure proper frequency linearity, provision is made to adjust the phase of the scope sweep signal with relation to the actual frequency-sweeping device in the generator. This adjustment is made with both traces visible as shown in Fig. 2, for best coincidence of both traces. Trace (*A*) demonstrates optimum phase coincidence, while traces (*B*) and (*C*) show varying degrees of phase displacement.

Almost all sweep-frequency generators can be set for at least the v.h.f. TV channels and the i.f. bands. Naturally, when the tuner is aligned, the sweep generator will be set for the channel under study. If only the r.f. bandpass is observed, the oscilloscope can be connected to the test point on the mixer grid provided on most TV tuners (through a 1-meg. resistor). This point corresponds to the mixer grid-leak bias, which provides an indication of the frequency response of the circuits preceding it. To check the i.f. amplifiers the signal may be injected either at the mixer or at some later stage.

Unless the second detector is used to demodulate the response curve for the scope, a separate diode probe must be used. Quite a few sweep generators, nowadays, have built-in markers to indicate certain frequencies, usually the video carrier and the sound carrier of the channel under study. For calibration and repair purposes, it is usually best to have an additional source of known frequency markers, and most technicians ordinarily use the sweep generator in conjunction with an external marker generator, often crystal controlled.

Performance Requirements

Ordinarily the sweep generator used for TV servicing is expected to live up to certain minimum standards without which it is hardly useful. Whenever these lower limits are reached, it is time to devote some attention to the device to bring its performance up to original specifications.

The quality of the r.f. or i.f. output signal is judged by its amplitude, sweep width, and the flatness or uniformity of the output over a sweep band. Typical minimum values for sweep width are 12 mc. for channels 7 to 13, 10 mc. for channels 2 to 6, 6 mc. for i.f. alignment and at least from 100 kc. to 5 mc. for the video. How sweep width and the rest of the parameters are measured and how they can be adjusted are described later.

The r.f. output can be measured in several different ways, depending on whether power or voltage is considered and what load is used. For our purpose, absolute values are not required and the voltage output of a high-impedance detector is measured. If the output of a standard diode probe connected to the sweep generator is at least 0.1 volt, the r.f. amplitude is sufficient for most needs.

The sweep generator output should be reasonably uniform within any band it is expected to sweep. Any point in a swept bandwidth should not be more than 3 db from any other point in the same band. A typical, acceptable instrument, for example, may have an output that is substantially flat over its maximum sweep width, with a slight drop-off of about 1 db at one of its ends. The phasing control should have a range of at least 120 degrees, or better than half a turn on the *unblanked* pattern produced in the scope.

Frequency linearity, another important attribute, is measured by comparing the frequency spread covered by a given horizontal distance on the scope trace with another similar distance on the same trace. Nonlinearity will usually show up as a difference in this spread between one end of the trace and the spread at the center portion of the trace. To illustrate, the trace in Fig. 3, approximately 10 mc. wide, carries eight 1-mc. markers. If output from the generator were linear with respect to frequency, these markers would be uniformly spaced. Where frequency linearity is off, as in this case, the varying spacings between markers will quickly indicate the situation.

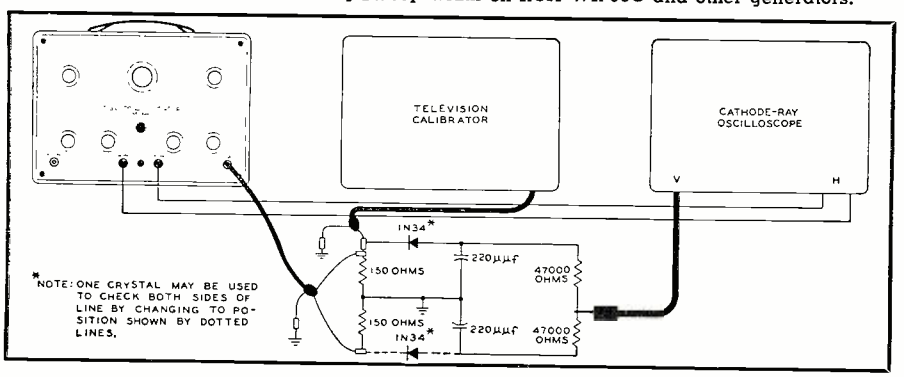
The generator's horizontal output is not very critical in amplitude and is not a frequent source of trouble. As long as the scope shows proper horizontal sweep, this portion of the instrument can be taken for granted. Where built-in markers are available, they should be visible on the scope trace irrespective of the sweep-generator output amplitude. Frequency accuracy is usually maintained by crystals; or else a means of checking against a crystal is available.

A word should be said about the importance of using the right cable for the sweep-generator output. Probably the most troublesome part of the entire generator is the cable, because it is subjected to a great deal of abuse. Dangling test leads get stepped on; on the bench they get accidentally burned, squashed, pulled, covered with dust, and suffer other mishaps. As a result the test clips, the wires leading to them, and the terminating network are all often damaged—and frequently such damage is invisible because of the insulation. Therefore, whenever the sweep generator is suspected of malfunction, the r.f. cable should be checked first. Similarly, whenever any measurements are made, be sure to use only a good cable with the right kind of termination.

Sweep Width Troubles

Sweep width can only be measured by means of markers of known frequency. One of the first symptoms to indicate insufficient or misaligned sweeps is the appearance of response curves like those in Fig. 4. To measure actual sweep width, the circuit of Fig. 5 can be used and, if possible, markers from an external source should be applied. The method is one recommended by *RCA*. Some sweep generators, like the *RCA* WR-59C, have provision for adjusting the center frequency of the sweep signal for individual channels. The rear view of Fig. 6 shows these adjustments on that unit. To vary the sweep width, the voltage on the vibrator is usually set by a fine control on the front panel, and a coarser setting is available on the instrument chassis. Care must be taken in changing the coarse setting, since excessive swing of the vibrator can

Fig. 5. Technique for measuring sweep width on RCA WR-59C and other generators.



damage the mechanism or upset the mechanical alignment of the entire sweep oscillator.

Insufficient sweep is often caused by aging of the vibrator itself (where one is used), by changes in the series resistance of the vibrator or the motor control circuit, or by some mechanical defect such as warped plates or loose parts. In generators using the beat oscillator system, tube failure can affect sweep width. In those systems using a permeability type sweep, insufficient sweep width can even be due to magnetic changes in the materials. Most likely, however, the circuits providing the frequency-changing power are at fault.

The v.h.f. oscillator ordinarily is quite a tricky circuit. When it is supposed to oscillate with equal strength over a wide band, the circuit becomes even more touchy. A few test equipment manufacturers house the sweep oscillator in a separate, sealed case, and warn the technician against attempting repairs of this section. In any event, extreme care is required and by no means should force be used on any of the v.h.f. oscillator components.

Signal Output Amplitude

Sweep generators are usually furnished with a set of cables which have their own built-in terminations. These resistors are intended to match the generator to the input impedance of the TV set. When the generator is connected to the 300-ohm antenna terminals, the 300-ohm r.f. cable will match the generator to the load and in addition to providing maximum power transfer, it minimizes the chance of reflections. Often, however, the generator is used to align only the i.f. section, and connections can be made in a number of ways.

One popular system, shown in Fig. 7, is recommended by *Allied Radio* (*Knight*). Here the actual impedance is anyone's guess. The signal is coupled capacitively to the mixer-tube elements, but the signal strength here depends on the tube used, on the position of the tube shield, and on connections. Whenever weak signal output is suspected, the following measurements can be made: Calibrate the oscilloscope to show 1 volt peak-to-peak as at least 1 inch vertical deflection on the screen. Then connect a diode detector probe directly across the output terminals of the sweep-generator output cable. Connect the horizontal sweep-generator signal to the oscilloscope, and measure the amplitude of the diode output on the screen. It should measure at least one tenth of a volt.

Weak signal output is most often caused by a weak oscillator tube. Fortunately, tube replacement is not too difficult. It is a good idea to try several tubes, since at v.h.f. tube selection is often required to give equally good performance at all channels. If tube replacement is not the solution, look for a bad ground or poor connection in the r.f. output system. Especially vulnerable are the various types of attenuators having a small pick-up loop which is moved closer or farther from the tank circuit. A more difficult trouble in this respect is the case of no output at all at certain frequencies or bands. Check the contacts of the bandswitch and the grounding at all points. Where a variable capacitor is used, check for contact between the rotor and stator plates, intermittent or worn grounding springs, broken bypass capacitors, or similar defects. The coaxial cable going to the front panel, as well as the test cable itself, are also prime suspects.

Amplitude Flatness

If the generator output varies in amplitude this will affect the apparent frequency-response curve of the receiver under test. While absolute flatness is not always possible, the variations and dips must be kept to less than 3 db. Fig. 8 shows the scope trace obtained with the set-up of Fig. 5 and indicates its limits. On the oscilloscope trace, 3 db corresponds to 0.707 of the maximum amplitude, since the scope shows voltage only and not power.

Tube failure is the most frequent cause for uneven generator output. In addition to the various defects just mentioned for insufficient output, so-called "suck-out" is often the cause of "holes" or dips in the output. This may be caused by a change in wiring of such minor components as filament chokes, the various bypass or coupling capacitors, or even just poor grounds. Tube selection may help to solve this type of defect, as well as careful lead dress. It is very important to check all frequency bands of the generator to make sure that the amplitude response is sufficiently flat everywhere.

Phasing Control

Since the return trace is usually blanked out, misadjustment of the phasing control will give the appearance of poor frequency linearity or even off-center sweep width. Typical of this are the illustrations of Fig. 9. Only when the blanking switch is turned off so that both traces are visible, as in Fig. 2, can proper phasing adjustments be made. Both traces should coincide in at least four different points. If the phasing control appears to have insufficient range or its adjustment has no effect at all, then the phasing circuit should be investigated. The most widely used basic circuit is shown in Fig. 10. The controlling elements are the resistor-and-capacitor network, which determines the relative phase between the blanking signal and the horizontal-sweep output signal. If any of the capacitors or resistors become defective, proper phasing will not be possible. In this connection, it might be mentioned that occasionally the blanking diode or its associated components become defective, so that either no blanking takes place or else the blanking occurs at the wrong portion of the cycle, producing a rather weird response curve.

Miscellaneous Troubles

The linearity of frequency *versus* horizontal displacement on the scope depends on the sweeping mechanism and its circuitry. In capacitor-type sweep generators, there is usually some correction circuit provided to improve the frequency linearity. As the capacity is increased by the upward stroke of the vibrator, the frequency

(*Continued on page* 154)

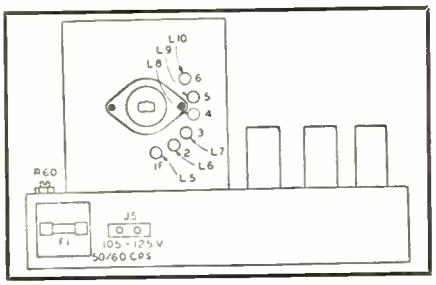
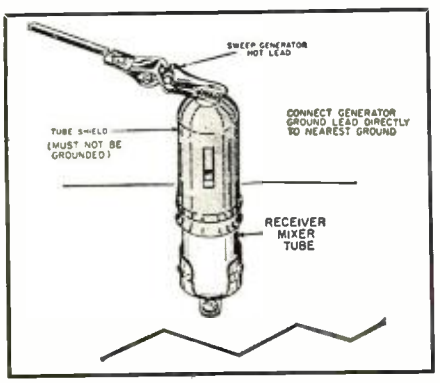


Fig. 6. Center-frequency adjustments for each channel on the RCA WR-59C.

Fig. 7. Signal injection to the mixer tube through a floating tube shield.



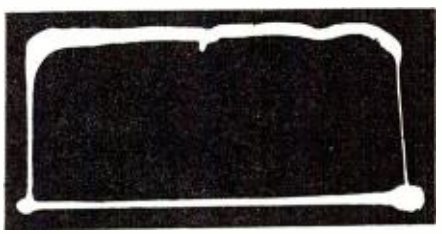


Fig. 8. Scope display of response on a swept band, after probe detection.

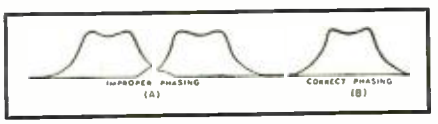
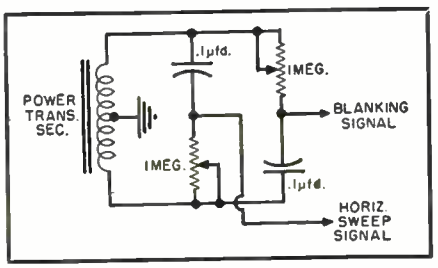
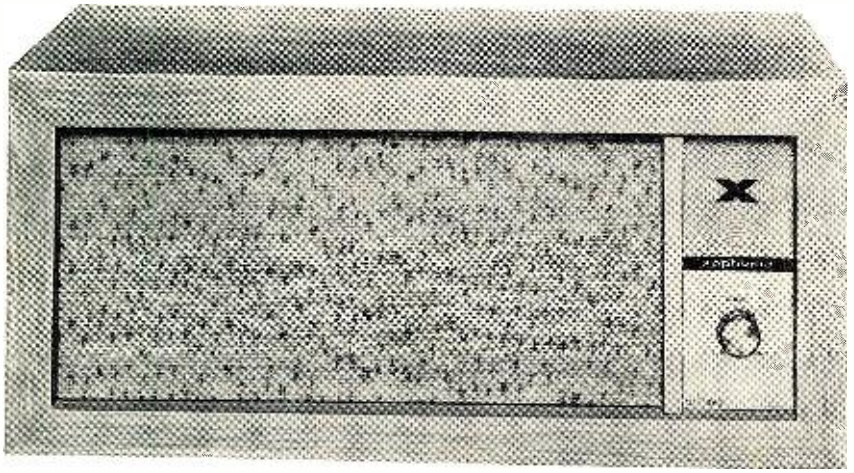


Fig. 9. Effects of phasing adjustment.

Fig. 10. Widely used basic circuit for providing the proper phase adjustment.





A Reverberation Unit For Hi-Fi Reproduction

Radio Craftsmen unit provides a method of obtaining concert hall reverberation by means of acoustic delay.

By
THE ENGINEERING DEPARTMENT
Radio Craftsmen, Division of
Precision Radiation Instruments, Inc.

THE recent announcement regarding "Xophonic" sound has stimulated the curiosity of all audiophiles. It is the purpose of this article to explain how such a unit can acoustically convert a small room so that it sounds like a concert hall, and also to summarize the design and development of the device for the technically minded.

Actually, the unit was developed to fill a definite need. The upsurge of interest in high-fidelity reproduction during recent years has made the average consumer aware of the superiority of a high-fidelity system over a conventional radio or phonograph. As a by-product of the increase in the use of high-fidelity equipment, we find that the "appreciation level" of most listeners is rising. Audiophiles and "laymen" alike are asking for even better approaches to "concert hall realism."

For this reason, audio engineers for some time have been carefully re-examining the physical differences between the actual performance and the home reproduction, in an effort to overcome (insofar as possible) such differences as may exist.

Past work has been devoted primarily to reproducing the sense of "location," that is, the relative position of the soloist to the orchestra, or of the various sections of the orchestra to each other. To do this requires two or more sound pickups and a similar number of recording or broadcasting and reproducing channels. Although this sense of "location" has proven effective, the necessary equipment is fairly complex. This has kept it out of the price range of the average home hi-fi listener in a good many cases.

There are, however, other differences between the concert hall performance and the reproduction in the home. One of the primary characteristics of a concert hall is its quality of reverberation. In a large auditorium, the sound from the performers reaches the listener directly, and also is reflected from the walls and ceiling of the hall. These reflected sounds reach the listener a fraction of a second after the direct sound, and are then re-reflected (and re-heard) again and again for a period dependent upon the reverberation time of the auditorium. The combination of undelayed (direct) and delayed (reflected) sound gives a concert hall its "character." An auditorium that produces these after-sounds is said to reverberate.

The type of room in which we do most of our music listening differs from an auditorium in two respects: (*a*) The walls and ceiling of residential rooms are relatively closely spaced compared to a concert hall. Sounds are therefore reflected only a very short time after leaving the speaker, and there is no significant delay; (*b*) there is usually a good deal of sound-absorbing material present, for example, upholstery, carpets, drapes, open doors, etc., which prevent repeated reflections.

For these reasons, a living room will not produce significant reverberation, and this is a serious difference between "reproduced" and "performed" music.

The engineering staff of *Radio Craftsmen* decided to attempt the development of a system for producing reverberation similar to those of a large auditorium, in an average-sized room. It was determined that a very realistic effect could be obtained with two sound sources: one "undelayed" (or conventional source) and a second source whose sound output followed the first by about 1/20th of a second.

A block diagram of a home reproduction system with reverberation was then drawn (Fig. 1). The heart of such a system is, of course, the delay device or network. Preliminary calculations indicated that an electrical *LC* "artificial delay line" was out of the question; to provide a relatively long and uniform delay at an audio frequency would require an inordinately large number of high-quality chokes and capacitors. The method used by Vermeulen to control theater reverberations appeared quite feasible for this application. See Fig. 2. In brief, a circular length of magnetic tape would "store" a short portion of the selection being reproduced for a time corresponding to one tape revolution, and the recording and playback heads would be displaced by 1/20th of a second in tape-travel-time. The recording head would be connected in parallel with the "conventional" speaker, and the playback head would drive the "delayed" speaker through the auxiliary amplifier. Of course, a bias-erase head and appropriate circuitry are also necessary.

The primary objection to this method is one of cost. The tape system, as outlined, is fairly expensive in even moderately performing equipment; but to maintain a good signal-to-noise ratio when continuously recording, erasing, recording, etc., requires the best of equipment. This is beyond the economic reach of the average listener.

A third approach, and one which ul-

timately resulted in the design of the "Xophonic," was the construction of an acoustic delay device. The velocity of sound in air is approximately 1100 feet-per-second. The distance covered by a sound wave in 1/20th second is, therefore, 1100/20 or 55 feet. If we could build a confined air path approximately 50 feet long, generate a "sound" wave at one and receive it at the other, the delay between generation and reception would be about 1/20th of a second. This delay would be inherently "flat," or uniform, over the audio range. The system would have to be confined so as not to lose energy. Also, we use "sound" in its physical sense as a wave motion of air —not as the auditory sensation of hearing.

There followed a good deal of experimenting to find a satisfactory combination of an exciter-driver unit, a suitable confined air path, and a sensitive microphone detector. After experimenting with different delaying structures, such as labyrinths, etc., we decided on a hollow-pipe air path. One of the problems encountered was to find a combination giving fairly uniform frequency response. To produce a uniform response, it was necessary that the driver-microphone combination compensate for the frequency sensitivity of the pipe.

At one end of the hollow aluminum pipe is the magnetic transducer as shown in Fig. 3. This is a loudspeaker-type device that is coupled *via* an impedance transformer to the 50-foot length of aluminum pipe. At the other end of the pipe is a sensitive crystal microphone which is made in a convenient configuration for coupling to the pipe. The over-all arrangement is shown in Fig. 4, which indicates the driver at one end of the pipe and a microphone at the other end of the 50-foot pipe.

Note the use of a 7.5-ohm series resistor between the output of the main amplifier (input of "Xophonic" unit) and the driver unit. This resistor serves a twofold function. In the first place, it raises the impedance level into the unit to 16 ohms, that is, it furnishes about 8 ohms in series with the 8-ohm impedance of the driver unit. It is important that the unit represent a high input impedance as it will be used by bridging it across the voice coil of the present speaker system. Therefore, in order not to present a severe mismatch, it should represent an impedance which is high with respect to that of the speaker system. The 16-ohm "Xophonic" input impedance performs satisfactorily with both 4- and 8-ohm voice coils. When used in conjunction with 16-ohm voice coils, it is advisable to connect both the "Xophonic" and the main speaker system to the 8-ohm output tap of the amplifier.

The second function of R_1 is to raise the input power rating of the unit so that, if it is connected to a 25-watt or higher rated amplifier, and the main speaker is inadvertently disconnected, the voice coil of the "Xophonic" driver will not be overloaded. The resistor then acts as a fuse and variable resistance which protects the driver voice coil.

Another problem was obtaining parts which permitted a tight, secure mechanical and acoustical assembly. We soon discovered that any vibrations or "sound leaks" would lead to impaired performance of the "Xophonic" reverberation unit.

After these problems were overcome, and a satisfactorily operating delay device had been designed and constructed, we turned our attention to the auxiliary amplifier. Since the power contained in the "reverbatory" sound should be less than that of the main sound, it was felt that it would be unnecessary and wasteful to utilize a high-powered amplifier. The circuit shown in Fig. 5 was designed and tested, and performed quite satisfactorily. The only unusual feature of the design is the floating paraphase phase inverter. This circuit, which utilizes negative feedback from plate (pin 6) to grid (pin 7) is fully described in the literature.

The last step in producing the unit was "packaging" it in a reasonably sized, attractively styled enclosure (see photo). The 50-foot length of pipe was coiled around a large diameter cylinder in the unit. In producing this coil, extreme care is necessary not to dent or "bend" the pipe. An integral speaker is incorporated, and the inside of the cylinder acts as part of the speaker backloading. Patents on this design have been applied for. The amplifier is assembled and tested separately, and then connected to the microphone and speaker at the final assembly of the unit.

In listening tests made on the unit both during development and subsequently, the "concert hall effect" has

(*Continued on page* 97)

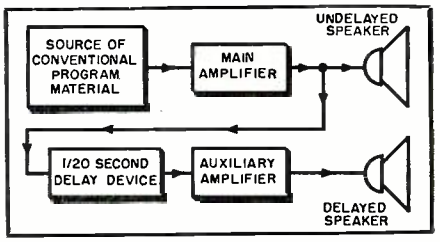


Fig. 1. Diagram of reverberation system.

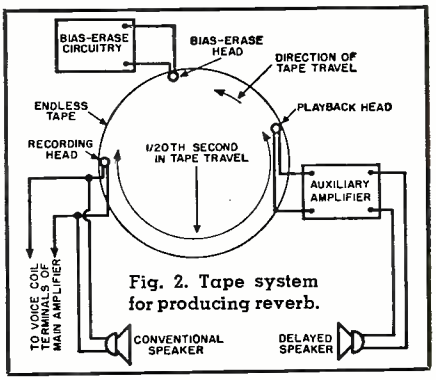


Fig. 2. Tape system for producing reverb.

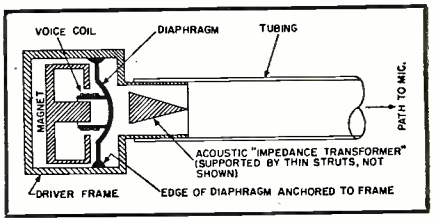


Fig. 3. Driver at input to hollow pipe.

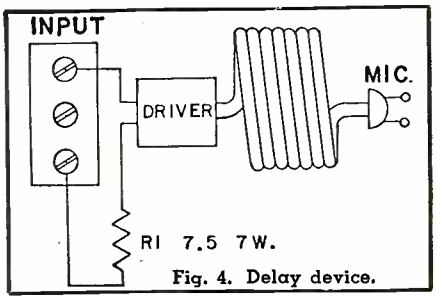
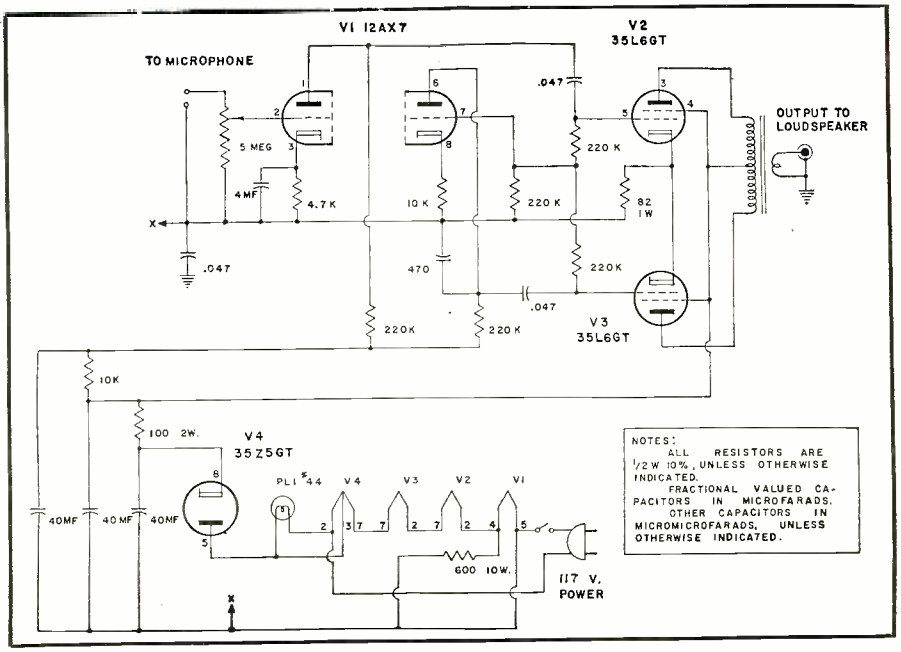
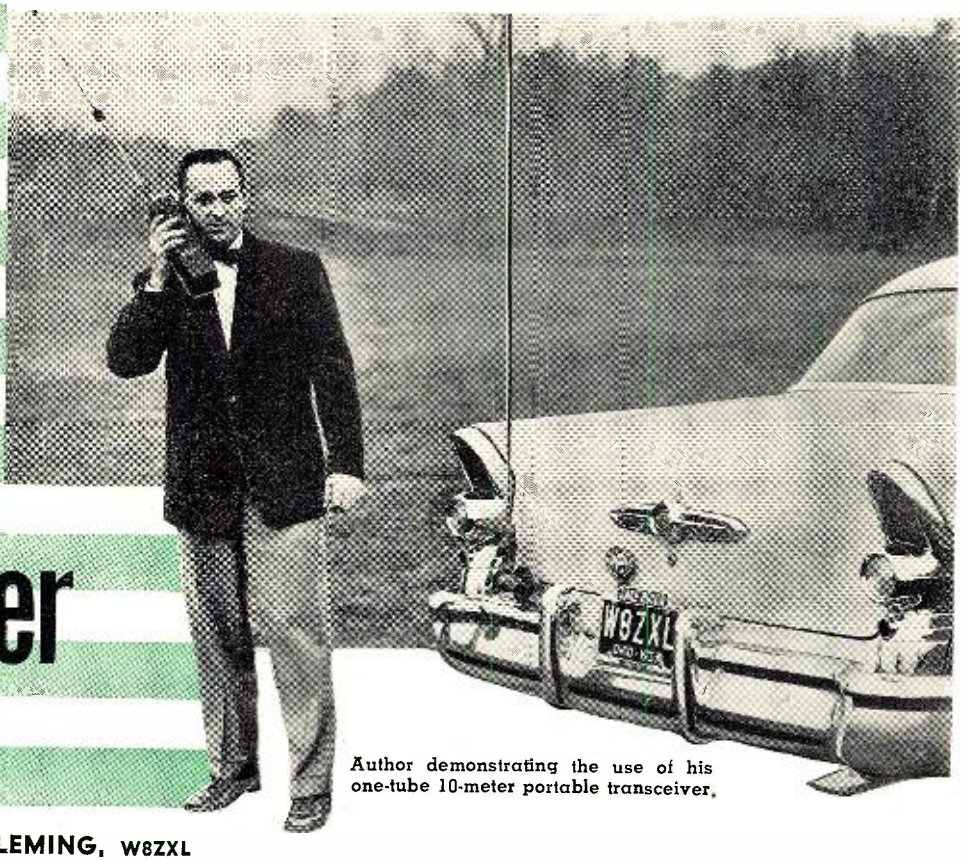


Fig. 4. Delay device.

Fig. 5. Complete schematic diagram of the auxiliary amplifier used in "Xophonic."



One-Tube 10-Meter Transceiver



Author demonstrating the use of his one-tube 10-meter portable transceiver.

By **NORMAN FLEMING, W8ZXL**
Designers for Industry, Inc.

Achieves maximum performance with minimum of parts. Suitable for emergency and Civil Defense applications.

WHEN the great rush for emergency and Civil Defense gear began to gather momentum, the writer plunged in and built a two-tube, 10-meter transceiver. The battery drain was a little too high so the idea occurred, "Use just one tube and make the batteries go twice as far."

The transceiver to be described is nothing new circuit-wise, but it is a crystal-controlled, single-tube unit which uses the barest minimum of parts. It is a little giant in performance.

Most of the components were picked up from the junk box or on the surplus market. The case is a surplus plug-in coil set container, type CW-47029. The mouthpiece for the T1 mike button was cut from a push-button shaving soap can. An F1 mike button works fine, also, but it is considerably larger.

The first attempt to switch from "transmit" to "receive" was accomplished with a ceramic wafer switch but was discarded in favor of a switch that could be pushed so as to leave one hand free for writing.

Two 4-pole, 2-position push-button switches were mounted back-to-back and their flat plungers soldered together. A single push-button was mounted on the end. Any midget push-button or sliding switch can be used if it has the required number of contacts.

Various types of microphone transformers were tried. They worked but they were large and occupied too much space. A chance trip to a surplus house uncovered a BC-347 interphone amplifier which contained two "Ouncer" transformers. One of the "Ouncers," stamped C-339, was tried. It filled the bill perfectly. The proper connections are noted on the schematic diagram. When this article was written, the BC-347 units were still available at some surplus stores and were usually priced at two dollars.

Poor results were obtained with the receiver when using some of the more common, low-impedance-type surplus earphones. A little time spent in securing a high-impedance earphone will pay off in greatly improved reception.

After much experimenting, the loading coil form factor was arrived at and found to give the best results with the particular length of antenna used. The antenna was made from an old pair of telescoping TV rabbit ears. A brass screw was driven into the hollow end of one leg of the TV antenna and soldered. The other leg of the antenna was dismantled and only the largest section used. A brass screw was soldered in this piece also.

A solid piece of polystyrene rod, 1" o.d. by 1" long, was used as the loading coil form. This piece was tapped at both ends and the two antenna sections were screwed in. A phone-jack plug was soldered to the end of the completed antenna to provide for easy removal from the case when going through doorways or low-hanging obstructions.

The transmitter doubles frequency in the plate circuit so a 20-meter crystal, whose second harmonic falls in the desired part of the 10-meter band, should be used.

All coils should be closewound and then coated with coil dope. Coils L_3 and L_5 should have sufficient lead lengths so their location can be adjusted to obtain optimum coupling. Be sure to wind all the coils in the same direction. Coil L_6 is wound over the cold or ground end of L_4.

The transmitter should be tuned up like any tri-tet circuit and the link coupling coil L_3 should be adjusted to give the largest reading on the "S" meter of a nearby receiver. Always re-dip the final after any adjustment.

Plate modulation was first tried but the percentage of modulation was way down. This transmitter is suppressor-grid-modulated, hence the necessity for a small "C" bias battery. Be sure to connect the positive side to the "C" battery to ground.

If a grid-dip oscillator is handy, the receiver can be lined up quickly. Capacitor C_3 is adjusted until the band limits are found by picking up the signal from the grid dipper. Capacitor C_2 is then used for tuning and will cover the entire 10-meter band.

When receiving signals within the output range of the transmitter, fairly loose coupling between L_4 and

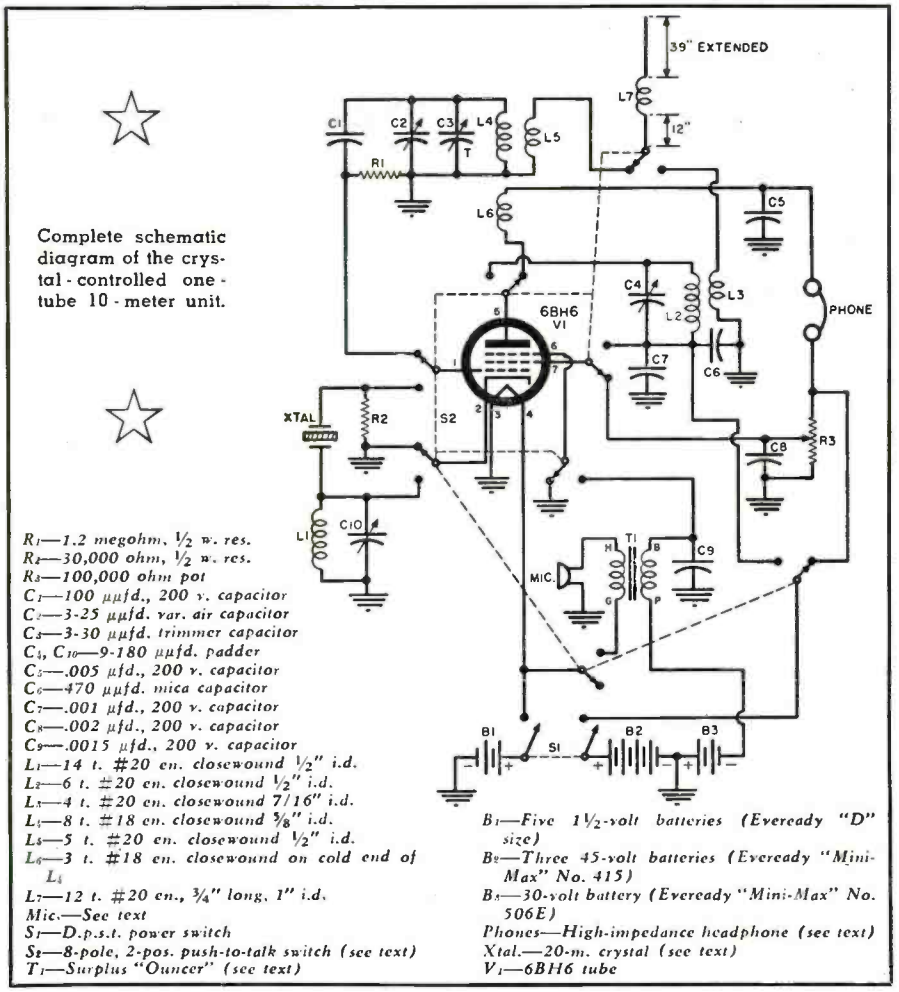
L_5 should be used. This will keep any body-capacity effects down to a minimum. In fact, no trouble of any kind due to body-capacity was experienced in the present model when receiving local signals. If the desire to pull in a little DX is encountered, (and no doubt it will be), tighten up the coupling. With a little care in adjusting the regeneration control R_3, the receiver will still be stable.

If the schematic values are followed fairly closely and all leads kept as short as possible, little trouble should be experienced in firing up this little rig within a few minutes after the last bit of solder has cooled.

No doubt each reader will see ways to improve or re-arrange his own model to suit individual tastes and components on hand. Perhaps some will go a step farther with printed circuitry, or even a transistor or two.

The performance of this little transceiver has been more than originally expected. A range of up to nine miles has been covered with the transmitter and when band conditions were right, practically every call area in the States was heard on the receiver, not to mention a mobile operating in Panama, and a few South Americans.

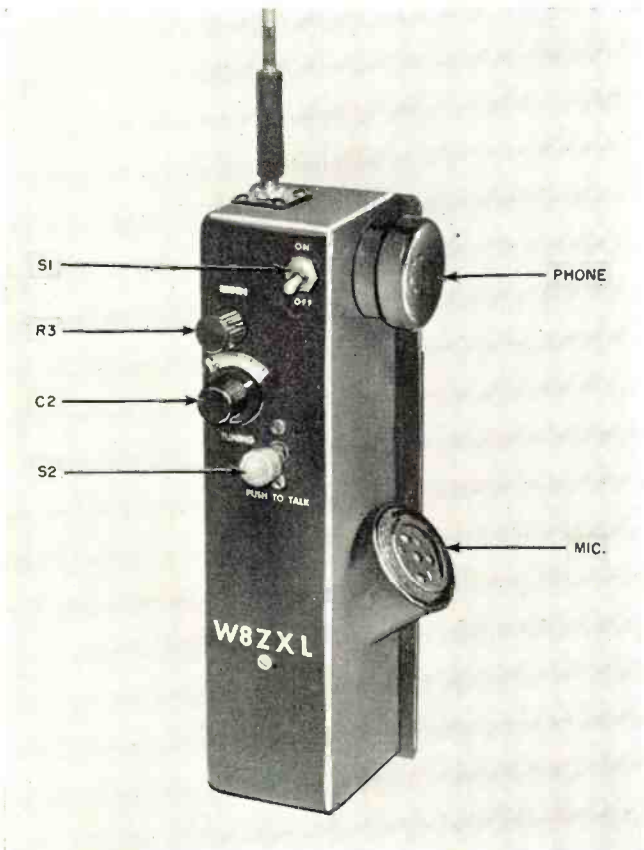
EDITOR'S NOTE: *This transceiver is intended for use only by licensed radio amateurs. It cannot be legally built or operated without the appropriate ham ticket. It cannot be adapted for use on the Citizens Radio Band and any attempts to do so would be contrary to Federal law.* -30-



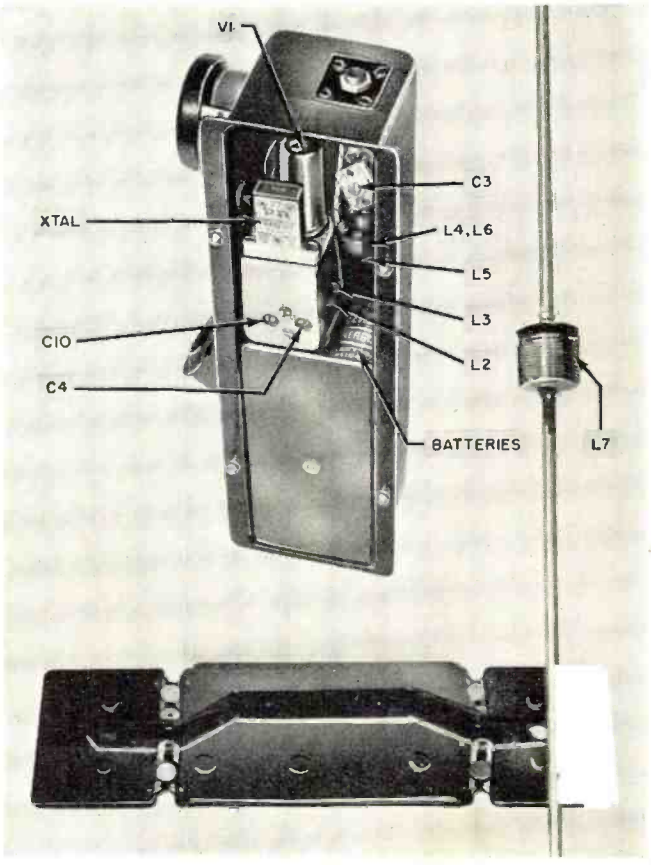
Complete schematic diagram of the crystal-controlled one-tube 10-meter unit.

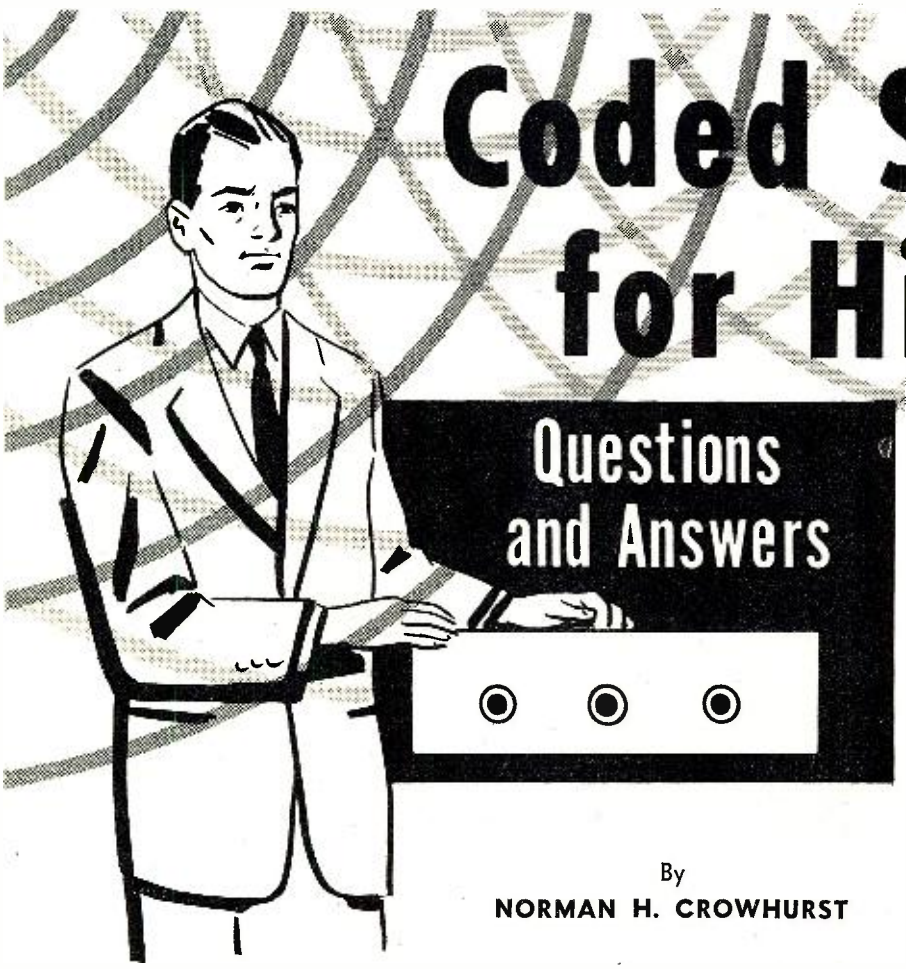
R_1—1.2 megohm, ½ w. res.
R_2—30,000 ohm, ½ w. res.
R_3—100,000 ohm pot
C_1—100 μμfd., 200 v. capacitor
C_2—3-25 μμfd. var. air capacitor
C_3—3-30 μμfd. trimmer capacitor
C_4, C_{10}—9-180 μμfd. padder
C_5—.005 μfd., 200 v. capacitor
C_6—470 μμfd. mica capacitor
C_7—.001 μfd., 200 v. capacitor
C_8—.002 μfd., 200 v. capacitor
C_9—.0015 μfd., 200 v. capacitor
L_1—14 t. #20 en. closewound ½" i.d.
L_2—6 t. #20 en. closewound ½" i.d.
L_3—4 t. #20 en. closewound 7/16" i.d.
L_4—8 t. #18 en. closewound ⅜" i.d.
L_5—5 t. #20 en. closewound ½" i.d.
L_6—3 t. #18 en. closewound on cold end of L_4
L_7—12 t. #20 en., ¾" long, 1" i.d.
Mic.—See text
S_1—D.p.s.t. power switch
S_2—8-pole, 2-pos. push-to-talk switch (see text)
T_1—Surplus "Ouncer" (see text)
B_1—Five 1½-volt batteries (Eveready "D" size)
B_2—Three 45-volt batteries (Eveready "Mini-Max" No. 415)
B_3—30-volt battery (Eveready "Mini-Max" No. 506E)
Phones—High-impedance headphone (see text)
Xtal.—20-m. crystal (see text)
V_1—6BH6 tube

Over-all view of transceiver showing the operating controls.



Inside view with side removed to show the internal layout.





Coded Stereo for Hi-Fi

By
NORMAN H. CROWHURST

Answers to readers' questions about the "Perspecta" coded stereo system described in August, 1956 issue.

SINCE the article, "A New Approach to Hi-Fi Stereophonics" appeared in the August, 1956 issue, we have received a steady flow of letters with questions about various aspects of the coded stereo system therein described. It would be impossible here to answer all the questions that have been asked, but we have gone over the letters carefully, selected questions that have been asked by more than one reader, and arranged them in a sequence that, we hope, will avoid confusion by keeping to the same general aspect in consecutive questions.

Some readers wrote in asking for complete details, wanting chassis size, layouts, details of components, parts lists, blueprints, etc., for the complete system. Others have wanted to get details about the theater system that was mentioned in the article. Questions of this kind cannot, of course, be answered at any length. It would require a whole series of articles to describe the construction of such a system. Different readers have varied ideas on the way they want to build it which would complicate any attempt to cover construction details.

The theater system has been quite extensively used and whatever data is available for release to anyone outside (or inside) the motion picture industry, can be obtained by applying to *Perspecta Sound, Inc.*, 711 5th Ave., New York 22, N. Y. The author cannot release any such information about the theater system.

At the outset it should be made clear that the system, some details of which were suggested in the previous article, had not been built. The theater system works perfectly well, using the same principles. Individual parts for the system, schematics for which were given in the previous article had been built, sometimes for other purposes. But the entire system had not been put together as a coded stereo system. The data put forward was given for the benefit of people who want to experiment and thus help forward the development of such a system, either for their own interest or as a contribution toward ultimate progress for all of us. The details that follow are offered with the same objective in mind.

Question 1. How do you make sure none of the low audio frequencies operate the control, and that the control frequencies are not heard?

This question arises out of calling the control frequencies "sub-audio." The "sub-" here is used in two senses: it means the control frequencies are lower in *frequency* than the band normally used for amplifying audio, at least in this system; and also that they are below the *level* that will allow them to be audible. Additionally, high-pass and low-pass filters are used in the system to separate the frequencies, so as to insure that not enough residual audio gets into the control circuits to upset their action, on the one hand, and that the control frequencies do not get through into the audio channels and produce an audible tone on the other hand.

In the theater system, the control frequencies of 30, 35, and 40 cycles are at least 20 to 26 decibels below the maximum audio level. This, however, is to allow for the possibility of a *Perspecta* track being played in a theater not equipped for this kind of sound, and which might therefore reproduce these frequencies at their recorded intensity. This margin proves adequate to insure the control frequencies are inaudible, even without filtering.

But when filtering is provided to eliminate the control frequencies from the audio, they can be operated at a somewhat higher level without risk of this kind of interference.

Some are probably going to object here that 30, 35, and 40 cycles are definitely within the audio range, so *how can they be called sub-audio?*

In application to theater systems it was found that most theaters failed to reproduce anything appreciably below 70 cycles. Consequently, nothing is lost by introducing a high-pass filter that cuts off everything *below* 70 cycles, so we can use frequencies down there for control purposes.

In the living room we have a further factor to help us in the same direction Unless your living room is at least a 50 foot cube (which is rather large for a living room!) you cannot possibly hope to develop even one complete wave of 20 cycle frequency in the room. It is true such a frequency might be audible *if* reproduced, but the theory about reproducing it is very different from practice.

Despite the stress that has been laid on requiring response down to 20 cycles, satisfactory fidelity for the living room can be achieved easily by reproducing down to 50 cycles. This only requires a living room with the dimen-

sion of a 20 foot cube to produce one complete wave. Most living rooms are even smaller than this!

Question 2. How do you set up the control frequency oscillators and tune the control frequency amplifiers?

The circuits originally given showed the components which set the frequency marked with an asterisk. These have to be adjusted by trying different values until the frequency comes out right.

The first thing to do is to set up the control frequency oscillators. The frequency for 30 cycles can be found by means of an oscilloscope. If you don't have an oscilloscope it would be good to arrange to borrow one for an evening, or some suitable time, from your local service shop. Many service shops have an oscilloscope which they seldom use and will be glad to lend if they are satisfied you know how to use it.

Getting a 30 cycle frequency is very easy with an oscilloscope, using the 2 to 1 Lissajous pattern. Forty cycles gives a 3 to 2 pattern. This is using line frequency as a time base. Almost all modern oscilloscopes have a mutiple switch for selecting horizontal deflection: the internal time base, the line time base, or an external connection. Using the "line" position of this switch, and applying the output from your control frequency oscillator to the normal vertical scope input, will produce the Lissajous patterns shown in Fig. 1 when the frequencies are correct.

Adjusting the values of the capacitors will alter the rate at which the pattern moves until you can get a steady or stationary pattern. Then you have the right frequency.

Having set up the 30 cycle and 40 cycle control frequency oscillators, the next step is to set up the corresponding control frequency amplifiers. This can be achieved by a similar method. Turning the gain adjustment up to the point where they oscillate, the frequency is adjusted in the same manner. Then the gain adjustment is turned down until they just do not oscillate. Finally set the gain of each control frequency amplifier so that the same input from the corresponding control frequency oscillator gives you the same output voltage from each.

Now you have a tool for setting up the 35 cycle frequency, which is not quite as easy as the 30 and 40 cycles, because there is not a convenient Lissajous pattern. Adjust the frequency of the 35 cycle oscillator until it gives an equal output from both the 30 cycle and 40 cycle control frequency amplifiers, showing there is equal leakthrough each way. (This output should be considerably less than when the correct frequency of 30 or 40 cycles is applied to its own amplifier, of course.)

Finally you can set up the 35 cycle control frequency amplifier by aligning it until it gives a maximum output on the 35 cycle oscillator.

This is quite a convenient way of setting up the frequencies without needing to have "reference standards," which is the method used for the motion picture system.

Question 3. How about using more than three channels to get greater realism, say 4 or 5? What control frequencies should I use?

This question illustrates the general trend of the correspondence on this subject in many aspects. One reader will be wanting to go down from three channels to two channels; another would like to extend it from three to four, or five, or maybe even six. One wants to combine the system with some special features he may have in mind, while another wants to make a totally different combination. This trend in thinking shows there is plenty of healthy initiative drifting around and we should come up with some really good developments as the result of all this experimentation. But to answer this question.

If you want to extend to, say, five channels, the best frequencies to choose would be down to 20 and 25 cycles. If you want six you can also go up to 45 cycles. The 45 cycle Lissajou pattern, that would be used on the oscilloscope to align the frequency, is fairly simple, as shown in Fig. 2. The 20 cycle pattern is easy, but 25 cycles is not. The author suggests making the 20 cycle oscillator and amplifier first and then fitting the 25 in as a midway point between 20 and 30, in the same way as 35 was fitted in between 30 and 40.

Using a combination ranging from 20 to 40 cycles would have the advantage that would not encroach any more on the audio frequency range than the three channel system. As you might run into difficulties in satisfactory recording of 20 cycles, it may be a good thing to use this channel for the position of the loudspeaker that you consider least important.

Question 4. Is it possible to add electronic reverberation effect with this system?

This question touches on the vast potentialities of a system of this type. As originally set up, this coded system just produces an equivalent of three-channel stereo. But it would be equally possible to utilize additional control channels for the purpose of adding artificial reverberation, in variable quantity, to suit the program. This opens a new vista of versatility in reproduction. Possibly, if you use five channels, the extra two, utilizing maybe the frequencies 20 and 25 cycles for control purposes, could be used to control reverberation distributed by two more speakers in a position behind the listener from the main three speakers.

This reverberation could use a second pickup. In the case of tape, this is quite easy to do, by putting a second pickup head so the tape passes it a fraction of a second later than the existing one. In the case of disc, a little more complication might arise. Possibly a special pickup would need to be developed with two stylus assemblies, one in front of the other. But for experimental purposes, at any rate, we could certainly use magnetic tape.

The output from the second head could be delivered to another preamplifier and the control frequencies picked off by the first head applied to control the output from the second preamplifier feeding the reverberation loudspeakers. A block diagram of this idea is shown in Fig. 3.

Before leaving this question, however, I would suggest that this is rather an ambitious arrangement, and it would be much better to get the system working in its simplest form and then add details like this as further refinements and improvements at a later date. This is one advantage of having a system which is adaptable in this manner.

Question 5. Can the control frequency oscillators and amplifiers be made so the frequency can be adjusted with a trimmer, instead of having to be set by a trial and error method?

Trimmer capacitors only come in values up to about 2000 micromicrofarads (.002 microfarad), but the tuning capacitors for these circuits are in the region of .1 microfarad. So any of the available trimmer capacitors would be totally inadequate as a means of frequency adjustment.

The only way to overcome this would be to use one of the phase shift oscillators where the frequency is adjusted

(*Continued on page* 107)

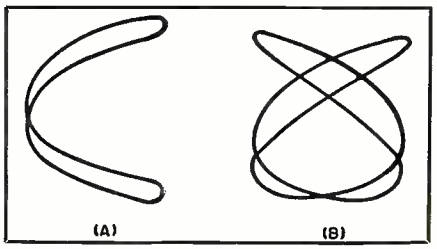


Fig. 1. (A) shows a 30-cycle Lissajous figure. (B) shows a 40-cycle pattern.

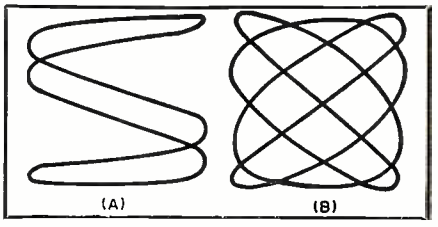
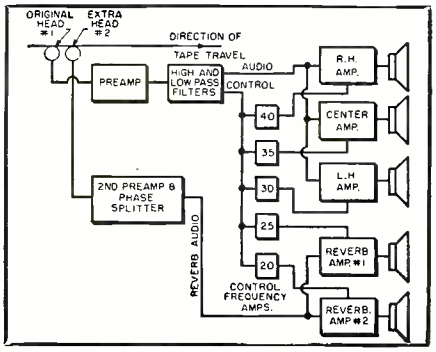
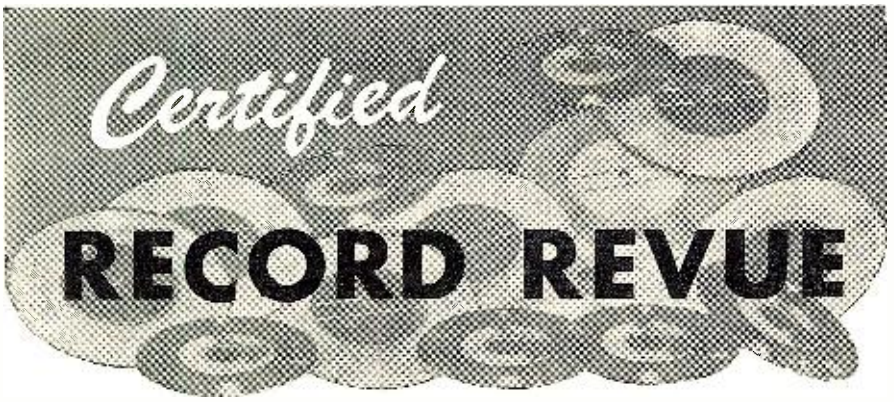


Fig. 2. (A) shows a 20-cycle Lissajous figure. (B) shows a 45-cycle pattern.

