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RADIO & TV NEWS

MARCH
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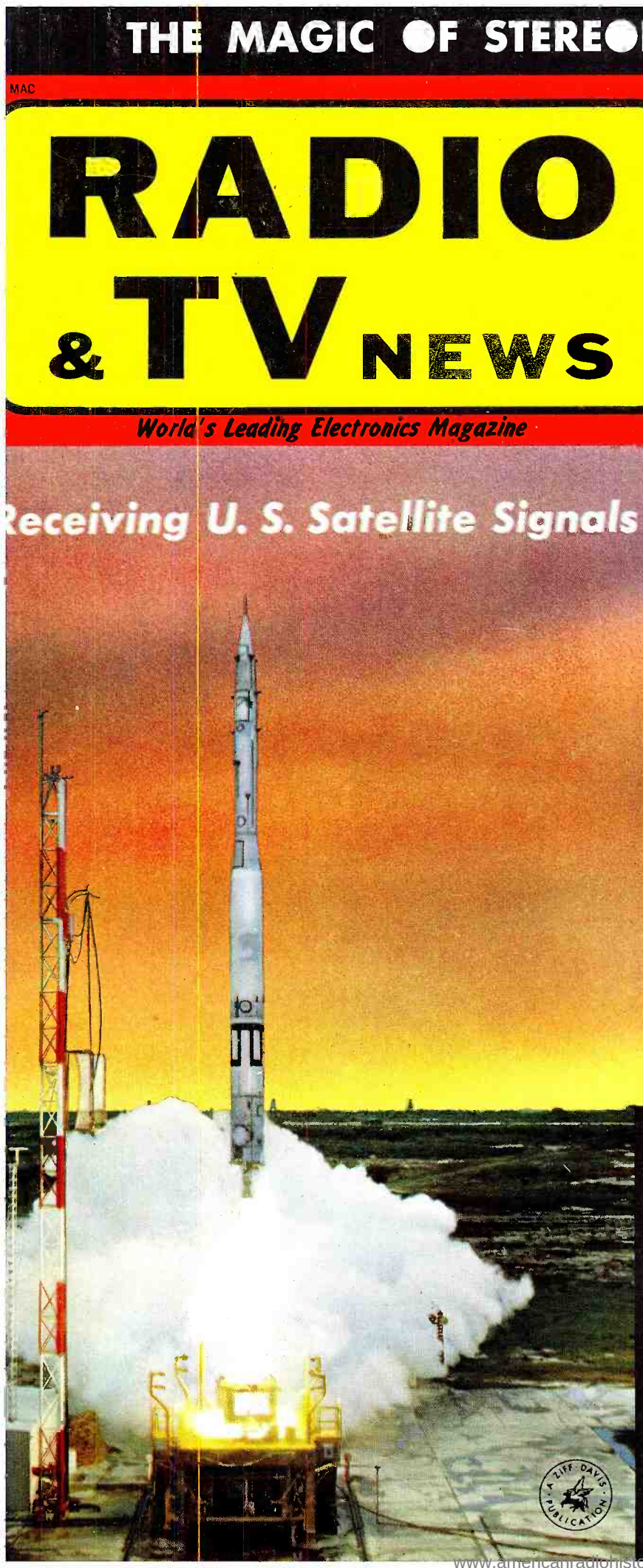
Receiving U. S. Satellite Signals



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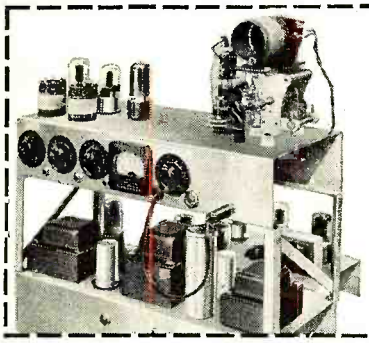

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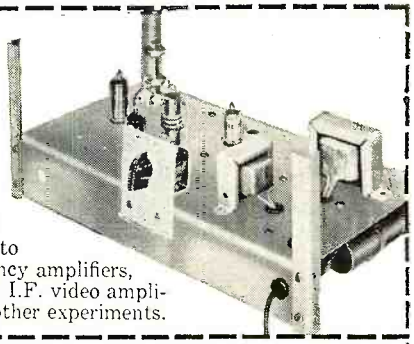

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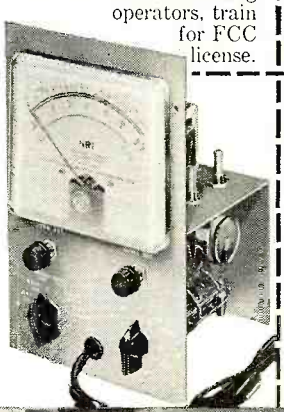

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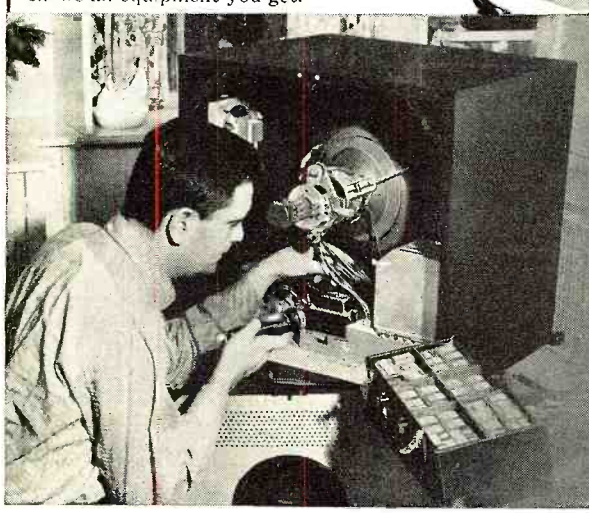

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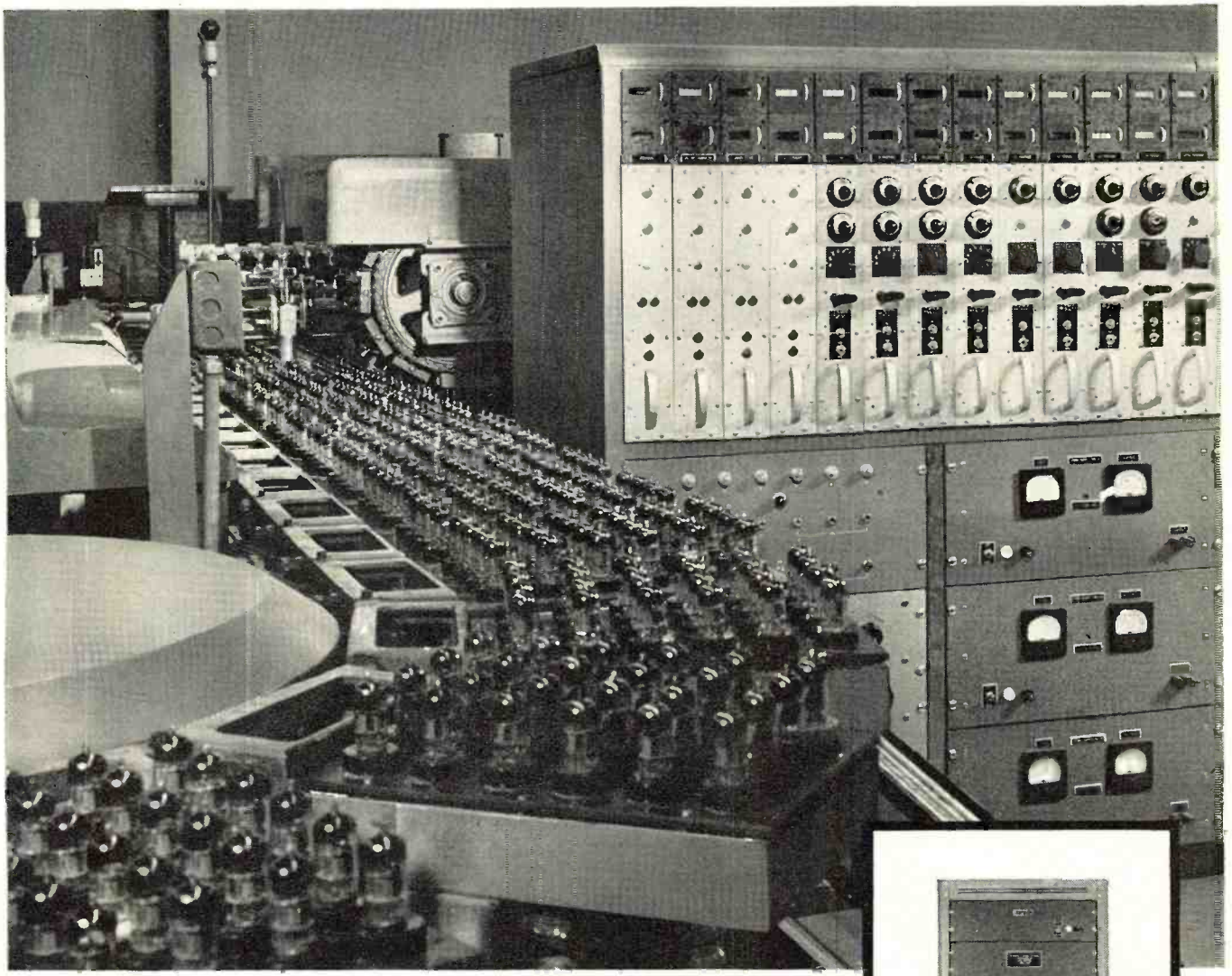

CBS tubes are mechanically transferred from the aging conveyor (left) to the automated tester (right) where they undergo up to 27 characteristics tests controlled by adjustable plug-in units.

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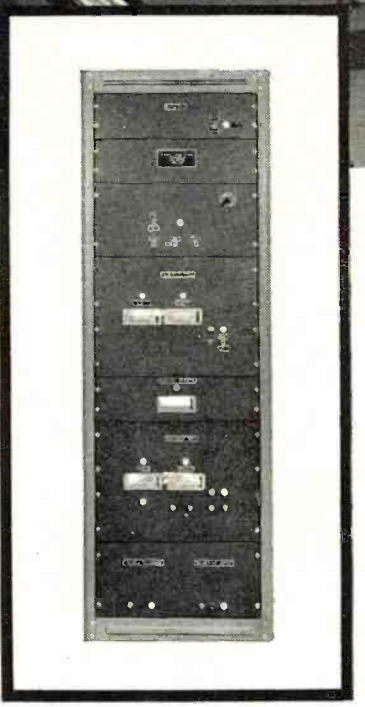

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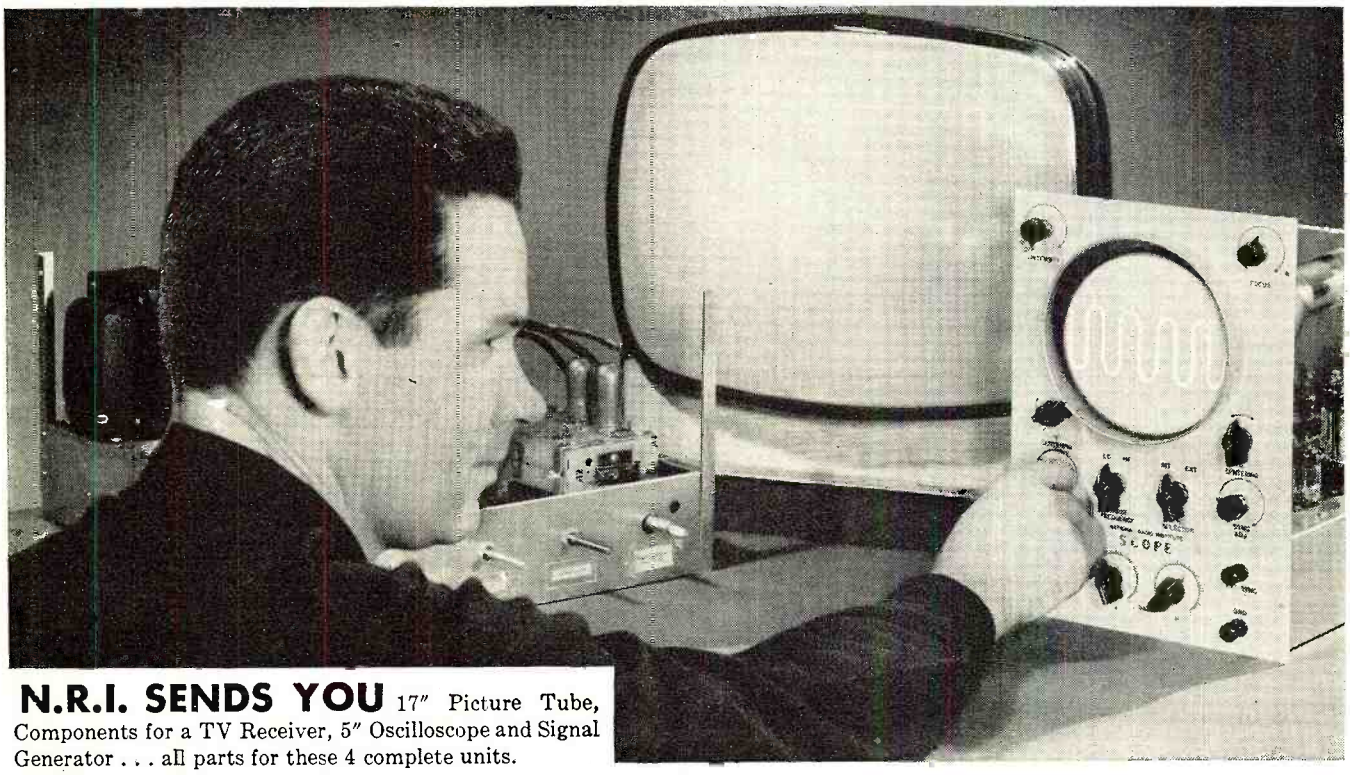

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For the RECORD

ELECTRONICS IN OUR ECONOMY

THE "Space Age," launched on the fourth of October last year with the orbiting of the first sputnik, also heralded a new and important era for electronics. Rockets, guided missiles, supersonic aircraft, early warning systems, atom subs, etc. could not have been developed nor would they be operable without electronics. Electronics is slated for an even more vital role as the Space Age moves into high gear. Although over 2 billion dollars was spent on guided missiles last year this sum will be increased substantially in 1958 with a healthy chunk of the business going to makers of guidance and control equipment. It has been estimated that up to 17% of all military expenditures last year was for electronic gear.

Important as the government is as a consumer of electronic products (about 50% of the dollar volume), the private citizen and the business man contribute substantially to the health and prosperity of the industry. Although last year's television receiver sales were down about 4% from 1956, the industry expects that this year approximately 7 million sets will move into the hands of the public. The replacement market is expected to account for approximately 3 to 4 million sets.

Radio, that stepchild of the age of the cyclops, has staged a remarkable rebirth with people everywhere discovering that an enlightened sense of hearing is well worth cultivating. The improvements and conveniences incorporated in the new tuners, amplifiers, phonographs, and other basic audio gear have wooed an entirely new following for high-fidelity equipment. The public bought some 14.7 million radio receivers and 5 million phonographs last year and is expected to up its purchases quite substantially this year.

With some 47 million TV sets and 135 million radios in use, the business of keeping this equipment in good working order has become an impressive one. Replacement parts, including tubes, amounted to almost a billion dollars last year and shows promise of topping its own record in 1958.

All in all, 1957 was a good year for the electronics industry with sales at the factory level exceeding 7 billion dollars, an increase of over 1 billion over the previous year.

It can be stated without successful contradiction that electronics is one of the most dynamic industries in the United States today. Not only are new uses being found for existing equipment and techniques but new products are pouring out of the research laboratories at an almost unbelievable rate. Who, ten years ago, would have envisioned a 2½ times increase in the production of transistors in a single year? Printed circuitry? Automatic assembly of radio and TV sets as well as more elaborate electronic devices? Long life and rechargeable batteries of minute size? Electronic devices deriving their power from the sun, or failing this, artificial light? The list is growing larger every day.

When the roll of these new miracle brain children is added to the inprovements that have been made in some of the more familiar products—new shorter picture tubes, a technique for producing audio tubes which reduces microphonics, methods for controlling the accuracy of turntable rotation to eliminate wow and flutter, etc.—the over-all picture is certainly truly impressive.

As with the economy as a whole, the electronics industry has hit some soft spots which has resulted in temporary cutbacks and the shut-down of some production lines with the furloughing of workers, but the consensus of most economists is that the situation in the electronics industry is transitory. The speeding up of the national defense program, the acceleration of the missile and space programs, and the increased application of electronics in both the heavy and light manufacturing fields will soon provide the necessary shot in the arm to get the electrons flowing again. In the meantime and until the full electronics program shifts into high gear, the audio equipment segment of the industry moves forward steadily, garnering a greater and greater percentage of the consumer's "recreational" dollar for a staggering total of $200 million last year—an increase of some 188 million since 1950!

Thus, while some persons are encountering temporary set-backs in their chosen field of electronics, due to some extent to regional situations affecting business as a whole, the over-all projection seems to indicate that while the "patient" may be under the weather at the present time, the disease is far from fatal and the essential vigor of the patient can be counted upon to effect a complete recovery—and then some. You can always count on our industry to invent its own "electronic bootstraps" to meet the current need. And the current need is tremendous and shows no signs of abatement. . . . W.S.

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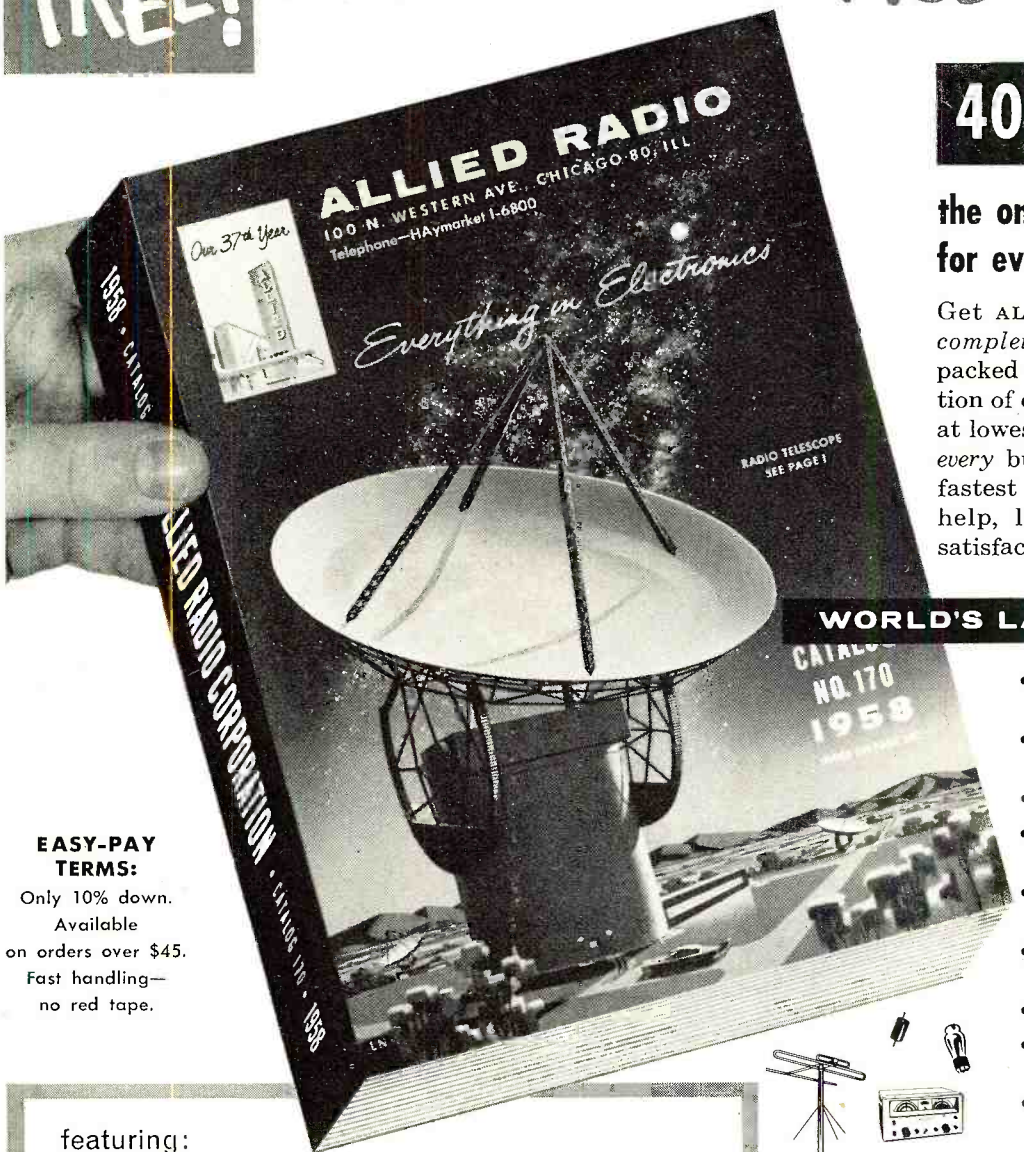

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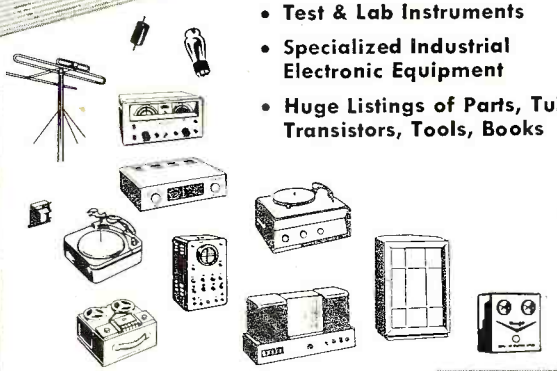

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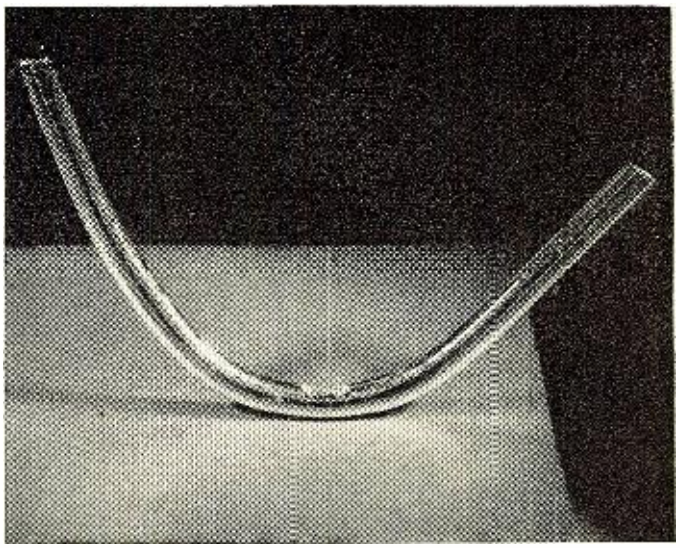
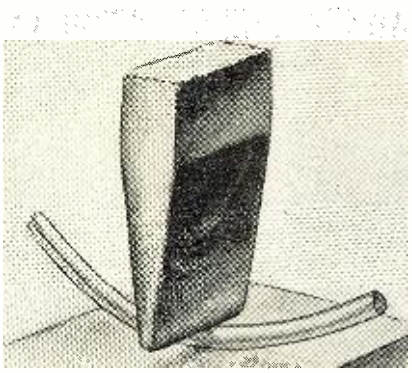


Wire bonded to germanium by thermo-compression technique (enlarged). Wires only 1/10 the breadth of a human hair have been successfully anchored to germanium wafers only three hairs thick. The bond may be an ohmic contact or rectifying contact by adding suitable impurities to the wire and the semiconductor.



One method of thermo-compression bonding. A heated wedge presses a wire against a heated semiconductor with enough force to deform the wire. Adhesion occurs in seconds.

new way to join metal to semiconductors

Thermo-compression bonding provides a new way to attach a wire to a semiconductor. It calls for heat and pressure—nothing else. The wire and the semiconductor are moderately heated, then pressed together under moderate pressure. The resulting bond is very strong—stronger actually than the wire. No chemical flux or molten metal is required.

Eliminating molten metal provides an enormous advantage in fixing electrical connections to transistors. That's because molten metal tends to spatter and spread uncontrollably over the surface of a semiconductor. And it may alloy with the semiconductor to alter its all-important crystalline structure and chemical purity. Thermo-compression bonding easily and quickly makes a strong permanent electrical connection without damaging the semiconductor. Furthermore, the lead may be attached to microscopic areas and precisely positioned, a most valuable aid in the construction of high-frequency transistors.

Thermo-compression bonding will speed the production of transistors . . . the transistors needed to fill all the new jobs Bell Laboratories finds for them in the quest to provide still better telephone service to our growing country.

At Bell Labs Howard Christensen and Orson Anderson discuss their discovery of new bonding principle with Peter Andreatch, Jr., who collaborated in the studies.

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☐ I'm a Service Technician: ☐ full time; ☐ part time

My Distributor is:_____

Shop Name:_____

Attn.:_____

Address:_____

City_____ Zone___ State_____

After some years of absence we are once more running a "Letters" column. So many of our readers have urged us to reinstate this feature in order that they might have a chance to express their views not only to us personally and privately but also to our many other readers, whom we feel sure would be interested. So if you have any constructive and worthwhile comments that you feel would be of general interest, please drop us a line. We can't guarantee to print all your letters because of space limitations, but we would like to hear from you.—Editor.

C.O.D. SERVICE

To the Editors:

As a customer, the man who pays the bill, I am commenting on the article "Strategy for C.O.D. Service" in the December issue.

While from the standpoint of the service shop operator, C.O.D. service may be advantageous, it is not always so for the customer. Perhaps, for example, the person present when the work is done in the home is not the person who will pay the bill. Also, many quite solvent families work on close budgets. When a bill is exceptionally large, an extension of credit into the following month may be desirable. If refused—or even if granted after a lot of hemming and hawing—the customer is apt to be resentful.

We customers have been educated to ask for credit when we want it. "Your credit is good!" "Open an account!" "Pay the painless way!" Here in the San Francisco Bay area perhaps the toughest competition for the independent service shops are two large department stores which aggressively push TV servicing, the charges for which may of course be added to the customer's regular bill.

WETHERBY BOORMAN
San Bruno, California

Our article presented one viewpoint that's useful to many service shops. We don't doubt that the view expressed above would be shared by other shops. —Editor.

* * *

SOUND TUNER "GIMMICK"

To the Editors:

In your November, 1957 issue there is an article "FM and TV Sound Tuner" by Bruce Morrissette. This is a very interesting circuit but it does not explain one important item and that is what is a "gimmick." I have spent much time and have exhausted all the local talent trying to decipher "a 2 μμfd. twisted wire gimmick."

J. W. BETHARD
San Diego, Calif.

Our "old-timer" readers certainly could answer this one, since "gimmicks" were widely used in some of the old broadcast sets. The "gimmick" is simply a very small capacitance, say a couple of μμfd., that is made up by taking two pieces of insulated wire and twisting them together for a few turns. In the case of the circuit referred to, all you would have to do is to simply wrap a couple of turns of one of the leads around the other as shown in the diagram. This will produce the required capacitance.—Editor.

* * *

COLOR TV INFO

To the Editors:

Your magazine is one of the best that we receive. This is especially true because of your information on color TV. This material is very welcome to us since we are now leading this area in sales of color-TV receivers, having sold about 55 sets since we started to handle them about 14 months ago. Thanks for your fine help in this matter.

CHESTER M. BENSON, W9IFB
Richmond's Television Center
Richmond, Indiana

Thanks for the compliments. To some color-TV is still a big question mark, but others are going full steam ahead with it.—Editor.

* * *

SERVO SPEAKER SYSTEM

To the Editors:

From your description of the new *Integrand* hi-fi speaker system (October 1957 issue) it would appear that this unit is just what I have been waiting for. But where can I hear one of the units in actual operation so that I can judge for myself if it sounds as good as it should? Also you promised us some further information on the system. I would very much like to know more about the system, especially about the speakers themselves.

J. W. KLINGENSMITH
Toronto, Ontario

We, too, feel that the system is quite unique; so much so that we have planned to run some more information on it. However, because of the very unusual design, the manufacturer is finding it difficult to obtain large enough supplies of components and transistors that conform to the tight tolerances required. Just as soon as this problem has been ironed out the systems will be put into production. At first a few of the units will be shipped to the major

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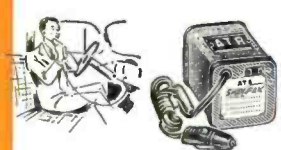

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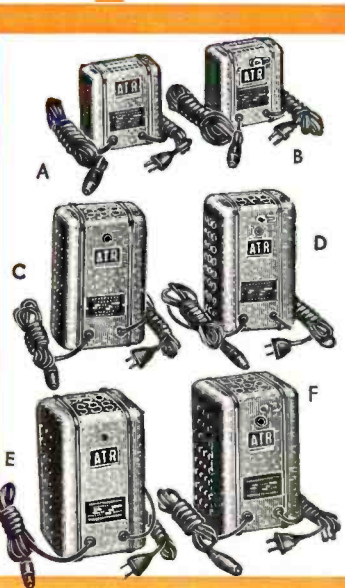

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hi-fi centers throughout the country so that they may be heard. When this occurs, we will cover the system more fully. In the meantime, further information can be obtained from the manufacturer, the Integrand Corp., 662 Main St., Westbury, Long Is., N. Y.—Editor.

* * *

STEREO GAIN CONTROLS

To the Editors:

Regarding our article "Stereo Balance and Gain Control" (December, 1957 issue), the circuit shown in Fig. 3B would perform better if tapped linear controls rather than log controls are used for gain adjustment. The commonly available log pots reach 250,000 ohms at about 75 per-cent rotation rather than at 50 per-cent. With linear controls now being recommended having taps at 250,000 ohms, the addition of R_1 and R_2 effectively changes the linear taper into one that closely approximates a log taper.

HERMAN BURSTEIN
Wantagh, New York

* * *

HIGH-STABILITY OSCILLATOR

To the Editors:

I have received many letters from hams who are very interested in the "High-Stability Oscillator Circuit" which I described on page 142 of the June, 1957 issue. The oscillator will actually perform better than was indicated in the article, but I felt better being on the conservative side. However, the oscillator will not perform properly with poor coils, especially at lower frequencies, although some coils hastily wound on old tube bases worked rather well. In order to reduce the necessity for extremely high quality coils, two changes are suggested. Capacitor C_2 in the schematic was changed from 5100 $\mu\mu$fd. to 3000 $\mu\mu$fd. and resistor R_1 was changed from 1 meg. to 2 meg.

The circuit as given (with the above minor changes) operated throughout the frequencies of 640 kc. to 11.8 mc. with no changes other than the number of turns on the coil. The coil form used was 1¼ inch diameter. You can see from this that the circuit is not at all critical and a much greater range may be obtained by winding coils with the correct length/diameter/spacing ratio in accordance with good coil winding practices.

May I suggest an easy method of determining whether or not the circuit is oscillating correctly? Disconnect the oscillator from the buffer amplifier so that it is operating with no load. Connect a 20,000 ohms per volt meter across the 10,000 ohm cathode resistor. You will get a reading somewhere around 10 or 20 volts. Place your grid-dip oscillator (in oscillating condition) near the v.f.o. coil and tune the g.d.o. through the frequency of operation. When the g.d.o. and the v.f.o. are operating on the same frequency, the voltmeter in the cathode circuit will show a great increase in voltage, depending to a great extent on the degree of coupling between the coils.

ROBERT J. ROPES, W9PAP
Kokomo, Indiana —30—

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...and every TV service-dealer and technician who enters this exciting "contest" receives a gift—just for entering!

Here's How:

1. To enter the contest, write a statement of 50 words or less telling how you think RCA's promotion of "National Television Servicemen's Week" benefits the independent TV service industry. The contest is open to all radio-television service dealers and their service employees, in the continental U. S., Alaska, and Hawaii, without any obligation on their part.

2. Your entry must be made on an official entry blank and must be submitted in your own name describing your own opinions in connection with "National Television Servicemen's Week"—March 24th to 29th, 1958. You may prepare your own entry blank, or you can ask your RCA Tube Distributor Salesman to help you prepare your entry blank. If your distributor salesman does help you, be sure to have him countersign your entry blank—he is also eligible for a prize if you win. Official entry blanks are available from your Authorized RCA Tube Distributor and from RCA Electron Tube Division advertisements. Only one entry per person is permitted.

3. Mail your entry, using adequate postage to: RCA Electron Tube Division, P.O. Box 551, New York 46, N. Y.

All entries must be postmarked on or before midnight, March 15, 1958. No general correspondence should be sent to this address.

4. The entries will be judged by Advertising Distributors of America, Inc., an impartial, independent contest judging organization, on the basis of originality, sincerity, and aptness of thought. Decision of the judges is final. All entries become the property of Radio Corporation of America, and none will be returned. Entry in the contest constitutes permission to RCA to use your name and entry in any way it sees fit.

5. The contestants will be ranked in each region, in the order of the merit of their entries, as determined by the judges as provided above. They will be visited in person or phoned, in succession, sometime between the period of April 1, 1958 and April 30, 1958, by a "Mystery Shopper". The "Mystery Shopper" will ask a question about the product features of RCA Silverama Picture Tubes or RCA Receiving Tubes. The first service dealer or service technician in each region who answers the question correctly will be presented with the grand award. The next 3 dealers or their service employees in each region who answer the question correctly will be awarded one of the beautiful, new RCA Victor color TV sets. An additional 10 contestants in each region who answer the "Mystery Shopper" question correctly will receive one of the exquisite RCA Victor High Fidelity Sets. And 10 additional contestants in each region who answer the question correctly will receive an RCA Victor Transistor Radio. All contestants will receive a token of recognition.

6. The "Mystery Shopper" is the name applied to a group of impartial employees of Advertising Distributors of America, Inc., located throughout the nation. The "Mystery Shopper" will visit or phone contestants in the guise of a consumer, and will not divulge his or her identity unless the contestant supplies the correct answer to the question asked by the "Mystery Shopper".

7. Only one award will be made per person. Duplicate awards will be made in the event of a tie. This contest is subject to state and local regulation. Void if taxed, restricted or forbidden by law. A list of award winners may be obtained after April 30, 1958 by sending a stamped, self-addressed envelope to the address given above.

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RCA ELECTRON TUBE DIVISION
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SIGNED _____
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Electron Tube Division ***Harrison, N. J.***

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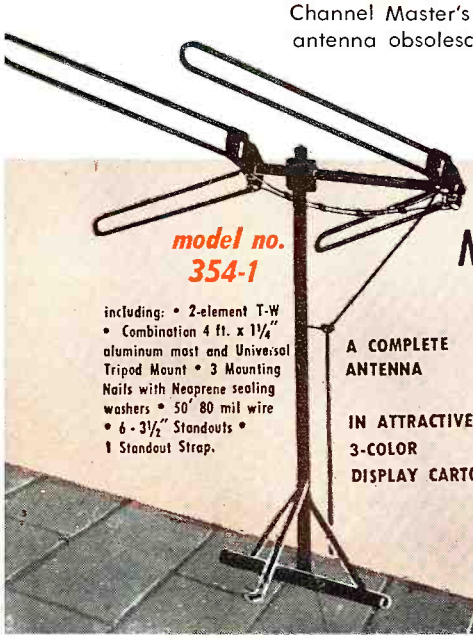

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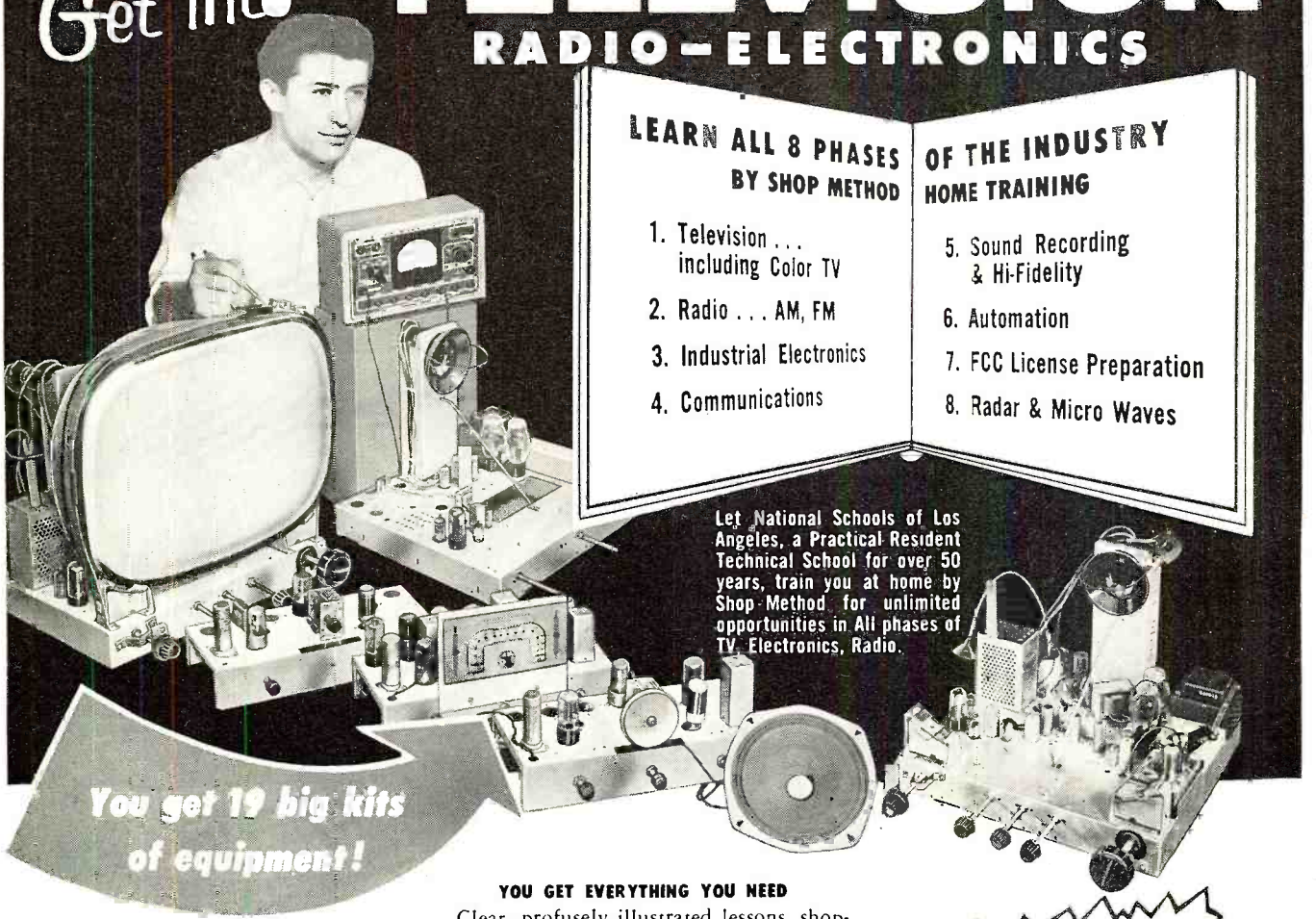

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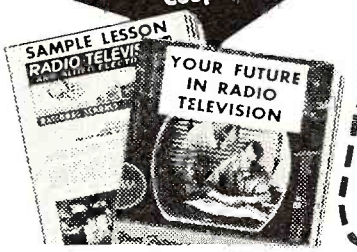

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
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THERE IS A DIFFERENCE IN P. A. SPEAKERS

you get a lot more to sell with

Electro-Voice®

CDP® SPEAKERS

Model 848 for the bigger jobs. 25 watts. 16 ohms. Response, 175 —10,000 cps. crossover at 1000 cps. RETMA sensitivity rating, 52 db. Size, 10½" x 20½" x 20." Wt., 12 lbs. List.....$75.00.

Model 847 CDP for smaller areas. 12 watts. 16 ohms. Response, 250 —10,000 cps, crossover at 1500 cps. RETMA sensitivity rating, 51 db. Size, 11¾" x 7¾" x 10½". Wt., 6½ lbs. List.....$46.33.

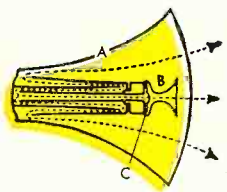
Yes, Electro-Voice gives you more to sell and more help in selling P. A. speakers. Hard-hitting, sales-pulling ads pre-sell architects, buyers in schools, universities, colleges, industry and all your prime P. A. prospects. They are told the CDP story . . . and what a terrific story it is. To tell it is to sell them!

HERE'S WHY CDP SPEAKERS ARE SO SUPERIOR, SO MUCH EASIER TO SELL THAN CONVENTIONAL P. A. HORNS . . .

High frequencies require one throat size and one horn taper rate; low frequencies require a different throat size and a different taper rate. The Electro-Voice CDP gives you a large horn (A), for lows and a second, smaller horn (B), coaxially mounted, for highs working from both sides of a single diaphragm (C). The Electro-Voice CDP gives you 2½ more octaves of sound reproduction . . . frequencies up to 10,000 cps. These 2½ octaves are indispensable for highest intelligibility. See the curve, compare response and efficiency. In addition, Electro-Voice CDP speaker disperses sound through a solid 120° angle for the widest coverage available in P. A. speakers.

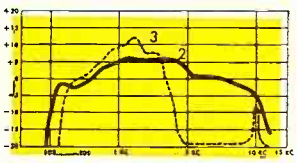
You can *hear* the difference.

1 This is a CDP Speaker with its two coaxially mounted diffraction horns.



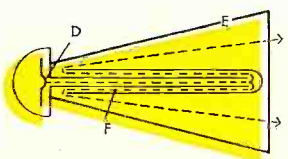
2 This is the frequency response curve of a CDP.

3 This is the frequency response curve of a conventional P. A. horn.



Conventional reentrant horns using single throat (D) and single horn (E) transmit highs along the same circuitous path (F) as required for lows. As a result, the highs become attenuated, sharply decreasing intelligibility. Electro-Voice gives you P. A. speakers with a large horn for lows and a second, smaller horn, coaxially mounted, for highs. **There is a difference and you can hear it.**

4 This is a conventional reentrant-type P. A. horn.



Electro-Voice

ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN

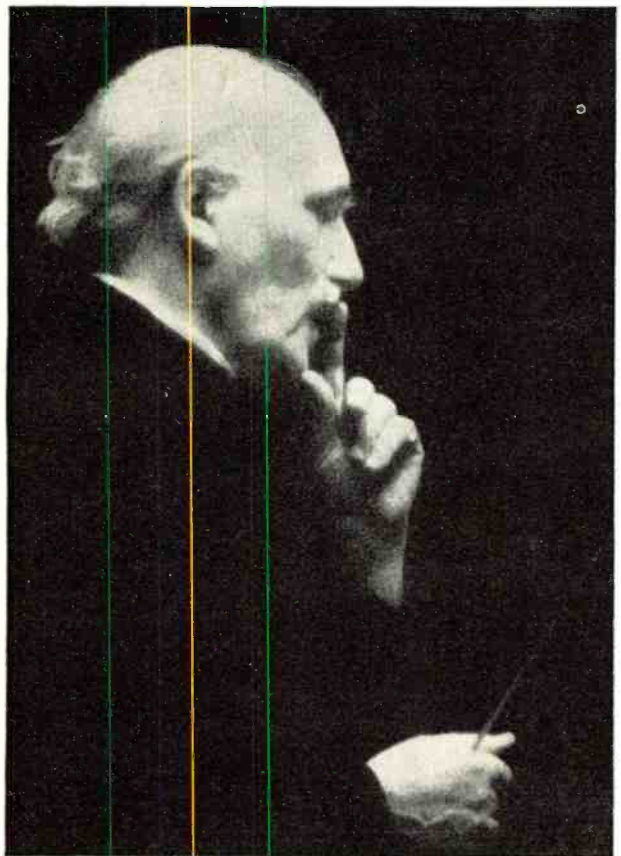
EXPORT: 13 East 40th Street, New York 16, U. S. A. CABLES: ARLAB.

CDP speakers are weather-proof, blast-proof and splash-proof, virtually indestructible. They're molded of fiberglass for better acoustical properties and extra strength.

Sell CDP Speakers . . . the speakers that sell because they are clearly superior. See your Electro-Voice Distributor TODAY. Get the facts and start selling the most revolutionary speakers in P. A. history . . . the Electro-Voice CDP.

Send for bulletin 195-N83

RCA VICTOR and Book-of-the-Month Club



ANNOUNCE THE FORMATION OF

The RCA Victor Society of Great Music

. . . its common-sense purpose is to help serious lovers of music build up a fine record library *systematically* instead of haphazardly. By doing so, they can save ALMOST ONE THIRD of what they would pay otherwise for the same RCA VICTOR Red Seal Records.

MOST MUSIC-LOVERS, in the back of their minds, certainly intend to build up for themselves a representative record library of the World's Great Music. Unfortunately, almost always they are haphazard in carrying out this aspiration. The new Society is designed to meet this common situation, sensibly, by making collection more systematic than it now is in most cases.

✶ Because of *more systematic* collection, operating costs can be greatly reduced, thus permitting extraordinary economies for the record collector. The remarkable Introductory Offer at the left is a dramatic demonstration. It represents a 45% saving the first year.

✶ Thereafter, continuing members can build their record library at almost a **ONE-THIRD SAVING.** For every two records purchased (from a group of at least fifty made available annually by the Society) *members will receive a third* RCA VICTOR *Red Seal Record free.*

✶ A cardinal feature of the plan is **GUIDANCE.** The Society has a Selection Panel whose sole business it is to determine "must-have" works for members. Members of the panel are as follows:

DEEMS TAYLOR, composer and commentator, Chairman
SAMUEL CHOTZINOFF, General Music Director, NBC
JACQUES BARZUN, author and music critic
JOHN M. CONLY, editor of *High Fidelity*
AARON COPLAND, composer
ALFRED FRANKENSTEIN, music critic of *San Francisco Chronicle*
DOUGLAS MOORE, composer and Professor of Music, Columbia University
WILLIAM SCHUMAN, composer and president of Juilliard School of Music
CARLETON SPRAGUE SMITH, chief of Music Division, N. Y. Public Library
G. WALLACE WOODWORTH, Professor of Music, Harvard University

HOW THE SOCIETY OPERATES

EACH month, three or more RCA VICTOR Red Seal Records will be announced to members. One will always be singled out as the *record-of-the-month,* and unless the Society is otherwise instructed (on a simple form always provided), this record will be sent to the member. If the member does not want the work he may specify an alternate, or instruct the Society to send him nothing. For every record purchased, members will pay only $4.98, the nationally advertised price of RCA VICTOR Red Seal Records (plus a small charge for postage and handling).

AS THE HEART AND CORE OF A LIFETIME RECORD LIBRARY

BEGINNING MEMBERS WHO AGREE TO BUY SIX RCA VICTOR RED SEAL RECORDS FROM THE SOCIETY DURING THE NEXT YEAR WILL RECEIVE

The Nine Beethoven Symphonies

Arturo Toscanini

CONDUCTING THE NBC SYMPHONY ORCHESTRA
IN AN ALBUM OF SEVEN 12-INCH LONG-PLAYING RECORDS FOR

$3.98

—plus a small charge for mailing

Nationally advertised price $34.98

RCA VICTOR Society of Great Music, c/o Book-of-the-Month Club, Inc., 345 Hudson St., New York 14, N. Y.

Please register me as a member and send me the seven-record *Toscanini-Beethoven Album* under the conditions stated at the left billing me $3.98, plus postage. If I continue, after buying six records, for every two records I purchase from the Society, I will receive a third RCA VICTOR Record, free. To maintain membership after the first year, I need buy only four records from the Society in any 12-month period.

MR. / MRS. / MISS .....
(Please print plainly)

ADDRESS .....

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

NOTE: If you wish to enroll through an authorized RCA VICTOR dealer, please fill in here:

DEALER'S NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE V166-3

Spot News

Latest Information on the Electronic Industry

By RADIO & TV NEWS' WASHINGTON EDITOR

OVER $2-BILLION SPENT FOR REPLACEMENT PARTS AND REPAIR DURING '57—A new high in component sales and service income was recorded during 1957. According to year-end records of the Electronic Industries Association in Washington, well over $1-billion was spent for installation, maintenance, and service, while nearly $1-billion went for repair parts, including tubes. For details on the "state of the industry," see page 8.

HI-FI BOOM SOARING RADIO-PHONO SALES—The radio-phono market, once pronounced killed by television, has made a striking recovery, thanks to the revived interest in sound and the evolution of popular hi-fi. Industry sold 14.7-million radios in 1957, compared to 13.3-million in '56. And an all-time record of 5-million phonographs were sold during '57; a substantial gain is forecast for '58.

SEMICONDUCTOR SALES MOUNTING—The future potential for semiconductors looks almost unbelievable; industry specialists predict an increase of 33% for both transistors and diodes for '58, with the record-breaking 1957 income of $143-million rising to about $200-million.

THOUSANDS OF NEW HAM STATIONS OKED DURING '57—Over 160,000 amateur transmitters are now registered with the FCC, according to the Commission's annual report issued recently in Washington . . . Commercial use of 2-way radio also jumped during the past year; some 40,300 aircraft are now radio equipped. In addition, there are over 105,000 transmitters in use by taxicabs; 51,300 two-way setups are being used by railroads, and nearly 4000 communications systems are in operation on bus lines. The fire departments of the nation are also extensive users of 2-way radio according to the Commission; there are now 50,000 transmitters in operation, and almost three times as many are being used by the police.

FCC, AIR FORCE, WEATHER BUREAU ADOPT CONELRAD FOR STORM WARNINGS—The Federal Communications Commission, U.S. Air Force, and the Weather Bureau in Washington have announced that they will use the Conelrad national defense alerting system as a weather-warning tool for seasonal hurricanes, inland tornadoes, and floods. . . . All broadcasters (AM,FM,TV) will participate in the weather-emergency program.

TOLL-TV OPPOSED BY LABOR—A resolution opposing toll-TV was passed recently by the second constitutional convention of AFL-CIO. This vote re-affirmed the stand that the body took two years ago at its first meeting.

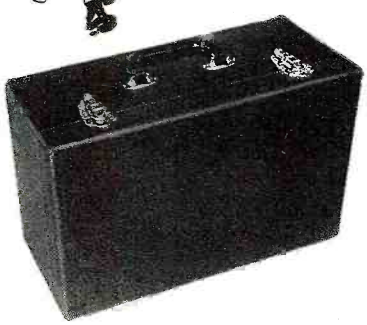
PHILLY U.H.F. STATION FILES FIRST PAY-TV APPLICATION WITH FCC—Channel 29 WSES in Philadelphia recently entered the first request for permission to charge for TV programs . . . The station told the Commission that it proposes to use the Skiatron system of punch-card decoders, especially for sports telecasts. The rate structure, it was noted, would include a $30 yearly fee for each receiver connection, plus $1.00 for each program. Commercial establishments, such as bars, clubs, etc., would be charged $100 yearly, and $5 for each program. In addition, there would also be small charge established for installation of the decoding system.

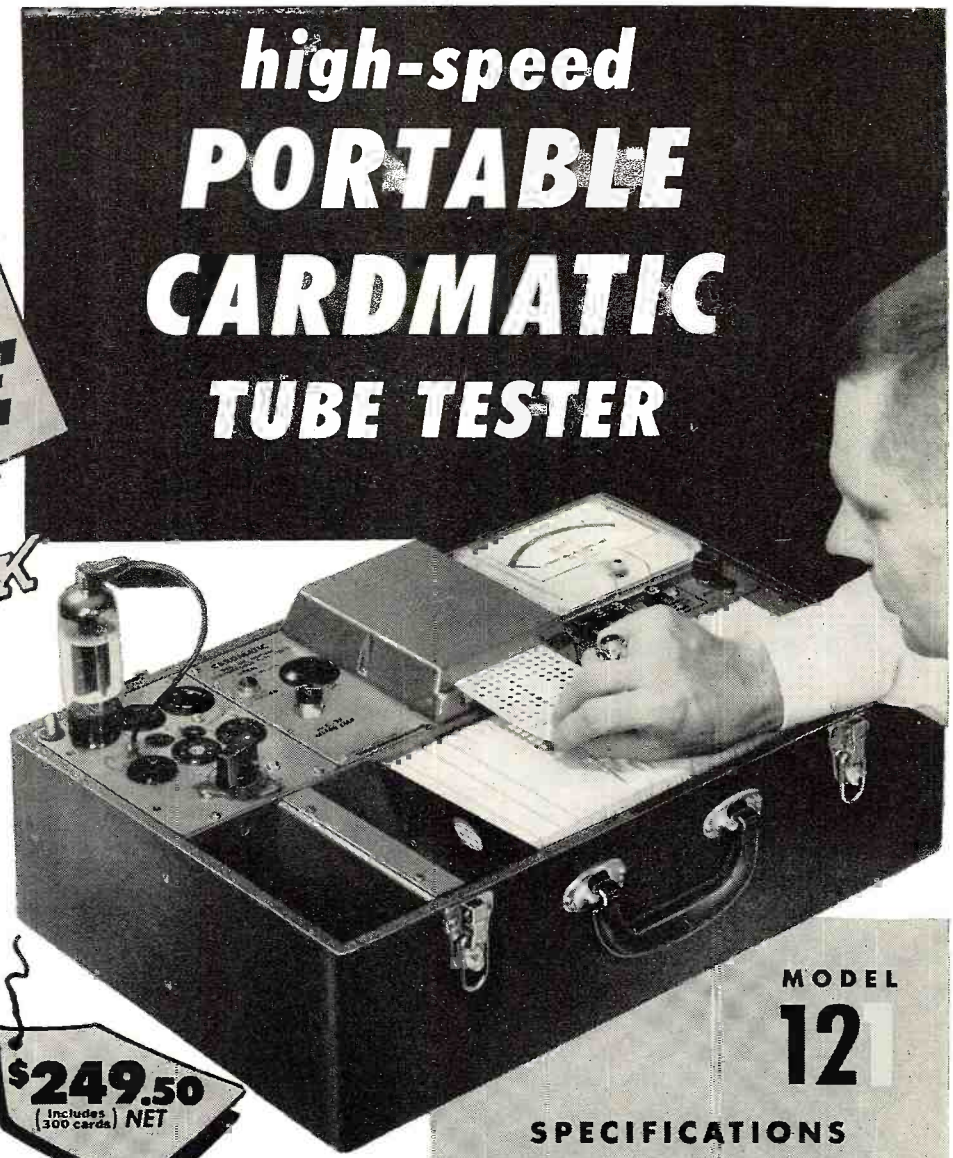
NEARLY 500 COMMERCIAL TV STATIONS ON THE AIR—The FCC records now show that 497 TV stations are operating, with 414 using the very-high bands and 83 the u.h.f. channels. As we went to press, the following received authorizations to telecast: Central Minnesota Television Co., Alexandria, Minnesota—channel 7 (174 – 180 mc.) with a visual e.r.p. of 26.3 kw.; Beehive Telecasting Corp., Provo, Utah—Channel 11 (198-204 mc.) with a visual e.r.p. of 3.029 kw.; Greenwood Broadcasting Co., Greenwood, Mississippi—channel 6 (82-88 mc.) with a visual e.r.p. of 30.4 kw.—30—

high-speed PORTABLE CARDMATIC TUBE TESTER

NEW, LOW PRICE

HICKOK





$249.50 (Includes 300 cards) NET

MODEL 121

SPECIFICATIONS

320 heater voltages.
140 fixed bias potentials.
640 plate voltages.
640 screen voltages.
100 self-bias settings
1000 quality-value sensitivity ranges
Instant shorts indication.
ALL AUTOMATICALLY!

Active card magazine holds over 600 cards instantly available with time saving automatic filing feature.

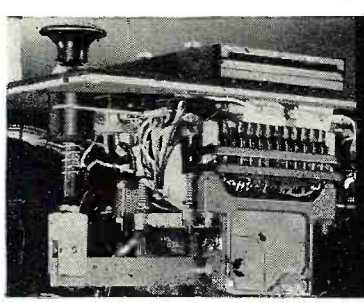
SEE THE 121 TODAY!

Fully Automatic

Tests any tube in 8 to 12 seconds . . . including handling of tube test data card.

Here is the new, low cost version of the famous Hickok Cardmatic so popular with leading lab engineers. Especially designed for high speed service work, this new 121 is high quality in a lightweight portable . . . and the price is low too.

The Hickok Cardmatic switch sets up all tests automatically and eliminates fussing around with adjustments. You can accurately check a tube for dynamic mutual conductance, controlled emission, cutoff point "Knee" point, shorts, leakage, gas and voltage drop . . . and rectifier tubes at their rated loads. Any way you look at it, this new automatic tube testing machine will be helpful to you in your work. It will pay for itself in a very short time . . . and give you many years of accurate dependable service.

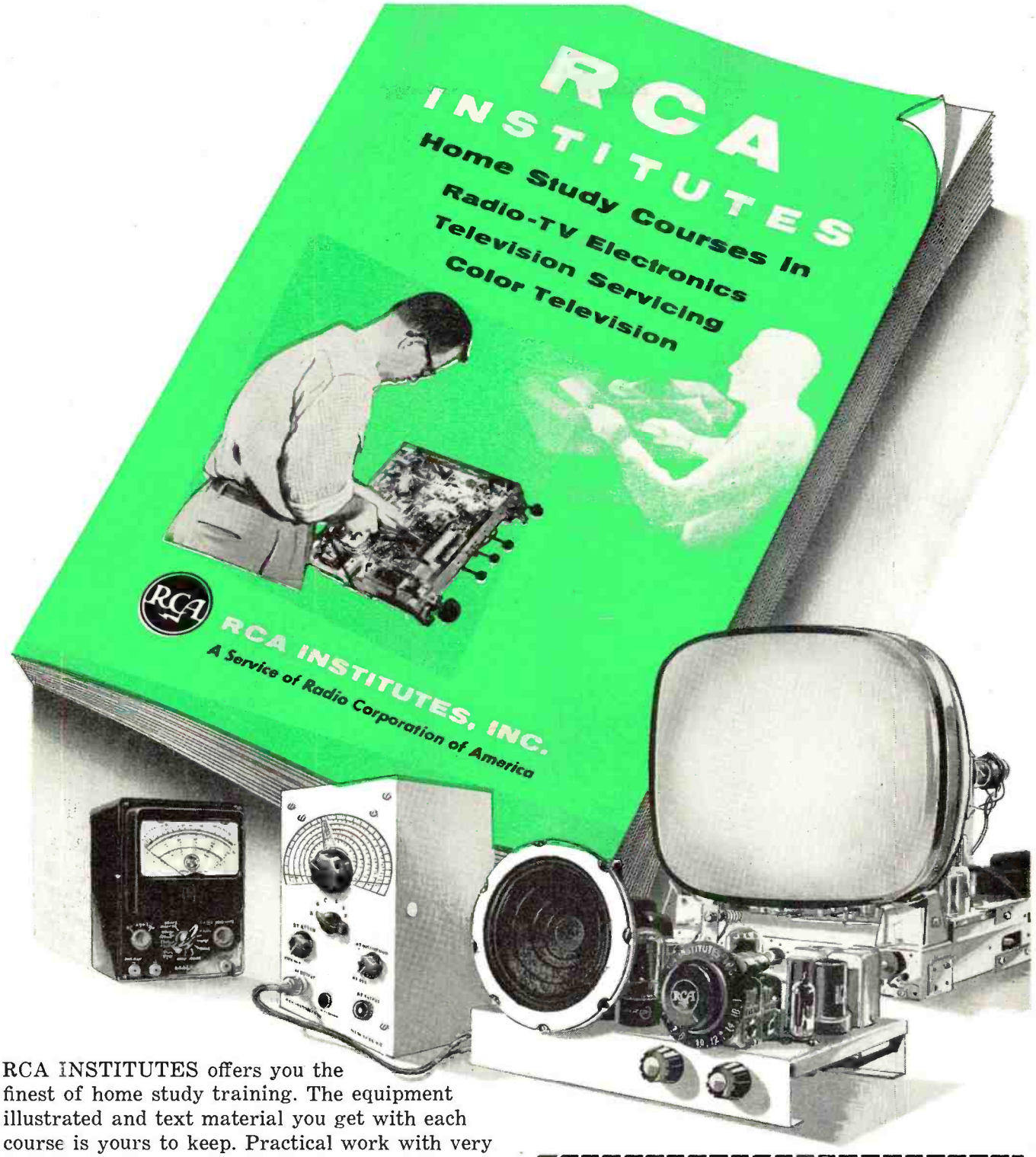


The new 121 incorporates a fully automatic mechanism actually incorporating 187 individual switches providing an almost unlimited number of voltage combinations to any tube element. This mechanism has been life tested in a cycling process over 100,000 times—without fail, and has proven superior to all other switching arrangements.

Now is the time to . . .
TRADE UP TO A HICKOK

Ask for a demonstration of the new 121 or write for descriptive literature.

THE HICKOK ELECTRICAL INSTRUMENT CO.
10524 Dupont Avenue • Cleveland 8, Ohio



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[RESIDENT SCHOOL courses in New York City offer comprehensive training in Television and Electronics. Day and evening classes start four times each year.
Detailed information on request]

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Without obligation, send me FREE 52 page CATALOG on Home Study Courses in Radio, Television and Color TV. No salesman will call.

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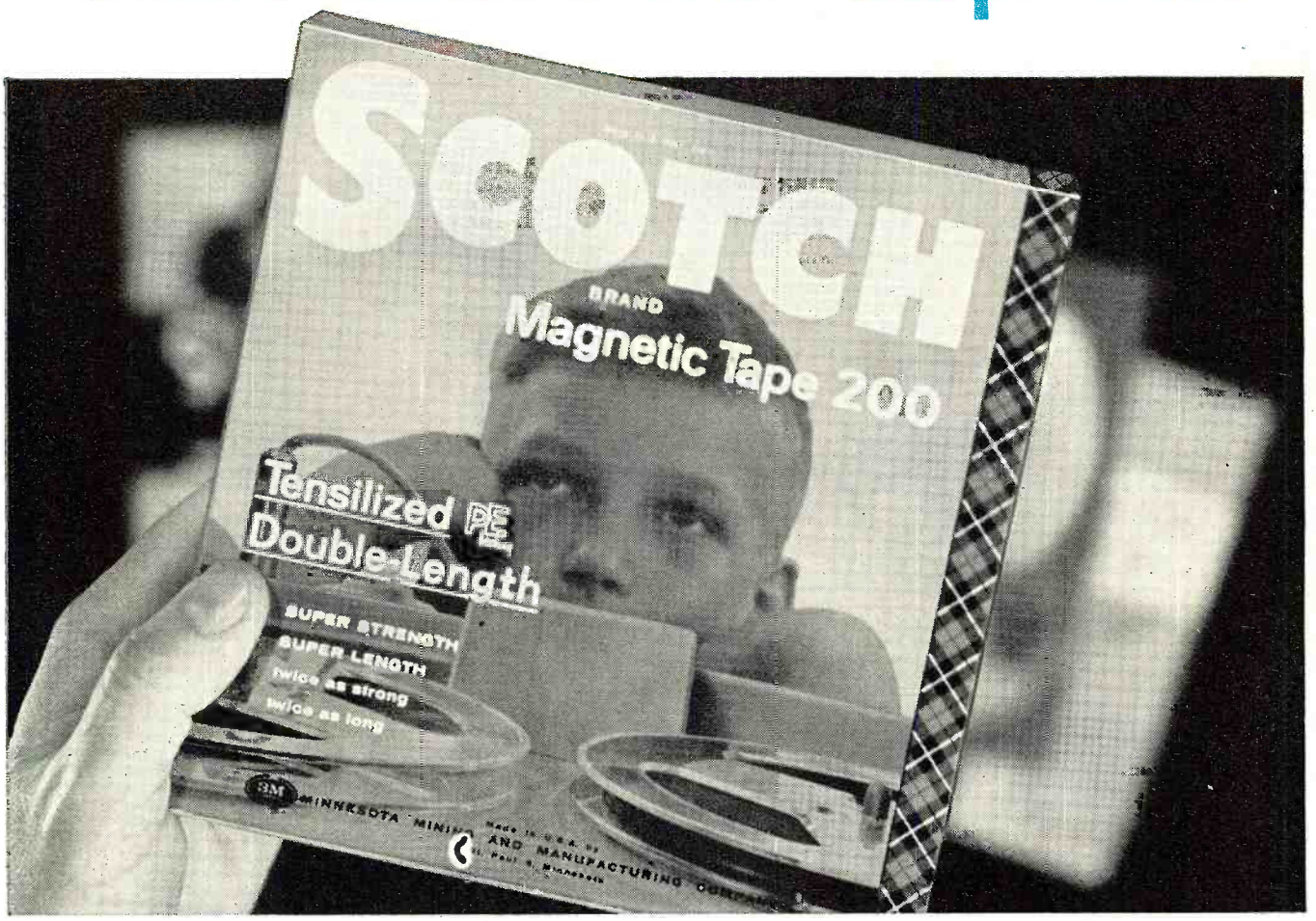
Korean Vets! Enter discharge date.....

In Canada — RCA Victor Co., Ltd.
5001 Cote de Liesse Rd., Montreal 9, Que.

To save time, paste coupon on postcard.

The magnetic tape that can't be copied!



Others try to imitate it... but no tape equals SCOTCH BRAND 200 Tensilized Double-Length Tape!

This is the original no-break, no-stretch tape that plays twice as long . . . and you can't buy better! "SCOTCH" Brand waited until it had perfected an extended play tape of unmatched quality. Now, here it is—"SCOTCH" 200 Tensilized Double-Length Tape—first to give you a Polyester backing with an ultimate tensile strength of 6.8 lbs! And it's the only tape of its kind that offers silicone lubrication, genuine built-in protection for your recorder head. Why settle for imitations when the original and best costs no more? Today, see your dealer for a reel of "SCOTCH" 200 Tensilized Double-Length Tape, newest of the "Tapes you can trust".

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

NOW YOU CAN ORDER precise KITS BY MAIL...

from Your Local Parts Distributor!

HI-FI ... by Precise

AM-FM TUNER

Precise Model **TUMK** Kit Form.....**$49.95**
Precise Model **TUMW** Factory Wired.. **69.95**

40-WATT AMPLIFIER

Precise Model **AM40K** Kit Form.....**$69.95**
Precise Model **AM40W** Factory Wired **89.95**

Precise Engineered

5" SCOPE

UP to 9 mc
FLAT to 5 mc
for color work

After you've built this 'scope, you'll be amazed at its versatility. No other 'scope below a $100.00 can meet all of its specifications. Design features include push-pull vertical and horizontal . . . high sensitivity . . . 5CP1 tube with post acceleration . . . frequency compensated stepping attenuators for both vertical and horizontal . . . focus, intensity and astigmatism controls . . . and calibration output voltage. Vertical amps ore flat through 5 mc ± 8 db through 9 mc. Sensitivity is 10 mv/cm. Horizontal amps within ± 6 db through 500 kc, have frequency compensated stepping attenuator input and cathode follower to assure linear horizontal trace. Hard vacuum sweep frequencies with sufficient expansion to see color bursts clearly, and a sensitivity approximately 40 mv/cm, made this instrument the exceptional buy of the year.

Precise Model **3151K** Kit Form .....**$ 59.95**
Precise Model **3151W** Factory Wired **109.95**

Precise Engineered

POWER LAB

For all your electrical needs!

For the first time in the industry, one instrument takes the place of more than 11 pieces of equipment. . . . Here's what you get:

- **A BATTERY ELIMINATOR for 6v and 12v radios**
- **A BATTERY CHARGER up to 24 volts**
- **A HIGH CURRENT LINE VOLTAGE VARIAC — up to 10 amperes**
- **AN AC LINE VOLTAGE METER**
- **AN AC LINE AMMETER**
- **AN AC LINE WATTMETER**
- **AN AC LINE ISOLATION TRANSFORMER — 100w or 300w**
- **A LOW VOLTAGE, HIGH CURRENT AC SUPPLY — 24v at 10 amperes**
- **A DC LINE VOLTAGE VARIABLE SUPPLY**
- **A DC HIGH CURRENT AMMETER**
- **AN AGC BIAS BOX**

Precise Model			Isolation
711K	KIT FORM	$49.95	100w
711W	FACTORY WIRED	64.95	100w
713K	KIT FORM	62.95	300w
713W	FACTORY WIRED	79.95	300w

★ **Printed-Circuit**
★ **Voltage-Regulated**
★ **Peak-to-Peak**

ALL-NEW

VTVM

featuring the
TILTING METER MOVEMENT and MAGIC LEAD SWITCH

Here's another all-new *precise-engineered* instrument, designed with you in mind . . . to make it easier and convenient as you test. Along with the all-new features of voltage regulation, printed circuitry and etched front panel . . . you have the *exclusive Meter Movement Tilt*, which permits you to turn the meter face to your eye level for more accurate readings no matter where on the bench you place the VTVM . . . plus the MAGIC LEAD SWITCH that permits you automatically to short and open leads for zero or infinite adjust without removing the leads from the circuit under test. Compare this meter with any other available today, and you'll know that *precise-engineered* means engineered to give you your dollars worth.

- *Frequency Range: Up to 250 mc with Precise Model 912 Probe (available at extra cost)*
- *Voltage Range: Up to 30,000 V with Precise 999 HV Probe (available at extra cost)*
- *Special true zero alignment scale for FM and TV discriminators*
- *Burn-out proof Meter Circuit*
- *Complete with test leads and internal battery*
- *RUGGED Oversize 4½" TILT Meter*
- *Reads p-p and RMS voltages*

RANGES:

DC: 0—1.5—5—15—50—150—500—1500 V.
AC: (RMS) 0—1.5—5—15—50—150—500—1500 V.
AC: (P-P) 0—4, 14, 40, 140, 1400 V.
OHMS: Rx1x10x100x1000x10,000x100,000 Meg from .2 ohms to over 1 Billion ohms.
Input Impedance of DC = 11 Megohms

Tube Complement: 12AU7, 6AL5, Selenium Rectifier Transformer Supply

Precise Model **904K** Kit Form.....**$34.95**
Precise Model **904W** Wired Form.....**$49.95**

Mutual Conductance and Emission

TUBE TESTER

Here is a tester that actually checks a tube for its applications, not whether it is just good or bad. On the Model 111, GM and Emission are checked separately. It is the first and only device that measures 600-mil tubes on a meter Sweeps from 0 through the normal testing range when making measurements, which gives an average evaluation for the tube over an extended range of operation. Connects test voltages to each tube element. Uses a single rotary switch to check each element against every other element for shorts, whether they're hot or cold. Measures tube bias directly on a meter. Features a no-backlash roll chart. Includes provisions for testing all prong types. Cathode-Ray tubes may also be checked with the use of an adaptor. An exceptional instrument for the shop, one that has won an impartial independent scientific survey hands down.

Precise Model **111K** Kit Form.....**$ 79.95**
Precise Model **111W** Factory Wired..... **139.95**

You benefit from faster delivery, lower price, postage savings, and the personal local service of your nearby parts distributor when you order by mail . . . if you are close enough, drop by and see the top quality parts included in each kit. Here are 8 of the many PRECISE distributors who are ready to serve you. Use the handy coupon to order your PRECISE kit by mail.

DAVIS ELECTRONICS
204 Main Street
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BOULDER DISTRIBUTING
1840 - 24th Street
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FISTELLS ELECTRONIC SUPPLY CO.
1001 Bannock Street
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FEDERATED PURCHASER
11275 Olympic Blvd.
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VARIETY ELECTRONICS
Bloomfield Ave. at State St.
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1002 Adams Street
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See your dealer for a complete test equipment bench engineered by Precise.

Mr. Precise Distributor:
I would like to order the following Precise kits:

☐ 904K ☐ 904W ☐ 3151 Kit ☐ 3151 Wired
☐ Model 711K ☐ Model 711W ☐ Model 713K ☐ Model 713W
☐ Model 111K ☐ Model 111W ☐ Model 116K ☐ Model 116W

Please send kits COD ☐ Bill my account ☐
Remittance Enclosed, Ship Prepaid ☐

Print Name Clearly

Street Address

City & State

Wi hin the Industry

LOWELL S. ("LOU") PELFREY, who has been active in the development program at *International Rectifier Corporation* since 1953, has been named director of research and development.

Mr. Pelfrey was graduated from the University of Kentucky in 1937 and has been active in the semiconductor field since 1944. With the company, he has performed much work in the purifying of germanium and silicon and in the production of single crystals of these materials.

His developments have led to the introduction of several new devices, such as high temperature germanium diodes, germanium mixer diodes for television, and several types of silicon diodes for radar.

* * *

HI-FONIC MUSIC SYSTEMS, INC., Palo Alto, Calif., has changed its name to **ALTO FONIC MUSIC SYSTEMS, INC.** . . . **ELECTRO-CONTACTS, INC.** of Osterville, Mass. has entered the slip ring field . . . **DIAMOND CALK HORSESHOE CO.** has changed its name to **DIAMOND TOOL AND HORSESHOE CO.** The year 1958 marks the 50th Anniversary of the firm . . . Announcement is made of a new organization in the electronics industry under the name of **QUANTECH LABORATORIES.** The firm is located at 236 Mt. Kemble Avenue, Morristown, New Jersey and will produce a line of electronic instruments and measuring equipment for laboratory and industrial use, including power supplies and special purpose amplifiers. John M. van Beuren is general manager, Alan P. Stansbury is chief engineer, and Fred R. Stampfli is business manager of the new organization.

* * *

INSTITUTE OF RADIO ENGINEERS, INC. has appointed six members to the Board for 1958.

Reappointed as treasurer of the group is W.R.G. Baker, vice-president for research of Syracuse University and former vice-president of electronics, *General Electric Company.* Haraden Pratt has been appointed to his sixteenth term as secretary and John D. Ryder, Dean of Engineering, Michigan State University, is now editor of the IRE.

Appointed as directors are Alfred N. Goldsmith, consulting engineer and editor emeritus of the Institute; D. B. Sinclair, vice-president of engineering, *General Radio Corp.;* and Ernst Weber, president of the Polytechnic Institute of Brooklyn and president of *Polytechnic Research and Development Company,* Brooklyn, N. Y.

* * *

RTTY has announced that its fourth annual dinner will be held in New York City on Monday, March 24, 1958. This dinner is held each year during the IRE show so that amateur radioteletypers from across the nation can attend.

The guest of honor will be Bruce H. Rowlings, ZL1WB, from New Zealand and one of the first overseas amateur operators to use radioteletype.

An attendance of 70 is expected and reservations for the dinner must be made in advance ($7.00). These may be obtained from Clayton Cool, W2EBZ, editor of the ARTS bulletin, 443 West 47th St., New York 36, N. Y.

* * *

FRANK RANDALL has been appointed president of *Amperex Electronic Corporation,* Hicksville, Long Island, New York. The company manufactures electron tubes and semiconductors for defense, communications, and industry.

Mr. Randall had been vice-president and general sales manager for the organization prior to his new appointment.

His promotion was announced by Mr. Pieter van den Berg, chairman of the board of directors.

* * *

MERIT COIL & TRANSFORMER CORP. is planning a new building in Hollywood, Florida. This 12,000 square foot addition to the firm's Florida plant will provide warehousing facilities to serve Southeastern distributors . . . **JOHNSON ELECTRONICS INC.** has moved to a new, modern building in Casselberry, Florida . . . Announcement has been made by **UNITED ELECTRODYNAMICS,** Pasadena, Calif., of the opening of a new facility to be called the **UNITED TESTING LABORATORIES.** This move represents a separation and expansion of the research and commercial testing operations carried on by the company for a number of years . . . **PIC DESIGN CORP.** has announced the establishment of an office at 7335 Van Nuys Blvd., Van Nuys, California for the convenience of its West Coast customers . . . **FOTO-VIDEO LABORATORIES, INC.** announces that it has acquired a new 10,000 square foot plant in Cedar Grove, New Jersey as part of a general expansion program . . . Shrewsbury, Mass. will be the new home of the **PHALO PLASTICS CORPO-**

RATION. The building will include 110,000 square feet of space and the new address will be 530 Boston Turnpike . . . **REEVES SOUNDCRAFT CORPORATION** is building a new magnetic tape plant in Danbury, Conn. . . . **WESTINGHOUSE ELECTRIC CORPORATION** has opened a new apparatus office in Compton, California . . . A new 22,000 square foot engineering building has been opened by **GENERAL PRECISION LABORATORY INCORPORATED,** Pleasantville, N. Y. . . . **MAGNETIC RESEARCH CORPORATION** announces the formation of the firm's new Stablvolt division at 200 Center St., El Segundo, Calif. . . . **ACOUSTICA ASSOCIATES, INC.** has opened its fourth plant at 11601 West Jefferson Blvd., Culver City, Calif.

* * *

RADIO CORPORATION OF AMERICA has awarded thirty undergraduate scholarships and one graduate fellowship in a new program to encourage students to prepare for science teaching careers.

The first Science Teacher Scholarships have been established at twenty colleges and universities in sixteen states where a survey by the corporation's education committee showed the shortage of such teachers to be most critical.

The first Science Teacher Fellowship, valued at $3000, has been established at Purdue University, West Lafayette, Indiana.

* * *

JOSHUA GINSPARG has been named chief industrial engineer of *Shure Brothers, Inc.*

Mr. Ginsparg has been associated with the company for eleven years. For the past five years he has been the superintendent of assembly departments. Previously he was a methods engineer and supervisor of assembly departments.

He attended Tufts College and did post-graduate work at the Stevens Institute of Technology. He is a member of the American Society of Quality Control.

* * *

HOWARD W. SAMS, head of the Indianapolis electronic engineering and publishing firm bearing his name, has resumed the presidency of *Waldemar Press, Inc.* . . . **J. C. MAXWELL** has been elected to the board of directors of *General Precision Equipment Corp.* . . . **SAMUEL B. FISHBEIN** has been appointed assistant general sales manager of the military operations department of *Allen B. Du Mont Laboratories, Inc.* . . . **ALBERT BOYD,** Major General, retired, U.S. Air Force, has joined *Westinghouse Electric Corp.* as consultant and advisor to the group general manager, defense products . . . **ROBERT H. WEEKS, JR.** has been named assistant division manager for the Edison storage battery division, *Thomas A. Edison Industries, McGraw-Edison*

(*Continued on page* 148)

(Commercial)

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James Faint, Johnstown, Pa.	1st	26 weeks

James Glen:

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
Tacoma, Washington

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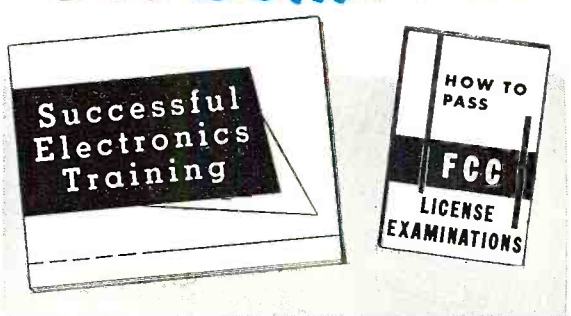

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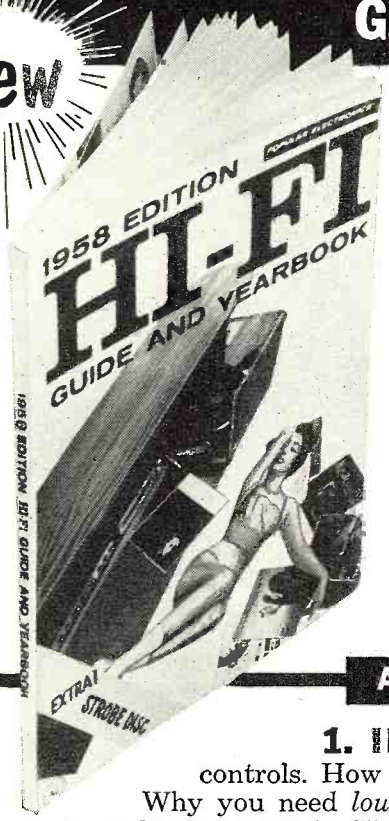

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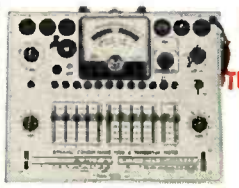

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COMPLETE with steel cover and handle.

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**

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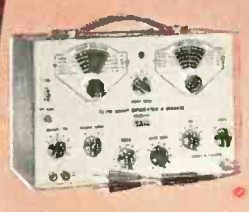

NEW! TV-FM SWEEP GENERATOR & MARKER #368

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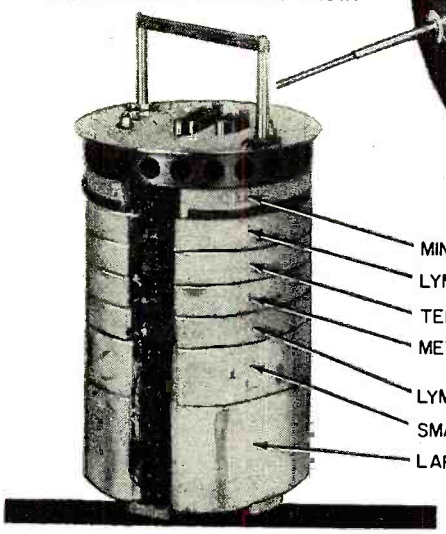
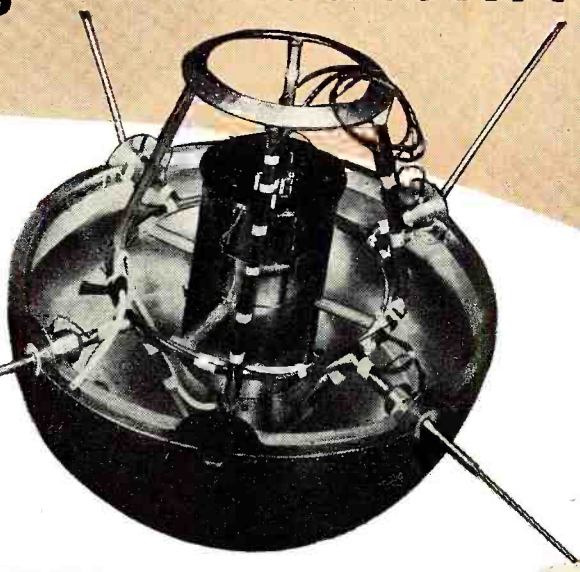
Receiving U. S. Satellite Signals

By **WHITNEY MATTHEWS**
Head, Applications Br., Solid State Div.
U. S. Naval Research Laboratory

Satellite with upper hemisphere removed is shown here. The complete electronic package with all its modules labeled is below.





The complete, authoritative story about the radio signals that the U. S. satellite will broadcast.

ELECTRONIC technicians and hobbyists have an opportunity to make valuable contributions to the scientific effort of the current International Geophysical Year. Plans for launching instrumented artificial earth satellites have been announced by the United States and the U.S.S.R. Signals from these vehicles can be received by radio amateurs, hi-fi enthusiasts, or electronic technicians without great difficulty. Extensive participation of amateur observers would make available potential sources of valuable data which would be prohibitively costly by means of primary recording stations. Numerous amateur tracking stations will be in operation using either visual or radio tracking methods. Technical data for the construction of such stations has been published previously. Amateur stations for the collection and recording of scientific data are much less complex than tracking stations.

Not all of the satellites to be launched by the United States will provide continuous transmission of scientific data. Early satellites may be placed in orbit as a part of the launching vehicle test program. These possible early satellites would carry unmodulated radio transmitting equipment intended primarily for radio tracking. While not regarded as true instrumented satellites, they would be capable of providing temperature information by accurate calibration and measurement of transmission frequencies. Several designs of fully instrumented scientific satellites are being prepared which will carry aloft, in succession, various combinations of scientific instruments. As presently planned, the first two instrumented satellites to be launched will provide continuous transmission of scientific data. It is these which would be of most interest to amateur observers. Designs for later launching will provide data transmission only when initiated by powerful ground transmitters. This technique is used where power required by scientific instruments prohibits continuous transmission or where it is necessary to play back and erase information recorded on magnetic tape. Amateur observers can participate in collecting the intermittently transmitted data only when located sufficiently close to a primary recording station to receive signals when data is being transmitted.

Receiving Satellite Signals

The U. S. satellite will be launched from the Patrick Air Force Base at Cape Canaveral in Florida. The satellite will circle the earth approximately once each 90 minutes. The plane of the orbit will make an angle of approximately 35° with respect to the equatorial plane of the earth. Due to the rotation of the earth, each successive orbit will receive an apparent shift westward of about 1200 miles. The general character of the path of the satellite over the surface of the earth is shown in Fig. 1. Eventually the satellite will rather thoroughly traverse the unshaded portion which represents nearly two thirds of the earth's surface area. Near overhead transits of the satellite would thus be available to observers between 35° N and 35° S latitudes. Reception of signals outside this zone would be determined by receiver sensitivity, antenna gain, and height of the satellite above the earth. The orbit of the satellite is expected to be elliptical with altitudes between 200 and 1500 miles.

Provision for an adequate number of official recording stations to permit continuous radio reception of satellite signals would be prohibitively costly. Primary recording station locations are also shown in Fig. 1. A chain of stations is located roughly along the 75th meridian down the east coast of the United States and the west coast of South America. These stations provide a "picket fence" coverage which the satellite must cross once each orbit. Two stations at Antigua, B.W.I. and San Diego, California provide data

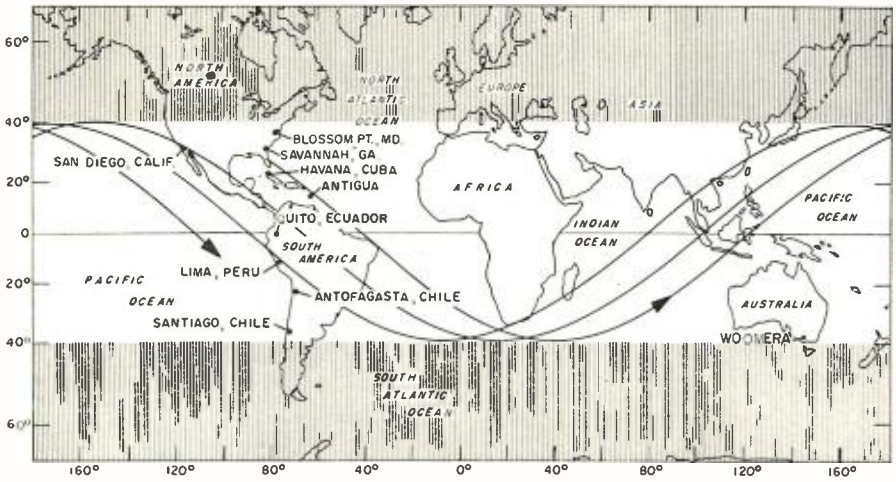
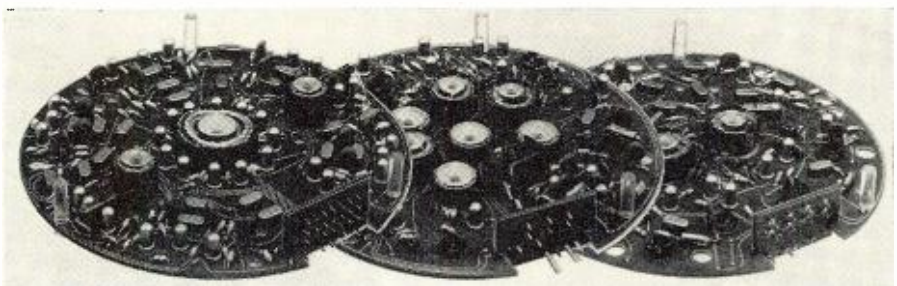


Fig. 1. Some typical paths of artificial earth satellite over the earth's surface.

Fig. 2. Satellite airborne telemetry encoder is at left. Center unit is the meteoritic collision electronics with its amplifier and three decimal digit counter. Unit at right is Lyman-alpha peak memory electronics including orbital switch for reset once each orbit. Circuits are printed and extensive use is made of transistors and magnetic amplifier coils. Units later covered with plastic foam.



early in and before completion of the first orbit. One additional station at Woomera, Australia will provide frequent data at approximately half orbital periods from other stations for the benefit of scientific experimenters. Orbital parameters will be calculated from tracking data and made available to news wire services. Contact with local newspapers, television or radio stations should provide adequate information to permit amateur observers to know when to seek these signals. Possibilities of visual observation of the satellite are limited to times just before dawn or after dusk. The sun must be sufficiently below the horizon to provide a dark sky yet sufficiently near to illuminate the satellite.

All scientific data will be transmitted by means of the "Minitrack" radio tracking transmitter in the satellite. This transistorized, crystal-controlled transmitter operates on a carrier frequency of 108.00 megacycles and is amplitude modulated (AM) for data transmission. Peak operating power is about 100 milliwatts with 100% modulation. Batteries carried by the satellite are expected to provide between three and four weeks' active life. Airborne telemetry equipment is used to accept inputs from the various scientific instruments and combine them into a single coded electrical signal for transmission to the ground receiving stations.

Telemetry signal frequency components are in the audio frequency range and within the recording capability of many high-fidelity home magnetic tape recorders. Maximum frequencies of 15 kc. are used with signals rarely exceeding 12.5 kc. Two alternatives are available to persons not now having equipment to receive 108-megacycle AM signals who wish to observe the satellite with their present equipment. Converters are available or can be built by owners of communications type receivers. This method offers the advantage of being able to use a beat-frequency oscillator to detect passage of a satellite transmitting an unmodulated carrier. The second method requires the addition of a simple AM detector circuit to a high-fidelity FM tuner. Commercially available antennas designed for fringe area reception of FM broadcast signals should provide ample gain for all but the most unfavorable reception conditions. Desirable mounting of such an antenna would be in a generally skyward direction for latitudes of 35° or less. Simple means could be provided for rotation of the antenna in a direction to permit adjustment in advance for best reception of the next anticipated transit.

Many of the scientific phenomena to be studied occur infrequently and at random. These very facts prevent their systematic study by high-altitude research rockets. Most desirable would be the occurrence of one of these events as the satellite signal was being recorded at a primary receiving station. Such an observation would provide a detailed record of instantaneous measurements as a function of absolute time. Although possible, unfortunately the chances for an official receiving station to record such an event are quite remote. An adequate number of properly located amateur observers would make certain the availability of the desired records. Airborne equipment will include memory devices for storing a limited amount of information concerning these events for later transmission to official ground stations. These signals will provide meager data on all such events viewed by satellite instruments but will be far less informative than a properly made amateur recording obtained during the event itself.

Recordings of amateur observers offer many possibilities of obtaining valuable data other than observation of specific events. This is particularly true of data obtained during the early life of a satellite. Obviously such data would be of utmost value in case of a short active life of a satellite or any of its scientific experiments. Such records would also be of value in case of errors in the predicted rate at which phenomena being studied are expected to occur. Details regarding potential value of amateur recordings will be presented later in the discussion of each experiment.

The Lyman-Alpha Satellite

One of the first fully instrumented scientific satellites planned for launching by the United States will be devoted to two general types of measurements. One group of measurements will study ultraviolet radiation from the sun in the region of the solar spectrum known as Lyman-alpha. The second group of experiments designed

THIS MONTH'S COVER

THE top half of the first fully instrumented U. S. satellite is carefully being put into place. The 20-inch, 21.5-pound shiny ball will then be mounted within the nose of the three-stage Vanguard rocket, shown blasting off on our cover. The rocket is then expected to rise vertically at first and then gently turn in the direction of its planned orbit. After successive burnout of the three stages, the tiny ball should be hurtling around the earth at about 18,000 miles per hour. (Photos: U. S. Naval Research Laboratory.)

to study the satellite environment includes measurement of temperatures and various types of information relative to collision between the satellite and small particles (micrometeorites) in space. Equipment in the satellite will include a telemetry encoder system. This equipment converts measurements made by the various airborne instruments into a single signal for transmission to ground receiving stations. The desired scientific information may be extracted from the received signal by appropriate decoding.

All information will be transmitted in the form of a series of high-frequency (5 to 15 kc.) bursts carrying information on the frequency of these bursts, time duration of each burst, and the time interval between bursts. Thus three information channels are associated with each burst. Each frame or scan of all information channels will consist of a sequence of sixteen such bursts for a basically 48-channel telemetry system. The airborne telemetry encoder system used to produce these signals is shown in Fig. 2. This unit is 5½ inches in diameter, ¾-inch high, and weighs about 3½ ounces. It operates on 2.7 volts with a current drain of 3 to 4 milliamperes. A new frame will begin immediately upon completion of each scan. Thus the exact scanning rate will be a variable quantity determined by the values of input signals which control burst duration and spacings. Signal values are expected to lie in a range which provides three to four frames of telemetered data per second.

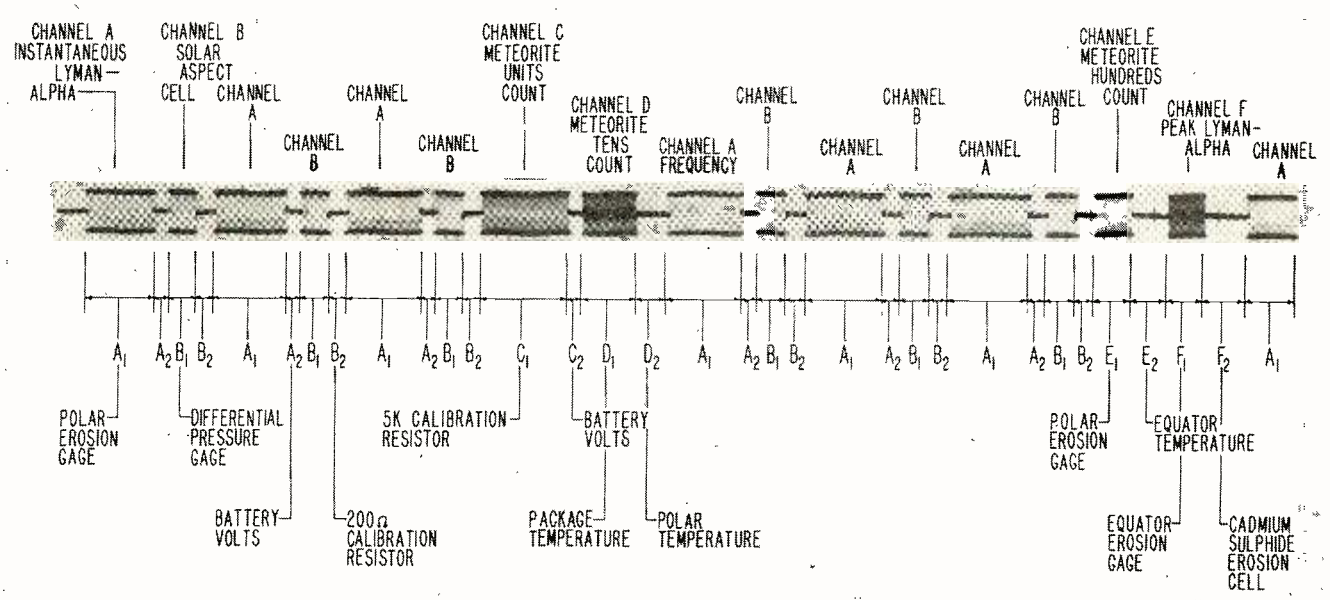
Of the measurements being made, some will undergo only insignificant short time changes while others will be changing rapidly with time. For example, outer shell temperatures will rise slowly as the satellite heats up when in sunlight and slowly drop as the shell cools when in the earth's shadow. Thus, temperature changes during one telemetry frame are of no great importance. On the other hand, measurements of inputs such as the Lyman-alpha radiation do undergo significant changes during a single telemetry frame. For this reason, several channels in each frame are devoted to frequent repetition of these rapidly changing signals. Such signals are also transmitted as a burst frequency to permit measurement of changes during the burst interval.

Fig. 3. Here the entire electronics package is being installed in the satellite. The electronic circuits are encased in a foam-in-place plastic material.

An oscillogram of a complete typical telemetry frame is shown in Fig. 4. Photographic resolution at the scanning rate used to present a full frame does not permit distinction between cycles in each high-frequency burst. This oscillogram, together with Table 1, will permit ample description of channel assignments to permit amateur observers to seek out any desired signal for study. It will be noted that all channels carrying information in the form of the burst frequency are identified by a single letter. Channels whose data is presented as a burst duration are designated by a letter followed by the numeral 1. Similarly information contained in a burst spacing carries a letter identification followed by the numeral 2.

Each telemetry frame may be conveniently regarded as being divided into two sequences of eight high-frequency bursts each. Each such half frame is distinguished by six initial bursts containing an alternate rhythmic repetition of long and short bursts carrying data on instantaneous solar Lyman-alpha radiation and solar aspect (orientation of the satellite with respect to the sun). Thus each half frame can be seen to start with the burst channel sequence *A-B-A-B-A-B* in Fig. 4 or Table 1. Identification of these channels is relatively easy in any display medium whether it be audible listening, oscillographic presentation, or photographic reproduction. The remaining two high-frequency bursts in each half-frame scan will carry data readout of satellite memory units. The two final bursts of successive half-frames will thus alternately

Fig. 4. Typical Lyman-alpha satellite scientific telemetry signal with all components of signal properly labeled.



HIGH-FREQUENCY BURST		BURST-DURATION		INTERVAL BETWEEN BURSTS	
Channel	Function	Channel	Function	Channel	Function
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
C	Meteor count, units	C1	Long calibrate	C2	Battery volts
D	Meteor count, tens	D1	Package temp.	D2	Polar skin temp.
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
A	Instan. Lyman alpha	A1	Polar erosion A	A2	Battery volts
B	Solar aspect	B1	Differ. pressure	B2	Short calibrate
E	Meteor count, hundreds	E1	Polar erosion B	E2	Equator skin temp.
F	Peak Lyman alpha	F1	Equator erosion	F2	Cadmium sulphide cell

Table 1. Telemetry channel assignments for Lyman-alpha-environmental satellite.

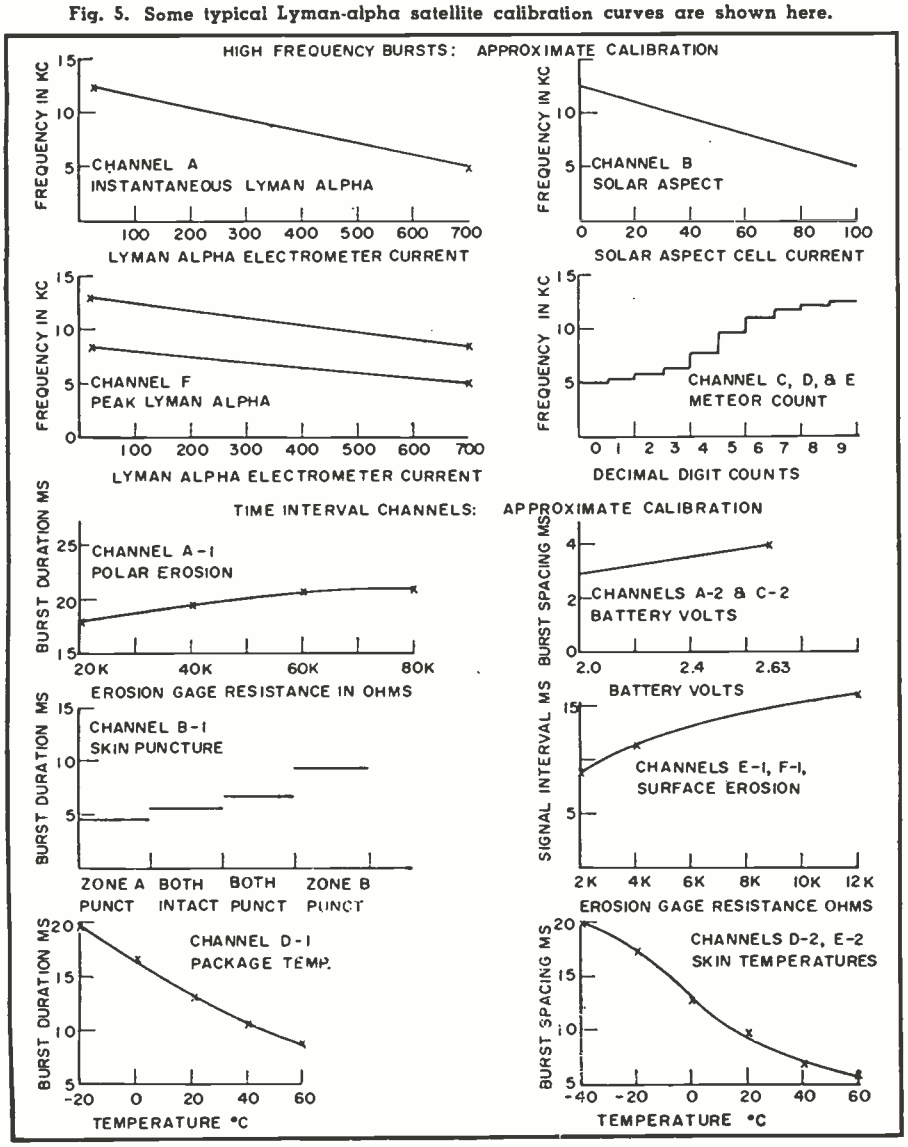
present information on (1) units digit and tens digit of the cumulative meteoritic collision count (channels C and D) or (2) hundreds digit of the meteoritic collision count and orbital peak value of solar Lyman-alpha radiation.

Positive identification of alternate half-frames is provided by appropriate control of burst and spacing durations. Thus the duration of the meteoritic collision count units digit burst (channel C) is used to present the long calibration channel (C1). This burst duration remains essentially unchanged and is always of greater duration than any other burst. This long calibration channel is followed immediately by the shortest burst spacing in the frame (channel C2). This shortest burst spacing monitors the telemetry battery voltage. This identification of the telemetry signal half-frames is evident from an examination of Fig. 4. The long calibration channel C1 in the first half-frame is obviously longer than its counterpart channel E1 in the second half-frame. Similarly the succeeding channel C2 is much shorter than is channel E2.

Methods used by amateur observers to study records made will be determined, to a great extent, by the equipment available. Experience has shown that, with practice, a simple listening test can reveal valuable information. Listening tests are greatly enhanced when original recordings are made at a high tape speed and played back at a lower speed. This technique reduces the high frequencies for improved audibility and at the same time increases burst durations and spacing for easier resolution.

Approximate calibration curves for the various information channels are shown in Fig. 5. These charts should be regarded as general guides only since variations can be expected between various telemetry assemblies. Precise measurements can only be made by use of individual calibration for the specific equipment flown in any satellite. Obviously this cannot be known until a satellite is launched since last minute equipment substitution may be required. The curves shown should however prove adequate for most needs of amateur observers.

Fig. 5. Some typical Lyman-alpha satellite calibration curves are shown here.



The Scientific Experiments

Solar Lyman-Alpha Radiation: Lyman-alpha radiation from the sun refers to a very limited portion of the ultraviolet region of the solar spectrum. Measuring devices sensitive only to this radiation are carried. The earth's atmosphere is quite opaque to such radiation and thus prohibits its measurement from ground based stations. Satellite or rocket vehicles must therefore be used in any such studies. Much has been learned by means of research rockets but this technique has many limitations. Time required for rockets to reach altitude and the short time they remain aloft have effectively hampered study of transitory Lyman-alpha phenomena.

Telemetry signals will contain two types of presentation of data relative to solar Lyman-alpha radiation. The first type of presentation will transmit an instantaneous value of this radiation at all times. Study of these signals will permit study of this radiation from a quiescent sun. Short time variations in this signal are of great importance. Not only may short term changes take place in the signal from the sun but will additionally be varying due to spin of the satellite itself. Thus the detectors will spend approximately two thirds of each spin period in the shadow of the satellite and the telemetry signal will be that indicating no input to the detector. Adequate study thus requires a great portion of the telemetry time to be devoted to instantaneous values of solar Lyman-alpha data. From Fig. 4 it can be seen that this is accomplished in two ways. First, this signal (channel A) is repeated six times in each telemetry frame. Second, each presentation is continued for a comparatively long period of time. Any single such dis-

(*Continued on page* 154)

Hidden Bypass Action

By **JAMES A. McROBERTS**

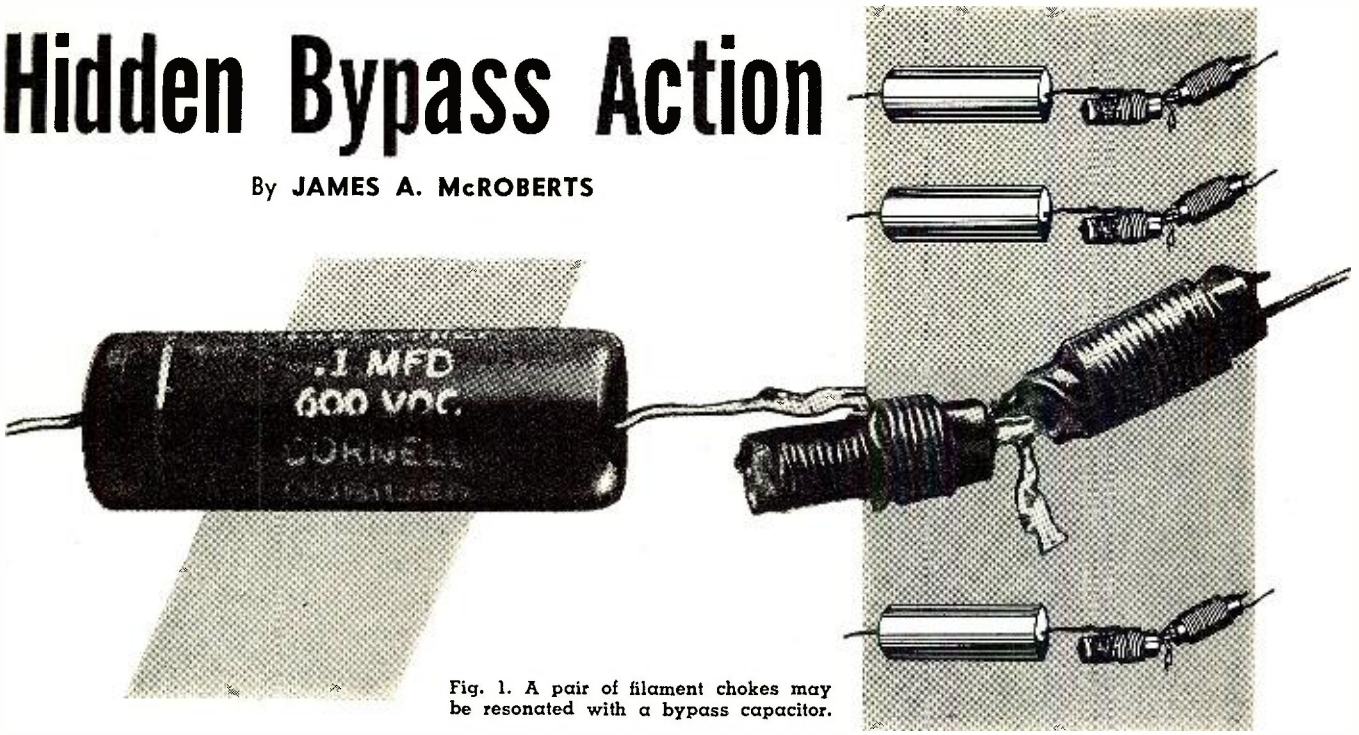


Fig. 1. A pair of filament chokes may be resonated with a bypass capacitor.

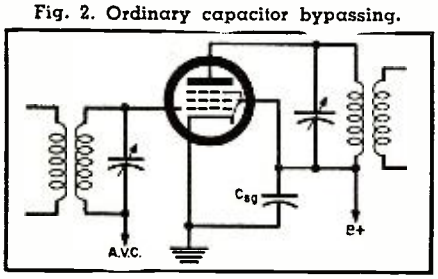
Lead dress, special components, and other factors may supply circuit action not shown schematically.

THE USE of bypass capacitors throughout the average TV receiver, radio, or other item of electronic equipment is no news to anyone in electronics. However, there is also frequent use of *series-resonant* bypass action, although only a capacitor may be obvious in the circuit. Commercially available self-resonant capacitors are used not only by set manufacturers, but also after manufacture in cooling down "hot" sets. Hence, some information on this subject is desirable.

Ordinary bypass of the screen grid to ground, by way of capacitor C_{sg}, is shown in Fig. 2. The capacitor presents a low-impedance path to the a.c. voltage present at the screen grid. The same is true for cathode bypass action and for the bypass capacitors on the "B+" and a.v.c. or a.g.c. lines. However, a capacitor alone is not a perfect bypass. It also presents some impedance to the flow of the unwanted signal current to ground. For most cases, the bypass impedance is low enough so that regeneration and other troubles do not occur.

With increasing gain, the rule for "most cases" may not hold true. Sufficient unbypassed a.c. voltage may remain present to cause trouble. Increase in size (capacitance) of the bypass capacitor will lower the unbypassed voltage; but there is a limit to the size of the bypass capacitor, both physically and economically. As a result, series-resonant bypass action may be required.

Fig. 2. Ordinary capacitor bypassing.



By placing an inductor (L_{sg} in Fig. 3) in series with the bypass capacitor, the circuit may be made to resonate at some particular frequency. This can be the frequency to be bypassed, such as the i.f. of a radio set. With a sufficiently low "*Q*" an entire band of frequencies can be bypassed. *Westinghouse* is one TV manufacturer that has used series-resonant bypassing with low "*Q*" circuitry to bypass in a TV i.f. circuit.

Radio Applications

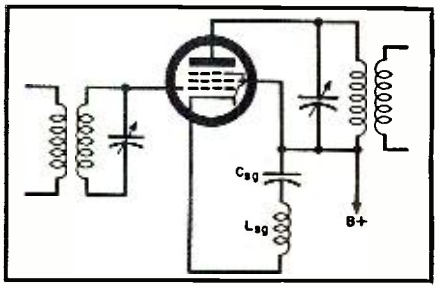
A set that has become an annoying "whistler" or "squealer" will probably be the most common case in radio service where it will be desirable to incorporate series-resonant bypass action. Special capacitors for this purpose are manufactured by *Sprague* (LP series) and *Aerovox* (RC series). The bandwidth of these units is broad enough to cover the commonly used intermediate frequencies in the vicinity of 455 to 470 kc. In operating on a radio troubled with whistling or squealing, such a capacitor is experimentally shunted across the "B+" line, the a.v.c. line, at each screen grid, and at each cathode, in turn. It is probable that the annoying regeneration originates, for the most part, at just one of these points. When the special capacitor is put in the right place, the symptom should vanish.

If the special units are not readily at hand and there is some inconvenience in obtaining them, they can be fabricated in the shop without great difficulty. An ordinary bypass capacitor may be combined with a suitable coil. In the i.f. range for radio sets, the inductor may be made up of a pair of TV filament chokes in series. Such a combination is shown in Fig. 1. One of the chokes has had about three-quarters of its winding (by trial and error) removed while the other choke is fully wound. In place of the two filament chokes, a 43-mc. TV i.f. coil with an adjustable slug may also be used. The resonant bypass works well when either type of choke is used.

The capacitive reactance of a .1-μfd. bypass capacitor at 455 kc. is approximately 3.5 ohms. Including a small amount of resistance, the total a.c. impedance is slightly higher than that figure. When this capacitor is made series-resonant by the addition of an inductor of the proper value, there is no reactance; and total impedance, which is purely resistive, will usually be a trifle under .2 ohm. This means

(*Continued on page* 117)

Fig. 3. Coil added to bypass circuit.



Intermittents Can be Licked

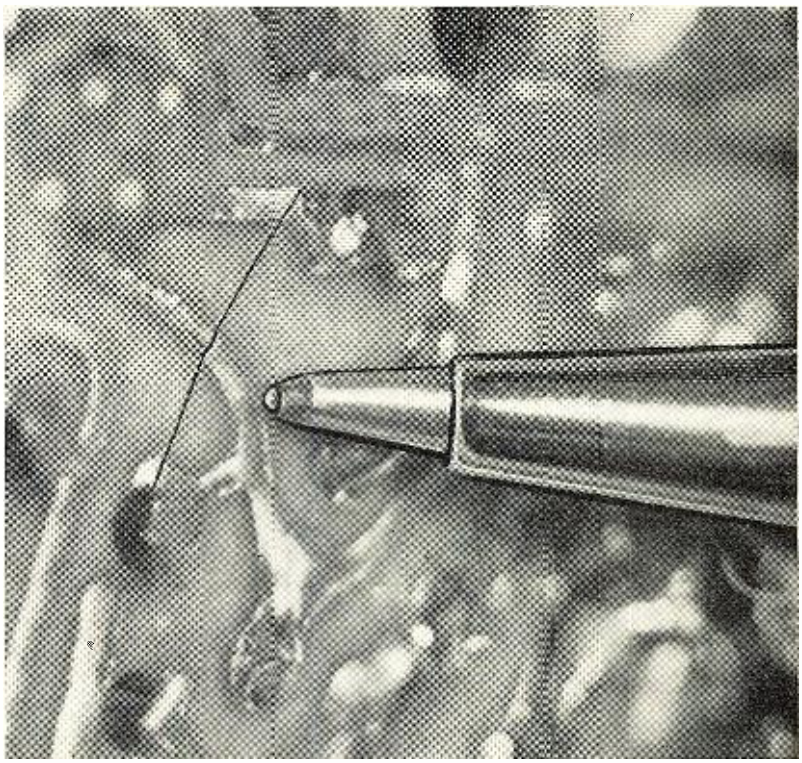


Fig. 1. Slight flexing of a printed board will often reveal a hairline crack, like the one shown, that has been responsible for a puzzling effect.

By
RALPH D. SAPPE

Take some of the guesswork out of finding faults that won't stay put; use persistence and method.

LITTLE exasperates a service technician more than an intermittently operating receiver. This type is almost always branded with the title of "dog," since it can and usually does result in loss of time and profit. Many shops are reluctant to service an intermittent but are more or less forced to do so in order to preserve good customer relationships.

In many instances, the section in which the intermittent component is located can be isolated in much the same way as in a set which is not intermittent. For example, if a TV receiver loses vertical deflection intermittently, you would check into the vertical oscillator, vertical output stages, and deflection yoke. If there is intermittent sound, you would check the sound section and speaker. If there is intermittent video and sound, you would check the tuner and all stages up to the point where the sound is taken off.

However, there are some cases in which the faulty section cannot be readily localized. For example, an intermittent raster could be caused by a fault in the picture tube, high-voltage rectifier, damper tube, horizontal-output tube, horizontal-oscillator tube, horizontal-a.f.c. tube, or any of these associated circuits. In some sets, a defective video amplifier will also kill the raster. An intermittently overdriven picture could be caused by any stage in the tuner or video i.f. strip, video amplifier, or in the a.g.c. circuit. In the case of intermittently operating radio receivers, the trouble could be in the r.f. amplifier, the oscillator, mixer, i.f. tube, detector, voltage amplifier, power amplifier or rectifier—in other words, just about anywhere in the set.

There are a few commercial intermittent analyzers on the market which are of great value in localizing the defective stage. Some of them can be connected to more than one circuit at the same time and, when the intermittent occurs, they will indicate what circuit the trouble is in.