Fig. 3. Block diagram showing method employed to introduce reverberation.





By BERT WHYTE

THE summertime used to be a slack period in the world of recorded music and record critics had a chance to divorce themselves from their phonographs. Some of the more affluent of my colleagues hied themselves to the festivals in Europe, others caught up on their golf, or ventured onto or into the briny deep; and no doubt many readers who have purchased records on the strength of a good review and have been disappointed, are quite sure that if nothing else, the summertime was a good time for some critics to have their ears re-tinned!

Whatever happy pursuits we enjoyed in those halcyon days, are, alas, denied us now. These past few summers the record companies may have faltered slightly in their mad churning out of releases, but they most assuredly never stopped! More than that, they have not neglected quality with their quantity. Many "big" and important works are now released in the summertime, a practice unheard of in former years. All kidding aside, this is a source of considerable satisfaction to a record critic. It shows that there *is* a place for good music in this troubled and war-weary world.

That more and more people are becoming educated to the delights of good music can be attributed to the booming market in hi-fi equipment. And the potential is vast and still relatively unscratched! In their most wild and optimistic dreams, the record companies never envisioned today's tremendous market. Caught up in the feverish pace imposed by this cultural revolution, the record companies have stepped up their release programs so that now there is very little seasonal difference. It is true that there is much dross issued along with the "gold" but even with careful, if not sometimes ruthless culling, the number of good recordings is somewhat staggering and about all a conscientious critic can do is dive in and start writing. So without further ado, here is the "cream" of the current record release crop!

ROUSSEL
SYMPHONIES #3 AND #4
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL1495. RIAA curve. Price $3.98.

Roussel is best known to music lovers for his ballet score, "The Spider's Feast". Yet I venture to predict that in this age of the hi-fi phonograph, these two symphonies will soon rival the ballet in popularity. For these are ingratiating scores which, although strongly modern in flavor, are singularly easy to digest. Here are all the elements which endear this type of music to the hi-fi sound enthusiast. The "3rd" symphony opens with a powerful *allegro,* very robust and hearty with splendid string ensemble work and resounding brass. After a relatively tranquil but expressive 2nd movement, the *scherzo* explodes in one of those rollicking dance-like episodes so typical of Roussel. Here the bouncy strings are joined by flute, piccolo, clarinet, and other woodwind, the scoring being exceptionally facile and full of humorous touches. The finale is vigorous, in fact earthy with its broad themes and rough wit. Here are rousing brass fanfares, more of the jubilant woodwind and heavy bass accents from tympani and contrabass. The work comes to its conclusion with several grandiose forte which make liberal use of percussion.

The "4th" symphony opens quite slowly with strings interspersed with successive passages from the English horn, tenor sax (the use of this is rather typical of French composers who had been influenced by the "Impressionistic" school which flourished in the early 1900's), and oboe. In swift transposition, the strings and brass leading the other instruments, the scoring becomes very vigorous and rhythmic. The second movement is characterized by beguiling melodies carried mostly by strings and woodwind and builds to a climax of intense emotionalism. The third movement is again a spritely *scherzo* with much bright trumpet work and ebullient woodwind. The final movement starts out with a recapitulation of the thematic material found in the opening bars of the *allegro* section of the first movement. Again much brass, rapid string and woodwind passages, strong percussion including a solid weighty bass drum, heavily accented tympani and a triangle whose sharply etched "tinkle" will delight the hearts of audiophiles addicted to this instrument. The work concludes with a great dance-like staccato figure in which most of the orchestral forces are employed.

Throughout both works Ansermet shows that this type of repertoire is certainly his metier. The performances are brilliant, perhaps even scintillant. Tempi, dynamics, orchestral balance . . . all are superbly integrated in his logical and convincing exposition. Best of all from the Suisse Romande, not always the most consistent of orchestras, he gets playing of a very high lustre. The *London* engineers have contributed a sound of outstanding cleanness. Frequency and dynamic range are very wide, transients are sharp with no audible distortions. Recording was rather close-up, proper for this type of scoring where instrumental detail and definition are of prime importance. In spite of this, the engineers have managed enough hall reverb to "round" out the sound and add that last little fillip of realism. While this review has been lengthier than most, I feel there is an obligation to go more fully into this less familiar music which may be wholly new to a great many readers. This is especially justified when we are dealing with a recording which is outstanding from both the sonic and musical viewpoints. This *London* disc certainly qualifies for that distinction.

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

BACH
VIOLIN CONCERTO IN E MAJOR
BEETHOVEN
ROMANCE IN G MAJOR
ROMANCE IN F MAJOR
Igor Oistrakh, violinist, with Gewandhaus Orchestra of Leipzig, conducted by Franz Konwitschny. Decca DL9875. RIAA curve. Price $3.98.

You've got to admire young Igor Oistrakh! This is about the fifth or sixth recording in which he has been in direct competition with his illustrious father, the great David Oistrakh. Here in the Bach concerto, he has the Francescatti and Heifetz versions to contend with as well as his father's *Columbia* disc. As far as I'm concerned, Igor seems to have a better command of this type of repertoire than that which he is usually given to perform. The result is a superior reading of the Bach in which he defers to no one, including Papa Oistrakh. His tone is firm and pleasing, his techniques irreproachable and he displays considerably more life and less pedantry than does his competition.

In the "Romances" he does well enough, but here he is up against Heifetz in a Heifetz specialty, and in the comparison he is found wanting in several aspects. Soundwise, Igor fares very well, with his instrument and the orchestra afforded clean and well balanced reproduction. Konwitschny and the Gewandhaus Orchestra furnish a knowledgeable and sympathetic accompaniment.

BRAHMS
PIANO CONCERTO #1
Rudolph Firkusny, pianist, with Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol P-8346. RIAA curve. Price $3.98.

Firkusny's first concerto recording since he signed with *Capitol* and an impressive debut. Firkusny's playing is at a consistently high technical level and if he could have managed to imbue his reading with a little more poetry and warmth, he would have shared top honors with the Rubenstein version. As it is, this recording is notable for the superb piano sound and for the wondrous playing Steinberg elicits from his Pittsburgh men. This orchestra has come a long way under Steinberg, and the precision of their ensemble work is breathtaking. Piano sound is ultra-clean, free from any transient-ringing, the strings are butter smooth, brass and woodwind have exceptional projection. Piano/orchestral balance is logical and spacious acoustics make for a highly realistic sound. All factors considered, the recording should have wide appeal especially to sound fanciers.

BARTOK
CONCERTO FOR ORCHESTRA
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL1632. RIAA curve. Price $3.98.

There seems to be a new recording of this work every other month, which is understandable in view of the popularity of the score. This version by Ansermet replaces one of the very oldest recordings in the *London* catalogue, the Van Beinum reading of the "Concerto for Orchestra" on *London* LL-5. It is interesting to compare the sound of these two *London* recordings separated in time eight years. While the older recording was considered a fine example of the art in those days, in comparison with the latest effort, it sounds very thin and dry . . . lacking that essential quality of "presence" that characterizes today's *London* records.

I understand Ansermet has wanted to record this Bartok work for a long time. With

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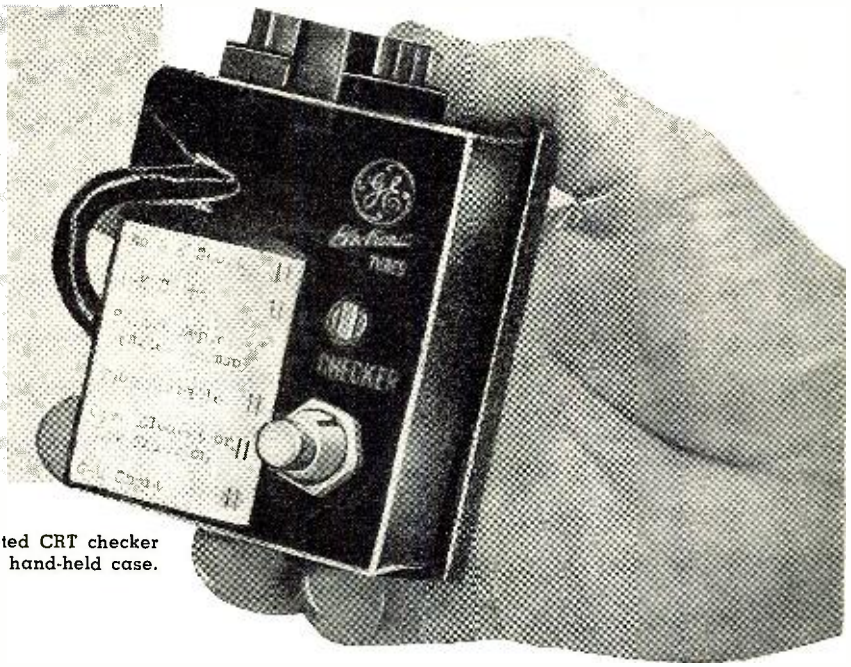

Fig. 1. The completed CRT checker can be housed in a hand-held case.

By **DWIGHT V. JONES**
Cathode-Ray Tube Department
General Electric Company

Is the CRT defective or is the set at fault? This handy unit will usually give the answer without removal of the set from its cabinet.

SMALL enough to fit into the palm of the hand, the conveniently portable picture-tube checker described here will quickly resolve many cases in which there is question as to whether the failure to obtain a raster—or a picture when a bright raster is present—lies in a defect in the CRT or in the associated circuits. The checker's foremost utility is during the house call, since it requires minimum set-up procedure and minimum disturbance to the chassis. The back cover of the TV set is removed, the hand tester is plugged to the base of the picture tube (Fig. 2) in lieu of the CRT socket, the tester is plugged into the nearest a.c. outlet, and—after a brief warm-up period—a button on the checker is depressed.

An NE-2 neon lamp built into the checker gives rapid indications covering five conditions, depending on whether one, both, or neither of the lamp elements glow. The conditions are tabulated in Fig. 3, together with their associated visual indications on the neon lamp.

This information enables the service technician who is faced with a blacked out set, or one with a bright raster and no video, to decide immediately: (1) whether to make repairs on the spot, (2) remove only the chassis, or (3) take both tube and chassis to the shop.

The simple checker can be wired in a short time with a total material cost of less than $3.00. The author assembled the circuit of Fig. 4 using the case of the *G-E* Series-Heater Checker available through distributors. This case is convenient because it already has a picture tube socket mounted on it, and all the components, including the filament transformer, can be fitted inside. The complete picture tube checker is shown in Fig. 1.

How the Checker Is Used

The chart shown in Fig. 3 may be attached to the checker for ready reference to interpret what the neon lamp indicates. Since the push-button switch, S_1 of Fig. 4, is wired so that it normally is in the position shown, the heater-cathode condition is indicated immediately after plugging the checker on the base of the picture tube. If there is a heater-to-cathode short, both elements of the NE-2 lamp will glow. Then after a warm-up time of about one minute, the push-button switch is pressed for the second and final check on the tube. The NE-2 lamp will indicate *one* of the three possible conditions shown in Fig. 3. For "Tube Operable" only one element of the NE-2 lamp will glow; for "Open Element or Low Emission" neither element will glow; and for "Grid No. 1-to-Cathode Short" both elements will glow. If the checker indicates "Tube Operable," then the tube should be able to produce a picture, with the exception of the few isolated cases mentioned later.

Circuit Operation

When sufficient voltage is applied to the electrodes of the NE-2 lamp, light is produced at the negative electrode. Thus, for "Tube Operable," only one

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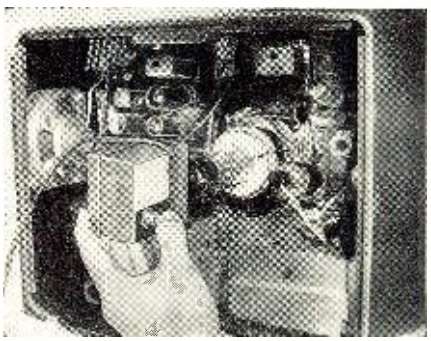


Fig. 2. The handy tester plugs directly into the receiver-mounted CRT.

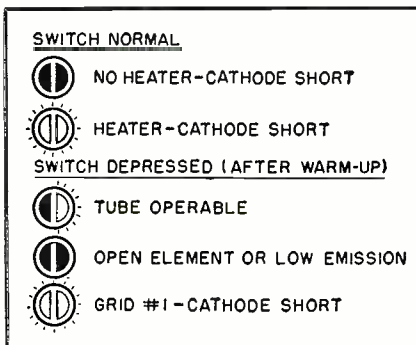
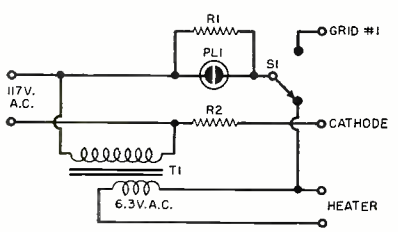


Fig. 3. Fix this chart of conditions and indications to the checker's face.

Fig. 4. Schematic of the test unit.

R_1—680,000 ohm, ½ w. res. ± 10%
R_2—220,000 ohm, ½ w. res. ± 10%
S_1—S.p. 2-circuit push-button switch
PL_1—NE-2 neon lamp
T_1—6.3 v. fil. trans., .6 amp or better
1—A.c. line cord
1—Case with CRT socket, see text



The "Dyna-Box" Doublechecks Tube Tester

Fig. 1. The completed "Dyna-Box" (left) connected to its associated instrument.

By
HAYDN P. ROBERTS
Col., U. S. Army Signal Corps (Retired)

Simple accessory for standard emission-type tube checkers provides a dynamic power-output test.

A SIMPLE emission-type tube tester, which also tests for shorts and leakage between tube electrodes, is considered essential by many service technicians and experimenters. When this checker indicates a short, a very bad leak, or very low emission, the tube under test is obviously defective, and the job of testing has been successfully completed. But when these factors check all right, it doesn't necessarily mean that you can stick an OK tab on the tube and go looking for trouble someplace else. Any experienced service technician knows that quite a number of tubes which test high on emission prove to be inferior, performancewise, to other tubes whose emission is lower.

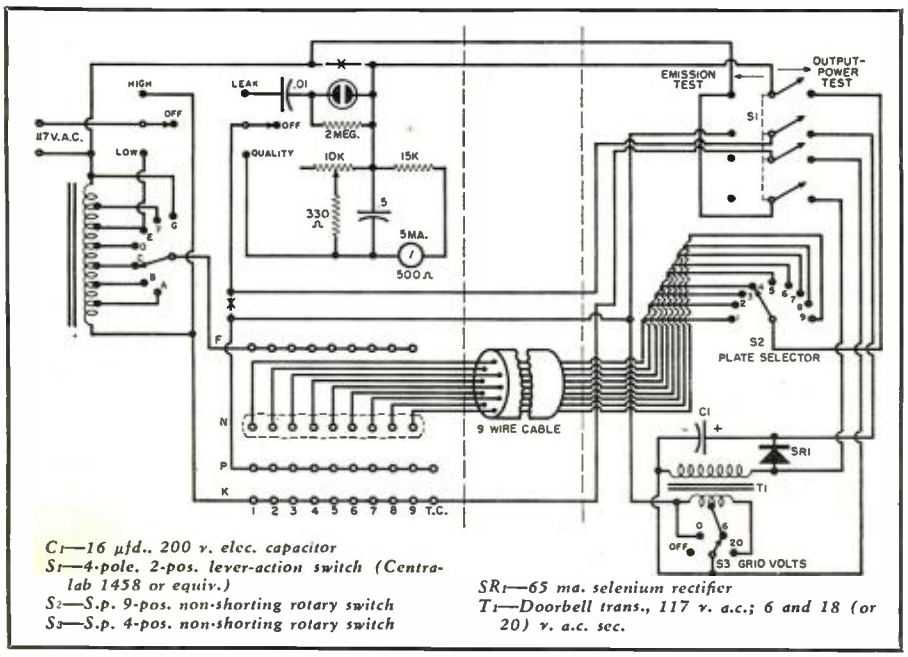
"Active spots" often develop on cathodes. An excessive stream of electrons may emit from such a spot, beyond the control of adjacent grid areas, while the rest of the cathode might be quite useless. In such cases, the emission looks very good on the meter but the tube may be inoperative.

To know what shape a tube is really in, it should be tested under conditions akin to its actual operating performance. The "grid-shift" transconductance test gives more information about the tube, but it is still a static test. The dynamic transconductance test comes much closer to actual operating conditions, but tube testers employing it are rather expensive.

Of all the tube tests, the power-output test comes closest to actual operating conditions. In its "Receiving Tube Manual," *RCA* has this to say: "In the case of voltage amplifiers, the power-output is indicative of the amplification and output voltages obtainable from the tube. In the case of power-output tubes, the performance of the tube is closely checked. Consequently, although more complicated to set up, the power-output test will give closer correlation with actual performance than any other single test."

The "Dyna-Box" is a simple accessory which, when used with an emission-type tester, provides a dynamic test of the power-output type. It can hardly be expected that such an inexpensive and simple device will provide the necessary power for a full-power test of power tubes. Within its power limitations, it will, however, provide a real power-output (if the user wishes to calculate the actual plate current and load resistance) which can be used for relative performance checks. As in the case of emission-type tube testers, the "Dyna-Box" is useful for relative rather than absolute readings, and these are used for comparison with performance of new tubes or those known to be good. The change in plate current

Fig. 2. Circuit of "Dyna-Box" and part of checker (left) shows interconnections.



C1—16 μfd., 200 v. elec. capacitor
S1—4-pole, 2-pos. lever-action switch (Centralab 1458 or equiv.)
S2—S.p. 9-pos. non-shorting rotary switch
S3—S.p. 4-pos. non-shorting rotary switch
SR1—65 ma. selenium rectifier
T1—Doorbell trans., 117 v. a.c.; 6 and 18 (or 20) v. a.c. sec.

due to a change in the value of a.c. grid voltages provides an excellent measure of the tube's ability to perform.

Although applicable to any type of emission tube tester, in this case the *Superior* Model TC-55 was employed. This tester, when used for emission testing, connects all elements to the cathode except the control grid, and it uses this grid as an anode. The "Dyna-Box," when switched into operation, selects the plate element, putting about 155 volts d.c. on it, and provides for tying all free grids together and supplying a choice of 0, 6, or 20 volts a.c. to the combined grids, in class B operation of the tube. By flipping a lever-type switch on the "Dyna-Box," the tube tester is immediately returned to its original status, as an emission-type tester. There is nothing complicated in the set-up and the entire accessory can be housed in a sloping, panelled meter box, cut with a hole for a three-inch meter, and measuring only 4" by 4". (See Fig. 1.)

The first step is the slight modification of the TC-55 tester. Referring to Fig. 2, obtain or make up a cable of 14 wires, each 12" to 15" long. (Differently colored wires will simplify connecting.) Under the TC-55 panel, it will be noticed that the *N* (neutral) strip of contacts are unwired. Connect nine of the wires in the cable to these nine contacts (omitting the tenth which is marked *T.C.* [top cap], which, of course, will never be selected for plate voltage). Now cut two wires at the points *X* (Fig. 2), connecting two wires in the cable across each cut. This completes all necessary modification in the tube tester, excepting a U-shaped cut in the side of the tester, large enough for the cable to be taken out. Tape the cable at this point of exit.

On a piece of 1/16" *Bakelite* or other insulating material, 3" by 3½", mount the 9-position rotary switch with its center 1⅜" from the top. Directly below, mount the 4-position rotary switch with its center 11/16" from the bottom of the panel.

In consecutive order (1 to 9) wire the 9-position switch with the nine wires in the cable, from the *N* strip in the tube tester. Wire the secondary of the doorbell transformer as shown. Now wire the 16-μfd. capacitor in series with the selenium rectifier, across the primary of the doorbell transformer.

On the top of the meter box, drill two 7/16" holes with centers 1⅝" from either side. Cut a slot between these two holes for the lever of the switch to rock back and forth in. Drill two 3/32" holes with centers 1 3/16" from either side, for the screws for mounting the lever switch. Now wire the lever switch as shown in Fig. 2, utilizing the remaining five wires of the cable. Mount the switch assembly on the *Bakelite* panel, upon the sloping front of the meter box, so that it covers the hole.

The doorbell transformer can now be mounted with four small bolts to the base of the meter box, and the "Dyna-Box" is now complete.

1. Throw switch S_1 on the "Dyna-Box" over to "Emission," and insert tube to be tested in the TC-55. Make the normal test for leaks, shorts, and emission.

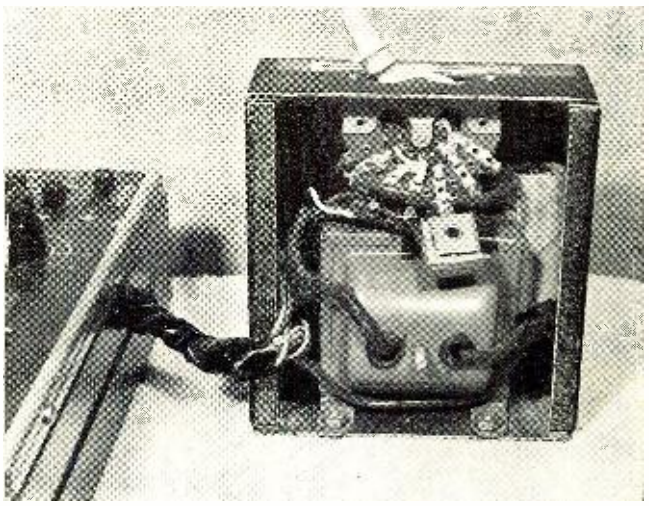
2. If not known, find out from a tube manual which element of the tube is the plate. (And while looking this up, record what elements are free grids, unless the tube is a triode.) If the tube is a double tube, record the number of both plates, as well as the grid or grids for each plate.

3. Set the "Plate Selector" (switch

(*Continued on page* 144)

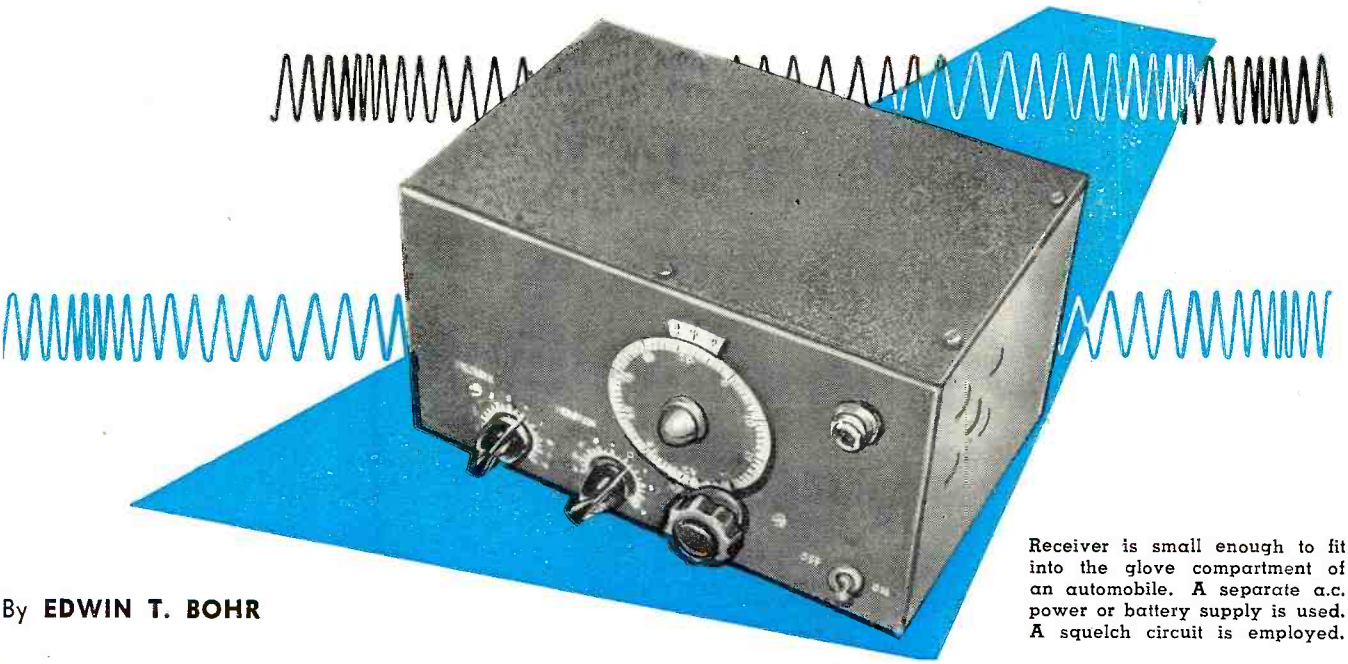
TUBE	EMISSION 1st Half	EMISSION 2nd Half	METER READINGS for Grid Voltages of 0	6	20	DIODES	ELEMENT NUMBERS Plate	Grids
6AG5	71		0	8	11		5	1, 6.
6AU5	66		0	41	64		5	1, 8.
6AU5	68		0	22	48	(Higher emission but lower performance)		
6B8	54		0	7	19	4, 5, OK	3	6, T.C.
6BK7A	71		66	83			1	2.
		72	62	82			6	7.
6CB6	71		0	6	12		5	1, 6, 7.
6J5	64			48	77		3	5.
6J5	64			54	85		3	5.
6J6	72		64	84			1	6.
		71	52	76		(Bad match)	2	5.
6J6	70		58	78		(Bad match)		
		70	50	72				
6J7	58		0	8	38		3	4, 5, T.C.
6J7	67		0	9	44			
6K6	61		0	6	20		3	4, 5.
6K6	61		0	11	36			
6K7	60		0	8	38		3	4, 5, T.C.
6K7	61		0	11	46			
6L6	65		0	30	60		3	4, 5.
6L6	68		0	30	59	(match for P.P., dynamically)		
6L7	65		0	10	40		3	4, 5, T.C.
6L7	66		0	12	44			
6L7	60		0	11	53			
6SN7	64		38	46	78		2	1.
		64	40	48	78		5	4.
6SN7	68		43	53	86		2	1.
		69	40	51	82		5	1.
5U4	65					4		
		68				6		
5U4	72					4		
		74				6		

Table 1. Specimen chart of recorded typical readings for many tube types.



Rear view of the "Dyna-Box" shows disposition of parts with switch on top, doorbell transformer on the bottom, and the selenium rectifier mounted on switch.

Mult band FM Rece ver



Receiver is small enough to fit into the glove compartment of an automobile. A separate a.c. power or battery supply is used. A squelch circuit is employed.

By **EDWIN T. BOHR**

Covers amateur, police, emergency, and utility services, plus standard FM broadcasts. Operates from line or battery.

THIS high-frequency FM receiver, whose construction will be described in detail here, will cover just about all of the present FM bands including: amateur, police, emergency and utility services, plus standard FM broadcast.

The circuit contains: a 6BK7 grounded-grid r.f. stage, an oscillator-mixer using a 6U8, temperature-compensated oscillator, high-gain i.f. stages, 6BN6 combined limiter-discriminator, and a smooth working squelch circuit. Even if you do not build the receiver, there are probably many ideas you can adapt to your own purposes.

The requirements of several people influenced the design of this receiver. The first was to pick up police calls in the 30-50 mc. band. This is the reason a squelch circuit is used. During the periods when there is no carrier the background noise is very objectionable. This made the squelch a top priority item.

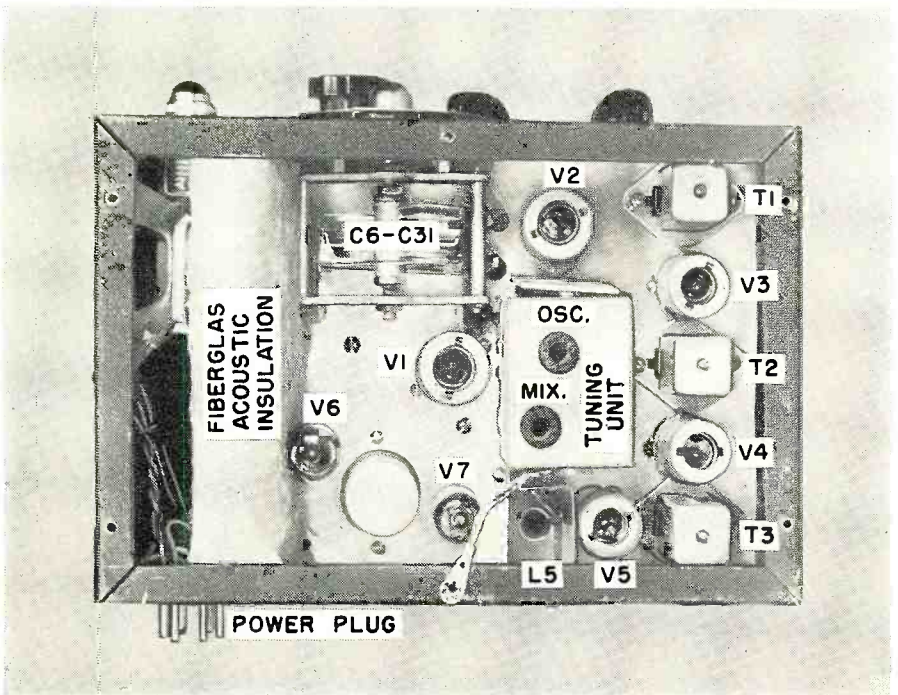
It was considered desirable to be able to operate the receiver from either 117 volts a.c. or from 6 volts d.c. This is accomplished by means of a flexible dual power supply arrangement. Each supply remains in its respective location—home or automobile—and the receiver is simply transferred from one location to the other.

Sooner or later the thrill of listening to emergency broadcasts begins to fade, so the design includes possible reception of the other bands, especially commercial FM. The easily changed tuning units make the receiver extremely versatile in this respect.

The final requirements included small size, professional appearance, and a reserve of power. As can be seen in the photographs, the receiver is small enough to fit into the glove compartment of an automobile.

The complete receiver has undergone several revisions. The mechanical and electrical features have been slicked-up and improved. For this reason the author is offering this as a "bug-free" piece of equipment.

View of topside of chassis. Note the locations of the tubes and tuning unit.



R.F. Amplifier

One half of a 6BK7 dual triode functions as the r.f. amplifier. The familiar grounded-grid circuit gives a substantial amount of gain and at the same time reduces oscillator radiation.

This circuit originally used a 12AT7 but the socket was later rewired for the 6BK7 with better internal shielding and slightly greater gain.

The input circuit for the 6BK7 is inherently broadband and does not

need to be tuned with a variable capacitor. This permits the use of a two-gang tuning capacitor, simplifying the construction and alignment of the tuning units.

The 6BK7 is roughly equivalent to a 200-ohm resistor shunted across the antenna transformer. (This accounts for the wide bandpass.) Nevertheless, the plate circuit is quite selective since it is resonated to the signal frequency by the tuning capacitor.

Some practical experimentation went into the antenna transformer for the grounded-grid stage. This unit matches 75-ohm or 300-ohm balanced and unbalanced antennas to the r.f. stage. The first arrangement tried was an autotransformer, however, the present two-coil unit is compact, simple to construct, and more efficient.

Three sets of winding data are given for this input transformer. The first is for the geometric center of the range from 30 to 108 mc. This gives the best *over-all* sensitivity for both emergency and FM broadcast. Two other sets of data are given for antenna coils that peak in each band.

As an example: The 30-50 mc. coil will give the greatest gain in the 30-50 mc. band, yet it will operate in the 88-108 mc. band and *vice versa*. The 88-108 mc. coil, of course, peaks in the FM broadcast range.

Mixer

The 6U8 is a combined oscillator and mixer. This tube is similar to a 6AG5 and one half of a 6J6—it makes a hot combination!

The mixer is the plate detector type biased near cut-off by a 470-ohm cathode resistor. Oscillator voltage is injected into the control grid circuit by wiring capacitance. A small negative temperature coefficient capacitor is placed across the oscillator tuning circuit. The method for determining the value of this capacitor can be used on almost any piece of equipment.

This is how the value of the compensating capacitor was determined. We arrived at how many micromicrofarads change each division on the tuning dial represents by dividing the capacitance range of the tuning capacitor by the number of graduations on the dial (this was a straight line capacitance tuning capacitor).

Next, as soon as the receiver is switched on it is tuned to a carrier for maximum signal by meter reading at the "test point" and the tuning dial position is recorded. A centigrade thermometer is placed inside the cabinet. When the temperature in the cabinet has reached a maximum, the receiver is *retuned* for maximum signal strength reading.

By noting the difference between dial settings for the set cold and after it has reached normal operating temperature, it is possible, by simple arithmetic, to calculate the capacitance drift. For this receiver, using the components shown, the total drift was about .7 $\mu\mu$fd. When this value is divided by the temperature rise, it gives the capacitance drift in micromicrofarads per degree centigrade.

It only remains to choose a suitable negative coefficient capacitor to equalize this drift. Two things determine the equalization; (1) the negative coefficient of the capacitor, and (2) its capacitance. A 10 $\mu\mu$fd. capacitor will give twice as much compensation as a 5 $\mu\mu$fd. unit with the same coefficient.

The capacitance multiplied by the coefficient (in $\mu\mu$fd./$\mu\mu$fd./ $C°$) will give the compensation in micromicrofarads per degree centigrade. This value should be as close as possible to the amount the receiver drifts. To avoid changing the tuning range appreciably the smallest capacitance possible is used. This capacitor was an *Erie* N750 5 $\mu\mu$fd. "Ceramicon" ordered from one of the mail order catalogues.

Tuning

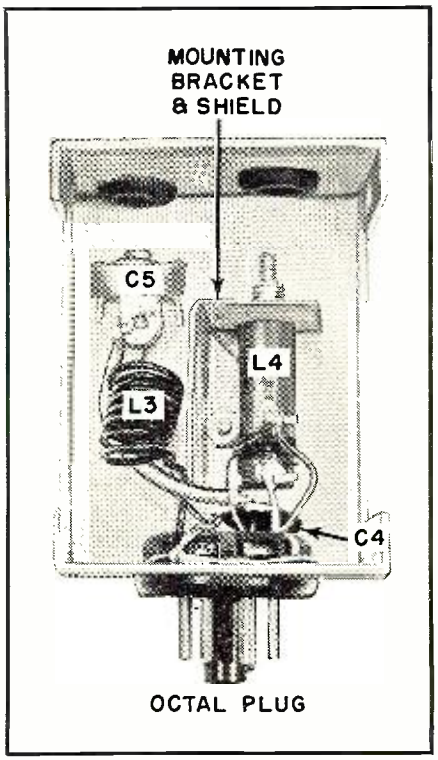
For the 30-50 mc. band no trimmer is used across the oscillator coil—the mixer coil is made to do the tracking. The oscillator coil must cover a greater range than the mixer coil since the oscillator operates below the signal frequency.

A large tuning capacitor is necessary to cover the almost two-to-one range of 30-50 mc., but considerably less range is needed for the 88-108 mc. band. Therefore, a considerable slowing down of *both* the oscillator and antenna coils is necessary to spread out the 88-108 mc. band. This is done with shunt trimmer capacitors across *both* coils.

Separate tuning units are built for each band. Each unit is a small aluminum box containing the oscillator and mixer coils, plus the necessary trimmers and adjustments for each range.

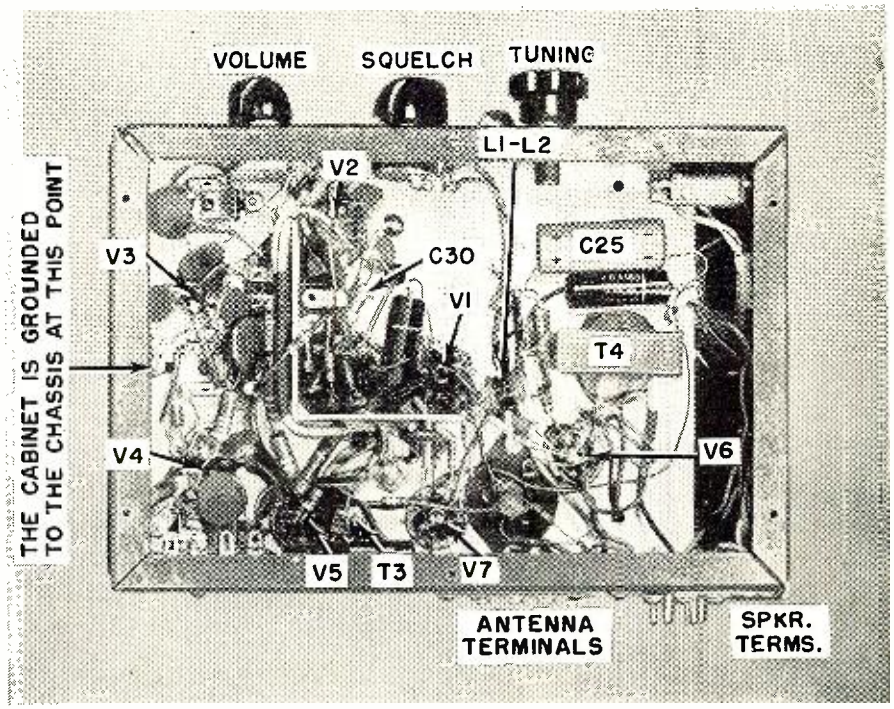
Rigid support for the tuning unit is provided by an aluminum upright bolted to the chassis and just clearing the tuning unit box by one sixteenth of an inch. The unit is held to the upright by a heavy rubber band.

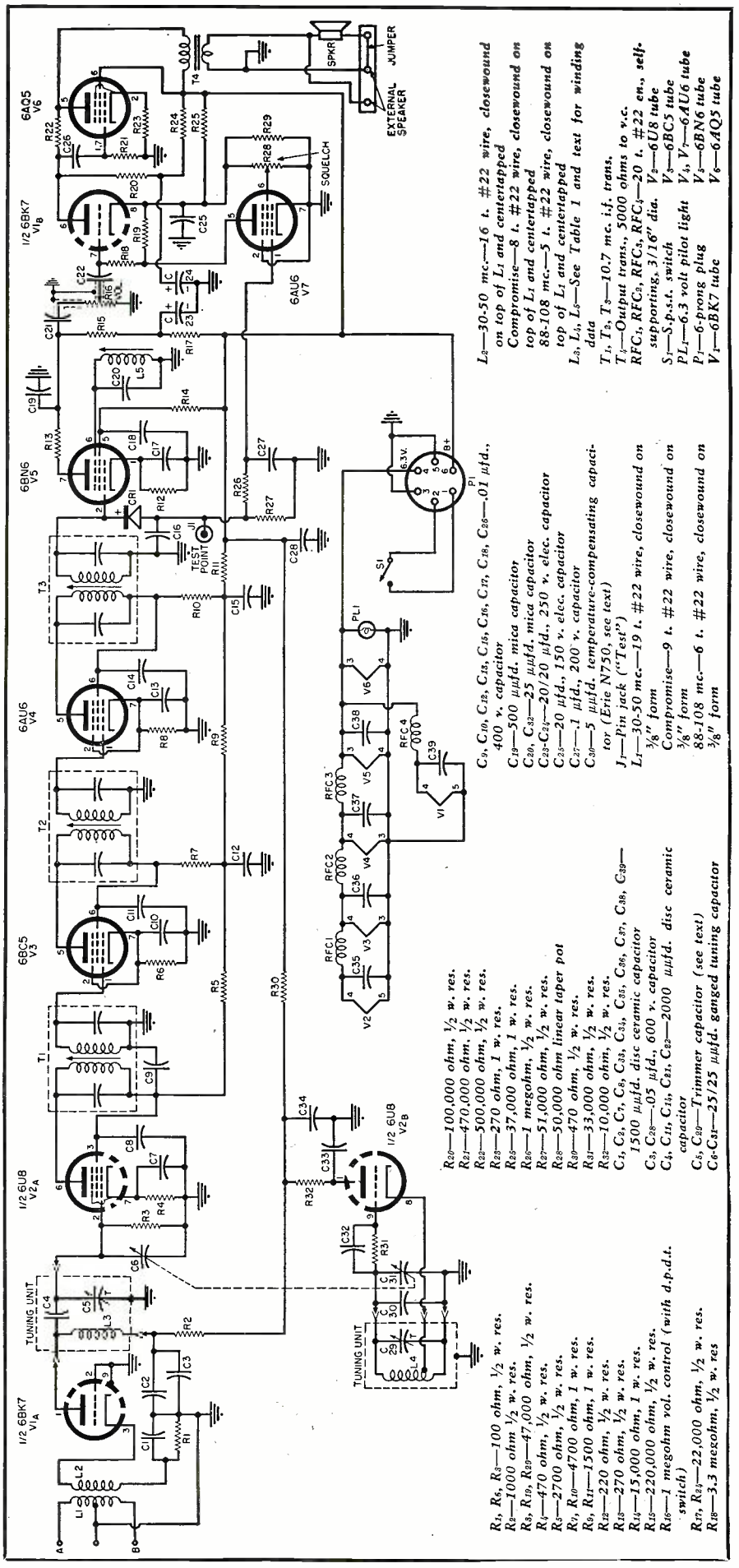
Be sure the frame and rotor of the tuning capacitor are grounded to the chassis at *several* points, either by large area metal-to-chassis contacts or heavy braid. At frequencies higher than 120 mc., fixed coils, wired to the tuning capacitor, should be used rather than the tuning units.



Inside view of the 30 to 50 megacycle tuning unit used in multiband receiver.

Photograph showing underside of the chassis used in the receiver. Note the placement of the various components with respect to the tube sockets.





R1, R6, R9—100 ohm, ½ w. res.
R2—1000 ohm ½ w. res.
R3, R19, R29—47,000 ohm, ½ w. res.
R4—470 ohm, ½ w. res.
R5—2700 ohm, ½ w. res.
R7, R10—4700 ohm, 1 w. res.
R8, R11—1500 ohm, 1 w. res.
R12—220 ohm, ½ w. res.
R13—270 ohm, ½ w. res.
R14—15,000 ohm, 1 w. res.
R15—220,000 ohm, ½ w. res.
R16—1 megohm vol. control (with d.p.d.t. switch)
R17, R21—22,000 ohm, ½ w. res.
R18—3.3 megohm, ½ w. res
R20—100,000 ohm, ½ w. res.
R22—470,000 ohm, ½ w. res.
R23—500,000 ohm, ½ w. res.
R25—270 ohm, 1 w. res.
R26—37,000 ohm, 1 w. res.
R27—1 megohm, ½ w. res.
R28—51,000 ohm, ½ w. res.
R30—50,000 ohm linear taper pot
R31—470 ohm, ½ w. res.
R32—33,000 ohm, ½ w. res.
C1, C2, C7, C8, C33, C34, C35, C36, C37, C38, C39—1500 μμfd. disc ceramic capacitor
C3, C28—.05 μfd., 600 v. capacitor
C4, C11, C15, C21, C22—2000 μμfd. disc ceramic capacitor
C5, C29—Trimmer capacitor (see text)
C6-C31—25/25 μμfd. ganged tuning capacitor
C9, C10, C12, C13, C14, C16, C17, C18, C26—.01 μfd., 400 v. capacitor
C19—500 μμfd. mica capacitor
C20, C32—25 μμfd. mica capacitor
C23-C24—20/20 μfd., 250 v. elec. capacitor
C25—20 μfd., 150 v. elec. capacitor
C27—.1 μfd., 200 v. capacitor
C30—5 μμfd. temperature-compensating capacitor (Erie N750, see text)
J1—Pin jack ("Test")
L1—30-50 mc.—19 t. #22 wire, closewound on ⅜" form
Compromise—9 t. #22 wire, closewound on ⅜" form
88-108 mc.—6 t. #22 wire, closewound on ⅜" form
L2—30-50 mc.—16 t. #22 wire, closewound on top of L1 and centertapped
Compromise—8 t. #22 wire, closewound on top of L1 and centertapped
88-108 mc.—5 t. #22 wire, closewound on top of L1 and centertapped
L3, L4, L5—See Table 1 and text for winding data
T1, T2, T3—10.7 mc. i.f. trans.
T4—Output trans., 5000 ohms to v.c.
RFC1, RFC2, RFC3, RFC4—20 t. #22 en., self-supporting, 3/16" dia.
S1—S.p.s.t. switch
PL1—6.3 volt pilot light
P1—6-prong plug
V1—6BK7 tube
V2—6U8 tube
V3—6BC5 tube
V4, V7—6AU6 tube
V5—6BN6 tube
V6—6AQ5 tube

BAND	L_2	L_4	MIXER TRIMMER	OSC. TRIMMER
30-50 mc.	8 t.	8 t. (tapped 2 t.)	0-30 μμfd.	Omit
88-108 mc.	3 t.	3 t. (tapped ¾ t.)	0-30 μμfd.	0-30 μμfd.

Table 1. Coil data for tuning units.

Bypassing

Bypassing in the mixer stage is very critical—much more so than in the i.f. stages. The bypass capacitor from the plate of the 6U8 triode should run *directly* to the metal tube socket saddle. Two bypass capacitors are used in the screen circuit: one to ground directly at the socket and another at the i.f. transformer lug. The cathode bypass capacitor should go *directly* to ground. *Do not* attempt to ground these mixer bypass capacitors to a single point. Get them to ground by the shortest route. This simple expedient cleared out all mixer troubles in the original model.

Spurious oscillation in the mixer stage may make it appear that every stage in the receiver is squealing or blocked with oscillation. Every component will become hypersensitive to capacitance effects.

I.F. Stages

By tying pins 2 and 7 together at the socket it is possible to use 6BC5, 6CB6, 6AG5, 6AU6, or 6BA6 tubes in the i.f. strip. With the 6BA6 it is necessary to change the cathode resistor to 100 ohms. The 6BC5-6AU6 is the recommended combination shown in the diagram.

The shelf-type chassis comes into contact with the cabinet only at the front and back. The end of the chassis containing the i.f. stages does not touch the cabinet. To prevent oscillation in these stages it is necessary to electrically connect the chassis and cabinet at this point with a piece of shielded braid. This can probably be seen in the under-chassis photograph Otherwise, there is no tendency toward oscillation. The plate supply voltage can increase as much as 60 volts with still no signs of instability. Close attention to the decoupling of filament and plate leads gives "built in" insurance against oscillation.

Any wire passing in the vicinity of the i.f. stages is capable of inducing feedback. For this reason simple uncluttered wiring is the most satisfactory. The under chassis shield helps to confine wiring to their respective stages.

6BN6 Limiter-Discriminator

There are several reasons for using the 6BN6 discriminator. First of all, the 6BN6 makes FM tuning as smooth and easy as AM tuning. The three-point tuning and distortion typical of slight mistuning are gone. The limiting action of the 6BN6 has no time constant. With the 6BN6 it is unnecessary to apply a.v.c. to the preceding

←**Complete schematic diagram of multiband FM receiver. Separate power supply is used.**

i.f. or mixer stages. The discriminator uses a very simple single-tuned circuit obviating the expensive discriminator transformer used with other detectors. This saving will more than balance the extra cost of the 6BN6.

The quadrature coil should be mounted above chassis in a shielded location as near to the 6BN6 as possible. A shield around this coil may be seen in the photographs but it is not absolutely necessary.

The quadrature circuit is made to oscillate at the intermediate frequency by energy coupled from the electron beam inside the tube. When the carrier swings above and below its center frequency, the quadrature "gates through" larger or smaller pulses of electrons, causing the plate current to vary at the audio modulation frequency. This makes it a true FM detector.

Audio Stages

A 6AQ5 and one half of the 6BK7 comprise the audio section. The 6AU6 squelch tube controls the bias on the 6BK7, driving it to cut-off when there is no carrier. A single 1N34 diode supplies the control voltage for the 6AU6. This 1N34 should be soldered directly to the i.f. transformer lug and directly bypassed to ground.

A voltage control in the screen circuit of the 6AU6 determines at what signal level the audio amplifier begins to function. Any carrier producing twelve volts or more of signal at the "test point" will cause the audio amplifier to operate no matter what position the squelch control is in.

Inverse feedback is used in the output stage. This produces a noticeable improvement in audio quality even on voice transmissions with the small internal speaker.

One trouble was noted on police calls. The sharp "attention" tone used to alert the police cars would set up receiver microphonics. A double layer of Fiberglas behind the speaker eliminated this condition.

Coil Data

In the tuning units the antenna coils are ⅜ inch in diameter, and wound with #22 enamel wire. The turns should be closewound and then spaced for tracking.

The 30-50 mc. oscillator coil is closewound with #26 enamel wire on a *Cambridge Thermionic* LS3 coil form. Number 16 enamel wire is used for the 88-108 mc. oscillator winding. The wire is rigid enough to be self-supporting around the coil form. Details for winding L_3 and L_4 are given in Table 1.

This winding data can be changed proportionately to hit other bands.

The quadrature coil L_5 is 22 turns of #26 enamel wire closewound on an LS3 form.

Alignment

To align the i.f. stages, pull the tuning unit from its socket and apply a 10.7 mc. signal to the stator plates of the mixer section of the tuning capacitor, after setting the unit at minimum capacity. A voltmeter, 0 to 5 volts will do, should be connected from the "test point" to ground. The meter will read the signal strength. Now adjust the i.f. tuning slugs for maximum meter reading, progressively reducing the output of the signal generator as the i.f. stages are peaked.

The quadrature circuit is tuned for greatest audio output and has no effect on the signal strength at the test point.

To align the 30-50 mc. tuning unit: First, adjust the oscillator slug until the radio will receive a 30 mc. signal with the tuning capacitor plates fully meshed. The antenna coil is adjusted by squeezing or spreading the turns for maximum sensitivity on the low end of the band. The antenna coil trimmer is used to track the antenna coil at frequencies near 50 mc.

For best tracking, go back to the low-frequency end of the band and repeat the above procedure once or twice more. If only one or two stations are to be received, adjust the antenna coil trimmer for maximum sensitivity and best tracking near these stations.

Alignment of the 88-108 mc. unit is much the same, except the oscillator coil has an added parallel trimmer capacitor. This trimmer reduces the tuning range to the required 20 mc. Slowly screw down the oscillator trimmer until the receiver covers the 20 mc. range. More capacity reduces the range and less tuning capacity increases the range. The oscillator slug is adjusted until an 88 mc. signal can be picked up with the tuning capacitor plates completely meshed. The antenna coil is adjusted for best tracking in the same way as the 30-50 mc. unit.

Power Supplies

Four selenium rectifiers are used in the a.c. power supply. A 6X5 or a 5Y3 rectifier tube, however, can be used just as well and will be slightly cheaper. Rubber lamp cord is used for the filament and switch wires between the receiver and power supply.

Stranded "primary wire" should be used to interconnect the receiver and vibrator power supply 6 volt leads. Notice the battery lead goes directly to the socket that fits the receiver rather than into the power supply. Since the vibrator supply is in a separate metal box, there is no hash from this source.

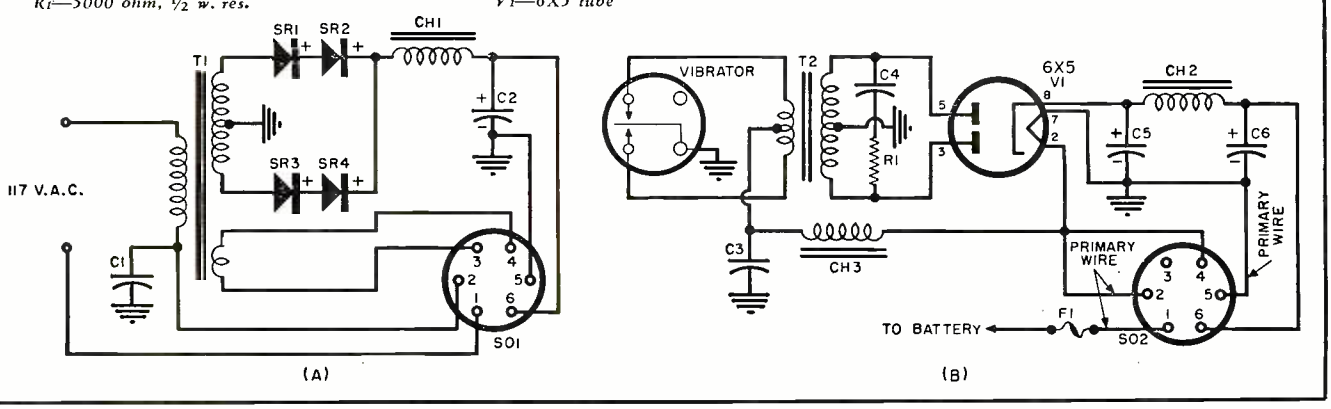
The life of the vibrator to a large extent will depend upon how accurately the buffer capacitor is chosen. Constants of the vibrator transformer determine the value of the buffer. In this case the value shown in the diagram is the capacitance specified by the manufacturer of the transformer.

One final word. While the FCC has no rule prohibiting the use of mobile FM receivers capable of tuning the police bands, many states have laws against such sets. To avoid any trouble of this sort, the FCC suggests that would-be builders check local police authorities before installing such gear in their family cars. —30—

(A)
C_1—.01 μfd., 600 v. capacitor
C_2—20 μfd., 350 v. elec. capacitor
CH_1—8 hy., 85 ma. choke
SR_1, SR_2, SR_3, SR_4—65 ma. selenium rectifier
T_1—Power trans. 240-0-240 v. @ 70 ma.; 6.3 v. @ 3 amps. (Stancor PC-8419 or equiv.)
SO_1—6-prong socket

(B)
R_1—5000 ohm, ½ w. res.
C_3—.25 μfd., 200 v. capacitor
C_4—.008 μfd., 1600 v. buffer capacitor
C_5-C_6—20/20 μfd., 350 v. elec. capacitor
CH_2—8 hy., 75 ma. choke
CH_3—Iron core filament choke (Mallory)
F_1—14 amp fuse
Vibrator—Mallory 4-4 vibrator
SO_2—6-prong socket
T_2—Power trans. 320-0-320 v. @ 75 ma. (Stancor P-4063 or equiv.)
V_1—6X5 tube

Schematic diagram and parts list for (A) power supply energized by a.c. line and (B) power supply energized by automobile storage battery for portable use.



By **JOHN T. FRYE**

MAC MEETS COLOR

IT WAS a beautiful June day, the kind that makes it hard to stay indoors; so Mac was quite understanding as Barney, his assistant, floated in from lunch a full quarter of an hour late.