After we think we have localized the circuit or circuits which are intermittent, with commercial analyzers or by other means, how do we go about finding the faulty component? There are various methods. Three of the most common ones are tapping tubes and suspected parts, applying heat to suspected parts, and increasing the operating voltage of the receiver under test with the use of a variable-voltage transformer.

EDITOR'S NOTE: *You know all about heat lamps, elevated-voltage techniques, cold-solder joints, and the other mumbo-jumbo pertaining to intermittents? Good; but we think this reprise will be well worth your time anyhow. The key to successful intermittent service, after all, is not so much uncanny skill combined with great inspiration as it is the dogged and thorough application of conventional techniques. How many of the last few "dogs" you tackled turned out to be something that you would have come across much sooner than you did, if you had been more thorough or systematic? The hints catalogued here, though they may be nothing more than reminders to you, may help break the next tough one.*

If tapping a tube brings on the trouble, the only sure way of testing that tube is to insert one which is known to be good in its place, since a tube may not show up as intermittent under the particular conditions of operation in a tube tester.

If tapping the new tube still causes intermittent operation, the tube-socket contacts may be loose or dirty or there may be a bad solder connection on any of the socket pins. A word about solder connections: it is a good idea to go over *all* of them in a suspected stage or, in the case of a radio, to go over all solder connections in the set, paying particular attention to ground connections. This procedure has been found to cure a good number of "dogs." Cold solder connections may look good, but could very well be the cause of your hair-pulling. Also look for lumps of solder which are extremely close to other contacts or the chassis that have been left by careless service technicians or even factory assembly workers. Heat may cause expansion of these sloppy joints and an intermittent short might result.

If the trouble is not a tube, dirty tube-socket contacts, or poor solder connections, it can be an intermittent resistor, capacitor, transformer, coil, worn insulation of a wire, dirty switch contacts, or, in the case of printed circuits, a microscopic break in the wiring.

Capacitors may often open intermittently after they become warm. Pushing and pulling on the component and its leads (Fig. 2) will reveal if this is the cause. An intermittent bypass or coupling capacitor can be the cause of oscillations or howls. Be especially watchful of small trimmer capacitors, like those used in the horizontal-drive circuits of some sets.

The thin mica dielectric may be cracked or split thereby causing intermittent operation.

Probing and tapping resistors, coils, and transformers with a nonmetallic instrument will sometimes reveal the trouble.

If probing components reveals nothing, a variable-voltage transformer may be used to increase the operating voltage from a normal 117 volts to about 130 volts. This will cause any faulty component which is on the borderline of breakdown to surrender, thus making possible the use of routine troubleshooting methods to locate the guilty component. However, do not, under any circumstances, increase the operating voltage to more than 130 volts, as this may also cause breakdown of good components and you will add new troubles to the ones already present.

When a receiver is on the bench for repairs, an intermittent which occurs due to the build-up of heat may be less likely to manifest itself, since the chassis is not enclosed in the cabinet. A box can be placed over the chassis while it is on the bench in order to simulate the relatively poor ventilation of actual operating conditions. Another method is to apply external heat to the particular suspected parts. This can be done with the aid of a soldering gun or with a heat lamp. The soldering gun is held close to (but not touching) the suspected component (Fig. 3) to see if the application of heat causes that component to become intermittent. When using a heat lamp, a paper funnel should be used, as in Fig. 4, to aim the heat directly at one component at a time. Be careful not to apply too much heat for too long a time, for the object of this test is to locate the bad component and not to ruin the good ones.

In the case of printed circuits, if pressure on the printed circuit board causes the intermittent trouble to occur, try to locate a break in the printed wiring by flexing the board slightly. Do not overdo this. A cracked board that was exposed in just such a fashion is shown in Fig. 1. If flexing the board shows nothing, try sweating all connections on the board. If the circuit is still intermittent, the costly but rapid method of replacing the entire printed board can be used. It could turn out to be the least costly method after all.

Watch for any wires which are run close to the chassis or which may be touching a contact or tube-socket pin. See Fig. 5. Check to see whether insulation is worn off or has been accidentally burnt off by the soldering gun of a previous technician who was perhaps a little careless. Clean the contacts on all doubtful switches with contact restorer (Fig. 7) and check them with an ohmmeter.

If the trouble is intermittent sound, do not overlook the speaker itself. One of the fine wires of the voice coil may be broken and intermittently making contact. Check this with an ohmmeter also. Make a continuity check while pressing lightly on the cone, as in Fig. 8.

Don't forget that a fault in one stage may be causing intermittent operation of another stage. For example, a heater-to-cathode short in one tube in a heater string may be robbing another tube of heater voltage, but still allow seemingly normal operation of all other tubes in its string—including the defective tube itself. With a heater-to-cathode short in tube "B" of Fig. 6, for example, tube "A" will receive no heater voltage, but tubes "C" and "D" will.

Before pulling a set for intermittent loss of sound and picture or intermittent snow, be sure that the trouble is in the set itself and not in the antenna. A badly rusted antenna or a broken lead wire may be causing the trouble. If the fault did lie in the antenna and this were overlooked by the technician, it might take a few days of testing and waiting in the shop before this conclusion would finally be reached.

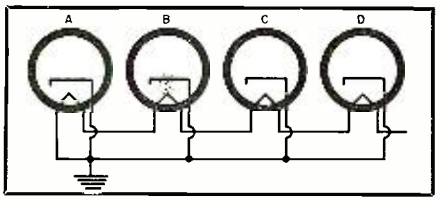


Fig. 6. A defective tube in a string will affect voltage supply to other tubes.

Above all, be sure that you have found the actual cause of intermittent operation of the set before returning it to the customer. Nothing can be more damaging to your reputation than returning a set with the same trouble it had originally. After making the repair, let the receiver play for a few hours *in the cabinet* so that you can be sure it is working properly. In the event a customer insists on having the set before you are satisfied with it, tell him that you cannot be sure of it unless you make additional tests. *Never* tell him that you *think* it's OK, or that you *hope* it's all right.

When you have repaired an intermittent "dog" you get a great deal of personal satisfaction as well as a boost in your reputation with the customer, especially when you have successfully tackled one where someone else has failed. Yet, in order to do this, you need more than just skill alone or "inspiration." A great deal of success with intermittents, or any tough service problems, depends on patience and perseverance—the willingness to employ approved service techniques and conventional test equipment properly, systematically, and insistently. —30—

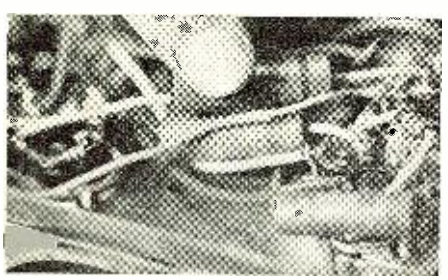


Fig. 2. Sometimes capacitor leads make contact with the inner foil intermittently.

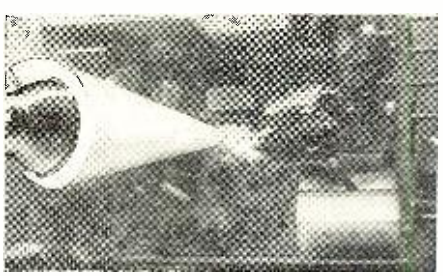


Fig. 4. To concentrate heat from a lamp in a restricted area, use a paper funnel.

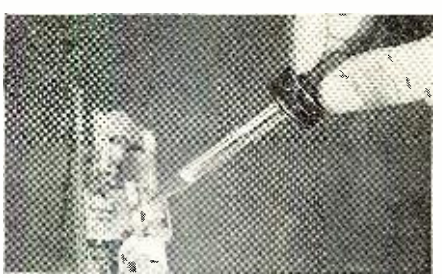


Fig. 7. To play safe, clean any doubtful switches with a contact restorer.

Fig. 3. A soldering gun being used to apply heat to suspected components.

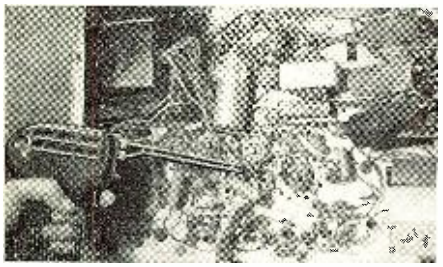


Fig. 5. Check for burned or frayed insulation on wires run close to chassis.

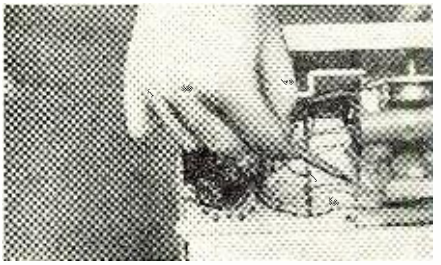
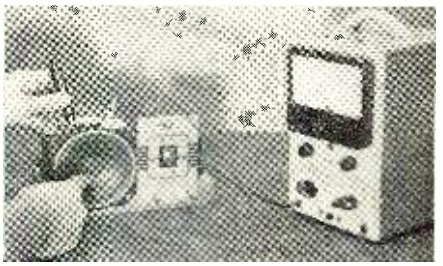


Fig. 8. Press on cone during continuity check to spot intermittent voice coils.



The MAGIC of STEREOPHONIC SOUND

By LOUIS E. GARNER, JR.

Here's how you can step into the wonderful world of stereo and prove to yourself that stereo is fun.

TRY to imagine the *ultimate* in a sound reproducing system . . . a perfectly matched preamp, power amplifier, loudspeaker system, and speaker enclosure with a frequency response flat beyond the limits of audibility, with an imperceptible level of intermodulation and harmonic distortion, and with a dynamic range capable of reproducing every signal from the softest whisper to the crashing thunder of a full symphony orchestra playing at peak volume.

Then take that ultimate system and install it in a room acoustically designed for it . . . with the right number of draperies, rugs, and other sound-absorbing material and with the exact amount of properly located sound reflecting or "live" surfaces.

Such a system in such a location should, and would, give a performance unequalled in quality. The most discriminating audiophile, the advanced audio engineer, the skilled musician, all would be thrilled and proud to own such a system.

But while every standard audio test instrument might indicate that the music played through such an audio system is identical to the music picked up at a "live" performance, this system would *still* lack an important quality of realism. It would lack a quality that would permit even the lowliest untrained ear to distinguish between the music played through it and the music which the listener hears at a live performance. This missing quality is *direction*.

Our ability to distinguish sound directions because of the slight differences in the sound picked up by our two ears is closely akin to our ability to perceive depth by mentally combining the two separate images picked up by our two eyes. Thus, many individuals feel that techniques which add *direction* to our sound perception is essentially the same as adding *depth* to sound.

Binaural Sound Reproduction

If we wish to reproduce sound mechanically while retaining the realistic quality of direction, it follows, then, that we must use *at least two* channels, one carrying the sound signals for the *left* ear and another carrying the sound heard by the *right* ear. Such a system is referred to literally as a "two-eared" or "binaural" system.

Let us consider a simple sound transmission system that would use such a technique. At the concert hall we could place an "artificial head" in the ideal position for a listener, say "10th row center." The artificial head may be made up of two microphones having response characteristics similar to a human ear and spaced about the same distance apart, say six inches, with a mass of some material separating them.

The sounds picked up by the microphones would be fed to two separate *but identical* audio amplifiers and from there to a pair of tightly fitted headphones on the head of the ultimate listener. The sound picked up by the *left* microphone, after amplification and transmission, would be fed only to the *left* earphone. Similarly, the sound picked up by the *right* microphone would be applied only to its corresponding earphone.

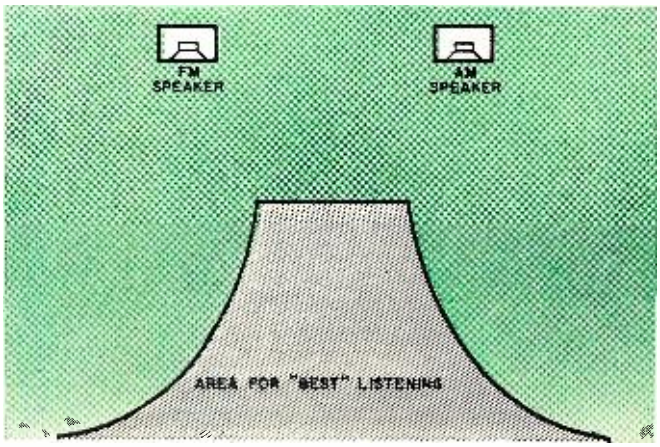


Fig. 1. Typical placement of loudspeakers for listening to stereophonic broadcasts. Probably the best point is a position on a vertical line between the two loudspeakers.

If the amplifiers, earphones, and microphones all had perfect reproduction characteristics, then *the listener would be unable to distinguish between the mechanically reproduced sound and that heard "in person" at the concert hall.*

Stereophonic Sound Reproduction

There is still another technique by which sound can be reproduced while retaining the quality of direction. To understand how this second technique works, let us consider that our listener is at his seat in the concert hall listening to a large orchestra.

Suppose, now, that an invisible wall is placed between the orchestra and the listener. This imagined wall will completely shut off the sound.

If small ideal microphones were placed at every point on this wall facing the orchestra, and these microphones, in turn, fed perfect amplifiers which drove ideal loudspeakers on the "listener" side of the wall . . . with a separate amplifier and loudspeaker for each microphone, and the loudspeakers located at points corresponding to the microphone positions, the sound reproduction on the "listener" side of the wall would be identical to that picked up on the "orchestra" side. *The listener would be unable to distinguish the reproduced music from that of the "live" orchestra.*

Theoretically, such a technique would require an infinite number of microphones, loudspeakers, and amplifiers, but, in practice, close to perfect results can be obtained with a smaller number of audio channels, provided the microphones (and reproducing loudspeakers) are widely spaced.

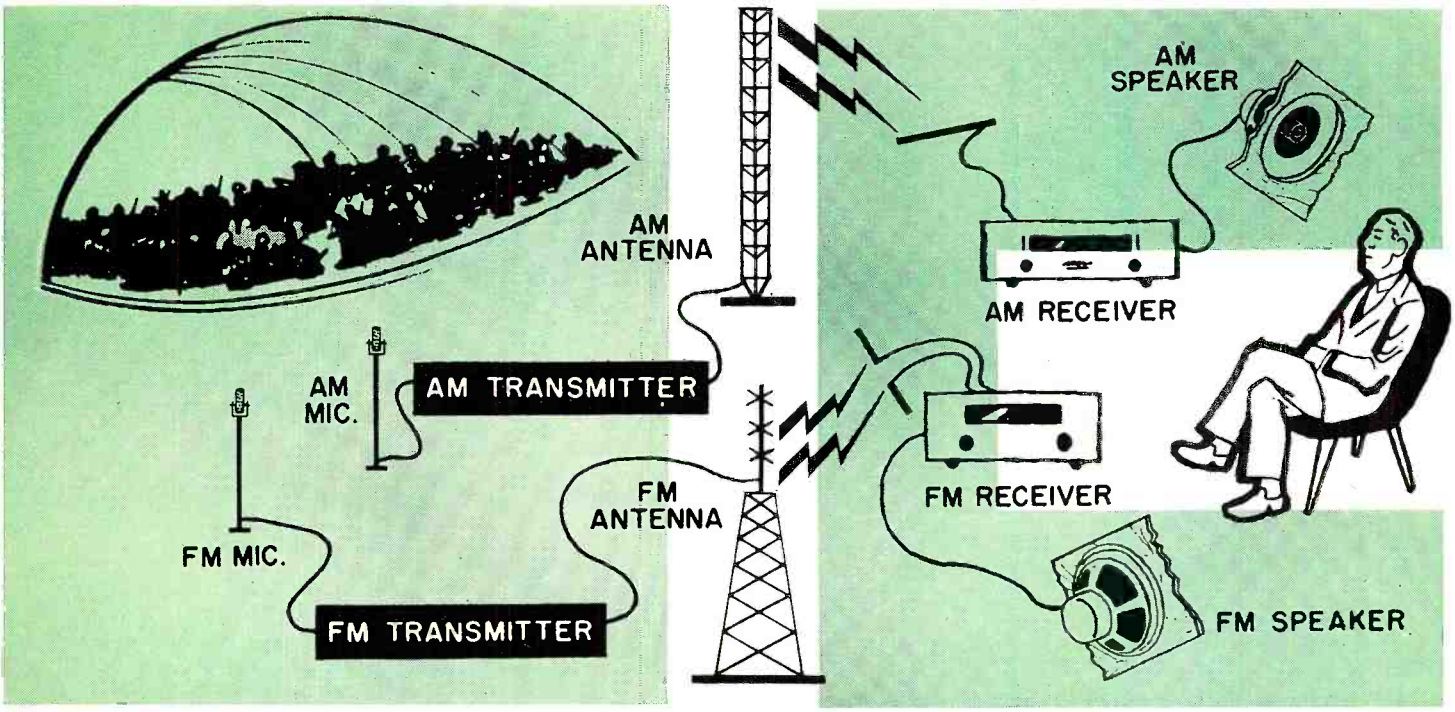


Fig. 2. This is the basic arrangement that is employed for a stereophonic broadcast. Note that two separate pickups (microphones) along with two separate channels (one AM and the other FM) are used in this setup.

Such a system, using widely spaced pickup microphones and similarly spaced reproducing loudspeakers, as well as *two or more separate channels* (amplifiers, etc.) is called a *stereophonic* ("solid sound") system and is analogous to the *stereo* (3-dimensional) system of using two pictures to give the illusion of depth to a reproduced image.

A *pure* binaural system, since it requires headphone operation, is suitable only for a limited number of listeners. In home applications it is common practice to use *two* channels, with the loudspeaker reproduction method of the stereophonic system. The results obtained give a real illusion of direction and are quite thrilling to hear.

Hi-Fi and Stereo

High fidelity audio equipment is designed for low distortion, wide frequency response, and a good dynamic range, irrespective of whether it is used for single channel or multiple channel reproduction.

Stereophonic equipment is simply multiple channel equipment and *need not necessarily be built to hi-fi standards*. It can be, of course, and should be if the best quality in sound reproduction is to be achieved.

Stereophonic Broadcasts

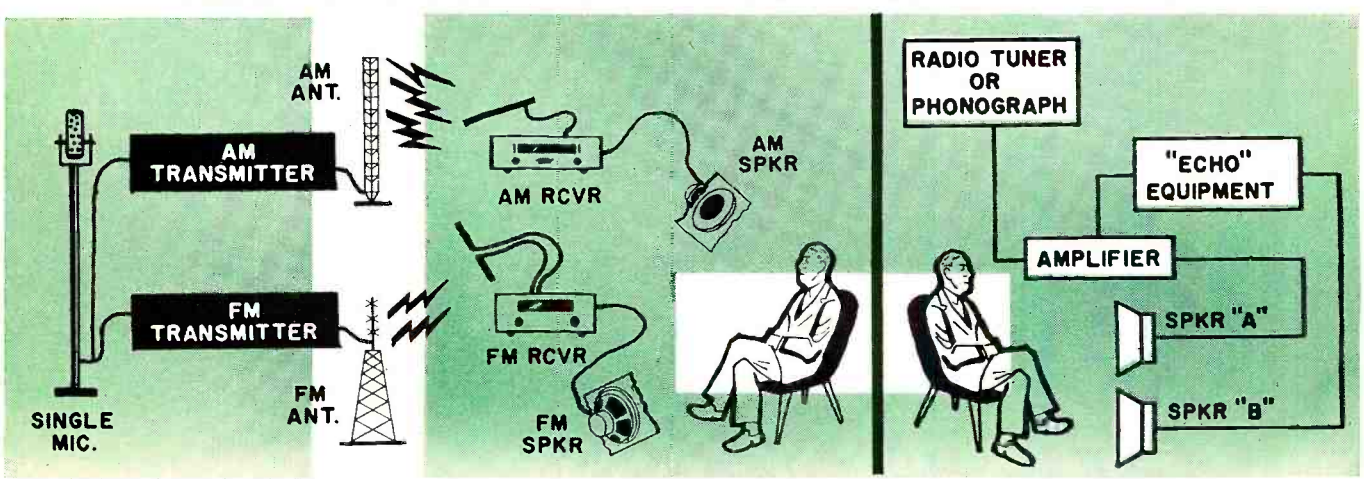
The basic technique used in stereo broadcast is illustrated in Fig. 2. Two wide-spaced microphones are employed. One is coupled, through the necessary amplifiers and networks, to one transmitter. The other is similarly coupled to another transmitter. Separate receivers are used for reception.

Since it is essential that the two channels be kept separate from the pickup (microphone) to the reproducer (loudspeaker or earphone), two complete broadcast channels must be used. These may be two AM channels, two FM channels, an AM and TV audio channel, an FM and a TV audio channel, or any similar combination. By far the most popular technique uses one AM and one FM broadcast channel, however. As a matter of fact, there are available special dual receivers for stereo with completely separate AM and FM channels that may be used.

Most of the stereophonic broadcast work to date has been carried on by local stations; sometimes on a regular, but more often on an experimental, basis. Generally, local "good music" stations pioneer in such work.

The program material usually features "concert" performances of some type . . . symphony orchestras, choirs, and so on, since solo performances do not carry the same realistic impact

Fig. 3. "Simulated" or "synthetic" stereo effects may sometimes be obtained by using separate receivers to pick up the same program (note single mike), or by using "echo" equipment as shown at the right.



that the stereophonic reproduction of a full orchestra can bring to the listener. Both "live" (using microphone pickups) performances and recorded magnetic tapes serve as sources of program material. When stereo tapes are used, the results may be true stereo; while with live broadcasts, compromises may be resorted to so as not to degrade either channel.

Setting Up for Stereo Reception

If stereophonic broadcasts are available in your area, you can "set up" for reception quite easily. As a start, all you need are two receivers capable of receiving the two channels used. In most cases these will be an AM broadcast band and an FM broadcast band receiver. Chances are you already have one of these.

While you may want dual hi-fi amplifiers, radio tuners, and loudspeaker and enclosure systems for your eventual "ideal" set-up, at the beginning you can obtain quite good results by using standard table model receivers.

Loudspeaker (or receiver) placement is extremely important. Since there is, as yet, no set "standard" accepted by all stations, you'll find it best to check with your local broadcast station for their recommendations.

However, a typical loudspeaker arrangement (suggested by WCRB, Boston) is shown in Fig. 1. The FM loudspeaker (or receiver) is placed to the left, the AM loudspeaker to the right, of the listener. Both speakers are spaced along the *length* of the room, and face the listener.

A corner location for the loudspeakers is *not* recommended. Instead, the speaker enclosures should be located with their backs close to (but not against, except in the case of small rooms) the wall, and spaced in from the side walls, from as little as 1½ feet in the case of small rooms (length about ten feet) to 2½ feet in the case of medium sized rooms (length 14 to 16 feet) to as much as 10 feet in the case of a large room (60 feet long). These measurements are to the "center" of the speaker enclosure.

Best listening is obtained when the audience is not more than twice as far from one loudspeaker as from the other, and when their distance from a line joining the two loudspeakers is, in general, *not under* five feet. The area for best reception is shown shaded in Fig. 1.

Once you have the necessary equipment properly arranged, check your local program schedules and carefully tune your two receivers to the proper stations. Adjust the volume controls for approximately equal sound levels. Then relax in an easy chair (placed in the shaded area, Fig. 1), and you'll enjoy a real thrill in radio reception.

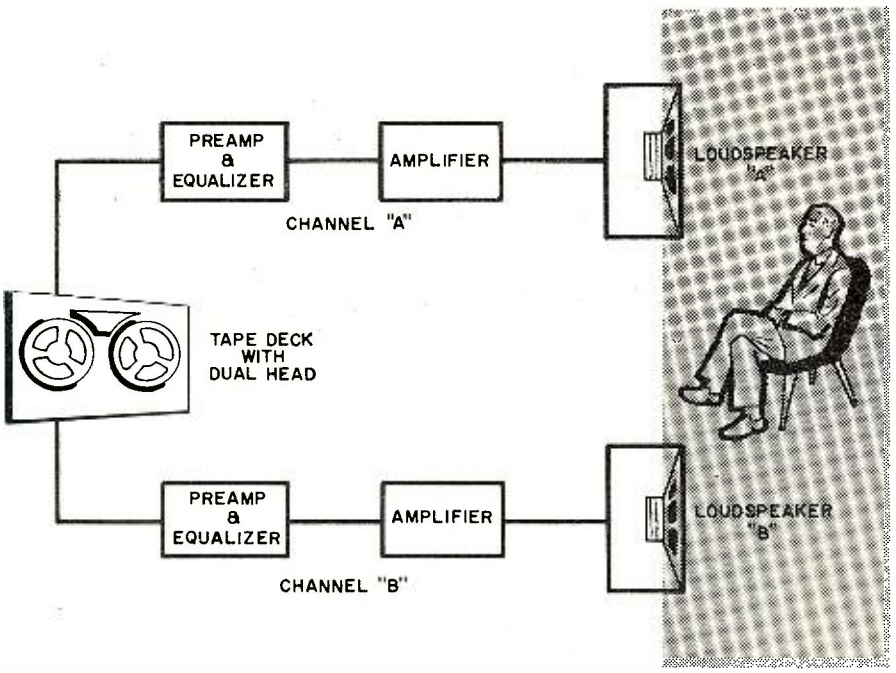


Fig. 4. A basic stereo tape playback setup is shown in this illustration.

Two (or more) *separate* channels are required to obtain a realistic directional effect in the reproduction of music or similar program material. But quite interesting audio "illusions" can be obtained by the use of multiple loudspeakers and a single channel.

"True" vs "Synthetic" Stereo

Perhaps the simplest technique is to connect two or more loudspeakers, particularly with differing frequency coverages, to the output of a single radio receiver or hi-fi amplifier. These speakers may be spaced around a room more or less equidistant from the listener. With this set-up the listener is immersed in sound although he does not hear the true stereo directional effect produced by the true stereo set-up.

Another technique may be used in those areas where both AM and FM stations broadcast the *same* program material (using a single pickup or microphone for both stations). This method is shown in Fig. 3 (left). Two receivers are used to pick up the AM and FM programs, with their outputs fed to separate loudspeakers spaced on either side of the listener.

Although identical program material may be broadcast by both the AM and FM stations, the signal path traveled by the two signals is different. Not only are there circuit differences in the two transmitters and the two receivers, but chances are that a different number of stages are used in each. These differences may result in *small* phase differences in the reproduced audio signal, particularly at higher audio frequencies. This, coupled with the use of multiple loudspeakers, will often give the listener an interesting illusion that is "semi-stereo" in character.

Still another technique which may give the effect of "depth" to the reproduced program material is the use of an "echo" device. This is an electrical or mechanical system which slightly *delays* audio signals sent through it.

The delayed signal, fed through a separate loudspeaker, adds an echo-like quality to the reproduced material. This basic technique is illustrated in Fig. 3 (right).

Stereophonic Recording

Although some of the methods described above may give good stereo, for the ultimate in home stereo reproduction at the present time the use of stereo tape is a must.

Without question, it has been the ready availability of good quality long playing phonograph records that has given the hi-fi hobby its greatest impetus. It would seem, then, that the ready availability of "stereo" phonograph records could do the same for the interest in stereophonic techniques.

Unfortunately, recording a stereo program on a record is quite a chore. Remember that two *separate* channels are required. If we use two separate records (discs), with identical turntable and pickup arms, we run into the almost insoluble problem of properly synchronizing the two records, and of starting the pickup arms in the right place.

Quite acceptable stereo discs have been "cut" in the past, however, by recording *both* channels on a *single* disc. A *dual* pickup head (on a single arm) is used for playback. But this technique offers a serious disadvantage; it cuts the available recording surface in half, and reduces the length of program that can be recorded by a similar amount. As a result, these stereo disc recordings have never achieved any real degree of popularity.

Two stereo disc systems have recently been introduced in which two channels are recorded in a single groove. Special pickups, which are already available on a limited basis pro-

duce the two outputs. These systems will bear watching in the near future.

Stereo Tapes

Magnetic tape recording is almost ideal for stereo program material. Several channels can be recorded side-by-side on a single tape, and these channels are kept in perfect synchronism as the tape is played back. Today, recorded *stereo tapes* are used extensively by broadcast stations and a large variety of taped programs are available *for home use.* These are obtainable from many of the larger recording companies as well as several of the smaller ones.

The basic arrangement used for the playback of stereo tapes is illustrated in Fig. 4. The tapes used in broadcast stations and home use generally have *two* channels, with one recorded near each edge (top and bottom) of the tape.

The tape is fed through a tape deck very similar to a conventional single channel (monaural) tape mechanism except that *two* pickup heads are provided. The output signal obtained from one head is fed through a preamplifier and equalizer circuit to a standard audio amplifier, and from there to one loudspeaker. The output signal obtained from the second head is handled in a similar manner by a separate audio channel.

Types of recorded tapes. With the variety of program material available, including symphonies, concertos, and other classical works, recorded magnetic tapes are available in two basic types, depending on the recording technique used and the playback technique required. Both basic types are illustrated in Fig. 5.

The older *staggered* tapes have been recorded with separate magnetic heads and are designed for playback on machines having two completely separate pickup heads, as shown in Fig. 5A. Since the two heads are displaced linearly, corresponding parts of the program material must be recorded at similarly displaced positions (that is, "staggered") along the tape.

This technique, and the use of such recordings, came about as a natural result of converting older "single channel" tape recorders to "dual" channel stereo recording by the simple expedient of adding a second magnetic head.

The more modern *stacked* (or *in-line*) tape is shown in Fig. 5B. Here, the two stereo channels are recorded at corresponding positions (that is, one directly "above" or "stacked" on the other) along the tape. A single *dual* pickup head is used for playback.

When recorded tapes are purchased, it is *essential* that the proper type of tape (*staggered* or *stacked*) be obtained for the machine on which the tape is to be played back. At present, most tapes employ the stacked or in-line method.

Setting up for stereo tape playback. You can enjoy the startling realism of stereophonic sound reproduction by using a stereo tape recorder (or playback) unit and recorded magnetic tapes. If you don't now own a tape recorder, you have several choices available. You can either purchase one of the new stereo tape recorders offered by leading tape recorder manufacturers or you can obtain a basic stereo tape deck with appropriate preamplifier-equalizers.

While some stereo tape recorders are equipped with dual audio channels, the majority of medium to low-priced units are equipped with but a *single* built-in audio channel, with a separate amplifier output jack. This is connected to a separate, external, audio amplifier and loudspeaker system.

If you prefer to obtain a basic stereo tape deck, then you'll also want to obtain matching preamplifier-equalizers for each head. And you'll have to provide *both* audio amplifier-loudspeaker channels. For the ultimate in sound reproduction, the amplifiers should be hi-fi units and should be identical in performance, as should the loudspeakers and enclosures used.

On the other hand, if you already have a tape recorder equipped with a single playback head, you needn't worry. Most large tape recorder manufacturers now offer special stereo conversion kits for modifying an older tape recorder for stereophonic playback. These kits include the extra pickup head, mounting hardware, and, in many cases, a preamplifier-equalizer. If the particular kit you obtain does not include a preamp or equalizer, you may have to obtain a separate unit to handle this job.

Once an older tape recorder is modified for stereo playback, you'll have to provide the "extra" audio channel; the built-in audio amplifier and loudspeaker used in the original recorder serve as one channel.

Whether you are using a new stereo tape recorder which requires an external audio channel or a "converted" old recorder, you can obtain the additional audio channel from any of a number of sources. Several suggestions are shown in Fig. 6.

First, of course, if you have a home hi-fi system, you can connect the output of the second pickup head to the tape input jack of the master control preamp used in the system. In many cases, the preamplifier will already be equipped with an equalizer circuit for the magnetic head and you won't need an extra preamplifier or equalizer.

If you don't have a home hi-fi system, you can connect the additional head through a preamplifier-equalizer to the phono input of an AM or FM receiver or to the input terminal of any standard phonograph amplifier. Shielded cable should be used for all equipment interconnections.

When setting up your final system, you should follow the tape recorder manufacturer's suggestions regarding loudspeaker placement . . . or, if no instructions are furnished, you can use the basic layout suggested for the

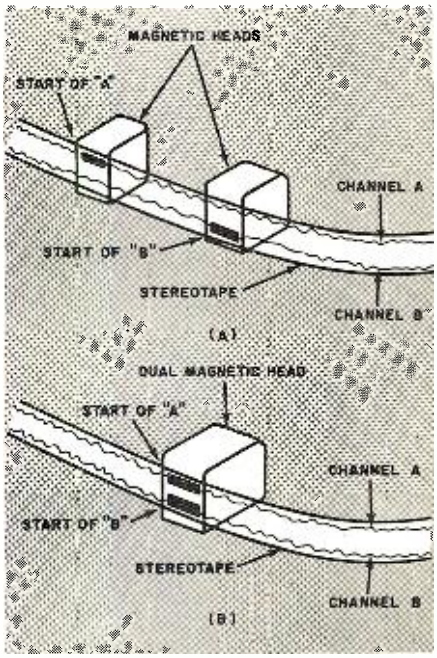


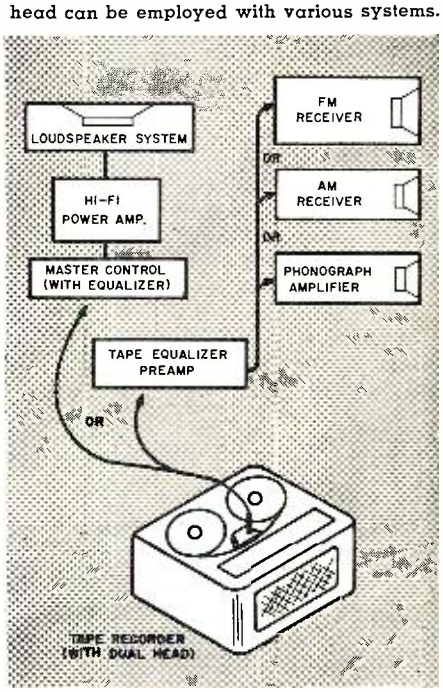
Fig. 5. (A) "Staggered" and (B) "in-line" or "stacked" stereo tapes are shown here.

reception of stereophonic radio broadcasts (see Fig. 1).

In addition, you'll want to adjust the volume and tone controls of your two audio channels for as near to identical performance as you can obtain. To aid in this, special recorded test tapes are available. By playing such a tape through your system, and following the instructions outlined by the manufacturer, you can obtain the most from your stereo system.

One final tip—once you're set up for stereo and have a collection of stereo tapes, keep it a secret. Otherwise, you may "go broke" buying refreshments for visiting friends and neighbors. Stereo is fun! -30-

Fig. 6. A tape recorder or deck with dual head can be employed with various systems.



By **B. VAN SUTPHIN**

SERVICING Communication Receivers

Fig. 1. The Hickok 295X is a typical signal generator designed especially for work with communication receivers.

Here's extra income for established technicians, useful data for new hams and unlicensed DX fans.

WHAT IS a "communication" receiver? How does it differ from the common type of set used for home entertainment? How are these differences important to the service technician?

A "communication" receiver is one designed for communication service, other than the commercial bands, where original performance must be of a high order and that performance is to be maintained for the life of the equipment. Perhaps the most evident difference is the number of controls. While most home-entertainment sets have only two controls—tuning and volume—even the simplest communication receiver may have 5 or 6 controls. The more complex will have more.

Electrically, the communication receiver must tune a wider range (more bands) thus, a bandswitch must be provided. On the crowded short-wave bands, a bandspread tuning control is necessary to allow easier separation of stations. For reception of code (c.w.) signals, a beat frequency oscillator (b.f.o.) and a means of "killing" the a.v.c. voltage are necessary. In addition to the normal audio volume control, a separate control for regulating the gain of the r.f. and i.f. stages is often provided.

Selectivity controls are provided on the more expensive models: these work in conjunction with crystal filters or "*Q*" multipliers, an electronic means of increasing the "*Q*" of a tuned circuit in the i.f. amplifier and thereby sharpening the over-all response curve. A signal-strength meter, called an "*S*" meter, may appear on costlier ones. More sensitivity, selectivity, and stability are the rule.

All communication receivers are superheterodynes—some are double-superheterodynes. In the double-superheterodyne, the incoming signal is conventionally mixed or heterodyned with the output from a local oscillator to form a new signal, the i.f. signal, having the modulation characteristics of the original signal. After amplification, this i.f. signal is mixed with the output from still another local oscillator to form another i.f. signal which, following further amplification, is fed to the detector and audio circuits.

A number of advantages are gained with this arrangement. The i.f. used following the first conversion is generally high—1500-2000 kc.—so that undesired image signals will be considerably removed from the desired signals. The i.f. used following the second conversion is low so that high selectivity can be obtained. The sensitivity and selectivity of receivers employing this principle is significantly greater when compared with receivers using a single-frequency conversion process.

Voltage regulation is frequently used in the "B+" circuits of certain critical stages. This, in addition to special temperature-compensating components, helps prevent drift. The remaining circuits of a communication receiver are generally similar to their counterparts in more conventional sets except that improved electrical and mechanical stability are stressed.

The service problems encountered in communication receivers are generally the same as those with any other piece of electronic equipment, such as defective tubes, defective resistors and capacitors, and the like. The methods of locating the defective part are also familiar. Signal injection, signal tracing, and voltage-resistance tests are just as useful in servicing these receivers as in servicing a.c.-d.c. sets. There is one important difference, however: correct service information must be available when working on a communication receiver. Technicians who can easily repair most a.c.-d.c. sets without consulting schematics should not attempt this with a communication receiver.

The replacement part installed in a communication receiver must be of the highest quality. Since some of the parts may have special characteristics, always consult the service data before installing a new part in a critical circuit. A particular example is the oscillator circuit where the individual capacitors must have the specified temperature coefficients if drift is to be prevented. Tolerance of individual parts is also important; if a 5% resistor is specified, there is a reason. Use the stated tolerance.

In terms of the technician, one of the greatest problems is the few special parts that must be ordered from the receiver manufacturer. In communication receivers more often than home sets, special parts that must be replaced with an exact duplicate are used. When this problem comes up, the best way to handle it is by explaining to the customer that the part needed is of special design and an exact factory replacement is necessary to restore peak operating efficiency. Generally, the customer will appreciate your extra trouble.

Alignment

Because of the extreme sensitivity, selectivity, and calibration accuracy of communication receivers, proper alignment is very important. Even the stable circuits in a communication re-

ceiver will drift over a period of time, and realignment is sometimes necessary following extensive repairs. This is particularly true if the repairs involved replacing parts in any of the tuned circuits.

The effects of improper alignment are the same that would be noticed with any other receiver: incorrect dial calibration, decreased sensitivity, and/or decreased selectivity. This type of set is generally operated under somewhat demanding conditions and such failings in performance are quickly noticed. (By the same token, improvements are noticed just as quickly.)

Complete alignment is a complicated job; therefore, the technician must have a clear idea of just what is needed before beginning. Proper pretesting is important to determine accurately just what part of the over-all alignment is most affected and where the greatest care must be exercised in aligning the receiver. When only the dial calibration is off, realigning the oscillator, mixer, and r.f. stages is often sufficient without the necessity for going to the i.f. section.

To determine whether the receiver needs alignment, first check the dial calibration, paying careful attention to the high-frequency end of each range. If the customer has indicated that he uses one band or tuning range more than the others, be sure to check that one very carefully. Most communication receivers have a separate bandspread tuning control that must be set to a certain position to attain correct calibration of the main tuning control. The correct position will be indicated in the service information.

On the broadcast band, the signals from nearby broadcast stations can be used in checking the calibration. On the higher bands, a 100-kc. crystal calibrator checked against WWV is convenient. As these tests are carried out, mark down the results so that you can be sure to re-check the calibration after alignment at points previously noted to be incorrect.

For checking the r.f. amplifier and mixer circuits having exposed coils without upsetting the alignment more than it was originally, a tuning wand is convenient. This is a tube of insulating material with a powdered-iron tip at one end and a brass tip at the other. Bringing the powdered-iron tip close to a coil increases its inductance, tuning the circuit to a lower frequency. Bringing the brass tip close decreases the inductance, tuning the circuit to a higher frequency. If bringing either end close to a coil increases the volume, the circuit containing that coil needs to be aligned. If both ends decrease the volume, the circuit is properly aligned. A tuning wand is most effective on the higher frequencies where the coils are smaller and better coupling can be obtained.

If no crystal filter or *"Q"* multiplier is used in the i.f. circuits, check the selectivity by tuning across a signal and noticing how sharp this tuning is. Some experience in making this test is required to obtain most accurate results. A better method involves the use of a narrow-range sweep generator (wobbulator) and an oscilloscope to actually look at the response curve. A drawing of the correct response curve is often in the service data.

Checking the selectivity of a receiver using a crystal filter is most easily done with the help of the wobbulator-oscilloscope combination which allows visual examination of the response curve; but it can be done by listening tests. To check the "broad" positions of the selectivity control, tune in a broadcast station transmitting speech. Advance the selectivity control: sideband clipping with consequent distortion of the voice should become evident. Also, the signal should tune more sharply. To check the "sharp" positions of the selectivity control, turn the a.v.c. off, the b.f.o. on, and the audio gain control all the way up (use the r.f. gain control to regulate volume). Tune across one of the amateur bands—the range between 7.0 and 7.3 megacycles is ideal—to find a c.w. station with severe interference from another station. Advancing the variable selectivity control should decrease the interference. By adjusting the phasing control, you should be able to reduce the strength of the interfering signal while maintaining the desired signal.

If the controls in the crystal filter circuit do not respond as they should, the i.f. amplifier must be realigned to match the crystal. Even slight misalignment can make quite a difference in receiver performance.

Some receivers include a *"Q"* multiplier instead of (and sometimes in addition to) a crystal filter to improve the selectivity. This is actually a sort of extra, adjustable i.f. stage. Others have a separate *"Q"* multiplier added by the owner as an "outboard" accessory. Either way, the *"Q"* multiplier must be checked. The separate ones generally provide two modes of operation: "peak" and "null." Some of those built into receivers provide only the peak function. The testing method is similar in each case.

Tune in a station; adjust the *"Q"* multiplier for peak operation and turn the peak control up slightly. As you tune the frequency control of the *"Q"* multiplier, an increase in response should be obtained at one setting. Further advancement of the peak control should further sharpen the response, ultimately causing sideband clipping, distortion, and, finally, oscillation. If the frequency control cannot be adjusted to peak the signal, this indicates that either the i.f. amplifier in the receiver or the tuned circuits in the multiplier are far off frequency. Check alignment of both.

Next, adjust the *"Q"* multiplier for null operation. As the null control is advanced, the received signal should become weaker and weaker. Again, check the operation of the frequency control to be sure it moves the null to each side of the desired signal.

Incorrect results in any of these tests indicates either the need for realignment of the receiver i.f. strip, realignment of the *"Q"* multiplier, or the need for repairs in its circuit.

A word about test equipment. The signal generator for use in aligning a communication receiver must have extremely low stray output, otherwise, it would be impossible to reduce the input signal sufficiently during the final stages of alignment. In many cases, the leakage output from a standard service-shop signal generator is so high as to make it useless in aligning a sensitive communication receiver. A signal generator designed especially for communication service is best.

Let's examine one of these, the *Hickok* Model 295X shown in Fig. 1, for a moment. The most important feature is one not obvious from visual examination. Inside the cabinet, the generator circuits are completely shielded by silver-plated copper sheets. The a.c. input leads are filtered to prevent r.f. leakage over that path. All this results in low stray output.

The dial is arranged for high accuracy with approximately 300° of scale for each band. A vernier control plus a scale calibrated in very small divisions assures high accuracy in setting the dial to precise frequencies. Metered output down to 0.1 microvolt and up to 100,000 microvolts is provided. Knowing the exact input-signal value is important in checking the receiver sensitivity. A separate crystal oscillator is provided for use as a frequency standard in conjunction with a 100-kc. crystal calibrator. Every technician working on communication equipment should have a 100-kc. crystal calibrator. Of course, separate audio output is included.

When aligning the i.f. amplifier and all other circuits except the receiver front end, extraneous signals can be kept from interfering by disconnecting the antenna and shorting the receiver input. In the final stages of align-

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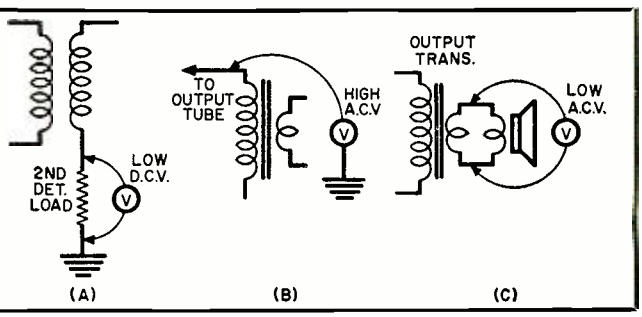
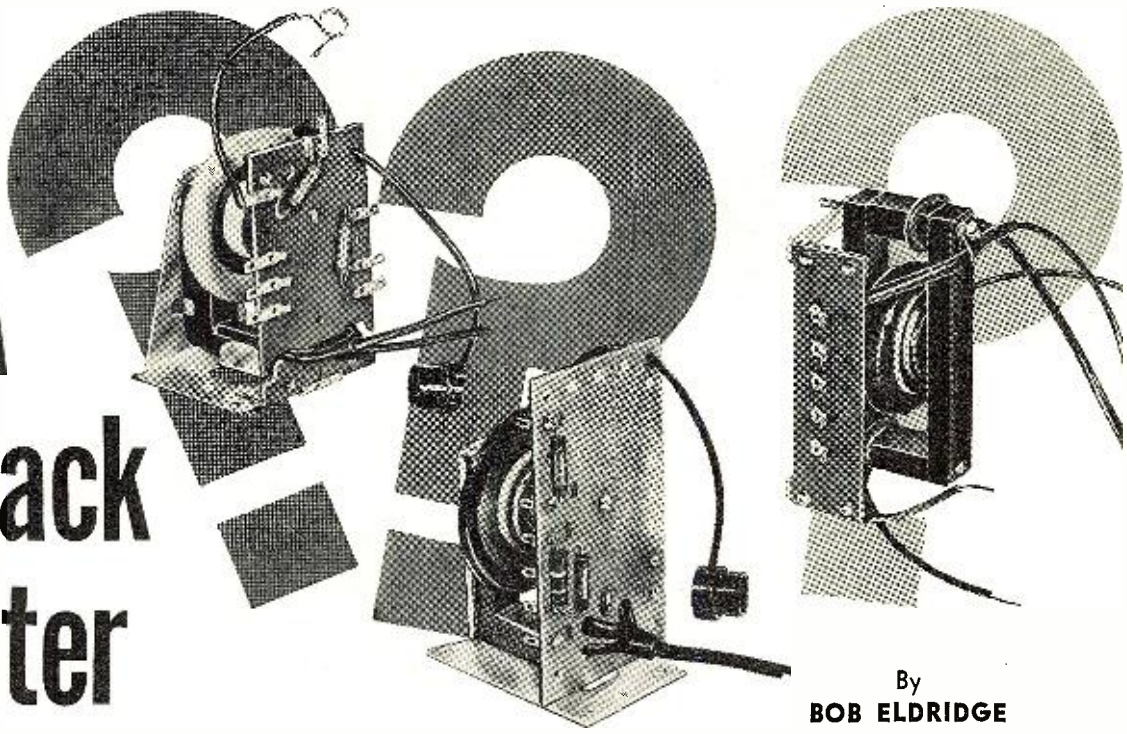


Fig. 2. Three points at which an output indicator may be connected for testing and repair work with meter function and approximate scale indicated for each. Meter shown at (B) must use series capacitor to keep d.c. voltage from meter.

A Flyback Tester



By
BOB ELDRIDGE

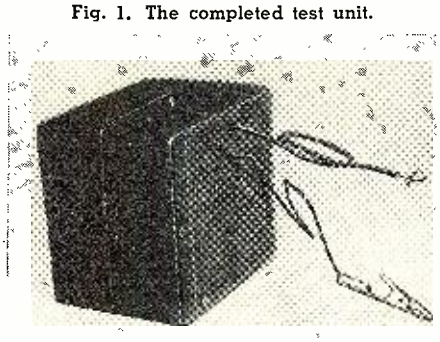
Horizontal-output transformer condition may be determined quickly and reliably with this unit.

WHEN everything around the horizontal section appears to check out normally, but there is still no deflection or high voltage, the technician is faced with the need to make a decision on the condition of the flyback transformer. He generally approaches this necessity with reluctance, after having first investigated every other possibility; for this important component that is the key to the entire horizontal-sweep section can be quite baffling.

The width coil can be checked merely by disconnecting it. The horizontal windings of the deflection yoke can be checked by substitution: almost any yoke that happens to be available can be tacked into place temporarily. However, few jobs are more tedious than that of unsoldering and dismounting one flyback transformer and then making all the connections necessary to put in another one.

There is a surprisingly simple and inexpensive way to get around this problem. It involves a method that sometimes proves more conclusive than a test with the type of flyback tester that checks transformer *"Q."* The basic requirement for the technique is another flyback transformer. The best thing is to buy one specifically for this purpose. A small one of the type used in direct-drive circuits, where the horizontal coils of the yoke are wired in series with transformer primary, as shown in Fig. 2A, is the most convenient to use. This type is inexpensive and is not cluttered with a number of confusing terminations. The fllament winding for the high-voltage rectifier, involving only two leads, is not used. The three leads of interest to us are the ones for the high-voltage rectifier plate, the plate of the horizontal-output tube, and the connection for "B+" or boosted "B+."

Fig. 1. The completed test unit.



If you wish to do the job at virtually no expense at all, any old flyback can be used in the same manner, but first disconnect *and remove from the core* any shorted portions of the primary winding. For safety, as well as for keeping out of harm's way any windings that are not used, the unit should be installed in a box, as shown in Fig. 1 and clarified in Fig. 2B. The lead that normally goes to the plate of the horizontal-output tube is brought out of the box and terminated in a suitable clip. The lead that normally goes to "B+" or boosted "B+," whether directly or through the yoke, is terminated in an alligator clip. The lead that normally would go to the plate of the high-voltage rectifier is brought out to an externally available contact button or other termination—which is, of course, insulated from the case.

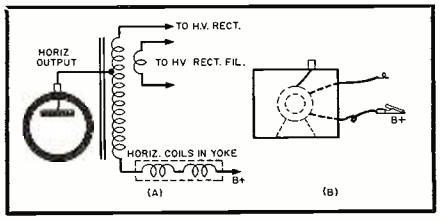
If you wish to be fancy, a neon bulb can be mounted adjacent to this top terminal, to indicate the presence or absence of r.f. This step, if it is performed, concludes the rather simple construction of the device. Now for the method of operation:

1. Disconnect the plate clip from the output tube in the set.
2. Connect the plate clip from your test box to the plate of the output tube.
3. Connect the alligator clip from your test box to a "B+" point in the set, preferably the boosted "B+" input terminal of the suspected flyback.
4. Switch on the set and attempt to draw an arc from the top terminal of the test box (or, in the fancy version, look for glow in the neon indicator). See Fig. 3A.
5. If no r.f. is present, and "B+" exists at the appropriate terminal, there is something wrong with the horizontal-output stage other than the flyback. (It is assumed a check has already demonstrated the oscillator to be providing drive to the output tube.)

If r.f. is present, this shows the stage is operating with a substitute plate load. (The arc may only be about half

(*Continued on page* 141)

Fig. 2. (A) Type of flyback recommended for test unit and (B) its box mounting.



The "Control Master"

Dialing unit being used with transmitter.

A Crystal Dialing Unit

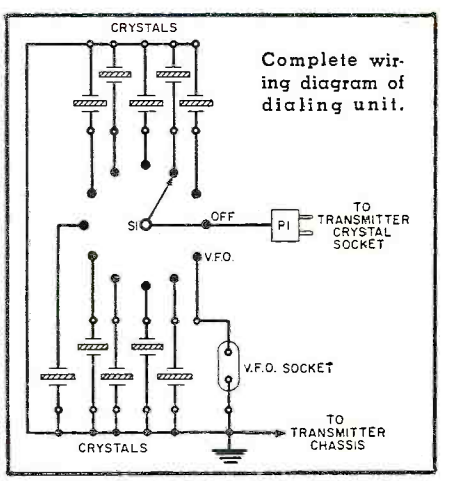
By **GENE BRIZENDINE, W4ATE**

Provides real convenience in the dialing of transmitter or signal generator frequencies.

INSTANT frequency selection is provided by this compact, crystal-dialing accessory. Finger-tip control of ten crystal, plus v.f.o., frequencies is made available, right next to the receiver. For Civil Defense, mobile, or amateur station operation, it is useful where the transmitter is two feet or less from the operating position. The circuit of the "Control Master" includes eleven crystal sockets, an eleven-position, single-pole rotary switch, and output leads.

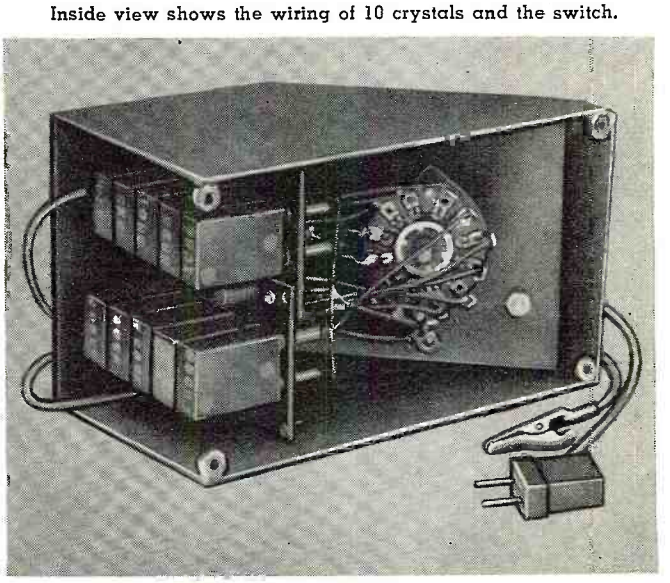
The simple cabinet was built, since no suitable ready made unit was found. Only three sheet-metal pieces are used. The panel portion is easily bent to shape, using a small vise. Assembly is by solder-spotting the mating edges *inside* the cabinet. Finally "flow" a bead of solder along each inside corner. Any excess solder on the outside may be dressed away with a file. Drill the switch mounting hole in the panel. Next, spot four large 6-32 nuts inside each lower corner, using a hot soldering tip. These are for later attaching the rubber feet. Two right-angle strips are

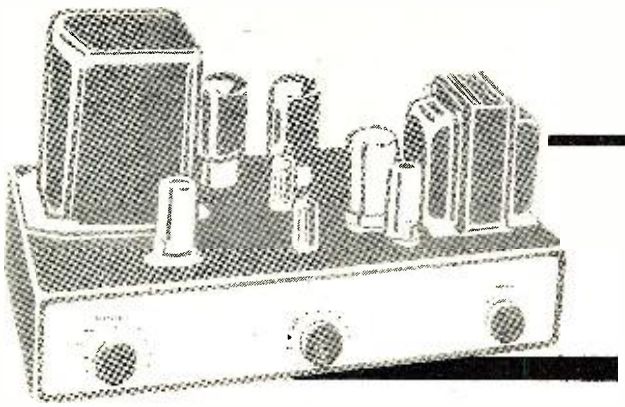
(*Continued on page* 98)



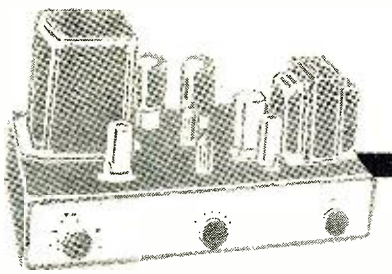
The over-all view of the "Control Master" is shown below.

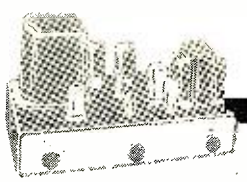
Inside view shows the wiring of 10 crystals and the switch.





Upgrading the Hi-Fi Amplifier





By **HERMAN BURSTEIN**

A step-by-step search for a really clean 15 watts output by slight changes in basic Williamson circuit.

STATEMENTS frequently appear in the audio literature that IM distortion below 1 or 2% cannot be detected by the ear. Yet in listening to several power amplifiers operating at moderate level, where no more than 1-watt equivalent sine-wave power is produced on peaks, a good ear will readily note that some amplifiers sound cleaner than others, even though in all cases the measured IM is below 1% at moderate level. This has been the cause of some concern to many listeners.

It would seem, therefore, that maximum permissible IM distortion is still open to question. In discussing this matter with various individuals in the audio field, some have indicated that the 1 or 2% limit should be radically revised downward. One, an engineer, stated that in a series of tests made with a number of power amplifiers, the findings of his ears inevitably correlated with the IM distortion found by instrument, even though the distortion was but a fraction of 1% at the test levels. On the other hand, it is possible that the differences among amplifiers are not actually due to distortion products, but rather to some other characteristic, and that the amount of IM is an index to this characteristic.

Desiring to do a little research on this question, the author recently borrowed a highly regarded 50-watt amplifier to compare with his 10-watt Williamson, vintage 1950. At quite modest reproduction levels, the 50-watter had a slight but definite advantage in terms of clarity, purity, and seeming ease. The initial temptation was to heave out the Williamson in exchange for a good 50-watter. On second thought, it was decided to have a go at the Williamson to see if it could be brought up to the quality of the comparison amplifier. The author's speaker system is relatively efficient; hence it was reasonably certain that the difference in performance of the two amplifiers was not due to power capacity, particularly since comparisons had been made at moderate listening levels.