"Ah, spring!" Mac said with a teasing grin as he looked at the dreamy expression in the blue eyes of the red-haired Irish youth.

"It's got me, all right." Barney admitted. "I drove Margie around a little before I took her back to work—but say! What's that huge cardboard carton doing on your front porch? I spotted it as we went past. You holding out on me again?"

"I might have known I couldn't keep anything from you," Mac sighed. "What would you say if I told you a new twenty-one-inch color TV set arrived in that box?"

"You kidding? Did you really get a color set? How does it work? When do I get a look-see?"

"Easy! Slow down!" Mac said with a chuckle. "No, I'm not kidding. I really do have the set, and it's quite a beauty. It has a 21AXP22A kinescope; mahogany cabinet; triple speakers; tuning, brightness, and volume controls up on the side; and a lighted window that shows you what channel you are watching even when you're sitting clear across the room."

"Sounds great, but what made you take the plunge?"

"It *is* sort of a plunge, for color sets are few and far between in this weak-signal area where most people are still trying to get a good reliable black-and-white picture; but as you know we are getting an increasing number of inquiries from our customers about the feasibility of buying a color set. Many of the questions are downright embarrassing simply because we don't know the answers."

"You can say that again. Just yesterday Mr. Palmer collared me down at the bank and wanted to know if he could expect good enough color reception here to warrant his buying a set."

"That question is thrown at me two or three times a week," Mac said with a nod; "and I hate to keep saying I don't know. After all, since we're in the TV business, we *should* know. Of course, we can quote from what we've read and heard in the TV clinics; but this information is, of necessity, of a general nature. What people around here want is specific information applying to this particular locality. That's why I decided to get a color set and find out the answers for myself."

"Most of the technicians I hear talk are discouraging the purchase of color sets around here."

"I know that, but I also know most of them have no more personal experience to back up their advice than I have. In fact, some of them have admitted they hate to think of having to service the new and complicated circuits in color TV receivers and are deliberately trying to keep color out of this area as long as possible. Doubtless some of the others are unconsciously acting from the same motives, even though they do not admit it, even to themselves."

"That's a kind of crazy attitude," Barney exclaimed.

"Maybe so, but it's also pretty human. When you're young and have no responsibilities, it's natural to be eager to try new things; but when you get a little older and have discovered that mastering something new usually entails a lot more effort and hard work than it does fun, you're not quite so eager. This is especially true when the innovation touches your way of making a living. In such a case you may feel the new thing poses a serious threat to your bread-and-butter and that of your family. I can see why many technicians are actually afraid of color television."

"You think they're right in knocking color?" Barney asked in amazement.

"Certainly not. You can understand a person's motives without condoning his behavior. Knocking color, for purely selfish personal reasons, will hurt the technician in the long run. Color is coming inevitably and faster than many people realize. The technician who disparages it in the hope of holding it back is in about the same position as the person who tried to sweep back the tide with a broom. All such a technician will succeed in doing is to convince people he is a mossy reactionary, unwilling or unable to keep up with advances in his own field."

"Then you think we should advise everyone to buy a color set right away."

"Will you quit trying to put words into my mouth? That would be like advising everyone to go out and buy a *Cadillac*. Color television is still expensive; there is definitely room for improvement in both transmission and reception; good color reception requires somewhat more signal strength than does a 'passable' picture in black-and-white—although not as much more as I had imagined—and there still are not nearly enough color broadcasts on the air. But for the man who can afford it, who likes to be in on new and exciting developments, and who feels the thrill of watching a spectacle such as the Rose Bowl Parade in full colors repays him for his considerable investment, color is here!"

"Tell me more about your reception. How long did it take you to set up the color set? I understand that's quite a job."

"How long does it take you to plug in a line cord and turn on a switch?" Mac asked quizzically.

"You mean that's all you did? You didn't have to spend hours de-gaussing the tube, correcting the purity, adjusting the convergence?"

"Nope. We simply took the set out of the shipping carton, put it alongside the good old black-and-white set, arranged the antenna lead-in so it could be switched to either set, and turned on the color receiver. There was no color on at the time, but stations rolled in on black-and-white without so much as having to adjust the vertical or horizontal hold controls."

"Maybe it was set up before you got it."

"Only at the factory. Since I wanted to learn exactly what to expect in all phases of color reception, I specified the set was to be delivered still sealed in a factory carton; and that's the way it came."

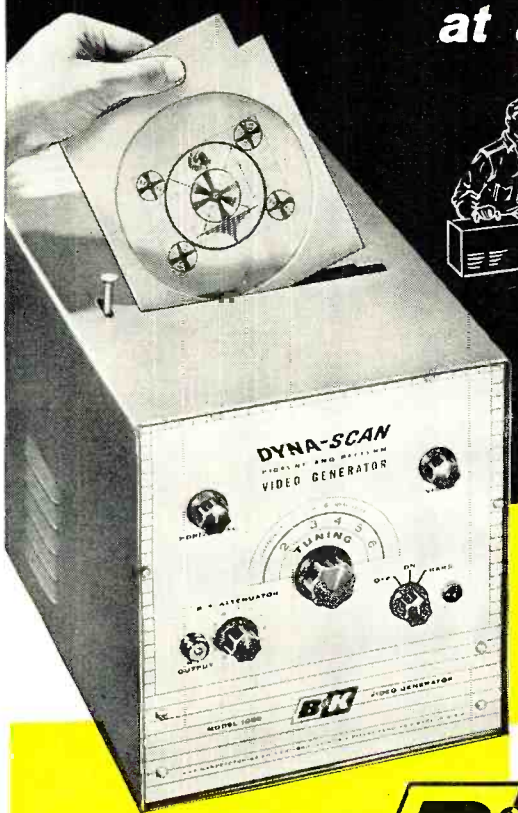
"And you're getting a perfect color picture?"

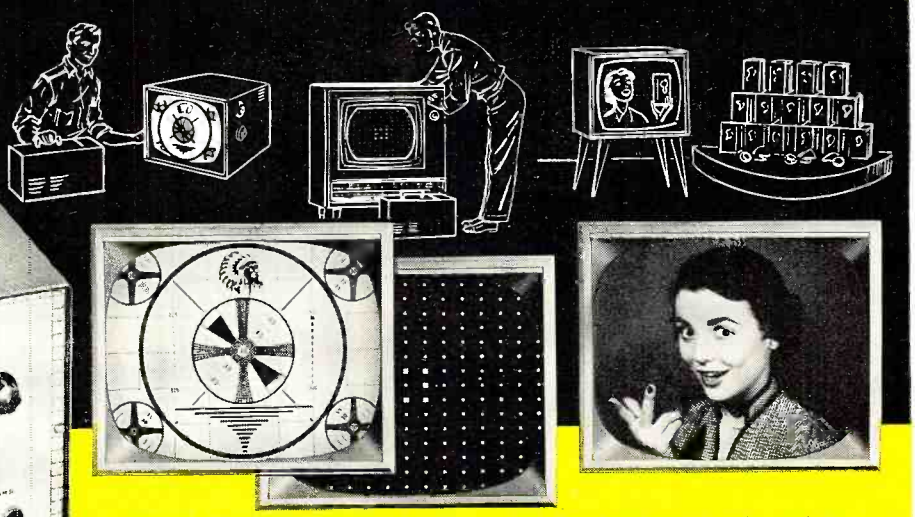
" 'Perfect' is a pretty strong word to use in connection with any TV picture, black-and-white *or* colored. Let's say I'm getting a much better picture than I have a right to expect for not having done a thing to the set except turn it on. Practically everyone who has seen the set—and that is quite a parade!—exclaims about how wonderful the picture is; but most of these people are seeing color television for the very first time and are not too critical. I am quite aware that there is some room for improvement both in purity and convergence; and as soon as the dot generator I have ordered arrives, I'm going to see what I can do about this."

(*Continued on page* 130)

SHOW ANY PICTURE or PATTERN

at any time—ON ANY TV SET





For Both Black & White and Color TV

Provides standard Indian Head Test Pattern for proper TV set alignment, and stable White Dot and White Line Patterns for color convergence adjustments.

For Merchandising & Industrial Uses

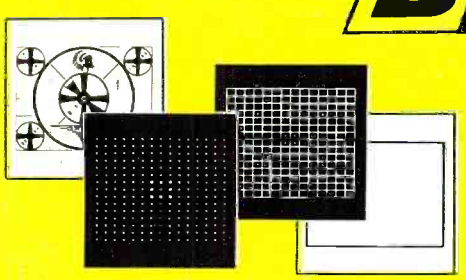
Provides closed circuit TV system. Transmits pictures or messages for advertising, educational and commercial visual communication.

MODEL 1000

B&K DYNA-SCAN

PICTURE AND PATTERN

VIDEO GENERATOR



3 TEST PATTERN TRANSPARENCIES AND ONE CLEAR ACETATE SUPPLIED

1 Indian Head Test Pattern

2 White Dot Pattern

3 White Line Crosshatch Pattern

These are broadcast-quality transparencies, and assure accurate, high-definition TV images. You can also transmit your own transparencies of any subject you wish. The clear acetate can be used for special messages. Extra transparencies and acetate available.

Make the most of this *Complete Flying Spot Scanner*. It produces a composite video and sync signal that operates any standard black & white or color TV receiver. Can be used with one or more TV sets or fed into a master antenna system or community antenna system. Maximum resolution capability is well in excess of 450 lines; band width in excess of 5 mc. Projects and reproduces pattern or picture with high definition from any slide transparency. Transmits messages typed or written on clear acetate. Makes convenient stand-by and break-in for community distribution operation. Rugged, compact, portable, and ready to operate.

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B&K

Model 950 Dyna-Scan Pickup and RF Generator only. Enables you to make your own picture and pattern video generator, at a saving. Supplied with three test pattern transparencies and one clear acetate. Net, $69.95

Model 500 DYNA-QUIK
Dynamic mutual conductance tube tester. Accurately tests tubes faster. Net, $109.95

Model 400 CRT
Cathode Rejuvenator Tester. Tests and repairs TV picture tubes. Net, $54.95

Model 750 CALIBRATOR
Designed to check and adjust test instruments with laboratory accuracy. Net, $54.95

New

MODEL O-11
Shpg. Wt. 21 Lbs.

$69.50

* *An improved model of what was already an outstanding instrument.*

* *Performance is unmatched in this price range.*

* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2 DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

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- Factory-to-you sales eliminate extra profit margin.
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- Heath purchasing power cuts component costs.

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- You deal directly with the manufacturer.
- We are interested in you before and after sale.

5 BIG REASONS WHY

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ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 15, MICH.

GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

- *Brand new model with improved performance specifications.*
- *Full 5" scope for service work at a remarkably low price.*
- *Attractively styled front panel in charcoal gray with sharp white lettering.*
- *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb.

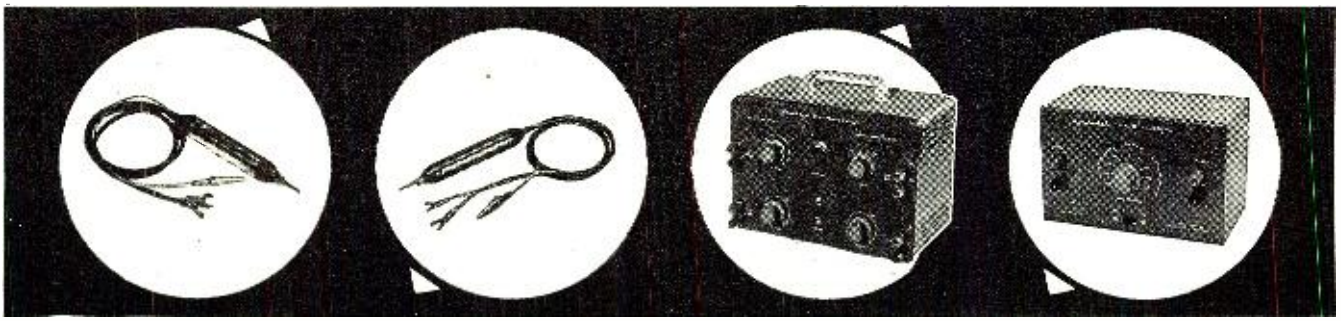
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

MODEL V-7A

$24.50

Shpg. Wt. 7 Lbs.

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

Shpg. Wt. 6 Lbs.

ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 Lbs.

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BENTON HARBOR 15, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- *Brand new circuit for extended frequency response and added stability.*
- *Ten accurate ranges from 0-.01 to 0-300 volts.*
- *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3
$29.95
Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

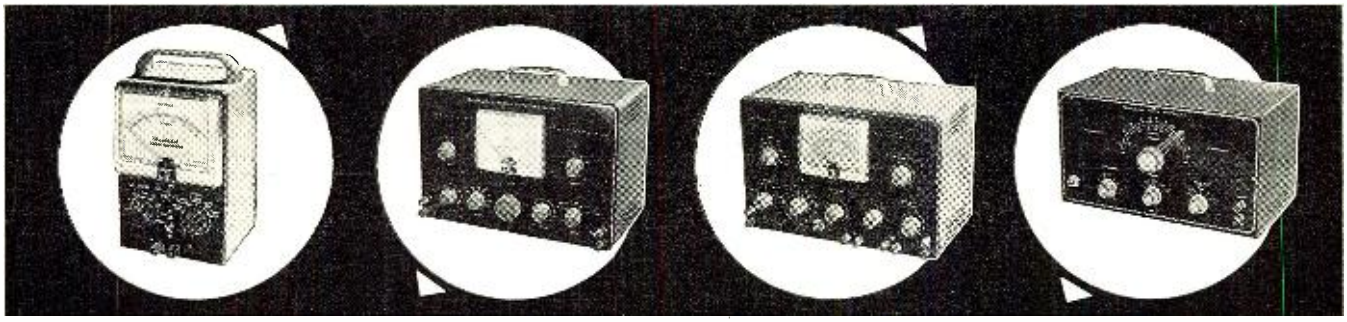
This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

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

HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. 1M scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1
$49.95
Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1
$49.50
Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

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

HEATHKIT

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

Audio Generator Kit

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

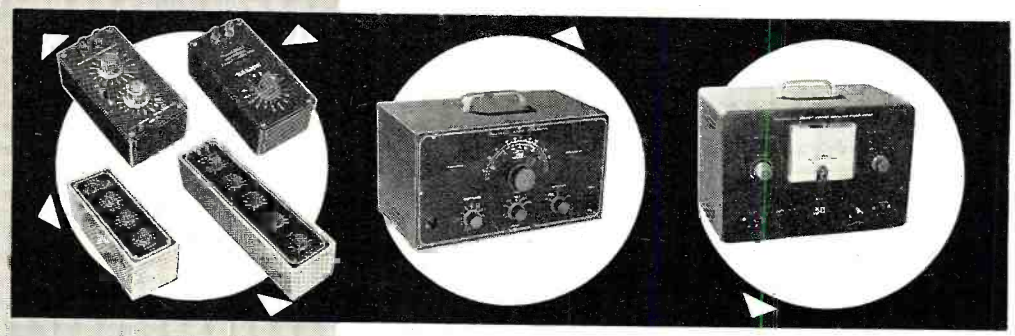
HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.



HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*

MODEL SG-8

$19.50 Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$48.95

Shpg. Wt. 16 Lbs.

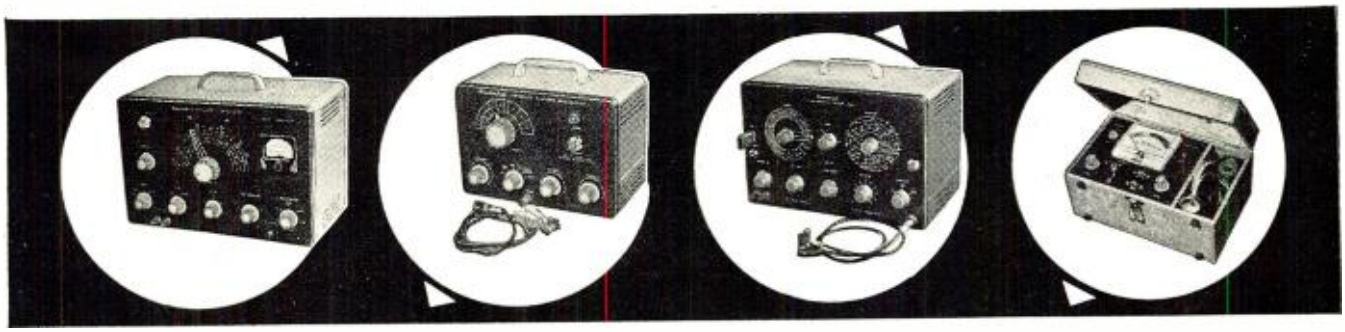
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

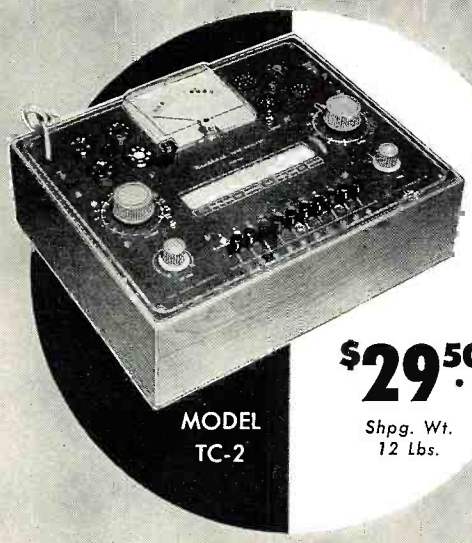
MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit



MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

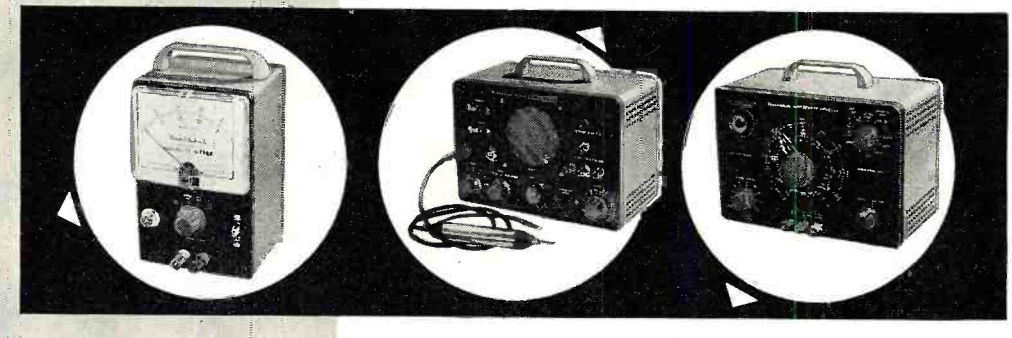
Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT



Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

PIONEER DESIGN . . .

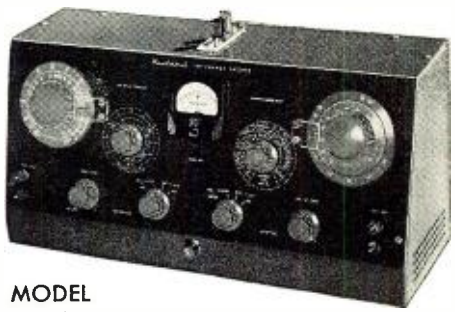
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 Shpg. Wt. 12 Lbs.

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

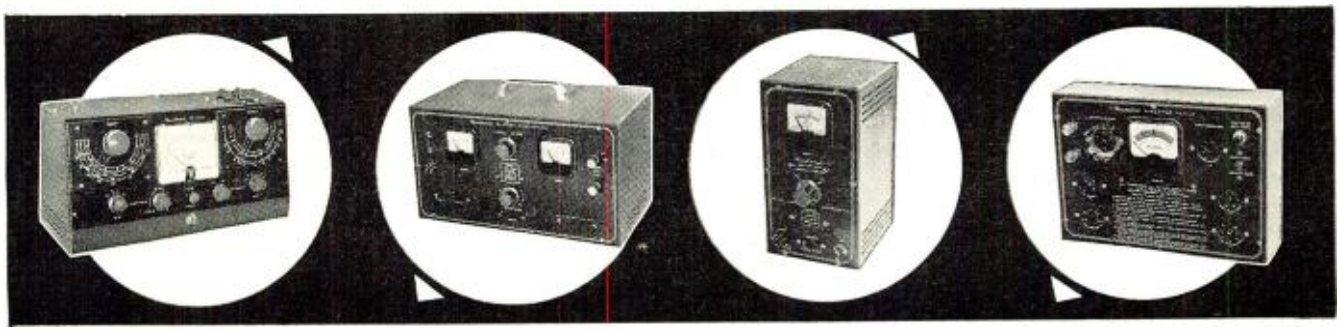
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

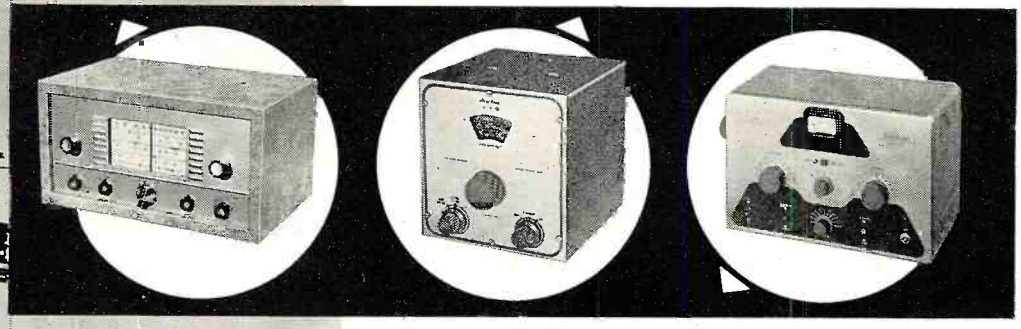
CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. **$4.95**

MODEL AR-3
$29.95
INCLUDING NEW EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

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



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

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BENTON HARBOR 15, MICH.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20
$35.95
Shpg. Wt. 18 Lbs.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

- *6146 final amplifier for full 65-watt plate power input.*
- *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
- *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

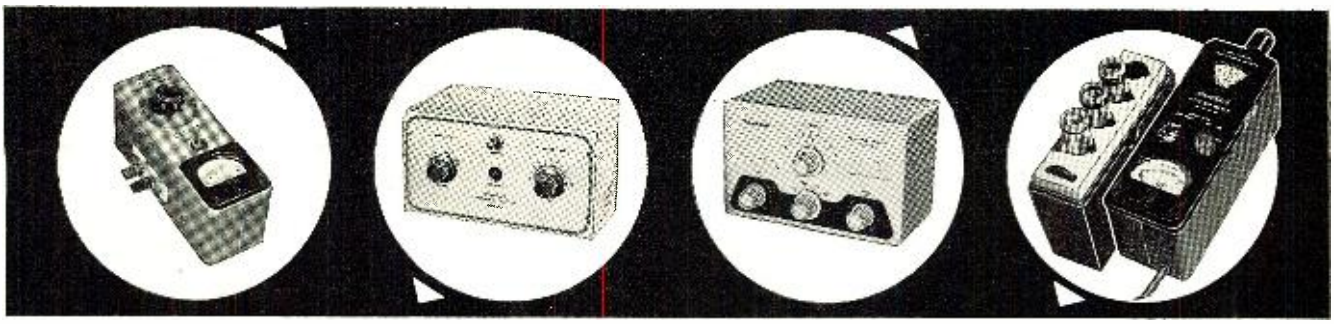
$14.50 *Shpg. Wt. 2 Lbs.*

HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95 *Shpg. Wt. 3 Lbs.*



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50 *Shpg. Wt. 4 Lbs.*

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95 *Shpg. Wt. 4 Lbs.*

HEATHKIT BROADCAST BAND

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX‡

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

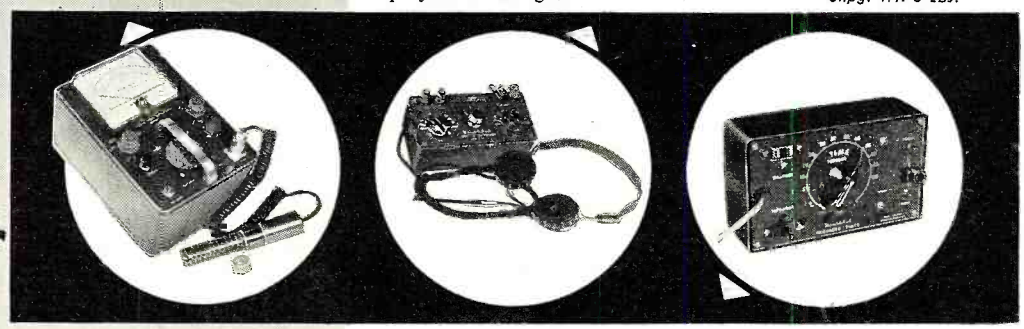
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception, This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.



- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

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COMPREHENSIVE INSTRUCTIONS . . .

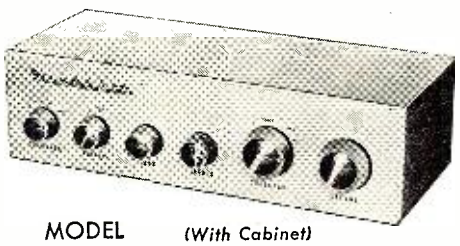
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.



MODEL WA-P2 *(With Cabinet)* *Shpg. Wt. 7 Lbs.*

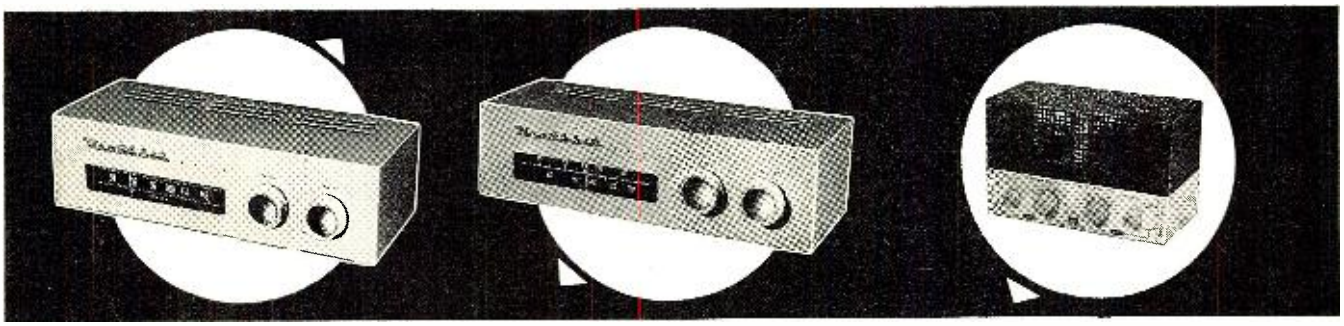
$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A
$25.95
INCLUDING NEW EXCISE TAX
(With Cabinet)
Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1
$25.95
INCLUDING NEW EXCISE TAX
(With Cabinet)
Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1
$18.95
Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

MODEL W-5M
Shpg. Wt. 31 Lbs.
Express Only

$59.75

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HIGH FIDELITY
Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only..... $49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only..... $69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only..... $39.75

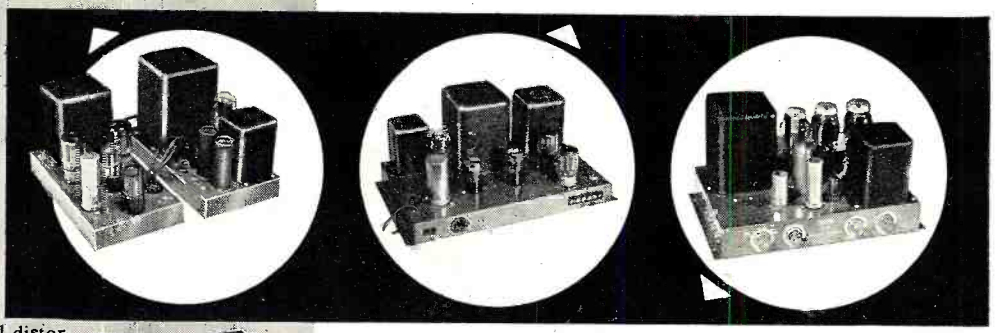
MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only..... $59.50

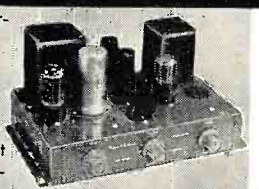
HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. *Shpg. Wt. 10 Lbs.*

MODEL A-7D
$17.95*
INCLUDING NEW EXCISE TAX

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. **$19.95‡**





HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency response of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

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

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

* *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
* *Easy-to-assemble cabinet of furniture-grade plywood.*
* *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

* *Special design ducted-port, bass-reflex enclosure.*
* *Two separate speakers for high and low frequencies.*
* *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

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 and APO'S must include full remittance.

Name_____

Address_____

City & Zone_____ State_____
(PLEASE PRINT)

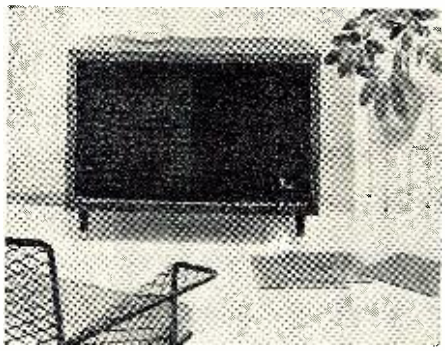
SHIP VIA
☐ Parcel Post
☐ Express
☐ Freight
☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

Hi-Fi-Audio Product Review

NEW LOWBOY ENCLOSURE

James B. Lansing Sound, Inc., 2439 Fletcher Drive, Los Angeles 39, Calif. is now offering its "Harkness" Model C40, a rear-loading horn which has



been especially designed for the smaller living rooms of city dwellers.

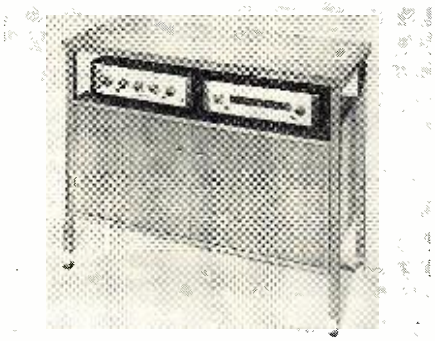
Entirely contained and independent of room position, this lowboy enclosure can be used against the wall or as an end table. Height without legs is under 24" and under 30" with legs. The enclosure measures nearly 38" wide and just under 20" in depth. This new unit is so designed that it can be used at a later time in an expanded two-way system.

EQUIPMENT HOUSINGS

American Loudspeaker, Division of *Contemporary American Furniture, Inc.,* 725 S. LaSalle, Chicago 5, Ill. has recently introduced a new line of housings especially designed for the high-fidelity equipment market.

Initially, the new line includes two matched speaker systems and one equipment console. Finishes include traditional mahogany, sandalwood mahogany, and natural walnut.

The equipment console will house a complete audio system, except for



speakers, and stores over 100 records. The Mark 100 unit includes solid brass ferrules on the legs, brass piano hinges for the doors, magnetic door catches, ball-bearing drawer slides for the changer, pre-cut changer drawer, and a rubbed finish. In addition, the lacquered hardboard back is pre-drilled to make installation simple. The unit is 36" wide, 27" high, and 16" deep.

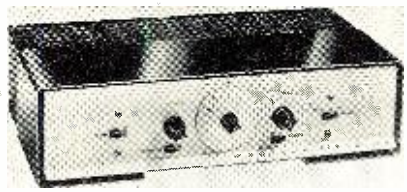
The two speaker systems are designed to match and complement the equipment console. The smaller unit measures 24" wide, 10" high, and 12" deep, the larger 27" wide, 23" high, and 14" deep. Speakers are included.

Write the manufacturer for full electrical and physical details on any or all of these cabinets.

16-WATT AMP-PREAMP

Madison Fielding Corp., 863 Madison St., Brooklyn 21, N. Y. is now offering a 16-watt amplifier which features an all-transistor preamplifier.

The Series A-15 has a uniform frequency response from 20 to 20,000 cps ± .5 db and from 10 to 75,000 cps ± 2 db. Distortion is less than 1% at full output and less than .1% at 1 watt. Output impedances of 4, 8, and 16 ohms are provided plus a low im-



pedance recorder output which provides 10 db of gain from input ahead of all volume and tone controls.

The instrument includes four high impedance, one low level, and one low impedance inputs. NARTB equalization is provided for tape playback and the RIAA curve within .5 db for phono reproduction. Accurately calibrated controls offer six other playback curves. Equalization is continuously variable for optimum settings under all conditions of program material and listening.

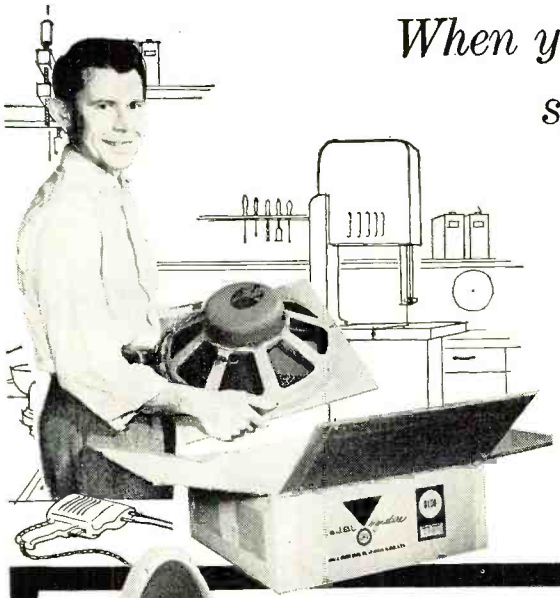
Over-all size of the unit is 14⅛" x 7" x 3⅝" high. Full details will be supplied by the manufacturer on request.

FISHER FM TUNER

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. has developed a new FM tuner which features a gold cascode r.f. amplifier.

The gold cascode, which is the costliest tube of its type in the world, together with special circuitry, brings the Model FM-90X to the theoretical limits of sensitivity, according to the manufacturer.

The tuner uses a full wide-band de-



When you build your High Fidelity sound system, use THE VERY BEST LOUDSPEAKERS YOU CAN GET

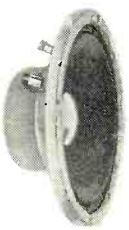
You are planning to build, or improve, your high fidelity sound system. Unstintingly, you will pour out your enthusiasm, time, and energy to get the finest music reproduction you can bring into your home. Get a loudspeaker that will do full credit to your handiwork . . . Install a JBL Signature Extended Range Loudspeaker, or two-way speaker system, in your enclosure.

JBL Signature Loudspeakers are made with the same careful craftsmanship, the same precision forming and fitting that you yourself would use if you set out to make the finest loudspeaker the world had ever heard. JBL Signature precision speakers are the most efficient loudspeakers made.

With a JBL Signature Loudspeaker in your high fidelity system, you can exhibit your components with pride, confident that those you have made yourself are being demonstrated in the most effective way possible.

MODEL D130—15" extended range loudspeaker The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.

MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.



MODEL D208—8" extended range loudspeaker A **precision transducer** in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.

MODEL 175DLH high frequency assembly The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens, the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.

MODEL 075 high frequency unit Another exclusive for James B. Lansing Sound, Inc. is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

JBL Signature two-way systems are available as kits

086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units—including the serpentine acoustical lens—which are used in The Hartsfield . . . units designed originally for installation in the most modern theaters in the world.

002 KIT Including some of the newest speakers made, the JBL Signature 002 Kit includes a D123 for low frequency reproduction, N2500 Network, 075 High Frequency Unit. The 002 Kit is moderately priced, yet gives the user all the advantages of a two-way system made with independent drivers.

001 KIT Probably the most popular high quality two-way system on the market, the JBL Signature 001 system consists of a 130A Low Frequency Driver, N1200 Network, 175DLH High Frequency Assembly. The D130 may be substituted for the 130A without disturbing the balance or coverage of the system.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

JBL *means*

JAMES B. LANSING SOUND, INC.

2439 Fletcher Drive • Los Angeles 39, California

Please send me the following:

☐ Free Catalog of JBL Signature Products

☐ Name and address of Authorized JBL Signature Audio Specialist in my community

TECHNICAL BULLETINS ON:

☐ D130 ☐ D123 ☐ D208 ☐ 175DLH ☐ 075 ☐ 130A ☐ 150-4C

Name_____

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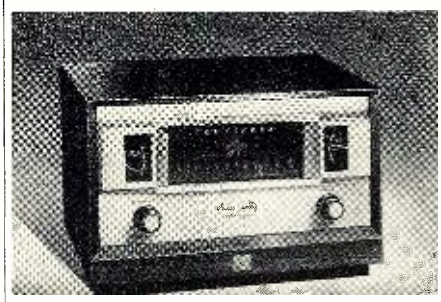
tector, dual dynamic limiters, variable a.f.c., and interchannel muting. Two meters are provided for micro-accurate



tuning—one indicating signal strength and the other indicating center-of-channel.

The tuner is available with optional cabinets in either blonde or mahogany finishes. The tuner measures 13 7/16" wide, 6⅛" high, and 8⅜" deep, plus 1" for knobs.

SOUND SYSTEM CONTROLS

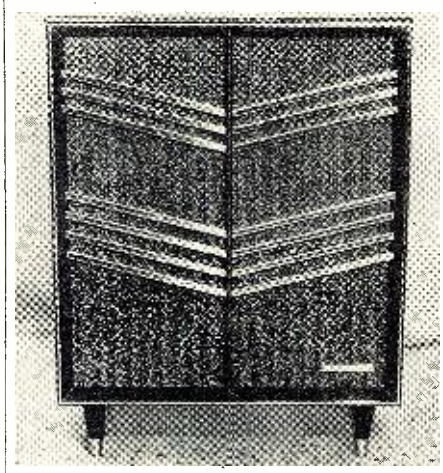
Clarostat Mfg. Co., Inc., of Dover, N. H. has released three new constant impedance attenuators for controlling remote speakers that lend themselves to more compact housings or outlet boxes, due to their reduced depth and diameter.

The new CIT43 controls are based on the popular 1⅛" diameter potentiometers. Rated at 2 watts d.c., these controls handle up to 4 watts of audio. The attenuation range is 0 to 30 db over 90% of the rotation and 60 db in the remaining 10%. Attenuation increases approximately linearly up to 30 db with counterclockwise rotation. Insertion loss is less than 6 db.

The CIT43 (T-pad) and the CIBT43 (bridged tap pad) have constant input and output impedances, while the CIL43 (L-pad) has constant impedance for input only. Shafts and bushings are insulated from circuit elements and all pads are supplied with bar knobs and dial plates.

"AUDIO-ELITE" SPEAKER

American Elite, Inc., 7 Park Avenue, New York 16, N. Y. is now offering a speaker system with changeable



grille which is being marketed as the "Custom."

The enclosure includes six speakers —two 12" dynamic oval speakers, two 8" dynamic oval speakers, and two tweeters. Frequency response is 20-20,000 cps when the system is used with the *Audio-Elite* tuner and amplifier. The cabinet is 32" high, 24" wide, and 12½" deep. It is available in high gloss mahogany or blonde finishes.

A unique feature of the enclosure is the changeable grille which makes possible a variety of decorative schemes. The grille is available with either model at additional charge.

ERIE AMPLIFIER KIT

Erie Resistor Corporation of Erie, Pa. has designed a new four-tube audio amplifier kit for the "do-it-yourself" market.

The kit includes one of the company's "PAC" modules of pre-assembled resistors and capacitors, an embossed wiring board, and additional plug-in components consisting of tubes,

tube sockets, output transformer, filter capacitor, volume control and switch, and tone control.

Complete instructions and recommendations for construction are included with the kit which is being handled by the company's regular distributors.

STEREO AMPLIFIER CHANGES

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio has announced that its Model 3-DTG two-channel stereophonic amplifier has been re-engineered and improved.

Power output is now fully rated in excess of 24 watts, 12 watts each channel, with peak output of 50 watts. New low-noise input tubes are now being used. The amplifier will operate in either the stereo or monaural mode. Stereo features include two separate amplification channels with single knob, simultaneous control of both channels. A six-position function switch provides selection of stereo or monaural amplification with or without loudness control.

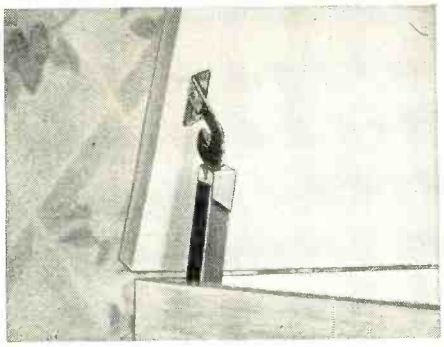
A reverse speaker switch makes it possible to switch the two stereo channels into the opposite speakers. A single-knob balance control assures simple component difference correction.

COVER LIFTS

Counter Balance Inc., Box 72, Stoughton, Wis. has added two new units to its line of equipment cabinet hardware.

The X300 and XB400 "Cover Lifts," which have been especially designed for use on record player cabinet lids, offer a number of unique features which compensate for the rough usage such

closure devices often receive. For factory assembly or servicing of the equip-



ment a cam pressure point has been provided so that the shoulder rivet is placed in a forward position and the cover remains locked in a wide open position for easy accessibility. Other features include compensation for cover weight at varying degrees of opening; reverse cam action which eliminates sudden jars when the cover is thrown open violently, thus protecting stylus and record; and torsional rigidity which preserves the alignment of cabinet back and delicate corner joints.

These units are being offered in a new two-tone finish with solid bright brass top slide and the balance dead black, making the units compatible with either blonde or dark finished cabinets.

Write the manufacturer for full specifications for various sized cabinets.

PRINTED CIRCUIT AMPLIFIER

Printed Electronic Research, Inc., 4212 Lankershim Blvd., North Hollywood, Calif. is now offering an easy-to-assemble, 50-watt amplifier kit which utilizes a deep-etched photoelectronic circuit board to speed construction and eliminate the need for special tools and equipment.

The circuit board replaces all wiring and forms the complete base of the "Peri-50" amplifier. The kit is not only

complete as to all components, including tubes, but even provides the correct type of solder and a soldering iron.

The amplifier has a power output of 50 watts continuous with 100 watts peak. IM distortion is less than 1% at

50 watts, less than .24% at 35 watts, and under .125% at 10 watts. Frequency response is 6 to 60,000 cps ± .5 db, and ± .1 db from 20 to 35,000 cps at any level from 1 mw. to 50 watts.

A free illustrated brochure showing the complete unit and supplying full specifications is available on request.

NEW TONE ARM

Audio Specialties, 13167 Steel Ave., Detroit 27, Mich. is now offering a new tone arm of the radial type. The design of the AS-30 completely eliminates tracking error, according to the company.

The tone arm transports the stylus carriage on precision jewel bearings which provide a good lateral compliance and extremely low lateral starting torque. The arm is engineered in such a manner that the stylus travels the same path established by the cutting head at the time the original master was made.

The arm is designed for automatic indexing of the stylus to the starting groove of 12" records. By raising the arm slightly, the stylus automatically positions itself, when lowered, and the stylus engages the starting groove.

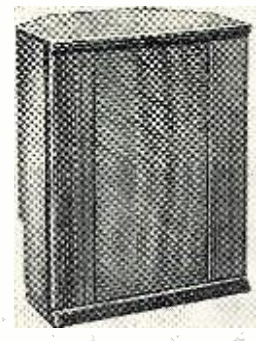
DUAL PREAMP FOR STEREO

David Bogen Co., Inc. of Paramus, N. J. has recently released a moderately priced unit for stereo tape playback applications.

The Model ST-10 incorporates dual preamplifiers and a 10-watt amplifier in a single compact unit, plus volume and tone controls. When used with a tape playback deck, the outputs of the stereo tape head are fed into both preamps. One of these drives the built-in amplifier while the other drives an external amplifier from a cathode follower. Frequency response is flat from 20 to 20,000 cps, ±2 db; distortion is 1% at 10 watts on channel 1 and 2% at ½ volt on channel 2. Equalization is fixed and hum and noise are said to be undetectable.

KLIPSCH-DESIGNED KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has announced the availability of a new line of low-priced, pre-finished speaker enclosures which are being offered in easy-to-assemble, knocked-down form.



Known as the "Quik-Craft" series, these enclosures are of the *Klipsch* corner-horn type. All exposed wood panels of the enclosures are furniture-finished in mahogany or blonde. Models for 12" or 15" loudspeakers are available at the present time.

The cabinets are designed so that they can be assembled with just a screwdriver. All parts are precision cut and there is no need for sawing, sanding, glueing or drilling. Six different versions of the enclosure are available: finished but not assembled 12" and 15"; unfinished unassembled 12" and 15"; and pre-finished and completely assembled 12" and 15". The enclosures are exclusive with this distributor.

CATALOGUES

PHONO AMPLIFIER DATA

The Commercial Engineering Department of *Radio Corporation of America,* Harrison, N. J., has issued a 4-page pamphlet describing a 200 mw. output battery-operated phonograph amplifier using *RCA*-2N109 junction transistors, which is of interest to audiophile.

The publication describes a three-stage transistorized audio amplifier which has been specifically designed for use in battery-operated portable phonographs. When driven by a medium-output crystal or ceramic pickup and operated from a 9-volt supply, the amplifier is capable of delivering 200 mw. output at the 10 per-cent distortion level.

A copy of Application Note AN-169 containing full details and a schematic diagram is available without charge on request.

UNIVERSITY "POWRPAGE"

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. is offering, without charge, copies of a new bulletin which graphically illustrates the wide variety of uses for its new ultra-lightweight portable soundcasting systems.

Details on two "Powrpage" models are included, the PP-1 and the PP-2. The former is a completely weatherproof 7½ pound unit which provides high-power localized soundcasting *via* a speaker that projects sound in any direction, a base stand that can be hung from a nail or hook, and a hand microphone with 11 feet of cable.

The Model PP-2 weighs 4½ pounds and consists of a compact loudspeaker-microphone unit with an easy-grip handle that holds the battery supply and the "press-to-talk" switch. The entire unit is held in one hand and directs the voice in the direction desired.

"AUDIOFILE" CATALOGUE

The *Audiofile* division of *United File-O-Matic, Inc.,* 60 Madison Ave., Hempstead, N. Y. has announced a new catalogue service for high-fidelity, sound, and audio dealers, and distributors.

The "Audiofile" is perpetually up-to-date. It completely catalogues the products of more than 228 manufacturers of high-fidelity and sound equipment in eight product sections: sound systems, tuners, amplifiers, and intercoms; speakers, enclosures, furniture;

microphones, stands, and accessories; phono motors and record players; recorders and recording equipment; recording discs, wire, and tape; pickups and cartridges; and needles.

Alphabetically arranged, each section catalogues the information of all manufacturers producing the respective products. Both catalogue and pricing replacement pages are sent to subscribers as often as necessary.

Complete information and rates on this service are available from the publisher.

BACKGROUND MUSIC EQUIPMENT

Browning Laboratories, Inc., 750 Main St., Winchester, Mass. has issued a new catalogue which provides complete details on its line of background music equipment.

Included are specs on the firm's line of "simplex-multiplex" receivers and tuners for various frequencies, a line of amplifiers for the background music operator, and a new "simplex-multiplex" broadcast monitor and relay receiver.

LAFAYETTE BROCHURE

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is offering a free 16-page brochure which covers a wide variety of equipment of special appeal to the audiophile.

Pictured and described are speaker systems, tuners, amplifiers, and other audio accessories. Copies of the HF-250 brochure may be picked up at any of the company's six hi-fi centers or it will be forwarded by mail on written request. —30—

ROCKY MOUNTAIN ARRL MEET

THE Denver Radio Club, Inc. will play host to this year's Rocky Mountain Division Convention to be held at Elkhorn Lodge, Estes Park, Colorado on June 15th and 16th.

The Club has planned activities for all, including technical talks, transmitter hunt, mobile judging contest, special programs for the ladies, riding, and swimming.

Registration fee is $3.50 per person with a special rate of $2.50 for those whose registration is postmarked before June 4th. Hotel reservations should be made direct with Elkhorn Lodge. Walter M. Reed, WØWRO, 1355 E. Amherst Circle, Denver 10, will supply registration information and other convention data on request. —30—

RAMONA RADIO CLUB MEET

THE Ramona Radio Club, K6SIR, has picked Sunday, July 28th as the date for its annual picnic and hamfest and Barnes Memorial Park, Monterey Park, California, as the site.

Last year 1200 persons attended the event and the committee is hoping for an even larger turn-out this year.

A full and interesting program has been planned with contests, prizes, and fun for all.

The club can be contacted at 717 Anderson Way, San Gabriel, California, or through the club station K6SIR; the club president, Ray Meyers, W6MLZ; or John S. Rice, K6GJV. —30—

Measuring Amplifier Damping Factor

Described here are two methods that may be used to measure the damping factor of an audio amplifier.

THE KNOWLEDGE of what your amplifier's damping factor is has become more important recently. With high-efficiency speakers it was usually felt that the higher an amplifier's damper factor the better this would be for the speaker in damping out undesired resonances. However, with the advent of high-quality, low-efficiency speakers, and especially with such speakers mounted in infinite baffles or other such enclosures that do not add to the bass response, the use of an amplifier with too high a damping factor is undesirable. This would result in overdamping the speaker and reducing its output, especially at the bass end. Perhaps the day is not too far away when speaker manufacturers will specify optimum damping factors for their speakers when used in specific enclosures. Several values might be given for different types of listening tastes. The amplifier manufacturers have already started the ball rolling by providing, in some cases, a variable damping control that allows the user to set the damping factor at whatever value he requires.

At present most speaker manufacturers are quite reluctant to quote any optimum damping factors for amplifiers to be used with their loudspeakers. This is partly due to the fact that not enough experiments have been done along these lines and also that the results obtained at various damping factors is so subjective. Some listeners might like the way their speakers sound with one certain damping factor, others might prefer another value.

Typical values of amplifier damping factor depend, in the main, on the output circuit used. For example, with push-pull triodes without feedback the damping factors are in the range of 2 to 4. With push-pull beam power tubes the damping factor is apt to be less than this unless negative feedback is used. With large amounts of negative feedback, tetrode damping factors may run as high as 10. Recent designs using triodes with feedback or "Ultra-Linear" stages with feedback may have damping factors from 10 to 30.*

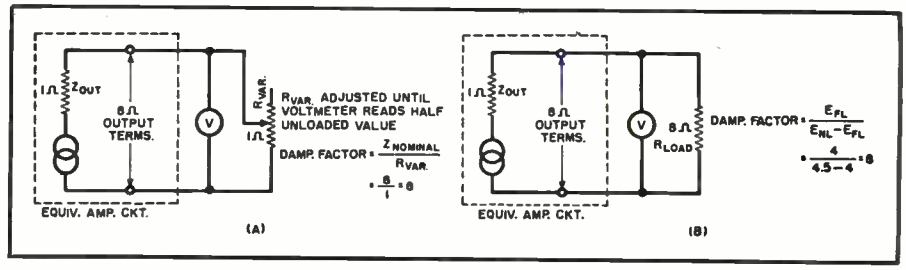
The measurement of an amplifier's damping factor is quite simple. This article will describe two methods of measurement.

Variable Resistance Method

To use this method a signal voltage is introduced into the input of the amplifier to be checked. This signal may come from an audio generator or even from the a.c. heater supply of the amplifier itself. Next the load is removed from the output terminals and the output voltage is measured with a suitable audio voltmeter. The input signal should be kept well below the overload point of the amplifier and below that point that might cause arc-over in the unloaded output transformer. Then a low value variable resistor (the author uses a 15-ohm wire-wound unit) is connected across the output terminals and this is adjusted until the voltmeter reading falls to one-half the unloaded value. Under these conditions the voltage across the variable resistor is equal to the voltage across the actual output impedance of the amplifier. See (A) of diagram. Now the variable resistor is removed and its resistance is carefully measured. This value of resistance is equal to the output impedance (technically, the effective source impedance) of the amplifier. If this resistance value is simply divided into the *nominal* output impedance of the amplifier (the value frequently marked on the amplifier itself), the result is the damping factor. For example, in the diagram shown assume that the value of the variable resistor is 1 ohm and that the measurement is being

* See "Control of Amplifier Damping Factor" by David Hafler in the July, 1955 issue.

Equivalent circuits for two methods described above for measuring damping factor.



made on the 8-ohm tap of the amplifier, the damping factor is 8/1, or 8.

If it is found that the output voltage of the amplifier should rise when the load is applied, then this indicates that the amplifier has a negative damping factor. The resistance value that causes the loaded output voltage to be doubled is equal to the negative impedance of the amplifier.

Several problems may be encountered in using this method. One is that with amplifiers having very high damping factors, it might be difficult to adjust and to measure the very small values of resistance required to make the voltage drop to one-half. Another problem occurs when very low resistances are shunted across the output terminals of an amplifier; the primary impedance of the output transformer falls and the plate current through the output tubes may be excessive. In one case where this method was used, the plates of the output tubes became dangerously red. Another method that will yield the same answer but with none of the drawbacks is described below.

Voltage Regulation Method

To use this method a signal is applied to the amplifier and an output voltage measurement is taken with no load connected. Let us call this no-load voltage E_{NL}. Next, a resistor with a value equal to the nominal output impedance is connected to the output terminals of the amplifier. The amplifier is now properly matched. Then, a second voltage reading is taken under these fully loaded conditions. Call this full-load voltage E_{FL}. The damping factor of the amplifier is simply equal to the full-load voltage divided by the difference between the no-load and the full-load voltage, or $E_{FL}/(E_{NL} - E_{FL})$. This may be recognized as the inverse of the regulation formula. As a matter of fact the damping factor of an amplifier is a measure of its regulation. If, for example, the output voltage falls only a very small amount when the circuit is loaded, its regulation is good (low) and its damping factor is high.

To show that this method gives the same results as the variable resistance method, consider (B) of the diagram. Assume that the same amplifier with its 8-ohm output tap and its 1-ohm output impedance mentioned before is used. Assume further that the no-load voltage measures 4.5 volts. There is no drop across the 1-ohm output impedance with no current flow. With the 8-ohm load connected, the full-load voltage will fall to 8/9 the no-load voltage, or 4 volts, in the simple series circuit. The damping factor then is $4/(4.5 - 4)$, or 8. This is the same value that was obtained with the first method described above.