The eventual result was that the Williamson was not tossed out — at least not yet. The events that took place serve as an illustration that, with the aid of a few readily available instruments. one can significantly improve the quality of an existing amplifier. There are still many 10- or 12-watt Williamsons around, as well as other amplifiers of similar wattage and not too different circuitry, which may be susceptible of such improvement. The audiophile or technician with access to the few necessary instruments can undoubtedly obtain results similar to those achieved by the author. The equipment used included an audio oscillator and a *Heath* Audio Analyzer, which combines in one package an IM distortion meter, a highly sensitive a.c. v.t.v.m., and a wattmeter. Such units, which but a few years ago were seldom found outside the laboratory, today are available in kit form at truly low cost. Since they are very popular items, one has a good chance of being able to borrow them from an engineer or technician friend or perhaps rent them from a service shop. Or, of course, the unit may be built from a kit.

Before departing for parts unknown, the author decided to check where he had been and obtained the readings given in Table 1A on IM distortion in the Williamson.

Then began the search for improvements. The first two steps were virtually barren. These were to precisely balance the d.c. current through the output tubes and to replace each tube in the amplifier (again balancing d.c. current when the output tubes were exchanged). Each of the remaining steps. however, was fruitful.

1. The original Williamson circuit employed triode operation of the output tubes. The author decided to try a switch to "Ultra-Linear" operation, or rather an approach to it. The output transformer in the amplifier is a *UTC* LS-63, which has intermediate taps between the "B-plus" and plate taps, although not at a point representing about 18.5% of the impedance as called for in true "Ultra-Linear" operation. Nevertheless, by connecting these intermediate taps to the screen grids of the output tubes, definite improvement was achieved. Figure 1 shows the

change in connections. Table 1B shows the results.

The improvement was an obvious one. The "Ultra-Linear" form of connection produced as little or slightly less distortion at low levels and decidedly less at high levels. An amplifier which barely qualified as a 10-watter was converted into a very satisfactory 15-watter.

(It should be mentioned that in checking IM distortion at various output levels, the wattmeter reading was always multiplied by 1.47, which is the customary thing to do, in order to convert the average power reading of the wattmeter into equivalent sine-wave power. The IM test employs a low-frequency voltage and a high-frequency voltage in the ratio of 4:1. These are fed into the power amplifier under test. Accordingly, the amplifier actually produces a total power proportional to $4^2 + 1^2$, which is 17, and this is what the wattmeter reads. However, the output of the amplifier is not a true sine wave, for it consists of one frequency superimposed on another. A sine wave with the same peak as the actual output would contain more power—designated as equivalent sine-wave power. Since the test voltages are proportional to 4 and 1, they add up to a peak voltage proportional to 5. A sine wave with a peak voltage proportional to 5 would produce a sine-wave power output proportional to 25, because power is proportional to voltage squared. Thus the ratio of equivalent sine-wave power to actual power output is 25/17, or 1.47.)

2. As shown in Fig. 1, the author's version of the Williamson included a cathode bypass capacitor across the common cathode resistance of the output tubes. According to the literature at the time, this capacitor served to improve low-frequency response. Upon removal of this component, IM distortion went down slightly but significantly, no doubt because of the current feedback produced by the unbypassed cathode resistance. A check of 20-cycle response (minimum frequency of the available oscillator) showed no deterioration in the response at low or high levels.

3. Next the author tried changing grid bias, by altering the value of cathode resistors in the various stages preceding the output tubes. Only in one case, at the input tube, did this measure help. Increasing the cathode resistor here from 470 to 870 ohms led to an appreciable drop in distortion.

4. The last measure was to adjust the amount of feedback from the secondary of the output transformer to the cathode of the input tube. Even after increasing the cathode resistor of this tube, it was found that feedback was only 14 db, whereas the design permits 20 db with stability. Using a pot as a temporary feedback resistor, it was adjusted for 20 db feedback. To determine amount of feedback, a very low signal input at 1000 cycles was used and amplifier output with and without the feedback resistor connected was measured. When the setting of the pot was such as to produce a power ratio of 1:100, this signified 20 db feedback. Again there was improvement, owing to 6 db more feedback.

IM DISTORTION BEFORE CHANGES		IM DISTORTION IN QUASI "ULTRA-LINEAR" MODE		IM DISTORTION AFTER ALL CHANGES	
Equiv. Sine-Wave Power (watts)	IM%	Equiv. Sine-Wave Power (watts)	IM%	Equiv. Sine-Wave Power (watts)	IM%
15	11	15	3.50	15	1.75
10	3.20	10	.72	10	.21
5	.33	5	.40	5	.13
2	.22	2	.21	2	.08
1	.16	1	.14	1	.07
.5	.12	.5	.12	.5	.066
.1	.09	.1	.08	.1	.063
(A)		(B)		(C)	

Table 1. Improvements in IM distortion resulting from simple circuit changes.

Table 1C shows the final results, incorporating the benefits of all four steps.

Below 10 watts, this performance compares with or excels that of some very highly regarded modern amplifiers, although the power capacity of the latter may extend to 30 or more watts. It should be noted that below 5 watts the IM distortion is probably less than indicated in the table inasmuch as the residual reading of the IM tester used, without an amplifier under test, was about .06%.

To make sure that the changes had not adversely affected frequency response or unduly altered sensitivity and other characteristics, these were checked. Response was found to be perfectly flat from at least 20 cycles (low end of the oscillator) to 25,000 cycles, dropping gradually thereafter in relatively smooth fashion; it was 3 db down at 40,000 cps and 6 db down at 100,000 kc. Sensitivity proved to be suitable: 1.7 volts input required for 10 watts output. Here it is appropriate to mention that two watts equivalent sine-wave power is the very most the author's relatively efficient speaker system can use. A calibrated oscilloscope has been placed across the power amplifier from time to time when feeding in various kinds of program material *via* FM, tape, and phono, and only at painfully loud levels did the scope show as much as the equivalent of a two-watt reading. Accordingly, it can be estimated that the most voltage required to drive this power amplifier is slightly under .6 volt.

No instrument check was made of signal-to-noise ratio, because with the amplifier connected to the speaker system absolutely no noise or hum was audible right at the speaker. In the matter of low hum content, it is of interest to note that the author's Williamson was built in the old-fashioned way, with *two* chokes in the power supply.

Before returning the power amplifier to use, it was decided to also check out the control unit, which was one of the very best in its day about seven years ago, although since outdone. IM distortion measured about 1.5% at 1.5 volts output (equivalent sine-wave voltage obtained by multiplying actual volts by 1.212), about 1% at 1 volt, about .5% at .5 volt, and proportionately less at reduced output. A couple of slight changes reduced IM to about .3% at 1.5 volts output and to less than .1% at normal levels. The modifications, shown in Fig. 2, consisted in part

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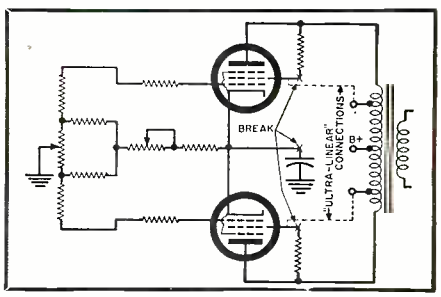

Fig. 1. Amplifier output stage changes.

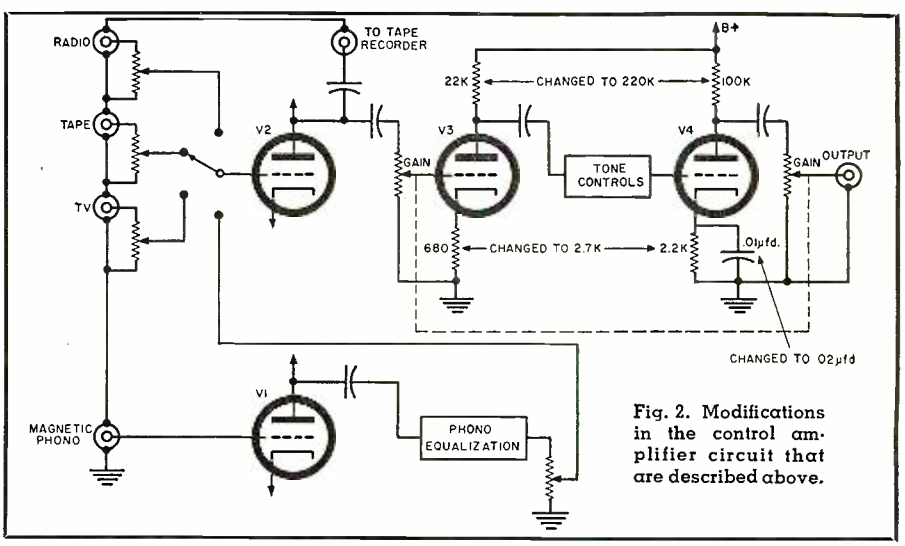

Fig. 2. Modifications in the control amplifier circuit that are described above.

By
WARREN PHILBROOK

FACTS About Vertical-Sweep Circuits

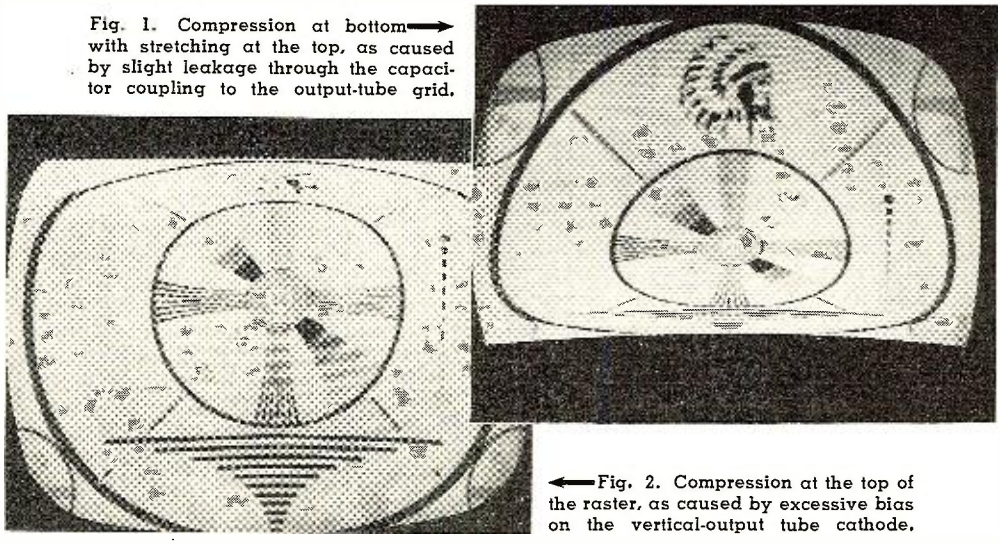

Fig. 1. Compression at bottom with stretching at the top, as caused by slight leakage through the capacitor coupling to the output-tube grid.

Fig. 2. Compression at the top of the raster, as caused by excessive bias on the vertical-output tube cathode.

An experienced bench man highlights the troubles, ordinary and unusual, that occur in this circuit.

COMPARED to the horizontal-deflection section of the TV chassis, there are relatively few complications or difficulties in the servicing of the stages concerned with vertical sweep. However a more than usually difficult job arises now and then in this part of the set. Then, because he has previously taken the vertical very much for granted, the technician may find himself out on his own in strange country. The most difficult problems are those involving incorrect linearity or size, rather than complete absence of scan.

Compression at the Bottom

This is one of the most frequent vertical faults. One of the more difficult things to do in a TV set is to produce and maintain a saw-tooth waveform which is of correct amplitude and at the same time perfectly linear throughout its entire length. It is particularly difficult when using magnetic deflection, owing to the fact that the yoke inductance has a great effect on the nature of the current waveform within the winding. To produce a sawtooth of *current* in the coil, it is necessary to impress across it a *voltage* waveform consisting of a sawtooth and a pulse combined. It is essential to bear in mind that, although the saw-tooth part of the waveform in the oscillator or output stage may look linear enough, this does not necessarily mean that the raster itself will be linear. The current waveforms in the yoke are illustrated in Fig. 5, the waveform corresponding to compression at the bottom of the raster being that of Fig. 5B.

The most frequent causes of compression at the bottom are lack of drive from the oscillator stage or lack of bias on the output stage. One reason for the low drive could be lack of "B+" at the source. Because the oscillator circuit usually needs a high plate load resistance, the "B+" is often derived from the boost supply, so this is the first place to check. However, the most likely trouble is a rise in resistance of either the height control (4.7 megohms in Fig. 3) or the oscillator plate load resistor (2.2 megohms). This can most easily be checked by a straightforward resistance measurement—first opening up one end of the circuit to remove any voltage effect from charged capacitors which would tend to cause a false reading on the ohmmeter.

A less frequent cause of bottom compression is leakage or change of value of the capacitor in the oscillator discharge network (.03 μfd. in Fig. 3). The two components shown here as .03 μfd. and 15,000 ohms play a very important part in determining both the shape and the amplitude of the waveform going into the 6W6. The purpose of the series combination of resistor and capacitor is to form the familiar sawtooth-plus-spike waveform illustrated in Fig. 5D. Within reason, nonlinearity due to irregularities elsewhere in the circuit can often be corrected by manipulating the values of the resistor and capacitor whilst watching the effect on a test pattern. Replacing the network with a resistor substitution box and a capacitor substitution box in series, and trying various combinations of values while watching the screen, will often make it possible to straighten up a linearity problem in just a couple of minutes. Slight leakage in the capacitor in this circuit sometimes causes the raster to creep up at the bottom as the set gets warmer and warmer in operation.

A slightly leaky coupling capacitor between plate of oscillator and grid of output tube (.1 μfd.) will produce a somewhat similar effect (Fig. 1), due to a positive voltage reaching the grid and causing a decrease in bias. Naturally, when bias is reduced by any means, the output stage conducts more heavily; thus when this fault occurs, the compression at the bottom is usually accompanied by excessive stretching at the top of the raster as shown.

Actual foldover at the bottom will result from an appreciable amount of leakage in the grid coupling capacitor. A more elusive cause of foldover is low "B+" to the output stage. The chain of events here is a little more complex. When the output stage has insufficient "B+," the vertical linearity control has to be cranked up to achieve full sweep at the top of the raster. This reduction of bias, combined with reduction of "B+," makes the output tube work at a nonlinear portion of its characteristic, and a current sawtooth somewhat like that of Fig. 5C results in the yoke. It is useful to bear in mind that, as a last resort, more "B+" can be obtained for the vertical-output stage by drawing it directly from the rectifier, instead of from a filtered point. Fig. 4 illustrates one such case, where take-off may be transferred from point *B* to *A*.

Compression at the Top

In some models, loss of capacity of the filter capacitor (C_f in Fig. 4.) will cause compression at the *top* of the raster (Fig. 2), as also will loss in the

100-μfd. filter at the cathode of the output stage. The importance of the latter capacitor depends on how much resistance is in the circuit when the linearity control has been set up.

The resistor (470 ohms in Fig. 4) in series with the vertical-linearity control is inserted to insure that the stage cannot be adjusted to zero cathode bias. If a short circuit or gas develops in the output tube, excessive conduction for a short time may damage the limiting resistor while leaving the linearity control itself undamaged. If overheating of the resistor has resulted in an increase of its resistance, this will cause compression at the top of the raster.

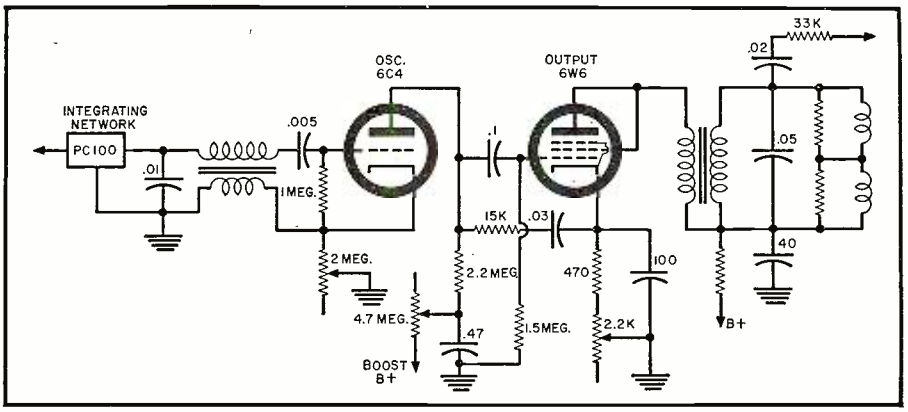

Fig. 3. A typical vertical oscillator and output strip using a blocking oscillator. Controls, from left to right, are hold, height, and linearity.

Change of Oscillator Speed

Apart from tube faults, the most frequent reason for the oscillator frequency becoming incorrect is a change in the value of the grid resistance (shown as 1 megohm in Fig. 3). If this resistor is replaced, select a value which will lock the picture at half-way rotation of the vertical-hold control. A word of caution: do *not* re-establish correct oscillator frequency by replacing the series resistor with a value totally different from that in the original design. If this seems necessary, there is probably another fault at the root of the trouble. The writer recently encountered a case where a technician had made a vertical oscillator work at 60 cps by adding an extra 1-megohm unit in series with the existing resistors. The next day, the set again became uncontrollable. The real trouble was gas in the oscillator tube. Thus when a good tube was plugged in, the extra resistor had to be removed to get back to 60-cps oscillation again.

Slight leakage in the vertical-oscillator grid-coupling capacitor will cause a somewhat similar effect, due to a change of bias resulting in variation of frequency.

Frequency Drift

Drift due to heating is not often caused by resistor trouble in the oscillator grid circuit as, under normal operating conditions, practically no grid current flows. The most likely offender is the grid coupling capacitor, which should be of a zero- or low-coefficient type. In a multivibrator oscillator, the plate-to-grid feedback capacitor is also likely to develop an allergy to warmth and this component too must be replaced with a good stable type, a good quality molded-mica unit for example.

Occasionally, frequency drift is encountered due to poor impregnation of the windings of a vertical blocking transformer.

Completely Wrong Frequency

One fault which never fails to puzzle the technician who meets it for the first time is an open circuit in the oscillator discharge network. At first glance, the trouble seems to be in the horizontal rather than the vertical section. There is a ringing noise from the yoke, the picture is apparently way out of horizontal sync, and straggly white lines appear on a black strip at the top of the picture.

An examination of Fig. 3 will show that the discharge circuit is effectively in parallel with the oscillator plate-load resistor, as far as plate-load im-

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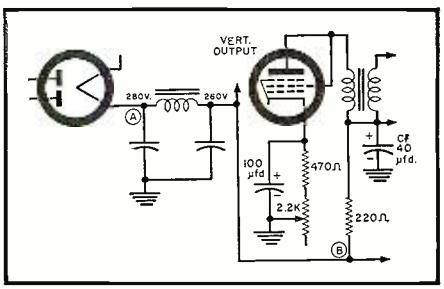


Fig. 4. If higher plate voltage is needed to obtain linear output from the vertical-output stage, "B+" may be taken from the input of the d.c. filter.

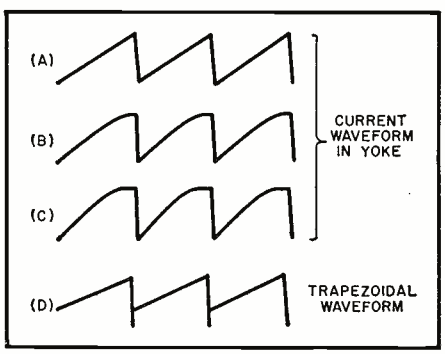


Fig. 5. Normal (A) and abnormal (B, C) current waveforms measured in the yoke. Oscillator output (D) voltage waveform.

Fig. 6. Appearance of normal vertical-sync pulse in the blanking bar. Contrast is reduced to make pulse visible.

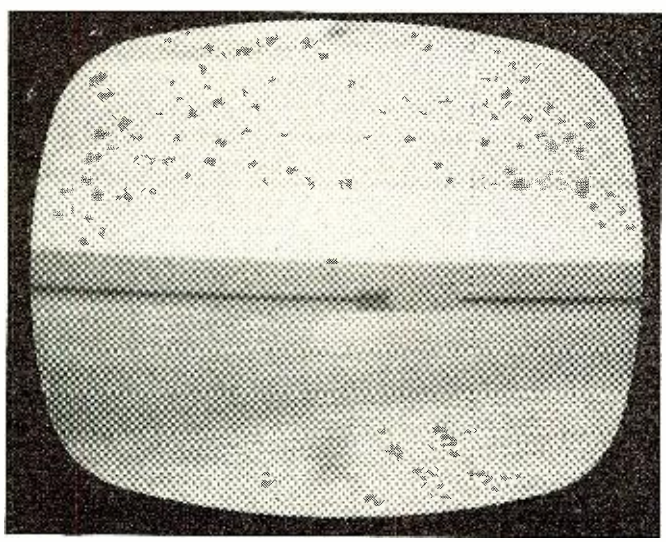
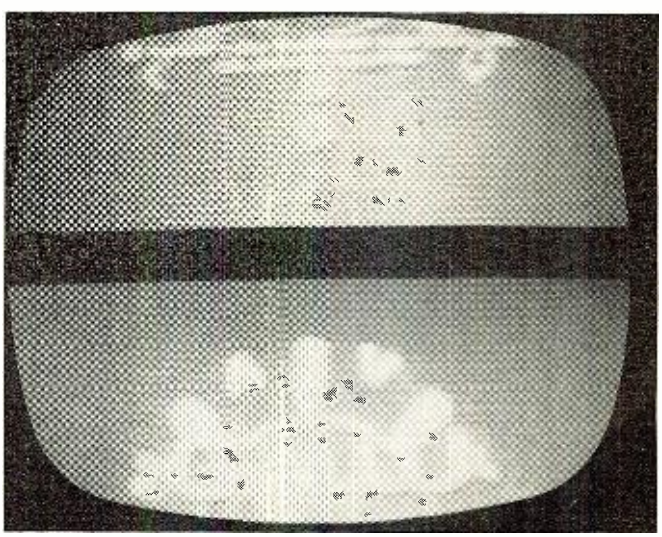


Fig. 7. When contrast and brightness are in proper adjustment, both pulse and blanking bar should be equally black.



Missile Master Air Defense System

The first fully operational electronic system operated by Army at Ft. Meade.

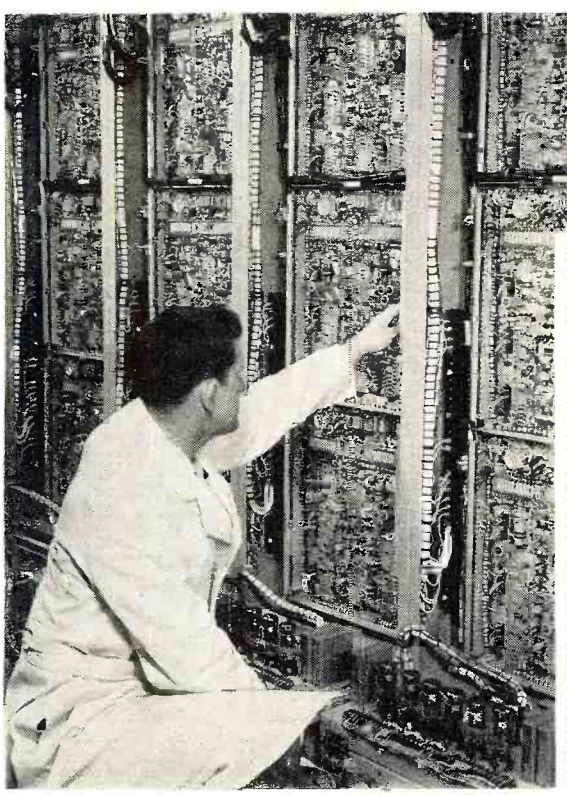
Here is a view of some of the radar tracking equipment used. The system was developed by the U.S. Army Signal Engineering Laboratories at Fort Monmouth, N. J. in conjunction with The Martin Co. of Orlando, Florida. Principal subcontractors were the Airborne Instruments Laboratory of Mineola, Long Island, N. Y., and the American Machine and Foundry Company, located in New York, N. Y.

MISSILE MASTER, the first fully operational electronic air defense control system in the U. S., was put into operation recently by the Army Air Defense Command.

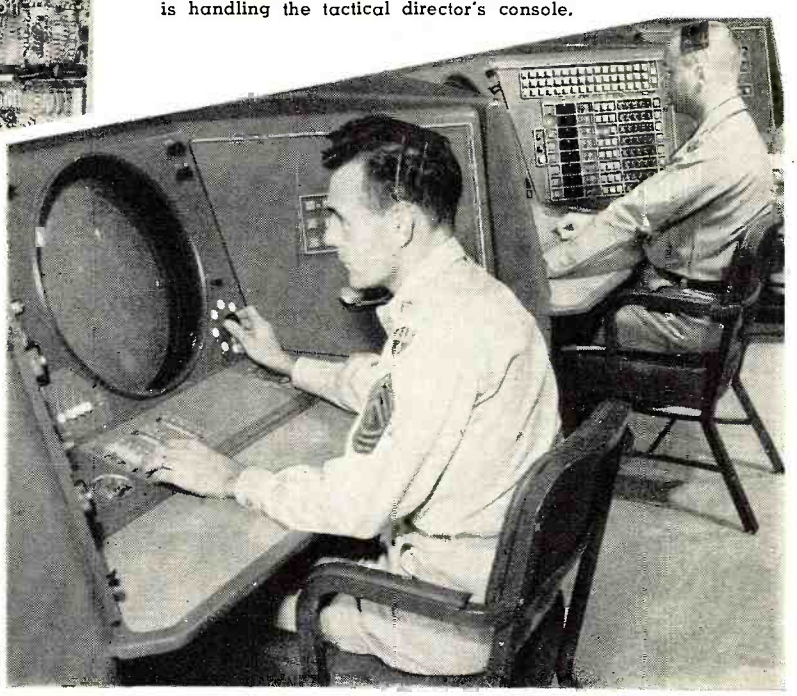
Located at Fort Meade, Maryland, Missile Master will help defend the Washington-Baltimore government-industry complex against air attack. It is an electronic system which controls and coordinates the fire of the Army's air defense weapons to insure their maximum effectiveness. Targets can be selected economically, with the control of each Nike missile being retained by local battery commanders. In this way, preselected targets in an attacking air fleet are assigned for destruction by Missile Master to individual batteries of a Nike network.

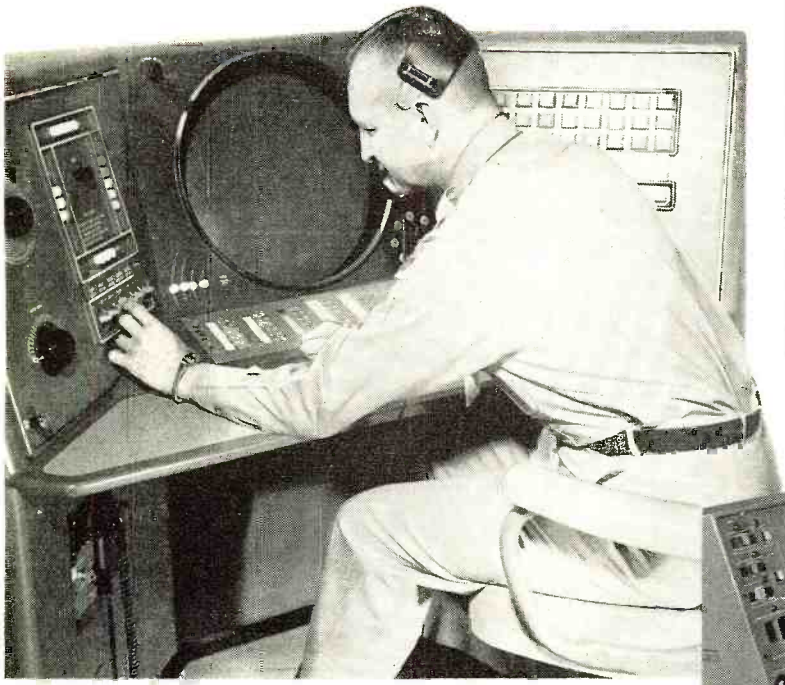
The Army said that the next Missile Master systems to become operational will be for the New York City defense area and other strategic, industrial, and high population centers throughout the nation. —30—

A few of the racks of electronic gear needed to operate the Missile Master system. Each one of the racks has its own power regulator, telephone jack, and line outlet.



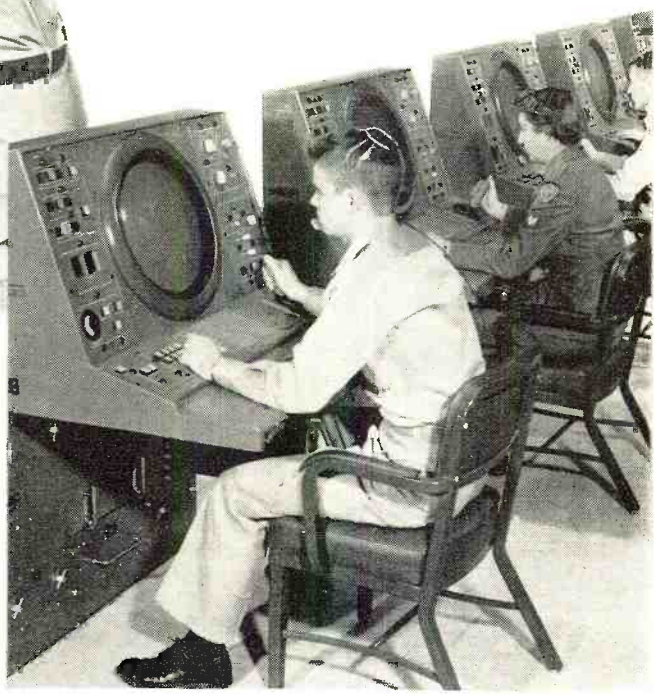
"Friendly protector" console is in foreground. Operator's task is to insure that known friendly aircraft are not fired on by our batteries. Operator in background is handling the tactical director's console.

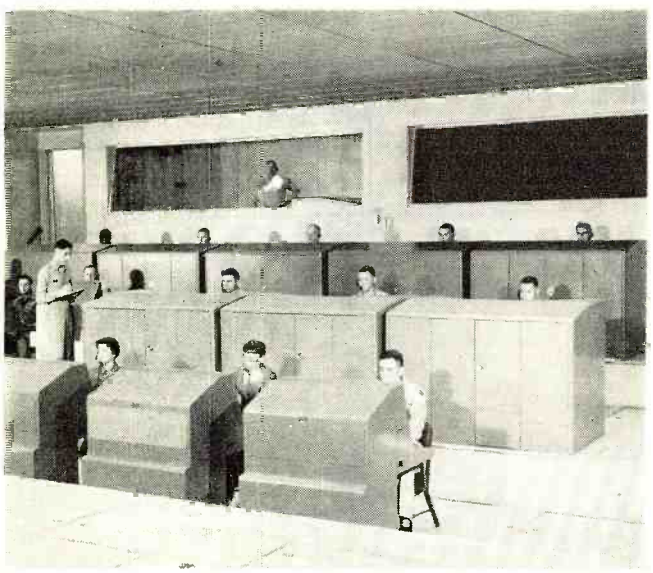




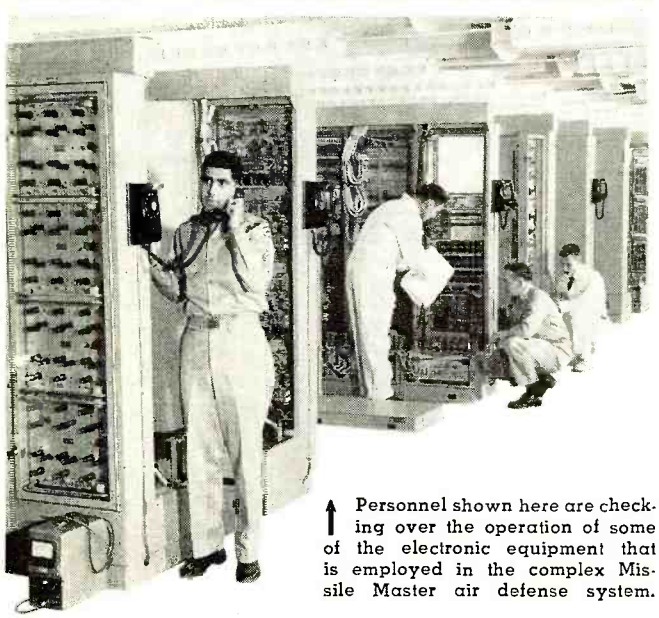
← Col. Jukas Hoska, Executive Officer of the 35th Antiaircraft Artillery Brigade, monitors the defense action from the defense commander's tactical console at the Ft. Meade Missile Master installation. The defense commander coordinates the related activities at the Antiaircraft Operation Center with adjacent AAOC's and the Air Force's Air Defense Direction Center in order to insure optimum use of the missile batteries which are at his disposal.

↓ Manning the tracking consoles which are used to monitor early warning information received by the Missile Master system at Fort George G. Meade, Maryland, are personnel of the 35th Antiaircraft Artillery Brigade. The over-all system concept originated at the U. S. Army Signal Engineering Laboratories, Fort Monmouth, New Jersey. Experience with a test system installed in 1954 enabled the development of a production system for operational use in relatively short time.



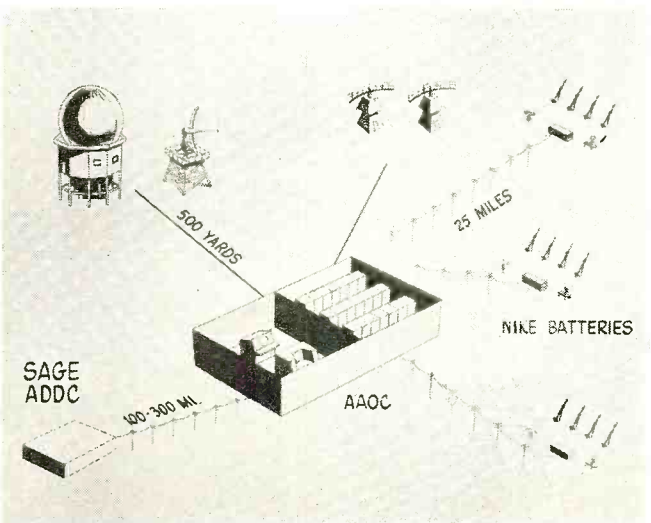


← The Antiaircraft Operations Center (AAOC) of the installation is shown manned by personnel here. In the foreground enlisted personnel are seated at tracking consoles monitoring early warning information. Gun teller consoles, surveillance and entry consoles, and range-height indicator console operators are in the second row. The third row has a "friendly protector" console, three tactical monitor consoles, and a tactical director's console. The defense commander's room may be seen at the top rear.

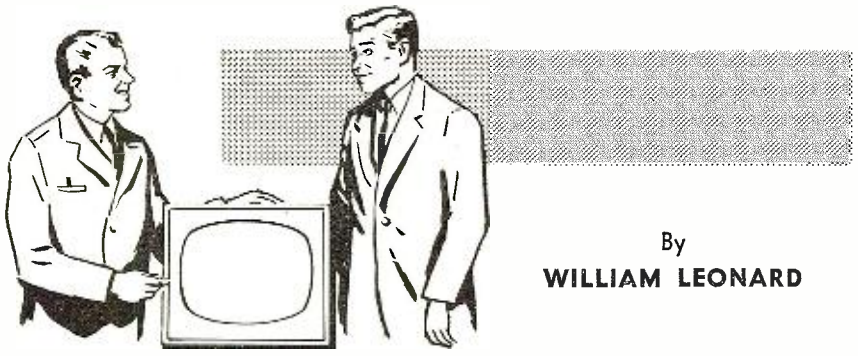


↑ Personnel shown here are checking over the operation of some of the electronic equipment that is employed in the complex Missile Master air defense system.

↓ Major elements of the Missile Master. System can also be coordinated with Air Force SAGE aircraft control.



SERVICE SALESMANSHIP



By
WILLIAM LEONARD

The need for improved public acceptance makes it perilous to rely on technical performance alone.

A WHALE of a lot of copy has been written about the dire need for better public and customer relations for the independent service industry. With the threat of expanding factory and distributor service hovering constantly over the service activity, a higher level of respect and confidence on the part of the set owner is sorely needed by TV service dealers.

A continuation of the unfavorable reputation the independent service industry has acquired can easily force set manufacturers to provide consumer service on their products—even though they would prefer *not* to be involved in retail product service. The public's confidence in brand-name service will impel them to pay higher prices for manufacturer-managed service if it is promoted, even though equal or better service is available from competent but relatively unknown local independent service shops.

Many people feel that a broad, national public-relations program is needed to create confidence in the independent service industry. They feel that, if the public is "educated" in the complexities of TV service through magazine, newspaper, radio and TV advertising, it will automatically raise the prestige of independent service shops.

While service is a commodity that must be merchandised and sold like a tangible product, the personal element that involves the technician who does the work presents a specialized selling problem to service management. Service is an intangible commodity. It is impossible for a lay person to measure its merit or value. Consequently, a set owner's reaction to and respect for the quality of the work done on his set will hinge on his opinion of the technician who did the work.

While the idea that independent service shops are competent, honest, and trustworthy can be promoted through national and regional advertising, the success of any such campaign would be determined by what individual customers think of individual technicians. In short, service will always be a man-to-man relationship, with the customers' opinions based solely on their reactions to the technicians who handle the service on their TV sets.

This highly individual nature of consumer acceptance of both service charges and technical competence makes it advisable for the service industry to start its public relations activities at the grass roots of the industry. The grass roots of the service industry are the field service technicians —the men who *are* the independent service industry in the eyes of the public. Set-owner respect for the independent service industry would rise rapidly if every field-service technician would study and apply the simple fundamentals of good salesmanship in all his contacts with set owners.

What are those principles as they would apply to service selling?

The first principle of good salesmanship is the studied use of *showmanship*. This application of the word showmanship does not mean that a technician should put on a three-ring circus act for his customers. It refers especially to his personal appearance; his bearing; the exterior and interior appearance of his tube caddy; the respect he shows for the customer's property by using drop cloths to protect rugs and furniture; his ability and willingness to explain circuit failures in simple terms and to offer helpful advice on how to get the best pictures and service from a set. All of these factors enter into the application of showmanship to TV service in the home.

Consider first the matter of personal appearance. If you managed a retail store and dumped a quality product on the counter without displaying it in a fancy package, your customers would buy it only if you offered it at a bargain price. Dress this same product up in a striking package, present it in an attractive display, and it will sell at a premium price.

The same selling psychology applies to personal service. A neatly dressed, clean-shaven technician inspires confidence in the customer. She is inclined to feel that he is a competent, trustworthy individual. If he carries a well-kept tube caddy, it creates the impression that he is efficient.

Family life now revolves around the TV set. Regardless of its make, the owner is proud of it. All of the furnishings in the room where it is located were carefully selected by the housewife. The chances are, it took some financial sacrifice to buy them. She is proud of them and is inwardly pleased when a technician shows respect for them by protecting them from possible damage. When a technician puts his tube caddy and everything he works with on a drop cloth, he is using the finest kind of service showmanship.

The job is completed and the set is back in operation. The bill is presented to the customer. A good salesman would buffer the normal feeling of antipathy toward having to pay for service by offering some advice on the care of the set at the time he presents the service ticket for payment. Quite often a compliment about the TV set or some piece of furnishing in the room, made at the time the service bill is presented, will serve to cushion a customer's resentment against needing service and then having to pay for it.

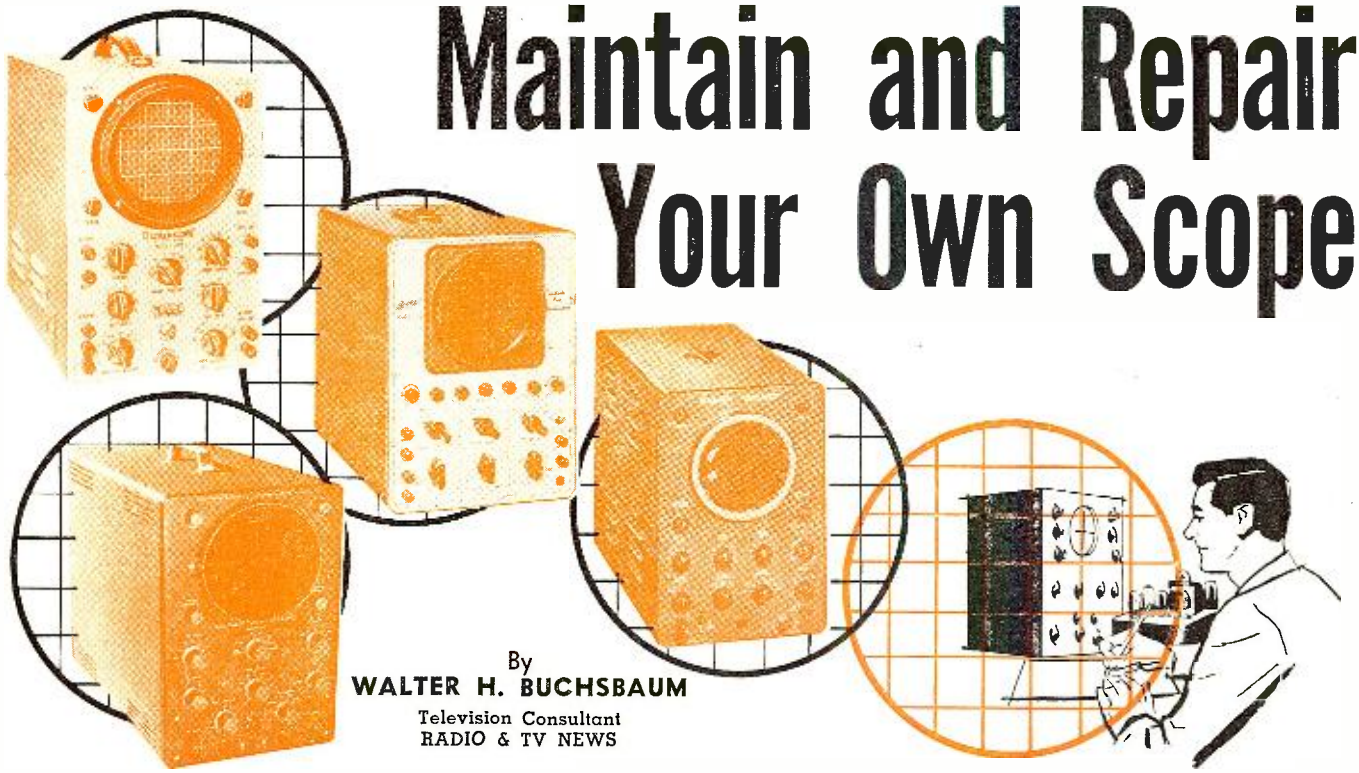
The second factor that is very important in effective salesmanship is to have a thorough knowledge of your product. This is also true of service salesmanship, with the added requirement that the technician should be able to explain TV circuit operation and breakdowns in simple language that the average person can understand. Even the simplest electronic and electrical terms are confusing to many people. Recently an elderly lady took her small radio to a shop to find out why it quit working. "It has a short circuit," the technician told her. "How much will it cost to lengthen it?" she replied.

A third factor that is involved in good salesmanship is one that every electronic service technician should try to cultivate. That factor is a sincere interest in and liking for people. In the early days of radio, dealers spent more time "servicing the imaginations" of their customers than they did in repairing sets.

Some of the most successful TV service dealers today built their businesses on their sincere interest in people. As one dealer put it, "If a TV technician really likes people and enjoys dealing with the general public, he will find service work both pleasant and profitable. If he likes people, he will find something interesting and likeable about every customer he calls on. When people feel you are really interested in them, they just naturally like you and consider you tops as a TV serviceman."

Showmanship, knowledge and a liking for people: those are the three key factors in effective service salesmanship. All of the necessary tools are available to do these things successfully. All a man needs to do is to get them and use them. —30—

Maintain and Repair Your Own Scope



By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TV NEWS

Don't suffer the loss of this important instrument when it is "out." There are many things you can do to keep it in shape or handle specific defects.

TODAY it is almost impossible to imagine a TV repair shop which does not have at least one oscilloscope. Many alignment and trouble-shooting procedures require the use of the scope and, for any bench trouble-shooting, it is a vital tool. There is a large variety of oscilloscopes on the market both in kit and wired form and many manufacturers offer different applications. Oscilloscopes range from the basic, small-screen, narrow-band models to large-screen models having such special features as variable display time, black writing, millimicrosecond sweeps, and bandwidths up to 100 mc. Prices range from less than $100—for a simple kit—to over $5000 for a laboratory instrument with special features. Irrespective of price, however, all scopes have one problem in common. When they are not in working order, they are worthless. The $5000 dolly-mounted, precision laboratory unit is just as much of a liability when it keeps blowing its fuses as the amateur experimenter's $50 model.

This article deals with the various troubles which are likely to occur in oscilloscopes and with the problems of calibrating and maintaining the type of scope usually found in radio and TV service shops, but the principles discussed here apply to scopes in general.

Basic Scope Circuitry

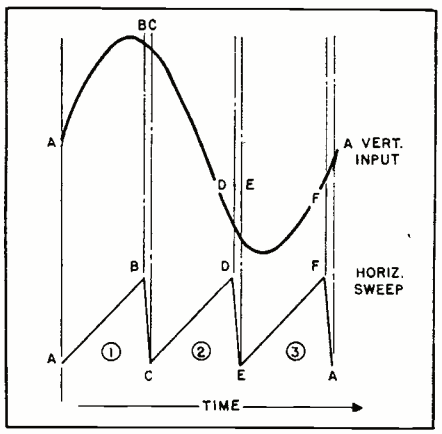
Some scopes contain built-in calibrators, special time-base generators, r.f. demodulators and features which, although useful for some applications, are not really a part of the scope function. The basic operation of the instrument is to trace out a line across the horizontal axis of the screen while the displayed signal is simultaneously moving the beam vertically. In this manner the waveform of the signal becomes visible. It is important to remember that, in most applications, the horizontal axis represents time and vertical axis voltage.

To display the signal "standing still," the horizontal motion must be in synchronism with the repetition rate of the signal. If the horizontal sweep is slower than the repetition rate, the displayed signal will appear several times. If the displayed signal is, for example, the 15-kc. horizontal-deflection signal from a TV receiver, the scope sweep would have to be at a 7.5-kc. rate to display *two* saw-tooth waves. When the scope sweep is faster than the displayed signal, then the signal will appear cut into strips and superimposed as in Fig. 1. The original sine-wave input signal is shown at the top of Fig. 1A. Underneath it are the 3 cycles of horizontal deflection that break the sine wave into the sections shown in Fig. 1B.

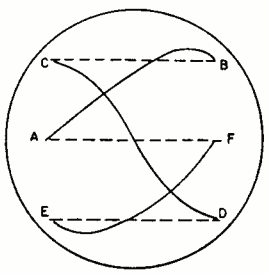
The basic elements of the scope are the cathode-ray tube, the vertical amplifier, and the horizontal-sweep section. Actually, as can be seen from Fig. 2, there are a few refinements which are necessary to make the scope versatile enough to display weak signals and to operate over a wide range of sweep frequencies and synchronizing levels. While representative, Fig. 2 is specifically based on the *Heath* O-11.

The attenuator in series with the vertical input acts together with the gain control to regulate the signal level at the vertical amplifiers so that vertical deflection on the scope does not exceed the height of the screen. The horizontal-sweep signal is generated by either a gas-tube type relaxation oscillator or by a multivibrator. This generator is synchronized by a portion of the vertical signal, if desired, or else it can be synchronized from some external source or the 60-cps line frequency. The sweep-oscillator frequency is adjustable by means of a range switch and a fine-frequency control and its output is applied to the horizontal-sweep amplifiers. In some applications, it is desired to supply the sweep signal externally through a selector switch, which permits using either the internal sweep-generator circuit, or some external signal, or, in some TV scopes, the internal 60-cps sine-wave signal can be used directly. This latter connection is for use with a TV alignment sweep generator. To avoid displaying the return trace of the beam, a blanking signal is applied to the control grid of the CRT during the retrace period. This signal is usually derived directly from the sweep generator circuit and consists of the shorter portion of the saw-tooth wave.

In addition to these circuits, the CRT must also get its filament and d.c. operating voltages, for which a conventional power supply is used. In scopes, the deflection plates and second anode are kept at a relatively low d.c. potential, while the cathode is



(A)



(B)

Fig. 1. When scope sweep is adjusted to be faster than the signal to be displayed (A), that signal will be shown "cut into strips" (B) by the sweep.

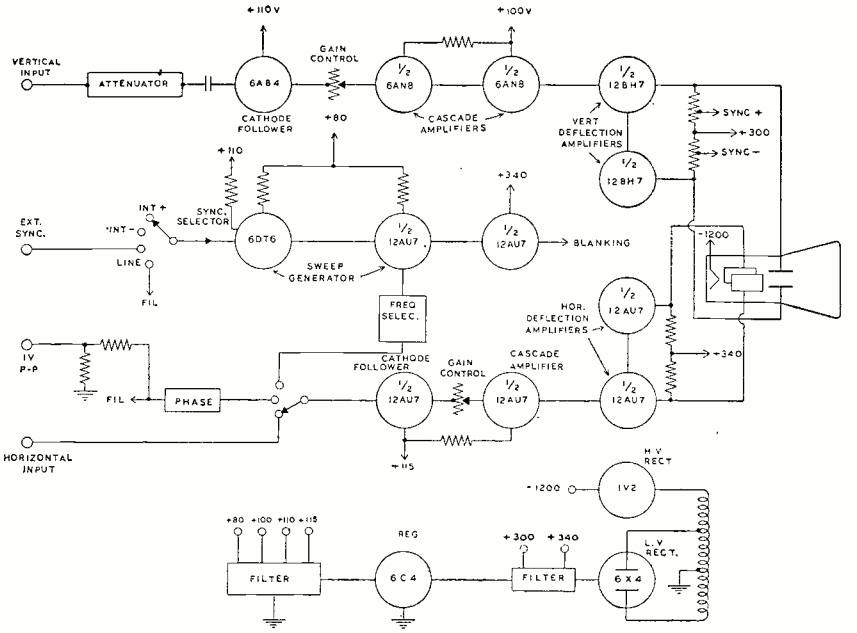


Fig. 2. This functional block diagram, although it is based specifically on the Heath Model O-11, is typical of modern, wide-band, service scopes.

operated at about 1200 to 1500 volts negative. This means that the CRT filaments are supplied from a separate winding and are usually tied to the cathode.

Troubleshooting

From the description of the basic functions of the scope, it will be apparent that, except for the power supply, we are dealing with pulse circuits in both the vertical and horizontal sections. In fact, these sections are very similar in operation to the video amplifiers found in TV receivers and the vertical and horizontal deflection systems. To trace defects through these circuits, another oscilloscope might be necessary. Many defects can be located by voltage and ohmmeter tests, but some troubles can only be verified with another scope and this can be a real problem in a small service shop. In a later paragraph a method is shown using a TV set to check some scope troubles—an interesting reversal of the usual relationship!

Table 1 (page 60) lists common defects which may beset a scope and the probable trouble for each symptom is arranged in the order of likelihood as well as simplicity of checking. For example, in the case of "no vertical deflection," the simplest check is to measure the input cable and terminal for short circuits. Only if this checks is it necessary to remove the instrument from its cabinet, and then the next step is possible tube failure.

The operation of the low-voltage power supply can easily be checked with the voltohmmeter, as can the continuity of the vertical-attenuator switch. Only if some particular component in the vertical-amplifier circuit is defective may it be more efficient to use another scope to locate it. Even for this troubleshooting procedure, it is possible to use a known input signal, such as one from an audio generator, and trace it through the amplifier with an earphone or signal tracer.

In the case of Items 7, 11, or 12 of Table 1, signal tracing will not be very effective, although it is theoretically feasible to locate bandwidth or sync troubles by injecting a signal of known frequency and amplitude and following it. Bandwidth problems can often be pinpointed by ohmmeter measurements of the components in the frequency compensating networks.

Fig. 5 shows the vertical-output amplifiers of the *Hycon* Model 617 and this circuit is typical of many TV service scopes now on the market. Two 6CL6 pentodes are connected in a cathode-coupled push-pull circuit having both low- and high-frequency compensation in the plate leads. Low-frequency compensation is provided by R_{48} and C_{33-A} at one plate and R_{53} and C_{33-B} at the other. These networks present additional plate load at very low frequencies, and thus compensate for low-frequency losses due to the increased impedance of the grid coupling capacitor. High-frequency peaking is provided by two sets of series and parallel video peaking coils similar to those found in the video stages of most TV receivers. Note that the deflection plates of the CRT are directly connected to the plate circuit. Thus, the d.c. potential of the two plates with respect to each other determines the centering of the electron beam on the screen. The vertical-centering potentiometer controls the relative d.c. bias on the two tubes and, therefore, regulates the relative d.c. voltage at the deflection plates.

If defects occur in the frequency-compensating networks, or some other portion of the vertical channel which seriously affect the over-all bandpass characteristic, this will become apparent in the waveforms displayed on the screen. Fig. 3 illustrates the appearance of various types of bandwidth defects when a square-wave signal is viewed. Of course, it is essential that we know the waveshape of the test signal. This can be checked with another scope, connected directly in parallel with the suspected unit. Sometimes the input impedance of a scope can ruin a waveshape. Using a high-impedance probe may help, provided that this probe is itself properly compensated. In judging bandpass troubles we must remember that the waveform of Fig. 3D can be due to a small, external series capacitance while the one of Fig. 3C can be caused by excessive shunt capacitance.

It is possible to use a good TV receiver to check for correct bandwidth in the vertical or horizontal scope amplifiers, if a source of pulses or square waves is available. First, check the scope manufacturer's data for the bandwidth specified. Assuming that it is 5 mc. within ±3 db, we should be able to see square waves with a rise time up to .2 microsecond, which is shorter than most generators found in service shops can produce. If a 100-kc.

square wave is used, the slope of the vertical line should be less than 4% of the width between vertical lines (which is half a cycle of the 100-kc. square wave). This time between vertical lines is 5 microseconds. To see if the output of the square-wave generator really is that sharp, connect it to the grid of the last video-amplifier stage of a good TV receiver and adjust generator frequency until vertical bars appear on the screen. These bars should stand out sharply, and the width of black sections and white sections should be equal to each other.

If the TV set is locked to 15,750-cps horizontal sweep and 7 bars appear, the square-wave generator is actually operating at a shade above 110 kc. A more accurate bandpass check can be made on the scope with either a signal generator which goes up to 5 mc. and a v.t.v.m. or else with a video sweep-frequency generator, such as is used for TV alignment work, and another scope. The vertical or horizontal amplifier sections of the scope are treated just as the video section would be in a TV set. The bandwidth of the horizontal section is usually considerably less than the vertical.

Another defect which occurs occasionally and is not too easily located is horizontal nonlinearity. When sawtooth signals or pulses are observed, this defect may not become apparent but may instead give the impression that the signal is distorted. To check for correct horizontal linearity on all sweep ranges, sine-wave signals are displayed, usually furnished by an audio signal generator. If the frequencies are known fairly accurately, these sine-wave signals can also be used to calibrate or check the range switch and vernier control settings. In Fig. 4, a typical display of this type is shown together with some commonly available frequencies and their meaning in terms of sweep time on the scope.

First, adjust the vertical gain until the signal fills the two large center boxes of the screen's calibrated overlay grid, as shown. Then set the sync-selector switch to its "internal" position. Adjust the range and vernier controls to obtain an image like the one shown in Fig. 4. In order to space the signal evenly across the vertical grid lines, it may be necessary to adjust the horizontal-gain control also. Note that the horizontal spacing of each cycle should be measured from each zero or center point to the next, rather than from one sine-wave peak to the next. Since the peaks tend to be broad, accuracy would be difficult. If a square-wave generator is available, it may be easier to use this type of signal for the test instead of the sine-wave signal. In the case of the square-wave signal, the distance is measured from one vertical line of the waveform to the next, or the portion of each horizontal portion of the waveform is measured.

If neither a suitable sine-wave nor square-wave generator is at hand, the vertical and horizontal sync pulses from a TV receiver can be used for some tests. To use these sync pulses, connect the scope input to the output of the first sync clipper in the TV receiver, or else to the output of the video amplifier directly. The only frequencies available in this way are 60-cps and 15,750-cps. However, other frequencies can be checked by counting multiples on the scope display.

Even relatively expensive scopes will not produce a sweep which is perfectly linear over the entire screen; some compression must usually be accepted at the edges. It is good to know, however, *just how far from the center* the sweep is linear, so that future waveform measurements can be made accordingly.

Horizontal nonlinearity will become apparent in that the sine waves will appear either compressed or expanded at the point of trouble. Such a symptom can sometimes be due to a gassy tube, a leaky capacitor, or some other "near-defect." Signal tracing with a second scope through the horizontal-sweep section will reveal the point at which the saw-tooth voltage becomes nonlinear. Usually, careful voltage checks will reveal the defective part, even without a second scope. Using a TV set is not very helpful here, although it is possible to use the vertical or horizontal sweep signal from the TV set to drive the horizontal amplifiers of the scope.

Probably the most bothersome defect in scopes is the lack of proper synchronization. Usually this is apparent first on internal locking. If no sync can be obtained in either internal, external, or line positions, then the sync tube is the most likely trouble spot. If sync is difficult or intermittent only on certain internal signals, then the trouble may be really hard to find. First, be sure that the amplitude of the vertical signal is sufficient and that it is not accompanied by noise spikes of equal height. In checking TV sync troubles, it occasionally happens that, in a noisy location, the noise pulses are as great as or greater than the desired sync pulses. While the TV set may have a noise-suppression circuit which permits its horizontal oscillator to sync correctly in such circumstances, the scope will tend to lock in on noise pulses, with the result that jitter and unstable sync appears. This does *not* usually mean that the scope is defective. If loss of sync occurs only on certain ranges of the scope sweep generator, then that circuit is at fault. If poor locking occurs on all internal sweep frequencies, the network coupling the vertical signal to the sweep generator or the sync selector switch and its wiring should be suspected.

In addition to the 13 symptoms listed in Table 1, there are some marginal-performance possibilities which can be determined by the methods already listed for the circuit involved. If, for example, the focus control does

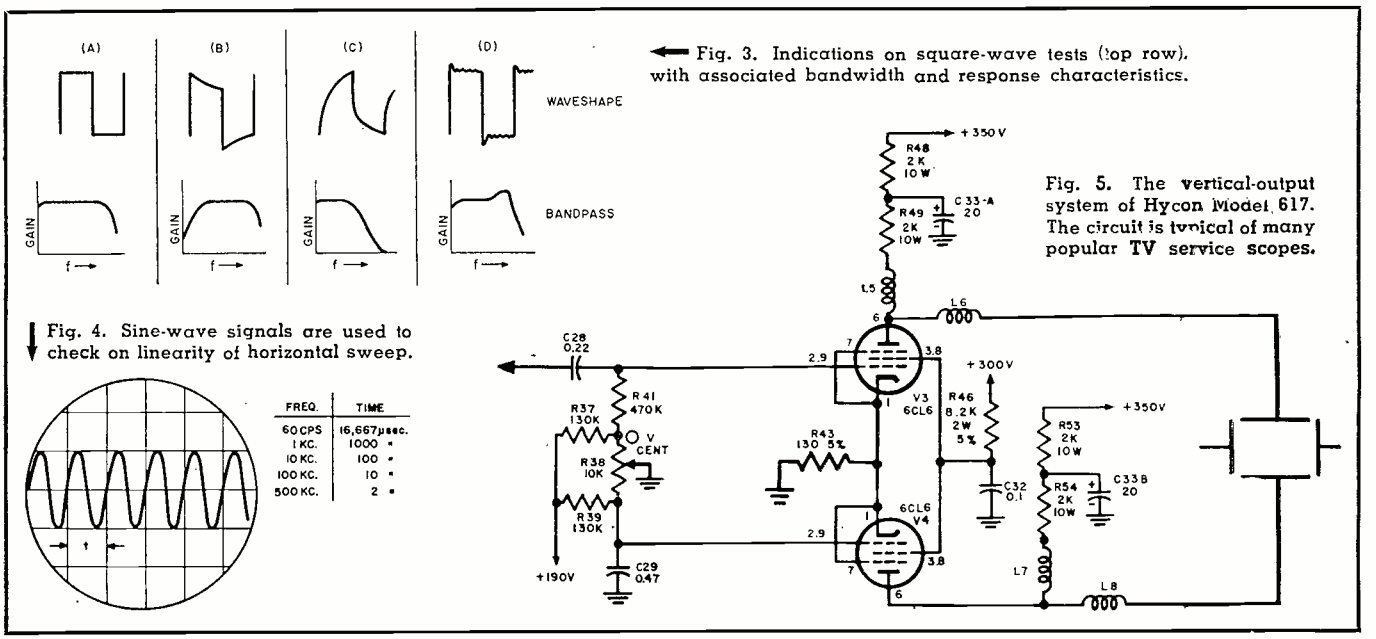


Fig. 3. Indications on square-wave tests (top row), with associated bandwidth and response characteristics.

Fig. 5. The vertical-output system of Hycon Model 617. The circuit is typical of many popular TV service scopes.

Fig. 4. Sine-wave signals are used to check on linearity of horizontal sweep.

FREQ.	TIME
60 CPS	16,667 μsec.
1 KC.	1000 "
10 KC.	100 "
100 KC.	10 "
500 KC.	2 "

not provide quite the sharpest focus, the steps listed under Symptom 3 are indicated. Similarly if the vertical deflection is insufficient, the steps under 6 are suggested. In this connection, it is important to know just what kind of sensitivity, frequency response, sweep frequency, and other characteristics a particular instrument is supposed to have. There may be no point, for example, in troubleshooting a scope because it fails to display the output of a color sync circuit. That signal is a 3.58-mc. sine wave and, if the scope has a bandwidth of 500 kc. and a horizontal-sweep rate of 100 kc., it cannot display such a signal.

Maintenance

Since a scope has few parts, maintenance is largely confined to replacing weak or gassy tubes. Some scopes use long shafts going from a point at the rear of the chassis to the front panel through shaft bearings. An occasional drop of oil is indicated, unless self-lubricating bearing are used. The frequency range switch and any other rotary switches in the scope should be cleaned with some contact cleaner and lubricated at least once a year. Cleaning of the scope screen behind the plastic grid, as well as the plastic grid itself, should be performed at regular intervals. Other points to check in any maintenance procedure are the various terminals, especially the vertical-input connections and its cables. Binding-post type terminals have a tendency to become loose and coaxial terminals often become worn and partly shorted by dirt.

Needless to say, particularly when the scope is moved around much, the line cord should be replaced before it gets completely frayed.

Table 1. Troubleshooting chart lists usual scope defects with their causes.

SYMPTOM	PROBABLE TROUBLE
1. Pilot doesn't light	Pilot light bulb defective A.C. power cable and plug Fuse Switch and wires Power transformer
2. No spot on CRT	Horizontal or vertical position control misadjusted High-voltage supply defective CRT filament open CRT socket loose Vertical amplifier plate resistor open Horizontal amplifier plate resistor open
3. No focus or intensity control action	CRT socket loose or defective High-voltage bleeder open Focus control defective Intensity control open CRT defective
4. No vertical positioning	Vertical amplifier tubes Vertical positioning control defective Low-voltage power supply Leads to deflection plates open Vertical amplifier circuitry defective
5. No horizontal positioning	Horizontal amplifier tubes Horizontal positioning control defective Low-voltage power supply Leads to deflection plates open Horizontal amplifier circuitry defective
6. No vertical deflection	Input cable and connector open or shorted Vertical amplifier tubes Low-voltage power supply Vertical attenuator switch open Vertical gain control defective Vertical amplifier circuitry defective
7. Poor vertical frequency response	Frequency compensating networks defective Coupling capacitors leaky Vertical amplifier tubes High-impedance probe defective
8. No horizontal sweep on some ranges	Range switch defective Capacitors on range switch shorted Horizontal sweep generator tubes
9. No horizontal sweep on any range	Horizontal sweep generator tubes Horizontal amplifier tubes Horizontal gain control defective Sync selector switch and wiring defective Low-voltage supply Horizontal sweep circuitry defective Horizontal amplifier circuitry defective
10. Horizontal sweep too narrow or non-linear	Horizontal amplifier tubes Horizontal amplifier circuitry defective Low-voltage supply Horizontal sweep generator circuitry defective Horizontal amplifier frequency compensation circuit
11. No sync on internal sync or 60 cps	Sync selector switch and wiring defective Sync amplitude control open or shorted Range switch defective Horizontal sweep generator tubes Sync injection circuit defective Low-voltage power supply
12. No sync on external sync	External sync terminal and wiring open or shorted Sync amplitude control defective External sync pulse shape or amplitude wrong
13. No retrace blanking	Blanking amplifier tube Blanking coupling circuit defective CRT socket loose

Calibration

Calibration of a scope for the most important characteristics requires a knowledge of the manufacturer's specifications as concerns frequency response of the vertical and horizontal sections, sensitivity, sweep frequencies, and sweep linearity. Frequency response of the vertical amplifier can be checked by displaying a sine-wave signal of the highest frequency within the flat portion of the bandpass and using it to check sensitivity. The horizontal amplifier can be checked in the same manner except that, in this case, the length of the horizontal line serves as indication of the gain. In calibrating the *RCA* type WO-91A, for example, the bandwidth in the wide-band position is given as 4.5 mc. ±1 db, and the sensitivity of the vertical amplifier as .15 volt peak-to-peak per inch. This means a 4.5-mc. signal of .053 volt r.m.s. should be 1 inch high.

To measure the input, it is only necessary to use a 4.5-mc. signal generator, connect a diode probe to it, and read the voltage at the voltmeter. If a voltage divider of two 100,000-ohm resistors is connected across the generator output, and the signal to the scope is taken off across one half of this divider, the meter diode probe can be connected across the other half of the divider, and the generator output is set so that the meter reads .15 volt d.c. The diode probe is a peak detector, meaning that the peak-to-peak signal at the generator output will be .3 volt, with the scope getting half.

In a similar manner we can calibrate the horizontal sensitivity and bandwidth. A method for checking sweep frequencies was given in an earlier paragraph, as was a method for checking the linearity of the horizontal scope sweep. Assuming that these checks show a need for adjustment, it may be necessary to remove the cover or else reach into the various adjustment points with a long alignment tool. Few scopes have any adjustment for high-frequency compensating networks, but some do have potentiometers for varying low-frequency response. When the sensitivity is substantially less than specified, aging of tubes is the most common reason. In some scopes, internal gain-adjustment potentiometers are provided to balance out the push-pull output stage. Almost all scopes have some adjustment for horizontal sweep linearity and this control should be set while a display like the one shown in Fig. 4 is observed. Perfect linearity is unlikely, but sweep should be uniform over at least 75% of its width.

Calibration of sweep frequency is usually accomplished by adjusting trimmer capacitors located in the sweep-generator stage. If really exact frequency calibration is desired, an accurate signal generator must be used against which the horizontal sweep is compared. —30—

RC Filter Tone Controls

By **H. ALAN SCHWAN**

Practical design information and examples of tone control circuits for the audiophile who builds his own equipment.

THE audiophile who builds his own equipment is inevitably faced with the problems of manual frequency response adjustment. Since the basement audio engineer rarely likes or feels at home with other people's tone control designs, outlining a simple control design procedure may be of interest.

It is generally agreed that a successful tone control must affect only the areas and quantities for which it is intended; *i.e.,* a treble control must have no noticeable effect on the low frequencies or on the apparent volume level. Further, the use of inductances in tone control circuits is pretty well precluded by their expense and susceptibility to hum. Hence, *RC* filters will be considered exclusively. Finally, it is desirable to be able to design one extreme of a given control independent of the other extreme, that is, the characteristic of the tone control at one extreme setting should be determined by the circuit at that particular end and should not be affected by the circuit at the other end.

With these considerations in mind the author has developed a simple design procedure for a generalized *RC* tone control based on the fundamental circuit of Fig. 2. This circuit was chosen because it allows accurate, independent design of the two end positions while offering smooth continuous control.

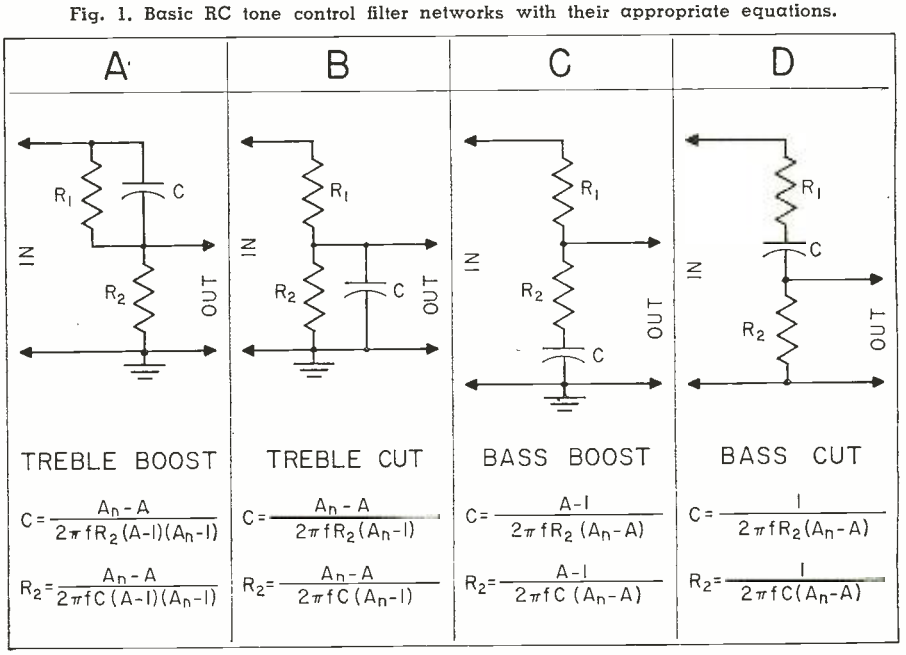
For frequency response correction in audio amplifiers, four basic types of tone control settings will satisfy virtually all of the practical requirements. These settings are: treble boost, treble cut, bass boost, and bass cut. Two independent controls and four filters are required to allow practical combinations of these settings.

RC filters, whether boost or cut types, must necessarily be attenuators. A filter which gives an apparent boost characteristic in its active area does so by reducing the amount of attenuation in that area. The maximum amount of boost available is equal to the nominal insertion loss of the filter. Thus, a treble boost filter must be designed so as to reduce the insertion loss of the filter at the higher frequencies. However, if the filter is to have no effect on the low frequencies, it must not begin its reduction of attenuation until some minimum frequency is reached. Similar criteria apply to the bass boost filter.

Treble Boost Filter: The basic treble boost filter is shown in Fig. 1A. As the source frequency is increased from zero, no significant change in output level is noticed until the reactance of the capacitor starts to decrease toward the value of R_1. At such a frequency the capacitor begins the effective bypassing of R_1, and the impedance in series with the source and the load (R_2) starts to decrease. As the input frequency increases further, the output voltage rises toward the input voltage until a frequency is reached where the capacitor's reactance is small compared with the resistance of R_2. At this point, the capacitor is a virtual short circuit and the output is effectively connected directly to the input. Here, the attenuation has dropped to a negligible value and a treble boost has taken place.

The designer of such a filter is interested in the rate of boost, the maximum amount of boost available, and the point where significant boosting starts. The rate of boost in an *RC* filter is fixed by the fundamental nature of *RC* circuits at some value

Fig. 1. Basic RC tone control filter networks with their appropriate equations.



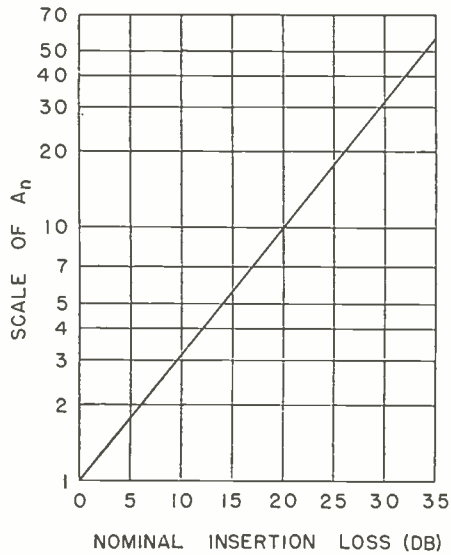


Table 1. Relation between nominal insertion ratio, A_n, and nominal insertion loss. Maximum boost desired is projected vertically to line, then horizontally to the vertical scale. This value of A_n is used in the equations.

less than six decibels per octave. However, the complete tone control circuit allows manual adjustment of the boost rate. The maximum amount of boost is equal to the nominal insertion loss of the filter where the nominal insertion loss is:

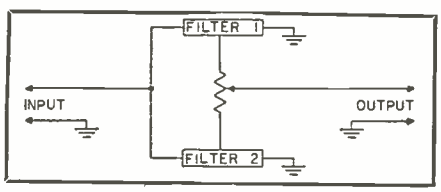
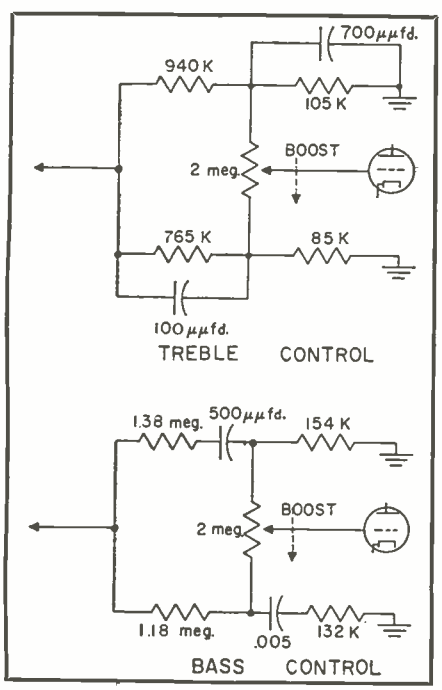


Fig. 2. Movement of pot wiper toward filter 2 causes the input-output relation to be modified more by filter 2 and less by filter 1. This is the basic tone control scheme.

Fig. 3. Treble and bass controls. Bass turnover is 500 cps, treble turnover is 1000 cps, and nominal insertion loss is 20 db.



$$\text{decibel loss} = 20 \log \frac{R_1 + R_2}{R_2} = 20 \log \frac{V_{in}}{V_{out}}.$$

In practice, the amount of boost is chosen to suit the requirements of the tone control. Twenty decibels is usually assumed for this value and is generally adequate. If twenty decibels is assumed, then:

$$\frac{R_1 + R_2}{R_2} = 10, \text{ and } R_1 = 9R_2.$$

At this point it is necessary to investigate the source impedance. If the tone control is to be driven from the plate of a voltage amplifier, the control circuit should have a mid-frequency input impedance of around 500,000 ohms. This requires that $R_1 + R_2$ be near one megohm since the tube must drive two such filters in parallel. If the control is to be driven by a cathode follower, $R_1 + R_2$ should probably be in excess of 50,000 ohms. Assuming a plate loaded amplifier as a source, 0.1 megohm might be a good value to assume for R_2 as a start. (Thus R_1 plus R_2 equals one megohm.)

If we let A_n be the nominal insertion ratio of the filter and A be the ratio of input to output voltage at some frequency f, then the decibel boost at that frequency is the nominal insertion loss minus the attenuation at the frequency f:

$$\text{decibel boost} = 20 \log A_n - 20 \log A = 20 \log \frac{A_n}{A}$$

where:

$$A_n = \frac{R_1 + R_2}{R_2}.$$

A consideration of the treble boost filter circuit shows that:

$$C = \frac{A_n - A}{2\pi f R_2 (A - 1)(A_n - 1)}$$

A determination of C can be made from this equation if a value of boost is assumed at some frequency. A convenient point to choose is the desired turnover point, the frequency at which significant boosting starts. The turnover point has a boost of three decibels and, for the treble boost circuit, should occur at around 1000 cps. Continuing with the previous assumptions in illustration, then:

$$C = \frac{10 - 7.07}{2\pi \times 1000 \times 100{,}000\,(7.07 - 1)(10 - 1)} = 85.4\ \mu\mu\text{fd}.$$

It is preferable to use standard component values where possible, hence, the value of C is to be regarded as an approximation, and a more convenient value would probably be 100 $\mu\mu$fd. However, if the value chosen for R_2 is kept and the rather arbitrary value of C is used, the turnover frequency cannot be expected to come out to the assumed value. Since the input impedance is rarely critical, it is expedient to alter the value of R_2 to bring the turnover frequency back to the assumed value. The final value of R_2, then, is found for the treble boost filter by substituting the desired turnover frequency, the new value of C, and the value of A at the turnover frequency into the equation:

$$R_2 = \frac{A_n - A}{2\pi f C (A - 1)(A_n - 1)}$$

In the present example, R_2 equals 85.000 ohms. R_1 is now found from the initial consideration of maximum boost where $R_1 = (A_n - 1) R_2$. In the example, $R_1 = 9R_2 = 765{,}000$ ohms.

The purist will insist on using these values for R_1 and R_2. However, a slight deviation in the interest of allowing the use of standard values will usually be satisfactory. (Changing R_2 from the ideal 85.000 ohms to the standard 82,000 ohms and R_1 from the ideal 765,000 ohms to the standard 750,000 ohms will change the turnover frequency from the assumed 1000 cycles to 1040 cycles. Such an alteration is almost always admissible.) However, care should be taken to change both resistors by roughly the same percentage in the same direction.

Treble Cut Filter: The circuit for the basic treble cut filter is shown in Fig. 1B. As the source frequency is increased from zero, no change in output is noticed until the reactance of C approaches the value of R_2. At such a frequency, effective bypassing of R_2 begins and the output voltage starts to drop.

The determination of the values to be used in this filter follows essentially the same procedure as was just outlined for the treble boost circuit. Assuming that this filter is to be used at the end of the tone control opposite from the treble boost filter, it should have a nominal insertion loss equal to that of the boost circuit in order to insure a constant volume level over the entire range of the control. Values of f and A are determined as before, and an approximate value of R_2 decided upon. In the case of the treble cut filter, an approximate value of C is determined from the equation:

$$C = \frac{A_n - A}{2\pi f R_2 (A_n - 1)}$$

and a standard value of C is chosen as close as possible to that determined by the equation. Then the final value of R_2 is calculated from the equation:

$$R_2 = \frac{A_n - A}{2\pi f C (A_n - 1)}$$

and a close standard value chosen. R_1 is then found as before.

The Bass Filters: If a very high frequency is applied to the input of the circuit of Fig. 1C, capacitor C will act as a short circuit and the output will be attenuated by the nominal insertion loss of the filter. As the input frequency is reduced, the reactance of C will increase until it approaches the value of R_2, at which time the output will begin to rise significantly. As the signal frequency is reduced toward zero, the capacitor

reactance will approach infinity so that with d.c. applied across the input no attenuation occurs. Thus a boost has been effected across the output in the region between d.c. and where X_c approaches R_2. The operation of the bass cut filter is similar.

The same procedure is followed in designing the two bass filters except that the equations used are:

$$C = \frac{A-1}{2\pi f R_2 (A_n - A)}$$

$$R_2 = \frac{A-1}{2\pi f C (A_n - A)}$$

and:

$$C = \frac{1}{2\pi f R_2 (A_n - A)}$$

$$R_2 = \frac{1}{2\pi f C (A_n - A)}$$

for the boost and cut filters respectively.

The Tone Control

The potentiometer used as a tone control to link any pair of filters should be large compared to the value of R_2 for either filter, otherwise adequate isolation of the two filters will not be effected and interaction will occur between them. If the pot is ten times larger than either R_2, adequate isolation should be accomplished. If it is twenty times as large, the isolation can be considered complete.

Care must be taken not to load the output of the control or significant changes in volume level will be experienced as the tone control setting is changed. An ideal situation in this respect is to drive an amplifier grid directly from the pot wiper, as indicated in Fig. 3, using only the control circuit for the d.c. grid return.

If two tone controls are to be included in an amplifier, probably the most reasonable choice would be a treble and a bass control, although this is not the only possibility. This choice requires a treble cut filter at one end of the treble control and a treble boost filter at the other. It further requires a bass cut filter at one end of the bass control and a bass boost filter at the other. In this kind of an arrangement both filters connected to a given control should be designed to have the same turnover frequency.

Very nice single control units can be built by employing a bass boost filter at one end of the control and a treble boost filter at the other. The two-control design is usually to be preferred, however. In any event, the filters associated with any given control should have the same value of nominal insertion loss.

Resumé of Design Procedure

In brief, the procedure for the design of the filters is as follows:

1. Decide which pair of filters is to be coupled to a given control.

2. Determine the maximum desired boost and calculate A_n from the equation: *decibel boost* $= 20 \log A_n$, or determine A_n from Table 1.

3. Determine an approximate value of mid-frequency impedance, Z_i, by considering the load requirements of the driver. (The tone control constitutes the load.)

4. Compute an approximate value of R_2 from the relation: $R_2 = Z_i/A_n$.

5. Choose some point on the desired frequency response characteristic of the filter; *i.e.*, determine a value of boost or cut at some specific frequency. (Usually the turnover point will be chosen, but this is not necessary.) From the value of boost or cut thus known and from A_n found in step 2, find A, either from the equation:

$$\textit{decibel boost} = 20 \log A_n/A$$
$$\textit{decibel cut} = 20 \log A/A_n$$

or from Table 2.

6. Calculate a first value for C by substituting the values for A_n, A, f, and R_2 found in steps 2 through 5 into the appropriate filter equation as listed in Fig. 1.

7. Choose a standard capacitor value near that calculated in step 6.

8. Insert the values of A_n, A, and f found in steps 2 through 5 and the value of C found in step 7 into the appropriate equation for R_2 as listed in Fig. 1.

9. Calculate R_1 from the equation: $R_1 = (A_n - 1) R_2$.

10. It is usually acceptable to use standard values for R_1 and R_2 if they are close to those calculated in steps 8 and 9.

It is to be noted that if R_1 and R_2 are expressed in ohms, then C will be in farads. If R_1 and R_2 are given in megohms, then C will be in microfarads.

Practical Filters

A practical example of each of the four types of filters in a tone control application is illustrated in Fig. 3. The values shown result in the response characteristics plotted in Fig. 4. These response curves represent the extreme limits of the tone controls.

The criteria used in designing the filters illustrated were as follows:

1. Input impedance, roughly 500,000 ohms (individual filter input impedance, Z_i, roughly one megohm).

2. Bass crossover point at 500 cycles.

3. Treble crossover point at 1000 cycles.

4. 20 decibels maximum boost.

It is to be noted that the exact values of R_1 and R_2, as calculated from procedure described previously were employed; *i.e.*, standard values were not substituted. It is suggested that the values of the components shown be computed by the designer to serve as a check on the over-all design procedure.

The technique described herein has given good results and should be very useful to anyone interested in the problems of tone control or fixed frequency response correction. —30—

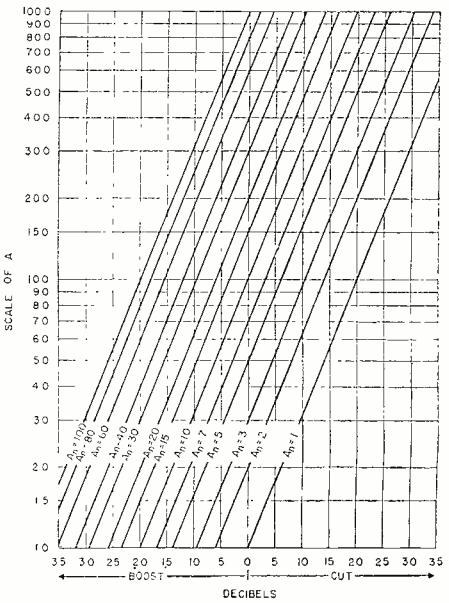
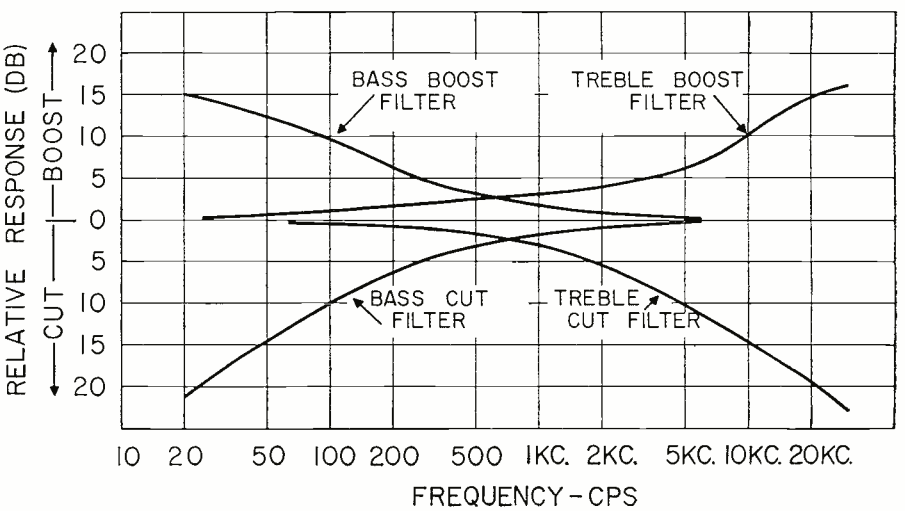


Table 2. Relation of input-output voltage ratio, A, of any RC filter with insertion ratio A_n and the decibel boost or cut. Project upward from the desired db value of boost or cut to the line representing value of A_n from Table 1. Then project horizontally to scale of A, and read the value of A.

Fig. 4. Response characteristics of four filters shown in Fig. 3. This represents the response of the controls when set at their respective extreme positions.



All About Audio and Hi-Fi

Speaker Mounting

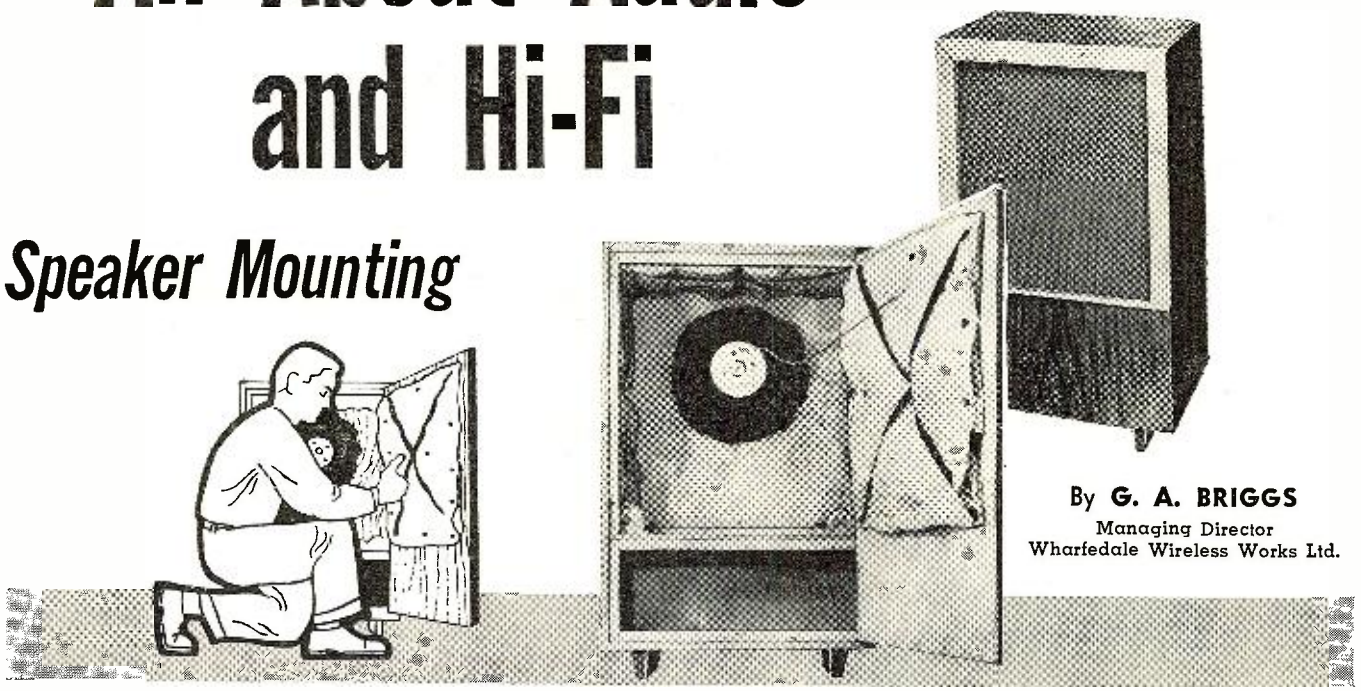


Fig. 41. Outside and inside views of cabinet described in article. The entire top section is lined with 1" padding.

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

Part 9. Concluding comments on cabinet construction along with characteristics of various cabinet types.

WE NOW come to the last—and most difficult to write — installment in this series of articles. In fact, if we had not already committed ourselves to deal with cabinets, baffles, etc., I think we should have put up the shutters at the end of Part 8. The subject is so vast, and so much has already been written about it, that it is difficult to know where to start; it is always much easier to write at length about a small problem than to deal briefly with a big one. At any cost, we must avoid a re-hash of what has gone before, but I think we might usefully begin by outlining our latest thoughts on the old, old questions that are so very important.

(1) The first thing to remember is that cabinets and horns are a necessary evil, used to avoid cancellation of sound waves from back and front of a cone. They don't improve the quality of sound and we should be much better off if we could do without them.

(2) Although it is possible to improve the performance of small enclosures by acoustic devices, it is almost impossible to make a small cabinet sound like a big one.

(3) With reflex enclosures, dodges like fitting pipes and diaphragms to vents make a difference to resonances, which are pushed around but not usually eliminated.

(4) Padding enclosures and hanging drapes in them gets rid of standing wave effects and often smooths the response, but the speaker unit is still working in a cabinet which colors results.

(5) Folded horns are a useful device for obtaining large-scale results in a limited space, but a folded horn is not truly exponential and never equals a straight one.

(6) Flat baffles are better than is generally believed. They are free from cabinet resonance. Two speakers in parallel on one baffle give a 3 db gain at low frequencies and double the power handling capacity so that bass lift can be used in the amplifier, resulting in four times the low-frequency output of a single unit. The floor also improves bass by reflection, and walls can be harnessed in the same good cause. Baffles are efficient because the sound from both sides of cone is used, and I am now inclined to the belief that equal air loading front and back is a good thing.

(7) Directional effects are serious. It is only necessary to look at an orchestra to realize how omni-directional most instruments are; hence the virtue of omni-directional reproducers, especially in upper registers.

(8) Convenience in use is becoming more and more a necessity as the interest in hi-fi reaches the music lover as distinct from the sound enthusiast. Some compromise is always necessary and perfection is as far off as ever, so the foregoing drastic observations should not be taken too seriously. Sighing for the moon does not bring it any nearer.

Cabinet Construction

Details are now given for the construction of reflex cabinets of two sizes. The fact that we deal with vented enclosures and not with corner horns does not mean that we have any prejudice against the latter; it simply means that we have done more work on reflex designs and therefore have more first-hand information available. Many people prefer horn loading; I could be happy with either if soundly conceived and constructed.

The cabinets described are fitted with an acoustic filter designed by my colleague, Mr. R. E. Cooke, and calculated to give bass without boom. The device is the subject of patent applications in this country and America and should therefore only be used privately in cabinets constructed at home. Although designed around *Wharfedale* 10" and 12" foam surround units, the cabinets can be used with other speakers provided the open baffle resonance does not exceed 45 cps.

The vent is tuned to resonate at about 40 cycles—low enough to avoid coloration and high enough to give body to the reproduction. The vent output will blow out a lighted match at the resonant frequency with 2 to 3 watts input to the speaker.

The acoustic filter is made of plywood and should form an airtight fit to the front, sides, and back so that the only air path from the upper compartment to the lower one is through the slits which permit the required transmission of low frequencies only. This also explains why the lower compart-

ment is not lined with absorbent material.

The design and dimensions for the 12″ model are given in Fig. 45 and are self-explanatory.

The data for the 10″ model is as follows:—

Cabinet in ¾″ plywood
Volume—2 cubic feet
Height—28″ outside
Width—14″ outside
Depth—12″ outside
Vent—2″ diameter circle

Acoustic filter in ⅜″ plywood with four slits 1/16″ wide and 8¼″ long over-all. Position 17″ from top, outside. Vent resonance 45 cps.

Suitable slits in the acoustic filter are easily made with a hand saw or better still, with a circular saw.

Photographs of a finished cabinet with inside and outside views are reproduced in Fig. 41.

Taking into account size, cost, and ease of construction, the reflex enclosure still pays better dividends in the bass than any other system.

The smaller unit can with advantage be used in the larger cabinet, but the process should not be reversed.

Adding a Tweeter

If it is desired to improve the high-frequency response, the simplest method is to mount a tweeter on a small baffle—preferably facing upwards—and stand it on top of the main cabinet, using the circuit of Fig. 42.

Baffles

Having paid baffles a few compliments, the least we can do is to give the reader a few hints on how to get the best out of such a system.

Two speakers in parallel are the obvious choice for 3 db gain at low frequencies. Sheet aluminum ¼″ thick, backed with fiber board or coated with a damping medium, makes a splendid baffle and gives a nice crisp tone to the reproduction. If plywood is used it should be sandfilled as shown in Fig. 43. The dimensions combine reasonable performance with convenient size.

For the bass end, a 10″, 12″, or 15″ speaker could be used, but the resonance should be not higher than 40 cycles. It must be made clear that it is the availability of low resonance units which makes possible this new approach to the long-discarded open baffle.

In order to reduce middle and treble but maintain maximum bass, an inductance can be placed in series with this unit, as shown in Fig. 44. The tapped coil (used alone) described in Part 8 would make an ideal variable control here.

The second speaker could be an 8″ or 10″ unit, with resonance preferably below 50 cycles, but even above 50 cps is acceptable because parallel working makes the higher resonance virtually harmless. Here we have shown a slot in place of the usual circular opening, to reduce beaming and improve high-frequency dispersal. Useful dimensions are: 8″ unit, slot 3″ x 7″; and 10″ unit, slot 3″ x 8″. The two speakers *must* be correctly phased. If they are out-of-phase, you will have a 20 db loss at low frequency instead of a 3 db gain. Adding a tweeter with the circuit of Fig. 42 is simple and phasing at high frequencies is of no consequence in this case.

Even a single speaker can be used on a baffle with good results, but low cone resonance is essential. So much for baffles. At least they are free from boom.

Reflex vs Horn Loading

It is not our intention to hold a Beauty Contest and pick the winner here, nor do we propose to outline vital statistics; it is better to leave the choice to personal preference. But I do think that the response curves of Figs. 46 and 47 throw some light on the question of relative efficiency which was raised in the previous article.

Both curves were taken out of doors with the same 15″ foam-surround unit, and with the cabinets placed in a corner formed by the walls of a building. The microphone distance was 4 feet on-axis in both tests.

The conclusions to be drawn from these tests are as follows:—

(1) The output below 100 cps is about the same in both cases.

(2) The main output from the horn is located between 100 and 400 cycles but, when comparing it with the reflex model, it should be remembered that this has considerable vent output with a peak around 200 cps as shown in Part 5.

(3) As usual, the working range of the horn is limited to 3 to 4 octaves, but the reflex design will easily extend to 7 octaves. Above 500 cycles, reflections play havoc with the output of the folded horn, but such effects are normally sidetracked by crossover networks.

So we are left with the 64,000 dollar question of how best to assess the efficiency of either system. If you take the horn performance between 100 and 300 cps, I will take the reflex output between 300 and 1000 cps and confound you, or I will take the next two octaves and knock you clean out of the ring. On the other hand, we can all take the region of 40 to 100 cycles and practically call it a draw.

The fact is that it is quite as logical to say that reflex loading is twice as efficient as horn loading because it covers twice as many octaves as to say

(*Continued on page* 120)

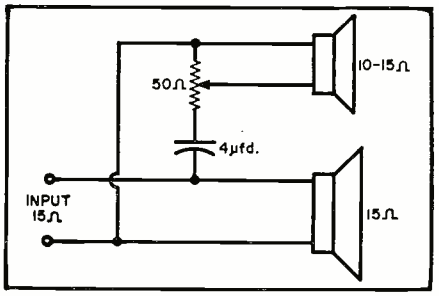


Fig. 42. Adding a 10-15 ohm tweeter to augment response above 3-5 kc. If the impedance of the main loudspeaker is 2-3 ohms, the tweeter should also be 2-3 ohms. The filter capacitor and volume control should then be 12 μfd. and 20 ohms respectively. For 8-ohm units, the capacitor that is employed should be about 6 μfd.

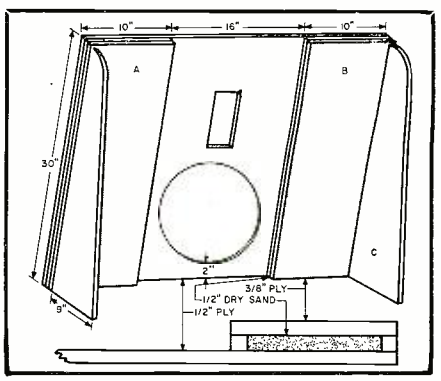


Fig. 43. Shown in this illustration is a back view of the simple flat baffle arrangement that is discussed in the accompanying text. The front sheet of plywood should be at least one-half inch thick. The two portions marked A and B are backed with three-eighths plywood which is spaced one-half inch for sand filling. This is shown in the detailed view. The side supports, marked C, may be constructed of one-half inch plywood. The dimensions shown are not critical.

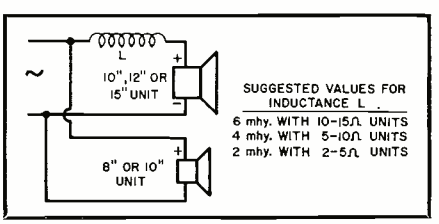


Fig. 44. Shown here is a useful circuit that may be employed to obtain good results with two loudspeakers mounted on an open baffle. The two speakers are connected together in-phase to avoid "hole" in the response.

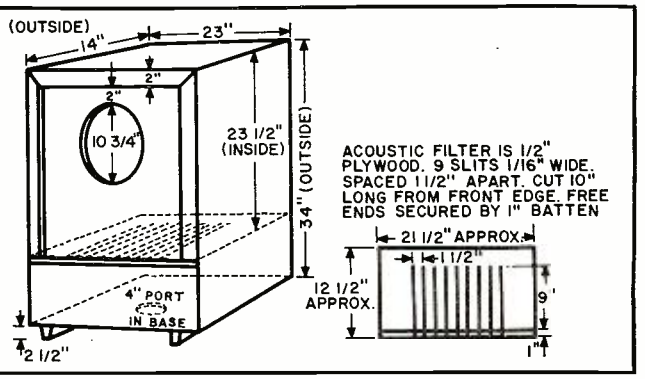
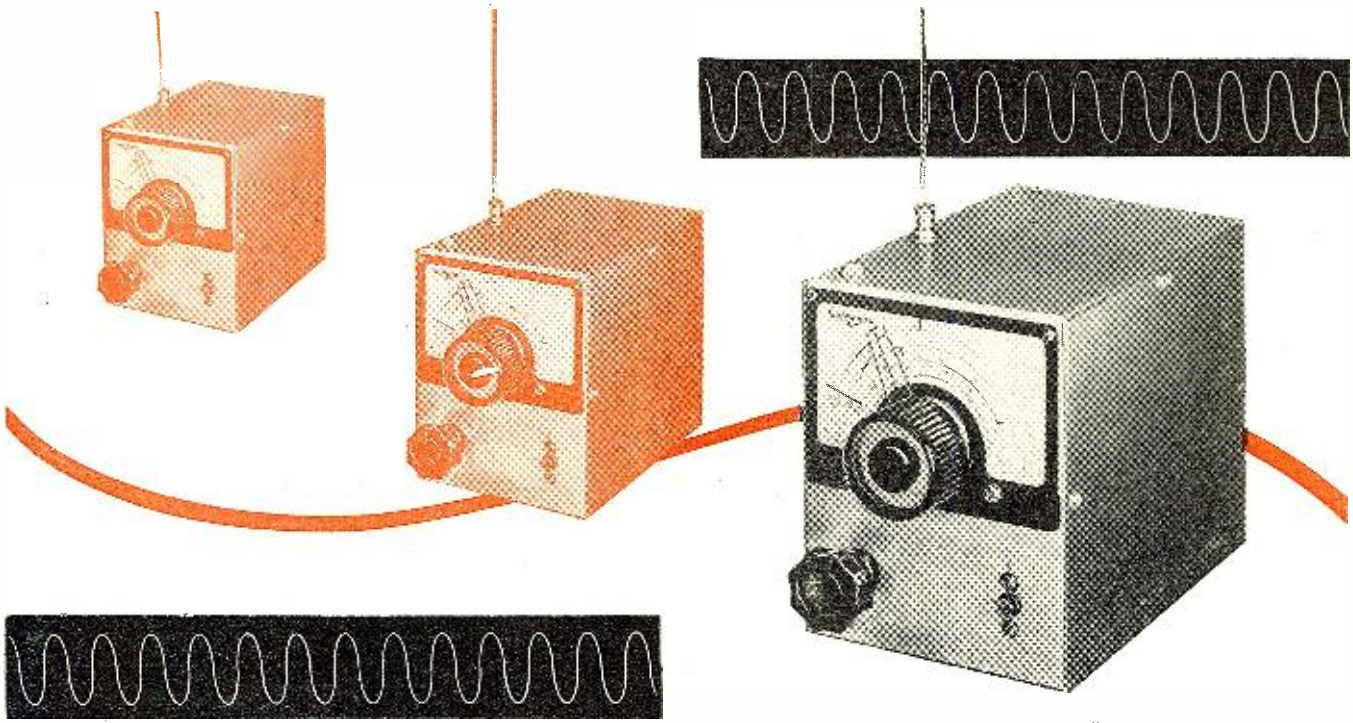


Fig. 45. Reflex cabinet with Wharfedale acoustic filter that is suitable for 12-inch loudspeakers with cone resonances not higher than 45 cps. The vent resonance in this unit is 40 cps.

Monitor Your Tone and Frequency



Over-all view of the monitor. A 12" length of wire from a coat hanger soldered to banana plug serves as pickup antenna.

By **LEON A. WORTMAN, W2LJU**

Simple two-tube c.w. monitor requires very little table space and is quite inexpensive to construct.

IT'S a very embarrassing experience. Your morale sinks to a very low ebb. You blush with shame. You hope your friends won't hear about it. You have violated a federal regulation! I'm talking about receiving a "green ticket" from an FCC monitor station. A "green ticket" is one of those, as the name indicates, green colored slips that the FCC listening posts use to notify hams when they have violated an FCC regulation; and the "green ticket" orders you to reply in affidavit form, "within three days," setting forth the exact causes for the violation and precisely what measures you have taken to remove them.

The notice may be for off-band operation, frequency changes caused by keying a transmitter (popularly or unpopularly known as "chirp"). It may be for key clicks, which are definitely spurious and superfluous radiations that cause unnecessary interference and annoyance to other radio communications; and, whether these spurious radiations occur inside or outside of the amateur band limits, they nevertheless constitute a violation of regulations.

An impure tone means an amplitude or a frequency modulated c.w. carrier. It can be ruled to be a modulated signal which is on a frequency permitting only unmodulated radiotelegraphy. For instance, a transmitter operating on 7.15 mc. is within the "ham" band but an "impure tone" (possibly caused by an improperly filtered power supply) can be cited for utilizing type A4 and/or type A2 modulation in a band permitting only type A1 transmissions. Harmonic radiations are a violation and quite often they could fall outside the limits of a ham band which is in harmonic relation to the band of fundamental operation. Such an occurrence might cause serious interference to other services. Thus the violator is guilty of off-band operation and/or causing unnecessary interference to other stations.

Any one of these violations can be quite easily detected by the alert FCC monitor stations scattered throughout the United States and operating 24 hours a day. There is no legitimate defense against the charges. The regulations require that the transmissions be as "pure as the state of the art permits" and that suitable means of monitoring the frequency and the character of the transmitted signal shall be provided.

However, many hams neglect to provide any monitoring facilities. Usually this is because of the estimated cost of the equipment and the table space required for the installation. The preference is to invest the money in "extra watts," a new chrome plated bug, or a new microphone. All these are nice to own and use and they might improve the station. But, holding an operator's license and a station call-sign are obligations that cannot be minimized, obligations to fellow hams, and obligations to a government that permits freer use of the ham bands than any other government does.

Here is a simple c.w. monitor that is compact in size, requiring very little table space, and inexpensive enough to construct and still permit those "extra watts" and accessories. To use an overworked phrase, "the unit can be built from the contents of almost any ham's junk box." All components are of standard manufacture, including the tuning coil. Once built, it should suffice for many years as a monitor. Once you develop the habit of using it, you'll wonder how you ever did without it.

The unit consists of an oscillator tunable over the 80, 40, 20, 15, and 10 meter bands, a signal mixer and audio amplifier, and a power supply. A 6BH6 is an excellent oscillator which drives the mixer-amplifier, a 12AT7 with its twin-triodes in parallel connection. A phone jack is provided

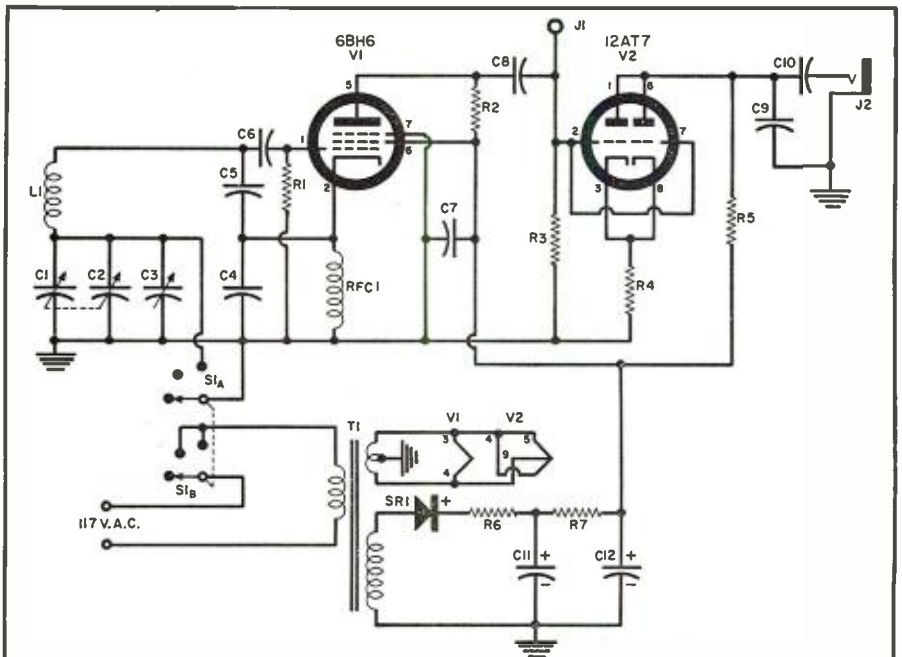
for earphone monitoring. An insulated banana jack on the top of the 4" x 5" x 3" metal box that houses the miniature monitor is connected directly to the grids of the 12AT7. A 12" length of wire from a coat hanger is soldered to a banana plug and serves as an antenna for picking up a small amount of r.f. voltage from the transmitter to be monitored.

The monitor operates on the heterodyne-detection principle. A radio-frequency signal is generated within the unit by the oscillator and is heterodyned or beat against another externally generated radio-frequency signal. When two signals are heterodyned there results, in addition to the two original signal frequencies, a signal that is the sum of the two frequencies and a signal that is the difference of the two frequencies. In this particular application we utilize the "difference" frequency. If the two original frequencies are separated by an audio frequency (approximately 16 to 20,000 cycles) they may be detected by a simple audio device. For example, assume the transmitter to be monitored is radiating on 7150 kilocycles. Tuning the monitor to 7151 kilocycles, a 1000 cycle tone will be heard in the earphones. The sum frequency, 14,301 kilocycles, and the two original frequencies of 7150 and 7151 kilocycles are removed by the small bypass capacitor (C_9) at the plates of the 12AT7. This capacitor is of a value selected to offer low reactance to the 7 and 14 megacycle radio frequencies and high reactance to audio frequencies. By listening to the quality and stability of the audio output of the monitor we can determine with suitable accuracy the character of the transmitter's signal as it might sound to a distant receiving station. Keying "chirps" are distinctly audible as are rough notes and modulated signals.

The frequency of the transmitter can be determined by directly calibrating the monitor against a calibrated receiver. The output of the monitor's oscillator is strong enough to be heard in the receiver with the b.f.o. on. For setting the transmitter to a certain frequency when the monitor is not directly calibrated, zero beat the monitor with the receiver. Then zero beat the transmitter frequency to the monitor. The transmitter will then be simultaneously tuned to the same frequency as the receiver.

Tuning the monitor to one side of the transmitter carrier gives an audio tone on the monitor earphones. At W2LJU this side tone is used to monitor the keying of a "bug" as well as the transmitter. Any breakdown or change in the signal is easily and immediately detected by listening to the tone as the rig is keyed. A 3-position switch is provided on the front panel for off-on-standby control. C_3, an air-trimmer, is also front-panel mounted for convenience in adjusting calibration frequency.

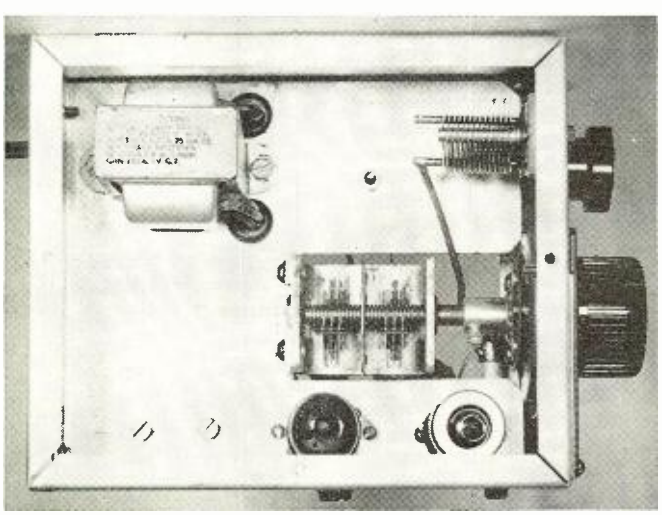
Continuous use of a tone and frequency monitor is a good operating habit. Not only does the FCC require it, good operating necessitates it. —30—



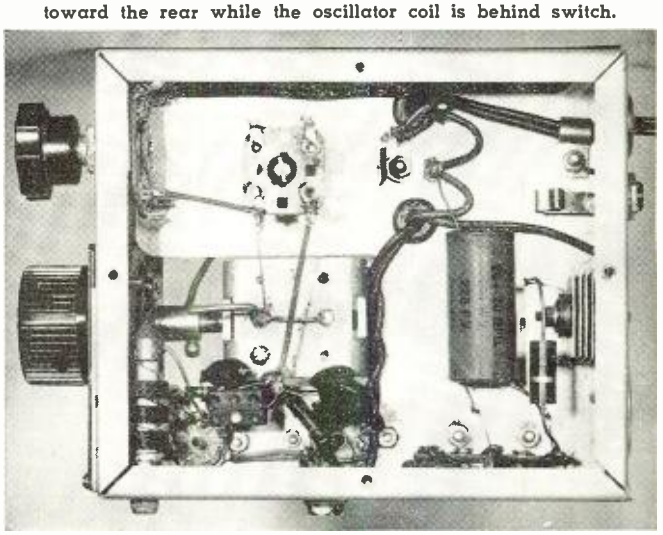
R_1—86,000 ohm, ½ w. res.
R_2—56,000 ohm, ½ w. res.
R_3—470,000 ohm, ½ w. res.
R_4—300 ohm, ½ w. res.
R_5—10,000 ohm, 1 w. res.
R_6—100 ohm, 1 w. res.
R_7—1500 ohm, 1 w. res.
C_1-C_2—15/15 μμfd. two-gang var. capacitor (parallel connected)
C_3—100 μμfd. air trimmer
C_4, C_5—.001 μfd., 200 v. capacitor
C_6, C_8—.0001 μfd., 200 v. capacitor
C_7—.01 μfd., 200 v. capacitor
C_9—.002 μfd., 200 v. capacitor
C_{10}—.05 μfd., 200 v. capacitor
C_{11}-C_{12}—20/20 μfd., 150 v. elec. capacitor
L_1—Osc. inductance (Meissner #14-4034 b.c. osc. coil. Use either of the two windings)
J_1—Banana jack for "antenna" (see text)
J_2—Phone jack
S_1—D.p. 3-pos. switch
SR_1—20 to 65 ma. selenium rectifier
T_1—Power trans. 150 v. @ 25 ma.; 6.3 v. @ .5 amp. (Merit P-3046 or equiv.)
RFC_1—2.5 mhy r.f. choke
V_1—6BH6 tube
V_2—12AT7 tube

Schematic diagram of the unit is seen to consist of a 6BH6 tunable oscillator which is used to drive a 12AT7 mixer-amplifier with triode sections in parallel.

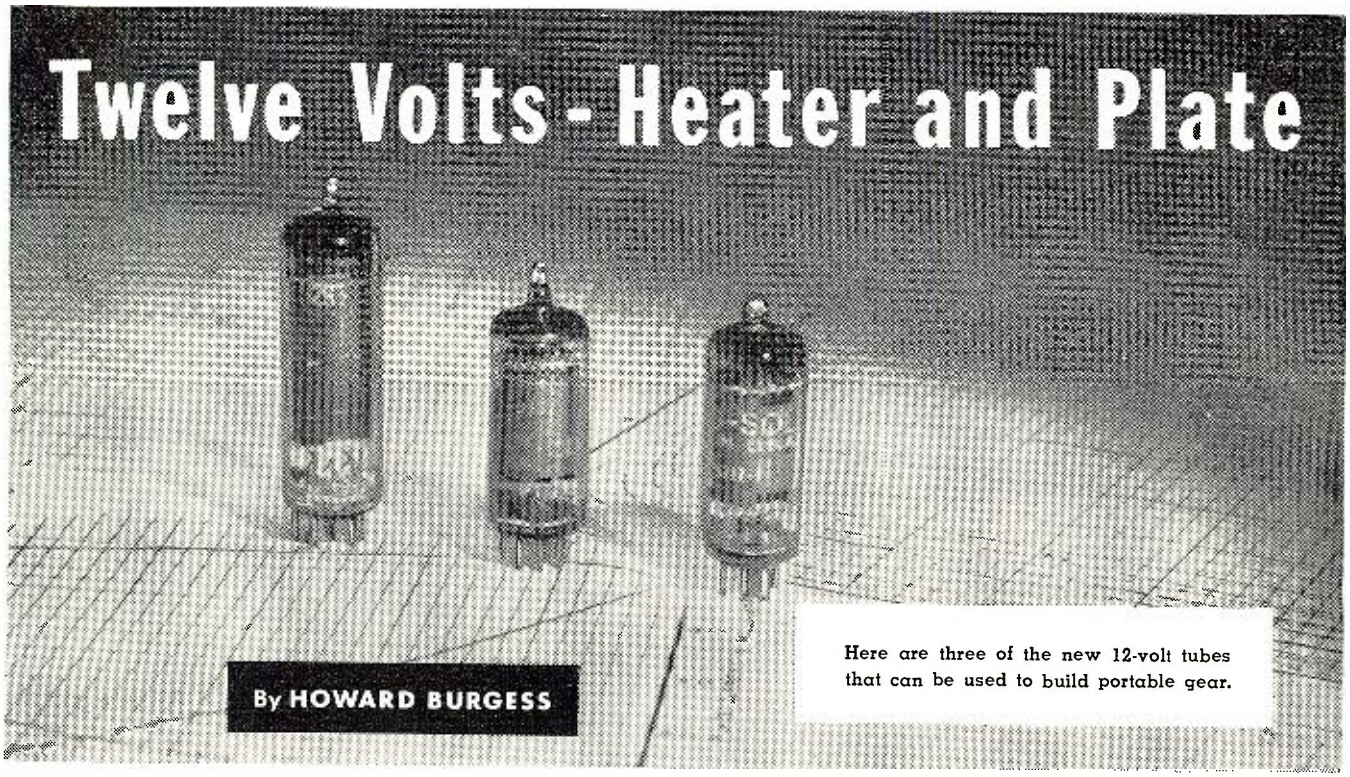
Top view of tone and frequency monitor. Power transformer, main tuning and trimmer capacitors, and tubes may be seen.