Obtaining the damping factor, using either of the methods described, may help you to evaluate the performance of your loudspeaker system and it will certainly give you one more important characteristic of your amplifier. —30—

Sound on Tape

By BERT WHYTE

IT IS pleasant to be able to announce that music recorded on tape has grown to such proportions to report on it adequately requires a new column, separate from the "Certified Record Revue." It will be the function of this column to review both monaural and stereophonic tapes which are commercially available and to make introductory comments on all matters pertaining to such recorded tape. This month we'll get right into the reviews. Next month, if plans jell in time, I hope to be able to bring you some technical information on stereophonic sound . . . such as the perception of stereophonic sound and why we hear it as we do . . . important factors in stereophonic sound reproduction in the home, including the effects of room acoustics, and some new ideas on speaker placement. A broad and fascinating subject, this recorded tape! I hope this column will be an effective instrument in helping you in your tape activities, as well as helping the cause of recorded tape in general.

STRAVINSKY
L'HISTOIRE DU SOLDAT
Ars Nova Chamber Orchestra conducted by Robert Mandell. Sonotape SWB8003, stereo, 7″ reel, 7.5 ips. NARTB tape curve. Price $9.95.

As most people probably know, *Sonotape* is a subsidiary company of *Westminster Records*. All the time *Sonotape* has been producing its excellent monaural tapes, its entry into the stereophonic tape field has been eagerly anticipated. At the last New York High Fidelity Show, *Sonotape* demonstrated a group of stereophonic tapes and they were one of the sensations of the show. Now *Sonotape* is in full production and its stereo release program is very ambitious indeed. You can expect that a large percentage of the repertoire which has appeared on *Westminster* discs in the past year or so, will be soon available in the stereo format.

This recording of "L'Histoire du Soldat" is from the first *Sonotape* stereo release and if subsequent tapes are as good, we are in for some rare musical treats! Sensational is not too strong a word to use in describing this recording. It has virtually all the desirable qualities a good stereo tape should possess. First and foremost, the sound is surpassingly clean and free from distortion, a fact which is instantly and audibly apparent. Frequency response and dynamic range are very wide, transient response is superb in its razor-sharpness and lack of distortion. As you will learn in dealing with stereophonic sound, this matter of frequency range and transient response is vitally important in the mechanics and perception of this type of sound. Directionality in this recording was excellent and quite equal to the demands of the score. The "hole-in-the-middle" effect, a common failing of much two-channel stereo, was absent to a most unusual degree. Thus this tape displayed the very open, spacious type of sound that is typical of the best in stereophony. The apparent depth effect was considerable and with the wonderful ability of stereo to "separate" and discriminate between the various instruments, the over-all definition and clarity of tone was astounding.

"L'Histoire" is a piece for a chamber orchestra of rather unusual instrumentation and a work highly effective for stereo recording. Here, again, as in most chamber works, we have the opportunity to reproduce in our living rooms, music which belongs in and which could be contained and performed in a living room. Chamber music reproduced through a very high quality monaural system at the same sound level that would obtain with a "live" performance in an average living room, attains a realism that is almost verisimilitude. Chamber music reproduced through a high quality stereophonic sound system, at the same loudness level as the live performance is as close to that overworked phrase, "on-the-spot-presence", as we are likely to get, barring some fantastic system wherein there is a separate channel for each instrumentalist. Such a system is, of course, economically unfeasible, indeed, one might get the ultimate in realism — the chamber group itself—cheaper than the multi-channel setup!

The *Sonotape* engineers wisely realized the chamber nature of this work and very sensibly used an extremely close-up microphone technique. They also used a moderate amount of reverberation. They can be forgiven for this since they could hardly be expected to know the acoustic conditions which prevail in all homes and thus they logically decided to use the "liveness" advantages of reverb, even though it is generally felt that to simulate a chamber group in the home no reverb should be used at all. Indeed, the subject of reverberation and hall acoustics in stereo recording and reproduction is a very touchy and controversial thing among audio engineers. Some feel that all stereo recording should employ reverb judiciously and that it should be played back in a room which has almost totally "dead", highly absorptive acoustics — others feel that to avoid some of the problems imposed by hall acoustics and reverb, the recording should be as "dead" and non-reverberant as possible and then reproduced in rooms with moderate reverberation times. Both sides have their points, but I personally feel the first approach is the easier to control and the more effective of the two.

Well, back to this recording. Be-

cause of the manner of recording and the intelligent spacing of the instrumentalists, the result is incredibly realistic. Remember, this music is one of Stravinsky's most "modern" sounding works employing all the devices of atonality and dissonance. Yet in spite of this and its seemingly limited appeal for many people, I have been flabbergasted by the number of people who commented on how much they enjoyed the music, after they had heard a stereo demonstration of this recording. That's the impressive thing about a good stereo tape. Most of these people had previously either ignored "modern" music or displayed a distinct antipathy towards it. Most extraordinary of all, the ladies (bless 'em) who usually wince when they hear *any* kind of music, modern or otherwise played at loud levels through a hi-fi system, never even flinched and smiled beatifically when this tape was reproduced at levels far beyond anything they would have previously tolerated! This is a wonderful score and as heard with this marvelous stereophonic sound is an outstanding listening experience.

For hi-fi fanciers there is a terrific sharp brazen cornet, the weighty blare of the trombone, sometimes growly sometimes gutteral — a bassoon and clarinet so pure-toned they have an almost palpable "liveness" — a violin which is played with smoothness and mellowness, with searing intensity, played with pizzicato, spicatto, and numberless other violin gymnastics, a double bass speaking in heavy but clear-voiced accents and percussion that is truly outstanding. There is a bass drum of noble proportion that gives forth mighty "whumps", the coruscating clash of cymbal, the tinkle of triangle and rattling jingle of tambourine and the explosive impact of side drums and the gutty snarl of the snares.

As for the performance of "L'Histoire", Mandell does not imbue the score with as much wit or humor as does Bernstein, for instance, but he gets virtuoso caliber playing from his men and the performance is generally quite good. A quick listen to several disc versions serves to confirm one's judgment of performance, but so strong are the blandishments of this stereo version that it overcomes all possible objections. Don't miss this outstanding tape.

LEIBERT TAKES A HOLIDAY ON THE MIGHTY WURLITZER

Dick Leibert playing the organ of the Byrd Theater, Richmond, Va. Sonotape SWB8012, stacked stereo, 7" reel, 7.5 ips. NARTB tape curve. Price $9.95.

At the opposite end of the pole from the close-up, chamber-sized recording of "L'Histoire", is this brilliant stereophonic organ recording. The sound here is gigantic, both in power and in apparent depth and spaciousness. This is an impressive and enjoyable tape from all musical aspects. From the hi-fi angle this should satisfy the most ardent lover of organ power and thun-

dering pedal. From still another angle, this is an important tape and should be listened to if at all possible. For this tape represents still another departure and innovation in stereophonic recording techniques.

Believe it or not, *eleven* microphones . . . two *Telefunkens,* six *Altec* condenser types, and three special design types were used to make this recording. All these were fed into three *Westminster* six-channel mixers and thence into specially modified *Ampex* stereo recorders operating at 30 ips. Over 3500 feet of mike cable were used to suspend this magnum array of microphones from the auditorium ceiling. The pipe chambers for this organ are wide and shallow and spread across the proscenium arch of the theater, making for a very open and brilliant sound. This extreme width evidently dictated the unusual microphoning. Is it effective? Are the results worth all the trouble? Decidedly so! In spite of the complexity of the organ scoring every voice is beautifully clean and articulate.

The organ here is not the traditional "grand blur", but takes on the fresh and lively aspects of the live instrument. As you might expect, directionality here is extremely good, yet ensemble tone is not adversely affected. The "hole-in-the-middle" here is reduced to insignificance. The sharp and heavy transients generated by the big organ are perfectly reproduced and for owners of really big speaker systems, the pedal will make your house shudder.

Leibert is organist of Radio City Music Hall in New York. and a crackerjack on techniques leavened with fine musicianship and good taste. In eleven numbers like "Laura", "Washington Post March", "All the Things You Are", "Donkey Serenade", etc., Leibert runs the full gamut of organ instrumentation and expression and exploits the dynamic resources of his tremendous instrument. For lovers of the organ, a must!

RACHMANINOFF
RHAPSODY ON A THEME OF PAGANINI
Arthur Rubenstein, pianist, with Chicago Symphony Orchestra conducted by Fritz Reiner. Victor CCS-20, stereo, 7" reel, 7.5 ips. NARTB tape curve. Price $10.95.

Victor, the big name pioneer in the stereophonic tape field, continues to release superb material utilizing its illustrious artists and organizations. It is also using a new stereo recording technique. Now all the recordings are made on *3-channel* tape machines and later in the studio the three channel master is post-mixed and re-recorded for both monaural disc use and for stereo. In the stereo the middle channel is "ghosted" with the two other channels . . . so many db to each of these "outer" channels. This is done to minimize the "hole-in-the-middle" effect, which it seems to do with a fair degree of success, success depending mainly on the type of repertoire.

Musically this tape is a masterpiece by Rubenstein. As I said about the disc recording of this work, it is hard to conceive a better and more positive statement of the "Rhapsody". Stereophonically this is sheer magnificence. Directionality is better than in most other *Victor* tapes and the piano stays "fixed" in its proper position. This is big, lush, romantic sound, not miked too close so that with the hall reverb the apparent depth is considerably enhanced.

As usual, the acoustics of Orchestra Hall in Chicago and the wonderful sound Reiner gets from his superb orchestra make for a very spacious, ultra-live perspective. The piano tone of Rubenstein can be appreciated as never before in reproduced music. Strong and confident, yet clean and pristine of line, it is a thing of rare beauty. The music, of course, is one of Rachmaninoff's finest achievements and when it can be heard so splendidly performed in the full glory of stereophonic sound, one cannot help but be sorry that everyone can't enjoy this in their homes except at considerable expense. It is to be hoped that stereo grows so fast that the means for reproducing it and the tapes themselves are soon brought down to a price more people can afford. Let us hope that this day is not too far off, 'cause it's a shame to miss the fun. —30—

TUNER MODIFICATION

By KENNETH W. BETSH

THE Fisher Models 80R and 80RT tuners contain two tuning meters, one for AM and one for FM. By means of a simple solder connection on the back of the selector switch, the AM tuning meter serves as an FM signal-strength meter. The regular FM meter indicates discriminator balance-center of channel tuning in these two tuner units.

A section of the switch opens the AM meter circuit on FM. Two contacts are used. They can be easily identified because one goes directly to one terminal of the meter. The other switch contact is right beside the other. These two are the only white wires in the area. To defeat the switch, merely solder a link between the switch contacts.

The meter is tied to the "B+" leads of the first and second i.f. stages. Since the same tubes act as i.f. amplifiers on both AM and FM, similar action occurs on both bands. Meter reading corresponds to reduction in plate current of the second i.f. by limiting. To prevent overdriving the meter, its other lead goes to the first i.f. "B+" (the end where on real strong signals the first i.f. plate current decreases).

This meter is in a strictly d.c. circuit and does not affect the sensitivity of either AM or FM. The writer has used this for several months with no effect on the tuner.

This added meter function is ideal for positioning a rotatable antenna. However, for extremely weak signals that are just audible, so little deflection is shown that the meter does not serve a useful purpose. The author suspects this to be the reason the manufacturer did not do this. All signals that limit to any degree to be listenable register between ½ and 5 on the meter. —30—

The "Xophonic"

(*Continued from page* 57)

been noted by audio hobbyist and layman alike. These tests have proven that the reverberation effect is not dependent on the relative placement of the main speaker and "Xophonic" system within a room. This was to be expected, as the acoustic delay is completely in the reverberation unit.

An interesting "*A-B*" comparison between a system providing "location" effect and an "Xophonic" system was made in our sound laboratories. A two-channel recording was used as the source material in the "*A*" position of the comparison switch, and this was reproduced through a pair of identical amplifiers into two matching speakers. The placement of the speakers was carefully chosen to provide the best feeling of orchestral "location." In the "*B*" switch position, the two original channels were mixed to provide the normal monaural source. This was reproduced in one of the speakers, and also by the "Xophonic." In this way, an immediate-comparison "*A-B*" test was made between a two-channel system and "Xophonic" sound.

The result of the comparison was as follows: 6% of the listeners could not distinguish between the two-channel reproduction and "Xophonic" sound; 94%, however, were able to differentiate between the "location" effect and the reverberation effect of "Xophonic" reproduction. What was significant was that, although all agreed that both systems were very pleasing, 65% of the listeners actually preferred the reverberation effect to the "location" effect of the two-channel system.

In the second phase of this test the effect of changing relative speaker positions was evaluated for each system. It was found that if the matching speakers of the two-channel system were placed in moderately close proximity, this system completely lost its effectiveness and the preference became unanimous in favor of the reverberation effect. On the other hand, the main and "Xophonic" speakers could be placed side-by-side with no apparent loss of effect.

One noteworthy feature of the unit is that it does not depend on special recordings or on two-channel broadcasts, but can be used with any standard disc or tape recording, or with any standard broadcast, AM, FM, or television. Secondly, it is not necessary to discard existing equipment since this unit can be used with any sound system irrespective of manufacturer or type; in fact, it can be used in conjunction with a hi-fi system, a phonograph, radio, tape-player, or a television set. Finally, the reverberation effect is not dependent on placement of speakers, room acoustics, etc. Thus, the listener is free to arrange the equipment to suit his own convenience without regard to unusual and critical speaker placements. —30—

SR-200 Control Amplifier

(*Continued from page* 51)

like that Crowhurst[3] recently pointed out with regard to microphones. An electronic device that varies source impedance with the frequency, when handling a multitude of frequencies may very well accurately follow the static complementary response of the loudspeaker system; but what is not taken into consideration is the fact that when the signal is a complex of frequencies, and dynamic as well, the decay rates for the boomy speaker system are entirely different from the decay rates of the amplifier. The amplifier with variable damping is always damping with regard to its incoming signal; while the loudspeaker system is thousands of milliseconds behind, resonating as much as ever. In *extreme* cases, the "mush" that results is worse than if the speakers were in an undamped state. The only real solution to speakers that have a high resonance (and carefully designed speakers need not have such peaks) is either a horn that *acoustically* damps the peak out, or some sort of resistance unit like Villchur's[4] that also damps acoustically. But for those who insist on using speaker systems that are not either inherently low resonance or *acoustically* damped, the best solution is the tunable, notched low-frequency filter control supplied in the SR-200, which can be adjusted so that the amplifier simply does not respond to the offending frequencies, thereby eliminating the boom and distortion that results from an amplifier trying to drive a speaker when badly mismatched.

Various types of tone controls circuits were tested, and while feedback types were found desirable from low distortion considerations, all had other objectionable characteristics: some peak badly in the 40 kc. range, others cannot be made to give a true "flat" response, while most were found to affect each other (bass boosting caused some treble boosting, etc.). And it was felt that the mid-frequencies should definitely be unaffected. A very conventional circuit was therefore chosen, primarily for its very high degree of accuracy and stability; and by driving the associated voltage amplifiers only moderately[5] the resultant distortion is quite low.

The preamplifier is an all-triode design, using feedback exclusively as a means of equalization. Even though the distortion created by using "T" type equalizing networks is small, it was felt that in such low level stages as these, distortion must be kept as close to non-existent as possible.

Inputs (with separate incoming volume controls) for all types of equipment that are likely to be associated with this amplifier are provided: tuner, tape, TV, crystal, FM pickup, etc. Provision for input direct from a tape head is included. Output for recording into a tape recorder is also available.

Extensive testing of output tubes revealed the clear-cut superiority of the EL34/6CA7 type, even though the rated power desired was but 25 watts. Distortion content was considerably lower with this tube than with any other type. As is well known, the EL34/6CA7 is usually found in 50-watt amplifiers, but with somewhat lower plate voltages, it is able to loaf along at 25 clean watts, resulting in long life and extreme reliability.

Hum and noise are kept to a maximum of 60 db below full output on phono channels, and 70 db below full output on all others. Careful layout of critical sections, chassis shields, and high-grade transformers that have very low radiated field characteristics make the use of d. c. on the filaments unnecessary.

The chassis is of 18 gauge steel, cadmium plated to prevent rusting. Special heat dissipating plates are employed to make the whole unit run within component manufacturers' tolerance, and yet be of such dimensions that the modern, functional styling was possible. Cabinets are of solid woods (either walnut, mahogany, or birch), hand crafted and finished with five coats of lacquer, each hand rubbed. The brass front plates are acid-etched and permanently treated with special chemicals to make the lettering literally un-removable. The total unit weighs 23 lbs.

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—30—

MOUNTAIN OBSTACLES BOOST RADIO, TV SIGNALS

METHODS for using high mountains between a radio or television transmitter and receiver to improve, rather than hinder, the reception of u.h.f. signals were described recently by R. E. Lacy of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. An extensive series of tests made at forty different locations in California has verified that sharp mountain peaks blocking the transmission path will actually strengthen the signal on the other side by a process much like the diffraction of light rays when passing by the edges of opaque objects. Tests were conducted over a wide range of frequencies above 50 mc.—the range used for television and communication services.

The phenomenon, technically known as "obstacle gain," was first noticed by American GI's during the Korean War who discovered that radio reception was unaccountably improved in the mountainous terrain of Korea.

The information gained from the tests makes it possible to compute the "obstacle gain" accurately and to locate transmitting and receiving sites to take advantage of the diffraction phenomenon described above. —30—

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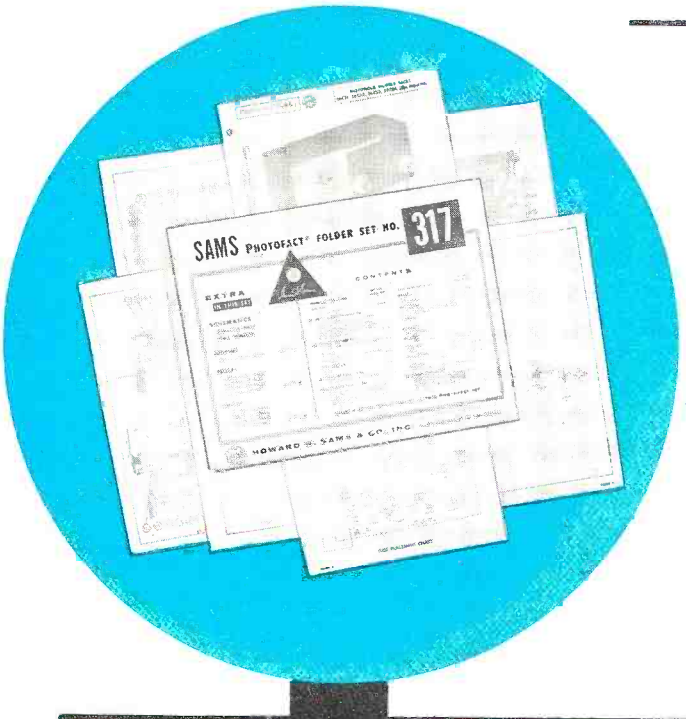

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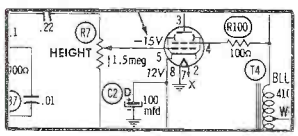
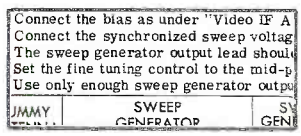


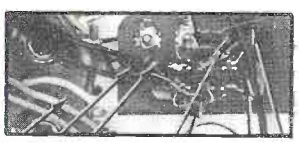
Famous "Standard Notation" uniform symbols (exclusive with PHOTOFACT) are used in every schematic. Diagrams are large, easy to read and handle. Waveforms and voltages are shown right on the schematic for fast analysis. Transformer lead color-coding and winding resistances appear on the schematic. Schematics are keyed to parts lists and to parts on chassis photos.

Alignment Instructions



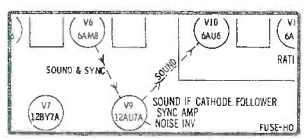
Complete, detailed alignment data is standard and uniformly presented in all PHOTOFACT Folders. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

Full Photographic Coverage



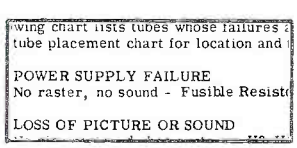
Photos of all chassis views are provided for each model (exclusive with PHOTOFACT); all parts are numbered and keyed to the schematic and to the parts lists for quicker parts identification and location.

Tube Placement Charts



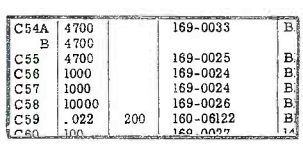
Both top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

Tube Failure Check Charts



Shows common trouble symptoms and tubes generally responsible for such troubles. Series filament strings are schematically presented for quick reference.

Complete Parts Lists



Detailed parts list is given for each model. Proper replacement parts are listed (with installation notes where required). All parts are keyed to chassis photos and schematics for quick reference.

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2	32	62	92	122	152	182	212	242	272	302	332
3	33	63	93	123	153	183	213	243	273	303	333
4	34	64	94	124	154	184	214	244	274	304	334
5	35	65	95	125	155	185	215	245	275	305	335
6	36	66	96	126	156	186	216	246	276	306	336
7	37	67	97	127	157	187	217	247	277	307	337
8	38	68	98	128	158	188	218	248	278	308	338
9	39	69	99	129	159	189	219	249	279	309	339
10	40	70	100	130	160	190	220	250	280	310	340
11	41	71	101	131	161	191	221	251	281	311	341
12	42	72	102	132	162	192	222	252	282	312	342
13	43	73	103	133	163	193	223	253	283	313	343
14	44	74	104	134	164	194	224	254	284	314	344
15	45	75	105	135	165	195	225	255	285	315	345
16	46	76	106	136	166	196	226	256	286	316	346
17	47	77	107	137	167	197	227	257	287	317	347
18	48	78	108	138	168	198	228	258	288	318	348
19	49	79	109	139	169	199	229	259	289	319	349
20	50	80	110	140	170	200	230	260	290	320	350
21	51	81	111	141	171	201	231	261	291	321	351
22	52	82	112	142	172	202	232	262	292	322	352
23	53	83	113	143	173	203	233	263	293	323	353
24	54	84	114	144	174	204	234	264	294	324	354
25	55	85	115	145	175	205	235	265	295	325	355
26	56	86	116	146	176	206	236	266	296	326	
27	57	87	117	147	177	207	237	267	297	327	
28	58	88	118	148	178	208	238	268	298	328	
29	59	89	119	149	179	209	239	269	299	329	
30	60	90	120	150	180	210	240	270	300	330	

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Certified Record Revue

(*Continued from page 62*)

his well-known reputation for success in conducting modern repertoire, Ansermet would certainly seem a logical choice. Yet I'm sorry to say that his reading is somewhat of a disappointment. And it is a pity, because there are so many other things to admire in the recording. Oh, all the notes are in the right places, but the over-all effect is lifeless. Why a conductor as astute in the ways of modern music as Ansermet would choose such slow tempi and conduct with such deliberation is really puzzling. I grant that the scoring calls for clarity and maximum articulation, but not at the expense of life and spirit.

Soundwise this is one of *London's* most stellar efforts, and Ansermet had evidently been building his orchestra up to this work, for I have never heard them play so well. Summing up . . . this will have its share of buyers for the excellent sound, as well as loyal adherents of Ansermet, but will not supplant several previous editions in the eyes of Bartok enthusiasts.

DVORAK
SYMPHONY #5
RIAS Symphony Orchestra conducted by Ferenc Fricsay. Decca DL9845. RIAA curve. Price $3.98.

There are now twenty versions of this popular work, and to the hi-fi fan and the classical music enthusiast, this is a most confoozin' situation! Of all these recordings which shall he buy? I would say that choice is largely dependent on individual temperament, education, and attitudes. What version appeals to the sound nut, may not necessarily stimulate the more musically erudite, and *vice versa*. Generally the Kubelik and Toscanini readings have been most successful from the sound and performance standpoints. This edition with Fricsay now must be given room at the top of the list. Here, in fact, is a reading that will have appeal for the connoisseur. The performance is powerful, well integrated and, above all, songful and unashamedly sentimental. It has more of the "folk" approach than the other versions, yet with all this "gemutlichkeit" and sentiment, Fricsay never oversteps the bounds of good taste. With the superb playing and beautifully balanced orchestration, and with fine clean sound of the "big hall" large-acoustic-frame type, this should satisfy the desires of many music lovers.

STRAUSS, RICHARD
DEATH AND TRANSFIGURATION
TILL EULENSPIEGEL
Vienna Philharmonic Orchestra conducted by Fritz Reiner. Victor LM2077. RIAA curve. Price $3.98.

This recording is one of the first fruits of the new association of *Victor* with *London* (English *Decca*) *Records*. What a combination for the music of Richard Strauss . . . Reiner and the Vienna Philharmonic! The results are as good as you might expect. I have never heard "Death and Transfiguration" so magnificently performed as on this disc. The eerie scoring and the way Reiner builds his tensions will make the hair on the back of your neck rise! "Till Eulenspiegel" is somewhat less successful, as Reiner drives a little too hard and loses some of the pathos of the work. But I quibble, for otherwise his "Eulenspiegel" is exemplary. Soundwise, this is typical of *London* recordings of the Vienna Philharmonic except for a somewhat closer perspective favored by the *Victor* engineers in their quest for greater orchestral definition. This is a huge sound, dark and rich, smooth of string and powerful of brass and percussion. The acoustics are superbly "live"

sounding. The Vienna orchestra plays with great precision and tonal beauty for Reiner and I must say they sound as good under his baton as any conductor since the late Clemens Krauss. I believe these performances were also recorded stereophonically and if true, the "Death and Transfiguration" should be overwhelming. I am drooling in anticipation! Don't miss hearing this reading of "Transfiguration".

ANDERSON, LEROY

MUSIC OF LEROY ANDERSON
Eastman Rochester Pops Orchestra conducted by Frederick Fennell. Mercury MG50130. RIAA curve. Price $3.98.

Well how about this! Freddie Fennell, the young conductor who has made such a tremendous impression with his notable series of band recordings for *Mercury* has entered the "Pops" sweepstakes and is already a front-runner! This boy really has talent which is easy to discern in his readings of works by the popular LeRoy Anderson. In such classics as "Sleigh Ride", "Trumpeter's Lullaby" and the "Sandpaper Ballet", to name a few of what is on this disc, he shows that he knows how to handle strings as well as his beloved brass and percussion. His tempi are well-chosen, his phrasing and dynamics neatly expressive. Fennell is, above all, never heavy-handed and he lets the essential humor and grace of the works speak for themselves.

On the flip side of the disc is Anderson's wonderful arrangement of traditional Irish tunes in what he calls the "Irish Suite". Faith now, oi didn't know Fennell was a Hibernian, but how can it be otherwise with him givin' a lovin' performance of the Suite and him wearin' a foine green jacket in his picture which adorns the record shuck! In matters of sound, I venture to predict that this disc will be widely used for demonstration in sound rooms. With the almost universally liked repertoire coupled with strings which are smooth and edgeless, yet bright and incisive, the very "forward" projection of the weighty brass, the mellow sweetness of the woodwind, and the impact and clean articulation of the percussion, this is a sure thing. In the "Sandpaper Ballet" the sandpaper blocks furnish a superb test for high frequencies. As usual with *Mercury*, the frequency and dynamics are ultra-wide, acoustic perspective is that magic blend of live spaciousness and fine orchestral definition. Don't miss this one.

MOZART

MASS IN C MAJOR (CORONATION)
Maria Stader, soprano; Sieglinde Wagner, alto; Helmut Krebs, tenor; J. Greindl, bass; with choir of St. Hedwig's Cathedral, Berlin.
SYMPHONY #38 (PRAGUE)
Berlin Philharmonic Orchestra conducted by Igor Markevitch. Decca DL-9805. RIAA curve. Price $3.98.

The "Prague" symphony receives a fine performance at the hands of Markevitch, but the plum on this disc is the superb "Coronation Mass". This is the second recording of the Mass to appear on LP, the first being an ancient *Haydn Society* effort, too old now especially in sonic terms, to challenge the splendor of this new edition. For those not familiar with this Mass or any of Mozart's choral work, I urge you to become acquainted with them. This is music making on an exalted plane, profoundly beautiful and moving and at the same time highly exciting. This "Coronation Mass" is the easiest of all to assimilate at first try. The performance on this disc is remarkable for the obvious zeal of the participants.

The soloists are of very high caliber, with a special bow to the lovely-voiced Maria Stader. St. Hedwig's Choir sings with proper reverence and what they lack in control they make up in enthusiasm. The instrumental

sections are expertly integrated with the vocal elements. Soundwise, the Mass was evidently recorded in a large Cathedral and as might be expected under this circumstance, there is some choral/orchestral blur and fusion. However, the acoustic perspective is one of the larger attractions of the disc as it is a completely authentic setting for the score. Here is that ultra large, highly reverberant sound, that achieves a liveness suited to the music. Sound is generally quite clean, with wide dynamic range. All in all, a superb recording of some of Mozart's finest music.

TCHAIKOVSKY

SYMPHONY #4

Leningrad Symphony Orchestra conducted by Kurt Sanderling. Decca DL-9879. RIAA curve. Price $3.98.

This recording is actually part of a three-record album entitled, "The Last Three Symphonies of Tchaikovsky", all performed by the Leningrad Symphony Orchestra under its conductors Sanderling and Mravinsky. However, *Decca* has wisely made them separately available for those who can't afford the tab on the big album. This is the first chance we Americans have had to hear an Iron Curtain orchestra recorded with high-fidelity sound. Or more properly I should say Russian orchestra, because the Czech Philharmonic and several other orchestras have had the benefits of good hi-fi recording. As far as this version of Tchaikovsky's rampant warhorse is concerned, it is strictly sensational! For one thing, the *Deutsch Grammophon* engineers have furnished a sound of the big, over-all type they favor of compelling realism. For another thing, all the reports one has heard about the excellence of the Leningrad Orchestra are most certainly confirmed. This is indeed a virtuoso group with a huge lush string tone, brass that is very full and weighty, percussion of notable accuracy. Only in the woodwind did the orchestra seem to be a little weak, as a good deal of the intonation was on the thin side. Sanderling is a conductor who, on the basis of what we hear on this disc, must be considered a master of the Tchaikovsky medium. Not since the old Koussevitsky days have I heard a performance that is so unabashedly romantic. This is a big, full blown reading with soaring strings, huge climaxes. The tempi essayed by Sanderling are moderate giving him plenty of time to exploit the resources of his orchestra. This simply exudes drama, or perhaps it should be called melodrama. At any rate, it is a refreshing change from the dry, hurried treatment with tragic overtones favored by so many conductors. Try this for a new view of Tchaikovsky.

Although it has become quite *de rigueur* for the musical sophisticate to sneer at Tchaikovsky and those who enjoy his music, there is something to be said for a well-loved and familiar piece. Only through repeated hearings is it possible to extract all of the meaning of any given selection—and if such a piece is easy on the ears, so much the better. If this is a "warhorse" it is a "favorite" and one likely to remain in the running for a long time to come—no matter what other entries make the race.

BALAKIREV

SYMPHONY #1 IN C MAJOR

Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Angel 35399. RIAA curve. $3.48 standard package.

Leave it to Sir Thomas to champion the unusual! Without the attention of someone of the stature of a Beecham, worthwhile music like this spritely first symphony of Balakirev would go unnoticed. In this first LP recording, we have a work which was begun while Balakirev was a young man and was not finished until he was quite old. He had very little formal music training and yet as a member of Russia's "Mighty Five" . . . Cui, Borodin, Moussorgsky, and Rimsky-Korsakov, he came under many influences, a fact which is reflected in the character of this symphony. The scoring is as you might suspect, fairly exotic with more than a touch of orientalism. Highly listenable, it contains much that will delight the hi-fi ear, with extensive use of brass and percussion. Sir Thomas and his superb orchestra create some lovely sounds in their sparkling performances and the *Angel* engineers have contributed one of the best recordings yet heard on this label. All is wide in frequency and dynamic transient reproduction is literally distortionless, acoustic frame permits of a very live sound. Highly recommended.

BEETHOVEN

SYMPHONY #3 (EROICA)

Berlin Philharmonic Orchestra conducted by Eugen Jochum. Decca DL-9865. RIAA curve. Price $3.98.

To those who may groan and wince and proclaim loudly that they've had their fill of "Eroica" recordings, let me recommend a listen to this disc. The performance is quite outstanding, ranking with the Klemperer and Toscanini as the best yet produced. Jochum in his reading is strictly no nonsense . . . there are no idiosyncrasies or temperament to contend with, no mannerisms to detract from one's enjoyment. The treatment is about as straight-forward as you will find but the success of the interpretation lies in the unerring musicianship of Jochum. His tempi, phrasing, dynamics . . . all show a deep understanding of the music's values and tensions of the score. Add

the virtuoso playing of the Berlin Philharmonic, sounding as close to their pre-war eminence as I've heard, and wrap all this in hugely sonorous sound of the "big hall" full bodied, yet highly detailed type and this is an outstanding listening experience.

STRAUSS, JOHANN, JR.
GRADUATION BALL
MEYERBEER
LES PATINEURS
Ballet Theatre Orchestra conducted by Joseph Levine. Capitol P-8360. RIAA curve. Price $3.98.

One of the most delightful ballet recordings to appear in some time, this features the by-now-familiar arrangement Antal Dorati made of Strauss pieces . . . called "Graduation Ball" and the late Constant Lambert's equally famous derivation from two Meyerbeer works, "Les Patineurs". Levine gives a fine performance of these scores . . . poised, very glossy, and above all spirited and full of animation.

ALBANESE SINGS PUCCINI
Licia Albanese, soprano. Victor LM-2033. RIAA curve. Price $3.98.

Here in a potpourri of arias from such Puccini operas as "Madame Butterfly", "Tosca", "Turandot", "La Boheme", and "Manon Lescaut", Licia Albanese gives us ample evidence of her particular flair for the works of this composer. Albanese has in abundance two qualities all good opera singers must possess . . . a beautiful voice and the ability to act. Hers may not be the most steady of voices, nor has she the strength of some others, but in her vocal projection and her inherent sense of the drama of these works she makes for very exciting listening. One has but to listen to her heart-rending version of "Un bel di Vedremo" from "Butterfly", to confirm this. With the high order of singing and the generally clean, well-balanced sound, this is a "must" for the opera lover.

BACH
SEVEN TOCCATAS
FOUR FANTASIAS
Agi Jambor, pianist. Capitol PBR-8354. RIAA curve. Price $7.96. Two discs.

Encouraged by the excellent reception afforded Agi Jambor's two-disc album of the Bach "Clavier Partitas", *Capitol* has boldly ventured another multiple disc album, to display her considerable talents. I must say I am impressed even more by Jambor's reading of these fascinating Bach "Toccatas and Fantasias", than I was with her handling of the "Clavier Partitas". Her playing, although technically unexceptionable, was a shade too mechanical in the "Partitas". Here she retains the technical facility, but somewhere along the way she has found the key to much greater warmth and more expression in her playing. With the dazzling brilliance of these superb Bach works and well-modeled, clean-lined piano sound, this is a treat for all Bach enthusiasts.

RHYTHMS OF THE SOUTH
Edmundo Ros and his Orchestra. London LL1612. RIAA curve. Price $3.98.

With all the accent these days on mambo, cha-cha-cha, and calypso, this new *London* disc should meet with much favor. A collection of tunes, some familiar and Latin such as "Siboney", "Isle of Capri"; and others familiar but transposed to Latin rhythms such as (believe it or not!) "The Blue Danube" and "Barcarolle". You will find just about every Latin rhythm represented here in very tasty and original arrangements. Ros is noted for this type of music and his orchestra is a top-notch ensemble. The sound is really terrific, with heavy accent on percussion of which there is a large and unusual variety. About the highest "fi" available with a Latin beat and an outstanding record. —30—

Coded Stereo

(*Continued from page 61*)

by varying one or more of the components in the circuit. I have developed a simple circuit for this purpose which gives quite good waveform and requires a lower plate current supply than the original circuit. This helps with the design of the power supply for the system.

Question 6. Are there any steps that can be taken to reduce the cost of this system, or to improve its performance?

This question really summarizes what many readers have asked in different ways, and with different specific suggestions. Editorial limitations prevent my going into any detail to answer these here. The high-voltage supply, as given in the original article, was only just sufficient for the requirements of the system as described. But several readers are interested in extending the system to include ideas of their own, and then they run into difficulties in getting enough "B+" supply conveniently.

Accordingly, to help this problem, I have gone over most of the sections of the system and redesigned them using different tubes and circuits, making very small plate current demand. As it is not practical to devote the large amount of space that would be required, we are preparing this information so it can be sent out on mimeographed sheets, to give the readers who are interested in pursuing the matter further the information they will need.

It still is not practical to give complete constructional details—chassis layout, drillings, detailed parts lists, and data of that nature, because of the variety of ways in which individual readers want to build this thing. But the data offered in this way will be sufficient for any reader who can work from a schematic, and will include details on setting up the complete system, to make it work, and answers to many questions that have been asked about different aspects of the system, that we do not have space to answer here. As a reader service, we are making this data available for a nominal cost of $1. This should be sent directly to the author at 150-47 14th Rd., Whitestone 57, N. Y.

Some of these changes will reduce cost. But it is still an experimental system. The real possibilities in cost reduction would come if and when it is designed for the consumer market. Then the whole system would be packaged into one unit, like a TV chassis, and the author foresees the *possibility* of this taking place in a unit that will not cost very much more than a single channel system of today. Coded stereo recordings need cost *no* more than the equivalent program time in single channel. But whether this all comes about is not entirely a matter of "engineerability," so we cannot prognosticate in this realm. —30—

Monitoring Short-Term Intermittents

By **JAMES A. McROBERTS**

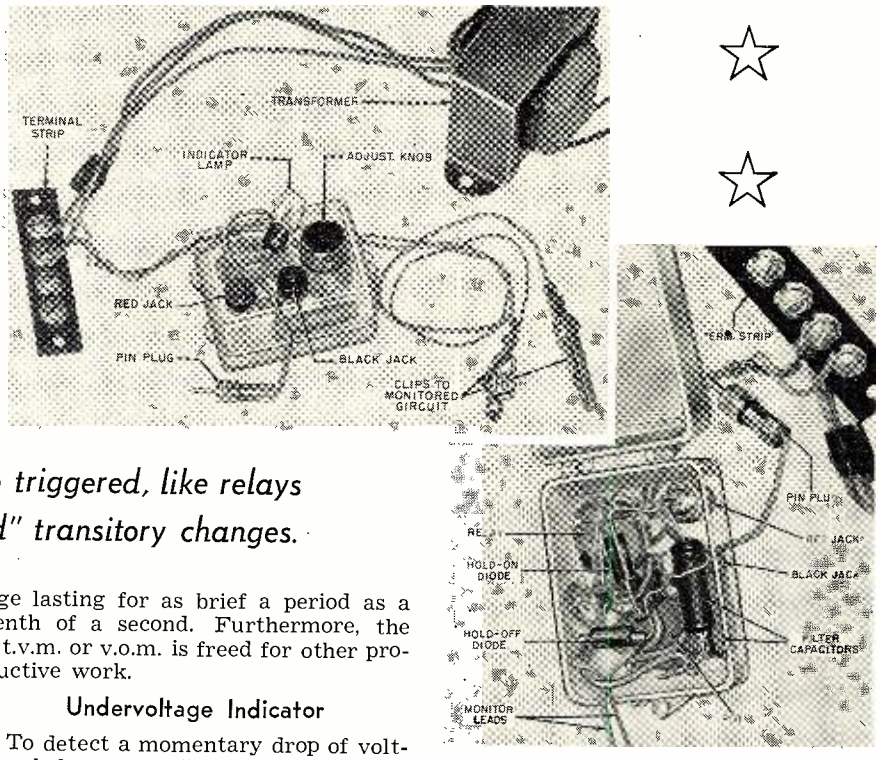


Fig. 1. These two views show the layout of the latching-monitor circuit, rendered schematically in Fig. 6, after it had been built into a compact, plastic case, which accommodates all parts except the transformer, terminal strip, plug, and leads. It is more convenient to have the last three externally available.

Simple devices that can be triggered, like relays or neon lamps, will "record" transitory changes.

MONITORING a suspected circuit with a voltmeter or ammeter is the classic method of trouble-shooting intermittents. The intermittent condition may be excited by vibration, heat, and surges, and the meter reading is noted. A change—or lack of a change—is interpreted. For those cases in which the intermittent lasts long enough, such monitoring pays off.

Unfortunately, some intermittents occur so infrequently, or are of such a short duration, that any meter change escapes notice. Either no information or faulty data may be noted. The technician may then proceed to some other section believing the faulty stage OK. Or, the trouble may be of the once-an-hour type, which cannot be watched continuously with profit. For these jobs a monitor with a more permanent indication than a meter provides is both desirable and profitable. If the intermittent trouble affects a particular section being monitored, then it should leave some definite, tell-tale sign of that fact.

Permanent Indicators

For those once-in-a-long-time cases, multiple monitoring of several points is the most feasible approach. Here an indicating or recording monitor rather than a meter immediately settles the question of which circuit(s) changed. Such "annunciator" type monitors stay put while the observer walks a few feet to inspect them.

Two very simple circuits are shown in the schematics of Fig. 2. Both the relay and the neon versions can serve as indicating monitors for many applications where an improved type, to be described later, is not required. With the variations noted, these monitors can check an intermittent TV set's several "B+" busses, boosted "B+," audio output, drive to the CRT, horizontal-output drive, vertical drive, and other points simultaneously. These indicators may be employed wherever the circuit will permit the current drain, which is quite low. Their advantage lies in the fact that they will indicate intermittent rise or fall of voltage lasting for as brief a period as a tenth of a second. Furthermore, the v.t.v.m. or v.o.m. is freed for other productive work.

Undervoltage Indicator

To detect a momentary drop of voltage below some "normal" value, the pot forming the series resistance of Fig. 2A is adjusted so that the relay is energized and then turned *almost* to the point where the relay armature drops out.

Any significant decrease in the voltage being monitored will decrease current through the relay coil, and the armature will drop out under spring tension. The normally closed contact will now be released, and connection is made to the upper contact which can be wired to a lamp and transformer, as shown, to provide indication. Or, if the relay is monitoring the audio-output or picture-tube drive, it could be wired to ring a bell to indicate that an intermittent had occurred. In this arrangement, the technician checks the other relays on different circuits to ascertain visually which has been tripped or has failed to trip on that intermittent. Then he can move the relays to a new set of circuits to be tested, if necessary.

The reason for the recording action of the relay lies in the difference between the relay's pull-in current and its drop-out current. The latter is always lower. This prevents a tripped relay from closing again when the intermittent clears up. Two recommended relays have the following factory characteristics in this respect: The *Sigma* "4F" pulls in at 1.5 ma. (12 volts across its 8000-ohm coil), but drops out at 0.75 ma. (6 volts across the coil). The *Argonne* Jewel pulls in at 1.4 ma. (7.2 volts across its 5000-ohm coil) and drops out at 1.2 ma. (6 volts). The Jewel is smaller and less expensive than the *Sigma,* but does not have the *Sigma's* ease of adjustment.

A relay can be adjusted for different current ranges as well as different pull-in and drop-out points. Range is adjusted by the retracting spring. Adjustments of the fixed points change drop-out (adjust normally closed contact) and pull-in (adjust normally open contact). Do not make any adjustment that allows the armature to touch the core pole, else the relay may stick.

Overvoltage Indication

Relays can also indicate either momentary or prolonged overvoltage. Adjust the pot to bring current through the relay to just below the pull-in value. Any surge or overvoltage will now pull in the armature. It will hold, in most cases, after the overvoltage drops back to normal, because of the differential between pull-in and drop-out values. In some cases, however, the return to normal voltage is low enough so that the relay will not hold. Such cases are fortunately rare.

Checking Actuating Points

The circuit of Fig. 3 may be utilized to check hold-in and drop-out points. A 22.5-volt battery in series with the relay input circuit and a milliammeter (0-3 to 0-5 ma. preferred) permits easy adjustment of the hold-in and drop-out values. Marks may be made for the various points on the potentiometer knob. The milliammeter can be left in the circuit if it is inserted between the coil and the series potentiometer. (A bypass capacitor may be required in some applications involving rectified a.c. through the meter.)

Neon Indicator

A neon glow lamp, type NE-2, can

be utilized as a monitor instead of a relay, as is shown in Fig. 2B. The neon indicator is less expensive than the one using the relay, and employs a simpler circuit. Its operating voltage is much higher, however. The NE-2 draws about 0.66 ma. at 60 volts. Like the relay, it has a higher striking (lighting) voltage than its normal value and extinguishing voltage. The adjustment for detecting a surge is just under the striking voltage. For monitoring a drop-in voltage, set at a trifle above the extinguishing point, or drop-out, as in a relay.

A.C. Monitoring

In the circuit of Fig. 4, a crystal diode rectifies a.c. from a signal source and applies this to the relay coil through an *RC* filter. Adjustment for operating points is the same as for straight d.c. service. This arrangement is good for checking grid drive, CRT drive, audio drive, etc., whenever a constant signal is supposed to be present. Use an oscillator to furnish this constant video or audio input to some previous point in the set.

Current Applications

To monitor current, the relay is inserted in series with the circuit broken at "X" in Fig. 5. The potentiometer is now used as a shunt across the coil. Decreasing its resistance decreases the current through the coil. Operating points for over- and under-current monitoring are set similarly to voltage duty with this exception.

Latching Circuit

For some critical applications, more positive latching may be desired. A circuit that will provide this is shown in Fig. 6. This circuit was actually built, using a Jewel relay, inside of the transparent plastic shipping case for the relay. Use of small parts of the type now readily available for transistorized circuits enabled this compact construction, which is shown in Fig. 1. The transformer cannot be included in the plastic container.

The function of the transformer is to supply a voltage to the diode(s). The diodes rectify this a.c. voltage, the output of the two rectifiers being in opposite polarity with respect to each other. After filtering by the capacitors, the d.c. voltages produced by these diodes become available at the output jacks. The pin plug is then used to select either a positive (red jack) or negative (black jack) voltage to be used as a holding voltage for the relay, depending on existing conditions.

Thus, whenever the relay armature swings to the energized position, inserting the pin plug in the red jack will supply an augmenting voltage. If the condition in the external circuit were such that the relay were in the dropped-out state, connecting the pin plug to the black jack would apply a negative voltage to the coil to re-inforce the dropped-out condition. With both voltages thus pulling the relay in the same direction, it would take a substantial change in voltage in the opposite direction in the circuit under test to cause a reversal of the armature's position. While the circuit is polarized, all that is required to permit the monitoring of a negative voltage is the reversal of the connecting leads.

Do not try to make any relay adjustments with the local power supply on. During such adjustment, both fixed contacts may touch the moving contact at the same time. This may destroy one or both crystal diodes. Similarly, some spacing must be left so the armature is not frozen between the two fixed contacts—a slip of thin paper is a good test gauge.

Two 220-ohm resistors have been added in series with each latching diode to limit current in case the "Bantam" electrolytics become deformed due to idleness. The pilot lamp has been shown with two optional connections to either (but not both) fixed relay contacts. Employ whichever causes the lamp to remain lit during normal operation. Back voltage through an unlit lamp may influence operation of the latch.

The dial lamp may be used with either fixed contact. A 12-volt transformer with a 12-volt bulb is preferable to the 6-volt system shown because of the greater value of latching voltage available to buck out or augment the signal voltage in maintaining the latch either off or on.

In use, the circuit is adjusted with the pin plug not connected to any jack, in a manner similar to that used for the simple relays of Fig. 2. Then the pin plug is inserted into either the red or the black jack, as required: The red jack supplies a positive voltage to augment a positive voltage from the monitored source to hold the armature latched on. The black jack supplies a negative voltage to buck the supply to the relay coil to hold the relay off except with a very sudden following surge.

The added latching voltages are also fed into the circuit under test through the series resistance. They may upset the operation of the equipment even though it is normal. The effect may be eliminated by unlatching the relay through removal of power to the transformer (pulling the plug) or by pulling the pin plug on the relay. Some leakage may still occur through one of the "Bantam" electrolytic capacitors, although this is slight.

The relay, its control, and the latch components have been made into one case so that a number of these may be driven from a common low-voltage a.c. latching current supply. The terminal strip facilitates connection of additional units.

As with the simple relay, the monitored voltage (if it is a.c.) may be rectified by a crystal diode and then applied to the relay coil through a rudimentary *RC* filter. —30—

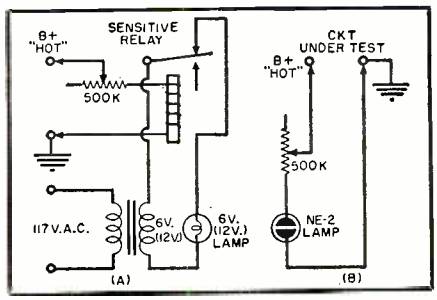


Fig. 2. (A) A relay-operated monitor, using a panel lamp as an indicator. (B) A neon lamp used as a voltage monitor.

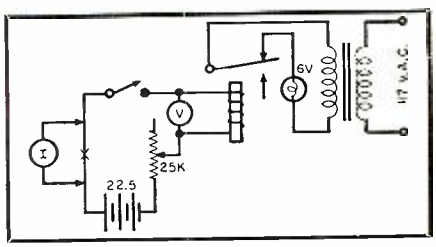


Fig. 3. This circuit is used to find critical operating values for a relay.

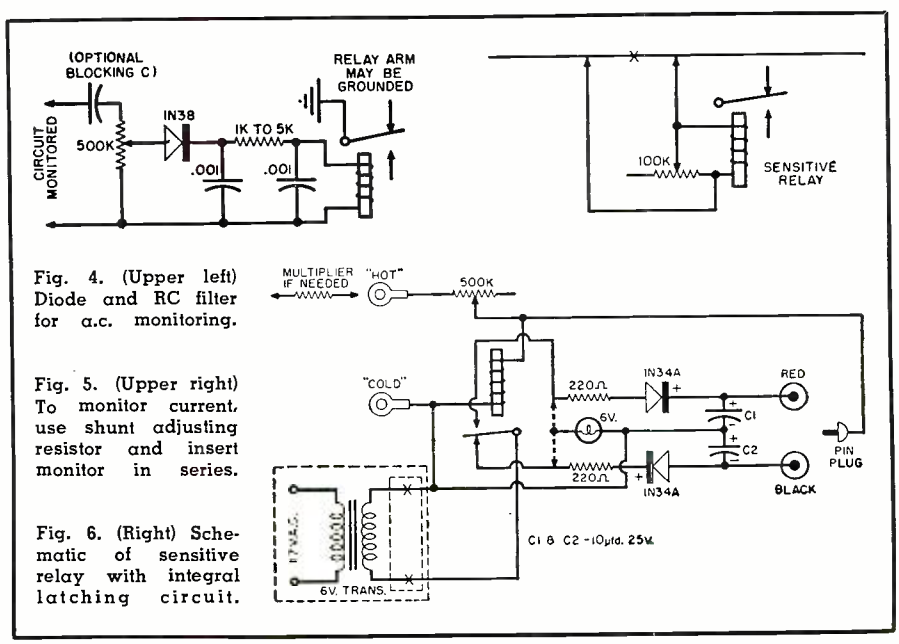
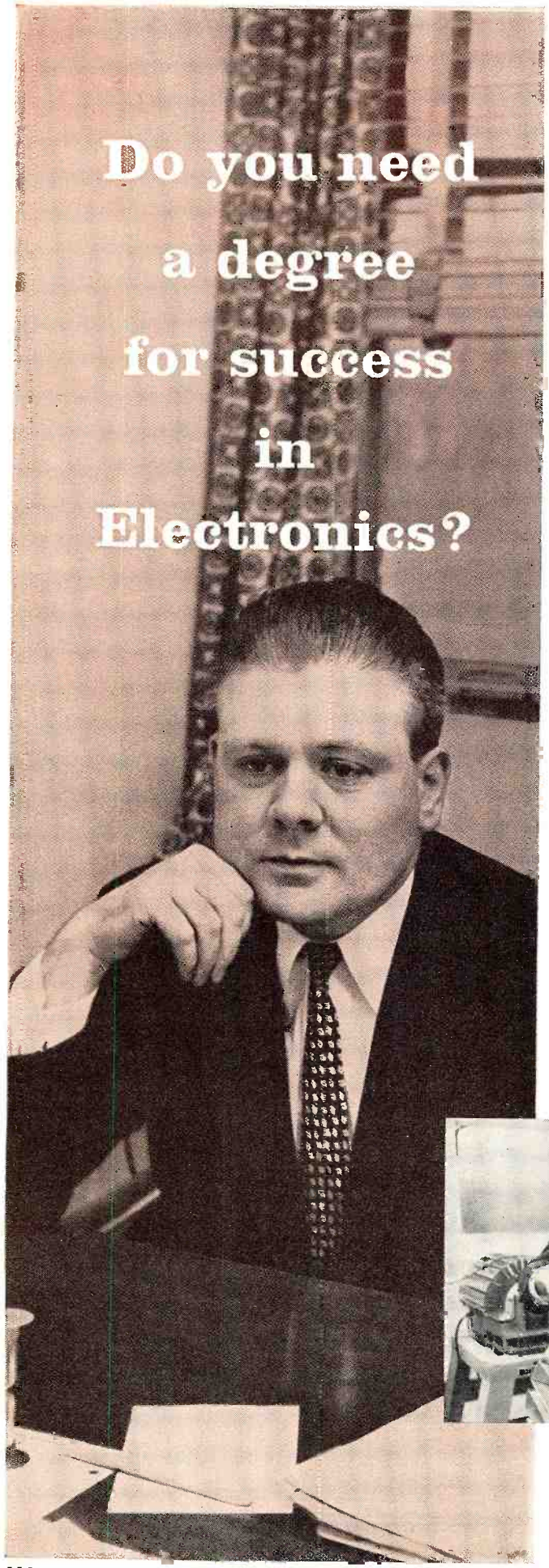


Fig. 4. (Upper left) Diode and RC filter for a.c. monitoring.

Fig. 5. (Upper right) To monitor current, use shunt adjusting resistor and insert monitor in series.

Fig. 6. (Right) Schematic of sensitive relay with integral latching circuit.



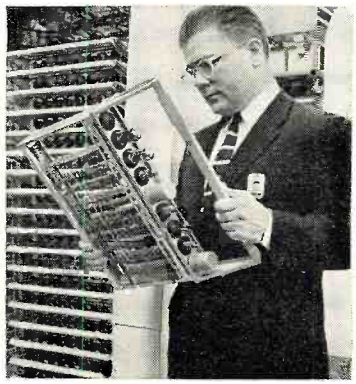
"Not necessarily," says Dick Brani, Instructor in Project Sage at IBM—Kingston, New York. "Oh, sure—I'm aware of my limitations to design electronic equipment—that's the big advantage of a formal degree. But I am qualified to maintain it. The point is . . . there are many management positions in IBM for men like myself, and I'm convinced that comparable positions elsewhere would probably require an engineering degree."

Some years ago, IBM took the initiative with respect to technical training within its own organization. It realized, even then, that a great number of intelligent and capable men were falling by the wayside because they lacked 4 years of college engineering. Statistics indicated that because of financial difficulty or improper high-school preparation, close to 50% of the potential engineers in the country became lost in the educational shuffle. While some people ignored or bemoaned the fact, IBM did something about it. Consequently, men like Dick Brani now enjoy satisfying, more rewarding work than ever before.

Great Interest in Mathematics. While Dick was attending high school, his principal academic interest was mathematics. And, like many other young men of that time, Dick was realistic about his future. He decided his best bet might be business accounting. When Dick graduated, he accepted a position with a New York banking firm. It was not until he entered the Army that he had the opportunity to pursue a more advanced form of mathematics—an A.S.T.P. training program at Lehigh University. This all-too-brief experience convinced Dick that he should make his career in a field related to electrical technology

Postwar Education. Discharged with the rank of Staff Sergeant, Dick returned home to marry a girl he had met at Lehigh. During this period, he successfully supported

Dick trouble shooting Magnetic Drum Frame.



He studies computer pluggable unit.

his family selling various lines of food. In the evening, however, Dick continued his study of radio, TV, and electronics at the Allentown Branch of the Temple Institute. In two years' time, he graduated and secured an F.C.C. license—his technical career began to take shape.

IBM Looks Especially Good. Glancing through an issue of *Time Magazine* one evening, Dick happened to read an article about Thomas J. Watson, Jr., the president of IBM. The story emphasized Mr. Watson's great faith in the future of electronic computers . . . the wonderful promise it holds for the ambitious, intelligent young man. Later, Dick spotted a classified ad describing IBM's association with Project Sage. That was all Dick Brani needed.

Asked to Become an Instructor. Three-quarters of the way through his nine-month computer systems course, Dick was invited to remain at Kingston as an instructor. "It was like a bolt out of the blue," he recalls. "I knew I'd enjoy teaching, but I always thought it was out of the question. I accepted all right. I can't tell you how much I've enjoyed helping these fellows and watching them grow within the organization. Right now, there's a fellow in my class whose education is limited to correspondence school. He's in the top third of his class, and has a real future with IBM—all because he has the native talent and is willing to work."

What Does Dick Brani Teach? "Actually, I teach three separate courses in field engineering. One is computer systems testing, which is for the more advanced student. It lasts for 33 weeks—a long time, perhaps, but it's well worth it. Another is a program of 24 weeks' duration that deals with computer input-output units. Finally, I teach a course in computer units displays. This also lasts for 24 weeks. Each one of these courses is an education in itself." Experience has shown that IBM's educational programing is most successful. Men accepted receive their training with no strings attached. Upon graduation the road to success is wide open in *all* divisions of the corporation.

Computer Analyzes All Air Traffic. "This computer is really fantastic. It contains approximately 1,000,000 parts, and it's housed in a building 4 stories tall. Information is filtered in from Texas towers, picket ships, reconnaissance planes—even ground observers. Every object in the sky is analyzed. Then it checks each object against available traffic data and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against a 'baddie.' Only authorized personnel can make that decision."

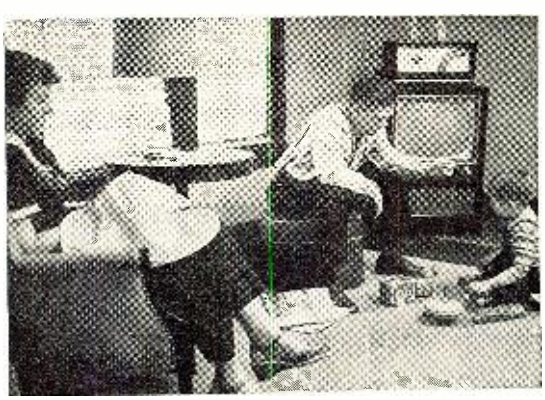
What About Dick's Future? "Well, right now, I'm doing work that most technicians couldn't touch with a ten-foot pole. I guess it's a matter of approach, but I know of few companies other than IBM where technicians are actually doing engineering work. Both kinds of companies will get the job done, but IBM prefers to think in terms of the man, encouraging him to grow into more responsibility. You might say that IBM gets more out of the man. In the final analysis, it seems a lot more efficient from the corporation's and employee's viewpoint. Personnel policy at all levels—management, engineering, or technical—is the same. The future is wide open."

Just recently, Dick bought a home in Saugerties, near Kingston, where his wife Betty and their three children, David, 9, Sharon, 7, and Paul, 3, enjoy a pleasant, contented life together. Occasionally, in the summertime, Dick plays softball with his co-workers. But his family is—and always will be—his predominant interest.

What About You? Permanent opportunities in the nationally important Project Sage program are still growing. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, valued at many thousands of dollars as a Computer Systems Engineer. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training as a Computer Units Field Engineer, with opportunity to assume full engineering responsibility. *Assignment in area of your choice.* Every channel of advancement in the entire company is open. All the customary benefits and more. For more information, please write to: Nelson O. Heyer, Dept. 4306, IBM, Kingston, New York. You'll receive a prompt reply.

Dick explains computer logic to a Systems Class.

At the Operating Console.



At home Dick plays with one of his three children.

"Hi-Fi" Video Output Stages

By CHARLES ERWIN COHN

Poor picture quality, intercarrier buzz, and sync woes may disappear with a simple change.

THE VIDEO output stage of a TV receiver has a big job to do. For good contrast, it must deliver about 50 peak volts of signal to the picture tube; yet, to maintain good bandwidth, load impedance is limited to about 5000 ohms. This combination of conditions calls for a plate-current swing of about 10 ma.

In many TV sets, this job is assigned to the 6AU6 or some similar voltage-amplifier pentode. The required plate-current swings can be obtained from such tubes, but usually at the expense of driving them into the nonlinear portion of their characteristics. This can result in severe distortion of the whites (or blacks, depending on whether the grid or cathode of the picture tube is driven). In addition, this nonlinearity may cause considerable amplitude modulation of the sound carrier, resulting in intercarrier buzz, and undesired sync difficulties too, in some cases.

The remedy for these conditions would seem to be the choice of a video-output tube with sufficient current capabilities so that the required current swing could be obtained within the limits of linear operation. In casting about for a substitute that would provide a simple conversion, the 6AQ5 power pentode seemed a good choice. The particular conversion was carried out on a *Meck* XB-702 receiver, which showed the symptoms already mentioned and also provided a video-output circuit to work with that is used in many sets. This circuit is shown in the accompanying diagram.

The only component change required, other than that of the tube, was to replace the 10,000-ohm bias resistor by a 47,000-ohm unit. Here the bias was adjusted for maximum contrast. The extra current drawn by the 6AQ5 can easily be handled by the power supply of the receiver, since it is such a small fraction of the total receiver drain.

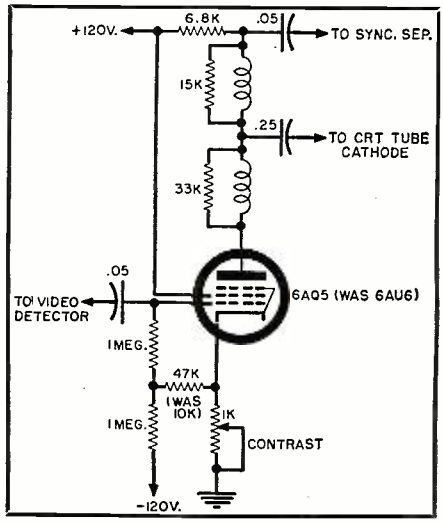
The only other problem that arose in this change involved the filament circuit. Where parallel filaments are used, there should be no difficulty. However, the series-filament arrangement of the receiver used made special consideration necessary. There were two filament strings, each carrying .3 ampere, converging into a .6-ampere string made up of the picture tube and a 6X5 rectifier. The 6AU6, with a .3-ampere filament, was in one of the .3-ampere strings. The 6AQ5, with a .45-ampere filament, was placed in the .6-ampere string in parallel with a 47-ohm, 2-watt resistor. No other changes were made, as resulting voltage changes were evenly distributed among all tubes so that the effect on any one was very small.

As expected, considerable improvement was effected in the receiver's performance. The previously evident compression of the blacks was eliminated, making the picture almost photographic in quality. Intercarrier buzz, heretofore very annoying, was virtually eliminated.

The described conversion can be used for any set using this type of video-output stage. The substitution of a 6AQ5 for a 6AU6 is a happy one on several counts. For one thing, the same tube socket can be used with very few changed connections being required. For another thing, there is not sufficient difference in capacitances between the two tubes to cause any trouble. Also, since the two tubes are just about equal in transconductance, each provides about the same amount of gain.

In some cases, a little extra gain is required, since some improvement in available contrast is desired. This, too, can be provided with a little extra trouble. It is accomplished by using a 6CL6, which has twice the transconductance, or more, of the other two mentioned. This would require removing the 7-pin socket and enlarging the chassis hole to accommodate a 9-pin socket. However, since the 6CL6 has a .65-ampere heater, it should work well without additional complications in a .6-ampere heater string. —30—

Typical video-amplifier stage, showing two changes that improve performance.



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1C7G .25	5V4G .57	6BY5G .57	7AU7 .69	12SK7 .47
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1J6GT .46	5Y3 .38	6CB6 .50	7B6 .41	12SQ7 .39
1L4 .45	5Y4G .42	6CD6G 1.17	7B7 .42	12V6GT .44
1L6 .54	5Z3 .44	6CU6 .79	7B8 .46	12W6 .59
1LA4 .55	6A7 .56	6D6 .47	7C4 .40	12X4 .36
1LA6 .46	6A8 .46	6E5 .43	7C5 .41	14A7 .44
1LB4 .58	6AB4 .44	6F5 .36	7C6 .42	14B6 .44
1LC5 .48	6AC7 .66	6F6 .37	7C7 .44	14Q7 .44
1LC6 .46	6AF4 .75	6H6 .37	7E5 .44	19T8 .69
1LD5 .56	6AG5 .49	6J4 1.59	7E6 .44	19BG6G 1.17
1LE3 .56	6AG7 .68	6J5 .38	7E7 .48	25BQ6GT .84
1LH4 .63	6AH4G2 .69	6J6 .48	7F7 .58	25CA5 .79
1LN5 .46	6AH6 .70	6K6GT .38	7F8 .65	25CD6 1.29
1N5GT .49	6AK5 .53	6K7 .38	7G7 .74	25CU6 .99
1R5 .50	6AL5 .41	6L6 .67	7N7 .57	25L6GT .46
1S5 .45	6AM8 .79	6N7 .59	7Q7 .58	25W4GT .42
1T4 .50	6AN8 .79	6Q7 .39	7X7 .64	25Z6 .36
1U4 .46	6AQ5 .45	654 .39	7Y4 .34	27 .24
1U5 .45	6AS5 .47	658GT .70	7Z4 .39	35B5 .47
1V2 .70	6AS7G 2.25	6SA7 .47	12A4 .59	35C5 .47
1X2 .66	6AT6 .38	6SB7Y .75	12A6 .40	35L6GT .46
2A3 .49	6AT8 .79	6SC7 .47	12AB5 .59	35W4 .38
2A7 .54	6AU4GT .64	6SG7 .40	12AQ5 .49	35Y4 .38
2D21 .95	6AU5GT .60	6SH7 .42	12AT6 .40	35Z3 .40
3A4 .50	6AU6 .42	6SJ7 .42	12AT7 .65	35Z5GT .38
3A5 .50	6AU8 .79	6SK7 .49	12AU6 .42	39/44 .25
3AL5 .52	6AV5GT .64	6SL7GT .56	12AU7 .58	50A5 .47
3AU6 .52	6AV6 .38	6SN7GT .56	12AV6 .41	50B5 .47
3BZ6 .57	6AW8 .89	6SQ7 .40	12AV7 .66	50C5 .47
3BC5 .57	6AX4GT .65	6SS7 .40	12AX4GT .64	50L6GT .44
3BN6 .57	6AX5GT .56	6T4 .85	12AX7 .62	80 .39
3CB6 .57	6BA6 .46	6T8 .67	12AZ7 .62	84/6Z4 .45
3Q4 .55	6BC5 .49	6U5 .54	12B4 .67	117L7GT 1.25
3Q5GT .56	6BC8 .89	6U8 .79	12BA6 .45	117N7GT 1.25
3S4 .46	6BD5GT .52	6V3 .79	12BA7 .59	117P7GT 1.25
3V4 .55	6BE6 .45	6V6GT .45	12BE6 .45	117Z3 .36
4BQ7 .75	6BF5 .39	6W4GT .39	12BH7 .59	117Z6GT .61
4BZ7 .75	6BG6G 1.17	6W6GT .52	12BY7 .63	
5AM8 .79	6BH6 .50	6X4 .38	12CA5 .59	
5AN8 .79	6BJ6 .46	6X5 .38	12CU6 .79	
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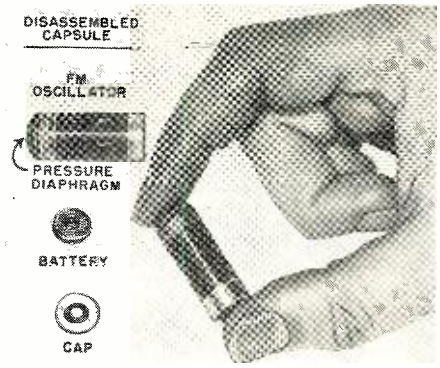
Radio Pill Broadcasts From Stomach



View of disassembled capsule is shown here.

Data from digestive tract sent by tiny FM transmitter.

A NEW radio broadcasting capsule which can be swallowed like a medicinal pill was demonstrated recently at the Rockefeller Institute. As it passes into the stomach and through the intestine, this world's smallest FM broadcasting transmitter signals the gastro-intestinal pressures to an outside receiver. It has been developed and tested jointly by the Institute, the N. Y. Veterans Administration Hospital, and *RCA*. The pill was designed by Dr. Vladimir K. Zworykin, honorary vice-president of *RCA*, and his associates, after having been envisioned by Dr. John T. Farrar, chief of the gastro-enterology section of the hospital.

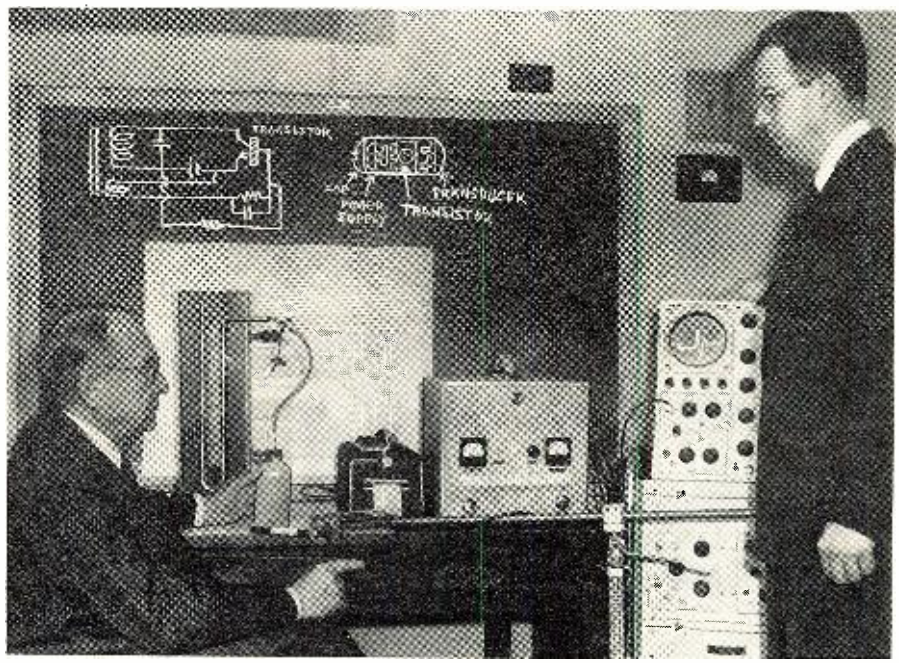
The little device permits pressure measurements to be made on internal organs with minimum disturbance to normal bodily functions. The new data is expected to be important in understanding gastro-intestinal disorders.

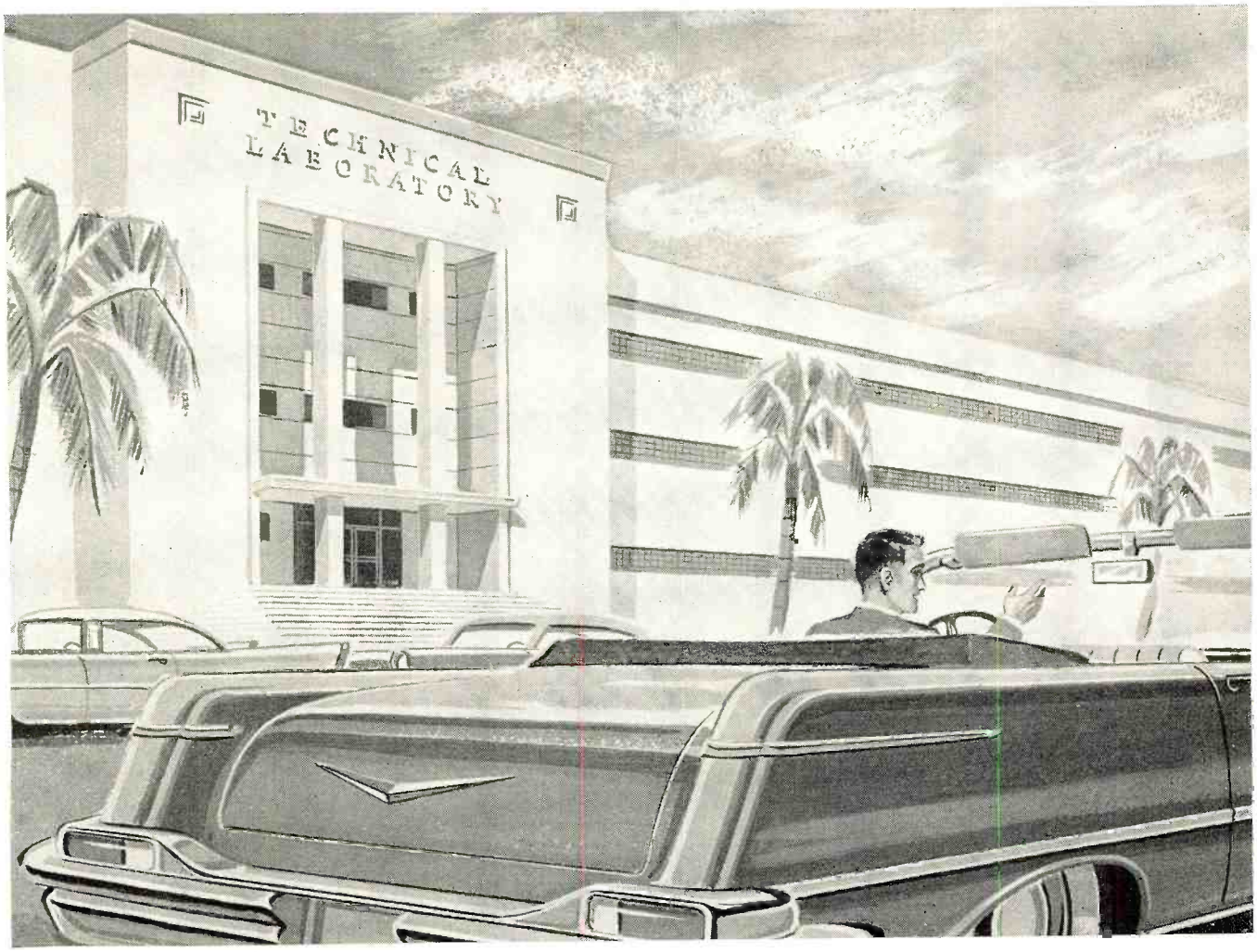
The pill is a plastic capsule measuring 1⅛ inches long and ⅜ inch in diameter containing a transistor oscillator powered by a tiny rechargeable battery which lasts about 15 hours before requiring recharge. At one end of the capsule is a pressure-sensitive rubber diaphragm through which the body's pressure variations are transmitted to a movable ferrite cup inductance core. This varies the inductance in the tuned circuit and results in frequency modulation of the oscillator, whose center frequency is about 1 mc.

The FM signal from the capsule within the body is picked up by an FM radio receiver by means of an antenna held close to the body. This signal is then recorded by a recording galvanometer or oscillograph, a cathode-ray oscilloscope, and a meter.

Plans are currently underway for recharging the battery from outside the patient's body. Also, it is planned to attempt to transmit information relating to temperature and acidity within the digestive tract. —30—

Drs. Zworykin (left) and Farrar demonstrate radio pill. Diagrams on blackboard show circuit and parts placement. Receiver is on right side of table with recording oscillograph to left and oscilloscope to right. Pill is inside plastic bottle connected to manometer. Small antenna in front of bottle picks up the FM signal.





It's Florida for the kind of missile work only RCA can offer electronic technicians

MTP

RCA careers are beginning for electronic technicians every day at the Missile Test Project at Patrick Air Force Base on Florida's central east coast. Each offers a unique opportunity to work on testing of all types of missiles now under development or planned. What's more, you can contribute to the Vanguard Satellite launching and tracking.

There's a broad range of RCA opportunity for technicians on all levels. A basic knowledge of electronics qualifies you for many of these openings. Complete facilities include latest electronic and optical data acquisition and transmission systems. Liberal RCA benefit program . . . relocation assistance, too. You'll live well in Florida.

Make *your* future in one of these field or shop assignments:

RADAR—RADIO—TELEMETRY
TIMING—INSTRUCTING
ELECTRONIC TEST EQUIPMENT

Mail the coupon for booklet which describes our Florida missile program and its advantages.

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RCA SERVICE COMPANY, INC.

Mr. H. N. Ashby, Employment Mgr., Dept. N-16F
RCA Service Co., Inc., Missile Test Project
P. O. Box 1226, Melbourne, Fla.

Please send me brochure with the information on RCA employment advantages in Florida.

Name _____ Age _____ Married Yes ☐ No ☐

Address _____ U.S. Citizen Yes ☐ No ☐

Electronics Experience (Include Mil. Service & Tech. Schools) _____

Earliest Date Available _____

The 21CEP4 (right) has the same size screen as the conventional CRT (left).

First 21" 110-Degree CRT

RCA research cuts tube depth by nearly 6 inches, improves brightness, pix quality, and stability.

NOW under regular production at the *RCA* tube plant in Marion, Indiana, is the first commercial 110-degree picture tube in the 21-inch size, the 21CEP4. Its appearance marks the culmination of efforts initiated as far back as 1952, when this manufacturer began to investigate the practical feasibility of increasing the deflection angle beyond 90 degrees.

By July 1954, it was decided that an angle of 110 degrees was a realistic commercial objective; that is, a CRT deflecting through such an angle could be designed without requiring such alterations in associated circuits and components as to result in unrealistic receiver prices. Little more than two years later, in October 1956, the design now under production was incorporated in the 17BZ4.

The 21CEP4, weighing in at 22 pounds and measuring 14¾ inches long, incorporated several features developed over the years during which the project has been under way. In addition to the determination that 110 degrees was the optimum angle, 1⅛ inches had been selected some time ago as the optimum neck diameter by *RCA* engineers. Also, extensive work was done on determining the actual electron-beam paths in a picture tube, involving the use of some unique techniques. This research was necessary to arrive at a shape for the tube that would not obstruct the electron beam. Out of these investigations came the parabolic contour presently associated with the new family of wide-angle cathode-ray tubes.

Other features found in the new line of picture tubes include a glass-button base, a straight electron gun that operates without an ion trap, and an aluminum backing on the screen of carefully controlled thickness.

The base of the tube combines the narrow pins used in miniature tubes with the plastic positioning key found on octal tubes. It should substantially reduce the number of otherwise usable picture tubes that must be replaced because of loose bases or poor base connections.

In using a straight gun, although ion burn can be avoided with proper aluminization, there is the additional danger of damage to the cathode with consequent shortening of tube life. A unique pre-focus lens, which gives superior focus and definition and is relatively insensitive to voltage variations, avoids contamination. In an extended-life test, 285 of the new tubes were subjected to 4000 hours of use. Results indicate average emission life superior to that of conventional tubes.

Costs to the manufacturer for the 17- and 21-inch sizes range about $2 more than for 90-degree tubes. Since only about 15 per-cent more deflection power and "B+" power are required from the receiver, no additional power requirement is made on present conservatively designed sets. A 24-inch version is planned for commercial availability this month. —30—

JUST RECEIVED! ASB-5 'SCOPE INDICATOR

BRAND NEW, including all tubes, together with 5BP1 'Scope Tube. Originally used in Navy Aircraft RADAR equipment. Easily converted for AC operation.
VALUE $250.00!
OUR LOW PRICE $15.95

ASB-5 RECEIVER FOR 420 Mc BAND!

As featured in "CQ" for October 1956. Easily converted, makes a marvelous receiver for 420 Mc band, with RF amplifier! Supplied complete with all tubes.
OUR LOW PRICE **$14.95**
Tuning Knob for ASB-5 Receiver $1.29
ASB-5 INDICATOR $16.95

MN26Y BENDIX DIRECTION FINDER

150-325 Kc; 325-695 Kc; 3.4-7 Mc. Complete with tubes, motor. **$26.95**
BRAND NEW $18.95
Used, like new, incl. tubes and dynamotor..

BENDIX DIRECTION FINDER

12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands, 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:

MN-26-C Receiver, used, with 12 tubes	$16.50
MN-26-C With 12 Tubes, BRAND NEW	$24.95
MN-20-E Rotatable Loop	4.25
MN-52 Azimuth Control Box	2.95

All necessary accessories for above in stock.

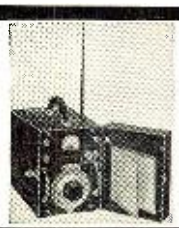
TS-16/APN TEST SET. BRAND NEW, complete with all cables **$12.95**

DETROLA BEACON RECEIVER

BC-1206A. A dandy little receiver for 200 to 400 Kc Band. Uses 135 Kc iron core IF's. Complete with six tubes: 6SK7, 6SA7, 6K7, 6SQ7, 2-25L6's.
Used **$4.99**

NAVY RECEIVER TYPE ARB

Four Band. 195 to 9050 kc. Low Freq., Ship, Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V, or 6 V. Schematic Included. Excellent Condition. Overall: 8¼" x 7¼" x 15¼". Wt. 30 lbs.
COMPLETE WITH ALL TUBES, Special $21.50



BC-906 FREQ. METER—SPECIAL!

Cavity type, 145 to 235 Mc. BRAND NEW in original factory packing, complete with antenna. Manual included.
OUR LOW PRICE **$8.88**

BC-221 FREQ. METER $129.50

BC-221 FREQ. METER CASE

Aluminum Case for BC-221 or TS-164 Freq. Meters. Shock Mounted. BRAND NEW **$3.99**
(add 50c for packing)
Original 1000 Kc Crystal for BC-221. BRAND NEW $8.45

DYNAMOTOR VALUES!

Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	2.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	....	7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24

PE-103 6/12V Input, 500V @ 160 Ma output. With cables and plugs, excellent, like new **$24.50**

2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery $2.45
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW!
Combination Price.... $4.99

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte ..... Only **$2.22**

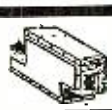
Ham Special! Famous BC-645 XMITTER-RECEIVER

BRAND NEW

With MANUAL for Easy Conversion to CITIZENS' BAND!

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** **$29.50**
Shpg. wt. 25 lbs.

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) ..... only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645 ... $2.45
Complete set of 10 Plugs for BC-645 ..... **$5.50**
CONTROL BOX for above $2.25
SHOCK MOUNT for above 1.25
CONVERSION BOOKLET. Instructions for most useful surplus rigs **$2.50**



ARC-5/R28 RECEIVER

2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **BRAND NEW** $18.95
110 V AC Power Supply Kit for above $9.75

ARC-5/T-23 TRANSMITTER

100-156 Mc Includes 2-832A, 2-1625 Tubes. BRAND NEW **$19.95**
SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. BRAND NEW, less tubes $7.95
Excellent Used, less tubes $5.95

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**

LORAN APN-4

FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual. **$129.50**
COMPLETE, BRAND NEW .....

SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized) **$29.50**

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, complete with all components. 100-156 Mc. 4 channels. Xtal-controlled, Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes.
COMBINATION .... Special $33.33
Receiver Only, with all tubes ... $19.50
Transmitter Only, with all tubes . $22.25

FREE! Schematic Diagram included **FREE** with each piece of equipment shown on this page. Schematics for any of these units also available separately at 50c each.

BRAND NEW SELSYNS

Operates from 37½ volts, 400 cycles. New tested. Conversion diagram for 110 volts AC included.
2J1G1 Selsyn Control Transformer.
2J1H1 Selsyn Differential Generator ..... Each **$2.95**
Caps for Above 50c

I-95-M FIELD STRENGTH METER

Tunes 100 to 155 Mc. Made for Signal Corps. Like New **$34.50**

AN/ARR-2 RECEIVER

BRAND NEW — A Terrific Value! Tuning Range 234 to 258 Mc. Tubes: 7-9001, 3-6AK5, 1-12A6. Schematic included. Only a few at this low price! **Complete. $8.88**
With 28 V 1.6A Dynamotor, complete $12.98
110 VOLT AC POWER SUPPLY KIT for above $9.75

WRITE FOR FREE CATALOG!

Please include 25% Deposit with order—Balance C.O.D. 50c Handling Charge on all orders under $3.00 All shipments F.O.B. Our Warehouse, N.Y.C.

G & G Radio Supply Co.
Telephone: CO 7-4605
51 Vesey St., New York 7, N. Y.

R24-ARC/5 NAVY TYPE (Similar to BC-946) BROADCAST RECEIVER

520 to 1500 Kc. 6 tubes: 3—12SK7, 12SR7, 12A6. 12K8. For dynamotor operation. Easily converted to 110 or 32 Volt. 2—IF stages, 3-gang tuning cond. Complete with all tubes, in original sealed carton.
BRAND NEW .. **$19.95**
BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal.
BRAND NEW **$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal.
BRAND NEW **$11.95**
ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.88**

110 VOLT AC POWER SUPPLY KIT

For All 274-N and ARC-5 Receivers

Can be assembled quickly and easily, on pre-drilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. Complete kit of parts with metal case, instructions. **$7.95**
Factory wired, tested, ready to operate $11.50
5PLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. **Only** **49c**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES Type	Description	Excellent Used	Brand Used	Brand NEW
BC-453	Receiver 190-550 KC...	$9.95	$11.95	$14.95
BC-454	Receiver 3-6 Mc.....	7.19	8.29	11.95
BC-455	Receiver 6-9 Mc.....	5.25	7.95	9.95
BC-456	Modulator	2.24	2.75	4.24
BC-450	3-Receiver Control Box	...	1.49	1.95
BC-451	Transmitter Control Box	...	1.25	1.49
BC-696	Xmtr 3-4-Mc (like new)	...	6.95	8.88

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW $8.88
Brand New, less tubes.. $5.95
USED, with tubes $5.95
USED, less tubes 2.95

BRAND NEW SPECIAL PURPOSE TUBES

in Original Individual Packing
JAN CRP-730A MAGNETRON, Raytheon $3.45

Type	Each	Lots of 12	Lots of 100
6J6W	$.45	$5.15	$41.00
1625	.26	2.75	21.50
1626	.16	1.75	13.50
1629	.27	3.05	23.95
826	.44	4.95	39.50
2J724B	.35	3.95	29.50
VR105	.79	8.88	70.00
VR150	.79	8.88	70.00
8002R	5.95	...	....
RK65	7.25	...	....

NEW! Cathode Ray Tubes NEW!

3CP1	$1.18	5BP4	$2.22
3FP7	1.18	5CP1	2.45
5BP1	2.22	5FP7	1.44
		9LP7	1.88

BUBBLE SEXTANT

Made for U. S. Armed Forces by AGFA ANSCO. Actually worth $150 or more! Has illuminated averaging disc for night-time use. Complete with carrying case. Only **$9.95**

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only $2.95

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special $3.95

HI-LO IMPEDANCE MATCHING TRANSFORMER for headphones. 600 ohms to 8000 ohms. With plug and jack, BRAND NEW **97c**

HI-FI DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. **$5.95**
BRAND NEW .....

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$5.45	$7.95
T-30	Carbon Throat Mike	.33	.69
T-45	Army and Navy Lip Mike	....	1.33
RS-38	Navy Type	2.45	4.95
T-24	Carbon Mike	....	5.95
TS-9	Handset	....	4.95

HEADPHONES

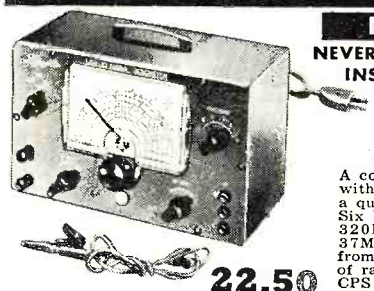
Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.25	$4.35
HS-33	Low Impedance	1.99	4.65
HS-30	Low Imp. (featherwt.)	1.49	2.25
H-16/U	High Imp. (2 units)	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack	....	.99

BC-442 ANTENNA RELAY

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator, 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW **$2.24**

LAFAYETTE SENSATIONAL VALUES!

IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!



LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- **FREQUENCY 120 KC TO 260 MC**
- **120 KC TO 130 MC ON FUNDAMENTALS**
- **LABORATORY ACCURACY AND QUALITY**

22.50

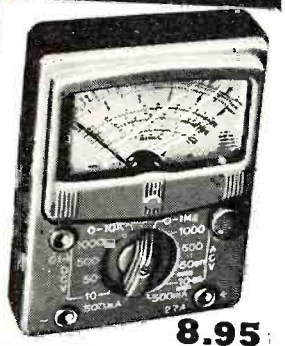
A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR **22.50**

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES

***DC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts — *AC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:* 500 ua and 500 ma — *Resistance:* 0-10K; 0-1 Meg — *Decibels:* —20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:* 250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:* 0-10; 0-50; 0-500; 0-1000 volts**

8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete **8.95**

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

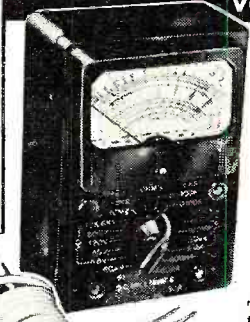
34.50

- **TWO INSTRUMENTS IN ONE**
- **CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS**
- **4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD**
- **CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS**
- **2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM**

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001 -.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¼"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET **34.50**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER



LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — A.C. VOLTS; 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — RESISTANCE: 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—D.C. CURRENT: 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — DECIBEL: —20 to +17 db (0 db—0.774V) — CAPACITY: .0001-.01; .005-.15 mfd — INDUCTANCE: 20-2000 millihenry —OUTPUT RANGES: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each **19.95**
In lots of 3, Each **19.25**

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

COMPLETELY WIRED AND TESTED

21.50

- **CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION**
- **DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS**

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET **21.50**

Lafayette Import Special! TRANSCRIPTION TYPE MANUAL PLAYER

- **MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED**
- **4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR**
- **STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM**

Complete Turntable and Tone Arm Assembly at the lowest price Ever for Such High Quality

24.50

Here is a new manual player for the audiophile who wants noiseless, "wow-free" and rumble-free reproduction of recorded music at nominal cost. All the important features of professional transcription players have been incorporated in this precision turntable. The lightweight pickup arm is an integral part of the mounting plate and requires no installation. Player is equipped with a heavy duty, 4-pole, 3-speed motor for 78, 45 and 33⅓ RPM records. An exclusive magnetic brake controlled by knob on the base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included with unit, checks speeds. Extremely smooth and quiet operation. No hum even with the most sensitive cartridges. Speed selector safety switch protects mechanism by making it necessary to pass through an OFF position when switching from one speed to another. Has automatic motor shut-off at end of record. 10" diameter, weighted cast turntable is supplied with a rubber traction mat for positive grip of record. Stylus pressure adjustment can be made easily and quickly with the conveniently located adjusting screw on the underside of the tone arm. Mounting plate is also equipped with pickup rest and ON-OFF switch. Dimensions of mounting plate: 12-15/16" left to right, and 10⅞" front to rear. Requires 2¾" clearance below motor board and 3" above. Supplied with AC line cord, two plug-in heads, output cable for connection to amplifier and 45 RPM adapter. For 105-120 volts, 60 cycle AC. Shpg. wt., 12 lbs. Less cartridge. (NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)

PK-160 Manual Player ..... Net **24.50**

PK-164. Same as above except equipped with genuine GE triple-play magnetic cartridge and dual diamond-sapphire styli ..... Net **36.50**

Wood base, cut out for PK-160 Manual Player. Top quality veneer attractively finished in mahogany or blonde (Specify).

PK-162. Shpg. wt., 5 lbs. ..... Net **3.95**

Unfinished mounting board only, cut out for PK-160 player. Strong, durable ⅝" gumwood, ready for stain or paint.

PK-163. Shpg. wt., 1 lb. ..... Net **.95**

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Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.

PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM

THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE

PK-300 TURNTABLE, PK-90 TONE ARM AND G.E. CARTRIDGE WITH GENUINE DIAMOND AND SAPPHIRE STYLI.

72.50

PK-300

ILLUMINATED BUILT-IN STROBOSCOPE & VIEWER

COMBINATION DEAL

PK-90

LATEST IMPROVED MODEL PK-300 TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-300 ..... Net **49.50**

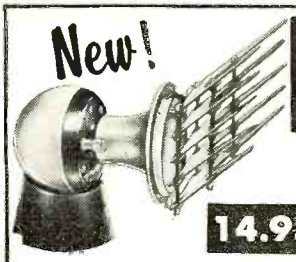
PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 12" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-300 with matching finish. Shpg. wt., 2½ lbs.

PK-90 ..... Net **15.95**

New!



HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

14.95

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 ..... Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000-16,000 CPS
HANDLES 20 WATTS OF POWER

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.

5.95 Net

HK-3 ..... Net **5.95**

CROSSOVER NETWORK

- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

8.75

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 ..... Net **8.75**

3 WAY CROSSOVER NETWORK

Carefully designed and engineered to Lafayettes own specifications. Insertion loss is well below the acceptable minimum. Crossover is at 350 and 5000 cycles. Permits full enjoyment of any 3 way system. Properly balances woofer-mid range speaker and tweeter inputs. Complete with 2 continuously valuable "presence" and "brilliance" controls for tonal adjustment and full instructions. 8"L x 3¼"H x 2¾"W. Shpg. wt., 7 lbs.

LN-3 ..... Net **14.95**

14.95

LAFAYETTE FM-AM TUNER KIT

Build Your Own Hi-Fi Tuner Kit and Save!

KT-100

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output: **FREQUENCY RESPONSE:** FM ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 kit, less cage ..... Net **34.95**

ML-100—Metal cage for above, shpg. wt., 3 lbs. ..... Net **5.00**

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CUT OUT AND MAIL TODAY!

Repairing Shorts in Vacuum Tubes

By HYMAN HERMAN

OF THE many tubes discarded each year by service technicians, a surprising number could have been restored to useful service. Many tubes in otherwise good condition are ruled defective because of inter-electrode shorts. For years, it has been the practice to remove such shorts, where possible, in picture tubes. The same can be done with other tubes.

The circuit described here will determine whether such shorts exist and, if they do, between what elements. It will also remove many of these shorts. The device has enabled the author to salvage more than 15 per-cent of so-called "defective" tubes.

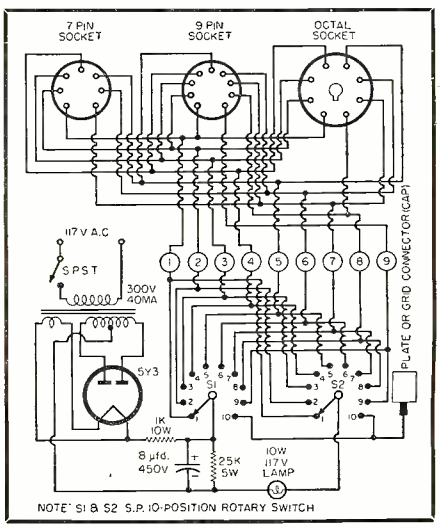
The three commonly used tube sockets are wired to two single-pole, 10-position switches so that all # 1 pins connect to the #1 switch positions, #2 pins to the 2# switch positions, and so on. Switch #1 is connected to "B+" and switch #2, through a 10-watt, 117-volt lamp, to "B—."

With the tube in its socket and the power switch on, switch #1 is progressively advanced through all positions. In each of its positions, switch #2 is rotated through all of its positions. In this way, all possible inter-electrode shorts are checked.

When a short completes the circuit, the lamp lights. Examination of the tube's basing diagram will show where continuity should legitimately be expected. When an unwanted short appears, current through the lamp will burn it out if it is caused by particles wedged between electrodes.

The limiting action of the lamp prevents burn-out of all except the 1.4-volt tubes used in portables. The latter should not be used with this device. A tube that has been restored with this device should be otherwise checked for quality before being returned to service. —30—

Circuit of the tube short remover.



"Pure Signal" CRT Eliminates TV Stage

This multi-beam picture tube can be driven directly by video detector.

A PICTURE tube now being shown both to receiver and CRT manufacturers can produce a full-contrast picture with no more drive than is obtainable from the video detector. A product of *Multi-Tron Laboratory,* the new display tube looks just like conventional CRT's. In fact, according to Nicholas Glyptis, president of *Multi-Tron,* its principle can be adapted to any bulb type now in use.

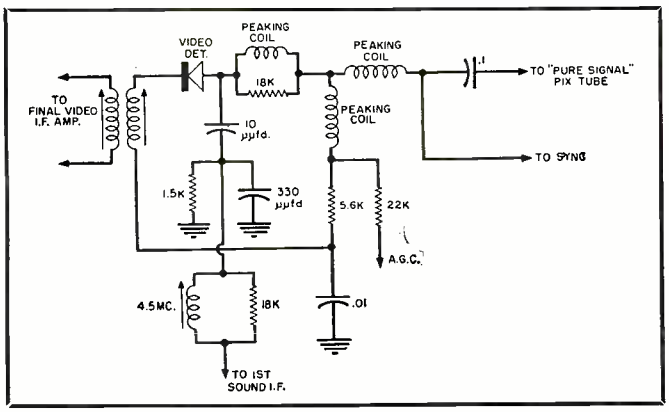
Distinctive feature of the new tube is its internal structure: it works on the multi-beam principle, rather than with a single electron beam. In operation, the spot on the screen is produced by the intersection of the beams. Spot brightness can therefore be controlled by modulating more than one beam. With more than one beam thus controlled, the sensitivity of the tube is increased to the point where only 5 to 10 volts drive, peak-to-peak, is necessary to produce an image of full contrast.

Since signal amplitudes of this order are common at the output of conventional crystal detectors in modern TV receivers, the need for a video-amplifier stage is at once eliminated. The accompanying illustration shows a detector stage designed to provide a.g.c. voltage, take-off points for the sync and audio i.f. stages, and drive to the picture tube. Elimination of the video amplifier means elimination of a stage that involves as many as 22 components. To the set manufacturer, this can mean a considerable saving in production costs. Aside from the tube used as the video amplifier and the usual group of resistors and capacitors for that stage, there are the peaking coils and other additional components needed to compensate the amplifier.

Designers of the tube report that retooling and redesign problems for those who manufacture the picture tubes or the sets are minor. Aside from the elimination of the video amplifier stage or stages, the receiver manufacturer will only be concerned with minor circuit rewiring. Since it is recommended that the receiver be operated at maximum sensitivity, removal of all a.g.c. voltage from the r.f. section is advised. The i.f. section will still be gain-controlled, but a.g.c. voltage to this strip should be reduced.

Quantity production of the tube should be no problem, according to *Multi-Tron,* as design tolerances meet the present standards of tube manufacturers. The multiple-beam CRT will also be of interest to those working toward a transistorized TV receiver. -30-

Detector drives CRT, sync, a.g.c., and audio i.f. circuits.



New Tube Tester Data

Settings for testing some of the newer tubes on two popular Triplett model tube checkers.

TRIPLETT MODELS 2413 & 3212

TUBE TYPE	KNOBS A Cir.	B Fil.	C Load	LEVER POSITION Up	Down
2B3	3	2	100	1345678	2
(Good tube reads 10)					
2BN4	3	2	18	3	146
(Pins 2 and 7 also show short)					
3CE5 (Adapt BX)	2	5	20	3	247
3DT6 (Adapt BX)	1	5	22	3	24
5AS4 (Test 1 & 2)	1-1	5-5	25-25	126-124	8-8
5BR8	2	5	20	46789	35
5BR8 (Test 2)	2	5	20	1234	58
5CG8	1	5	21	4679	358
5CG8 (Test 2)	1	5	21	124	358
5V3	3	5	25	135678	2
5V3 (Test 2)	3	5	25	134578	2
6BL4	5	6.3	18	2468	37
6BN4	3	6.3	18	3	146
(Pins 2 and 7 also show short)					
6BR8	2	6.3	20	46789	35
6BR8 (Test 2)	2	6.3	20	1234	58
6BW4	5	6.3	20	123468	59
6BW4 (Test 2)	5	6.3	20	234678	59
6CB5A	2	6.3	20	2	367
(Move pins 4 & 5 and pins 1 & 8 at same time on shorts test)					
6CE5	2	6.3	20	3	247
6CG8	1	6.3	21	4679	358
6CG8 (Test 2)	1	6.3	20	124	358
6CH7	1	6.3	22	46789	35
6CH7 (Test 2)	1	6.3	22	1234	589
6CH8	2	6.3	22	23467	15
6CH8 (Test 2)	2	6.3	21	1489	56
6CU5	3	6.3	19	3	14
(Pins 2 and 5 also show short)					
6DN6	3	6.3	18	1246	37
6DT6	1	6.3	22	3	24
12CU5	3	12.6	19	3	14
(Pins 2 and 5 also show short)					
12DQ6	3	12.6	18	12369	78
12K5	1	12.6	22	3	14
5647	1	6.3	23	2	34
CK5694	1	6.3	24	2568	17
CK5694 (Test 2)	1	6.3	24	1234	78
5852	5	6.3	20	12456	78
5852 (Test 2)	5	6.3	20	12346	78
5915A	2	6.3	22	3	2457
5915A (Test 2)	1	6.3	44	3	124
CK5967 (Adapt. BW)	1	1.2	24	2678	45
CK5967 (Adapt. BW, Test 2)	1	1.2	24	1237	45
6145	3	6.3	18	15	78
6267/EFS6	1	6.3	23	247	35
CK6286	1	1.2	24	2	4
6386	2	6.3	22	15678	29
6386 (Test 2)	2	6.3	22	12345	89
6679	1	6.3	24	45	36789
6679 (Test 2)	1	6.3	24	45	12389
6680	2	6.3	25	10	345
6680 (Test 2)	2	6.3	25	10	458
6681	1	6.3	20	10	345678
6681 (Test 2)	1	6.3	20	10	123458

VACATION SPECIA S

WRITE FOR CONCORD'S CAMERA BARGAIN BULLETIN

SOLIGOR "45" 35mm Camera

Camera	$12.75
Case	4.50
Flash	5.50
TOTAL	$22.25

Complete Outfit **$19.95**

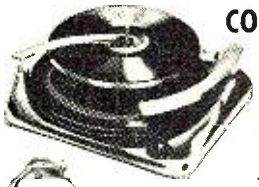
$31.90 VALUE

Shutter speeds from 1/25, 1/50, 1/100, 1/200 sec and B, built-in flash synchronization, optical viewfinder, standard accessory clip. Color corrected, coated 40mm f:4.5 Soligor lens in focusing mount with rapid-selector color-coded system.
With case and Flash Gun Stock No. SOLIGOR-45 RN-6 Wgt. 2 Lbs.

COMPLETE SYSTEMS for your COTTAGE

Concord's 2 SPEAKER HI-FIDELITY SYSTEM

FULL 10 WATT OUTPUT 3 SPEED CHANGER IN FACTORY SEALED CARTONS



PLUS 12" WOOFER

This combination will make all our competitors groan. We have selected the famous Concord 10 watt hi-fidelity amplifier with PP 6v6 output, the renowned VM 3 speed automatic changer with flip-over cartridge and two needles, a fine base for the changer, then we added a Rola 12" woofer PLUS a Utah tweeter with built-in crossover network. Best of all we cut the original price of $112.50 by more than 50%. Don't hesitate on this one!

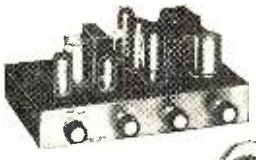
CONCORD'S FANTASTIC PRICE **$55.95** COMPLETE

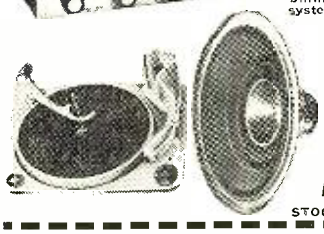
COMBINED VALUE OVER **$112.50**

STOCK NO. BUDJ-COMBO-RN-6 Shipping Wgt. 35 Lbs.

10 WATT AUTOMATIC PHONO MUSIC SYSTEM #2

Latest 4 SPEED CHANGER





Famous brands include Bogen, Norelco, British BSR Monarch record changer. Concord goes all out in combining the finest units for their hi-fidelity combination system. No finer 10 watt music system available at any price!

NATIONAL ADVERTISED PRICES

Bogen hi-fidelity amplifier No. Amp.-10	$ 44.50
Imported British Monarch BSR 4 speed changer with flip-over cartridge	46.50
Famous Norelco 8" twin cone hi-fi speaker	16.50
REG. TOTAL	$107.50

CONCORD'S AMAZING PRICE **$69.95**

FAMOUS BRAND SAVE $37.55

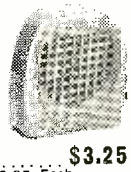
STOCK NO. COMBO-No. 2-RN-6. Shipping Wgt. 30 lbs.

CRYSTAL MIKES ! ! !

MODEL 101-RN-5
Die cast case, baked on gray enamel finish. 6 foot shielded cable, stand adaptor. Response better than 60-7000 CPS. Output level 49 db. Shipping Wgt. 1 lb. Reg. Price $9.95.

Concord's Closeout Price—Singly **$3.69**
Lots of 3 $3.95 Each

MODEL 102-RN-5
Handy durable plastic case tan finish. 5 feet of shielded sable. Response is 60-8500 CPS. Output level 45 db. Shipping Wgt. 1 lb. Reg. Price $8.95. Concord's Famous Price,



Each Singly **$3.25**
Lots of 3 $2.95 Each

SHURE WIRE RECORDING HEAD

$1.95 ea.

Regular $15.00

Normally sold Mounted in hum-shielded case. Uniform Output. Excellent Frequency Response. Prong Contact.

Stock No. WRH-RN-6
8 ozs.

MULTI-METER

MEASURES UP TO 10 MEGOHMS!
SENSITIVE 160 UA. 3" METER.
Your Complete Lab. Pocket Sized.
AT CONCORD
$13.75 EACH
REG. $29.50

Unmatched performance in a factory wired multimeter. Loaded with features found only in instruments costing many dollars more. Measures resistance up to 10 megohms with internal 22.5 V. battery. Enclosed in durable plastic case. Complete with testprods and battery.

RANGES
Inductance: 0-1000 Henries
AC Volts: 10, 50, 250, 500, 1000 (@ 200 opv)
DC Volts: 10, 50, 250, 1000, 5000 (@ 4000 opv)
DC Current: 250 UA. 2.5 Ma, 25 Ma, ½ amp.
Resistance: 0-10,000, 100,000, 1 Megohm, 10 Megohm.
DB: —20 to +36 DB.
Capacity: 250 MMFD. to .2 MFD.
Size: 3⅞" x 5¾" x 2¼".
STOCK NO. TEST-C30-RN-6
Shipping Wgt. 4 Lbs.

CP-6 Pocket Multi-Meter

$9.75 Each

Complete with test-prods and battery

Stock No. TEST-CP-6-RN-6

2000 OHM PER VOLT SENSITIVITY!
SENSITIVE 3" 140 UA. METER
SILVER CONTACT SELECTOR SWITCH

RANGES
AC Volts: 6, 12, 60, 300, 1200.
DC Volts: 6, 12, 60, 300, 1200.
DC Current: 300 UA, 3 MA, 300 MA.
Resistance: 0-10,000 Ohms, 0-1 Megohm.
Decibels: —20 to +17 DB.
Inductance: 0-1000 Henries.
Capacity: 250 MMFD. to .2 MFD.
Size: 3⅞" x 5½" x 1¾".
Shipping Wgt. 4 Lbs.

RCA-VICTOR 45 RPM PLAYER

Famous Slide-O-Matic + 6 Best Selling Records

Concord Radio Offers the Finest!
RCA-Victor Slide-O-Matic 45 RPM Player-Record Combination!
Player PLUS 6 Top Seller 45 RPM Records.
Brand New in Factory Sealed Cartons!
Your Dealer Cannot Buy These at TWICE Our Price!
Save Over 60% Off NET Prices! Reg. Combination.

Value $21.00

Concord's Combination Price **$79.99**

Fully Automatic Start and STOP!
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- Plugs Into Any Amplifier, Radio or TV Set Equipped with Phono Jack.
- Compact Hi-Impact Cabinet in Handsome Ebony.
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- Size: Only 3¾" x 10½" x 7½".
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Shipping Wgt. 10 Lbs.