Bottom view of unit. Power supply components are mounted toward the rear while the oscillator coil is behind switch.



Twelve Volts-Heater and Plate



Here are three of the new 12-volt tubes that can be used to build portable gear.

By HOWARD BURGESS

Some ideas on using the new 12-volt tubes in simple, portable gear that works directly off the car battery.

ONE of the great accomplishments of the transistor has been its ability to show what can be done with very low power. This new appreciation of low-level power has even moved into the field of vacuum tubes and several manufacturers are offering tubes that require 12 volts or less on the plate. These include such tubes as the 12AC6 r.f. pentode. 12AE6 double diode triode, 12AD6 heptode converter, 12K5 space charge tetrode, and many others such as double triodes and special types.

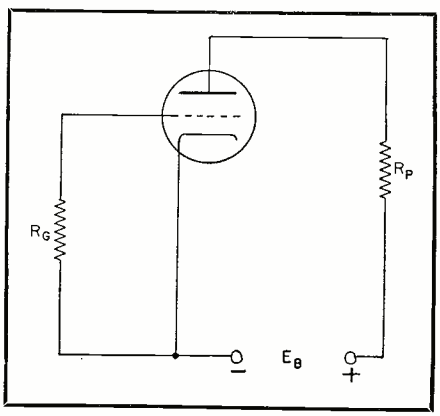
After using the customary 200 to 300 volts on receivers and test equipment, one is amazed by the number of jobs that can be done well with very low values of plate supply. Superhet all-wave receivers, grid dip meters, v.h.f. converters, crystal calibrators, and many other pieces of equipment can be made to work with plate voltages as low as 6 volts in many cases.

With the coming of the 12-volt automotive systems and the 12- and 24-volt systems in use on aircraft and boats, those interested in portable and mobile operations will find these new tubes a great asset in simplifying equipment. The same voltage that is applied to the heater can be used on the plate circuits. This eliminates the need for expensive vibrator and dynamotor power supplies, not to mention the reduction in noise that accompanies such power sources. The fact that no cathode bias resistors or capacitors are required, no screen resistors are used, and one bypass capacitor can usually serve for all plate and screen circuits, contributes to the utmost in circuit simplicity.

New tube types can be difficult to obtain in some rural areas and for this reason tests were run on some of the popular numbers using very low plate voltages. Surprising to say, all of the common types tried worked very well if certain basic rules of low-plate-voltage operation were followed.

Nearly all commercially available tubes have a certain amount of grid current leakage (sometimes called contact potential). In Fig. 1 this electron flow from the cathode to the grid, through R_g and back to the cathode will develop a voltage drop across R_g and place a negative voltage on the grid. In the average tube this voltage may range from .2 volt to 1.5 volts depending upon the value of R_g and the grid structure of the tube. In high-voltage applications this small grid voltage goes unnoticed but when only 12 volts is used for plate supply, this self-developed grid voltage can bias many tubes beyond cut-off. However this objectionable voltage can be turned into an advantage. When controlled it can be used as a source of useful grid bias. Generally speaking this leakage current becomes worse on tubes with high amplification factors.

Fig. 1. Contact potential bias is common.



When the new 12-volt tubes are used, good results will be obtained if the manufacturers' specifications are followed but if ordinary tubes are used, several rules of thumb can be followed in selecting tube types and in circuit design. These simple rules would include:

1. Select tube types with a low amplification factor and a high transconductance.
2. Except in special cases keep the grid circuit resistance as low as possible to reduce bias voltage.
3. When practical, the plate circuit resistance should be kept low to avoid excess loss in voltage. This applies mainly to high-resistance interstage transformers.

Very few tube manuals continue the curves down to the lower voltages. Shown in Figs. 3, 4, and 5 are several curves for some of the new 12-volt series and some of the older 12-volt tubes. As might be expected, the curves do some odd things in the very low voltage regions. Two tubes that proved to be very useful were the 12AW6 triode-connected and the 12BH7.

Nearly all of the well-known circuits operate quite well with the new tubes if a few changes are made. These changes are simple and consist of such things as removing any cathode biasing

Fig. 2. Simple equipment can be built for Novice who likes to "rough-it." Power is gotten from car cigarette lighter socket.

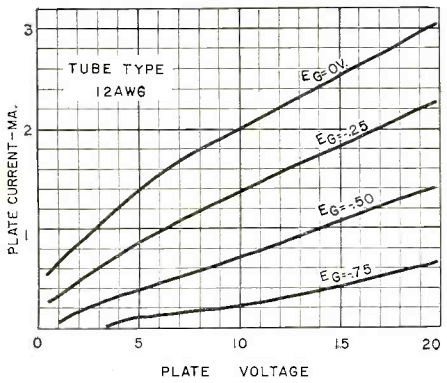


Fig. 3. Curves for triode-connected 12AW6.

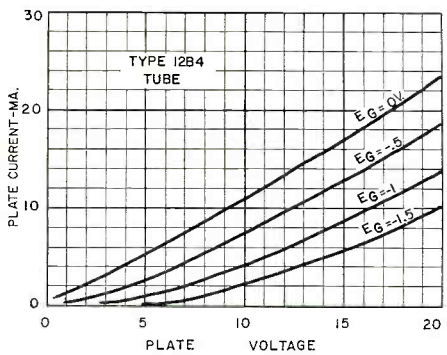


Fig. 4. Low voltage curves for 12B4 tube.

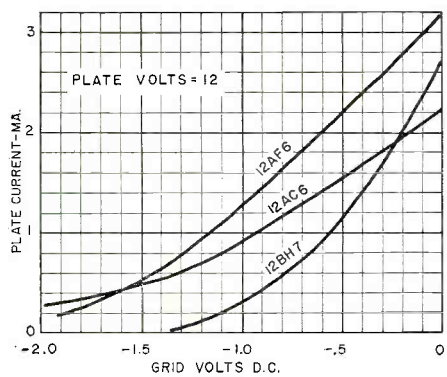
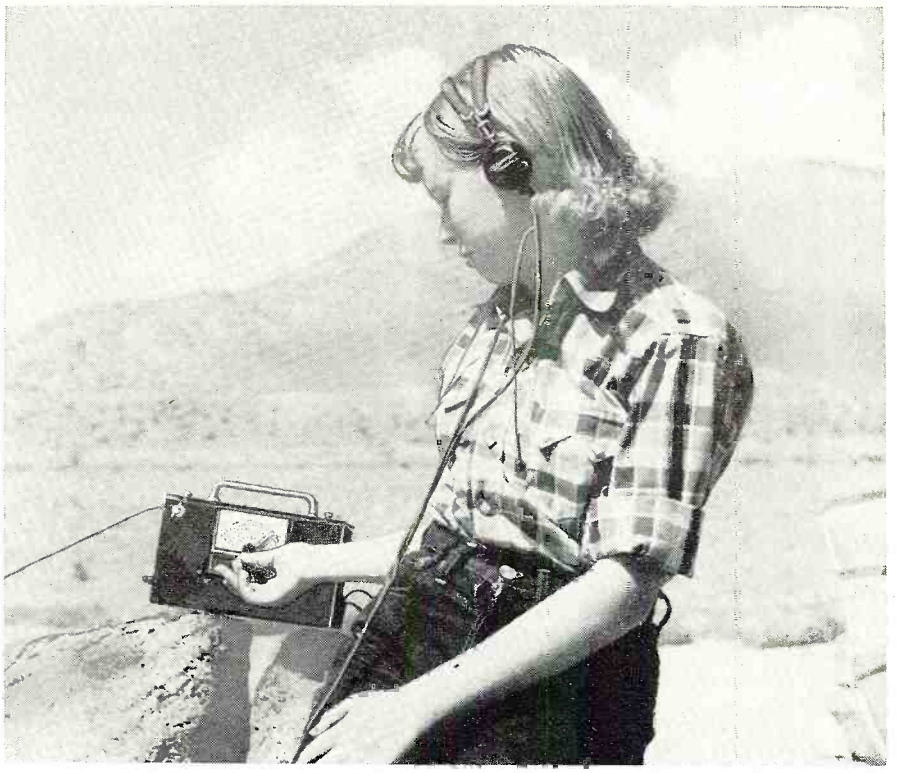


Fig. 5. Comparison of three useful tubes.



and placing full plate supply voltage on the screen. When required, insert a grid resistor such as the one used in the r.f. amplifier in the converter diagrammed in Fig. 7B.

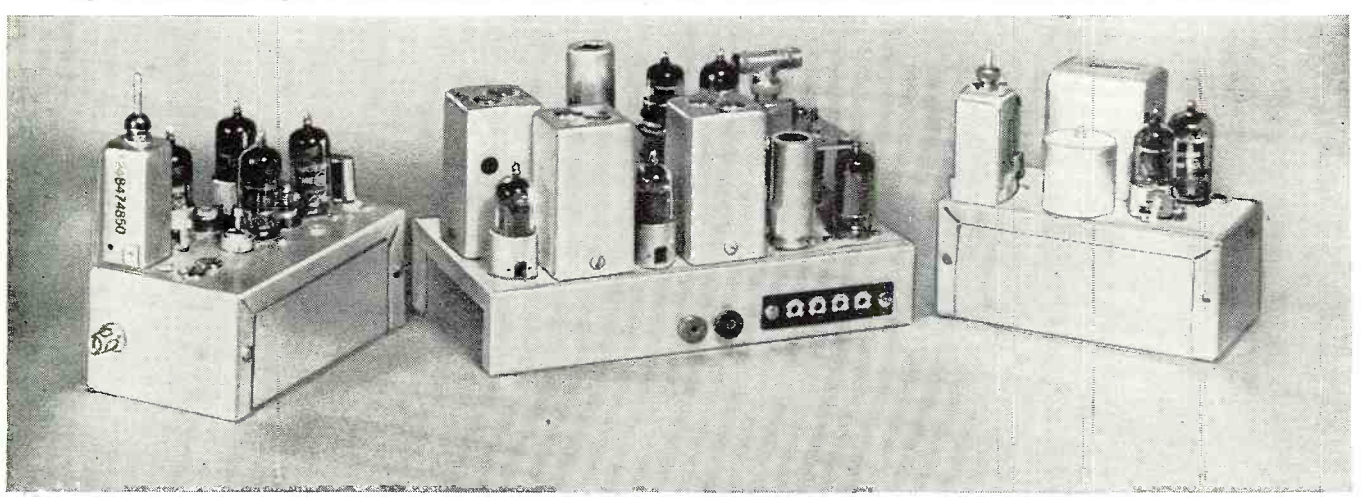
Perhaps one of the most widely used single pieces of mobile gear is the high-frequency converter. Either fixed frequency for nets or the tunable kind have given very good results when used with a 12-volt plate supply. Fig. 7B is the circuit of one designed for a fixed net frequency. Tuned circuits L_1C_1 and L_2C_2 are tuned to the signal frequency. L_4C_7 are tuned to the desired i.f. frequency. The frequency of the crystal is above or below the signal frequency by an amount equal to the i.f. frequency. The tuned circuit L_3C_6 is tuned to a frequency several hundred kilocycles higher than the crystal frequency and is not critical. Of special interest is the grid resistor of the 12AC6 r.f. amplifier. Do not be alarmed if all r.f. and i.f. amplifiers resemble a grid leak detector. This is the method for obtaining grid bias.

Fig. 7C is almost identical to Fig. 7B except that a tunable oscillator is used in place of the crystal. The oscillator gave very good results with the coil tapped about one third of the way up from the bottom. This circuit gave excellent results as high as 35 megacycles with only nine volts of battery supply. An ordinary 12BE6 also gave very good results as a converter with this low voltage. A newcomer desiring to construct a converter such as this will no doubt need more information than we have room to give at this time. However, these circuits are just the old "standbys" simplified to use low-voltage techniques and any good handbook may be consulted for the mechanical construction details.

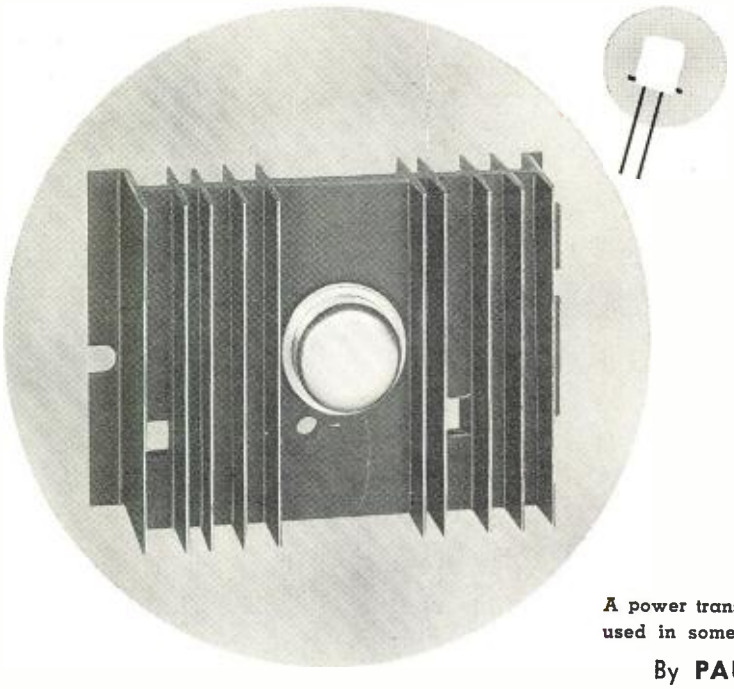
Another gadget (Fig. 7A) using the

(*Continued on page* 107)

Fig. 6. From left to right, a v.h.f. converter, a v.h.f. superhet, and a superregen detector plus audio. All use 12 v. on plates.



Transistor Heat Sinks



A power transistor mounted in a heat sink used in some Delco-built automobile sets.

By **PAUL PENFIELD, JR.**

Thermal resistance calculations and some practical suggestions for experimenters using power transistors.

THE major problem in operating power transistors is temperature. Germanium models should usually be kept below 90°C, and unless steps are taken to insure that the heat generated is removed to a heat sink, the transistor dissipation are sometimes

Manufacturers' ratings on power transistor dissipation are sometimes given assuming an "infinite heat sink" —a mathematical entity which is not approximated by the usual chassis. It is important to calculate just how effective your heat sink really is and keep your power dissipation down.

This is really quite easy to do because of an analogy with electric circuits which makes it easy for radio people to understand.

All power dissipated in a transistor appears as heat. Although heat can be transmitted by at least three processes —conduction, convection, and radiation —only conduction is important now. Fig. 1 shows the path of heat flow from a power transistor—through the mounting, through the mica washer, to the chassis, which heats up. The chassis, in turn, gives the heat to the surrounding air. This cooling method is simple and widely used.

How hot the transistor *junction* gets (call this temperature T_j) depends on the power dissipation P (in watts), on the temperature T_a of the surrounding *air*, and on a property of the heat sink called the thermal resistance θ. In fact, $T_j = T_a + P\theta$ so the higher the dissipation, the further T_j is above T_a.

Since all work in this field is done in degrees centigrade, not Fahrenheit, convert to °C by the formula:

$$°C = \tfrac{5}{9}(°F - 32).$$

It is necessary now to call the transistor mounting base temperature T_t and the chassis temperature at the transistor T_c, as indicated in Fig. 1. (Don't worry if you get scared by the math here. It will all be clear in a minute.) Now the same power P flows as heat through the mounting base, the mica washer, and the chassis. How much the mica hinders the flow of heat is expressed in its thermal resistance θ_w, equal to the ratio of the temperature difference across it $(T_t - T_c)$ to the rate of heat flow through it, or

$$\theta_w = (T_t - T_c)/P.$$

In a similar way the thermal resistance of the transistor proper, θ_t, measures the difference in temperature between the collector junction and the mounting base bottom, or

$$(T_j - T_t) = \theta_t P.$$

And, finally, the difference in temperature between the surrounding air and the chassis is accounted for by the thermal resistance θ_c of the chassis heat sink.

Each of these three thermal resistances is characteristic of a different part of the set-up—one of the transistor, one of the mica washer, and one of the heat sink. Each is calculated in a different way, but all are necessary.

It is no accident that these θ quantities are called thermal *resistances*. They behave with heat flow and temperature the same way electrical resistances do with current and voltage. In fact, the thermal properties of Fig. 1 are the same as the electrical properties of Fig. 2, if we let R_t correspond to θ_t, R_w to θ_w, I to P, V_j to T_j, V_c to T_c, and so forth. This is seen by writing the equations for the electrical "analogue" and replacing each quantity by the one to which it corresponds. If you do that, you will come out with just the equations previously given.

While the thermal quantities and equations may be strange, the corresponding electrical ones (using Fig. 2) should be easy enough. If you got bogged down in the math thus far, go over it again, using the electrical analogue, and you'll see how logical it is.

For example, what we need in practical cases is the total thermal resistance θ relating the difference between T_j and T_a to the power P. The other three thermal resistances are helpful only in calculating this over-all value.

It is obvious from Fig. 2 that this over-all θ is equal to the sum of the other three smaller thermal resistances—an important fact which was not obvious a moment ago.

With other types of arrangement involving heat sinks in parallel and series, the corresponding resistances in parallel and series make a similar type of electrical diagram. Heat flow splits between two parallel paths the same way current does with parallel resistors. The combined thermal resistance is found from the well-known parallel resistance rule.

Complicated structures can be analyzed this way very easily.

Calculating Thermal Resistances

The fact that, in our case, the over-all θ is just the sum of the three smaller ones, is very important. Each of these thermal resistances is found in a different way.

The transistor thermal resistance θ_t is either specified by the manufacturer, or can be obtained from a graph such as Fig. 3, which the manufacturer supplies.

In Fig. 3, the maximum power dissipation is shown for every mounting base temperature T_t. This "de-rating curve" goes to zero at the maximum recommended junction temperature, marked T_m here. The difference in temperature between the points "A" and "B," where the allowed dissipation

is one watt, is numerically equal to θ_t.

As far as the mica washer goes, for the newer transistors with the oblong mounting base and leads coming out the bottom, the mica thermal resistance is about .31 °C/watt for each mil (.001 inch) of thickness. Thus a 3-mil washer would have a thermal resistance of 0.93 °C/watt.

A good number for the smaller-contact-area transistors is 0.5 °C/watt per mil thickness.

The thickness can be measured with a micrometer if one is available. Generally thicknesses run from 1.5 up to 4 or 5 mils.

A mica washer only needs to be used when the transistor case (usually the collector) cannot be electrically connected to the chassis. Otherwise, omit the washer and call its thermal resistance zero.

It is assumed good thermal contact is made between washer and transistor and between washer and chassis. Before mounting the transistor, be sure the chassis area is free from metal filings, burrs, and dirt, which not only make for bad thermal contact but may also punch through the mica. Even with the best surfaces, though, there will be air pockets tending to make a bad contact. To prevent these, coat the washer with something to drive out the air.

Ordinary water would be suitable if it didn't evaporate so quickly and wouldn't short the transistor to the chassis. For high reliability such as is required by the military, silicone grease (a *Dow-Corning* product) is used. But for ordinary use good non-evaporating lubricating oil, SAE #40, or preferably a thicker grease, will do. Test it before use to make sure it is non-conducting.

Power transistors should never be mounted "dry" if much power dissipation is expected.

Ordinary screwdriver tightening is sufficient to insure good contact if oil or grease is used.

The thermal resistance of the heat sink is found by Fig. 4. Use the appropriate line. For instance, if air is trapped on one side of the chassis and is not very free to move, that side does not help the process. The labels on Fig. 4 indicate on which sides the air is free. It is best (lowest thermal resistance) to use both surfaces. Where that is impossible, arrange it so the top horizontal surface is free and use the second line from the bottom in Fig. 4. The reason for the difference, of course, is that hot air rises away from the top horizontal surface, but tends to stay near the bottom surface, if that side is the free one.

Aluminum is the best material (besides copper and silver) to use for a heat sink and Fig. 4 was drawn for this material. Steel is not as good as a heat sink.

While these curves were made for a circular disc of that area, they are not far off for rectangular chassis provided the longest dimension is under about 25 inches.

The sum of the three thermal resistances θ_c, θ_w, and θ_t gives the overall thermal resistance θ, the quantity of interest. Now we are able to find out how much power can be dissipated safely. For a given T_a (room temperature is 20-23°C) and maximum recommended junction temperature T_m (given by the manufacturer) the power dissipated should not exceed

$$P_m=(T_m-T_a)/\theta$$

It's as simple as that. The only hard part was in calculating the thermal resistance.

Think of the electric analogue of Fig. 2. Now the problem reduces to, "how much current can I send through the total resistance without the voltage drop exceeding the safe value?" Phrased this way, the answer is easy enough to find.

Other problems can be solved as well. "How big a fin, or chassis, do I need?" That depends on the power dissipation. Once that is determined, the value of θ_c necessary comes from working with Fig. 2 and the size of the fin needed is read from the values given in Fig. 4.

The only problem remaining is, what power is meant by P? The original assumption was that of a steady dissipation. In practical cases, is P the peak power? the instantaneous power? the average power?

No harm can come if P is interpreted as the peak power and this is often done. Because the instantaneous power is never greater than this, and is normally lower, an automatic safety factor is provided. It is possible to improve this rating by considering the time constants of the thermal circuits, but improvement this way may not be worth while. In experimental circuits it is good to keep the instantaneous power *always below* the rating calculated for steady power.

However, this is somewhat wasteful, and if you want to get the most out of your transistor the next section tells how to do better.

Improving This Power Limit

If the power dissipation is varying as time goes on, as it will in practical cases, then there is an *average* of this dissipation and let's call it P_{av}.

For class A operation the difference between the average and the maximum power is not great, since with no signal the transistor dissipates the greatest amount of power. Since an audio amplifier, at least, should be able to operate safely with no signal, the no-signal power dissipation should be used throughout the calculation and the method of this section will not help.

For class B (or AB) operation, however, there is an advantage. The average power P_{av} will be greatest with full signal and will be very small with no signal. For ideal class B operation, the average power dissipation is about one quarter of the power input, the other three-quarters appearing as useful power output. However, in practical circuits the efficiency will probably

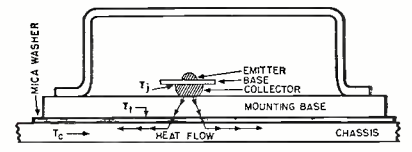


Fig. 1. Cross-section of power transistor showing heat flow. Mountings not shown.

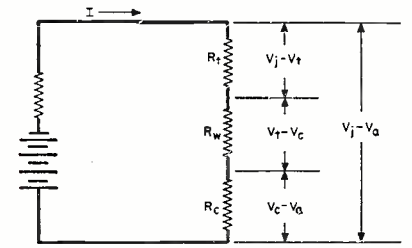


Fig. 2. This electrical analogue of heat flow problem has the same sort of equations.

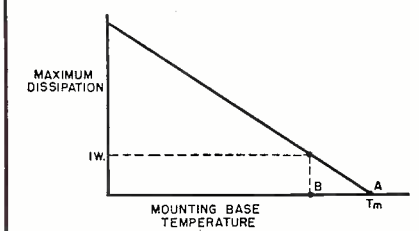


Fig. 3. Power derating curve of the type normally supplied by the manufacturer.

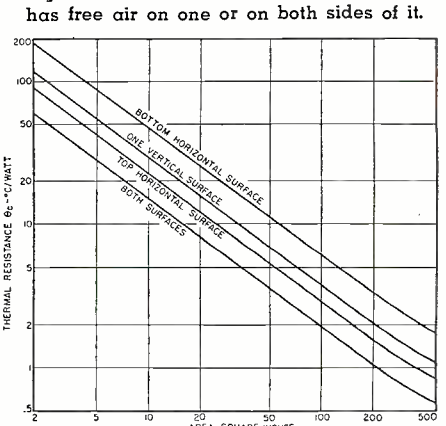
be less than 50%, meaning more power dissipation than output.

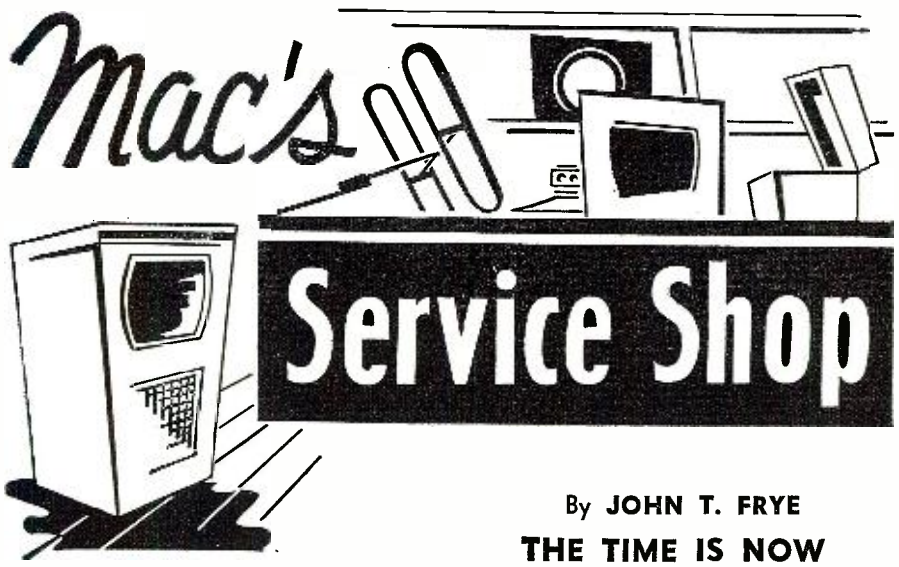
When computing the junction temperature, it is permissible to use the average power P_{av} in connection with the thermal resistance θ_c of the chassis, but we should use the peak power in connection with the other two thermal resistances.

The reason for this is very simple. The chassis, being composed of a large amount of metal with a high heat capacity and losing its heat by the relatively inefficient method of transferring it to the free air, has a large *thermal time constant*. That is, if you try to heat up a chassis, it takes several minutes before it reaches temperature. The transistor is trying to do just that —heat up the chassis. Because the chassis is so sluggish, it takes several minutes.

(*Continued on page* 142)

Fig. 4. Thermal resistance of a fin that has free air on one or on both sides of it.





By **JOHN T. FRYE**

THE TIME IS NOW

"AHA!" Barney exclaimed as he came sailing into the service shop out of a gusty March morning and found Mac, his employer, bent over a piece of test equipment on the bench; "new gadget, huh?"

"Yep," Mac answered as he plugged the cord of the instrument into a socket. "This is a replacement for our old battery eliminator. I bought it in kit form and put it together last night."

"What was the matter with the old one?"

"Nothing except that it's outmoded. As you know, we've been hooking a battery in series with the eliminator to work on twelve-volt sets but that arrangement leaves a lot to be desired. For some time I've been intending to buy a new eliminator that would handle both six- and twelve-volt radios, but I was holding out in the hope someone would build in the extra filtering needed in powering hybrid or all-transistor sets. In the past few months several manufacturers have come on the market with just such instruments; so I no longer had an excuse."

"I get you. Since the battery voltage furnished a hybrid or transistor receiver is equivalent to the plate voltage in a tube radio, it must be well filtered to prevent hum."

"Your little gray cells are working today!" Mac applauded. "As you can see, this eliminator has continuously variable output voltages of either 0-8 or 0-16 volts. Output voltage and current are monitored by the two meters. Notice there are two sets of binding posts, one on each end of the panel. Those on the left provide moderately filtered output, with about 2% ripple, for use in battery charging or with vibrator-type sets. You can take continuous currents of ten amperes at six volts or five amperes at twelve volts from them. The posts on the right furnish five amperes at either voltage with very low ripple."

"How is the ripple reduced?"

"By passing the moderately filtered output through an extra L-section filter consisting of a heavy choke and a 10,000 μfd. capacitor. This brings the ripple down to less than .3%. I am not just taking the manufacturer's word for this; I measured it with the scope; but let me show you the difference."

As he said this, Mac connected a high-wattage, low-resistance resistor across the right-hand output terminals and adjusted the eliminator so that it was furnishing about four amperes of current to the resistor. Then he connected a large capacitor to one of the tip leads of a pair of earphones and touched the other earphone lead and the free end of the blocking capacitor to the two output terminals on the left side of the panel. A very noticeable low-pitched hum came from the phones. He transferred the connections to the right-hand terminals.

"Hey," Barney exclaimed as he pressed the muff-type earphones tightly against his head, "I can't hear the least trace of hum!"

"And you shouldn't," Mac said as he turned off the eliminator. "That ripple level must be very low if you are going to use the eliminator to power all-transistor sets as I expect to find in many cars next year. Of course, when the variable voltage feature is not needed, we can always cut the hum still more and provide very good voltage regulation by floating a battery across the output of the eliminator, but I don't think that will be needed. In a few cases in working with extremely high-gain transistor amplifiers we might want to cut the ripple to an absolute minimum. Such circuits would not require any appreciable current; so it would be very simple to use an outboard filter section consisting of a high-inductance, low-resistance choke and a whopping big capacitor of low voltage between the eliminator and the transistor circuit. About the only time you would need such extreme filtering would be in experimental work, but it's nice to know a simple addition to the eliminator will provide very nearly pure direct current.

"While we're talking about it, I want to mention a couple of other points to watch in working on the new hybrid or all-transistor auto sets, in fact, for working on any set that employs power transistors in the output. With the auto sets, you must be very, very sure that the voltage applied to the set on the bench has the same polarity as that provided by the car battery. Reversed polarity will ruin the transistors almost immediately. After being used to working with interrupter-type vibrators in which the polarity of the connections makes no difference, you could overlook this very easily.

"Make sure, too, that the output transistors are working into a proper load at all times. Running a signal into them with the speaker disconnected is a fine way to ruin them. And you've got to be careful what you do with your test prods when you're working on one of these sets. They are as touchy in that respect as battery portables, but for a different reason. With the portables, you have to be careful that you do not accidently short the high plate voltage across the fragile filaments and blow them. With the transistor sets, it's not the voltage as much as the almost unlimited current provided by the battery that you have to treat with respect. A test prod that accidentally grounds the base of an output transistor can ruin the transistor while you are batting your eyes. That's why you must *never* try to use the old circuit-disturbance type of troubleshooting in which you ground a tube grid and listen for a click in the speaker in working on transistor sets. Ground a base and the click you hear will probably be the last."

"I'd think that a battery-eliminator, being fused and providing only a limited amount of current, might provide some measure of insurance against that kind of damage."

"It does, but don't depend on it. A charged 10,000 μfd. capacitor can put out a lot of current for a few milliseconds and a fuse takes an appreciable time to melt. Let's just say you'd be *less* likely to ruin a transistor when the set is being powered by an eliminator than you would when a battery was furnishing the current."

"Sounds to me as though we're getting pretty transistor-minded all at once."

"That we are and I think this is precisely the time we should. We have to keep in mind that the attitude of a practical service technician toward new electronic developments has to be considerably different from that of an experimenter or hobbyist. The latter start working with the new device as soon as they can get their hands on it, but the wise service technician knows that he cannot do this and still take care of his bread-and-butter job the way he should. He has just about all he can do to keep abreast of the new circuits that are constantly being thrown at him by radio, TV, and hi-fi manufacturers. When and if the new development proves itself and is incorporated in the equipment the tech-

(*Continued on page* 119)

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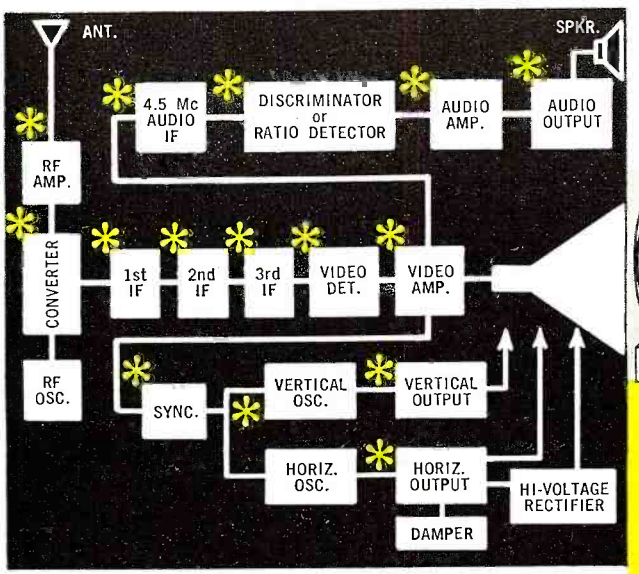

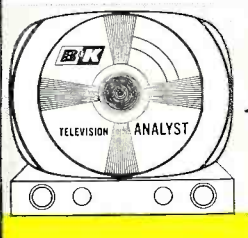

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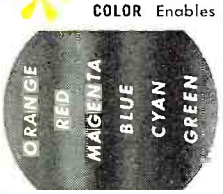
AUDIO Provides a 4.5 mc sound channel, FM modulated with approximately 25 kc deviation. (This audio carrier is modulated either from a built-in 400 cycle tone generator, or from your own external audio source.) Injection of the 400 cycle tone signal simplifies trouble-shooting of the audio section.

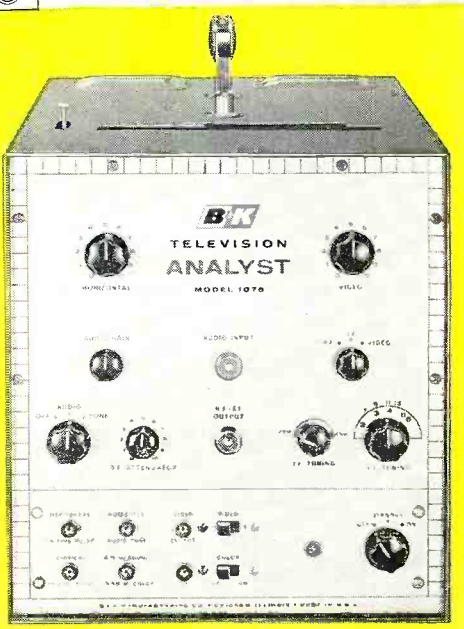
COLOR Enables you to trouble-shoot and signal trace color circuits in color TV sets.



Generates white dot and crosshatch patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow pattern of orange, red, magenta, blue, cyan, green to test color sync circuits, check range of hue control, align color demodulators, etc.

SET ADJUSTMENT Enables you to check and adjust the vertical and horizontal linearity, size and aspect ratio of television receivers.



NEW B&K MODEL 1075

QUICK, DIRECT, COMPLETE TV TROUBLE-SHOOTING

Now, by point-to-point signal injection and test pattern reproduction, you can easily trouble-shoot and signal trace *any stage throughout the video, audio and sweep sections* of black & white and color TV receivers. With the remarkable new Model 1075 B&K TELEVISION ANALYST, you can quickly isolate and diagnose TV troubles (including intermittents). By use of the generated test pattern, you can *actually see* the condition directly on the picture tube of the television set itself. No external scope is needed. The TELEVISION ANALYST is practically a *complete* TV service shop *in one instrument!* Net, **$259.95**

See your B&K Distributor or write for Bulletin 1075-N

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois

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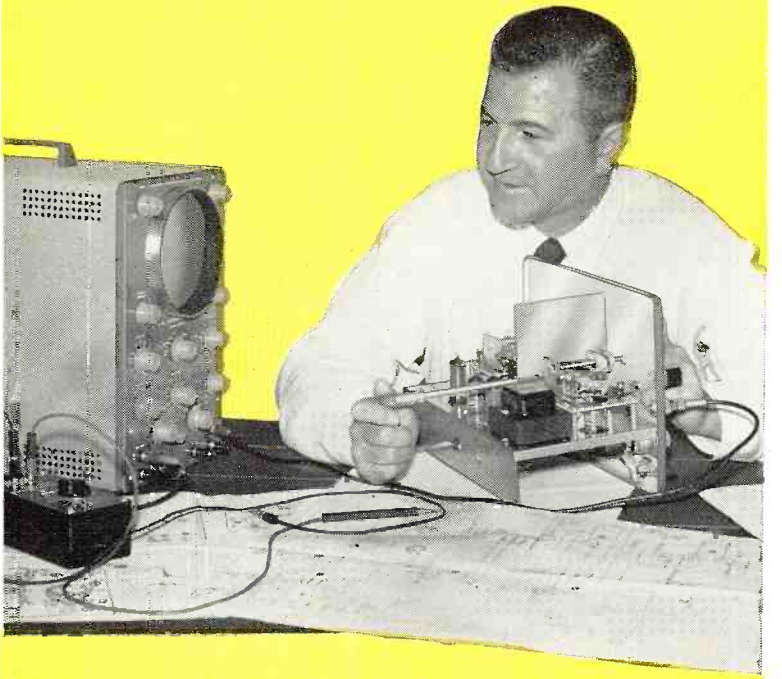
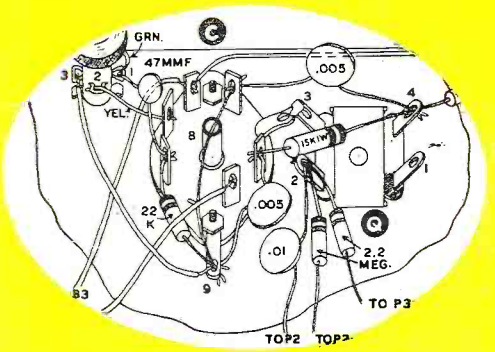
DICK JURGENS and his band have played in virtually every state in the union, and just about every important hotel, night club, theater, and one-night stand, in the country, has echoed to the sounds of his music. He has done a number of radio shows, and made over five-hundred recordings with Columbia Records in seventeen years. He was head of the first all-marine entertainment unit during World War II, and toured the South Pacific for almost two years with this group. His own band was reorganized again after the war. Dick Jurgens was co-author of such hit tunes as: "One Dozen Roses", "Elmer's Tune", "Careless", "If I Knew Then", "A Million Dreams Ago", and his theme song, "Daydreams Come True at Night." He has come a long way in the world of music and entertainment since his first "big time" engagement at the St. Francis Hotel in San Francisco some years ago, and is now well known for his musical talents.

A lesser known side of Dick Jurgen's life, however, is his interest and ability in electronics—that had its beginnings in the late 20's, and has continued as his main hobby until the present time. Dick has built about twenty-five Heathkits, and considers electronics his serious hobby. He especially likes test equipment and high fidelity projects, and hopes some day to make a business of his electronics interests. We are quite proud to list Dick Jurgens among our "do-it-yourself" customers.

everybody's doing it!





You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

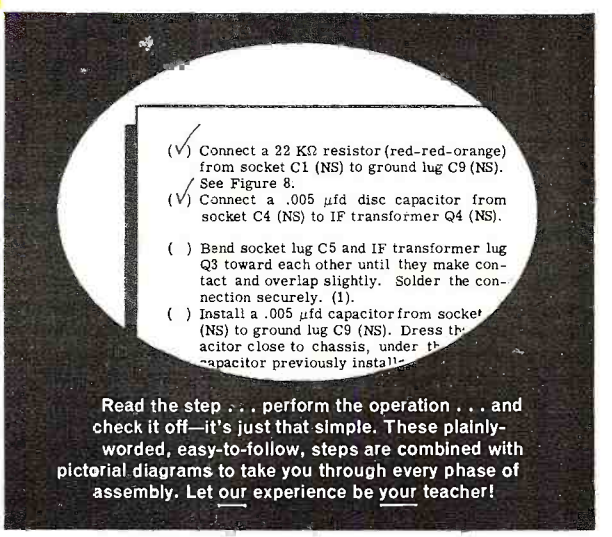
Heathkits®

By DAYSTROM

...fun to build and a thrill to own!

and here's why...

1. You get higher quality at lower cost by dealing direct, and by doing your own assembly.
2. You receive personal, friendly, service (before and after sale) for complete satisfaction.
3. You benefit from the latest in engineering designs because of our concentration on kit-form equipment only.
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.



Read the step . . . perform the operation . . . and check it off—it's just that simple. These plainly-worded, easy-to-follow, steps are combined with pictorial diagrams to take you through every phase of assembly. Let our experience be your teacher!

TIME PAYMENTS . . .

The Heath Time Payment Plan was designed for your convenience. Now, you can order the kits of your choice, and pay for them in small monthly installments. Write for full details.

HEATHKIT EXTRA PERFORMANCE 70-WATT AMPLIFIER KIT

For really high performance, with plenty of reserve power, the W-6M is a natural. The full 70-watts output will seldom, if ever, be required. However, this reserve insures distortion-less sound on power peaks. The W-6M will loaf along at normal listening levels and yet is always ready to extend itself when program material demands it, without the least amount of strain. The output circuit employs 6550 tubes with a special-design Peerless output transformer for maximum stability at all power levels. A quick-change plug selects 4, 8 and 16 ohms or 70-volt output and the correct feedback resistance. A variable damping control is also provided for optimum performance with any speaker system. Extremely good power supply regulation is possible through the use of a heavy-duty transformer along with silicon-diode rectifiers, which are noted for their very long life, and yet are smaller than a house fuse. Frequency response at 1 watt is ±1 db from 5 cps to 80 kc with controlled hf rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 cps and IM distortion below 1%, 60 and 6,000 cps. Hum and noise 88 db below full output. In addition to high performance, its fine appearance makes it a pleasure to display in your living room. Proper layout of chassis insures ease of assembly by eliminating those cramped and difficult places to get at. Clear instructions—and top-quality components. Get started now and make this amplifier the heart of your hi-fi system. Shipped express only. Shpg. Wt. 50 lbs.

MODEL W-6M

$109.95

MODEL W-6: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. $129.70

HEATHKIT HIGH FIDELITY FM TUNER KIT

This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascode RF amplifier, and has AGC. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-3A

$25.95 (with cabinet)

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ±1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from 550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 UV. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A

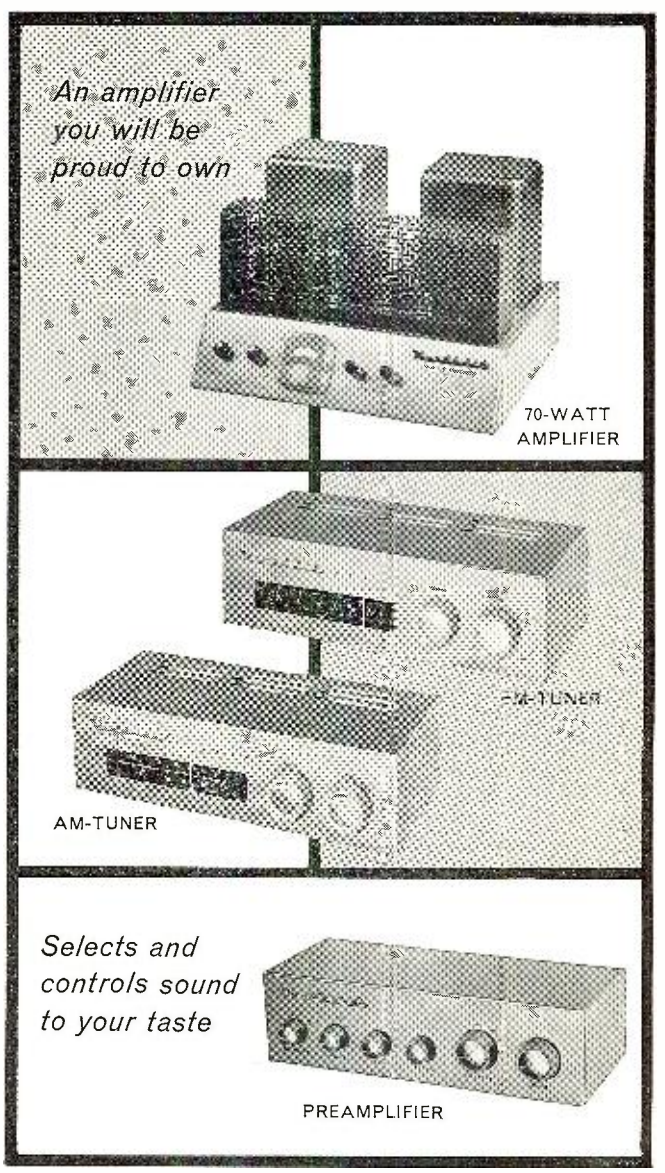
$25.95 (with cabinet)

HEATHKIT MASTER CONTROL PREAMPLIFIER KIT

Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or fading while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within ±1½ db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

MODEL WA-P2

$19.75 (with cabinet)



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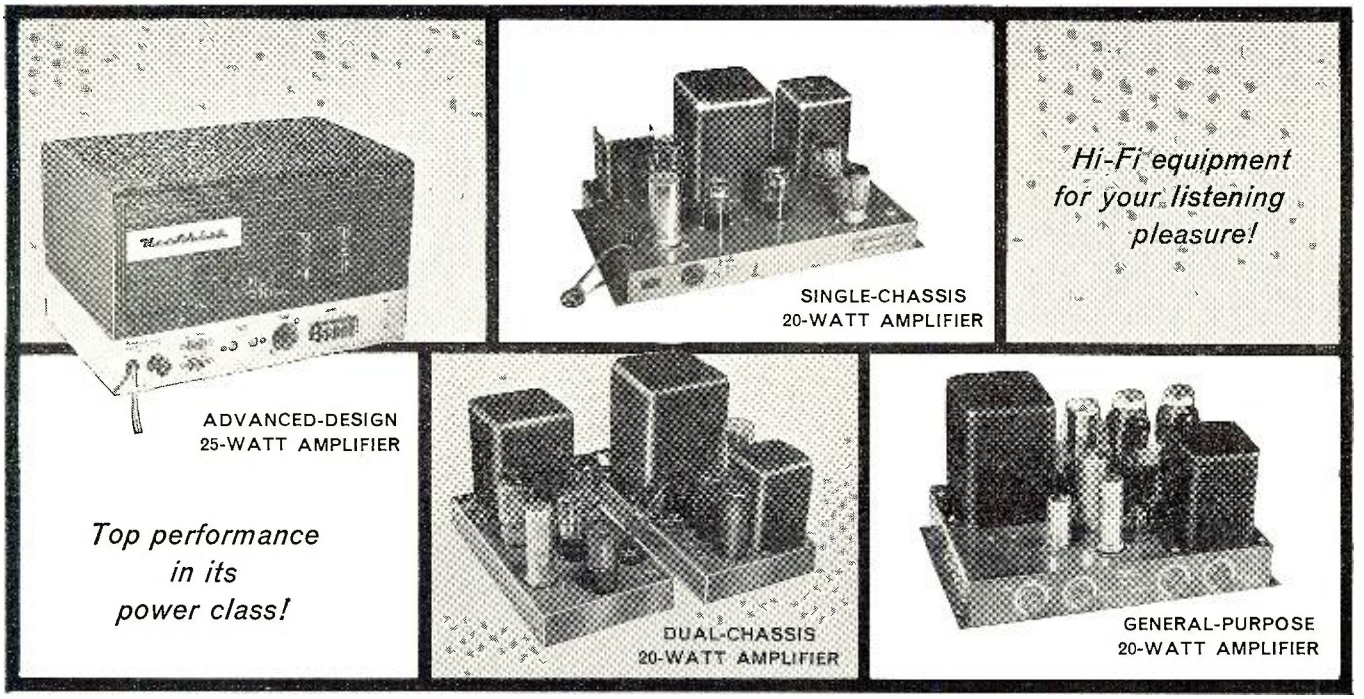

HEATHKIT ADVANCED-DESIGN 25-WATT HIGH FIDELITY AMPLIFIER KIT

Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to compliment the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of ±1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bal" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. $79.50

MODEL W-5M
$59.75

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ±1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50.

MODEL W4-AM
$39.75

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

MODEL W-3AM
$49.75

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bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ±1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C
$35.50

HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ±5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11½" H x 23" W x 11¾" D. Constructed of veneer-surfaced plywood, ½" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

MODEL SS-1

$39.95

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Extends the range of the SS-1 to ±5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17½" D. Constructed of veneer-surfaced plywood ¾" thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B

$99.95

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let you save up to ½ or more on all types of electronic equipment.

HEATHKIT SINE-SQUARE GENERATOR

The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are; radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ±1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

MODEL AG-10

$49.95

HEATHKIT AUDIO ANALYZER KIT

The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-.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 and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

MODEL AA-1

$49.95

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

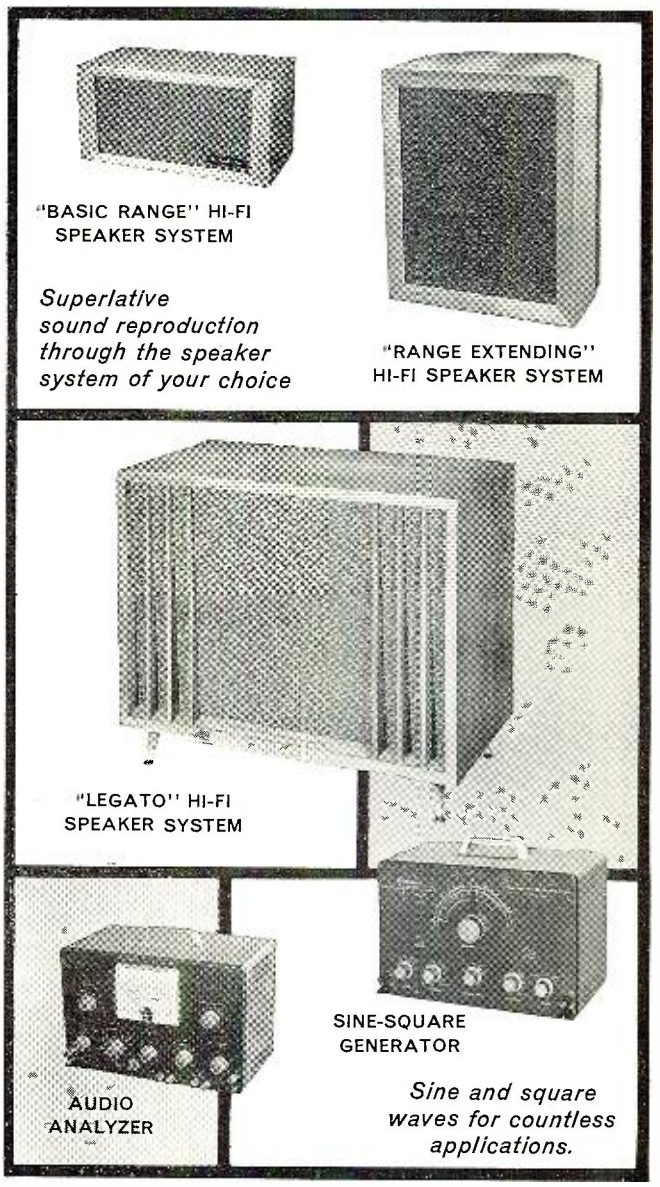
The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, ¾" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22¼" D x 34" H.

Choice of two beautiful cabinets. Model HH-1-C in imported white birch for light finishes, and HH-1-CM in African mahogany for dark finishes. Shpg. Wt. 195 lbs.

MODEL HH-1-C
MODEL HH-1-CM

$325.00

EACH



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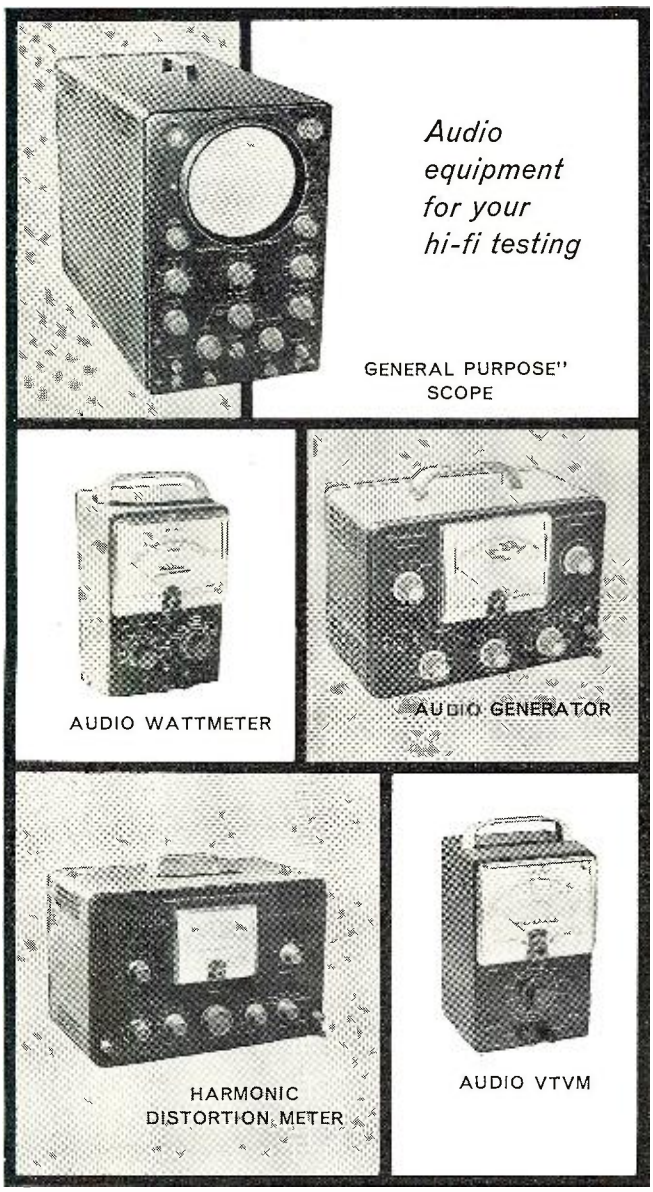


HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch crt, and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2

$42.50

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover −10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1

$29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1,3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A

$34.50

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1

$49.50

Heathkits...

By DAYSTROM

are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3

$29.95

HEATHKIT COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white-dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs.

MODEL CD-1

$59.95

Heathkits...

By DAYSTROM

are guaranteed to meet or exceed advertised specifications

HEATHKIT TV ALIGNMENT GENERATOR KIT

This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs.

MODEL TS-4A

$49.50

HEATHKIT "EXTRA DUTY" 5" OSCILLOSCOPE KIT

This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a 5UP1 CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within +1.5 and −5 db from 3 CPS to 5 MC. Response at 3.58 MC down only 2.2 db. Sensitivity is 0.025 volts RMS/inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in an oscilloscope of this type. Shpg. Wt. 21 lbs.

MODEL O-11

$69.50

HEATHKIT ELECTRONIC SWITCH KIT

A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ±1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs.

MODEL S-3

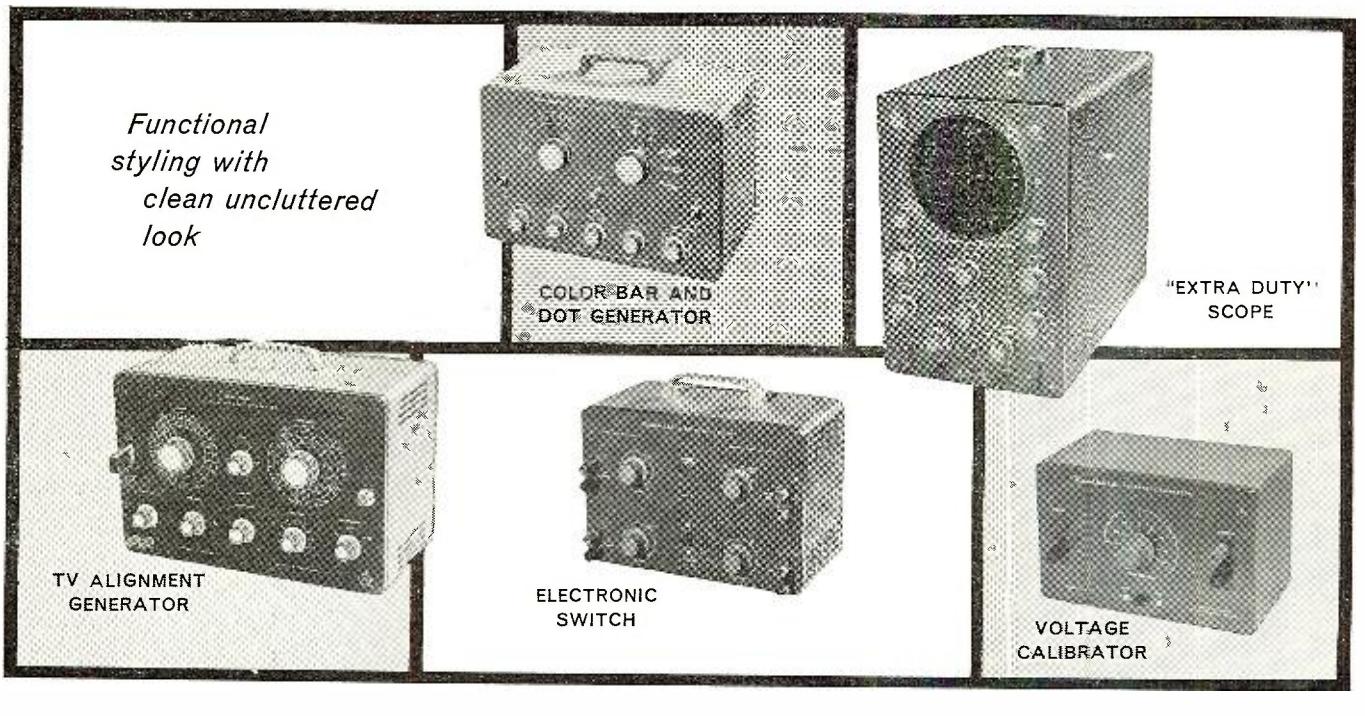
$21.95

HEATHKIT VOLTAGE CALIBRATOR KIT

This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurment of unknown signal amplitude by comparing it to the known output of the VC-3 on oscilloscope. Shpg. Wt. 4 lbs.