Free! 23 Carat Gold Signature Kit

CROSLEY
Famous Transistor Book Radio

$24.95

Concord's Buyers this hot item and your price is amazingly low! You will thrill at the fine tone of this radio. The handsome binding in genuine leather is made in a book form. A special automatic switch starts radio when cover is raised. Small enough to keep in your pocket.
Sold Nationally for $54.50. CONCORD'S LOW, LOW PRICE. (Less Batteries). **$24.95**
Stock No. BUK-RAD-RN-5, Shipping Wgt. 3 Lbs.
Batteries for above—No. 415, $1.75 (B). No. E233, $1.68 (A).

4 TUBE PERSONAL PORTABLE RADIO

$13.95 LESS BATTERIES

Imported to save you money.
- FULL 4 TUBE SUPER-HET CIRCUIT (1—1R5, 1—1T4, 1—1U5, 1—3S4).
- FULL BROADCAST COVERAGE—532Kc.—1640Kc.
- QUALITY 2½" PM SPEAKER.
- "HI-IMPACT" PLASTIC CASE FOR ADDED SAFETY.
- USES LONG LIFE BATTERIES FOR ECONOMICAL OPERATION.
- RETRACTING HANDLE FOR PORTABLE USE.
- YOUR CHOICE OF COLORS AT NO ADDED COST—EBONY, MAROON, IVORY.
- ONE PIECE CHASSIS, EASILY REMOVED.
- HIGHLY SENSITIVE BAR TYPE ANTENNA.
- PERSONAL SIZE: 6¾" x 4" x 1½".

WEIGHT WITH BATTERIES ONLY 1.7 LB.
STOCK NO. 5 STAR RN-6
SHIPPING WGT. 2 LBS

3 WAY PORTABLE RADIO

$17.49 Each

FEATURES
- 4 Tubes plus Rectifier. 1U4 1U5, 1R5, 3V4.
- Built-in Antenna.
- Sturdy Modern Plastic Case.
- Slide-Rule Dial.
- Powerful Circuits Enable Long Distance Reception.
- Fine Alnico Magnet PM Speaker.
- Lightweight. Weighs 4 Lbs. (Less Batteries).
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Complete Set of Batteries for above $3.25
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Stock No. ITCMR-1-C6
Special Net $5.95
Additional: 3 cond. cable for above .03 per ft.

$15.95 Value $29.95

Stock No. ITCM-1-RN-6
Shipping Wgt. 10 lbs.

FULL 30-35 WATTS FAMOUS UTAH 15"

- HANDLES 35 WATTS.
- RESPONSE: 20-5,000cps.
- VOICE COIL IMPEDANCE 8 OHMS.
- MASSIVE FRAME CONSTRUCTION.
- ONE PIECE CONE.

$27.50

Shipping Wgt. 13 Lbs.
STOCK NO. UTAH-15-RN-6

UTAH WOOFER-TWEETER COMBINATION

When used with companion Utah Tweeter you will have a Hi-Fidelity combination delivering a frequency response of from 20 cps to high frequency beyond audibility.

$32.95

FREE! FREE! 9 SQ. FT. OF FIBRE GLASS WORTH $2.95. Ship. Wgt. 16 lbs. Stock No. UT-15-TW-RN-6.

Your 1957 Catalog Is Ready . . . Write for Free Copy

CONCORD RADIO CORP.

45 Warren St., N. Y. 7, Dept. RN-6

RUSH THE FOLLOWING ITEMS:

1—..... 3—.....
2—..... 4—FREE CATALOG

☐ I AM ENCLOSING $.....
☐ SEND C.O.D. I ENCLOSE 20% DEPOSIT

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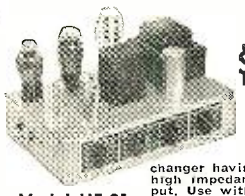
AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20-WATT AMPLIFIER $24.95



Model HF-21

$24.95

Push-Pull 6L6 Output Tubes
Response 30-15,000 cps
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V. R. Phono

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20-watts power output. Use with any 8-ohm speaker. Chassis size 13⅜" x 10½" x 7⅛" high. Complete with tubes 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use High Fidelity amplifier at less than the cost of a kit. Ship. wt. 19 lbs. Model HF-21, 20-watt Hi-Fi amplifier. Sale price $24.95.

12" COAXIAL PM SPEAKER RESPONSE 25-17,000 CPS

$9.95

Model 12X3Y, new 1957 12" Coaxial PM Speaker, has high efficiency 12" woofer with Alnico V magnet and coaxially suspended 3½" Alnico V tweeter. Built-in crossover with variable brilliance control on an 18" lead for remote control of the tweeter volume. 10-watts, response 25 to 17,000 cps. Ship. wt. 7 lbs. Stock No. 12X3Y, 12" coaxial PM Speaker. Sale Price $9.95.

TREMENDOUS McGEE VALUE
NEW 1957 HI-FI SPEAKER SYSTEMS
ON BAFFLE BOARDS

Model B-125-X, high fidelity 20-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" High Efficiency woofer, 2—4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in LC crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-125-X, 5-way, 20-watt Hi-Fi speaker system. AUDIOPHILE VALUE $30.00. SALE PRICE $18.95.

SALE PRICE $18.95

Model B-347, high fidelity 30-watt, 5-way speaker system, mounted on an 30" x 24" baffle board. Has 15" UTAH 21½-oz. woofer, 2-new high fidelity extended range 6 x 9" speakers, plus 2-5" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 22 lbs. Stock No. B-347, 5-way, 30-watt Hi-Fi speaker system. AUDIOPHILE VALUE $59.95. SALE PRICE $39.95.

SALE PRICE $39.95

Mount these Hi-Fi speaker systems in your own cabinet or use for custom installation. Ideal for use with any radio or amplifier. Completely wired, with only 2-wires to connect to any 8-ohm output (Take 10% discount if ordered with any radio or amplifier listed hereon.) Grill cloth, 75¢ extra.

3 - 1957 MODEL Hi-Fi SPEAKERS

- COMPLETE SYSTEMS WITH 4 SPEAKERS
- ACOUSTICALLY LINED ENCLOSURES

The new 1957 Hollywood, 4 speaker high fidelity speaker systems are expressly designed to give realistic reproduction from your Hi-Fi amplifier or FM-AM radio. Juke box bass response with brilliant, middle and high range response. All 3 models have genuine L-C crossover networks and variable brilliance controls. Only 2 wires to connect to the 4 or 8 ohm tap on your Hi-Fi amplifier. A fine speaker system to use with our Imperial 20, 30 and 34 high fidelity amplifiers, and all FM-AM chassis in our Radio & TV News offerings. Adjusting the twin tone controls on our Imperial amplifiers along with the brilliance control on the Hollywood speaker systems you can have fidelity of your own personal taste. All 3 Hollywood models are housed in the same fine cabinet. Choice of either Mahogany, Walnut or Maple finishes. Baffles are fully enclosed and acoustically lined. Small enough in size for the average room, yet large enough for proper baffling. 35" high, 19" front to back, 25" wide. Specify cabinet finish when ordering, otherwise we will ship mahogany finish. Take $3.00 discount when you order with any of the Imperial amplifiers or Espey FM-AM chassis offered in this 3 page ad.

Model H-4H, Hollywood 4 speaker high fidelity speaker system. 20 watts, response 20 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features a 12" General Electric 6.8 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance L-C crossover network. Model H-4H. Ship. wt. 55 lbs. Price $39.95. **$39.95**

Model Y-4Y, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 20 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features 12" General Electric 14 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance L-C crossover network. Model Y-4Y. Ship. wt. 55 lbs. Sale price, $44.95. **$44.95**

Model Z-4Z, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 18 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features a 15", 21½ oz. Alnico V Utah heavy duty woofer, plus 6" mid-range and 2-5" tweeters. Built/in variable brilliance, L-C crossover network. Model Z-4Z, Ship. wt. 57 lbs. Sale price, $49.95. **$49.95**

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker

$19.95

3-Way Imperial VI with 12" G.E. Speaker

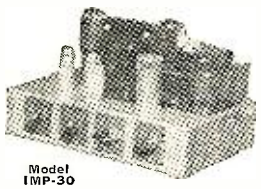
$29.95

New 1957 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 8SQ or 9770 Norelco 8" extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvilinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Ship. wt. 14 lbs. Model IV Imperial $19.95.

1957 Model Imperial VI. 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers. A 12" G.E. Model 12D3 with 9 oz. Alnico V magnet, plus 5¼" PM for middle range and 3" tweeter. Simple to connect to any high fidelity amplifier. (8 ohms impedance). Ship. wt. 25 lbs. Stock No. IMP-VI. Sale price, $29.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

IMPERIAL 30-WATT AMPLIFIER $29.95
NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

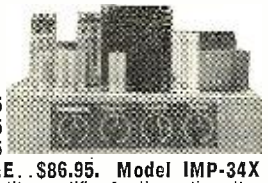


Model IMP-30

With CU-14Y, 12" Coax Speaker . $39.95
With P15-CR, 15" Coax Speaker . . $49.95
With Imperial IV Speaker System . $46.95
With Imperial VI $55.95
With HF-33GE $76.95

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12¼" x 7¾" x 7¼" high. Complete with tubes: 6AT6, 12AU7, 6C4, 12AU7, 2—6L6GA, plus 5U4G rectifier. Stock No. IMP-30, 30 watt Imperial High-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs.. Sale price only $29.95.

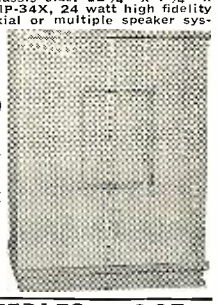
NEW IMPERIAL 24 WATT AMPLIFIER $39.95
PUSH-PULL EL-34 ENGLISH MADE MULLARD OUTPUT TUBES
WILLIAMSON TYPE CIRCUIT
RESPONSE 15-20,000 CPS



With CU-14Y, 12" Coax Speaker . . $49.95
With P15-CR, 15" Coax Speaker . . $59.95
With Imperial IV Speaker System . $56.95
With SP12125CR . . $65.95. With HF-33GE . . $86.95. Model IMP-34X

New, 1957 model Imperial 34X, 24 watt high fidelity amplifier for the audio enthusiast who wants McGee's finest amplifier. This amplifier features push-pull Telefunken or EL-34 English made Mullard output tubes in a Williamson circuit. Heavy duty 6 lb. specially wound Williamson type ultra-linear output transformer in potted case has a response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. Amplifier has input for crystal pickup and built-in pre-amplifier for the popular General Electric and Goldring variable reluctance cartridges; as well as input for crystal or high impedance dynamic microphones. 4 controls are microphone gain, phono gain and separate variable treble and base boost tone control with off-on switch. Chassis size: 12¼" x 7¾" x 7¼" high. Complete with 7 tubes and diagram. Model IMP-34X, 24 watt high fidelity amplifier, ideal for use with any of our high fidelity coaxial or multiple speaker systems. Ship. wt. 26 lbs. Sale price, $39.95.

NEW 1957 MODEL 8-WAY SPEAKER SYSTEM BLOND OAK CAB. $69.95



New 1957 model, 8-way Hi-Fi console speaker system. Features a beautiful full door blond oak speaker enclosure that would cost $100.00 to duplicate. Size: 43" high, 31" wide and 23" deep. A lister of eight PM speakers matched to an L-C type crossover network give a cone area equal to almost half of the baffle board. Included are 2—10", 2—7½", 2—5½" 2—4" speakers. System will take 30 watts of audio. Frequency response, 20 to 17,500 CPS Juke box quality when connected to any good Hi-Fi amplifier. Only 2 wires to connect to 8 ohm output.

Stock No. AHK-8, 8-way system. Ship. wt. 120 lbs. Sale price, $69.95. Order with our IMP-30 or IMP-34X amplifier and take $5.00 discount.

McGEE OFFERS DIAMOND NEEDLES $25.00 to $27.50 LIST VALUE $9.95

McGee offers $25.00 and $27.50 list value Diamond phono needles for only $9.95. Made by a nationally known phono needle manufacturer and guaranteed 1st quality, free of any defects.

Stock No.	Speed (RPM)	Cartridge Maker	Cartridge Type No.	List Price	Sale Price
MA-21D	33-45	Astatic	QT-33, CAC, CQM, LQD, QT, CQ Series	$25.00	$ 9.95
MA-61D	33-45	Astatic	AC, ACD, Series, 10L3, 11L3	25.00	9.95
MATO-55DS	33-45-78	Astatic	GD-J, 55J, 55TM	30.00	10.95
MGE-61D	33-45	Gen'l Elec.	RPX-041A, RPX-050A RPX-061A, RPX,052A RPX-053A	27.50	9.95
MGE-713DS	33-45-78	Gen'l Elec.	RPX-050A, RPX-052A	31.00	10.95
MGL-11D	33-45	Goldring	500, 546	25.00	9.95
MRC-11D	45	RCA	74067	25.00	9.95
MRC-31D	33-45	RCA	77779, 75475, 70332, 38453, 38598, 39550.	25.00	9.95
MP-41D	33-45	Shure	W22A, W22AB, P72 P72AF, P72V, P76, P77, Admiral 409A-11.	25.00	9.95
MSA-113DS	33-45-78	Sonotone	W9980, S12E	30.00	10.95

Note: Stock numbers ending in "D" indicate 1 mil diamond stylus. Numbers ending "DS" indicate 1 mil diamond and 3 mil sapphire. Other diamond needles are available. Write for price.

LITTLE GIANT HI-FI PM SPEAKERS $4.49

Hi-Fi 8"

McGee offers its new 1957 models of little giant Hi-Fi PM speakers. List values of up to $15.00 at only $4.49; two for $8.25. Order either 8" or oval 6x9 sizes. Features heavy 3.2 oz. alnico V. magnets and 8 ohm voice coils. New Hi-Fi cone features center horn feature to extend the high frequency range. Rated 6 watts at from 35 to 15000 cps.

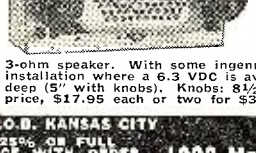
8 inch size stock CL-81. Net $4.49; 2 for $8.25.

6x9 oval size stock No. CL-69. Net $4.49; 2 for $8.25.

Hi-Fi 6x9"

WRITE FOR McGEE'S 88-PAGE 1957 CATALOG

GENERAL PURPOSE AUTO-RADIO



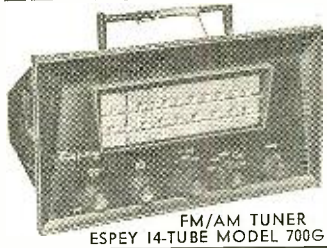
SALE PRICE $17.95

Over $49.95 List Value Radio, Nash model NH3C for Nash Rambler, manufactured by Motorola. Works on 6-volt storage battery, custom built Superheterodyne receiver, rating 4.3 Amp., 6.3 volts D.C., broadcast range 540-1600KC, five tubes: 1 each 6BE6 Conv., 6BA6 Det. AVC-AF amplifier, 6A5S audio output and 6X4 rectifier with a 4x6" PM 3-ohm speaker. With some ingenuity, this set can be adapted to many other types of installation where a 6.3 VDC is available. Overall size: 10½" long, 5¼" high, 4½" deep (5" with knobs). Knobs: 8½" centers. Ship. wt. 10 ibs. Stock No. NH3C, Sale price, $17.95 each or two for $34.00.

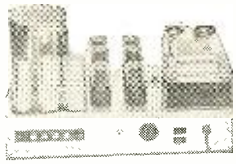
22 TUBE ESPEY FM-AM HI-FI TUNER-AMPLIFIER

SALE PRICE $119.90

A REGULAR $199.50 NET VALUE COMBINATION FOR $119.90



FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



ESPEY 24 WATT
MODEL 501G AMPLIFIER

MODEL 700G FM-AM TUNER ONLY— SALE PRICE **$79.95**

MODEL 501G AMPLIFIER $49.95 SEPARATE **$39.95** If Ordered with Tuner

ESPEY DEAL—1A

Espey 700G-501G tuner with 24 watt amplifier plus VM-956 GE 3 speed VM on metal base—1 Mill Diamond GE Needle $10.00 extra. Net **$144.95**

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net **$164.95**

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net **$194.95**

SPEAKERS RECOMMENDED

Order any of the following speakers with your Espey tuner and amplifier:
12" coaxial PM, CU-14Y—$10.00 extra
15" coaxial PM, P15-CR—$20.00 extra
Imperial IV system—$15.00.
Imperial VI system—$25.00.
Norelco 9762—12" regularly $59.50 at $30.00 extra.
EV84—15W system—$150.00 extra.

McGee offers you both the regular $119.50, 14 tube Deluxe FM-AM tuner and the $79.50 value 8 tube audio amplifier for the special sale price of only $119.90. The Model 700G Espey tuner has its own built in power supply. Performance features are: Sensitivity 3mv on AM, 5 mv on FM for 30 db quieting. AM selectivity 10kc at 6 db. FM 240kc at 6db. Audio response flat from 20 cps to 20,000 cps., with less than ¼ percent distortion with one volt audio output. Chassis is 14" long, 8½" high and 10" deep. Features a one-piece molded, gold color plastic front which makes a custom installation both extremely attractive and easy at the same time. Full tuned RF stages-AFC on FM with defeating switch for easy FM tuning. Built-in preamplifier for GE or other popular variable reluctance cartridges. Three position equalizer switch for LP, AES or European records. Separate bass and treble tone controls with 23db boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Has built-in ferrite loop antenna for AM broadcast band and 300 ohm input for FM band. This fine quality FM-AM tuner is 6 tubes and rectifier which was designed with no tone control or preamplifier circuits. has all of the features that you might expect of a tuner that would cost as much as $200. All of the controls are on the front panel. This is a most desirable feature when the tuner is used in conjunction with a good audio amplifier, such as the 501G

The Model 501G, 8 tube ultra linear high fidelity, 24 watt audio amplifier is made to match the 700G tuner. This amplifier is offered separately at the special sale price of $49.95, but costs you only $39.95 when purchased with the 700G Espey tuner. This amplifier features less than ½ percent distortion with high fidelity response from 10 cps to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size, 12"x5"x8". Output tubes; 4—6V6GT in push-pull Williamson circuit. 6SN7GT phase inverter and 2—5V4G rectifiers. Has an 8 pound potted case output transformer with specially made grain-oriented iron core. Output impedance taps of 4, 8 and 16 ohms. This output transformer alone is a $20.00 value.

Buy just the 700G FM-AM tuner at the special sale price of $79.95, or buy both the 700G tuner and the matching 501G amplifier for $119.90. Model 501G amplifier sale price, $49.95 when purchased separately. Tuner shipping wt. 20 lbs. Amplifier shipping wt. 22 lbs. See the special deals of the 700G-501G tuner-amplifier combination with record changer and GE cartridges for extra money saving values. Also, special discount on speakers and speaker systems when ordered with your Espey tuner and amplifier.

VM HI-FI CHANGER. SALE PRICE $29.95 LESS BASE LESS CART.

VM-936HF
$32.95

COLLARO
456 - $34.50

MONARCH
UA8H $27.95

$45.90 WITH GE RPX-052A

4 Speed Monarch SALE PRICE $27.95 with 222 Ronette Ceramic Cart. Diamond 1 Mil Stylus $10.00 Extra

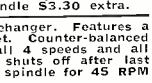
New offering of VM Hi-Fidelity, 3 speed record changer with or without metal base. A large special purchase makes this low sale price possible. Reg. net on VM-935 less cartridge was $38.97. Reg. net on VM-936 less cartridge was $45.47. The VM-935-936 Hi-Fi Series changers are equipped with two plug-in tone arm heads which will hold popular G.E. or Pickering single or dual play cartridges. Both have 4-pole motors for constant speed, hum free operation with a VR cartridge. Plays all 3 speeds and all 3 sizes. Will inter-mix 10" and 12" records of same speed. Shuts off after last record plays. Muting switch silences pickup during change cycle. Furnished with large 45 RPM spindle. Chassis size 13½ x 13¼ x 8½" high, 4½" above plate. Ship. wt. 12 lbs., with base 18 lbs.

VM-935HF, 3 speed Hi-Fi changer, less cartridge and base, only $29.95.
VM-935HF-GE with G.E. RPX-050A VR cartridge, $35.90.
VM-935HF-GED with "Golden Treasure" RPX-052A VR cartridge; 1 mil diamond and 3 mil sapphire stylii, only $45.90.
VM-936HF, 3 speed Hi-Fi changer with metal base, less cartridge, Sale price, $32.95.
VM-936HF-GE with G.E. RPX-050A VR cartridge, $38.90.
VM-936HF-GED with G.E. RPX-052A "Golden Treasure" cartridge; 1 mil diamond, 3 mil sapphire stylii, only $48.90.

4-SPEED COLLARO Latest 1957 Model RC-456. Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $46.95. Large spindle $3.30 extra.

New Model UA8, Monarch 4 speed imported High Fidelity record changer. Features a high fidelity 4 pole motor, 9" turntable with molded rubber pallet. Counter-balanced tone arm will accept most of the popular Hi-Fi cartridges. Plays all 4 speeds and all 3 sizes. Intermixes 10" and 12" records of the same speed and shuts off after last record plays. Base size, 10⅞" x 12¾". Ship. wt. 15 lbs. Large spindle for 45 RPM records, $1.88 extra.
Model UA8-H with ±222 Ronette Hi-Fi flipover ceramic cartridge, $27.95.
Model UA8-HD, same as above but with 1 mil diamond stylus, $37.95.
Model UA8-U with ±500 Goldring variable reluctance cartridge, $29.95.
Model UA8-UD, same as above but with 1 mil diamond stylus, $39.95.

GOLDRING V. R. CARTRIDGE



WITH 2 SAPPHIRE STYLII $5.95
WITH 1 MIL DIAMOND, 3 MIL SAPH. $13.95

McGee offers the internationally famous Goldring variable reluctance phono cartridge, made in England and sold throughout the world to those who want the finest and most accurate music reproduction from 33⅓, 45 and 78 RPM high fidelity phono records. (Input gain and compensation similar to G.E. v.r. cartridge required.) Furnished as standard equipment with sapphire 1 and 3 mil stylii. A regular $9.90 net item on sale at McGee for $5.95. For $13.95 with a diamond 1 mil stylus. These are the latest production, individually cartoned turnover cartridge with mounting bracket. Fits tone arms on most changers. Made for and bearing the famous Wilcox-Gay Recordio name.
No. 546 Goldring V.R. (Wilcox-Gay) cartridge, Net $5.95. No. DS46-DS, Goldring V.R. (Wilcox-Gay) cartridge with diamond 1 mil stylus, $13.95. 1 mil diamond stylus for Goldring V.R. cartridge, purchased separately, $9.95.

SAVE ON NORELCO SPEAKERS AT McGEE

World Famous Hi-Fi		Imported From Holland
12" Model 9762 reg.	$59.97	Sale Price $39.95
12" Model 9760 reg.	$32.97	Sale Price $19.95
8" Model 9750 reg.	$22.17	Sale Price $15.95
8" Model 9770 reg.	$ 9.90	Sale Price $ 7.95

NORELCO Model 9762—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice Coil imp. 8 ohms—new Alnico VI magnet gives 11,000 gauss. Regular $59.97 net, on sale at McGEE for only $39.95.
NORELCO Model 9760—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice coil imp. 8 ohms—new Alnico VI magnet gives 8,000 gauss. Regular $32.97 net, on sale at McGEE for only $19.95.
NORELCO Model 9750—8" wide range Hi-Fi PM speaker, res. 50 to 20,000 cps at 10-watts. Voice coil 6 ohms—New Alnico VI magnet gives 13,500 gauss. Regular $22.17 net, on sale at McGEE for only $15.95; or 2 for $30.00.
NORELCO Model 9770—8" wide range Hi-Fi PM speaker, res. 75 to 19,000 cps. New Alnico VI magnet gives 11,000 gauss. Reg. $9.90 net, on sale at McGEE for only $7.95; or 2 for $15.00.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $37.95

New model SH-7855S-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ5 high-powered audio. Stock No. SH78-555-X with 6x9 speaker—$37.95. With 2—5x7 speakers—$39.95; with 1—5x7 speaker $37.95. Specify speaker size wanted. Three-section top cowl mounting antenna —$2.29 extra.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.

McGee's new 15" Junior coaxial PM speaker, 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker. Sale price, $16.95.

FAMOUS STANDARD COIL CASCODE TUNERS

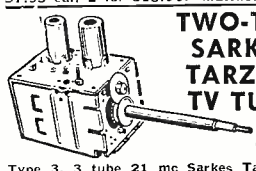
SALE PRICE **$12.95** 2 FOR $25.00

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59c a pair.

STANDARD COIL PENTODE TUNERS $7.95

5C-948, Standard Coil, 21 mc Pentode tuner with 6BC5 or 6AG5 and 6J6 tubes. Popular 12 channel, 2 thru 13, used in millions of TV sets. Why spend time repairing an old tuner when it may be easier to just replace it. Shaft can be cut to desired length. Available with 2⅞", 3", 4¼" or 4½" shaft. Specify length of shaft. Sale price, $7.95 ea., 2 for $15.00. Matched knob set 59c extra.



TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

21MC OR 41MC $7.95

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel tuner for 21mc. Used in CBS, Arvin, Crosley, etc. Ideal for general replacement. 3½" shaft. With tubes, $7.95 each, 2 for $15.00.

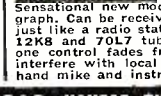
No. TT-2C, 2 tube Sarkes-Tarzian 41 mc Cascode tuner with tubes, 4½" shaft. Smallest cascode tuner made. Popular in many sets. $7.95 each, 2 for $15.00. Either of the above tuners with 9" shaft, $1.00 extra.

Type 3, 3 tube 21 mc Sarkes Tarzian tuner with tubes. Rotary switch type complete with 6C4, 6BH6 and 6AG5 tubes. Regular cost is several times our new low price of only $4.95. Wired, ready to hook-up to video and sound I.F. strip. Use with either separate sound or inter-carrier. Built-in fine tuning. 2⅞" shaft. Net, $4.95.

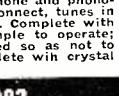
100 ASSORTED BY-PASS COND. $4.95

Do you build, service or experiment? If you do and never seem to have the right paper tubular condenser on hand, McGee offers you this assortment of 100 tubular bypass condensers for only $4.95. No two condensers are alike. You get one each of the following sizes. Stock No. CP-XI.

1 Each of the following 100 volt condensers: .01 .2 .25 .47 .5
1 Each of the following 200 volt condensers: .0012 .0015 .0018 .002 .0022 .0039 .005 .0068 .007 .0082 .01 .015 .02 .022 .027 .047 .05 .068 .08 .1 .2 .22 .25 .27 .33 .39 .47 .5
1 Each of the following 400 volt condensers: .002 .0022 .0027 .0033 .0039 .004 .0047 .005 .0082 .01 .015 .018 .02 .022 .025 .033 .039 .04 .047 .05 .08 .1 .15 .22 .25
1 Each of the following 600 volt condensers: .001 .0012 .0015 .002 .0022 .0027 .003 .0033 .0039 .004 .0047 .005 .006 .0068 .007 .008 .01 .015 .02 .022 .033 .035 .047 .05 .06 .068 .1 .15 .22 .25
1 Each of the following 1000 volt condensers: .0015 .0022 .0027 .003 .0033 .0082 .01 .047
Plus 1 each of the following: .007—1600v .007—2000v .001—3000v



MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE



SALE PRICE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete wih crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

"Operation Smoke-Puff"

By O. F. VILLARD, JR., W6QYT and R. S. RICH, W6OPX
Radio Propagation Laboratory
Stanford Univ., Stanford, Calif.

AN EVENT of great interest to radio amateurs—in fact to all users of the ionosphere for long-distance communication—occurred on March 12, 1956. On that date an "Aerobee" rocket, fired from Holloman Air Force Base, N. M., into the E-layer of the ionosphere, apparently created a man-made cloud of ionization by releasing some 18 pounds of nitric oxide gas.

That an ion cloud appeared there can be no doubt, since it was detected simultaneously on the screens of at least two different radars. The fact that the cloud showed up shortly after the release of the gas is highly significant. The presumption is, therefore, that the experiment was successful. If ions can be produced in later tests, it will be possible to say that the March rocket firing represents the first time that man has ever created ionization in the ionosphere in an experiment expressly designed for that purpose.

The U. S. Air Force proposes to continue with tests similar to those performed last March and would like to invite radio amateurs and SWL's to participate in the task of determining: (a) whether ion clouds are really formed, (b) how large they are, and (c) what becomes of them after they are formed. All these things can be explored quite effectively simply by seeing to what extent the cloud is capable of reflecting radio waves.

Since the present assault is on the E-region of the ionosphere, the reflecting cloud will be at a height of approximately 70 miles. Owing to the earth's curvature, such a cloud will only be able to reflect signals between stations whose locations are indicated on the map of Fig. 1. This area is centered on the rocket's launching point at Alamogordo, N. M. and is deliberately made a bit generous to account for the possibility that some clouds may drift appreciably during their estimated lifetime of 10 or 20 minutes. The aim, as can be seen, is to generate an artificial patch of "short skip."

Stations at locations within this area wishing to participate in the tests, will be advised by mail of the expected dates and times of rocket firings. They may then listen to the range count-down station, which operates on 4870 kc. and should be audible over most of the area at most times of day. This station broadcasts the status of the test and gives the number of minutes until the expected firing time, followed (for a period) by the number of minutes after the rocket has gone off.

The best frequency band for getting a bounce from the cloud will depend on the time of day. Tests are planned for morning twilight, noon, and evening twilight, and some may be held at night. In general, the 14, 21, 30, 50, and 144 mc. bands may be useful. It is proposed to designate a particular frequency in each band as the one to be used by the stations participating in the test. All participants will be sent a list of each others' call letters so as to save time in checking to see if a station is within the area of the test.

A postcard to the authors of this ar-

ticle who have been designated as coordinators of the amateur activities in connection with the project, in care of the Radio Propagation Laboratory at Stanford University, is all that is required of participants. If you live within the indicated area, your name will be placed on a mailing list and you will receive a questionnaire, some detailed suggestions, logs sheets, and information as to test times. You will also be advised, after each firing, whether the experiment went off as planned.

In order to make this project more enjoyable, it has been decided that each ion cloud test would be run as sort of ad hoc sweepstakes contest, wherein participants would exchange serial numbers and earn a score proportional to the number of stations contacted, the total number of contacts, and the number of bands used. Contestants on a given frequency band may contact each other more than once, but not more often than once every three minutes. The three highest scoring participants (phone, c.w., and SWL) in each rocket firing will receive certificates from the Air Force.

All participating stations should initially have their beams pointing in the direction of Alamogordo and the cloud. Transmission should open up more or less simultaneously. It will be best to start out at a relatively low frequency, say, 14 or 21 mc. As soon as the cloud-reflected signals are identified, an attempt should then be made to operate in the highest available frequency since the high frequencies may be expected to drop out first. A cloud-reflected signal will fade and this fading may help to distinguish such signals from ground wave or extended tropospheric propagation.

Hams and SWL's having tape recorders are asked to record the output of their receivers and send them in on the tape. The recordings will be analyzed for fading rates, etc. and will be quite valuable. Tapes will be transcribed and returned promptly.

Mexican ham and SWL participation is especially sought. Coverage south of the border is urgently needed. XE stations should have a definite advantage over the W's in this contest.

The proposed tests offer a real challenge to skilled ham operators and provides a chance to render an important service in furthering upper-atmosphere research. Here's a chance to make history and have fun too. Anyone for "Operation Smoke-Puff," gang? —30—

Fig. 1. General area in which communication by cloud reflection should be obtainable.

FM "Musicasting" —a New Industry

By WALTON N. HERSHFIELD
President, Harkins Broadcasting Co.

One broadcast station's experiences with multiplexing and how it actually pulled the station out of the red.

ON MARCH 28, 1955, the Federal Communications Commission authorized multiplexing on commercial FM stations and created an entirely new industry.

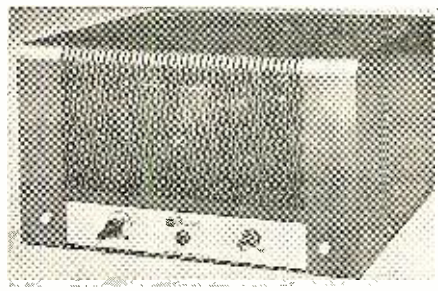
Although faced by such technical problems as crosstalk, multi-path fading, and noise, an intrepid group of pioneers plunged undaunted into the business. In Jackson, Tucson, Phoenix, Cincinnati, Augusta, and many other American cities, salesmen ventured forth to tell American business and industry the story of FM "musicasting" and extol its benefits.

Day and night station and field service technicians worked; installing, aligning, and improving their new product. Daily, the confidence of the salesmen increased and the technicians became more familiar with this intriguing and unique science of transmitting three separate programs, simultaneously, on an FM carrier.

For those unfamiliar with multiplexing, the FM station transmits its regular 50 to 15,000 cycle audio program plus two supersonic tones (usually 41 and 67 kc.) which are above the range of human hearing and inaudible on a regular FM receiver. However, with a special receiver, the supersonic tone is amplified and detected to provide a separate program. This program is usually continuous background music, of constant volume level, without vocals or commercials. The industry has dubbed this service FM "musicasting."

The sales story for FM "musicasting" is one of quality coupled with economy. A simple receiver without moving parts is connected to a standard amplifier and continuous background music is available to the user—usually 19 hours a day, from 6 a.m. to 1 a.m.

The economy of this type of service is obvious since there are no telephone line charges to pay, no expensive record-player or tape recorder to buy, maintain, and operate. The musical variety is limited only by the total number of suitable recordings available at the station. At the author's operation there are 7000 selections, representing some 350 hours of programming without repetition. Only with central programming using eight hour tapes can this variety of selections be made available to the subscribers since few businesses not directly connected with the audio field could afford the space to store such a varied record collection.



A typical FM "musicast" receiver.

Now for a quick look at the market potential for this type of service. When a group of hard-headed broadcasters leap into an unproven and untried field, you can be certain that there are some substantial incentives behind their decision. A look at any city population index will show that there are over 125 cities in the United States with a population in excess of 100,000. Each of these cities is capable of supporting one or more successful "musicasting" operations.

It is estimated that the average number of subscribers per town is 400. This figure varies, of course, from 100 sets in the smaller communities to 3000-4000 in cities the size of New York, Chicago, and Los Angeles. A little multiplication indicates that there is a potential market for almost 50,000 receivers. The average monthly charge for background music service of this type is $25.00 per receiver. This means a monthly national rental income of $1,250,000 or a brand-new industry grossing $15,000,000 a year—which is not "chicken feed."

The next question that naturally arises is how much does it cost to enter the "musicasting" field. First, of course, you must have an FM station. At KTYL-FM our station was seven years old and had yet to show a nickel's profit. A study of our signal pattern indicated that the station should be able to cover the entire metropolitan area of Phoenix with its total population of 400,000. The market potential was estimated at some 400 receivers.

After careful thought, the station decided against installing and servicing the equipment and arranged with *Ra-Tone Electronics Co.*, a commercial sound distributor, to handle that phase of the operation.

On January 5, 1956 we threw the switch and commercial FM "musicasting" became available throughout the metropolitan Phoenix area. Our first installations, on a trial basis, were in a national chain clothing store, a grocery store, a bank, and one of the local night clubs.

Since that date, our salesmen have placed the service in over 100 establishments in Phoenix and we are adding new subscribers daily. But still more important, the FM station is operating in the black for the first time in its history. Listeners on the regular FM channel can enjoy daily programs of fine classical and semi-classical recordings—a service that the station could not have afforded to continue without the "musicasting" revenue.

Even if you don't own an FM station but still want to get into the "musicasting" field, there are some 600 such stations which could be approached. To date only about 30 FM stations are using their facilities for multiplex operation. Any sound distributor or TV service technician with the capital to invest in receivers (about $100 per unit) would be welcomed by most FM broadcasters.

Our initial investment in transmitting equipment was about $6000 including tape machines. Using regular bank financing, our initial capital outlay was only $3000 for transmitting equipment and receivers. We are not only liquidating our indebtedness to the bank but making a profit. Our associated service organization is enthusiastic since this new venture represents an entirely new field of sound equipment sales to them.

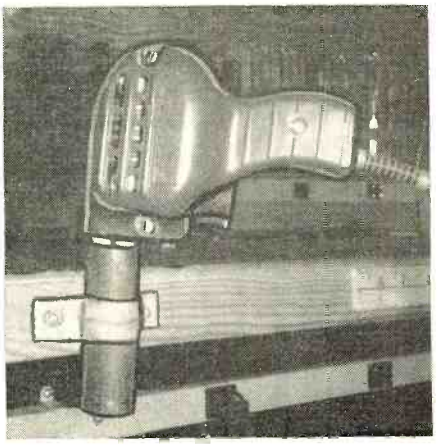
If you are enterprising, have determination, and a little ready cash, a whole new industry is ripe for plucking. —30—

SOLDER GUN "HOLSTER"

By RAY HAWKSLEY

A SIMPLE and sturdy solder gun holder can be made from a piece of ¾" pipe about 3½" long, fastened to the edge of the bench with an ordinary pipe strap. This gets the gun off the bench when not in use, but makes it easy to pick up when wanted. The holster also prevents damage to the tip which might occur if the gun were hung up on a nail. —30—

"Holster" your solder gun for safety sake.



Mac's Service Shop

(*Continued from page 70*)

"From what I've read, that's where trouble begins," Barney said with a grin.

"Possibly so, but that's what I want to find out. I'm just mule-headed enough to believe I can learn to do anything anyone else has done. This color set is going to be my guinea pig, and before I'm through I hope to be able to make every adjustment on it quickly, correctly, and confidently. It may take me a week to do a complete 'set-up' job on it the first time; but eventually I expect to cut this down to less than an hour. I'll say this: everything I've read about color sets and have heard in lectures takes on a new and much more 'real' meaning when I have a color set right in front of me; and it's mighty nice to know I can take all the time I want in making adjustments without having to worry about getting the set back to an impatient customer."

"I've been told you have to be constantly adjusting a color set. Right?"

"Not in my experience. Last night I tuned in on a color program at six-thirty and spent the first couple of minutes adjusting the hue, color, contrast, brightness, and fine tuning controls for what seemed to be the best color picture—and incidentally, every one of these affects the color—then I did not touch the set again until the end of the color programming at nine o'clock. You can, if you like, be messing with the controls constantly trying to compensate for slight differences existing between color cameras, studio lighting, and—in this fringe area—signal strength; but I'm about convinced that one of the most important controls in the enjoyment of colored television is self control. On a hunch, I ran a bunch of my prize slides through the projector last night, and in practically every one of them I felt I could make a marked improvement if I could just twist a 'hue' or 'color' knob a little this way or that!"

"Does noise interfere more with a weak color signal than it does with black and white?"

"I can't see that it does; but *you* do!"

"What do you mean by that crack?"

"I never heard a peep out of you on my black-and-white set when you were operating seventy-five meters; but night before last you were coming in very loud and clear on the sound, even though you did not disturb the picture. I put a high-pass filter in the antenna lead, and that took care of you. It was a simple case of fundamental overload and actually has nothing to do with the set's being a color receiver."

"Outside of getting first-hand information on what can be expected in the way of color reception in this area and getting some experience in adjusting color sets, what else do you expect to gain by having a color set?"

"I want to know if the adjustments are stable over a long time or require touching up. I want to see for myself how much more service a color set is going to require than a black-and-white receiver. I want to know what components fail in a color set and how hard they are to locate when they do fail.

"Mostly, though, I want to prove something to myself. I've often noticed things that look terribly complicated and difficult from a distance lose much of this quality once you become familiar with them. While I'm not kidding myself that color TV service is going to be a snap, I still have a strong hunch it's not so bad as a lot of the technicians who go around scaring one another about it think. In other words, I'm going to become familiar with color TV. While in this case I do not expect familiarity to breed contempt, I do expect it to dissipate unreasoning fear."

"One final question," Barney said. "How does a black-and-white picture on a color set compare with the same picture on a black-and-white set?"

"That's one of the things I wanted to know, too; and that's why I arranged the sets side by side. The pictures are different. The color set picture has a slightly bluish tinge, but not any more than many black-and-white sets—and of course this tint can be changed. Also the dot structure gives the color set picture more of a 'satiny' look and actually makes it seem to have more detail than it does, for when I compared test patterns on both sets the detail was approximately the same. People who like an extremely high contrast picture prefer the black-and-white set; but those who like a softer, lower-contrast picture—and incidentally these seem to outnumber the others around here—go for the color set picture.

"But why should I try to describe it. Bring Margie over this evening and see for yourself. The SRO spaces are only fifty cents each; but of course if you want to sit on the love seat, that will be an extra four bits a head."

"Reserve the love seat! We'll be there!" Barney exclaimed. —30—

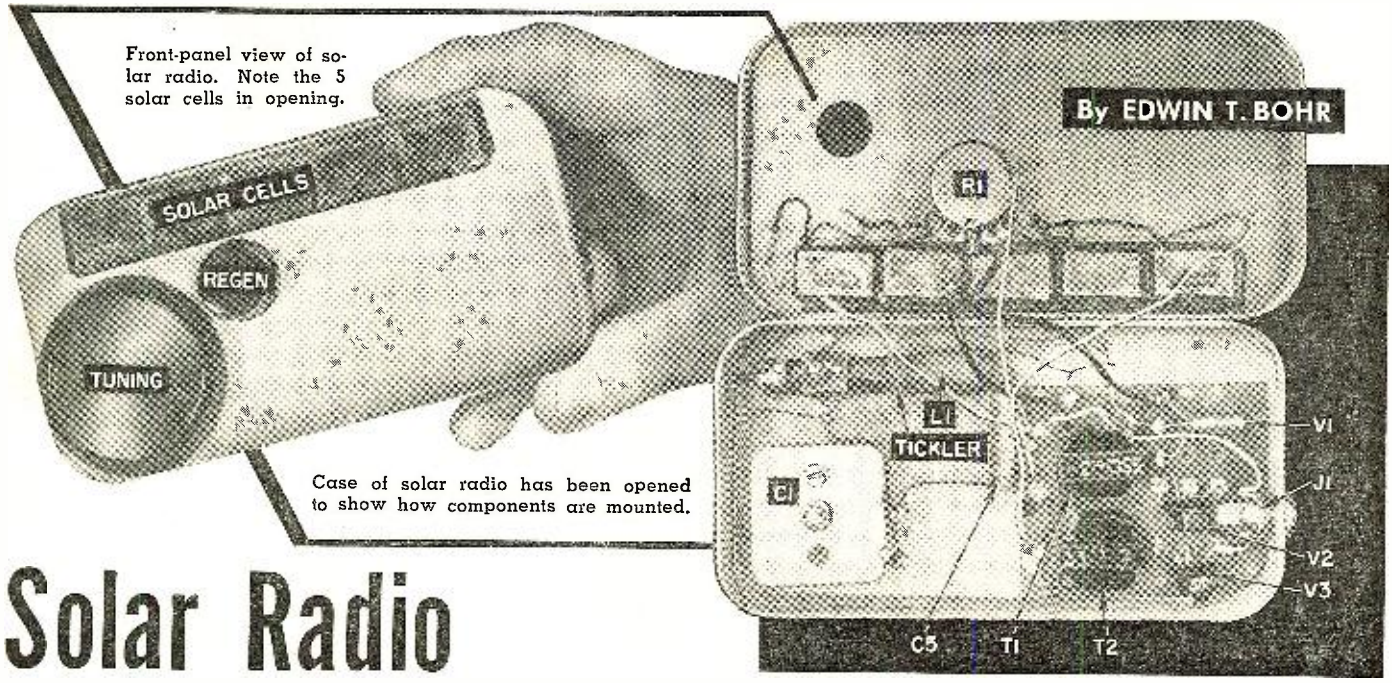
TV AND X-RAYS

By PROF. A. V. J. MARTIN

PERSISTENT rumors have been going around to the effect that television picture tubes emit harmful "x-rays". Many technicians have been queried about the possible danger of exposure with long viewing sessions.

A definite answer to this question has been provided by the Liege University in Belgium. Two geiger counters were used in making the test. The background count for one unit was 60 while for the second, more sensitive unit, the count was 90.

Four different television receivers were switched on and the counters held less than two inches away from the tubes. No difference was noted in the counts on the geiger units, indicating no radiation. The experimenters stress that there is no danger due to x-ray radiation from TV receivers. —30—



Front-panel view of solar radio. Note the 5 solar cells in opening.

Case of solar radio has been opened to show how components are mounted.

By EDWIN T. BOHR

Solar Radio with Surface Barrier Transistor

Sensitive 3-transistor regenerative receiver operates from solar cells, uses new surface barrier transistor.

THE tiny solar radio to be described receives stations up to one hundred miles away without an external antenna! The styling is smart and attractive; and there is plenty of reserve volume for earphone operation.

Selectivity is very sharp, enough to separate even the most closely spaced local stations. All of the parts are easily obtained, no special items needed, and there is a minimum of necessary special drilling and cutting. The cabinet is a standard 4⅝" x 2¼" x ¾" plastic case that costs only twenty cents.

Circuit

Although the circuit is not a superhet, it has plenty of zing and go. In fact, it has as good long distance reception as many four-transistor superhets. Two *G-E* 2N107 transistors are used in the audio stages and a *Philco* SB-100 surface barrier transistor in the regenerative detector.

Only five inexpensive *International Rectifier* solar cells are necessary to power the entire three-transistor circuit. The high-efficiency surface barrier transistor makes this possible since it oscillates vigorously throughout the broadcast band with less power consumption than any other readily available transistor.

A type of regenerative surface barrier circuit, presenting an unusual degree of smoothness and freedom from spurious audio squeals, has been developed for the surface barrier transistor. Unfortunately, it could not be used in the solar radio, however, because of the power loss in the required biasing resistors. The circuit used is conventional.

One of the solar cells supplies the emitter bias through individual emitter resistors. This results in an exceedingly well stabilized circuit immune to the usual temperature effects, transistor aging, and individual transistor idiosyncracies. Many novelty transistor circuits employ less complicated circuits using fewer components, but these circuits are completely at the mercy of the foregoing effects.

The remaining four solar cells are connected in series to provide the collector voltage. Each transistor stage operates with a carefully apportioned amount of power. Since the collector current is almost exactly equal to the emitter current, the reader can ascertain the power level of each stage by noting the value of the emitter resistance. The audio output stage, of course, operates with the largest signal and has the smallest emitter resistance. The first audio stage has a larger emitter resistance because it handles a much smaller signal.

Although the detector amplifies a smaller signal than either of the audio stages, there is a certain minimum emitter current necessary for regeneration. Consequently, the detector consumes more current than the first audio stage, but less than the audio output stage. An approximate value for the emitter current can be had by simply dividing the emitter supply voltage by the emitter bias resistor.

Construction

The problem of a suitable cabinet, cutting the holes, and mounting the components always consumes more time than wiring the circuit. Our solar radio, by design and short cuts, keeps such dull labor at a minimum. The cabinet is a *Lafayette* MS-160 plastic case which has been given a coat of *Krylon* spray. Possibly other brands of spray can be used, but with certainty we can say the *Krylon* produces a very beautiful finish.

Transparent tape masks the solar-cell area when the outside of the case is sprayed. Inside, where the solar cells will be cemented, should also be masked, since invariably some of the spray will reach the inside case surface. The *Krylon* will dry to the touch in a matter of minutes, but several hours are necessary for the spray to reach a completely hard, tough finish.

We suggest that you try your spraying skills on a scrap piece of plastic or box before spraying the solar radio case. *Krylon* is available in many beautiful colors. Chrome yellow is attractive and a recommended color.

The tuning capacitor is one of the new "solid dielectric" types. This capacitor is not mounted to the case front, instead, it is welded to the main body of the case. To do this, wet the back of the tuning capacitor with *General Cement* service solvent two or three times. Also, do the same thing to the inside of the case where the tuning capacitor will be mounted. Now press the back of the capacitor hard

against the case and, at the same time, twist it back and forth, finally positioning it in the proper place.

The solid dielectric tuning capacitor is now available with a flattened and tapped shaft that will fit most knobs, but some knobs will require a little more flat which a few file strokes will take care of nicely. To accommodate the knob shank, a large hole is required in the cover. To avoid cracking of the cover, drill a smaller hole and ream it to the necessary size.

Only two more holes are necessary, one for the regeneration control and another for the earphone jack.

The solar cells, ferrite antenna coil, and some of the internal wiring are cemented in place. Rigid leads from the earphone jack and cemented-in-place wires from the tuning capacitor are all that hold the circuit chassis in place. This is sufficient since the chassis is very light weight.

The "Sub-SubOuncer" audio transformers are held in place by pulling their leads through the terminal board and soldering them to the proper terminals. Again, this is satisfactory because of their light weight. It certainly would not do, however, with conventional electronic circuitry.

Of course, the lid must be securely attached to the case. Straight pins are used for this. Cut two pins to a ¼" length, warm with a soldering iron, and push one in at each end of the cabinet through both the cover and case. Do not overheat the pin! The result is a very secure fastening that can be removed, if necessary, by prying with a fingernail or knife blade.

The parts used in this construction merit a few remarks. The ferrite antenna coil is one of the newer types which are tapped for transistor operation. A tickler is added by winding ten turns of wire near the terminal end of the antenna coil. The size of this wire is not too important, but it should be light and flexible.

The short antenna wire supplied with the ferrite antenna coil is wound around inside the case and cemented in place. After the tuning slug is adjusted for the proper tuning range, part of the adjusting screw must be cut off to reduce the over-all length.

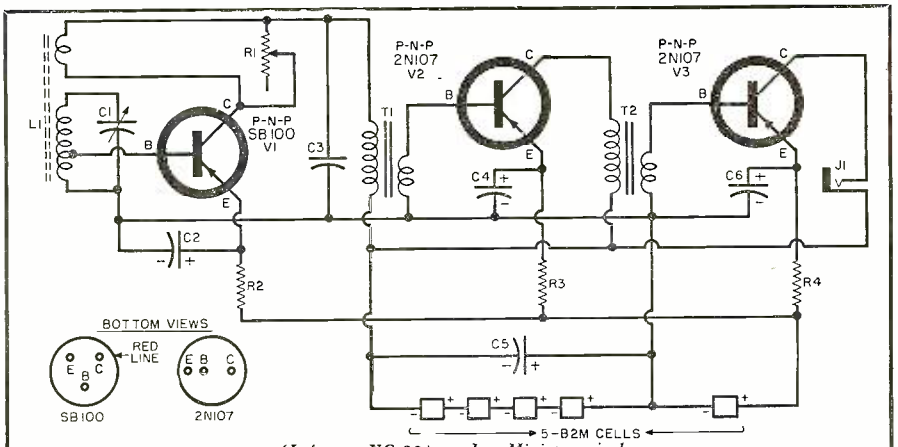
The electrolytic emitter bypass capacitors are the very small type designed for transistor circuitry. The smaller DOT-1 (*UTC*) transformers may be substituted for the same company's SSO-3 transformers. In fact, almost any of the interstage transistor transformers are satisfactory. The earphone jack employed is a subminiature type.

Several wires are necessary between the chassis and lid. The excess flexible wire salvaged from the solar cells is excellent for this purpose.

Operation

With construction complete, plug in the earphones and hold the radio in direct sunlight. If any one of the five cells is covered the receiver will not operate, so be careful not to cover any of the cells with your fingers. As the regeneration control is rotated back and forth, a putt-putt oscillation sound should be heard at one extreme of rotation. Now rotate the regeneration control until the oscillation just stops and you are ready to tune in stations. If it does not oscillate, swap the two leads from the tickler.

Local stations will come in without an external antenna and require a minimum of regeneration. Distant stations sometimes can be received without an external antenna, but the regeneration adjustment is critical. At night, operating the receiver under a strong electric light, stations four to six hundred miles away can be received. For greater sensitivity, an external antenna may be added to the short antenna coil wire.



R_1—1000 ohm miniature pot (Lafayette VC-32)
R_2—1000 ohm, ½ w. res.*
R_3—3300 ohm, ½ w. res.
R_4—470 ohm, ½ w. res.*
C_1—365 μμfd. miniature tuning capacitor (Lafayette MS-274)
C_2, C_4, C_6—8 μfd., 6 v. elec. capacitor (Barco P6-8)
C_3—.002 μfd., 400 v. capacitor (Acrovox P83Z microminiature)
C_5—25 μfd., 6 v. elec. capacitor (Barco P6-25)
L_1—Ferrite antenna coil (Lafayette MS-299) with 10 turn tickler added (see text)
J_1—Miniature jack
T_1, T_2—Plate-to-line trans., 10,000 ohms to 200 ohms; 25,000 ohms to 500 ohms (UTC "Sub-SubOuncer" SSO-3 or UTC DOT-1, see text)
V_1—Surface barrier transistor (Philco SB-100)
V_2, V_3—"p-n-p" transistor (G-E 2N107)
5—Solar battery cells (International Rectifier B2M)
** R_2 and R_4 to be changed to 3900 ohms and 2700 ohms respectively for battery operation, see text.*

Complete schematic diagram of 3-transistor regenerative receiver using solar cells.

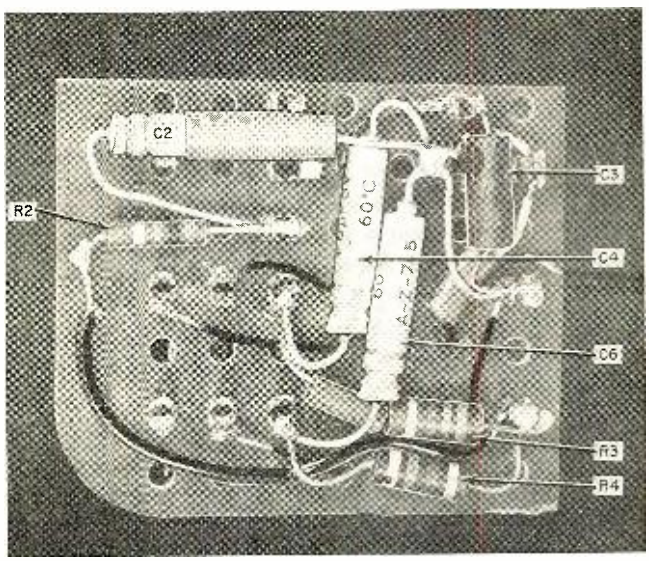
Battery Operation

This receiver works exceedingly well with a simple battery supply. For battery operation, do this: Substitute a single mercury or dry cell for the bias solar cell and two cells in series to replace the four collector solar cells. Also change the emitter resistors to the values shown with the asterisks.

This radio, considering the simplicity of the circuit, performs well enough to be taken out of the novelty category. It has definite utility and shows just what can be accomplished with only two milliwatts of power supply.

We have used both standard earphones and the lightweight hearing-aid type without the earplug insert. Of the two, the regular earphones certainly are far superior in tonal quality, volume, and clarity. Too, they shut out more distracting noise. This accounts, in large part, for the better performance.

The builder may have trouble finding the surface-barrier transistors locally. *Lafayette Radio* catalogues these units and carries them in stock. —30—



View of underside of circuit subassembly on which is mounted all the components except controls, solar cells, and the ferrite-core antenna coil with tickler.

Within the Industry

(*Continued from page 32*)

announces the purchase of **WARREN PLASTICS CORPORATION,** and its subsidiary, **GROPP ENGINEERING DIVISION.** Both firms are wholly owned subsidiaries of the parent organization . . . Formation of **SYLVANIA-CORNING NUCLEAR CORPORATION** is announced by **SYLVANIA ELECTRIC PRODUCTS INC.,** and **CORNING GLASS WORKS,** joint owners of the company. The firm has been established for the purpose of expanded research, development, and production activities in the atomic energy field. Headquarters will be in Bayside, L. I. . . . Preliminary plans have been completed for the **KAMA INSTRUMENT CORPORATION** to become a wholly owned subsidiary of **THE NARDA CORPORATION.**

* * *

JOHM M. KELLIE has been appointed controller of *Radio Condenser Company . . . Potter Instrument Company, Inc.* announces the election of **EDWARD D. GRAY** as vice-president . . . **JOSEPH P. BOUR** is now sales manager of the *Duotone Company* . . . **T. ROBERT BURNIGHT** has been appointed director of engineering for *The Maico Company, Inc.* . . . **DR. ARTHUR O. McCOUBREY** has joined the *National Company, Inc.* as head of the organization's physics department . . . *International Resistance Company* announces the appointment of **FRANK G. DAVELER** as division manager, computer components division . . . **JAMES M. IGOE** has been appointed distributor sales coordinator for the operation sales services department of the *Raytheon Manufacturing Company . . . Electro-Pulse, Inc.* announces the election of **THOMAS C. RIDGWAY, JR.** as treasurer . . . The promotion is announced of **M. E. (MEL) KRUMREY** as manager of the jobber division of *Q uam-Nichols Company* . . . **SAM I. PICHEY** has been named sales manager for *Electrical Communications, Inc.* . . . *Ampex Corporation* announces the appointment of **PAUL O. FRINCKE** as director of video service engineering . . . The appointments of **A. K. MALLARD, R. W. FRISBEE,** and **R. K. JOSLIN** to new posts in the *RCA* tube division are announced by the company. Mr. Mallard is now manager, entertainment sales coordination, a newly created position; Mr. Frisbee is manager, industrial sales coordination; and Mr. Joslin is the new district manager of the Dallas territory . . . The newly organized *Tucson Instrument Corporation* has elected **FRANK R. PERIER** president and treasurer . . . **WILLIAM D. TASKER** is now production manager of *Microwave Associates, Inc.* . . . **NORMAN C. ANDERSON** is appointed vice-president, photoconductor-transistor division for *Electronics Corporation of America* . . . **ROBERT F. SIM, JR.** has been named manager of the distributor order service department for receiving and picture tubes, *Raytheon Manufacturing Company* . . . The promotion of **WILLIAM H. MADDEN** to distributor trades sales manager, magnetic products division, is announced by *Minnesota Mining & Manufacturing Co. . . . Sylvania Electric Products Inc.* announces the appointment of **ERNEST H. ULM** as general sales manager for the semiconductor division . . . The election of **THOMAS ALLINSON** as vice-president of marketing of *Daystrom, Inc.* is announced . . . **ORGAIN E. McCULLOUGH, JR.** is named as assistant to the president of *Clevite Corporation* . . . The promotion of **CHARLES PRAWDZIK** to chief engineer, device development section, *General Transistor Corp.* is made known by the company . . . The appointments of **MURRAY ELLIS,** and **SAMUEL WIEGAND** as assistant managers in the sales department of *Datamatic Corp.* are announced by the firm . . . **WILLIAM SPANG** has been made quality control supervisor of the *Cambridge Thermionic Corp.* . . . **WARREN F. MORGAN** is elected vice-president in charge of customer relations for *Federal Electric Corp.,* service and maintenance organization of the *International Telephone and Telegraph Corporation* . . . **E. S. WILLIS** is now sales manager of the electro-mechanical division of *Erie Resistor Corporation* . . . **JERRY BADLER** is appointed to the post of purchasing agent for the *Aerovox Cinema Engineering Division* . . . The *Electronic Specialty Co.* announces the appointment of **WILLIAM R. MARTIN** as chief engineer and product manager of the r.f. systems and components division . . . **PAUL J. WEBER** is the newly appointed marketing manager for the instrumentation division of *Ampex Corporation* . . . **RICHARD D. HANSON** has been named manager of manufacturing for *Donner Scientific Co.* . . . **ERIC DYMOND** has been appointed assistant manager of electronic component sales of *Sangamo Electric Co.* Also, **R. R. WYLIE** has been named to the newly created position of marketing manager . . . **EDWARD W. ALLEN, JR.** is now manager of public relations at *Allen B. Du Mont Laboratories, Inc.* . . . **MICHAEL BALOG** has been appointed general manufacturing manager of the semiconductor division of *Sylvania Electric Products Inc.* . . . The appointment of **EDMOUR F. GIGUERE** to the newly created position of manager, new market coordination, is announced by the *RCA* components division . . . **A. JOHN HINCK,** and **ALBERT STEADMAN,** the first employees of *Allen B. Du Mont Laboratories, Inc.* have received 25-year service pin awards. —30—

STARVED ROCK HAMFEST

THE 11th annual hamfest of the Starved Rock Radio Club has been scheduled for June 9th (Sunday) at the LaSalle County 4-H Fairgrounds near Ottawa, Ill.

Almost 5000 hams and their families attended last year's gathering so the committee is making plans to accommodate an even larger number this year.

Midwest hams are cordially invited to attend this get-together. Contact George E. Keith, W9QLZ, club secretary, for additional details on this event. —30—

Superior's New Model 770-A

The FIRST Pocket-Sized VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER 71% MORE SCALE AREA!

Yes, although our new **FULL-VIEW** D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

• Compact — measures 3⅛" x 5⅞" x 2¼". • Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

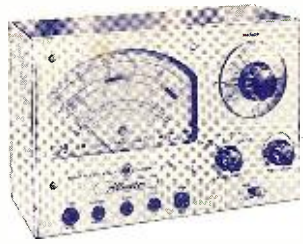
Specifications — • **6 A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

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

$15.85 NET

Superior's New Model TV-60

20,000 OHMS PER VOLT ALLMETER



AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified at right except that it is used for the location of cause of trouble in all audio and amplifier systems.

SPECIFICATIONS

8 D.C. VOLTAGE RANGES (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.
7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES: —6 db to + 58 db.
R.F. SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

FEATURES

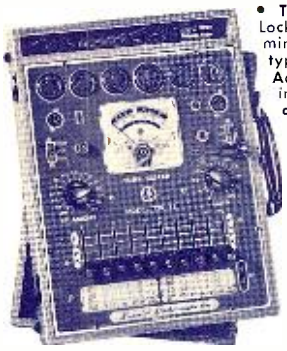
Giant **recessed** 6½ inch 40 Microampere meter with **mirrored** scale. Built-in Isolation Transformer. Use of the latest type **printed circuit** and 1% multipliers assure unchanging accurate readings.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Plio-film bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

$52.50 NET

Superior's New Model TW-11 STANDARD PROFESSIONAL

TUBE TESTER



• Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyraton, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc. • 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 TW-11 as any of the pins may be placed in the neutral position when necessary. • The Model TW-11 does not use any 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. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the standard scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

Superior's New Model TV-12 TRANS-CONDUCTANCE

TUBE TESTER

ALSO TESTS TRANSISTORS!

TESTING TUBES

• **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

• **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

• **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

• **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE!

Cut out and mail TODAY!

All prices net, F.O.B., N.Y.C.

FIRST CLASS
Permit No. 61430
New York, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the U. S.

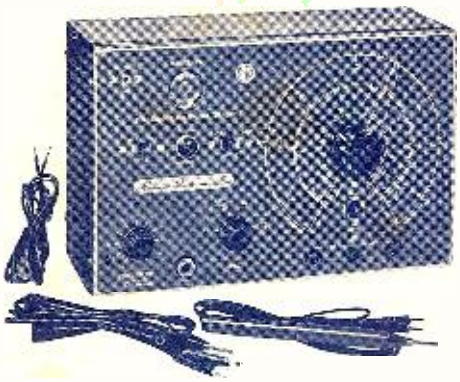
VIA AIR MAIL

POSTAGE WILL BE PAID BY —

MOSS ELECTRONIC DIST. CO., INC.
3849 TENTH AVENUE
NEW YORK 34, N. Y.

Superior's New Model **76**

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!



IT'S A
CONDENSER BRIDGE
with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A
RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms

IT'S A
SIGNAL TRACER
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A
TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

SPECIFICATIONS

✔ RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

✔ CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✔ SIGNAL TRACER SECTION
A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✔ TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy .....Only **$26.95 NET**

Superior's New Model TV-50

GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio • F. M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- ✔ R.F. Signal Generator for A.M.
- ✔ R.F. Signal Generator for F.M.
- ✔ Audio Frequency Generator
- ✔ Bar Generator
- ✔ Cross Hatch Generator
- ✔ Color Dot Pattern Generator
- ✔ Marker Generator

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

CROSS HATCH GENERATOR: Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only **$47.50 NET**

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-347 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. 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-A Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-60 Total Price $52.50 $12.50 within 10 days. Balance $8.00 monthly for 5 months.
- ☐ Model TW-11 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-12 Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ Model 76 Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-50 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

Name .....

Address .....

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

All prices net, F.O.B., N.Y.C.

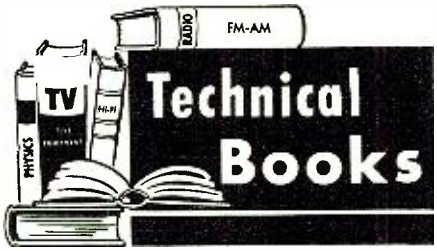
We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE!

◀ Cut out and mail TODAY!



"AN INTRODUCTION TO JUNCTION TRANSISTOR THEORY" by R. D. Middlebrook. Published by *John Wiley & Sons, Inc.,* New York. 292 pages. Price $8.50.

This book is for the electrical engineer who finds it advantageous to understand the physical processes in semiconductors as related to circuit properties of the junction transistor.

The author first deals with the physical qualities of semiconductors and the theory that applies to this type of component. The second and third parts of the book are devoted to actual circuit applications under various circuit parameters and special conditions.

The material, as presented, is thoroughly practical but the reader must have a strong mathematical background as the treatment is largely mathematical. An appendix listing the properties of germanium and silicon is included as are references at the end of each chapter for additional study. An excellent basic work for the engineer.

* * *

"THE ELECTRONIC MUSICAL INSTRUMENT MANUAL" by Alan Douglas. Published by *Pitman Publishing Corporation,* New York. 242 pages. Price $7.50. Third Edition.

In revising this third edition the author points out that so many new circuits and techniques have been developed since the Second Edition made its appearance some three years ago, this new edition is justified.

As with the earlier volume, the text covers the electronic generation of music, describes conventional multi-note instruments; the production and mixing of electrical oscillations; amplifiers; tone controls and loudspeakers used with electronic musical instruments; commercial instruments; experimental methods; and, finally, provides schematic diagrams of circuits used in *Hammond, Solovox, Clavioline, Novachord, Conn,* and *Hammond* pedal instruments.

* * *

"HI-FI EQUIPMENT YEARBOOK—1957" edited by Sanford M. Herman. Published by *Herman & Stephens,* New York. 127 pages. Price $1.95. Paper bound.

This is a listing of commercially available audio equipment with specifications, prices, physical size, and photographs (as supplied by the manufacturer) on amplifiers, tuners, phono equipment, speakers, cabinets, and tape recorders. The products of most of the well-known audio manufacturers have been included.

An introductory section entitled "The Presence of Distortion and the

Distortion of Presence" is written by Peter Aczel, an ardent hi-fi fan.

* * *

"U.H.F. TUBES FOR COMMUNICATION AND MEASURING EQUIPMENT" by Electron Tube Division Staff. Published by *Philips Technical Library,* Einhoven, Holland. 60 pages. Price $1.50. Available from booksellers or from the publisher direct.

This handbook covers tubes designed to operate at frequencies of 300 mc. and up. Radio and radar gear, navigation equipment, two-way radio equipment, etc. are all shifting into the higher bands hence the need for information about the tubes designed to handle these u.h.f. and s.h.f. waves.

The text covers the *Philips* DC70, EC80, EC81, EC55, EC56, EC57, 2K25, 723A/B, K81A, K50A, and K51A tubes. Technical data, application notes, and other pertinent data is provided in the form of performance graphs and electrical and mechanical tabular material.

* * *

"TUBES FOR COMPUTERS" by Electron Tube Division Staff. Published by *Philips Technical Library,* Einhoven, Holland. 51 pages. Price $1.50. Available from booksellers or from the publisher direct.

The fast-growing computer field has focused the attention of engineers on various electronic tubes which have been designed for or are especially suitable for computer applications.

This compact handbook provides general notes on computer circuits and discusses the various tubes for use in high- and low-speed computers. The material covers tubes of *Philips'* manufacture but since many of these components are available in the U. S., the reader will find this discussion both interesting and useful.

* * *

"TUBE SELECTION GUIDE 1956-1957" compiled by Th. J. Kroes. Published by *Philips Technical Library,* Einhoven, Holland. 124 pages. Price $1.50. Paper bound. Available from booksellers or from the publisher direct.

This compact tube handbook, whose instructions are carried in English, French, German, and Spanish, is designed to assist electronic tube users in selecting the correct tube for the job at hand. The text is divided into various tables which list all tubes in the *Philips* manufacturing range or which can be replaced by suitable *Philips* equivalents, tubes by important properties, preferred tubes for new apparatus, tubes for replacement purposes only, and tubes which may be used for the replacement of obsolete types. Descriptions of type-number systems and data on several tube bases and tube holders are also included; an invaluable aid to engineers, technicians, and those who work with various electronic gear of European manufacture.

* * *

"PIN POINT TV TROUBLES IN 10 MINUTES" compiled by Coyne Staff. Published by *Coyne Electrical School,* Chicago and distributed by *Howard W. Sams & Co., Inc.,* Indianapolis. 299 pages. Price $3.95. Spiral paper binding.

According to the compilers of this handbook some 700 receiver troubles will result in 70 basic types of faulty pictures. It is to help service technicians pin-point these circuit difficulties that this unique system for locating faults has been devised. Simple check charts, along with cross-references allow the rapid, accurate location of the most probable causes for each picture symptom. Having localized the fault to a specific section of the receiver, the technician should then be able to correct the trouble in minimum time and with little effort.

Although no single book can list all the ills that might beset a TV circuit, this volume has made an excellent stab at the problem. TV receiver circuits from 1953 on are covered in this presentation. Service technicians should find this a worthwhile investment as a time saver.

* * *

"HOW TO LISTEN TO THE WORLD" compiled by O. Lund Johansen. Published by *World Radio-Television Handbook,* Copenhagen. 54 pages. Price $.60. Paper bound. Available from *Gilfer Associates,* P. O. Box 239, Grand Central Station, New York 17, N. Y.

This is a "how-to-do-it" book in which experienced SWL hands tell the beginner how to get the most out of his dialing. The text explains the principles of short-wave propagation, how atmospherics affect reception, how to pick the best bands, antenna systems, operating the receiver and identifying stations, QSL cards, how to describe reception, logging and reporting, DX-ing on medium waves, listening in on the hams, tips on DX-ing, how to identify languages, time differences, abbreviations, and QSL bureaus and their addresses. This book should answer a lot of "toughies" for the short-wave addict—both old and new.

* * *

"WORLD RADIO HANDBOOK" edited by O. Lund Johansen. Published by *O. Lund Johansen,* Copenhagen. 170 pages. Price $2.00 plus 20 cents postage and handling. Paper bound. Eleventh Edition. Available from *Gilfer Associates,* P. O. Box 239, Grand Central Station, New York 17, N. Y.

Short-wave listeners will be happy to hear that the 1957 edition of this invaluable handbook is now available. As was the case with the earlier editions, the new volume carries a listing of standard frequency, long-, medium-, and short-wave stations throughout the world. The programs, station call letters, frequencies, and "best times to listen" are given for some 184 countries that maintain overseas services.

How to report reception, whether or not the station acknowledges such reports, and whether an IRC is expected are also given for each country, along with a section of musical themes where stations identify by such means.

For the serious SWL, hams, and others interested in tuning in on the world, this handbook is a "must"!

* * *

"TELEVISION EXPLAINED" by W. E. Miller, revised by E. A. W. Spreadbury. Published by *Iliffe & Sons Ltd.,* London. 175 pages. Price 12/6 plus postage. Sixth Edition.

It has been four years since the Fifth Edition of this text made its appearance and during that period many important changes have been made in British television. In order to cover both of the current systems now in use in England, the text material has been considerably revised and enlarged.

* * *

The author and reviser have assumed that the reader has a basic understanding of radio receiver circuitry but does not necessarily know anything about TV transmission and principles. The treatment is non-mathematical, written in simple language for the beginner or student. The circuits, equipment, and transmission standards discussed are British but the U. S. reader will find much basic material applicable to Stateside TV sets.

* * *

"BUILDING AN ENGINEERING CAREER" by Clement C. Williams & Erich A. Farber. Published by *McGraw-Hill Book Company, Inc.,* New York. 290 pages. Price $4.75. Third Edition.

Since it looks as if engineering will remain in the "most-in-demand" category for some time to come, many would-be engineers will welcome this over-all picture of their chosen profession.

The text material is divided into three major sections covering the education for engineering, the historical background of engineering, and, finally, the achievements in engineering. Chemical, civil, electrical, mechanical, mining and metallurgy are the engineering fields covered in the discussion.

As a source of basic information for the student deciding on a career, as a shot-in-the-arm for the man in the midst of his training, and for the practicing engineer who needs a revitalizing view of the "forest," surrounded as he is by the "trees," this book is recommended.

* * *

"FOUNDATIONS OF RADIO" by M. G. Scroggie. Published by *Philosophical Library,* New York. 338 pages. Price $10.00 Sixth Edition.

The appearance of this new and completely revised edition of one of the best-known basic radio texts, will be welcome news to the author's many "fans" who appreciate and enjoy his lucid presentation of the subject.

In order that the complete tyro can use this text, the author has devoted an introductory section to an explanation of "radio shorthand" or electronic terminology. As a further aid to the non-British user, the U. S. publishers have appended a listing of American equivalents for United Kingdom terms used in the text.

The author covers all the basic material so essential to an understanding of radio and then discusses tubes, transmitters, receivers, television and radar, antennas, power supplies, and transmission lines. Appendices covering symbols and abbreviations, circuit symbols, and decibel tables contribute to the "one-volume-library" concept.

* * *

"THE FIRST ONE HUNDRED AND FIFTY YEARS" by the House of Wiley. Published by *John Wiley & Sons, Inc.,* New York. 225 pages. Price $7.50.

This is the history of a great publishing house during its first 150 years and a record of the people and events that contributed to its greatness.

Established in 1807, the firm has long been associated with the publication of technical books and its catalogue is, in reality a history of engineering progress. A number of engineers whose names are household words have contributed short pieces to this history which are, in effect, appreciations for the role of this dedicated publisher in advancing the frontiers of human knowledge.

* * *

"ANTENNAS" edited by Alexander Schure. Published by *John F. Rider Publisher, Inc.,* New York. 76 pages. Price $1.50. Paper bound.

Volume 14 in this publisher's "Electronic Technology Series" covers both

the theory and practical application of antennas, transmission lines, input impedance, polarization, etc. and deals with antennas ranging in complexity from the basic dipole through parasitic arrays, long wires, and other varieties.

Practical antenna types are covered in some detail in the 5th and final chapter of this book. Service technicians, students, and practicing engineers will find this material of interest.

* * *

"EQUIVALENT RADIO TUBES—VADE-MECUM" edited by Dr. J. A. Gijsen. Published by *P. H. Brans, Ltd.*, Antwerp. 342 pages. Thirteenth edition (1957).

This is the newest and most up-to-date version of the equivalent radio tube "bible" which is widely used wherever equipment incorporating tubes is used.

Instructions for using the comprehensive tables are given in eight languages and the tabular material made as simple yet complete as possible. A bookmark-symbol guide, in the language of the country in which the edition is distributed, makes it unnecessary to consult another source for the terminology. A master index of all the tubes covered refers the user to the pertinent section.

Those whose work involves the servicing, installation, or operation of non-American-built equipment would find this listing a time and trouble saver in making repairs, troubleshooting, or determining suitable American-made equivalents.

* * *

"RELIABLE ELECTRICAL CONNECTIONS" sponsored by the RETMA. Published by *Engineering Publishers*, G.P.O. Box 1151, New York 1, N. Y. 103 pages. Price $5.00. Paper bound.

This is a compilation of the papers presented at the second RETMA conference on reliable electrical connections held last fall at the University of Pennsylvania.

Some 13 authors are represented and, in addition, the compilers have provided supplementary data and information supplied by 23 other experts on the subject. The material contained in this book is of particular interest to engineers, management personnel, and government agency representatives. —30—

UNIONTOWN GABFEST

THE Uniontown Amateur Radio Club has scheduled its Eighth Annual Gabfest for Saturday, June 29th. The event will be held at the Club House on Old Pittsburgh Road, just off Route 51, 2 miles north of Uniontown.

The Club will open at noon with the prize drawing scheduled for 6:30 p.m. and movies after the drawing. This is a stag affair and hams are invited to come early and stay late. Registration fee is $1.50. Refreshments will be available at nominal cost with coffee, pretzels, and side dishes free.

Contact the Club at P.O. Box 849, Uniontown, Pa. for further details or call W3PIE, the Club station. —30—

Motorola Color TV Sets

(*Continued from page 48*)

dynamic convergence set-up procedure is followed. This latter procedure is essentially the same as for other color sets using the 21AXP22 picture tube.

Service Hints

The *Motorola* color sets use two fuses. One is a 2-ampere, pigtail type which is located in the power-supply subchassis. To get at this fuse, the four mounting screws holding the subchassis in the cabinet must be removed and the cables going to the power supply disconnected. The second fuse is a 3/8-ampere, time-lag plug-in type located at the rear of the main chassis between the 6AU4 damper tube and the 6CM6 vertical-output stage. This fuse is accessible simply by removing the back cover of the cabinet.

Several separate test receptacles are available in these receivers. The five-pin plug on the rear chassis apron is used for checking a.g.c., video, and horizontal-oscillator operation. On the main chassis near the front of the set, the three picture-tube grid leads are plugged into a receptacle, and their signals can conveniently be checked there. The conventional mixer-grid test point is located on the tuner, and then there are two i.f. test points located on the main chassis near the first and third i.f.'s respectively. Individual test points are also provided for the color sync and color demodulator section.

Since the bell of the color CRT is made of metal, there is always the chance that one of the fields in the receiver may magnetize it. This will result in the inability to achieve proper color adjustment over one or more areas of the screen. Demagnetization is accomplished by placing next to the magnetized area a coil that is energized by a.c., then withdrawing it to a distance of about 10 feet before current is cut off.

The safety glass in front of the screen is removable for cleaning purposes. The h.v. should either be shorted out after the set is turned off or a "cooling off" period of at least 10 minutes should be observed before probing inside the set is undertaken. When the channel selector and fine-tuning knobs are pulled off, two screws become visible holding a circular insert. Remove the screws. Remove the five screws holding the metal molding trim at the bottom of the safety glass, as well as the four hex-head screws holding the metal glass retainer at the bottom. Finally, unscrew the five screws at the top of the screen, but be sure to hold the glass at this time to prevent it from falling out with the last screw. The glass has to be jiggled slightly to move it out, since it has to clear the flexible molding. When returning the glass be sure to attach the flexible molding at the top, bottom, and left side before inserting it into the frame again. —30—

A High-Stability Oscillator Circuit

By **ROBERT J. ROPES**

Details on a ham circuit which oscillates vigorously and easily and tunes very well over a wide frequency range.

THE circuit to be described is a practical application of the circuit originally developed by Harris[1] as a *"Q"* multiplier, and recently suggested by Clapp[2] as having possibilities as a stable *LC* oscillator. This oscillator is exceptionally stable and its output possesses excellent waveform when the circuit is designed around the correct circuit constants.

The circuit can be called the "class A Colpitts," since it operates in class AB_1. As pointed out by Clapp,[2] the frequency coefficient of an oscillator is independent of the *LC* ratio of the oscillator tuned circuit *if* the operation of the circuit is *linear;* that is, class A, AB, or B. Since class A operation of an oscillator is, for all practical purposes, impractical, class AB or B operation must be used to give the necessary linearity of operation. Clapp has discussed[3] several other oscillators in which the input and output circuits of the tube are connected across portions of the tuned circuits and in which the tube is operated in a linear manner. In an oscillator of this type, the greatest stability is obtained when the grid and plate circuits are connected to points on the tuned circuit of the lowest impedance which will sustain oscillation.

This "class A Colpitts" oscillator is somewhat reminiscent of the old Colpitts oscillator, but does not resemble it at all in operation. Since the oscillator operates in class AB_1, no grid current flows during any part of the oscillatory cycle, there is no "grid-leak" capacitor and no grid bias voltage is produced by grid current flow, as is the usual case in a class C oscillator.

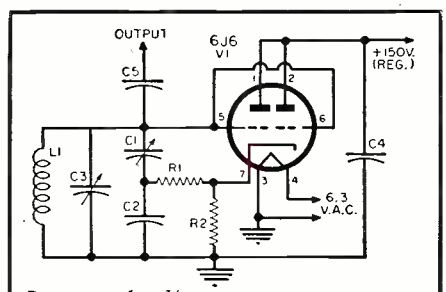
In referring to the schematic, the large values of resistance in the cathode circuits are at once apparent. The resistance between the cathode and the tuned circuit "tap" insures adequate isolation between the cathode and plate circuits, their associated capacitances, and the tuned circuit itself. In addition, this resistance helps to maintain the operation of the tube in class AB_1. A tube should be chosen which has a very small input capacitance, with transconductance being a somewhat secondary factor. The large cathode resistance limits the plate current to a low value and assures a minimum of distortion in the waveform. The highest stability (and, incidentally, the lowest output) is obtained with a high grid-to-cathode capacity ratio in the tuned circuit. Ratios for C_g/C_k on the order of 1/35 to 1/100 seems to be practical; ratios as low as 1/5 should not be used.

The circuit overcomes the distinct disadvantage of the Clapp series-tuned oscillator—that of limited frequency coverage when used as a variable frequency oscillator. In many amateur installations, trouble is encountered with the Clapp series-tuned oscillator when attempting to cover a rather large frequency range. Since, as Clapp has stated, with constant circuit *"Q,"* the value of transconductance required to maintain oscillation of the series-tuned oscillator tends to become very unstable at the high frequency end of the band being covered. The Clapp oscillator cannot be used for frequency changes greater than about 1.2 to 1 for this reason. W. B. Bernard[4] has pointed out (and Clapp has admitted[5]) that "the series-tuned oscillator is no more stable than a high-C Colpitts having the same circuit *'Q'* and the same impedances presented to the tube." Clapp goes on to state that the advantages of the series-tuned oscillator begin to deteriorate at high frequencies (although he does not state what the frequency limit of the circuit seems to be), but he indicates that "improvements in stability of from 10 to 100 times over conventional circuits are readily obtained." This last statement would seem to refer to fixed-frequency operation of the series-tuned oscillator at the lower radio frequencies.

The foregoing information is brought in by the author to attempt to show reasons why the so-called "Clapp series-tuned" oscillator has been disappointing to many amateurs who have built the circuit into variable frequency oscillators and exciters covering the high amateur bands, with the oscillator usually on 160 or 80 meters.

In constructing the "class A Colpitts" oscillator, the oscillator tank

Complete schematic of a stable oscillator.



R_1—1 megohm, ½ w. res.
R_2—10,000 ohm, ½ w. res.
C_1—100 μμfd. variable capacitor (set at approximately 75 μμfd. and used as "bandset" capacitor)
C_2—5100 μμfd. silver mica capacitor
C_3—25 μμfd. var. capacitor (covers 3.5 to 4 mc. with approximately 90% rotation)
C_4—.01 μfd., 400 v. capacitor
C_5—100 μμfd. mica capacitor
L_1—21 μhy. coil, 24 t. #22 solid copper wire, closewound on 1¼" dia. form
V_1—6J6 tube

coil should have a high "Q" and should be wound on a good form, preferably ceramic. The tuning capacitor should be of the double-bearing type and should be mounted rigidly to avoid mechanical vibration and modulation of the oscillator. All wiring should be direct and short, using heavy solid conductor wire. The extreme stability of this oscillator, coupled with the ease of tuning over a wide frequency range, should make this new circuit very popular with the amateur fraternity.

The author chose to use a 6J6 tube, because several were available and reasonably high transconductance with fairly low input capacity was obtained. There are numerous other tubes which are equally suitable. The circuit oscillates easily and vigorously.

The operating conditions of one oscillator built using this circuit were: Plate current—1.2 ma. (approx.), plate voltage—150 volts (regulated), grid voltage—0 volt, cathode voltage—12 volts, and frequency—2.5 mc.

The oscillator frequency would hover within a very few cycles per second of WWV for hours at a time and could be tuned over a wide band with but slight variation in plate current.

In conclusion, the author feels that the circuit qualities enumerated above along with the simplicity of the design should be enough incentive for having the amateur and experimenter give the oscillator a trial. We believe the results will fully justify our claims.

REFERENCES

1. *Harris, H. E.: "A Simplified Q Multiplier," Electronics, May, 1951.*
2. *Clapp, J. K.: "An Inductance-Capacitance Oscillator of Unusual Frequency Stability," Proceedings of the IRE, March, 1948.*
3. *Clapp, J. K.: "Frequency Stable LC Oscillators," Proceedings of the IRE, August, 1954.*
4. *Bernard, W. B.: Correspondence section of the Proceedings of the IRE, July, 1955.*
5. *Clapp, J. K.: Correspondence section of the Proceedings of the IRE, July, 1955.*

—30—

The Dyna-Box Checks Tubes

(*Continued from page 65*)

S_2) to the number corresponding to the element which is the plate.

4. Set the "Grid Volts" switch, S_3, to zero.

5. On the tube tester, throw the switch corresponding to the number of the plate of the tube up to the *N* position. Also set up any other elements to the *N* position that are required by the TC-55 tube chart (if any) for that particular tube.

6. On the tube tester throw all switches corresponding in number to free grids of this tube, up to position *P*. This connects grids together.

7. Now flip the lever switch over to the "Power Output" position. With many tubes, you will get little or no reading, with zero grid volts. (Such tubes as the 6J6 and 6BK7A, however, will provide a reading.) Normally, increasing the grid volts to six will provide a reading which is recorded. Now switch to 20 volts (excepting for 6J6's, 6BK7A's and others that would read too high at this grid voltage), and record the reading.

An immediate comparison between two tubes of the same type can be obtained from these readings. Also, each section of a double tube can be compared, and tubes which require matching can thus be matched.

Just as the manufacturers of tube testers obtain the data supplied in their charts, users of the "Dyna-Box" must obtain such data from records kept on each tube tested. A suggested chart is shown in Table 1. Very soon, the user will have recorded information concerning new tubes or tubes known to be good, and, by comparison, can tell the condition of any tube tested. Because some tubes (such as the 6J6's mentioned before) may approach or exceed their maximum dissipation using 150 volts on the plates and 20 volts on the grids, tests are not made on 20 volts, if a high reading has already been obtained with 6 grid volts. Table 1, made in a few days use of the "Dyna-Box," is provided for information.

Before throwing away those old tubes out of your radio set, try them on the "Dyna-Box." You may find, as the author did, that some tubes eight years old, whose emission was down some, were as good as new, dynamically, and in some cases outperformed new tubes. And when you have tried to balance up a push-pull amplifier with tubes that check out on emission and with precision resistors in the circuit, the "Dyna-Box" may show why the balance isn't there.

Remember that a tube that tests really low on emission is certainly no good; but a tube that tests OK on emission is not necessarily a good tube. It may actually be so poor in performance that it is inoperative. These are the "dogs" that the "Dyna-Box" finds. —30—

Pocket CRT Checker

(*Continued from page 63*)

electrode glows because of the rectifier action in the picture tube, with the grid and cathode acting as a diode. The circuit is designed to indicate operable condition if the tube has a zero-bias emission of at least 100 ±50 microamperes. There will be a broad tolerance because of the variations in resistors, neon lamps, and line voltage. This amount of current flowing through the 680,000-ohm resistor (R_1) develops sufficient voltage to cause one element of NE-2 lamp to glow. If the picture tube has enough emission to fire the NE-2 lamp, then it is also sufficient to illuminate the phosphor screen. This, then, tells the technician if a blacked-out screen is caused by a fault in the chassis or the picture tube. The amount of emission, however, may not be sufficient for satisfactory viewing. However, this latter factor can best be determined by observing brightness capabilities of the tube operated in its own TV circuit.

A "Grid No. 1-to-Cathode Short" will cause both neon elements to light. The electrodes appear to glow continuously because of the fast repetition of the applied a.c. voltage, which now goes straight through the short without rectification in one direction only.

If the picture tube base is loose, there may be a short in the flexible leads to the base that is not indicated by this checker. Grid No. 2, anode, or electrostatic-focus electrodes are not checked for opens or shorts. However, the percentage of tubes with these faults developing after they are in the home is small.

If the switch is depressed before emission begins, there is a positive peak of 75 volts on Grid No. 1. It is for this reason that the waiting period is recommended. After the emission starts to build up, Grid No. 1 and the cathode of the picture tube go into operation as a half-wave rectifier. The 220,000-ohm resistor then serves to limit current and acts as a voltage-dropping resistor, so that the positive-peak voltage on Grid No. 1 after warm-up will be less than one volt.

This picture tube checker can also be an asset in the service shop if it is used to check new tubes before they are installed in TV sets.

Construction

The technician can use his ingenuity in the assembly of the required components into a small case of his own choosing. The case the author used, already discussed, required no drilling or punching. The filament transformer was mounted to a molded stud on the case with a spring fastener. The NE-2 lamp was mounted behind the opening that appears on the front of the checker in Fig. 1. These standard components were easy to assemble. The completed tester has the advantages of simplicity and low cost. —30—

Adding "Volumatic Control"

By CHARLES ERWIN COHN

New Motorola circuit can be used with most auto radios.

SOME late-model Motorola car radios have incorporated a circuit development known as "Volumatic Control," which is claimed to give more effective automatic volume control and, thus, less volume fluctuation. This new circuit is simple enough to be added to any car radio.

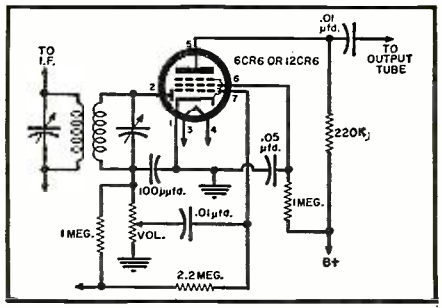
The circuit, shown in Fig. 1, replaces the existing detector-first audio circuit and uses the 6CR6 (or 12CR6)—a tube developed especially for the purpose. Basically, the new departure consists of the application of a.v.c. voltage to the audio stage. To understand its operation, it is necessary to take a brief look at a.v.c. theory. In the conventional a.v.c. system, a d.c. voltage developed by the detector is applied to control the gain of the r.f. and i.f. stages which, in turn, feed the detector. Due to the fact that a closed loop exists here, the detector output can never be completely constant. In practice, it is roughly proportional to the logarithm of the input.

However, the situation is different with a.v.c. applied to the audio stage. Since this stage is outside the loop, it is possible for sufficient a.v.c. voltage to be applied to it such that the gain reduction will be proportional to detector output, resulting in an over-all output which is constant over a wide range of signal strengths. This is the ideal situation. In fact, if too much a.v.c. voltage is applied to this stage, it is possible to get too much gain reduction and thus have an output which actually decreases with increasing signal.

The circuit modifications are quite simple. First, the socket for the detector-first audio tube must be changed to a 7-pin miniature if it is not already such. If the existing socket is an octal, the easiest way to make the change is to enlarge the socket hole to 1-5/32" diameter if it is smaller and use the Amphenol 73-A7P adapter socket; then rewire.

With the modification completed, volume fluctuations caused by driving under a bridge, etc. should be greatly reduced or eliminated. In some cases, so much a.v.c. voltage might be applied that a decreasing output characteristic might be noted. In such a case, connect a resistor between the 6CR6 grid and ground. This will act with the grid resistor as a voltage divider. The value of this extra resistor should be determined experimentally. —30—

Fig. 1. The "Volumatic Control" circuit.



JUNE 8-12

Technical Personnel Recruiting Exposition. Sponsored by the Technical Career Conference. Hotel Sherman, Chicago, Ill. Further information available from Marcus W. Hinson, 19 S. LaSalle St., Chicago 3, Ill.

JUNE 10-11

Second RETMA Symposium on Applied Reliability. Sponsored by the Engineering Dept., RETMA. Hotel Syracuse, Syracuse, N. Y. Details and registration from RETMA Engineering Office, 11 W. 42nd St., New York 36, N. Y.

JUNE 11, 12, 13

Third Western Plant Maintenance and Engineering Show. Civic Auditorium, San Francisco. Full details from Clapp and Poliak, Inc., 759 Monadnock Bldg., San Francisco 5, Calif.

JUNE 12-14

Operations Research Conference. Sponsored by Illinois Institute of Technology. IIT Campus, Chicago, Ill. Additional information from R. D. Meade, Conference Coordinator, IIT, 3300 S. Federal St., Chicago 16, Illinois.

JUNE 17, 18, 19

1957 National Convention on Military Electronics. Sponsored by the IRE Professional Group on Military Electronics. Sheraton-Park Hotel, Washington, D. C. George Rappaport, % Emerson Radio & Phonograph Corp., 701 Lamont St., N.W., Washington 10, D. C., director of public relations for convention.

JUNE 17-21

1957 Annual Meeting of American Society for Engineering Education. Cornell University. Details from Society secretary, W. Leighton Collins, University of Illinois, Urbana, Illinois.

JUNE 24-28

Gaillard Seminar on Industrial Standardization. Sponsored by the American Standards Association. Engineering Societies Bldg., New York, N. Y. Further information from D. E. Denton, % ASA, 70 E. 45th St., New York 17, N. Y.

JUNE 27-JULY 1

Electronics in Automation Convention. Sponsored by the British Institution of Radio Engineers. University of Cambridge. Further information from the Institution's offices, 9 Bedford Square, London W.C. 1, England.

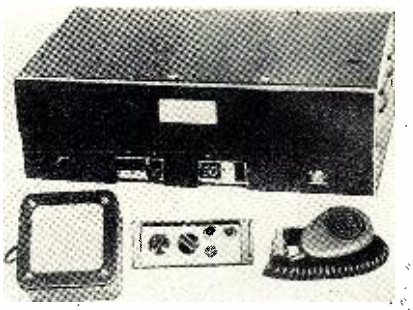
What's New in Radio

MOBILE RADIOTELEPHONE

Kaar Engineering Corp., Box 1320, Palo Alto, Calif., has added a new item to its line of communications equipment.

The new mobile AM radiotelephone, the TR-245, is a 50-watt, two-way unit specifically designed to handle field communications in oil exploration, mining, foreign construction, pipe lines, geological survey, and governmental applications. Easily installed in cars, trucks, jeeps, or other vehicles, the TR-245 permits these mobile units to keep in touch with each other and/or a base station.

Using a frequency range of 1.6 -8 mc., the unit features strip chassis construction for easy maintenance, optional dual-channel operation, and 6 or 12 volt



operation without modification. The entire unit measures 6" x 19" x 11" and weighs 27 pounds.

SNAP-IN SCREWDRIVER SHAFT

Xcelite, Incorporated, Orchard Park, N. Y., is now offering a new snap-in shaft extension which is designed to be used with the company's screwdrivers and nutdrivers.

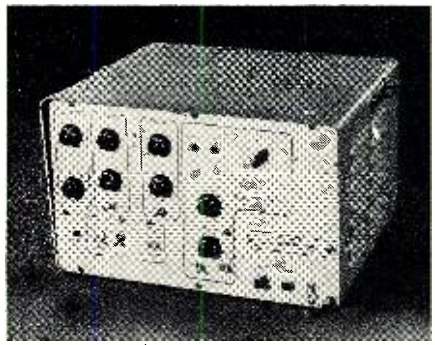
The shaft, which is 8" long over-all, has winged prongs on one end to fit into the socket of the combination handles of the 99-PR and 99-JR sets. The other end of the shaft has a socket fastener like that in the handles to receive all the nutdriver shafts and single-end screwdriver shafts in the kits. The extension shaft provides an additional 6" reach for work in formerly inaccessible places.

Write the manufacturer direct for full details.

PULSE GENERATOR

Electro-Pulse, Inc., 11861 Teale Street, Culver City, Calif., is marketing a new pulse generator which has a wide range of laboratory and test applications.

The Model 2125B combines easily accessible internal design and simplified circuitry to provide fast rise time pulses at high repetition rates. The controls provide for good resolution, utilizing multiple-decade ranges for pulse spac-



ing, delay, and width. Repetition rates from 10 cps to 100 kc., variable advance or delay operation from 0 to 100 μsec., variable pulse width from less than .1 to 100 μsec., and variable amplitude low-impedance output are provided.

Snap-off top and bottom plates provide complete accessibility. An overhanging light shield minimizes instrument panel glare.

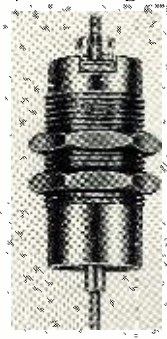
PANEL MODERNIZATION

Seco Manufacturing Company, 5015 Penn Ave., South, Minneapolis 19, Minn. is offering a new panel modernizing service to owners of its Model GCT-5 grid circuit tester.

The new panel, which is available from distributors for a nominal sum, lists a number of new tube types which can be handled by the tester. A small folder which pictures and describes the new panel service and lists a number of seldom used and industrial types that can also be handled by the instrument, is available from the company on request. Ask for the Model GCT-5 panel modernization folder when writing.

DOUBLE-ENDED COIL FORM

The Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge 38, Mass., has recently introduced a new double-ended miniature coil form that allows space for primary and secondary windings, with separate tuning slugs for the independent tuning of each section.



Designated the LS-14, the new unit is extremely compact and rugged. It is designed for applications where reliability is a "must." The form measures approximately ½" o.d. and 1 3/16"

over-all length, excluding tuning slugs. It is available with up to six terminals and mounts by means of a threaded middle section. The interior of the LS-14 is made up of powdered iron components and the main housing is nickel-plated brass. The tuning cores are held in adjustment by means of built-in locking devices.

For additional information on these new units, write the manufacturer direct.

TINY FOIL ELECTROLYTICS

Cornell-Dubilier Electric Corporation of South Plainfield, N. J., has designed a new line of electrolytics especially for transistorized and printed circuits as well as other compact or miniaturized low-voltage d.c. gear.

Known as the "Electromite" Type NL, the new line is available in d.c. working voltages of 1, 3, 6, 10, 15, 25, and 50 volts in capacities from 1 to 200 μfd. and in sizes from $\frac{3}{16}$" x $\frac{1}{2}$" to $\frac{3}{8}$" x 1".

The capacitors are compression-sealed and resistant to moisture and humidity. Terminal leads are tinned copper wire with the positive lead connected to the anode through a rubber bushing of the compression seal and the negative lead grounded to the aluminum can.

Bulletin No. 533 covering complete specifications on the "Electromite" line is available on request.

TINY POWER SOURCE

The *General Electric Company's* Specialty Electronic Components Department, West Genesee St., Auburn, N. Y., is in pilot production on a tiny new

power source, only $\frac{1}{35}$th the size of a common flashlight battery, but with 60 times the voltage of such a battery.

Designed for highly specialized uses requiring small size, long life, and high voltage output, the new cylindrical, 1" long battery has a projected life of over 20 years. It can be used in such equipment as remote fire and radiation warning devices, deep well survey equipment, and electronic instruments.

The new battery produces 95 volts, weighs less than $\frac{1}{5}$ ounce, and measures less than $\frac{1}{8}$ inch in diameter. Although it is priced at $12.50 now, the company believes mass production could eventually lower this to about one dollar.

VOICE-OPERATED RELAY

Miratel Incorporated, 1080 Dionne St., Saint Paul, Minn. has developed a new voice-operated relay which is designed to be used in program failure alarms, automatic programming, subcarrier keying, controlling transmitters, etc.

The new instrument has a maximum input level of + 5 db; threshold level of — 15 db ± 3 db at 1000 cps; average energize time of 7 milliseconds within the operating range of —15 db to +5 db; and drop-out time independent of input level and adjustable from 1 to 5 seconds on the front panel.

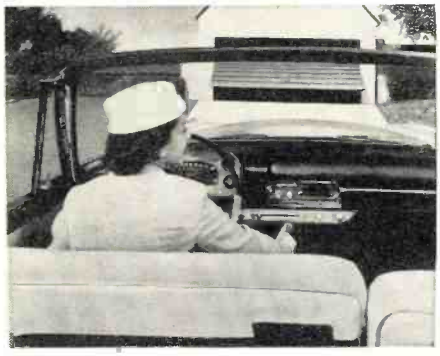
The relay is housed in a standard 5¼" rack mounting panel with an over-all depth of 5¾". A data sheet on the voice-operated relay is available from the manufacturer on request.

GARAGE DOOR OPENER

Packard Bell Electronics Corporation of Los Angeles, Calif., is now in production on a newly developed elec-

tronic garage door opener which will be marketed only on the West Coast for the present time.

The electronic opener, which is designed to operate any single or double residential overhead door, consists of three basic units: the transmitter, receiver, and garage door actuator. Features of the new system include a limit



switch which governs the travel of the door in either direction, a simple detaching latch in case of power failure, provision for extra push-buttons so the door may be operated from convenient locations around the house, and a handset thermal cut-out for protection from overload.

The device is being marketed with installation charges included in the purchase price. The firm's service personnel will handle the installations.

"LOW-OHM-METER"

Simpson Electric Company, 5200 W. Kinzie St., Chicago 44, Ill. has just introduced a new ohmmeter which features accurate measurements of low resistance values and utilizes low circuit currents.

The model 362 will give readings from .1 to 25 ohms with an accuracy of 3% of the full scale value. This accuracy is attained by using the expanded scale of the suppressed-infinity, shunt-type ohmmeter. The circuit current is only 5 ma. maximum which prevents damage to low-current components and promotes long battery life.

The circuit uses one self-contained battery and has two ranges, 0-5 ohms and 0-25 ohms. Over-all size of the instrument is 3" x 5⅞" x 2½".

NEW HAM RECEIVER

Radio Manufacturing Engineers, a division of *Electro-Voice, Inc.,* Buchanan, Mich., has released a new, improved, medium-priced receiver designed especially for the radio amateur.

The Model 4350 features crystal controlled dual conversion on all bands, reducing images 54 db or more. A crystal filter gives crisp single-signal reception. The receiver covers only the ham bands, allowing maximum efficiency and wide bandspread in areas where the ham intends to operate. To

increase stability, the 4350 has triple spacing between tuning capacitor plates, a 6 pound die-cast front panel, welded chassis and case. Voltage regulation and temperature compensation

of thermal sensitive elements have further reduced the possibility of signal shift or drift, allowing retention of single-sideband signals for long periods without retuning.

Write the parent company for further details on this receiver.

GREGG SOLDERING GUN

Gregg Electric Co., 2 South Broadway, Lawrence, Mass. is now offering a new single-pole, instant-heat soldering gun, the "250".

According to the company, the gun will heat in two seconds, is the only single-pole, built-in transformer type gun that will handle deep-in work with its over 5-inch reach, and provides prolonged tip life due to instant soldering ability.

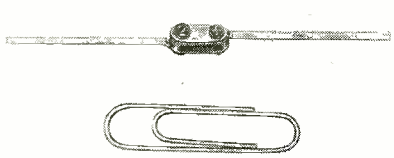
Tips can be changed in seconds. There is no need for set screws or wrenches as the tip simply unscrews with finger pressure. Changeable barrels are also available in standard and custom lengths. A pre-focused spotlight further enhances the convenience of the gun.

Write the company direct for a data sheet and full details on this new model.

"DWARF" RECTIFIERS

The Semiconductor Division of *Radio Receptor Co., Inc.,* 240 Wythe Ave., Brooklyn 11, N. Y., is importing and stocking a new line of subminiature selenium rectifiers, the *Siemens* "Dwarf."

The new rectifier, about a fourth as long as an ordinary paper clip, weighs



.015 ounce. Assembled in a black plastic body with flat pigtail leads, it is inexpensive and rugged and capable of withstanding vibration and shock.

While available only in half-wave, several units may be connected for other circuits, such as bridge arrangement and doubler. They can be used

for test instruments, small power supplies, computers, control circuits, etc.

Full details on these components are included in Bulletin No. 242 which the company will supply on request.

NATIONAL RECEIVER

National Company of Malden, Mass., has recently introduced a new model general coverage receiver, the NC-109.

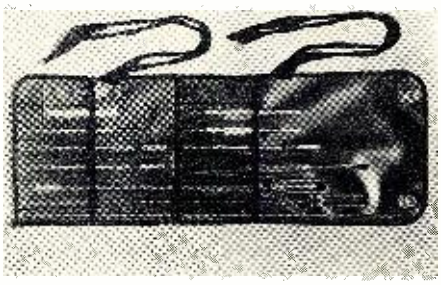
The receiver features an exclusive "Microtome" crystal filter and separate product detector for c.w. and SSB reception. Also included are a big "S" meter; four-band coverage; phone, c.w., or SSB reception; a bandspread dial calibrated for 10, 11, 15, 20, 40, and 80 meter amateur bands; and an 11-inch indirectly lighted Lucite slide-rule dial.

The cabinet is of modern design in two-tone metal and measures 16 13/16" x 10" x 10 7/8".

G-C TOOL KIT

General Cement Mfg. Co., 400 S. Wyman St., Rockford, Ill., is now marketing a new kit which contains the twelve most-often-used TV alignment tools in handy and compact form.

"The Top Twelve Tool Kit" contains both long- and short-reach aligners, *K-Tran* and soldering aids, and special tools for *RCA* and *Zenith* sets. The set is neatly housed in a compact and durable plastic roll-up case.



Literature and other information on this tool kit are available from the manufacturer on request.

TINY SELECTOR SWITCH

Clarostat Mfg. Co., Inc., of Dover, N. H., is now offering a miniaturized rotary selector switch for applications in military and commercial assemblies such as guided missiles, aircraft electronics, mobile radio and radar, computers, range finders, pocket radios, and hearing aids.

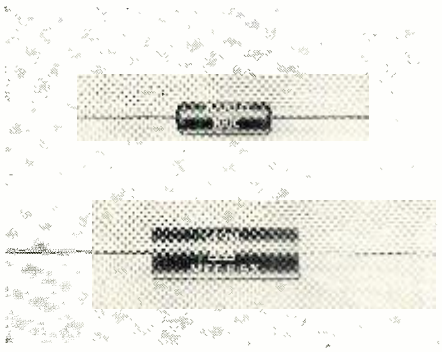
The BHM series switches are rated at 50 ma. at 300 volts a.c. or d.c. and 500 ma. at 30 volts a.c. or d.c. All moving parts and contact mechanisms are totally enclosed and the switch assembly is sealed for protection from dust and atmospheric conditions. Only ¾" in diameter and ¾" deep, including terminals, the new line is available in single-pole, 12-positions; double-pole, 6-positions; three-pole, 4-positions; and four-pole, 3-positions; and in either shorting or non-shorting versions.

This new line is being carried by the company's regular distributors or additional information can be obtained from the manufacturer direct.

METAL FILM RESISTOR

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa., has added two new types of metal film precision resistors to its line.

Available in two molded sizes, ½ and 1 watt, these close-tolerance units have the metallic resistive film firmly bonded to a specially compound ceramic core. Designed to combine high accuracy and stability with low and controllable temperature coefficients, Types MEC and MEF resistors also provide low noise and negligible voltage coefficient and have low capacitance and inductance which permits their use in high-frequency applications. Units for special requirements can be supplied.



A copy of Bulletin B-3, which is available without charge, provides complete specifications on these new components.

POCKET FM RECEIVER

The Commercial Electronic Products Division of *Radio Corporation of America,* Camden, N. J., has announced the development of the first commercial pocket-size FM radio receiver for mobile communication service.

The fully transistorized, 10-ounce receiver has been designed to provide extensions of several miles for radio systems now operating in the 150 mc. band.

It will be available to the public later this year after field tests have been completed.

The receiver is a single-channel device which will operate on any frequency in the 148-175 mc. band. The frequency is factory adjusted. The circuit incorporates an antenna and speaker which eliminates the need for an earpiece. It measures 2¾" wide, 1" thick, and 6½" high. It operates from mercury cells.

KNIGHT TWO-TRANSISTOR RADIO KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., has just released a new two-transistor pocket radio kit which is being marketed as the "Knight" No. 83-Y-262.

An efficient reflex circuit used in the design provides excellent reception of local broadcast stations without an external antenna being required, according to the company. Current drain is so low that months of operation are provided by the newly developed, long-life alkaline battery that comes with the kit. Printed wiring is used to cut assembly time. A simulated leather case, which may be carried or worn on a belt, houses the receiver.

A miniature dynamic earphone on a three-foot cord permits private listening. The set weighs 11 ounces.

TRANSFORMERS FOR TRANSISTOR CIRCUITS

Gramer Halldorson Transformer Corporation, 2734 N. Pulaski Rd., Chicago 39, Ill., has announced that it is prepared to supply a complete line of miniature audio transformers for transistorized circuit applications.