MODEL VC-3

$12.50



HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT TUBE CHECKER KIT

Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorted elements, open elements, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multicolor "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2

$29.50

HEATHKIT HANDITESTER KIT

The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. 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 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Slips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1

$17.95

HEATHKIT PICTURE TUBE CHECKER KIT

The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or cartons if desired. Checks cathode emission, beam current, shorted elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadowgraph" test. Permanent test cable with CRT socket and anode connector. No tubes to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1

$24.95

HEATHKIT ETCHED-CIRCUIT VTVM KIT

This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The V7-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7 lbs.

MODEL V7-A

$24.50

Heathkits...

By DAYSTROM

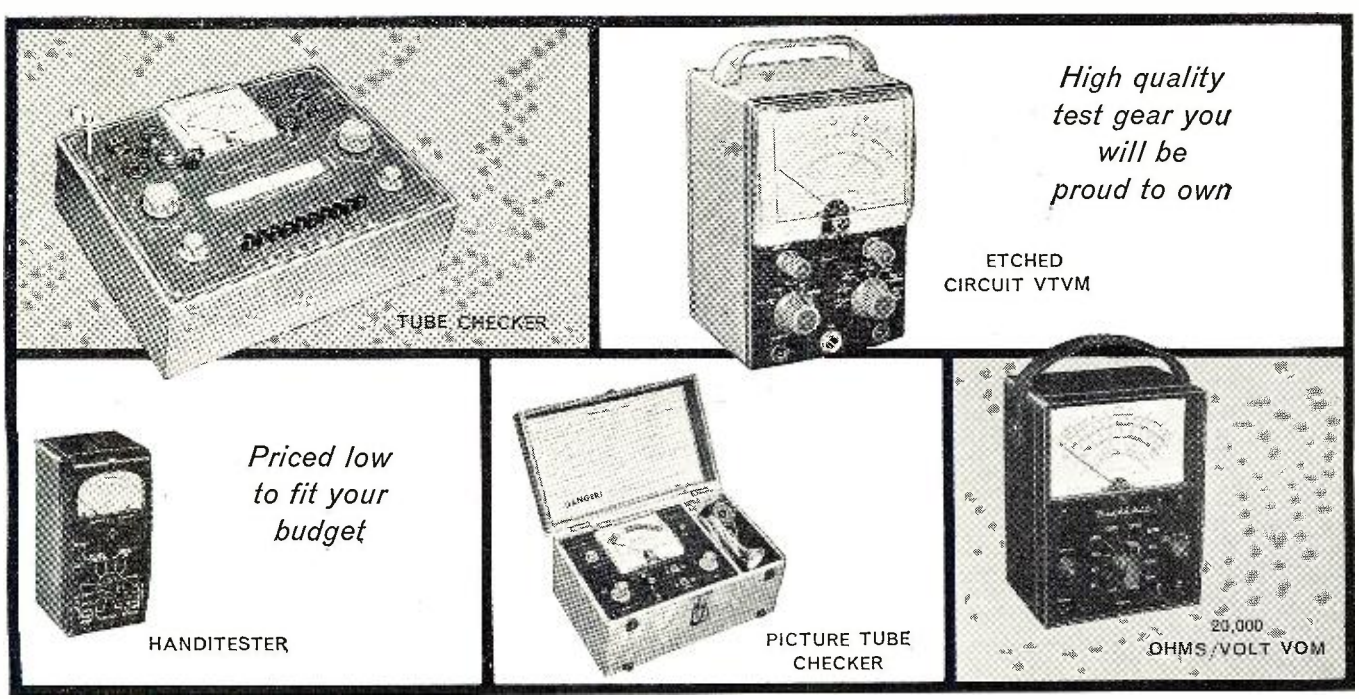
let you fill your exact needs from a wide variety of instruments

HEATHKIT 20,000 OHMS/VOLT VOM KIT

This fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a 50 ua 4½" meter, and features 1% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers −10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 6 lbs.

MODEL MM-1

$29.95



HEATHKIT RF SIGNAL GENERATOR KIT

Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8
$19.50

HEATHKIT LABORATORY RF GENERATOR KIT

Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1
$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT

Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1
$29.50

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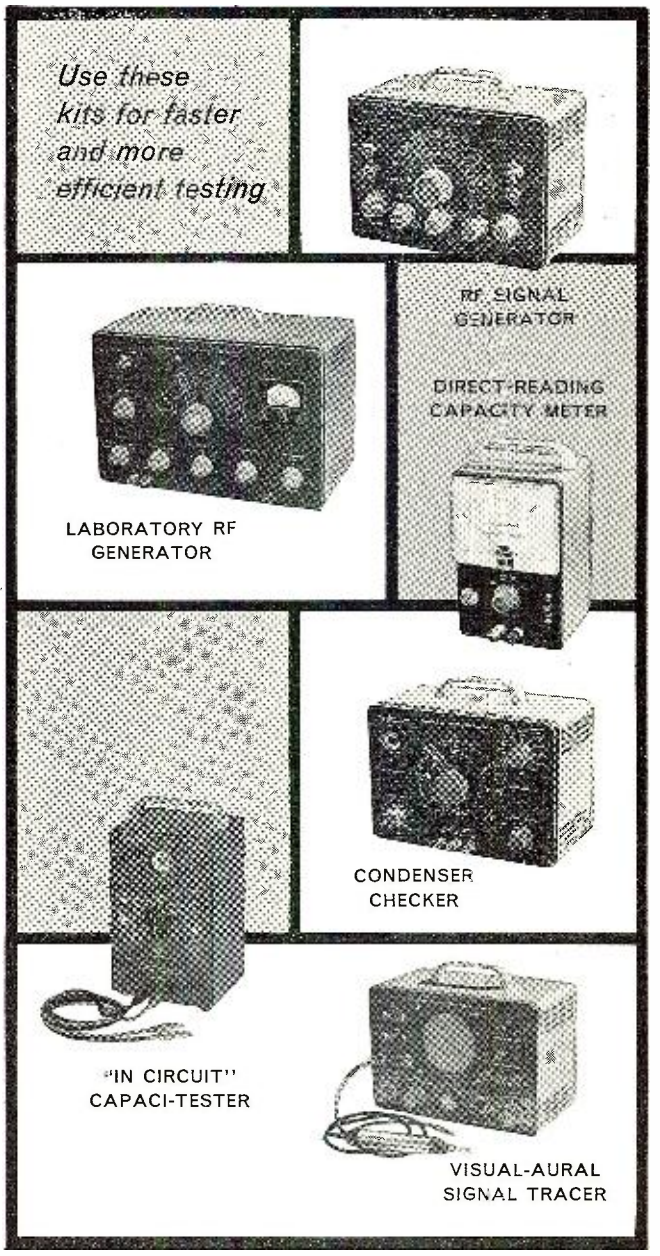
are educational
as well as functional

HEATHKIT "IN-CIRCUIT" CAPACI-TESTER KIT

With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1
$7.95



HEATHKIT CONDENSER CHECKER KIT

This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3
$19.50

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and/or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3
$23.50

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

MODEL IB-2A

$59.50

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than .3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

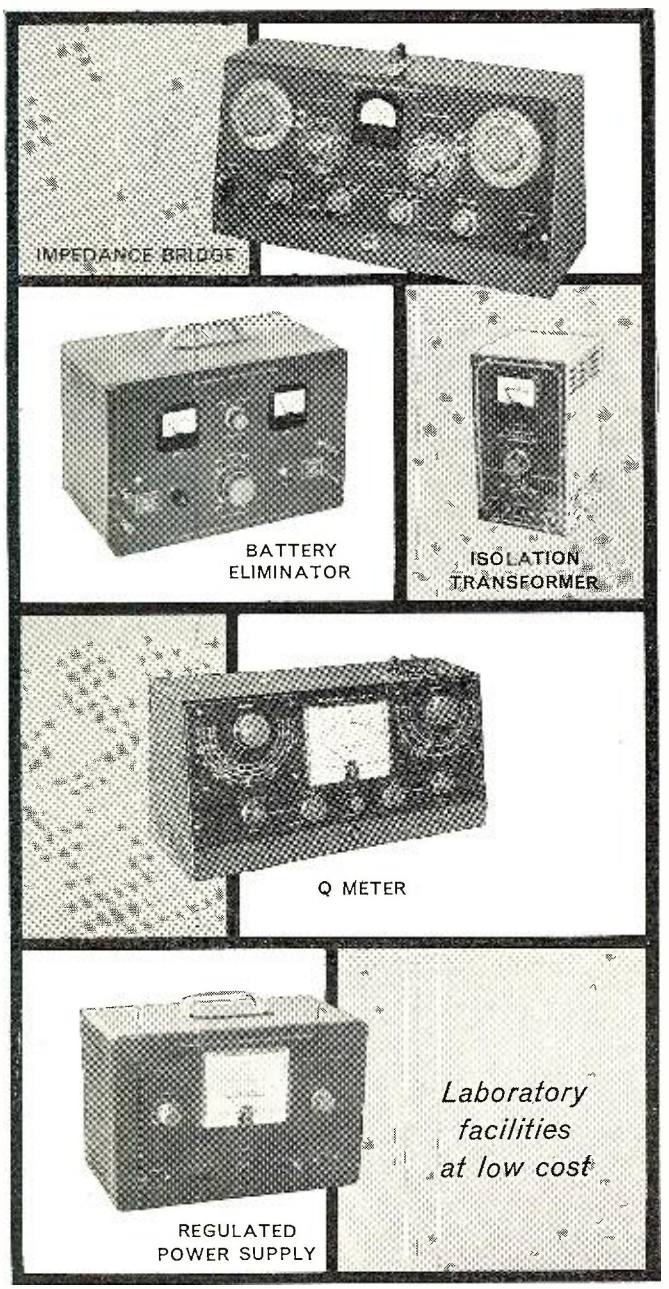
$39.95

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

$16.50



Heathkits...

By DAYSTROM

are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 milihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf ± 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. 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. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

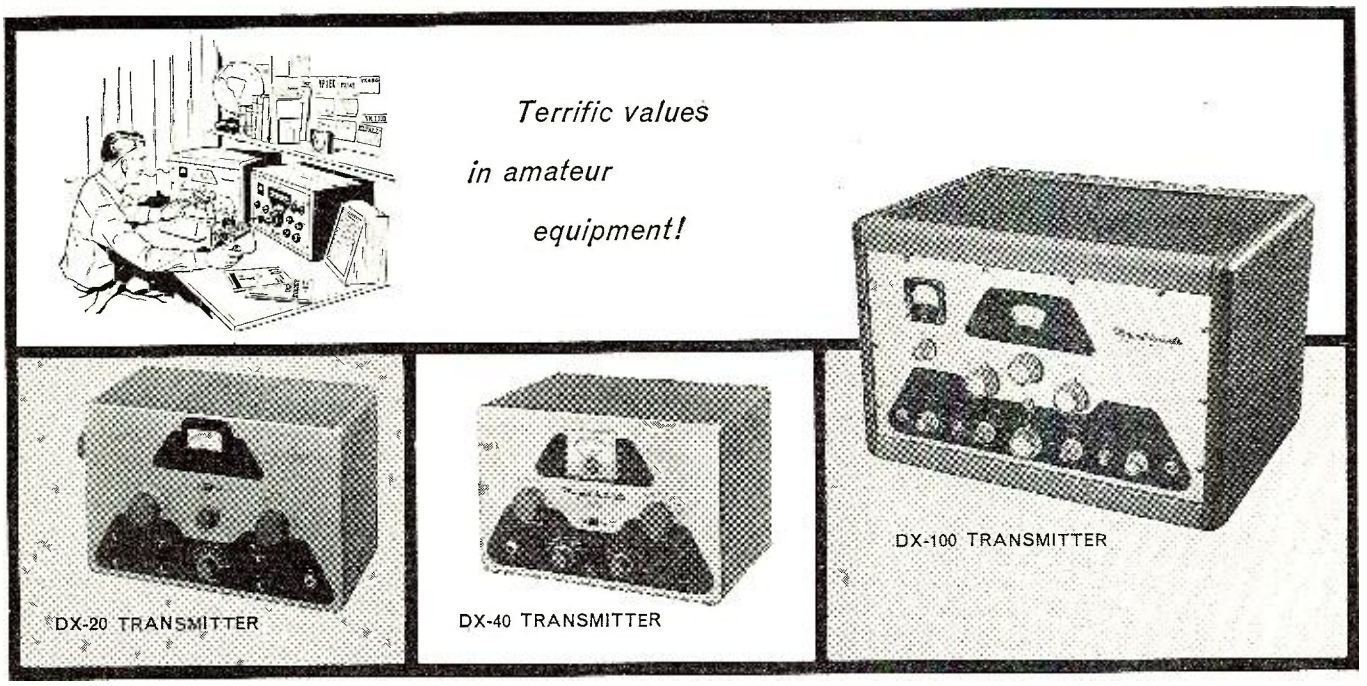
$44.50

HEATHKIT REGULATED POWER SUPPLY KIT

Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filaments. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

$35.50



HEATHKIT DX-20 CW TRANSMITTER KIT

The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DQ6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

MODEL DX-20
$35.95

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are designed by licensed ham-engineers, especially for you

HEATHKIT DX-40 PHONE AND CW TRANSMITTER KIT

A most remarkable power package for the price, the new DX-40 provides both phone and CW facilities for operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 75 watt plate power input on CW, or control carrier modulation peaks up to 60 watts for phone operation. Modulator and power supplies are built right in and single knob bandswitching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. A 4-position switch provides convenient selection of three different crystals or a jack for external VFO. The crystals are reached through access door at rear of cabinet. You can build this rig yourself and be proud to show it off to your fellow hams. Get your DX-40 now for many hours of operating enjoyment. Shpg. Wt. 25 lbs.

MODEL DX-40
$64.95

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT

Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

MODEL DX-100
$189.50

FUNCTIONAL DESIGN . . .

The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.

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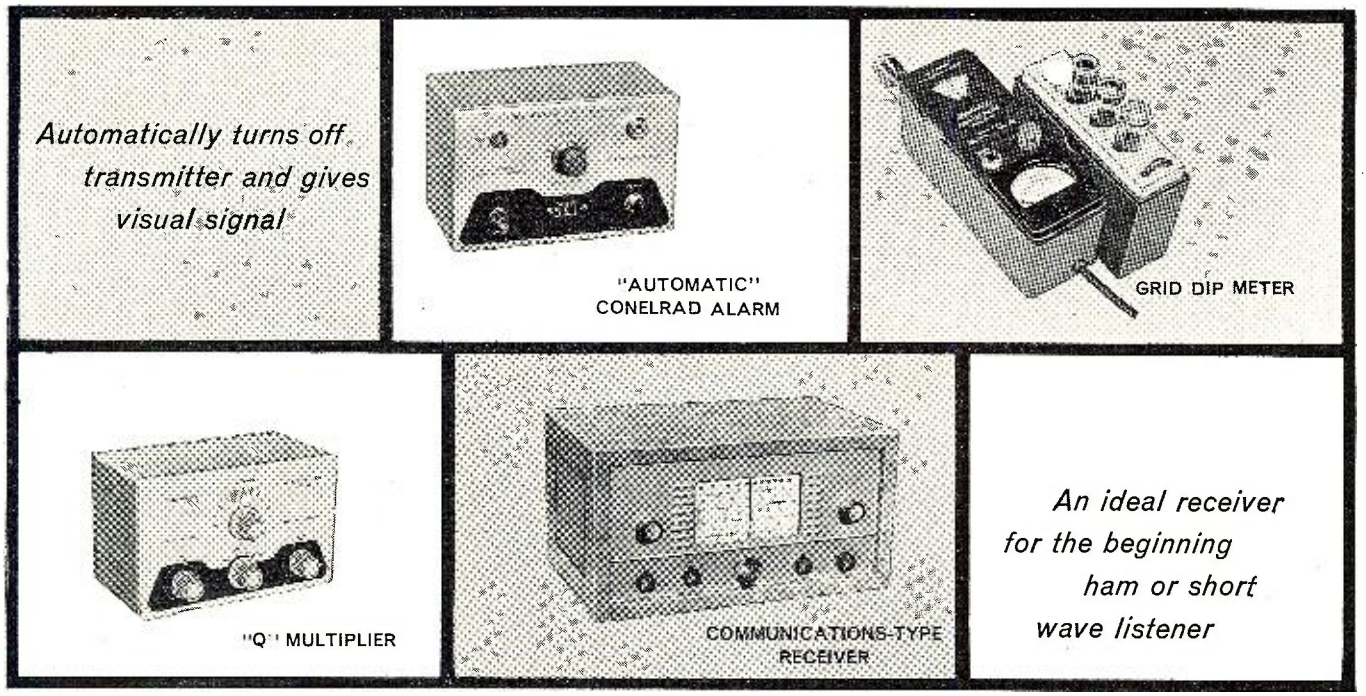

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT

This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

MODEL CA-1
$13.95

HEATHKIT "Q" MULTIPLIER KIT

The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

MODEL QF-1
$9.95

HEATHKIT GRID DIP METER KIT

A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

MODEL GD-1B
$21.95

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.00

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT

This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

MODEL AR-3
$29.95
(Less cabinet)

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

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are outstanding in performance and dollar value

HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2

$15.95

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 miliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1

$19.50

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are the answer for your electronics hobby.

HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1

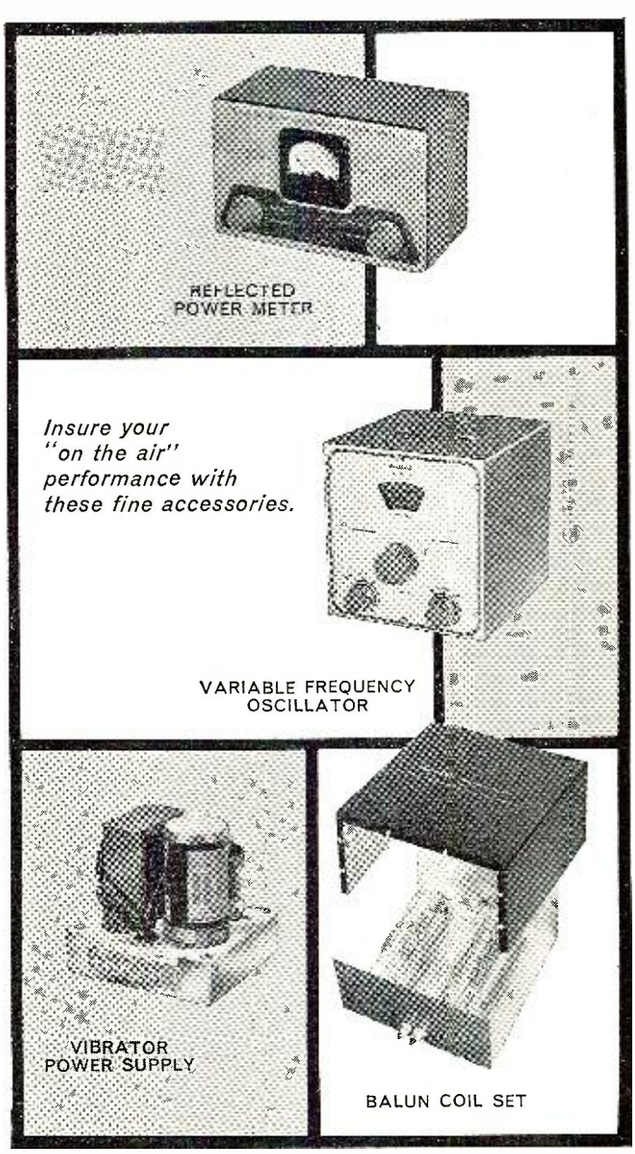
$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12.volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 miliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT
MODEL VP-1-6
12 VOLT
MODEL VP-1-12

$7.95 *Each*



HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

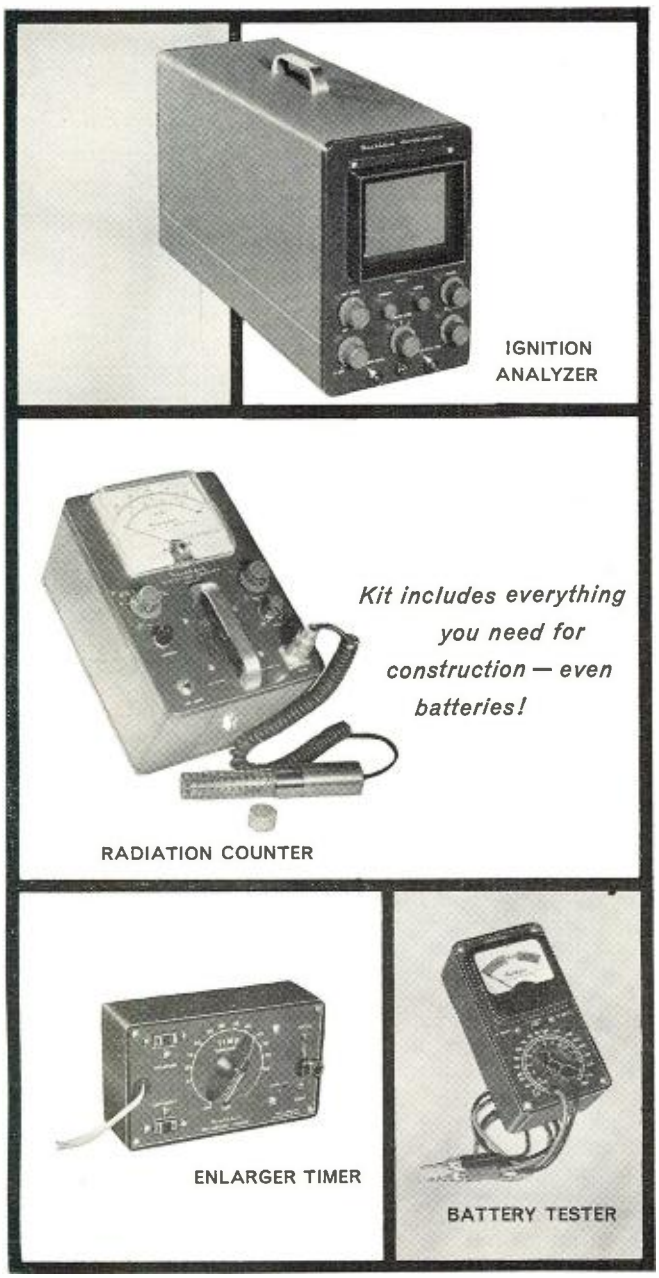
Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The wave form produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed, and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1
$59.95

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-.02, .1, 1 and 10 miliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1
$79.95



Heathkits...

By DAYSTROM

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

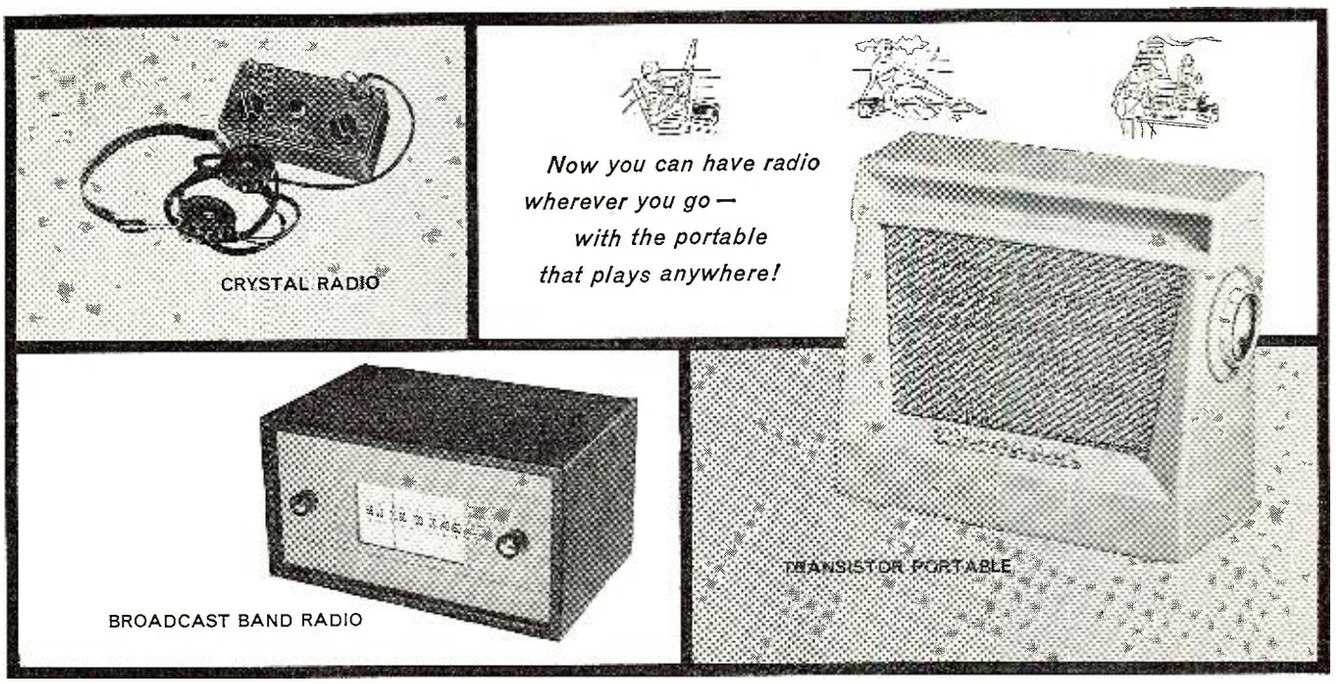
The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1
$11.50

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-weak-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1
$8.50



HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

MODEL CR-1
$7.95

Heathkits...

By DAYSTROM

are easy and fun to build, and they let you learn by "doing-it-yourself"

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3¾" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

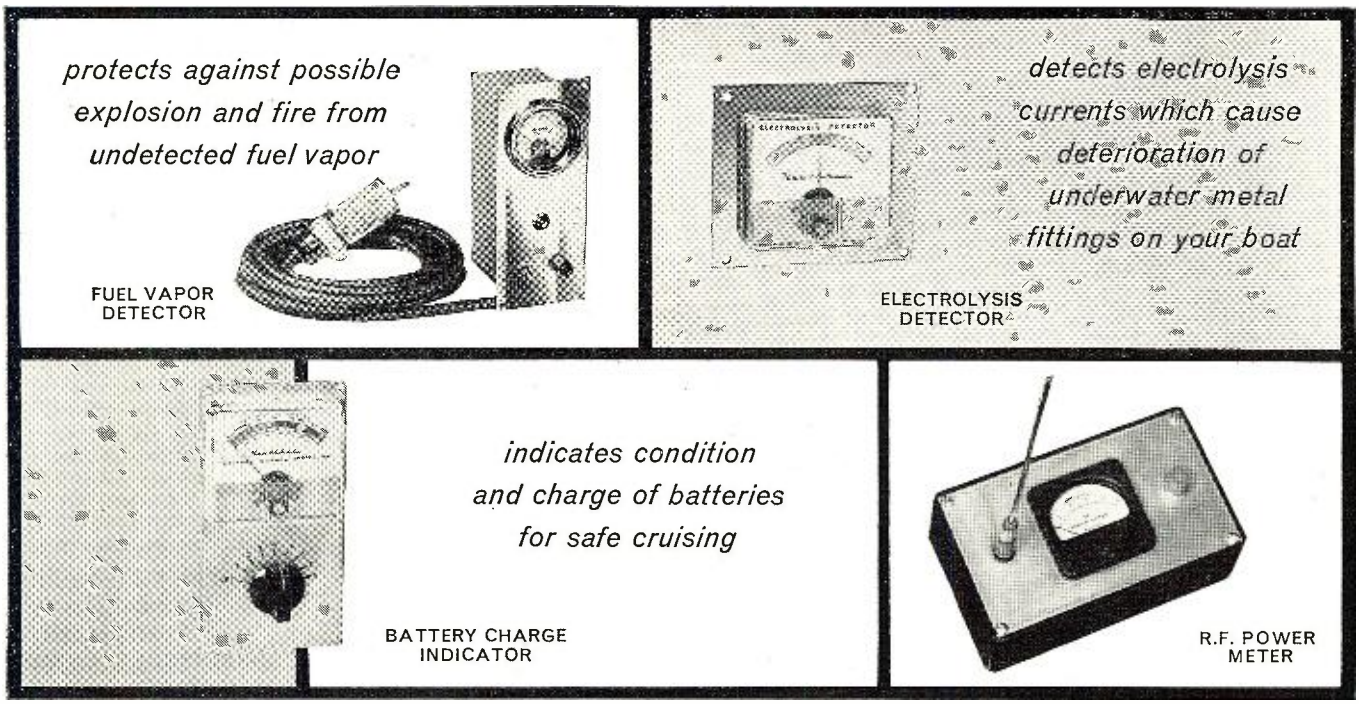
MODEL XR-1
$34.95
(Less batteries)
(With cabinet)

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5½" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. $4.95.

MODEL BR-2
$18.95
(Less cabinet)



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Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

6 volt MODEL FD-1-6
12 volt MODEL FD-1-12
$35.95 EACH

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8"W x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

MODEL CI-1
$16.95

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

MODEL ED-1
$9.95

HEATHKIT RF POWER METER KIT

The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3¾" W x 6¼" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

MODEL PM-1
$14.95

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MODEL DF-1

$54.95

TRANSISTOR
RADIO DIRECTION FINDER

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By DAYSTROM

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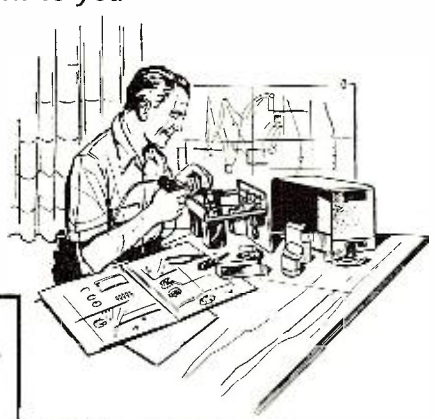

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Certified Record Revue

by Bert Whyte

AS 1957 passed into limbo, the almost universal and dominant subject of the record industry was the monogroove stereo disc. That the stereo disc should become such a matter of prominence is not surprising—after all, as the most aesthetically satisfactory means of musical reproduction, the stereo disc carries within itself the seeds of a great new industry.

What was a little surprising, however, was the rapid acceleration of interest and fast-moving developments in the stereo disc during the last few weeks of the year. Supposedly, the various types of stereo discs were under study and discussion by various industry groups, with the avowed purpose of determining which system was the best and most desirable. On the results of these studies an industry-wide meeting was to be held and the system of choice was to be voted as the universal standard for stereo disc recording. By the time you read this, that meeting may have taken place and the stereo disc standard may be a reality. If this has happened . . . it is much sooner than anyone anticipated.

A little background on this may be of interest to you. When the *Westrex* and *London* stereo discs were demonstrated at the October AES convention in New York, all the record companies who were members of the RIAA, resolved that there would be no repetition, with the stereo disc, of the disastrous situations imposed on company and public in the early days of the LP record. The internecine "speed war" of that period had the industry and the public in an uproar and before the "war" was ended, a great deal of money was lost and, along with it, a great deal of public good-will. So the idea of an industry-wide approach and a mature and intelligent handling of the stereo disc was greeted on all sides with approbation. Oh, there were cynical eyebrows raised . . . there were those who felt that the record industry was, to put it mildly, "highly competitive" and that the "dog-eat-dog" participants would make strange bedfellows indeed!

In spite of this, the industry kept its resolve and the stereo program got under way without any defections. Everything seemed to go along smoothly and then the first chinks in the armor began to appear. Rumors began to circulate that so-and-so was favoring the *Westrex* system or that such-and-such was "definitely" going to switch to the *London* system, etc., etc. Soon, some of the rumors began to have some foundation and the pressures began to build up and then the stereo "peace pact" was rudely shaken by a story which appeared in the show business weekly "Billboard." *Audio Fidelity Records,* a small independent record company well-known in hi-fi circles, announced that it was issuing the first stereo disc and that it would be cut in the *Westrex* system. In a later story in "Retailing Daily," this announcement was expanded to the point where the company was issuing 11 stereo discs in January 1958, all in the *Westrex* system. This was quickly followed by *Fairchild* announcing the availability of a stereo cartridge and arm to play *Westrex*-type stereo discs.

After some of the smoke cleared away, there were some modifications of the original stories concerning the discs, with phrases like "misquote" being bandied about. *Audio Fidelity* contended that it had merely made the disc as an investigational tool for use by pickup manufacturers. Whatever the reason, it did indeed furnish a means of demonstrating stereo cartridges and *Fairchild* quickly took advantage of this fact. Not long afterwards, *Pickering & Co.* demonstrated its stereo cartridge which also espoused the *Westrex* cause. *Pickering* emphasized however, that the cartridge was *not* commercially available and that it intended to wait the outcome of the industry meeting on stereo standards and to abide by whatever standard was chosen. But still the snowball was rolling . . . it was purported that stereo cartridges were in the works at *Brush, Electro-Voice,* and *Webcor,* and, in all cases, they were to be utilized with the *Westrex* system.

Your reporter was very kindly invited to *Fairchild's* laboratories where I was fortunate enough to hear a stereo disc demonstration. The *Fairchild* stereo disc playback equipment is quite interesting. The arm used is the large studio turret head type which is found in many broadcasting stations. The cartridge is a novel design, utilizing two moving coils to pick up the "45-45" groove modulations of the *Westrex* system. Reduced to its most simple geometry, the *Westrex* system can be likened to two vertical channels. In the *Fairchild* cartridge there is a very clever "decoupling" or isolation circuit which is used to separate the left and right channels. With this design the claimed cross-modulation figures are on the order of minus 30 db and as I listened to the *Audio Fidelity* stereo disc and to some of the original *Westrex* material which was used at the AES convention, from audible evidence at least, this figure would seem realistic.

The *Audio Fidelity* disc turned out to be quite good. One side was the well-known "Dukes of Dixieland" and the other side was devoted to steam railroad sounds. The left-right separation was good although, as a whole, the directionality feature was overdone. Frequency and dynamic range seemed quite normal and I was again impressed by the very good signal-to-noise ratio of the stereo disc. The *Fairchild* stereo cartridge is at present quite a bit larger than its conventional 225 units and for this reason the large studio arm is used. Engineering on the stereo unit is continuing with a view towards reducing the size to normal limits but the present arm and cartridge works very well and it is actually available to those affluent people who can afford the rather breathtaking 250 dollar price tag. But, then, there are always those who want to be "fustest with the mostest."

Pickering & Co. was also kind enough to invite me to a stereo demonstration . . . in fact I attended two separate demonstrations. One, the first, was held at the *Pickering* laboratories and the other was at the Park Sheraton Hotel in New York in company with many worthy cohorts from the hi-fi press corps. Of the two, I was impressed most of all by the private demonstration, because *Pickering* had set up its stereo demonstration in a room closely approximating normal living room dimensions and the room was treated with draperies and carpeting greatly aiding the stereo reproduction. The playback system may be of interest . . . each channel was a *Marantz* preamp feeding into a 60-watt *McIntosh* and this driving a large infinite baffle with 15" *Wharfedale* speaker for the woofer and crossing over at 400 cycles into the new model of *Pickering's* large electrostatic speaker. A standard *Garrard* transcription turntable was used to spin the disc and a conventional *Pickering* 190D arm was used for the *Pickering* stereo cartridge. The arm and cartridge was *Pickering's* real surprise . . . it was evident that the engineering and development was very well advanced. The cartridge was roughly the same size as a standard *Pickering* "Fluxvalve" and the arm a completely standard production unit. The cartridge itself employs the principle of two moving irons with, of course, a means of decoupling for minimum cross-modulation. The cartridge utilizes a one-half mil stylus and tracks at approximately two grams. *Pickering* advised me that tests had been conducted with the cartridge in a changer, in which a one mil stylus is used at a stylus force of 4 or 5 grams. The significant thing here, of course, is that *Pickering's* cartridge has already been reduced to dimensions sufficiently small for use in standard hi-fi equipment.

I listened once again to the *Audio Fidelity* disc and to some *Westrex* material. The resultant reproduction was absolutely first rate and, in fact, the *Westrex* material which quite frankly had sounded pretty poor and was very noisy at the AES convention, was excellent in this demonstration. The *Audio Fidelity* disc displayed all of the stereo virtues with the *Pickering* cartridge and since this was a brand new pressing, the signal-to-noise ratio was very good.

This business of signal-to-noise ratio on the stereo disc, is to me, one of the most attractive features of the whole process. You must remember that a stereo disc, in common with any disc, is cut from a master tape and in the whole recording process from the lacquer master to the production stamper, you've still only had a one-time duplication. Thus the hiss level of a high quality vinylite record in new condition is generally not too far removed from the hiss level of the master tape. In other words, given first-rate playback equipment and a good stereo disc, it is likely to have less hiss than a commercial stereo tape dub.

The *Pickering* demonstration at the Park Sheraton was very well attended and, although the acoustical environment was not as good as in *Pickering's* plant, the demonstration was quite impressive and well received. In fact, there were a number of comments from the audience that the stereo disc equipment and the resultant demonstration seemed to be of more than acceptable commercial quality and when would the playback equipment become available. This attitude is really the crux of this whole matter. As noted, *Pickering* says that it will await the outcome of the industry decision before going into production on any cartridge. Most other manufacturers say the same thing. Yet for all the laudable intentions of avoiding

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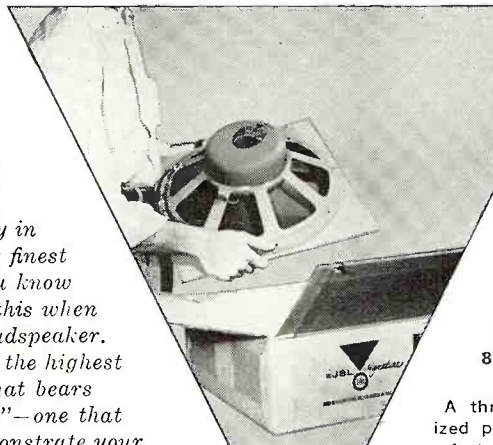

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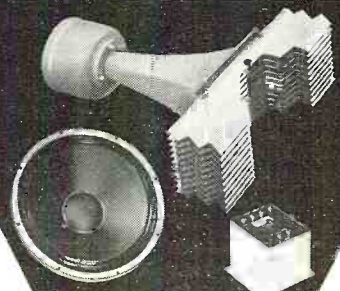

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industry strife, most seem to be paying little more than lip service to the idea. After all, developmental engineering costs money and it may be assumed that since virtually all the manufacturers working on a stereo cartridge have based their prototypes on the *Westrex* system, they are taking what amounts to a "calculated risk" that the *Westrex* system will indeed become the industry standard. Thus, as it stands now, there are some cautious souls who say that anything is possible, that there hasn't been sufficient time to properly evaluate the merits of the various stereo disc systems. They caution against rushing into a system which may look good on the surface but which may present unforeseen problems, such problems being thrust upon the hapless consumer. This reporter is all for precise and thorough investigation, but must frankly admit that I agree with many of the people at the *Pickering* demonstration, that what we heard was without any question "commercial." One thing is certain . . . the industry has a tremendous stake in the stereo disc. There are those who feel, and I think quite rightly, that the stereo disc will be the ticket to that magic land of the "mass hi-fi market." I think it is fairly safe to say that with the advent of the stereo disc, the hi-fi movement will enter its golden age and the real hi-fi boom will begin. Let me hasten to add that I believe all aspects of hi-fi will benefit therefrom, including stereo on tape.

Tape still has inherent advantages as a stereo medium over disc and in the improvements and modifications which are sure to come, the co-existence of tape and disc is reasonable to expect. It is also highly probable that the advent of the stereo disc will hasten research and development towards the ultimate goal of true three-channel stereo on tape. In summing up, unless some unforeseen problem crops up, the "ground swell" of the equipment manufacturers' development of *Westrex* type stereo cartridges, will exert pressure for an early decision on the stereo disc standard and I will be one very surprised guy if at the next New York Hi-Fi Show, there isn't a plentitude of stereo discs and cartridges for their playback!

(Unless otherwise indicated all discs reviewed are 12-inch, 33⅓ rpm long play with RIAA playback equalization. Note: Prices quoted are those in effect when records were received and are subject to change.)

BARTOK
VIOLIN CONCERTO
Yehudi Menuhin, violinist, with Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50140. Price $3.98.

This is, without question, the outstanding violin concerto recording of the past few seasons. The score is sheer magnificence, a musical distillation of the genius that is Bartok. Menuhin displays an extraordinary affinity for the work, most sensitively attuned to its demands, and Dorati, dedicated pupil of Bartok, honors his mentor with a brilliant performance. I was fortunate enough to hear the concert performance of this work at Carnegie Hall, on the occasion of a special all-Bartok program for Hungarian Relief. Menuhin, Dorati, and the Minneapolis were tremendous and richly deserved the accolades the music critics lavished upon them in the morning papers.

But the critics missed the best performance! The same night about an hour after the concert, at approximately midnight, Menuhin once again took bow in hand, Dorati gave the downbeat and thus began the *Mercury* recording session that lasted into the wee small hours. I was invited to the session and as you can imagine, I accepted with alacrity. Now the most astonishing thing was that after having played this complex and exhausting work earlier in the eve-

ning, Menuhin, Dorati, and the orchestra were surpassing their previous effort. There was an almost palpable sense of rapport, a spirit, vigor, and assurance to the playing beyond the earlier conception. Menuhin's steel-fingered, but loving, perusal of the score was virtuosity in its fullest meaning. His technique was impeccable and, when the score permitted, an abundance of his lush rich tone.

The Bartok work is by no means as formidable as many people think. Of course, there is the usual dissonance and atonality and, in some sections, the scoring is very lean and perhaps even a little astringent. But there is also a considerable leaven of typical Bartok folk melodies and a lyric quality that is quite lovely. In the allegro sections we have the rhythmic propulsion that makes Bartok's music so exciting.

Soundwise, this is simply gorgeous. Menuhin's instrument is liquid gold, an undistorted sonic splendor. In the strange but felicitous acoustics of Carnegie Hall. the Minneapolis sound is superb. All is pristine, clean of line and transient, the violin/orchestral balance is nigh perfect, dynamic and frequency range is impressively wide. Recommended without reservation.

PROKOFIEV
CINDERELLA (BALLET)
Royal Philharmonic Orchestra conducted by Robert Irving. Angel 35529. Price $4.98.

This recording fills a gap in the LP catalogue of Prokofiev repertoire. There was a recording of excerpts from the ballet on *Columbia* in the early days of LP but it has been deleted from the LP catalogue for some time. This present recording is handsomely mounted. Irving is an old ballet hand and he affords the work the kind of light-handed, strongly contrasting performance it needs. The playing he elicits from the Royal Philharmonic is really outstanding, both in solo work and in ensemble. The score is one of Prokofiev's most delightful, full of musical whimsy, racy and impudent, an ebullient and effervescent fantasy.

Hi-fi buffs will enjoy the work for its brilliant scoring, employing much brass and it abounds in percussion of all types. The sound, too, is some of the best we have had from *Angel*. Good clean string tone. brilliant brass and woodwind, and the percussion is notable for its accuracy and clean sharp impact. With the medium-close-up recording and the spacious acoustics, detail is sufficient to lend snap and sparkle and enhance the excellent over-all feeling of "presence." A delightfully "different" Prokofiev work, that I assure you will offer any music lover a full measure of enjoyment.

FALLA
NIGHTS IN THE GARDENS OF SPAIN
Gonzalo Soriano, pianist.

RODRIGO
CONCERTO FOR GUITAR AND ORCHESTRA
Narciso Yepes, guitarist. National Orchestra of Spain conducted by Ataulfo Argenta. London LL1738. Price $3.98.

Manuel de Falla's "Nights in the Gardens of Spain," has always seemed to me one of this composer's most brilliant and evocative works. In it he has truly caught the atmosphere of Spain . . . its color and rhythm, its mystery and passion. Because it is so representative, it requires a pianist sensitive to its values and capable of deep expression. This is the 8th recording of the work and I feel that at last we have a recording which comes close to satisfying all requirements. Soriano is not a "big" name among pianists and, in truth, in matters of technique and

tone, there are other pianists in other versions of this work who surpass him on that score. But in this recording Soriano has the essential feel of the work, he responds most expressively to its demands. Most of all, there is an authenticity to his phrasing and dynamics missing from the competing editions. Here too we have the superb support of Argenta, whose star grows ever brighter with each new recording. He has the insight and understanding to cope with the rhythmic complexities of the score and the ability to develop and enhance its Spanish flavor.

Soundwise this is at the head of the class. The piano is slightly favored over the orchestra and is a lovely, clean-toned thing with sharp transients, no harshness or ringing evident. The orchestral sound is big with very clean strings, very fluent smooth woodwind, some rich mellow French horn, and all wrapped in a spacious acoustic frame. Wide frequency range and expressive dynamics help in maintaining the illusion of "presence."

The Rodrigo work is quite interesting and unusual . . . you don't hear concertos for guitar and orchestra very often! The work is on the light side, easily digested and quite entertaining.

For those looking for a slightly off-beat recording with both a different instrumental and musical content, this will be refreshing.

VIVALDI
THE FOUR SEASONS
I Solisti di Zagreb conducted by Antonio Janigro, Jan Tomasow, solo violinist. Vanguard-Bach Guild BG564. Price $3.98.

There have been other recordings of this wondrous Vivaldi work and good ones too . . . there comes to mind the excellent I Musici version for *Epic* and the Giulini/*Angel* disc. Good as they are, they are but pale shadows when compared to the scintillant brilliance of this recording. I have been lavish in praise of the Solisti di Zagreb before . . . on this occasion words fail me. This is simply fabulous. This is transcendental playing . . . a group virtuosity that is hard to believe. Their balance, their phrasing, their tight-knit control is a unique experience.

Of course, no small credit should go to the *Vanguard* engineers. The sound is of the type that upon hearing it, you know at once that this is wide-range high-fidelity sound at its best. The strings are smooth as butter, and yet they have a nice sharp incisive bite when the score demands. Couple this with acoustics perfectly balanced for maximum liveness and you have not only the recording of choice, but one of the prize gems of the year.

POPULAR PIANO MUSIC OF RAVEL AND DEBUSSY
Robert Casadesus, pianist. Columbia ML5213. Price $3.98.

Don't let the title of this scare you away! This is a long way from the tasteless conglomeration the title may imply. Rather, this is a brief compendium of the extraordinary talents of Casadesus, applied to piano works of Debussy and Ravel with which his name has long been associated. I do not mean to stigmatize the word "popular," for although the works recorded herein have certainly been long-time favorites with many people, I feel that the title was ill-chosen and the record might be passed over by the casual observer. The program is neatly balanced . . . Ravel contributing such items as "Pavanne for a Dead Princess." "Fountains," "Habanera," "Ondine," and others . . . and Debussy represented by "The Sunken Cathedral," "Golliwog's Cakewalk." "Reflections in the Water," "Minstrels," and others.

In all of them, Casadesus displays his innate understanding of the music's meaning, his playing is sensitive, expressive yet re-

strained. His tone and temperament are ideally suited for the music's dimensions. The sound is pure delight, with a very luminous, almost transparent piano, clean-lined and free from wow or flutter in the slower sustained passages and holds. A delightful record for easy listening and every bit as "hi-fi" as its more spectacular brethren. Surely, on the strength of this recording, Casadesus inherits the mantle from the late, great Gieseking as the greatest living exponent of the piano music of Ravel and Debussy.

TCHAIKOVSKY
MANFRED (SYMPHONIC POEM)
State Symphony of the USSR conducted by Natan Rakhlin. Westminster YXN-18536. Price $3.98.

This is the third recording on LP of this massive and moody work. Often referred to as Tchaikovsky's "7th symphony," it is surprising that it is so little known, since it has much of the style of writing and orchestral devices that have made this composer's symphonies so popular. Here we have a Russian performance that is heavy on the drama and a little ponderous at times, but is probably closer to the spirit of the work than any of the existing versions.

Soundwise, this is once again that which is becoming less and less a rarity . . . a good Russian tape. This is generally clean with excellent string tone, good bright brass, sharp weighty percussion. This is not as fine-grained a sound as the *Angel* recording, but it is quite acceptable and with the fine performance adds up to a good buy.

BEETHOVEN
SEPTET IN E FLAT (OP. 20)
Chamber Music Ensemble of the Berlin Philharmonic Orchestra. Decca DL9934. Price $3.98.

Before you lovers of the massive symphonies quickly pass this over, try just a little listen to this recording. I think you will be pleasantly surprised to find that given a master like Beethoven, a work of this nature can make some very impressive sounds. The work is one of Beethoven's most ingratiating and few who call themselves music lovers can deny its blandishments. This has beauty of form, is melodious, has plenty of spark and drive. The instrumentalists are obviously top-notch men, as the playing here is nothing but exemplary. The sound is splendid, just the sort of thing that *Deutsche Grammophon* has long been famous for . . . the lovely over-all blend of good individual instrumental detail coupled with an acoustic perspective that enhances "liveness" and smooths out sonic contours. Of its type, a superb recording.

BEETHOVEN
FIVE CONCERTOS
Artur Rubenstein, pianist, with Symphony of the Air conducted by Josef Krips. Victor LM6702. Price $24.90. Five discs.

A monumental undertaking this recording and for the most part quite successful. Needless to say this album could take pages to review if one were to evaluate each concerto *versus* all the existing versions. I think a rather less ponderous idea is to take the concertos as a whole with the over-all impression afforded by the interpretations of one artist. On that basis, this effort of Rubenstein must be adjudged as the best to date. Performance-wise he is variable and is happier with the 4th and 5th concertos than with the first three. To all of them he brings the weight of his forceful personality, that almost brash assurance bolstered by his tremendous technique and characterized by his unflagging drive and spirit. His conception is fuller,

richer, and more "romantic" if one can use that term, than Kempff's complete edition on *Decca,* but does not quite have the depth nor understanding nor grandeur of conception that was peculiarly Schnabel's in his exposition of the five concertos.

Soundwise, this is generally good clean recording with, at times, the piano miked too distant for effectively sharp detail. However, the piano itself is never guilty of ringing, transients are clean, wow and flutter nowhere apparent. Krips, in general, furnishes a sympathetic accompaniment, although some of his tempi are questionable. The orchestral sound is scaled to be big if at times a little formless. Acoustics are a mite overly spacious, which also accounts for some loss of detail. Of course, in comparison to the other two complete editions, this sound is infinitely better . . . and in comparison with many individual Beethoven concerto recordings is equal to many and better than most.

GLIERE
SYMPHONY #3 (ILYA MOUROMETZ)
Houston Symphony Orchestra conducted by Leopold Stokowski. Capitol P8402. Price $3.98.

This recording of Gliere's long, but interesting, symphony based on prehistoric Russian folktales, is notable in several respects. It gives us the first opportunity to hear what Leopold Stokowski has accomplished with the Houston Symphony and it is the Maestro's first modern recording of this work with which he has always been closely identified. As a performance, there is no question of its definitiveness. Stokowski himself, helped Gliere edit the original score into practicable concert length. The Maestro knows its every twist and turn, all its subtleties and nuances, the compass of dynamic expression. All his years of knowledge and experience with this score are effectively realized in this recording. As to the orchestral playing, this was quite a revelation. No, the Houston orchestra is not on the same plane with the Boston or Philadelphia outfits, but the playing as a whole was excellent.

I have heard the Houston Symphony in person on a number of occasions previous to the Maestro's engagement as permanent conductor. While a reasonably proficient group, the improvement noted in this recording is nothing short of astonishing and serves to highlight Stokowski's teaching ability.

In the matter of sound there is some spectacular material here. The work abounds in sections where full and elaborate use of brass and percussion make an almighty sound. Dr. Stokowski has explored the extremes of dynamics on this recording and I think it safe to say that no other *Capitol* recording has ever displayed such crashing fortissimos. However, I must again call attention to some of the odd balances favored by the *Capitol* engineers. The sound is still heavily weighted towards the top and middle at the expense of the bass. But, at least this time, the balance can be restored by judicious use of the bass tone control. something almost impossible with the earlier *Capitol*/Stokowski recordings. All things considered, despite its shortcomings, it is the recording of choice among the existing versions. —30—

TELEPHONE PICKUP AMPLIFIER KIT

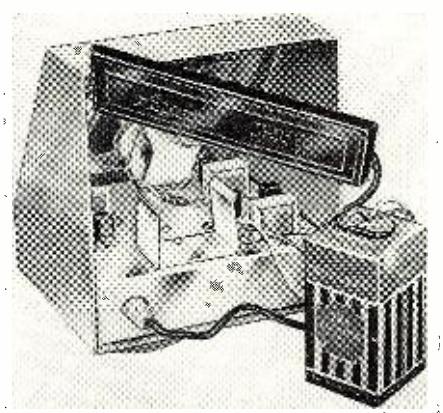
LAFAYETTE RADIO is now marketing a 4-transistor, speaker-operated telephone pickup amplifier in kit form.

Telephone conversations are picked up inductively by means of the coil, amplified, and fed through a 3.2 ohm PM speaker which is housed in a sloping panel metal case.

The circuit features transformer coupling and class B push-pull output. As can be noted from the schematic below, the circuit requires few parts and is free from gimmicks. Argonne transistor transformers are used. The circuit is powered by a single 9-volt battery which fits into a special holder on the rear of the chassis, as can be seen from the photograph.

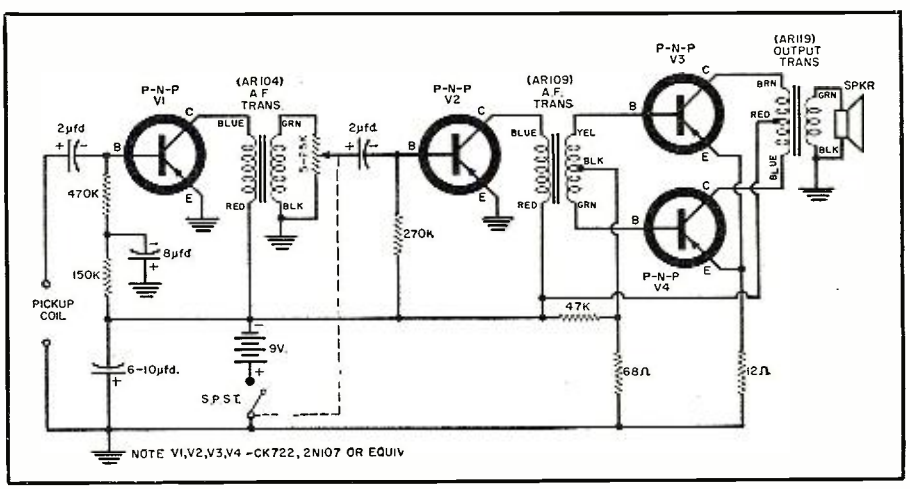
The pickup coil, which slips under the telephone instrument, is supplied assembled while the construction of the device itself is left to the buyer. Complete instructions accompany the kit.

Construction of the unit is quite simple and should pose no problems. —30—



Over-all view of telephone pickup unit.

Complete schematic of pickup. Four inexpensive transistors are used in circuit.