The new line consists of thirty-two items comprising two series: a 150-mw. series which measures 21/32" x 1 1/16" x 5/8" with mounting tab centers 1 3/16" at .6 ounce and a 300-mw. series measuring 1 3/16" x 1 5/8" x 1 3/16", weighing 1.1 ounces.

The units are supplied in individual plastic containers with complete installation instructions enclosed. Two charts, which allow selection of the proper transformer for the job at hand, are available on request. —30—

Sweep Generator Repair

(*Continued from page 55*)

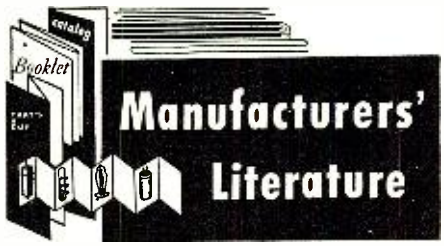
changes faster as the plates come closer. If, for example, the oscillator operates at 170 mc. when the capacitor plates are farthest apart, it will be at 168 mc. when they are in mid-position, but when they reach the three-quarter point the increase in capacity will have changed the oscillator to something like 160 mc. At maximum capacity, it may be at 150 mc. This type of nonlinearity is overcome by modifying the waveshape of the signal driving the vibrator or by distorting the horizontal-sweep output so as to compensate for this apparent nonlinearity. In sweep generators using magnetic-type frequency changers, such as the *Knight, Heath* and *EICO* units, the problem of frequency linearity is much less probable. In either type of generator, it will be necessary to study the circuit carefully before troubleshooting this type of defect—but before frequency nonlinearity is suspected be sure to adjust the phasing and blanking controls properly.

The horizontal sweep signal in some generators is simply a portion of the 60-cycle sine wave from the power transformer, while in other units this signal passes through one or two stages of amplification and shaping. In the latter system, the loss of horizontal sweep is usually due to tube failure. Circuit tracing with the oscilloscope will locate the defect quickly.

Other defects likely to be encountered in sweep generators include various mechanical failures of the switches, gears, and potentiometers which form the channel tuning and the attenuator controls. The latter is occasionally subject to shorts or open circuits. Built-in markers can, of course, be lost if their crystals or the oscillator tubes become defective. In changing crystals, it is important to obtain the exact replacement part since differently cut crystals will not operate the same way.

Conclusion

The sweep generator is one of the most important and valuable tools in TV servicing, and its operation must meet certain minimum standards. Marginal or poor generator performance can give the appearance of TV receiver defects even though the set works perfectly. For this reason and also for the sake of efficient TV servicing, it is important to maintain and repair sweep generators from time to time. Minimum performance requirements, simple tests and most frequent trouble sources have been described here. It is hoped that they will enable readers to help themselves to some extent with their sweep generators. In some cases, the wisest course will be to return the unit to the manufacturer for repair and alignment, but there are many defects which the technician can spot and cure without losing the use of this important instrument for weeks. —30—



PHOTOCONDUCTORS

The Photoconductor-Transistor Division of *Electronics Corporation of America,* One Memorial Drive, Cambridge 42, Mass. has issued an 8-page bulletin describing its line of infrared-sensitive lead sulfide photoconductors for detection and guidance systems.

Technical specifications and ordering information is given for four general cell types having a wide range of performance characteristics. Charts for cell response as a function of both wavelength and source temperature are also given.

Applications for these devices include missile guidance, fire control, aerial mapping, data reduction, and spectroscopy.

CONTROL-RESISTOR DATA

Controls and resistors for practically all standard applications can be selected easily with the new condensed catalogue recently released by the Industrial Sales Dept. of *Clarostat Mfg. Co., Inc.,* Dover, N. H.

Essential facts and figures, together with photos and dimensional drawings, provide all the required information free from "sales pitches." Among the items listed are composition-element and wire-wound potentiometers in different sizes and wattages, power rheostats, a selection of switches, precision pots and encapsulated potentiometers, molded composition-element potentiometers, allied hardware, and a full line of all types and sizes of wire-wound power resistors.

HICKOK TEST EQUIPMENT

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio, is now offering, for a limited time only, copies of its new 8-page composite test equipment catalogue, Form SM-30.

This handy compilation lists twenty-five pieces of new test gear, two new color generators, and the new "Cardmatic" automatic tube tester. Each instrument is pictured, described in detail, and its special features outlined. Equipment for the service shop and laboratory is included in the new catalogue.

RIDER BOOKS CATALOGUED

A 32-page Spring-Summer catalogue describing the various publications currently available has been issued by *John F. Rider Publisher, Inc.,* 116 W. 14th St., New York 11, N. Y.

The catalogue describes the contents of each book and identifies approximately nineteen titles which are scheduled to be released later this season.

Copies of the listing are free and to

all who request the catalogue, the publisher will send, in addition and without charge, a genuine leather bookmark stamped in gold.

G-E REPLACEMENT GUIDE

A replacement guide to assist television technicians in using the new *General Electric* replacement germanium TV rectifiers has recently been issued by the company and is being offered without charge by the firm's tube and transistor distributors.

The guide contains a listing of TV sets and the particular germanium rectifier unit which may be used to replace the rectifier in the set. The sets of 32 TV receiver manufacturers are included.

NEW TRU-OHM CATALOGUE

Tru-Ohm Products, 2800 N. Milwaukee Ave., Chicago 18, Ill., has just issued an elaborate multi-color catalogue covering its complete line of resistors and rheostats.

The 22-page publication provides complete information on fixed enameled, adjustable enameled, oval, vitreous axial, "Tru-Rib," and caged resistors as well as the new printed circular resistors and the new Blue X-60 series resistors. A complete line of power rheostats is covered in text and illustration.

The company will supply copies of this new catalogue to those making their requests direct.

CENTRALAB CONTROL GUIDE

Centralab, a division of *Globe Union, Inc.,* 900 E. Keefe Ave., Milwaukee 1, Wis., has announced the availability of a new edition of its popular "Pocket Control Guide."

This handy control cross-reference guide is published semi-annually to make the latest and most up-to-date replacement control information available. Hundreds of new listings have been included in the 106-page guide which has been designed to slip easily into the pocket or repair kit.

Copies of the guide may be obtained from the company's distributors or from the manufacturer direct. The price of Guide No. 5 is 20 cents a copy.

HOOK-UP WIRE BULLETIN

Philadelphia Insulated Wire Co., 200 N. Third St., Philadelphia 6, Pa., has issued a one-page data sheet on its new "Series 100" hook-up wire.

The wire features silver-plated copper conductor, extruded Teflon insulation, and is intended for continuous operation at 600 volts over a temperature range of from —60 to +200 degrees C.

Full specifications on the "Series 100" are given along with other pertinent mechanical and electrical data.

TRANSISTOR DATA

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y., has just issued a new four-page data sheet listing all the transistors and transistor transformers it carries in stock.

Of interest to experimenters, hobbyists, hams, and others engaged in building transistorized equipment, the listing includes transistors made by *General Electric, Raytheon, Texas Instruments, Sylvania, Philco, Transitron, CBS, RCA, Amperex, Clevite;* and diodes made by *Hughes, Raytheon, G-E, Sylvania, Texas Instruments, Transitron,* and *RCA; Veco* thermistors and varistors are also listed along with the complete *Argonne* line of transistor transformers.

Copies of this reference data sheet are available from Dept. ST-1D of the company.

ALLIGATOR CLIP LINE

Mueller Electric Company, 1583H E. 31st St., Cleveland 14, Ohio, has recently issued a catalogue sheet which describes its new "70 Series" of streamlined alligator clips.

Design-simplified version of the company's standard "60 Series," the new line is described, specifications and prices given. The data sheet is available without charge upon written request to the manufacturer.

NEW RETMA STANDARDS

The Engineering Department of RETMA, 11 W. 42nd St., New York 6, N. Y., has announced the publication of three new standards of interest to the industry.

RS-181 covers iron core charging inductors and is available for 60 cents a copy. RS-182 deals with class A variable air capacitors and is priced at 30 cents each, while RS-183 covers standards for output transformers for radio broadcast receivers and is available for 25 cents a copy.

Any or all of these standards are available from the Engineering Department. Payment should accompany all orders.

RADIOACTIVITY TEST GEAR

Nuclear-Chicago Corporation, 229 W. Erie St., Chicago 10, Ill., has just issued a new 64-page, two-color catalogue which illustrates and describes over thirty new radioactivity measuring instruments introduced since the last catalogue was published.

Sections in the catalogue are devoted to nuclear scaling units, ratemeters, *gamma*-ray spectrometer systems, geiger and scintillation detectors, portable survey instruments for *alpha-beta-gamma* and neutron measurements, lead shields, personnel protection devices, counting systems, high intensity *gamma* and *beta* sources, and nuclear accessories.

TEST EQUIPMENT BULLETIN

Simpson Electric Company, 5200 W. Kinzie St., Chicago 44, Ill., is distributing without charge copies of its Bulletin No. 2058 which includes a representative selection of its line of test equipment.

The 6-page bulletin lists test equipment for servicing radio, television, and industrial electrical equipment as well as refrigeration, air-conditioning, appliances, and heating equipment.

Special emphasis has been placed on

the company's Model 362 low-ohm meter, its Model 382 in-circuit horizontal systems analyzer, and the Model 387 millivoltmeter for testing safety thermocouples on gas-fired equipment.

BATTERY GUIDE

Ray-O-Vac Company, 212 E. Washington Ave., Madison, Wis., is currently distributing copies of its 1957-58 portable radio battery comparative guide which lists its battery numbers and those of seven other major battery makers.

The guide is available free to anyone selling or handling portable radios and provides dealers with a handy reference source when servicing customer battery needs. The guide is in the form of a chart with a riveted hole for hanging on the wall, promoting customer self-service. All of the information contained in the guide is non-confidential and is simple so that anyone who reads can understand it.

The guide has a section on transistor batteries and provides the latest information on batteries for transistor sets as well as vacuum tube models and 100 standard type batteries. Details on the battery component of more than 600 models of portable radios, including 41 different brands, are also given.

Write Dept. 284 of the company for a copy of this new guide.

COLOR TUBE APERTURE MASK

Superior Tube Company, 1744 Germantown Ave., Norristown, Pa., has issued "Data Memorandum No. 5" describing and illustrating its line of aperture masks for color television picture tubes.

Of interest to set makers, this publication illustrates the principal steps in manufacturing the masks which are, in fact, paper-thin metal sheets into which are etched approximately a half million tapered holes that confine and guide beams from the three electron guns in the tube.

DRAWN CASES AND COVERS

Hudson Tool & Die Co., Inc., 18 Malvern St., Newark 5, N. J., has issued a four-page data sheet on its line of precision-drawn cases and covers designed specifically for the electronic industry.

Included is data on standard square, rectangular, and round cases; MIL-T-27 cases; cover assemblies; and custom closures. The company can supply these components in copper, brass, aluminum, Mumetal, steel, or stainless steel. Write the manufacturer for full details and a copy of the data sheet.

BETA TESTER DATA

Baird-Atomic, Inc., 33 University Road, Cambridge 38, Mass., is offering copies of its Bulletin TP-106-1, which describes its portable *beta* tester for transistor measurements.

The Model KT-1 is designed for the rapid measurement of basic transistor characteristics in quality control testing, circuit design, incoming inspection, and troubleshooting. The data sheet explains these applications in addition to supplying complete electrical and mechanical data on this self-contained unit.

PERMANENT MAGNET DATA

The Magnetic Materials Section of *General Electric Company,* Edmore, Mich., has released a 12-page catalogue covering its line of both cast and sintered permanent magnets.

The new publication, PM-121, includes information on magnetic and mechanical properties, approximate tolerances, magnet assemblies, sales and service, in addition to information on how to order either cast Alnico 5 or sintered Alnico 2 magnets. The illustrations and engineering data provide the user with required information on the various available shapes.

BROCHURE ON WWV-WWVH

As a service to hams and others who use the National Bureau of Standards radio stations WWV and WWVH, the *Shasta Division* of *Beckman Instruments, Inc.,* P. O. Box 296, Station A, Richmond, Calif., is offering an 8-page, 2-color brochure describing the function, applications, and recent improvements in this service.

The brochure also describes the company's new Model 905 WWV receiver which was introduced earlier this year. Those desiring a copy of the bulletin are asked to specify "Data File #10."

—30—

Service Industry News

LICENSING continues to hold the service spotlight. The Council of the City of Long Beach, N. Y., recently passed an ordinance requiring the licensing of all TV distributors, dealers, and technicians serving that city. A bill was introduced in the Missouri State legislature to license all television, radio, and electronic service firms in that state. Municipal license ordinances are under consideration in Milwaukee, Wis. and San Francisco, Cal.

The Long Beach, N. Y., ordinance is the first licensing measure to be passed by a Long Island community. The bill defines six separate categories of TV activity, each of which carries a ten-dollar annual license fee and requires the posting of a $5000.00 surety bond. The six divisions of the industry covered by the ordinance include: service contractors, service dealers, dealers, distributors, accredited TV technicians and accredited TV apprentices. The ordinance took effect May 1, 1957.

The Long Beach bill was endorsed by the Radio Television Guild of Long Island after it had been amended to include two representatives of the service industry on the administering board. The five-man Board of Examiners that will administer the law is made up of one member who is engaged in selling and servicing television, one member who services TV as a technician, an attorney, a science teacher from the local high school, and an electrical engineer with experience in electronic equipment.

The Missouri bill, which has the active support of the Television Service Association of Missouri, a NATESA affiliate, is opposed by the Television Electronic Association of Missouri, said to number in its membership more than 100 St. Louis area TV service technicians. Requiring all TV-electronic service firms and technicians to pay a $50.00 annual license fee and to post a $1000.00 surety bond, the Missouri license measure would be administered by a five-man commission with broad powers for rescinding or refusing licenses.

There are sharp differences of opinion among service dealers over the wisdom of encouraging political control of the consumer electronic service industry. Many firmly established service operators who have successfully weathered all types of unethical competition and business ups-and-downs have expressed concern over whether small service operators are not toying with economic suicide in supporting some of the license measures that are proposed.

Experienced service dealers point out that license measures are frequently aimed at part-timers who, in the mass, may account for a sizable chunk of the TV service business. However, the rigidly licensed plumbing and electrical industries have lost most of the consumer service market to part-timers and do-it-yourself home owners. If an extensive and expensive policing force is not created to search out and prosecute violators, part-time technicians will continue to operate without licenses, aided and abetted by a public that is very cost-conscious.

These dealers also feel that the registration of small shops as licensed service dealers will make them prime targets for jealous competitors and innately dissident set owners. The small-shop operator who is hard pressed for time to handle the current non-productive activities associated with his business could ill afford the loss of even more time in appearing before a board to explain the details surrounding a customer complaint.

Political jurisdiction over any business activity often leads to the extinction of the small businesses engaged in that field because they cannot afford the accounting and legal help they need to protect their interests. Such supervision tends to favor larger businesses, which have enough employees constantly engaged in income-producing work to carry the non-productive overhead burden of professional counsel.

Many dealers feel that, from a practical standpoint, small service operators have nothing to gain from licensing. The fact that a man is a licensed service dealer or technician will not inspire set owners to deal with them, these dealers feel. It will not lift the level of service charges nor relieve them of the necessity for competing for business in an open market. It will add to their costs of doing business while contributing no increase in their income.

Another approach to finding some answers to the numerous problems that beset the service industry was initiated in a recent meeting of service association officials with representatives of RETMA and NEDA. The electronic parts industry coordinating and educational committees have shown a keen interest in developing and sponsoring programs that would benefit the independent service industry. They have been stymied, however, in finding a satisfactory pattern for selecting a couple of representatives for the service industry to meet with these committees. Currently the coordinating committee is made up of 13 men who represent parts manufacturers and distributors. The problem is how to select about three men from service who would be accepted by the service industry nationally as their representatives on this and the educational committee.

Questionnaires were sent out to the officers of 333 service associations requesting each of them to submit the names of their choice of men to repre-

sent the service industry on these replacement industry committees. It was conceded, however, that it will be extremely difficult to select service representatives who will receive the approval of all service associations throughout the country, regardless of their affiliation or lack of such affiliation.

About 79 representatives of components manufacturers, distributors, and service groups convened in the joint meeting. It was the second meeting of its kind between representatives of NEDA and the service industry, but the first to include manufacturers. The first meeting with distributors was sponsored by the Eastern States District Conference of Service Associations, an informal organization which includes practically all service associations in the densely populated seven northeastern states.

The Eastern States District Conference of Service Associations was organized as a result of a series of conferences on a 20-point program designed to bring about more harmonious relations between parts distributors and the service industry. The major bone of contention between service associations and parts distributors has been the indiscriminate sale of replacement parts and equipment to all comers. Thousands of local parts distributors make a serious effort to restrict sales to *bona fide* dealers and technicians but the widespread distribution of electronic mail order catalogues tends to circumvent any local program for rigid control of distribution.

Henry E. Rogers, in an article titled "Wholesale Suicide" which appeared in the February issue of the *"Guild News"* (Radio-TV Guild of Long Island), called attention to a situation that "places the radio and service dealer in the embarrassing, if not untenable, position of paying more at wholesale for merchandise and many parts and components than the general public and part-timers pay for the same items at retail."

Referring to a recently published catalogue of a large electronic parts and equipment retailer, Mr. Rogers cited five products listed by brand name and part number which are offered to all comers at a lower price than a service dealer can buy them from a recognized electronic parts distributor who restricts his sales to legitimate accounts, preserving the clear-cut relationship between wholesaler and retailer.

The rugged competition in distribution poses as many problems for parts jobbers as the service dealer finds at the retail level. Parts distributors do have an effective national association that is able to combat sales plans that would make a shambles of the distributing activity. The service industry is still slowly groping its way toward the development of an effective united national force working in its behalf. —30—

Spot Radio News

(*Continued from page 24*)

can be made closer, making room for more stations.

A further improvement in single-sideband technique can be realized by making use of what is called suppressed carrier, so that the power of a station is concentrated in whichever sideband is being used and the station automatically shuts itself down between words, when the power is not needed. This is equivalent to a type of clean-up campaign to help rid the air of clutter caused by radiation of large amounts of wasted power. For example, such power is responsible for the undesirable byproducts such as the familiar whistling type of interference observed when two stations are on the same frequency.

The use of the split channels offers another means of obtaining greater use of the frequency space available. Because of the need for additional channels in the land mobile service, efforts have been made to develop equipment which requires less spectrum space and can, therefore, be operated in narrower channels. For example, ten years ago assignments could not be made closer than 60-kilocycles apart in one typical land mobile band, because of the width of the channel which the signal required. Through a combination of technical improvements in equipment design, manufacturers found that they could produce equipment which could operate in channels half as wide. As a result, many more assignments can now be crowded into a particular band of frequencies.

But the methods mentioned are not the only means of saving spectrum space. Ways to get more economical use of radio frequencies are now receiving the cooperative attention of industry and the FCC.

Commenting on the need for a constant study of the problem, FCC Headman George C. McConnaughey said recently: "Spectrum-saving techniques of all kinds must now be given high priority in planning circles in both the government and industry . . . the most fertile and productive ground for research and development lies in the area of new techniques for compressing more and more intelligence into the narrower bandwidths, thus opening the way for more and better services of all types to the public."

THE EFFECTIVENESS of scatter techniques has won over the Canadian government: They have agreed to build a $650,000 forward-scatter station near the famous Gander Airport in Newfoundland, as part of a new chain of radio stations.

The scatter program was proposed when it was found that scatter transmission could curb the frequent radio blackouts, which occur in the existing high-frequency radio-teletype circuits

because of the sub-Arctic conditions.

Recommendation of the scatter chain came after the International Civil Aviation Organization's special jet age task force found that the . . . "world's outstanding case of immediate and compelling need for aviation improvement relates to air traffic control and communications in the North Atlantic region . . ." and predicted that, unless collective action is taken by all governments whose airlines fly the Atlantic, development of air traffic in this region will be more and more handicapped as the traffic continues to grow. The task force found that, in the summer of '56, more than half the flights across the North Atlantic suffered substantial difficulties in making contact with air traffic control services. It was felt, therefore, that a forward-scatter network would provide a partial answer to this problem.

IN COLORADO, at the Bureau of Standards Boulder labs, a short while ago, a group of scientists met to find out how to solve problems that still exist on the 3 to 300-kilocycle band; the region that is particularly suited for use in navigation systems, long-distance communication, and for the precise measurement of radio frequencies.

Commenting on radio reception difficulties experienced in a submerged submarine, one of the experts at the meeting pointed out that since propagation in sea water is nearly vertical (downward from the surface) the only operative types of antennas here are horizontal dipoles, electric and magnetic. The electric dipole, it was said, is coupled by resonance and the magnetic dipole by induction in a loop. The former has no resonance and nearly unlimited bandwidth, but fails when not submerged. The latter, by resonance, is able to present much greater interception area and available power. The magnetic interception area can be determined by the size of a radome and by the radian length or skin depth in the sea water; 2 meters at 15 kilocycles. And the radiation power factor (which is essential to bandwidth and efficiency), the scientists were told, is influenced by the size of the inductor and by the magnetic permeability of an iron core.

Thus, it was noted, it's necessary to resort to quite a bit of advanced engineering to come up with an antenna design that's adequate for subsurface reception.

A HISTORIC DECISION by an FCC examiner has brought together a university and a commercial TV operator who will share time on a v.h.f. channel.

The school—Michigan State University; the operator—*TV Corporation of Michigan*. They will operate jointly on channel 10, and will use separate call letters. The university will provide the transmitter, tower, and antenna, and the private company will use the physical facilities under a rental plan.

Elsewhere in the hearing rooms, grant action was slow, as usual, as the new-station listing on page 20 of this issue indicates.

ONCE MORE, the wonder tool of the century, electronics, has demonstrated its uncanny might.

Through an electronic control system on a hydraulic motor, coupled to an 11-ton telescope, it has become possible to guide the huge instrument through a single revolution in but 18 seconds.

At this terrific speed, a photographic resolution as high as 100 lines per millimeter has been obtained; a striking display of precision control, thanks to electronics. . . . . L. W.

WORLD-WIDE RADIO SETS

THE U. S. Information Agency has estimated that there are now 130,498,400 radio receiving sets in use throughout the world outside of the United States, its territories, and Canada.

The report shows an increase of almost 21,697,300 sets, or about 20 percent, over the last previous similar survey made in July 1954.

In addition to the almost 130½ million receivers, the Agency estimates there are also 24,747,500 wired radio speakers, most of them in Eastern Europe.

By areas, sets are as follows: Western Europe, 64,737,100; Eastern Europe, 17,200,000; Arabic countries, 2,141,500; non-Arabic Asia, 4,295,600; non-Arabic Africa, 1,158,100; Far East, 19,488,000; and Latin America, 21,478,100.

The Agency believes there are about 6,100,000 radio receivers and 20,000,000 wired speakers in the Soviet Union territories.

Thus, slowly but surely, the world is shrinking through wider contact with other peoples and civilizations. —30—

It took this Sikorsky helicopter just a brief three minutes to line up and lower a bulky directional antenna atop the 240-foot radio tower at the L. M. Ericsson Co. in Stockholm, Sweden, putting into operation Sweden's first permanent TV link. The country's only other TV transmitter is located on a water tower in Sodertalje, 15 miles away. Since it was physically impossible to assemble the parts on the tower, the helicopter was used to lift the 1300 pound antenna in place. The antenna was made to extremely exact tolerances which were held to within 1/20 millimeter per ten feet of the assembled unit. The new TV link is now in experimental service.

SCOTT KIT FOR DEALERS

Initiating a program for increased support of hi-fi dealers at the local level, *H. H. Scott, Inc.,* is offering a comprehensive, practical kit to be used in cooperative advertising.

This kit enables the dealer to run effective hi-fi component ads in newspapers, other printed media, and on the radio. It gives practical pointers on in-store promotion, and tells how to garner publicity.

A 25-page loose-leaf brochure encompasses the basic fundamentals of good advertising and shows how these principles can be applied by the dealer. Sample newspaper ads (including layouts) are supplemented with information on the use of effective copy, how to place space, how to place radio time, and how to get the most out of the advertising dollar.

One minute, and ten-second scripts are included, plus a complete section on store publicity with sample publicity releases, and a book of newspaper mats covering the company's line.

Layouts, blocks of copy, headlines, mats of art, or photographs are separately supplied with directions for use.

The kit is available from the company's sales representatives, or contact the firm at 385 Putnam Avenue, Cambridge, Mass., for details.

* * *

BASEBALL FACT BOOK

A handbook of baseball facts and figures containing complete major and minor league schedules for 1957 is now being made available by *Sylvania Electric Products Inc.* through television service dealers.

The 48-page booklet includes a section on "basic baseball strategy and plays" by the game's top experts. It also lists outstanding major league records for 1956, together with a 1957 outlook for both the American and National leagues.

The company's service dealers will provide this handy pocket-sized booklet to fans who want statistics "at hand" as they watch their favorites in action.

* * *

BATTERY PROMOTION

The inclusion of a new permanent dealer aid, the "Select-a-File," in *RCA's* 1957 portable radio battery promotion kit, has been announced.

The "Select-a-File" is a complete, illustrated, up-to-date source of battery replacement information for practically every portable radio now in use. Contained in a sturdy steel file box, a data card carries a photograph of a portable together with the manufacturer's name and model, plus the company's recommended battery complement.

The kit, which includes additional promotion material, is now available from all the company's battery distributors.

* * *

MERIT SALES CONTEST

Gail S. Carter of *Merit Coil and Transformer Corp.* (right) and Lee Smith of *American Airlines* (left), put the finishing touch on a rep sales contest which will send three winners to

Bermuda, Mexico City, or Havana, Cuba.

According to the company, the purpose of the contest, simply put, is to sell more of the firm's coil and exact replacement transformers.

If the contest winners elect to go on selling instead of taking a plane trip, the company will buy shares in the *Television-Electronics Fund, Inc.* of equal dollar value to the trip.

Winners will be the three rep agencies showing the highest sales percentage increase over the first seven months of 1956. The contest ends on July 31, 1957.

* * *

NEW SALES PROGRAM

CBS-Hytron has announced it will continue and expand its support of independent radio-TV service dealers across the nation in its 1957 sales promotion program.

The program calls for extensive national advertising augmented by concentrated local promotion aimed at attracting business into the shops of independent service dealers.

Suggestions from dealers throughout the nation indicate that the prime needs are for improved public relations in the dealer's local community, and to advertise and promote his services and products to potential customers. Among suggestions offered were both national and local advertising, direct mail campaigns, local meetings to stimulate cooperative action between dealels and distributors, and other activities aimed at enhancing the dealer in his local business community, and increasing his sales volume.

Along with national advertising, local promotion will include window displays, ad mats, etc., and an independent service dealer decal emblem which will identify the dealer to his customers. The emblem carries no company promotion. It is designed for the promotion of the dealer in his local community. —30—

Selling Service

(*Continued from page 52*)

was used successfully by a southern service dealer several years ago. In this promotion, the dealer had some string tags cut in the shape of a four-leaf clover. These were die-cut, green-colored stock and were called "Good Luck Charms for Better TV Pictures."

The gimmick in this promotion was that the charm was worth fifty cents credit on the service call if the dealer's technician found it hanging some place on the TV set when he called to service it. Technicians reported that they found these charms hanging on rabbit ears, tuning controls and other places on sets where a string could be attached. It was a highly successful promotion.

Last year one of the business-form publishers developed a doorknob hanger for technicians to put on the doorknobs of homes close by those in which they serviced TV sets. The copy on it read, "We did it and we're glad. We just serviced your neighbor's TV set. Why not call us whenever your TV set needs service?" The dealer's name, address, and telephone number is imprinted on the hangers. One ingenious service dealer found it very successful during the first week he tried it. His men put the hangers on about sixty doorknobs a week. These cards brought in an average of two calls per week. This was about one call out of every thirty doors on which the hangers were placed.

This dealer concluded that, if he would arrange to place the doorknob hangers on sixty homes daily, he would pick up two additional service calls per day. As a result, he hired a high school student to work two hours every afternoon to systematically cover residential streets, putting the hangers on doorknobs. He said the plan proved highly successful.

Initiative, energy, and ingenuity will keep business flowing into any service shop without regard to seasons. —30—

PHOTO CREDITS

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ERRATUM

A printer's error on page 42 of the May issue has resulted in a lack of continuity in the text. The last line of the first column should read "gie's tests were carried out using head-". Our apologies.

INDEX OF Advertisers

JUNE, 1957

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

Classified

RATE: 50¢ per word. Minimum 10 words. August issue closes June 10th. Send order and remittance to: RADIO & TELEVISION NEWS, 366 Madison Ave., N. Y. C. 17.

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 18 or 21 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

TRADE IN TV's—ship anywhere. 10 inch $8, 12 inch $11, 16 inch $17, 17 inch $22, 19 inch $25, packing $3. Justis Bros., Newport, Delaware.

RADAR publications. Practical circuits, theory, illustrations. Free descriptive list. Techbooks, B207, Ocean Springs, Mississippi.

NEW TG-34A Photoelectric Tape Code Practice Sets with manuals $24.95; New BC-645's, with original and Citizen's Band conversion schematics, data, $24.95. Engineering Associates, 430 Patterson Road, Dayton 9, Ohio.

216 INDIVIDUALLY cartoned tubes and 144 used tubes as removed from equipment. Lot price $140.00. Express Collect. J. R. Davis, P.O. Box 9062. Knoxville 20, Tenn.

TELEPHONE Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions. $1.25. Q. Carrier Co., 734—15th St., N.W., Washington 5, D.C.

TELEVISION, radio repair, service store, fully equipped, latest Instruments, tools, busy Avenue Manhattan, fine-going, profitable business, established 25 years. Original Owner retiring. 1954 Chev Del Truck, Sacrifice, rare opportunity, valuable trade name included, taking offers. Classified Box 557, c/o Radio & TV News, 366 Madison Ave., New York 17, N. Y.

304TL TUBES, $8.95 each, Four for $29.95. Oldenburg, 764 Vann, Evansville, Indiana.

"COIL Winding Methods" Handbook 30¢. Laboratories, 328-H Fuller, Redwood City, California.

TV SETS—10 to 21"—$12 Up, Catalog available others. Surplus Appliances RFD 2, Abele Park, Putnam Valley, N. Y.

BAKALITE And Fiber, Assorted Pieces, send $2 to Lloyd Summers, 171 Somerton, Kenmore, N. Y.

MARINE Crystals Since 1933. Free brochure. Discounts. Airmail Service. C-W Crystals, Box 2065, El Monte, Calif.

PRINTED Circuits: Design and construct your own. Wonderful for transistor units. Copper boards, etching compound, and all instructions $2.00. Dawntronics, SDM, 2051 Lansing, Denver 8, Colorado.

DIAGRAMS! Repair Information! Radios—amplifiers—recorders $1.00. Televisions $1.50. Give make, model, chassis. TV Miltie, Box 101RA, Hicksville, New York.

DIAGRAMS—Radios, Amplifiers, Changers, $1.00 Each. Television Service Data $2.00. Unknown Models, Give Tube Layout and Part Numbers. Kramer's Radio Service, Dept. 656, 36 Columbus Ave., New York 23, N. Y.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

COMPLETE Television Sets $11.95. Jones TV, 1115 Rambler, Pottstown. Pa.

LARGE Stocks Bargain Priced Electronic TV, HI-FI, Radio Components. Chicagoland's Biggest Bargain Centers. Mid-America Company, 2412 S. Michigan, VIctory 2-0702; 6101 N. Broadway, ROgers Park 4-3745.

WANTED

CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, Klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone: Barry, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

WANTED: Short Wave & Communications Receivers. New or Used. All types Electronic Tubes. Highest Cash Prices Paid. Write or Phone: North Radio Co., 62 Cortlandt St., New York 7, N. Y.

CYLINDER and old disc phonographs. Edison Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % RADIO & TELEVISION NEWS.

WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, I-152C, Collins, Bendix equipment, Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 40th St., New York City, telephone LExington 2-6254.

SELL Your Way to Wealth! Wanted: Surplus military and commercial aircraft electronics: ARN-6, ARN-6, ARN-6, AS-313, AS-313, AS-313, AS-13, ART-13, ART-13, ART-13, ARN-7, ARC-3, 51R-3, APN-9, BC-348, BC-788, I-152, MN-53, test equipment and All Vacuum Tubes. Top prices paid! For fattest checks—sell to Rex! Bob Sanott, W6REX, 1524 S. Edris Dr., Los Angeles 35, California. Phone: REpublic 5-0215.

WANTED: Signal Generators TS-403, TS-621, SG-3/U, TS-437, TS-510, TS-588, TS-608, etc.; TS-186 Frequency Meters, AN/APR-4 Tuning Units, other "APR-" Receivers, ARC-3, other Surplus; also Hewlett-Packard and other laboratory quality equipment, Weston, etc. instruments; technical manuals; for quick cash or swap for Zenith Transistor Portables, etc. LITTELL, Firhills, Box 26, Dayton 9, Ohio.

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

PLATINUM Electronic Scrap. Highest prices. Estimates by mail. Satisfied customers from coast to coast. Ship with perfect confidence. Cash sent by return mail. Noble Metals Co., Box 1113, Santa Monica, California.

REPAIRS AND SERVICING

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., N. Y. 7, N. Y. Ba. 7-2580.

HELP WANTED

WANTED—instructor with a major interest in small transmitter service to teach in a two-year post high school service program. Write or call Jon P. Adams, Ferris Institute, Big Rapids, Michigan.

TAPE RECORDERS

TAPE Recorders, Tape. Unusual Values. Free catalog. Dressner 69-02 R, 174 St., Flushing 65, N. Y.

RECORDERS Wholesale! Tapes: 1200' $1.39; 1800' $1.85. Towers—155, Philadelphia 5.

DISCOVER our "Six-Unique Services" and Rock-Bottom prices on Hi-Fi; Stereo. Write the Silver Trumpet, 406R Walnut, Alexandria, Indiana.

HIGH FIDELITY

DISGUSTED of "Hi" Hi-Fi Prices? Unusual Discounts on all your High Fidelity requirements. Write now. Key Electronics Co., 120 Liberty St., New York 6, N. Y.

CORRESPONDENCE COURSES

USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

INSTRUCTION

LEARN While Asleep! Details free. Research Association, Box 610-RT, Omaha, Nebraska.

DO you want to be a writer? No engineering background or writing experience required to be a technical writer. Our students earning over $600.00 per month before completing course. Write Technical Publications Institute, 9022-L, Melrose, Los Angeles 46, California.

ENGINEERING Degrees, EE Option Electronics earned by home study. Residence classes also available. Pacific International University (American College of Engineering), 5719-C Santa Monica Boulevard, Hollywood 38, California.

MISCELLANEOUS

DECALS—Trademarks, Service, Sales, etc. Write Allied Decals, Inc., 8378 Hough, Cleveland, Ohio.

BUSINESS Cards. Free TV cuts. Raised printing. 1,000—$4.50 postpaid. Polart Company, 20115 Goulburn, Detroit 5, Michigan.

TUBE SPECIALISTS to the WORLD

SELECT THE TUBES YOU NEED FROM ONE OF THE MOST COMPLETE TUBE INVENTORIES IN THE WORLD

First Quality — Fully Guaranteed — No Seconds

RECEIVING TUBES

0A2	.69	6AD7G	1.50	6L6G	.98
0A4G	.95	6AF4	1.23	6L7	.95
0B2	.65	6AF6G	.85	6N7	.89
0Z4	.49	6AG5	.72	6Q7	.85
1A3	.68	6AG7	.98	6Q7GT	.79
1A7	.52	6AH4	.85	6R7	.85
1AD4	1.20	6AH6	.85	6R7GT	.68
1AE4	.92	6AJ5	1.49	654	.57
1AX2	.95	6AK5	.69	658GT	1.05
1B3GT	.79	6AK6	.75	6SA7	.79
1C5GT	.52	6AL5	.58	6SA7GT	.79
1G4	.65	6AL7	.95	6SB7Y	.87
1G6GT	.49	6AM4	1.50	6SC7	.72
1H5GT	.58	6AM8	1.10	6SF5	.72
1J6GT	.69	6AN4	1.50	6SF5GT	.69
1L4	.74	6AN5	2.75	6SF7	.92
1L6	.79	6AN8	1.15	6SG7	.65
1LA4	.79	6AQ5	.57	6SH7	.74
1LA6	.85	6AQ6	.57	6SH7GT	.59
1LB4	.85	6AQ7	1.15	6SJ7	.69
1LC5	.79	6AR5	.70	6SJ7GT	.59
1LC6	.79	6AR6	2.15	6SK7	.64
1LD5	.85	6AS5	.70	6SK7GT	.59
1LE3	.79	6AS6	1.95	6SL7GT	.75
1LG5	.85	6AS7G	2.35	6SN7GT	.75
1LH4	.85	6AS8	1.15	6SQ7	.59
1LN5	.79	6AT6	.52	6SQ7GT	.59
1N5GT	.59	6AT8	1.05	6SR7	.55
1Q5GT	.95	6AU4	1.05	6S57	.75
1R4	.65	6AU5	1.10	6ST7	.95
1R5	.65	6AU6	.65	6T8	.95
154	.65	6BA7	.85	6U5	.85
155	.65	6AV5	1.20	6U8	.95
1T4	.65	6AV6	.53	6V3	1.25
1T5	.69	6AX4	.79	6V6	1.10
1U4	.67	6AX5	.69	6V6GT	.59
1U5	.59	6B4G	.95	6W4GT	.65
1V	.65	6B8	.67	6W6GT	.79
1V2	.59	6BA6	.63	6X4	.48
1V6	1.49	6BA7	.85	6X5GT	.49
1X2A	.85	6BC4	1.50	6X8	.95
2A3	.95	6BC5	.68	6Y6G	.89
2A6	.59	6BC7	1.20	7A4	.79
2X2	.49	6BD5	1.35	7A5	.69
2X2A	1.35	6BD6	.73	7A6	.78
3A3	1.08	6BE6	.65	7A7	.75
3A4	.50	6BF5	.82	7A8	.75
3A5	.64	6BF6	.68	7AD7	1.65
3AL5	.65	6BG6G	1.75	7AF7	.89
3AU6	.70	6BH6	.79	7AG7	.95
3AV6	.60	6BJ6	.69	7AH7	.95
3B4	2.95	6BK5	.95	7B4	.75
3B7	.39	6BK7	1.05	7B5	.65
3BC5	.80	6BL7	1.05	7B6	.75
3BN6	1.05	6BN6	1.10	7B7	.75
3BY6	.75	6BQ6GT	1.15	7B8	.85
3CB6	.80	6BQ7A	1.15	7C5	.75
3CF6	.85	6BX7	1.20	7C6	.75
3D6	.39	6BY5G	1.25	7C7	.79
3FL4	.85	6BZ7	1.20	7E7	1.15
3Q4	.65	6C4	.38	7F7	.85
3Q5	.75	6C5	.48	7F8	1.10
354	.65	6C5GT	.46	7G7	1.10
3V4	.69	6C6	.49	7H7	.79
4BQ7A	1.30	6C8G	.85	7J7	1.25
4BZ7	1.35	6CB5	4.40	7K7	1.15
5AM8	1.05	6CB6	.68	7L7	1.10
5AN8	1.10	6CD6G	1.75	7N7	.85
5AQ5	.75	6CF6	.90	7Q7	.95
5A58	1.10	6CG7	.85	7R7	.95
5AT8	1.10	6CL6	1.10	7V7	.95
5AV8	1.15	6CM6	.85	7W7	.95
5AW4	1.10	6C56	.75	7X7	.90
5AZ4	.60	6CU6	1.30	7Y4	.65
5J6	.90	6D6	.59	7Z4	.65
5R4GY	1.45	6DC6	.95	12A4	.85
5T4	.90	6E5	.75	12A6	.57
5U4G	.58	6F5	.59	12A8GT	.79
5U8	1.10	6F6	.85	12AH7GT	1.05
5V4G	.88	6F6GT	.69	12AL5	.65
5V6GT	.70	6F7	.85	12AQ5	.70
5W4GT	.65	6F8G	.72	12AT6	.48
5X4G	.75	6G6G	.72	12AT7	.92
5X8	1.05	6H6	.59	12AU6	.62
5Y3GT	.49	6H6G7	.49	12AU7	.75
5Y4G	.65	6J4	2.55	12AV6	.52
5Z3	.69	6J5	.48	12AV7	.95
5Z4	.89	6J5GT	.47	12AW6	.95
6A3	.95	6J6	.68	12AX4	.85
6A6	.82	6J7	.82	12AX7	.78
6A7	.89	6J7GT	.65	12AY7	1.15
6A8	1.05	6K6GT	.65	12AZ7	.85
6AUGT	.95	6K7	.74	12B4	.85
6AB4	.59	6K7GT	.59	12BA6	.60
6AB7	.95	6K8	1.10	12BA7	.89
6AC5	1.05	6K8GT	.95	12BD6	.70
6AC7	.85	6L6	1.69	12BE6	.65
12BF6	.60				
12BH7	.89				
12BK5	.95				
12BQ6GT	1.35				
12BY7	.90				
12BZ7	.95				
12C8	.69				
12CU6	1.35				
12H6	.59				
12J5GT	.65				
12K7GT	.85				
12K8	.69				
12Q7GT	.75				
12SA7	.69				
12SA7GT	.69				
12SC7	.75				
12SG7	.79				
12SH7	.65				
12SJ7	.65				
12SK7	.69				
12SL7	.85				
12SN7	.75				
12SQ7	.59				
12SR7	.59				
12V6GT	.73				
12W6GT	.87				
14A4	.95				
14A5	1.30				
14A7	.75				
14AF7	.95				
14B6	.69				
14C7	.95				
14E6	1.05				
14E7	1.15				
14F7	.85				
14F8	1.10				
14H7	.85				
14N7	.85				
14Q7	.85				
14R7	1.20				
1457	1.10				
14W7	1.25				
19BG6G	1.89				
19T8	.95				
25AV5	1.25				
25AX4	1.05				
25BK5	.95				
25BQ6GT	1.25				
25CD6G	1.75				
25CU6	1.30				
25L6GT	.65				
25W4GT	.72				
25Z5	.75				
25Z6	.62				
30	.65				
32L7	.85				
35A5	.69				
35B5	.68				
35C5	.68				
35L6	.65				
35W4	.44				
35Y4	.65				
35Z3	.65				
35Z5	.59				
41	.75				
42	.69				
43	.79				
50A5	.68				
50B5	.68				
50C5	.68				
50L6	.62				
50X6	.85				
50Y6	.78				
50Y7	.78				
53	1.25				
70L7	1.15				
75	.65				
77	.47				
78	.57				
80	.59				
81	1.85				
83	1.19				
83V	.95				
84/6Z4	.49				
117L/M7	2.45				
117N/P7	2.45				
117Z3	.68				
117Z4	1.05				
117Z6	.95				

XMITTING TUBES

0A3/VR75	.86	5JP2	6.35		
0B3/VR90	.73	5JP5	9.95		
0C3/VR105	.68	5LP1	7.40		
0D3/VR150	.68	5NP1	4.95		
1B22	1.25	6AC7W	1.45		
1B23	2.68	6AK5W	1.45		
1B24	4.85	6AL5W	.95		
1B27	12.95	6AQ5W	1.70		
1B35	3.45	6AS6W	2.69		
1B38	33.50	6BF7W	3.45		
1B40	3.45	6C4W	6.75		
1B41	14.95	6C21	14.95		
1C21	1.89	6F4	2.65		
1N21	.39	6J4WA	4.45		
1N21B	1.45	6J5WGT	3.90		
1N23	.68	6J6W	2.20		
1N23B	1.40	6J6WA	3.90		
1N34	.42	6K4	2.20		
1N34A	.48	6S7W7GT	1.85		
1P21	29.50	6X4W	1.20		
1P22	13.25	6X5W	1.35		
1P23	1.85	7BP7	4.45		
1P24	1.45	12DP7	14.95		
1P25	64.50	15E	1.45		
1P28	8.95	15R	.49		
1P30	1.95	28D7	.95		
1P32	.95	100TH	6.25		
1P39	1.45	100TL	8.25		
1P40	1.25	211	.45		
1P41	2.45	249B	2.95		
1P42	2.35	249C	1.95		
2AP1	4.95	250TH	18.95		
2B22	1.95	250TL	14.75		
2C21	.39	262B	4.95		
2C34	.25	274A	3.45		
2C36	21.50	274B	.85		
2C39A	10.95	304TH	9.95		
2C40	9.45	304TL	12.50		
2C43	10.25	307A	1.10		
2C52	2.95	350A	2.65		
2C53	10.75	350B	2.35		
2D21	.65	371B	.85		
2D21W	1.95	393A	4.50		
2E22	3.15	WL417A	2.95		
2E24	2.40	417A/5842			
2E26	3.25		14.95		
2E30	1.55	434A	2.95		
2G21	2.45	450TH	47.50		
2J31	14.00	450TL	35.00		
2J32	12.50	575A	12.50		
2J33	14.00	705A	.68		
2J34	14.00	707A	4.95		
2J36	14.95	707B	3.95		
2J51	97.50	715B	2.95		
2J55	39.50	715C	10.95		
2J61	12.95	717A	.35		
2J62	12.95	721A	.65		
2K23	15.25	723A/B	8.45		
2K25	11.95	725A	2.95		
2K28	27.50	726A	4.95		
2K33A	56.95	726B	32.50		
3AP1	2.90	726C	32.50		
3B24	1.50	750TL	65.00		
3B24W	4.95	801A	.38		
3B25	4.95	802	2.45		
3B26	7.45	803	1.40		
3B27	3.45	804	8.85		
3B29	5.95	805	3.95		
3BP1	2.45	806	4.85		
3C22	59.50	807	1.18		
3C23	3.45	808	1.25		
3C24	1.48	809	2.20		
3C45	5.95	810	10.50		
3D21A	2.95	811	2.75		
3DP1	3.25	811A	3.25		
3E29	9.00	812	2.75		
4-65A	13.25	812A	3.25		
4-125A	22.50	813	10.50		
4-250A	32.50	814	1.95		
4C27	8.95	815	1.95		
4C28	17.45	816	1.15		
4C35	13.45	826	.65		
4E27	8.50	828	7.42		
4X750A	22.45	829B	7.95		
4X150G	31.95	830B	.65		
5BP1	2.35	832	5.75		
5BP4	1.95	832A	7.95		
5C22	27.50	833A	42.50		
5CP1	1.95	836	1.45		
5CP1A	8.45	837	1.25		
5CP7	7.95	838	.69		
5D21	7.45	845	4.85		
5FP7	1.20	851	8.95		
5J29	29.50	860	2.75		
5J30	17.25	861	12.95		
5J33	6.95	866A	1.15		
5JP1	12.45	872A	1.25		

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876	.72	5687	2.65	6099	1.35
878	.48	5692	5.10	6101	1.45
884	.95	5693	4.65	6113	1.25
885	.95	5696	.90	6146	4.75
902	2.45	5702	1.95	6161	69.50
918	1.65	5703	.95	6187	3.95
923	1.25	5704	1.85	6189	2.25
925	1.50	5718	2.75	6263	11.45
927	.95	5718A	4.75	6264	11.45
930	1.19	5719	2.15	6539	2.95
931A	2.95	5725	1.45	8005	4.75
954	.25	5726	.60	8008	3.95
955	.35	5727	1.25	8012	.98
956	.35	5732	2.95	8013	2.65
957	.35	5744	1.75	8013A	3.75
958A	.35	5751	1.45	8014	67.50
959	1.32	5762	99.50	8020	1.25
991	.29	5763	1.25	8025	1.45
1603	2.95	5783	4.45	9001	.82
1616	.50	5787CK	4.05	9002	.60
1619	.30	5794	5.95	9003	1.20
1622	1.45	5812	2.70	9004	.35
1624	.95	5814	.95	9005	1.39
1625	.29	5819	32.50	9006	.25
1626	.19	5820	495.00	C1JA	10.95
1633	.85	5823	1.35	C6J	7.95
1635	1.48	5829	1.35	CK1005	.32
1641	1.35	5840	4.40	CK1006	3.45
1654	1.75	5841	7.40	CK1007	.65
2050	1.25	5844	.95	CK1038	4.70
2051	.65	5851	3.45	CK1039	4.70
5516	6.45	5876	12.50	F123A	2.75
5517	1.65	5879	1.25	F127A	22.50
5634	6.95	5881	2.95	F128A	14.95
5636	2.90	5886	3.25	FG17	4.95
5637	4.95	5894	15.95	FG27A	10.90
5638	7.45	5896	4.45	FG32	3.95
5639	8.95	5899	3.95	FG95	17.50
5641	5.95	5902	5.95	FG105	12.95
5642	.95	5905	8.75	FG172	17.95
5643	5.95	5906	14.95	HF100	6.95
5647	3.95	5908	7.85	HF200	9.95
5651	1.35	5932	3.95	HF300	17.50
5654	1.25	5933	2.25	WL616	47.50
5656	7.90	5963	5.45	RK65	7.50
5670	1.10	6021	4.45	RK72	.50
5675	10.95	6080WA	7.95	RX21	5.50
5676	1.25	6096	1.45	TZ40	4.95
5678	1.25	6097	1.45		
5686	1.95	6098	1.85		

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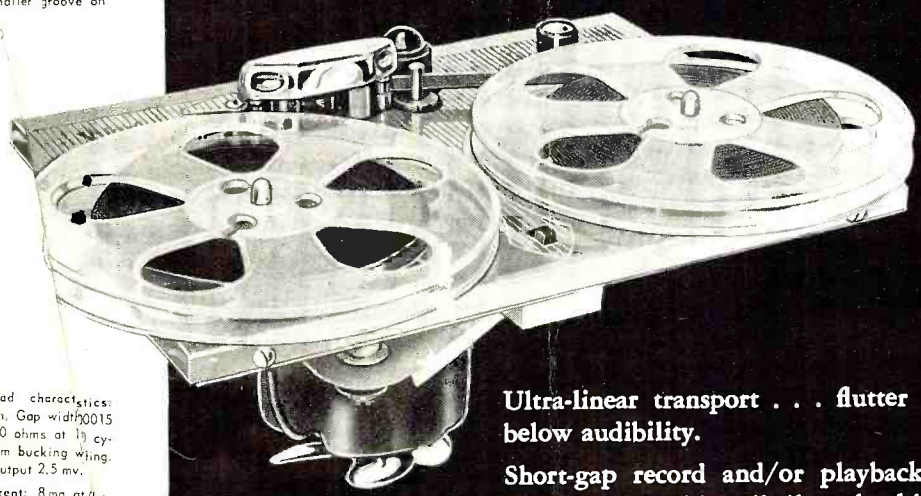


Ultra-linear transport . . . flutter and wow completely below audibility.

Short-gap record and/or playback heads for extended range . . . Double-coil (hum-bucking) record and playback heads for minimum hum. Double-gap erase heads for *dead quiet* erase.

The finest of bearings, and the ultimate in machining tolerances in capstan and drive members — *where precision counts.*

Rugged simplicity for enduring performance.

Physically independent amplifier components for increased flexibility and minimized hum pick-up.

Very high erase-bias oscillator frequency permits extended range recording without bias intermodulation.

NARTB equalization. Physical separation of mechanical and amplifier components, plus clean design, eliminates need for roll-off of lower *(hum)* frequencies.

SPECIFICATIONS

ALL VIKING DECKS

frequency response: 20 to 14,000 cps plus, at 7½ ips. 40 to 7,000 cps plus, at 3¾ ips.

signal-to-noise: db or better.

flutter: 0.2 percent average.

long term speed regulation: ½ of 1.0 percent.

tape speed: 7½ or 3¾ ips available by changing belt to smaller groove on motor pulley).

maximum reel size:

record/playback head characteristics: track width .090 inch. Gap width .0015 inch. Impedance 2000 ohms at 1000 cycles. Double coil hum bucking wiring. Mu-metal shielded. Output 2.5 mv.

recommended bias current: 8 ma. at 60 kc.

erase head characteristics: track width .125 inch, double gap (each .005 in.), inductance 53 mh. at 1 kc, erase 60 db at 68 kc.

SPECIFICATIONS

RP61 SERIES PREAMPLIFIERS

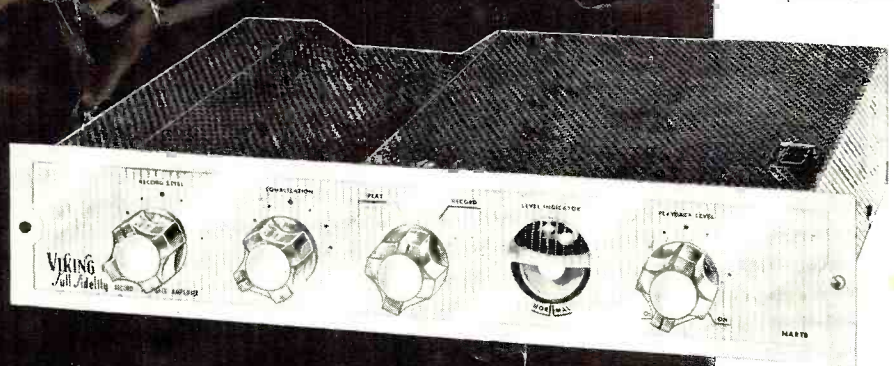
frequency response, playback: 30 to 14,000 cps ± 2 db.

frequency response, record-playback cycle: 30 to 12,000 cps ± 3 db.

distortion (tapes recorded 12 db below saturation): less than 2% within specified frequency range.

internal signal-to-noise ratio: 60 db minimum all units.

equalization: modified NARTB



recording channel gain: low level input. Requires .002 volt rms at 400 cycles for recording level 8 db below saturation. (High level input, .3 volts rms.)

playback channel gain: 55 db.

recording inputs: high impedance microphone (62 db overall gain) and high impedance radio or phono input (32 db gain).

bias frequency: 68 kc.

output: 1 volt, high impedance.

tube complement: 1-12AX7, 1-12AU7A, 1-12AV7, 1-6X4, 1-6E5 Indicator.

Ask your dealer for a *Viking* recording and playback demonstration before you buy *any other* recorder.

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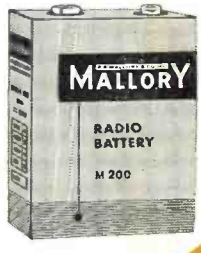

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