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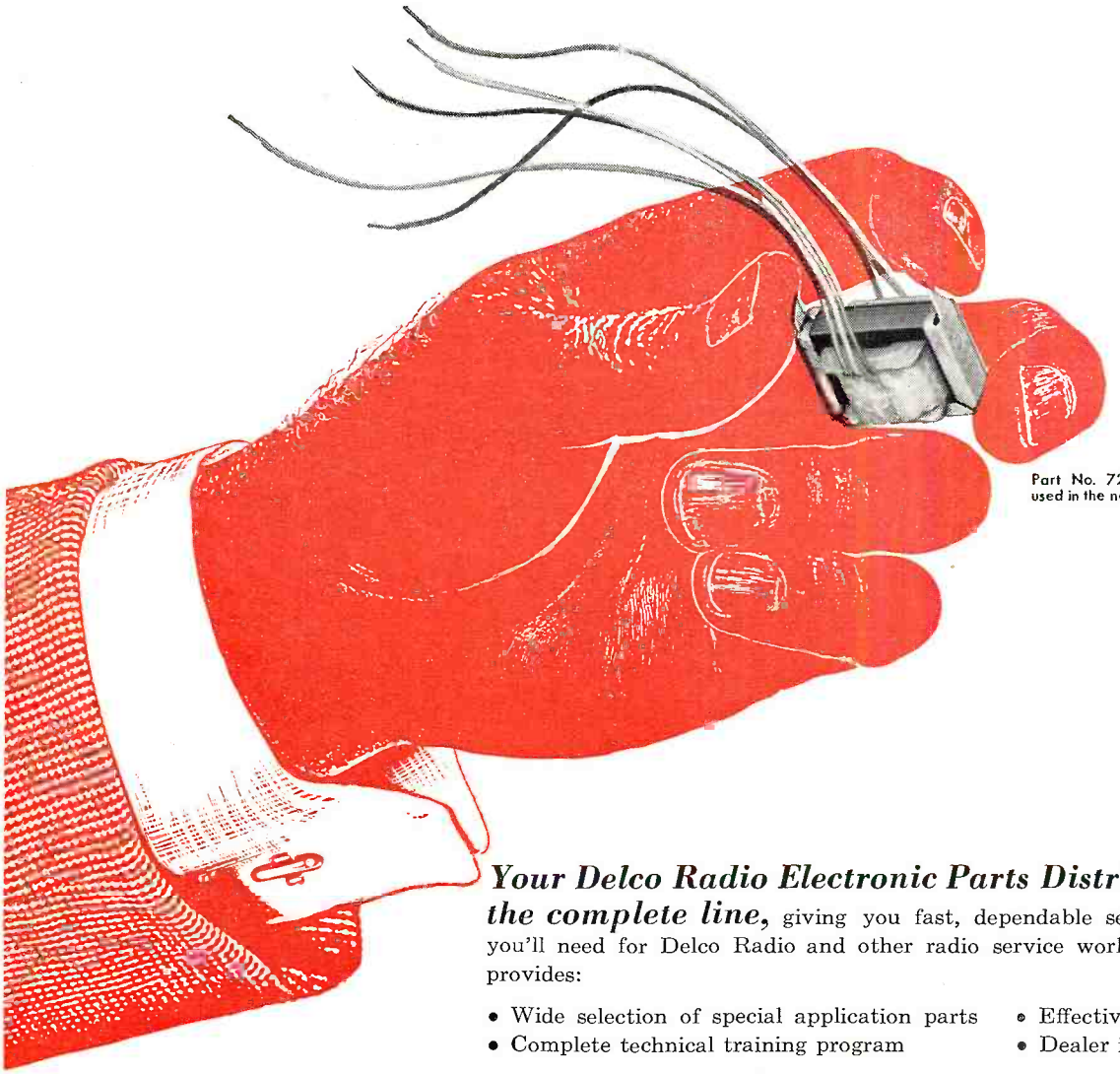

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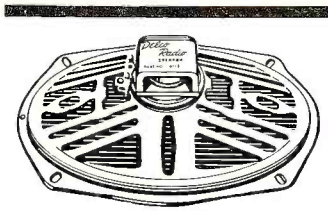
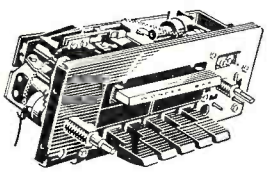


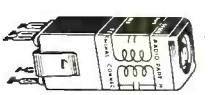
SPEAKERS



TUNER PARTS

TRANSISTORS

TUBES



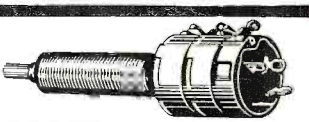
COILS

VIBRATORS

IRON CORES

RESISTORS

CAPACITORS



CONTROLS

The "Control Master"

(*Continued from page 49*)

next soldered inside the cabinet, near the rear, for mounting the crystal socket board.

A coat of enamel or other finish to match the transmitter may be desired. The pictured unit was given a coat of gray *General Cement* wrinkle varnish. With the finish dry, mount the rotary switch.

The crystal socket board was salvaged from a BC-604 transmitter and cut to fit the cabinet. If this item is not handy, eleven separate sockets may be mounted on a similar board.

Wiring is made easier by partially wiring the crystal board before assembly. Start the wiring, connecting one side of all sockets together, using a single length of bare wire. This becomes the common, grounded side of the crystals and the v.f.o. input socket. Next, attach a piece of wire to each remaining socket terminal, long enough to reach the switch terminals. Mount the socket board, using sheet-metal screws. Complete the wiring, connecting each wire to the switch terminals, making connections as short as possible. Connections should be made so that, viewing the crystals from the rear, there is a logical, top-to-bottom and left-to-right order of frequencies.

The dial assembly is a simple "sandwich" of four discs, each 3⅛" in diameter, and clamped together with a ¼" collar from a discarded volume control. The "finger hole" disc of ⅛" aluminum sheet, contains twelve equally spaced, ½" holes. Ten are for crystals, one for v.f.o., and one for the "off" position. The dial markings are typewritten on the white paper disc and protected with a transparent plastic disc. Incidentally, the "VFO" marking is covered with a small square of red Cellophane as a cautionary measure.

The dial clamping collar is positioned on the switch shaft next and a small hole drilled through both the collar shoulder and the shaft. A pin through this hole secures the collar solidly to the shaft. Now the dial may be stacked on the collar and clamped firmly with the original volume control nut. The ornamental center cap was taken from a surplus telephone, as was the finger stop. Two small bolts fasten the stop to the cabinet panel.

The four rubber feet may now be added. These provide stability during dialing and protect furniture surfaces.

The output leads should be no longer than necessary for convenient operation, their length being limited chiefly by their mutual capacity and the activity of the crystals. A single, two-wire cable is *not* recommended. The output plug, *Lafayette Radio* number TS-102, is attached to one lead and a *Mueller* 30 clip to the ground lead. Since only one pin of the output plug is active, the plug may be marked so that the "hot" crystal plate always connects to the oscillator grid circuit.

Adjustment

The dial action may be too stiff for comfortable dialing. This is easily corrected by discarding *one* of the steel balls from the switch detent or otherwise reducing the detent tension until a gentle, but positive, operation results.

If the dial holes do not properly align with the finger-stop after dialing, proceed as follows: Loosen the center dial clamping nut, rotate the top disc and the paper disc, until the finger just comes to rest as the selected contact closes. Tighten the dial to retain this alignment.

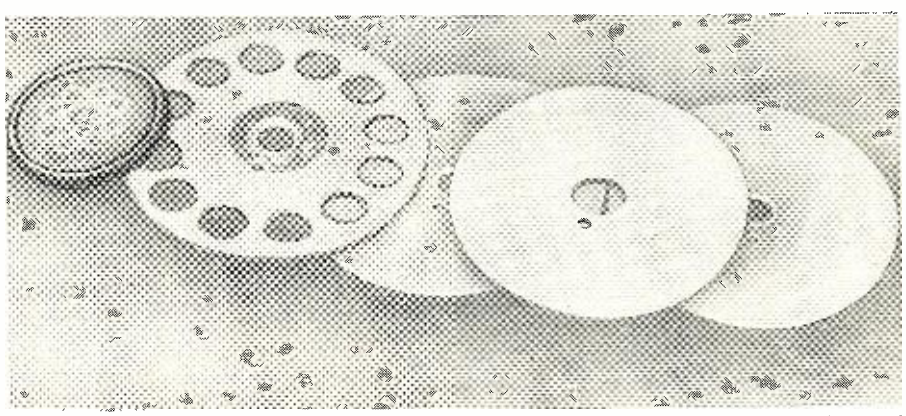
Operation

Load the "Control Master" with crystals of good activity, arranged to correspond with the dial markings. Clip one lead to the transmitter chassis, plug the other lead into the transmitter crystal socket, and you are ready to operate.

Some eyebrows may be hoisted, at the relatively long crystal leads. However, during tests, satisfactory operation has resulted with leads up to six feet long! Also, several different crystal oscillator circuits were tested with equally good results.

When ten crystals whose frequencies are close together are used, eliminating any transmitter re-tuning, real "push-button" convenience is enjoyed. Ideal for "net" operation, v.f.o. calibration may be checked against a crystal frequency with a flick of the finger. In addition, this little gem "files" those loose crystals out of sight, yet they are always instantly available for the dialing! —30—

The sandwich construction of the dial is illustrated in this photograph.



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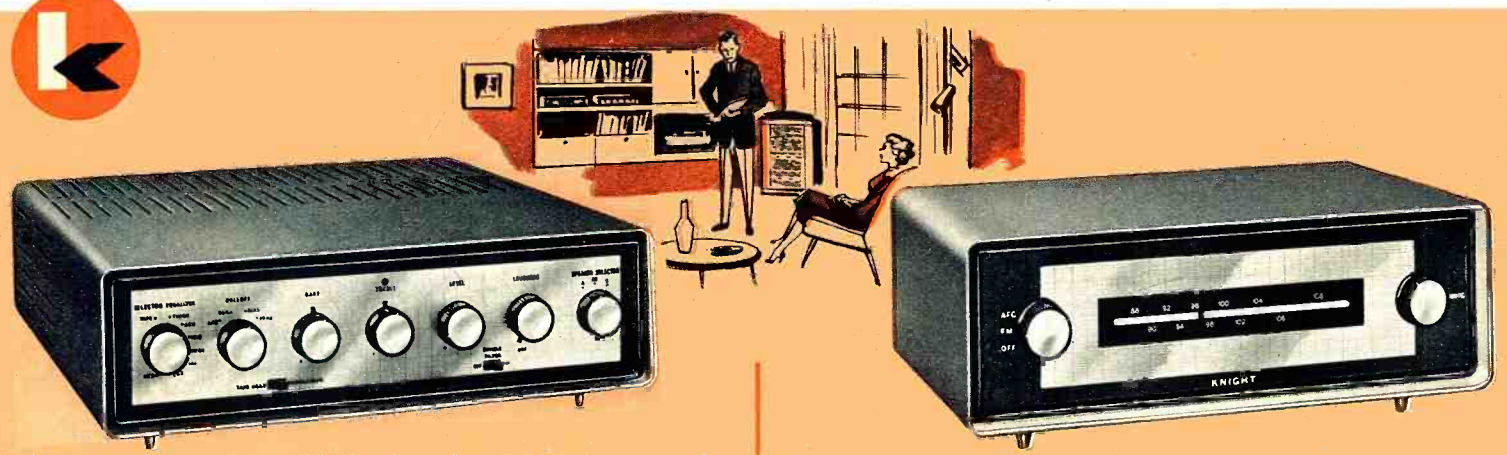

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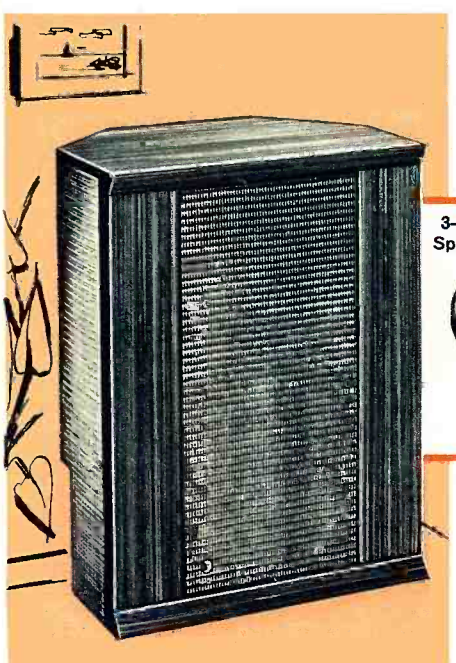

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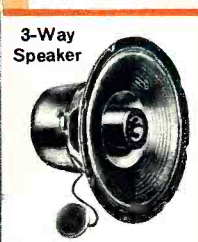

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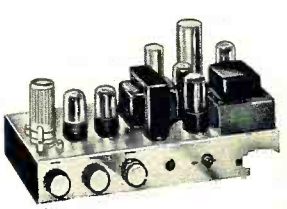

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- Williamson-Type Circuit with Over 25 Watts Output

Here's superb Hi-Fi performance at less than half the cost of a comparable commercially-assembled unit. Williamson-type linear-deluxe circuit delivers over 25 watts of virtually undistorted reproduction. Ideal for use with the KNIGHT-KIT preamp at left. Includes printed circuit board for simplified, error-free assembly. Remarkable hi-fi response, ± 0.5 db, 10-120,000 cps at 20 watts. Harmonic distortion, 0.15% at 30 watts; IM, 0.4% at 20 watts. Hum level, 85 db below 25 watts output. Output impedances, 4, 8 and 16 ohms; output tubes, 2-5881. Includes balance control for precise matching of the output tubes; variable damping control for maximum performance with any speaker system—prevents low-frequency distortion from overdamping or underdamping. Very attractive black and chrome styling, 6¼ x 14 x 9″. An outstanding engineering achievement in a basic hi-fi amplifier, delivering performance equal to the finest commercially assembled units. Includes all parts and tubes; with step-by-step instructions, ready for easy assembly. Shpg wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only.....**$44.50**
Y-759. Metal Cover for above; black finish. 5 lbs. Net.....**$4.25**

knight-kit 20-Watt Hi-Fi Amplifier Kit

Y-750
$35.75
$3.57 down

True hi-fi for less! Complete with full set of controls and built-in preamplifier. Response, ± 1 db, 20-20,000 cps; distortion 1% at 20 watts. Inputs for magnetic phono, microphone, crystal phono or recorder, and tuner. Compensation positions for 78 and LP records. Separate bass and treble controls. Output impedances, 4, 8, 16 and 500 ohms. Chrome-plated chassis. 7 x 13 x 8¾″. Ready for easy assembly. Shpg. wt., 20 lbs.

Model Y-750. Net only..**$35.75**
Y-758. Metal Cover.....**$4.15**

knight-kit 2-Way Hi-Fi Speaker System Kit

Model Y-789
$49.95
Only $4.99 down

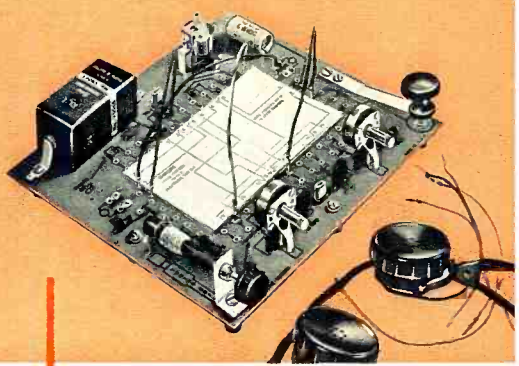
- Easy to Assemble—Pre-Finished Enclosure
- High Fidelity Response, 45 to 14,000 cps
- 12″ Woofer and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-way speaker system—it's quick and easy! The cabinet is *pre-finished* in full-grained, high luster blonde or mahogany—you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features "ducted port" construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 16 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 19 x 14″. Beautifully styled to blend in any room. Kit includes Jensen 12″ woofer, Jensen compression-type tweeter, pre-finished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. *Specify blonde or mahogany finish when ordering.* Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit.
Net only.....**$49.95**

knight-kit HI-FI IS AVAILABLE ON EASY TERMS TO FIT YOUR BUDGET

Fascinating ALLIED knight-kits FOR EXPERIMENTERS AND HOBBYISTS



knight-kit 2-Transistor Pocket Radio Receiver Kit

Model Y-262 $14.65

- Loud, Clear Local Reception
- Newest Printed Circuit Board
- Built-In Loop Antenna
- Complete Kit—Nothing Else To Buy

It's fun to build this pocket-size two-transistor radio—and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4x3¾x1¾". Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1½ lbs.

Model Y-262. Net only **$14.65**

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767 $2.45

Tiny, cigarette-pack-size one-transistor radio kit—fascinating to build—so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, compact case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.) Shpg. wt., 8 oz.

Model Y-767. Net only **$2.45**
J-149. 4000 Ohm Headphones. 1 lb. . . **$2.15**
C-100. Antenna Kit. 1½ lbs. **$1.03**

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299 $15.75

Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenter, student or hobbyist. Assemble basic parts once, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits; AM radio for strong headphone reception; 2-stage audio amplifier; wireless broadcaster; code practice oscillator; electronic timer; electronic switch; electronic flasher; photoelectronic relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.

Model Y-299. Net only **$15.75**

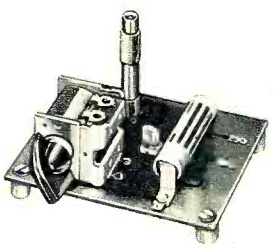
knight-kit 5-Transistor Superhet Personal Portable Radio Kit

Model Y-766 $29.95

- Styled to Equal the Finest
- Push-Pull Audio Drives 3½" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening. Provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½x3⅝x1¾". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.

Model Y-766. Net only **$29.95**



1-Transistor Radio Kit

$3.95 Offers excellent AM local broadcast headphone reception. Printed circuit board for easy assembly. Operates from single penlight cell for months. Complete with all parts, transistor and penlight cell. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-765. Net only **$3.95**

"10-In-One" Electronic Lab Kit

$12.65 Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phono oscillator, code practice oscillator, signal tracer, relays, etc. Shpg. wt., 5 lbs.

Model Y-265. Net only **$12.65**

"6-In-One" Electronic Lab Kit

$8.45 A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcaster, etc. Shpg. wt., 3 lbs.

Model Y-770. Net only **$8.45**

Crystal Set Hobby Kit

$2.15 Entertaining, educational. Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-261. Net only **$2.15**

Wireless Broadcaster Kit

$9.50 Play music or make announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set. Shpg. wt., 3 lbs.

Model Y-705. Net only **$9.50**

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. • CHICAGO 80, ILL.

FUN TO BUILD . . . INSTRUCTIVE . . . LATEST CIRCUITS FOR TOP PERFORMANCE

WIDEST CHOICE OF QUALITY HOBBYIST KITS

Interruption of light beam triggers relay, which in turn sounds chime or bell, turns on lights, etc.

knight-kit Photoelectronic Relay Kit

Model Y-702 $13.50

Advanced-design, ultra-sensitive photoelectronic relay—build it yourself and save! Dozens of uses: for automatic control of lights, door announcer, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "unseen" light (red filter) from Light Source Kit listed below. Selectable operation, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimes, counting devices, turning on lights at darkness). Has SPST relay operated from thyratron; 6.3 v. terminals provide power for accessories. For 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net only . . **$13.50**

Model Y-703. Light Source Kit. With bulb and red filter. Shpg. wt., 3½ lbs. Net. **$6.75**

knight-kit "Ocean Hopper" All-Wave Radio Kit

Model Y-740 $11.95

This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 kc to 35 mc. including every type of radio transmission: AM broadcast, marine, aircraft, distress channels, direction-finding, Amateur, frequency standard, foreign broadcast, and police. With bandspread tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. (Less extra coils, headphones, speaker and cabinet.) Shpg. wt., 5 lbs.

Model Y-740. Net only **$11.95**

Y-746. Cabinet for above. 1½ lbs. Net **$2.90**

Extra coils available: Long Wave Coil (155-470 kc), Net 79c. Short Wave (1.65—4.1 mc; 2.9—7.3 mc; 7—17.5 mc and 15.5—35 mc), Each 65c.

knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit

Model Y-243 $15.95

- Broadcast or Short Wave Reception
- Sensitive Regenerative Circuit
- Convenient Bandspread Tuning
- Built-In Loudspeaker

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch, being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police and marine radio on the 6.5 to 17 mc range, as well as standard 540-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. 7x10x6". Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. (Less cabinet.) Shpg. wt., 5 lbs.

Model Y-243. Net only **$15.95**

Y-247. Cabinet for above. Shpg. wt. 2 lbs. Net. **$2.90**

"Ranger II" Superhet Receiver Kit

$17.25

Popular Broadcast band receiver built and enjoyed by thousands. Features built-in antenna, automatic volume control, ball-bearing tuning condenser, PM dynamic speaker. Handsome plastic cabinet. Easy to assemble. AC or DC operation. Shpg. wt., 8 lbs.

Model Y-735. Net only **$17.25**

knight-kit 2-Way Intercom System Kit

Model Y-295 $14.75

- Low Cost—Easy to Assemble
- High Gain—Clear Tone
- Handsome Metal Cabinets
- Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remote also may be set for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to even a whisper. Handsome Antique white cabinets, each 4¾x6½x4⅜". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., AC or DC. 8 lbs.

Model Y-295. Master and one Remote. Net only . . **$14.75**

Y-296. Extra Remote Station Kit. 3 lbs. **$3.75**

Phono Amplifier Kit

$9.45

Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and 3-4 ohm speaker. 1½ watts output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs.

Model Y-790. Net only **$9.45**

Electronic Photoflash Kit

$28.50

Ideal for color or black and white photography. 1/700th-of-a-second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. (Less battery.) Shpg. wt., 4 lbs.

Model Y-244. Net only **$28.50**

Code Practice Oscillator Kit

$3.95

Ideal for beginners learning the code. Transistorized circuit. Operates for months from single penlight cell supplied. Clear, crisp 500 cycle tone. Jacks for headphones; screw terminals for key. 1 lb.

Model Y-239. Net only **$3.95**

Phono Oscillator Kit

$5.85

"Broadcasts" recorded music through any standard radio set up to 50 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs.

Model Y-760. Net only **$5.85**

FINEST ELECTRONIC EQUIPMENT IN EASY-TO-BUILD MONEY-SAVING KIT FORM

Better By Far— ALLIED knight-kit QUALITY TEST INSTRUMENTS

knight-kit Low-Cost Tube Tester Kit

Model Y-143 **$29.75**

- With 16 Filament Voltages
- 600 Latest Tube Types Listed
- Easy-to-Read 4½" Meter
- Tests Series-String TV Tubes

Expertly designed for complete, up-to-date coverage of tube types. Tests *series-string TV tubes;* tests 4, 5, 6 and 7 pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. Tests for open, short, leakage, heater continuity and performance (by amount of cathode emission). Big 4½" square meter has clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 16 filament voltages from 0.63 to 117 volts to check virtually all receiving tubes; blank socket for future type tubes. Universal-type selector switches permit selection of any combination of pin connections. Single-unit, pre-assembled 10-lever function switch simplifies and speeds assembly. Up-to-date illuminated roll chart lists over 600 tube types. Counter model case, 5 x 14 x 10". Easy to build. 14 lbs.

Model Y-143. Net only **$29.75**
Y-142. Portable Case model. 15 lbs. Net **$34.75**
Y-141. Picture Tube Adapter. 1 lb. Net ..... **$ 4.25**

knight-kit RF Signal Generator Kit

Model Y-145 **$19.75**

Build this wide-range, extremely stable RF signal generator—save two-thirds the cost of a comparable wired instrument! Large, semi-circular dial is clearly calibrated; range is covered in 5 separate bands for close accuracy in setting individual frequencies. Ideal for aligning RF and IF stages in radio and TV sets and for troubleshooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 112 mc; useful harmonics to 224 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit. Convenient jack for external modulation. Maximum audio output 10 volts; RF output over 0.1 volt on all ranges. Step and continuous-type attenuator controls. Supplied with precision-wound coils that require no adjustment. 7 x 10 x 5". Shpg. wt., 11 lbs.

Model Y-145. Net only **$19.75**

knight-kit 1000 Ohms/Volt VOM Kit

Model Y-128 **$16.95**

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab or Amateur use. Large 4½", 400 microamp meter with separate scales for AC and DC voltage and current, decibels and resistance. *Uses 1% precision resistors;* has 3-position function switch and 12-position range switch. *38 ranges* include: AC, DC and output volts, 0-1-5-10-50-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg (center scale readings of 60, 150 and 1500 ohms); Current, AC or DC, 0-1-10-100 ma and 0-1 amp; Decibels, −20 to +69 in 6 ranges. Precision resistors are used as shunts and multipliers to assure exceptional accuracy of measurements. With all parts, battery, test leads and black bakelite case with convenient carrying handle, 6¾ x 5¼ x 3¾". A great value in an easy-to-build quality instrument. Shpg. wt., 2½ lbs.

Model Y-128. Net only **$16.95**

knight-kit Vacuum Tube Voltmeter Kit

Model Y-125 **$24.95**

- 200 μa Movement, 4½" Meter
- Includes AC, Peak-to-Peak
- Balanced-Bridge, Push-Pull Circuit
- 1% Film-Type Resistors

Top buy in an extremely stable, highly accurate VTVM. Easy to assemble—entire chassis is printed circuit board. Perfect for radio-TV service work, lab and Amateur use. Features low-leakage type switches; 1% film-type precision resistors; balanced-bridge, push-pull circuit (switch to any range without readjusting zero set); zero center scale and direct-reading db scale; polarity reversing switch. Ranges: Input Resistance, 11 megs; DC and AC rms, 0-1.5-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-1400-4000; Response, 30 cycles to 3 mc; Ohms, 0-1000-10K-100K and 0-1-10-100-1000 megs; db, −10 to +5. Includes all parts, tubes, battery, test leads and portable case, 7¾ x 5¼ x 4-5/16". Easy to assemble. Shpg. wt., 6 lbs.

Model Y-125. Net only **$24.95**
Y-126. Hi Voltage Probe; extends DC to 50,000 v. ..... **$ 4.75**
Y-127. Hi-Frequency Probe; extends AC to 250 mc. ..... **$ 3.45**

6V-12V Battery Eliminator Kit

$32.95 High current rating; continuously variable filtered output; delivers 15 amps at 6 volts, 10 amps at 12 volts. May be used as battery charger. Two meters provide simultaneous current and voltage readings. Shpg. wt., 18 lbs.

Model Y-129. Net only **$32.95**

Transistor Checker Kit

$8.50 Checks gain ratio of all types of transistors; checks germanium and silicon diodes; checks for continuity and shorts. A valuable instrument at very low cost. Easy to assemble. Shpg. wt., 2½ lbs.

Model Y-149. Net only **$8.50**

Flyback Checker Kit

$19.50 Checks condition of all types of horizontal output transformers and deflection yokes, as well as TV linearity and width coils. 4½" meter; widest range in its field. Shpg. wt., 6 lbs.

Model Y-118. Net only **$19.50**

Sweep Generator Kit

$43.75 Extreme linearity on a par with costly lab instruments; fundamentals to 250 mc; output flat within 1 db; electronic blanking. Easy, money-saving assembly. Shpg. wt., 16 lbs.

Model Y-123. Net only **$43.75**

Capacitor Checker Kit

$12.50 Tests capacitors while in the circuit! Has widest range—20 mmf to 2000 mfd. Exclusive circuit for cancelling lead capacity. "Magic Eye" indicator. Save 60% over factory-wired units. 5 lbs.

Model Y-119. Net only **$12.50**

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. • CHICAGO 80, ILL.

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM

knight-kit 20,000 Ohms/Volt VOM Kit

Model Y-140 $29.50

Outstanding quality and performance at money-saving low price. Features 1% precision multipliers; 4½" meter accurate within 2% of full scale deflection; 50 microamp sensitivity for 20,000 ohms/volt input resistance on DC; front panel "Zero adjust"; single switch to select function and range. 32 ranges: AC, DC and output volts, 0-2.5-10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-0.1-10-100; DC amps, 0-1-10; Decibels, −30 to +63 in six ranges. Moisture-resistant film-type resistors for extreme accuracy. Carefully engineered circuit design achieves high sensitivity and extremely versatile application. Kit includes all parts, battery, test leads and black bakelite case with highly legible white markings; size 6¾ x 5¼ x 3¾". Easy to assemble. Shpg. wt., 5 lbs.

Model Y-140. Net only.....**$29.50**

knight-kit High-Gain Signal Tracer Kit

Model Y-135 $26.50

A remarkable value in an easy-to-build instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits. Has *highest gain in its price class.* Traces signal from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of *91,000;* "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; combination 2-position probe, one for RF (6 mmf. input), the other for audio. Provides noise test; built-in watt-meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Binding posts provide output transformer and speaker substitution test, plus external 280 volts B+. With all parts, tubes and probe. 7x10x5". 12 lbs.

Model Y-135. Net only.....**$26.50**

knight-kit 5" Wide-Band Oscilloscope Kit

Model Y-144 $69.00

Only $6.90 down

- 5 mc Width for Color TV
- Horizontal Sweep to 600 kc
- 25 mv/inch Sensitivity
- Z-Axis Input
- Printed Circuit Construction

Equals or betters the performance of commercially wired scopes costing far more. Two printed circuit boards and laced wiring harness assure wiring accuracy and cut assembly time. Ideal for lab use, color TV servicing and high frequency applications. Wide sweep range—*15 to 600,000 cps.* Vertical response, ± 3 db, 5 cps to 5 mc; only 1 db down at 3.58 mc color burst. High vertical sensitivity of .025 rms v/inch. Input capacity, 20 mmf. Outstanding features: cathode follower inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull amplifiers; positive and negative locking; frequency-compensated attenuator; Z-axis input; one volt P-P calibrating voltage; astigmatism control; retrace blanking circuit; DC positioning control. Includes CRT. 14½ x 9½ x 16". 40 lbs.

Model Y-144. Net only.....**$69.00**
Y-148. Demodulator Probe. Net.....**$ 3.45**
Y-147. Low Capacity Probe. 12 mmf. Net....**$ 3.45**

Voltage Calibrator Kit

$12.75

Permits use of any scope as precision peak-to-peak AC voltmeter. Puts a true square-wave voltage on scope screen. Selects any voltage between .01 and 100 volts; feeds external signal direct to scope for instant comparison. Shpg. wt., 5 lbs.

Model Y-136. Net only.....**$12.75**

knight-kit 5" General-Purpose Scope Kit

Model Y-146 $42.00

Only $4.20 down

- Phantastron Linear Sweep
- 25 mv/inch Sensitivity
- Printed Circuit Board
- Retrace Blanking Circuit

Feature for feature the world's best oscilloscope kit value. A standout in its class with all these fine features: *Printed Circuit* wiring board and laced harness for quick, error-free assembly. *Phantastron Sweep Circuit* for high linearity of sweep from 15 to 150,000 cps. *25 Millivolts Per Inch Sensitivity*—3 times that of similarly priced scope kits. *Calibration Voltage*—1 volt peak-to-peak square wave, fully regulated. *Vertical Amplifier*—frequency response ± 3 db, 3 cps to 1.5 mc (± 6 db to 2.5 mc). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive and negative internal sync; high 2nd-anode voltage for high-intensity trace; input capacity, 45 mmf. Kit includes CRT. 9½ x 13¾ x 17¾". 26 lbs.

Model Y-146. Net only.....**$42.00**

Resistance Substitution Box

$5.95

Easily determines resistor values required in a circuit. Makes available 36 standard 1-watt resistance values in 2 ranges between 15 ohms and 10 megohms, with 10% accuracy. Slide switch selects range; 18-position switch for value selection. Shpg. wt., 2 lbs.

Model Y-139. Net only.....**$ 5.95**

Capacitance Substitution Box

$5.95

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard values from .0001 mfd to .22 mfd, ± 20%. All values are 600 volt, except .15 and .22, which are 400 volt. 18-position selector switch. Shpg. wt., 2 lbs.

Model Y-138. Net only.....**$ 5.95**

Audio Generator Kit

$31.50

Excellent design; range, 20 cps to 1 mc; less than .25% distortion; 600 ohm output. Ideal for hi-fi testing; offers the flat response of a lab standard. Shpg. wt., 16 lbs.

Model Y-137. Net only.....**$31.50**

R/C Tester Kit

$19.50

Measures capacitance and resistance. Balanced-bridge circuit; indicates power factor; tests capacitors at rated voltage. Large, easy-to-read dial and "magic eye." Shpg. wt., 10 lbs.

Model Y-124. Net only.....**$19.50**

EASY TERMS AVAILABLE

Take advantage of the most liberal Easy Pay plan in electronics. On Knight-Kit orders totaling $45 or more—just 10% down, small monthly payments thereafter. Low carrying charges—no "red tape."

knigh -ki s FOR THE RADIO AMATEUR

knight-kit All-Band Amateur Receiver Kit

Model Y-726
$104.50
Only $10.45 down

- Tunes 540 kc to 31 mc
- Built-In Q-Multiplier
- Constant Running HF Oscillator
- Worthy of the Advanced Ham Operator
- Printed Circuit Bandswitch
- Printed Circuit Board • 1.5 μv Sensitivity

A sensational communications receiver value with all the selectivity, sensitivity and features of high-priced commercial units. Uses printed circuitry throughout, including the exclusive new KNIGHT-KIT printed circuit bandswitch, for remarkably easy assembly. Covers 540 kc to 31 mc in 4 ranges; calibrated, electrical bandspread on 80-10 meter Ham bands; slug-tuned Hi-Q coils; continuous, VR tube-regulated B+ applied to HF oscillator lets you switch from standby to receive with no drift; built-in Q-multiplier peaks desired signal or nulls interference; delayed AVC; provision for crystal calibrator (below). Sensitivity, 1.5 microvolts for 10 db signal-to-noise ratio. Selectivity: variable from 300 cps to 4.5 kc at 6 db down. Exalted BFO injection. Controls: Main tuning, bandspread, band selector, Q-multiplier selectivity, Q-multiplier tune, null-off-peak, BFO pitch, RF gain, AF gain, BFO-MVC-AVC-ANL, off-stby-rec-cal, antenna trimmer, and phone jack. Cold-rolled 1/16" steel chassis. Handsome metal cabinet, 10 x 10 x 16½". (Less phones, 8-ohm loudspeaker and S-meter.) 23 lbs.

Model Y-726. Amateur Receiver Kit. Net..... **$104.50**
Y-727. S-Meter Kit for above. 1 lb. Net..... **$9.50**

knight-kit 50-Watt CW Transmitter Kit

Model Y-255
$38.95
Only $3.89 down

- Ideal for the Novice
- Pi Antenna Coupler
- Bandswitching—80 to 10 Meters

There's exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates at up to 60 watts on 80 and 40 meters. Oscillator is efficient 6AG7; final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pi coupler permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 8½ x 10½ x 8¼". With tubes and all parts for easy assembly. (Less crystal and key.) Shpg. wt., 19 lbs.

Model Y-255. 50-Watt Transmitter Kit. Net only..... **$38.95**

knight-kit Self-Powered VFO Kit

Model Y-725
$28.50
Only $2.85 down

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread; separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 8¾ x 6 x 6". Ready for easy assembly. Shpg. wt., 8 lbs.

Model Y-725. VFO Kit. Net only..... **$28.50**

knight-kit 100 Kc Crystal Calibrator Kit

Model Y-256
$10.50

Crystal frequency standard at very low cost. Gives marker every 100 kc up to 32 mc. A "must" for marking band edges. Mounting flanges for installation in or back of receiver cabinet. Size only 1½x 1½x3". Requires 6.3 v. at 0.15 amp and 150-300 v. DC at 3-6 ma. Trimmer for zero-beating with WWV; On-Off switch. Complete with tube, crystal, all parts and easy-to-follow instructions. Shpg. wt., 1 lb.

Model Y-256. 100 Kc Crystal Calibrator Kit. Net only..... **$10.50**

knight-kit Amateur RF "Z" Bridge Kit

Model Y-253
$5.85

Measures standing wave ratio (SWR) and impedance of antenna systems; ideal for adjusting antenna systems for optimum results. Measures impedances from 20 to 400 ohms up to 100 mc; SWR to 150 mc. Any VOM may be used for null indicator. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart (less meter). 2½ x 3 x 4½". Shpg. wt., 1½ lbs.

Model Y-253. "Z" Bridge Kit. Net only..... **$5.85**

ORDER BLANK ALLIED RADIO

100 N. WESTERN AVE., CHICAGO 80, ILL.

ALLIED RADIO, Dept. RE; 100 N. Western Ave., Chicago 80, Ill.
Ship me the following KNIGHT-KITS:

Quantity	Description	Model No.	Price

$.....enclosed. (For parcel post, include postage—express is shipped collect).
☐ My Down Payment in the amount of $..... is enclosed. Send Time Payment form.

Name.....

Address.....

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

ALL PRICES NET F. O. B. CHICAGO

Our 37th Year

FREE 1958 404-PAGE ALLIED CATALOG

See the 1958 ALLIED 404-Page Catalog for complete listings of more than 50 KNIGHT-KITS, covering Hi-Fi, Hobby, Test Instrument and Amateur Kits. The 1958 ALLIED Catalog is your complete Buying Guide to the world's largest stocks of everything in Electronics.

☐ Send FREE 404-Page 1958 ALLIED Catalog.

12 Volts—Heater and Plate

(*Continued from page 69*)

low-voltage approach which is very useful to the mobile operator is a portable grid dip meter. This meter can be clipped across any 12-volt battery and will then be ready for operation. The circuit is not as complicated as it appears at first glance and was used because of the high value of grid current which could be obtained with very low plate voltages. If a more sensitive meter movement is available, the cathode resistor is increased from 100 ohms to a value which will reduce the grid current to the desired amount. The mechanical layout is not critical.

Fig. 6 is a photo of three pieces of experimental gear designed to use low-voltage tubes. The small chassis at the left is a crystal-controlled v.h.f. converter designed to operate on the 144 mc. band. A 12AW6 is used as a conventional triode crystal oscillator. Another 12AW6 is used as a screen grid multiplier (x6). The r.f. amplifier uses a 12AW6 as a screen grid amplifier and the mixer is the very conventional grid leak mixer. An i.f. frequency of 10.7 mc. was used. For the information of anyone attempting a unit such as this it is suggested that the multiplication of the crystal oscillator output be accomplished in two stages (2x3) rather than in one stage. This will deliver more oscillator power to the mixer.

The center chassis is a full superhet for use on the aircraft frequencies at 120 mc. and at the right is a superregenerative detector plus audio to be used as a second detector with v.h.f. converters.

In conclusion it might be suggested that this type of operation should be a natural for the experimenter or Novice who has access to a 12-volt auto system (Fig. 2). A simple receiver constructed along these lines can be used as portable or mobile without a complicated power supply and at the home location from a simple filament transformer-rectifier power supply. It is impossible to cover all the potential uses for this type of tube operation in one article but perhaps this quickie summary can help kick a few new home projects into the mill. —30—

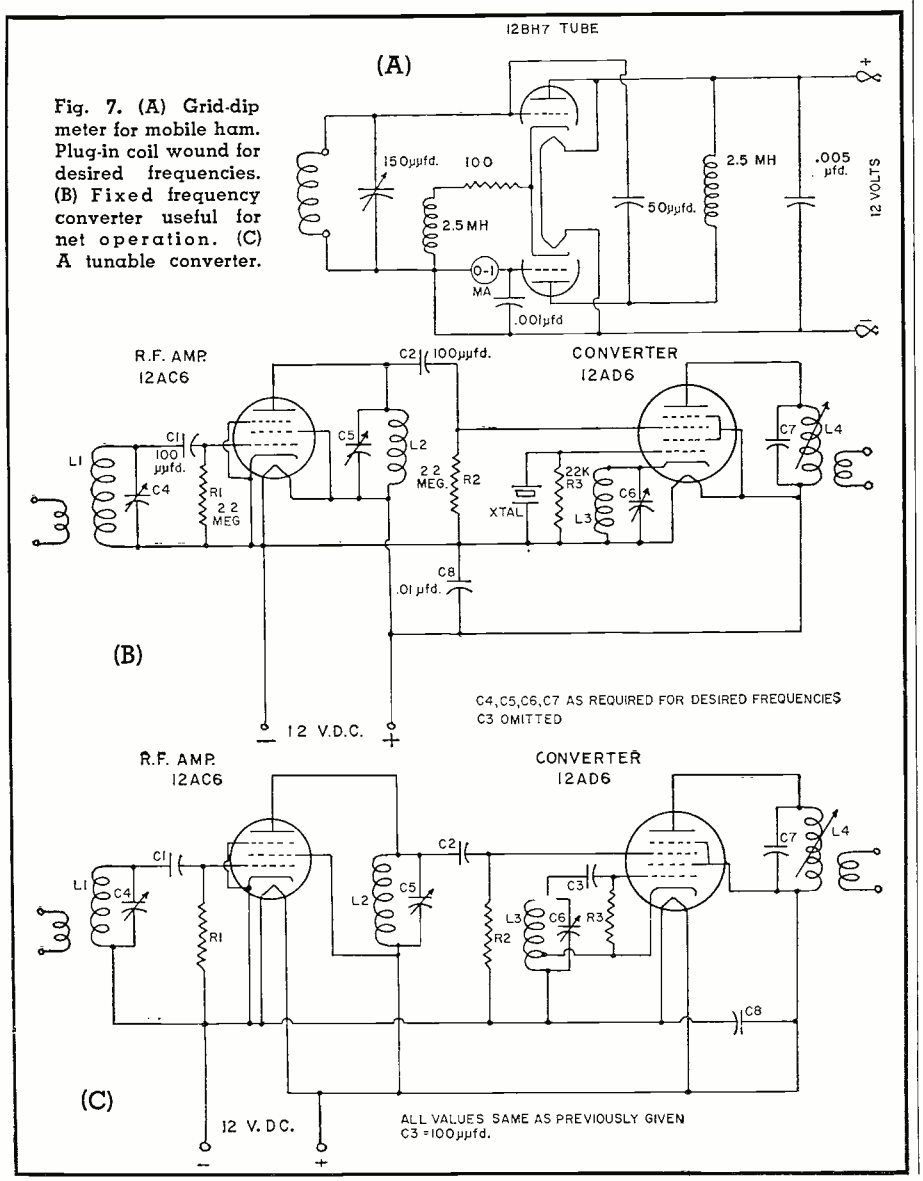


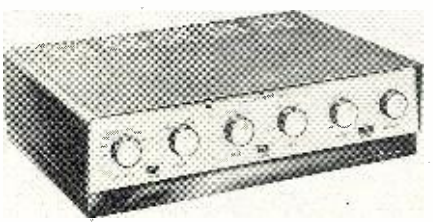
Fig. 7. (A) Grid-dip meter for mobile ham. Plug-in coil wound for desired frequencies. (B) Fixed frequency converter useful for net operation. (C) A tunable converter.

Hi-Fi-Audio Product Review

30-WATT AMPLIFIER

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has just released a new 30-watt amplifier in its "Knight" audio line.

The Model KN-530 can be used with a tape deck; tape recorder; record player equipped with magnetic, ceramic, or crystal cartridge; radio tuner; TV sound; etc. It features a 3-way speaker selector switch for playback through either of two speaker systems or through two speaker systems simultaneously, rumble and scratch filters



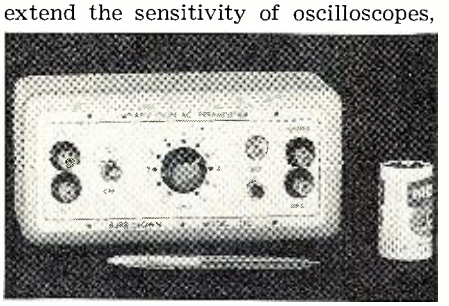
for suppression of turntable and record noises, loudness control, twelve combinations of record equalization and NARTB equalization to permit direct use with a tape head. Variable damping is also provided.

Frequency response is from 20 to 40,000 cps ± ½ db at 30 watts. Harmonic distortion is ½% at mid-frequencies and does not exceed 1.5% from 30 to 20,000 cps, according to the company.

VARIABLE GAIN A.C. PREAMP

Burr-Brown Research Corporation, Box 6444, Tucson, Ariz., is now offering a transistorized variable gain a.c. preamplifier which is designed to be used as a preamp for microphones, magnetic pickups, search coils, strain gauge systems, gyro pick-off coils, and similar transducers.

The Model 110 may also be used to extend the sensitivity of oscilloscopes,



meters, and volume level indicators and is useful for noise measurements in audio, supersonic, and low-radio-frequency applications. The unit is completely transistorized and self-powered from ordinary "C" size flashlight cells. It features an input impedance of over 1 megohm, continuously adjustable gain to 50 db, response from 10 to 500,000 cps, .5% maximum distortion, and 750 hour battery life.

The unit is housed in a deep-drawn aluminum case measuring 4"x8"x4". It can be supplied with either continuous or stepped gain control. A data sheet on the unit is available on request.

"FORTIFIED" RECORDING TAPE

ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. has added a "Fortified" double-play tape to its line of "Irish" magnetic recording tapes.

Designated as catalogue number 400, the new tape is made on *Du Pont* "Mylar" polyester base, especially reinforced for sinewy strength. This 60-gauge Mylar tape will withstand a pull of 3 pounds without distortion. A 7" reel, carrying 2400 feet, will record 2 hours at 3¾ ips single track or 4 hours on dual track.

KARLSON CONSOLE

Karlson Associates Inc., 1610 Neck Road, Brooklyn 29, N. Y. is now marketing the "18" console which is designed to accommodate 12", 15", or 18"

coaxial, triaxial, extended range speakers and woofers in addition to tuners and amplifiers, etc.

The console measures 42" high, 40⅝" long, and 22" deep. It measures 37½" high, without legs. It is available in blonde, walnut, and mahogany wood finishes or can be supplied unfinished on special order. The top panels are hinged.

The compartment interior size is 38" x19⅜"x9¾". The unit is one of the enclosures covered by U.S. Patent No. 2,816,619 on which basic claims have been allowed.

A.F. TRANSISTORS

The Semiconductor Division of *Radio Corporation of America,* Somerville, N. J. is now offering two new "p-n-p"

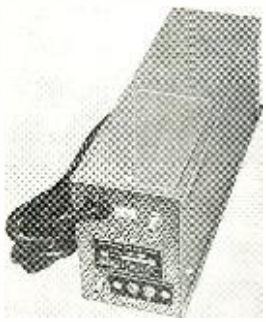
germanium junction transistors which have been designed especially for class A audio-frequency driver service in compact, entertainment-type receivers.

The 2N405 and its flexible lead version, the 2N406, are said to have excellent stability throughout life. In a common-emitter type of circuit, these transistors have a typical small-signal current transfer ratio of 35 and a matched-impedance power gain of 43 db. These characteristics make them especially useful in low-power audio applications.

A technical bulletin on these two transistors is available on request.

FM "RANGE EXTENDER"

Jerrold Electronics Corporation, 23rd and Chestnut Sts., Philadelphia 3, Pa. has announced the availability of an



FM preamplifier which effectively extends the reception range of high-fidelity FM tuners.

Known as the "Range Extender," the new FM preamp is designed to be installed between the antenna and FM tuner. The unit is available in two models with option of either indoor or antenna mast mounting and 24-volt remote or 117-volt local operation. Both units are available with either 300 or 75 ohm input. Frequency response is flat ± 1 db across a 20 mc. bandwidth. The preamps, using only two tubes to achieve a minimum gain of 25 db and a maximum undistorted output of .5 volt r.m.s., composite signal, have input and output matched to a v.s.w.r. of less than 1.4.

TRANSISTORIZED AMPLIFIER

Video Instrument Company, Inc., 2340 Sawtelle Blvd., Los Angeles 64,

Calif. has introduced an all-transistorized audio power amplifier designed for use in home music systems.

The "Vico" Model 77 amplifier has a power output of 20 watts. The front panel is provided with bass, treble, input selection, and loudness controls. Hum and noise are more than 100 db below rated output. The amplifier is

THE VIKING BILLBOARD

Vol. 1 *No. 2*

Tape heads should be demagnetized at frequent intervals to avoid damage to recorded tapes and to insure minimum distortion in recording. This does not necessarily involve use of a bulk eraser or head demagnetizer. The heads on your Viking deck can be degaussed using a gun-type soldering iron. Hold the transformer case (not the tip) close to the heads. Energize the transformer, and slowly withdraw it to a distance of two feet or more before releasing the trigger. A bulk eraser, of course, works equally well. It is almost unnecessary to say that any valued tapes should be kept at a distance of at least two feet during this procedure.

Viking owners frequently ask whether they can use the phono input on a general purpose mixer-preamplifier for playback of recorded tapes . . . The equalization controls provided on such preamplifiers are usually adequate to provide for proper equalization. Usually, however, the phono input is shunted by a resistance of from twenty to fifty thousand ohms. When used as the input for a tape head, this shunting resistance should be removed.

A few instances have been reported where the capstan drive belt on a Viking deck had been replaced with a *somewhat similar belt* obtained from jobber replacement parts stocks. The belts in question were not Viking belts, were originally intended for another purpose, and resulted in a pronounced increase in flutter and wow.

The highly compliant belt used on the Viking 75 Series decks in combination with the heavy capstan flywheel, provides a unique filtering effect. The filtering out of interpole variations in motor speed is one of the largest factors responsible for the very low flutter and wow characteristic of the Viking deck.

You can expect five thousand hours of operation from this fragile appearing belt. If and when you do replace it, however, be sure you use the regular Viking belt. It was built for the job.

One of the best ways to check the performance of a tape recorder is to "AB" the recording performance against the original source. This is most easily accomplished using a record player, or AM-FM tuner as the source.

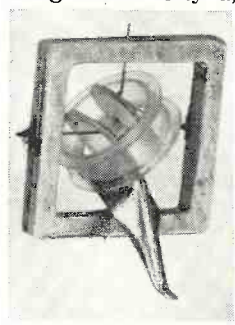
Viking "RM" models, or other recorders equipped with independent heads for recording and playback, can be set up for instantaneous "AB" comparison, selecting either the original program or the recorded track at the flip of a switch. This provides for the most practical evaluation of what we call "the R/P factor"; the degree to which a recorder will record and play back with absolute fidelity. Ask your Viking Dealer for an "RP" demonstration.

designed for operation from a 117-volt a.c. source or a 12-volt battery. It may be operated directly from vehicle batteries without internal or external vibrators or other conversion devices.

Frequency response is said to be flat within ± ½ db from 20 to 30,000 cps. A data sheet giving complete specs is available on request.

STEREO CARTRIDGE

Fairchild Recording Equipment Co., 10-40 45th Ave., Long Island City 1, N. Y. has developed a stereo cartridge designed for playing stereo discs cut by the *Westrex* system.

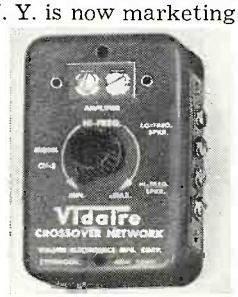


The heart of the single-stylus cartridge consists of two coil forms mounted in a frame at 45 degrees to the vertical axis of the record groove. Each coil form is at 90 degrees to the other with an aluminum stylus arm secured to both members. Two crossed wires provide a unique method of pivoting the pickup coil.

According to the company, the new cartridge will play any of the *Westrex* stereo recordings or can be used to play back standard vertical or standard lateral recordings, making it completely compatible for existing discs.

CROSSOVER NETWORK

Vidaire Electronics Manufacturing Corp., Baldwin, N. Y. is now marketing a crossover network, Model CN-5, for hi-fi system applications.



The unit is a high-pass filter network which permits the range of an amplifier system to be extended by the addition of a high-frequency speaker. The circuit is designed to be used with either 8 or 16 ohm speaker systems. The crossover frequency matches most hi-fi speakers and, according to the company, there is no network loss in the pass region.

A data sheet on this new crossover is available without charge on request.

FOUR NEW ALTEC SPEAKERS

Altec Lansing Corporation, 1515 S. Manchester Avenue, Anaheim, Calif. has added four new residential speaker systems to its 1958 line.

The cabinets, all of the phase-computed, base-reflex type, are of extremely heavy construction, braced and blocked so that no part of the enclosure can vibrate and absorb any speaker energy.

The "Laguna" has a guaranteed frequency response from 30 to 22,000 cps without peaks, false bass, treble rise, or other misleading frequency accentuations. It incorporates a matched

pair of 15" speakers, a high-frequency driver mounted on a horn, and a 500 cps dividing network.

The "Capistrana" has one 15" bass speaker, a dividing network, and a driver with horn. Guaranteed range is 35 to 22,000 cps. The "Corona" system is a corner version of the "Capistrana" and incorporates the same components.

The final new model is the "Verde" which houses a duplex loudspeaker. Its 35 to 22,000 cps range is designed for hi-fi systems of moderate size.

NEW "WIGO" SPEAKERS

United Audio Products, 202-4 East 19th St., New York 3, N. Y. has announced the availability of two new speakers in the "Wigo" line.

The Model WD155 is a 16" super-woofer which will cover the range from 25 to 6000 cps with a 30 cps cone resonance. Impedance is 16 ohms and the woofer will handle 50 watts. The second unit is the Model ER85, an 8½" extended range speaker designed especially for applications requiring minimum size. Frequency response is 40 to 15,000 cps. Impedance is 16 ohms and the power rating 15 watts.

Complete specifications on either of these units is available from the manufacturer.

STEREO ADAPTER KIT

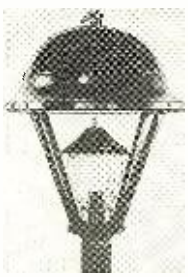
Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. has placed a do-it-yourself stereo adapter kit on the market for the benefit of those who own *Revere* and *Wollensak* tape recorders.

The kit consists of an in-line stereophonic magnetic tape head which replaces the standard monaural head. Two amplifiers and two speakers are needed to play stereo recordings. One set of leads from the new stereo tape head goes directly to the self-contained amplifier and speaker in the recorder. The other leads may be carried to any external amplifier and speaker system available to the user.

The new TK-41 magnetic head also contains an a.c. erase head and can be used for standard recording-playback of monaural tapes.

"HIFILITE" BAFFLE

Lowell Manufacturing Company, 3030 Laclede Station Road, St. Louis 17, Missouri, has introduced a combination all-weather light and baffle which has been especially designed for outdoor sound applications.



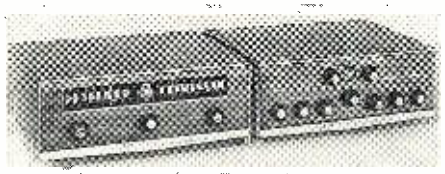
Although designed primarily for commercial use by country clubs, motels, resorts, and drive-in restaurants, the new unit can also be used by home owners. The baffle is constructed of heavy-gauge spun aluminum and the upper dome section of the baffle is lined with ¾" jute to make it waterproof. Atop the

dome is a gold-finished eagle. The lower baffle section is a modified version of the company's STL baffle and is supported on four steel tubes ½" in diameter. One of these support tubes is punched for concealment of the speaker leads. The baffle will handle 7" and 8" speakers.

STEREO AMP-TUNER

Madison Fielding Corp., 5 Lorimer St., Brooklyn 6, N. Y. has just released a matched stereophonic amplifier and tuner as the Series 320 and 333.

The amplifier is a 40-watt unit which contains two complete amplifiers, each with a fully integrated preamp section. In addition to the individual controls for each channel, the unit features a master volume control which



controls both levels simultaneously for stereo program levels. Another special feature is the novel "dual magic eye" configuration which, together with a calibrated scale, permits preprogram level settings and adjustment of outputs to meet special conditions.

The companion FM-AM multiplex tuner can be used for either AM or FM reception individually or both signals simultaneously.

Matching cabinets are available at a slight additional charge so that the companion units present a uniform appearance.

DYNAMIC PREAMP

Dynamic Electronics-New York, Inc. of Forest Hills, N. Y. has developed an inexpensive preamplifier unit which is intended to make possible the conversion of any amplifier or radiophonograph to operate with a variable reluctance pickup or tape recorder.

Measuring 6"x3¼"x3½" in a black and copper shielded cabinet, the unit has a frequency response from 11 to 25,000 cps ± 1.5 db, noise and hum level 60 db below 10 millivolts, and an over-all gain of 34 db.

The unit features a shielded cable with molded-on pin plug, a pilot light, phono input jack, "on-off" switch, and operation on a.c. from 110 to 117 volts. Power drawn is 15 watts.

MAGNECORD PT6-6 RETURNS

The *Magnecord Division* of *Midwestern Instruments, Inc.,* Tulsa, Oklahoma has announced the resumption of production on its PT6-6 series of tape recorders.

Housed in two separate cases for convenience in handling, the new PT6-6 is unchanged except for a front panel of stainless steel and an increase in panel size to 19" instead of the former 17" so that the units will fit standard relay racks in studios.

Specifications on this new professional recording equipment will be supplied by the manufacturer on request.

AUDIO CATALOGUES

CABINART ENCLOSURES

Cabinart, a division of *G & H Wood Products Co., Inc.,* 99 North 11th St., Brooklyn 11, N. Y. is now offering a multi-colored catalogue which describes its line of high-fidelity equipment cabinets and speaker enclosures suitable for virtually any type of home application or decor.

The line is pictured and described in some detail. Both finished and unfinished types have been included. Dimensional drawings provide complete information concerning the placement of individual components. Copies are available from local dealers or the manufacturer direct.

"SPLIT/KITS"

Transvision, Inc. of New Rochelle, N. Y. has issued a 20-page catalogue which describes its complete line of "Split/Kits."

Included in the line are hi-fi kits, hi-fi cabinets, as well as kits for assembling television receivers, electronic instruments, and electronic photoflash units. Among the audio items listed and described in detail are 24- and 10-watt amplifier-preamps, a 4-watt amplifier, record changers, a 50-watt amplifier, AM/FM tuner, speaker enclosures for all speaker and room requirements, equipment cabinets, as well as complete "packaged" units assembled from quality components.

Write the manufacturer direct for a copy of the catalogue and full details on the "Split/Kit" plan.

KLIPSCHORN LINE

Klipsch and Associates of Hope, Ark. has issued a 16-page general catalogue and 4-page price list covering its line of "Klipschorn" speaker systems.

The publication describes the design principles involved and then pictures and describes the various models currently available in the line. The enclosures are shown in room settings and complete specifications are given as to finishes, dimensions, and performance.

Write the company direct for a copy of this catalogue or additional details on any unit in the firm's line.

UNIVERSITY "KWIKITS"

University Loudspeakers, Inc. 80 S. Kensico Ave., White Plains, N. Y. is now offering a handy illustrated folder which describes its line of folded-horn "Kwikits"—the do-it-yourself high-fidelity enclosure kits.

Full specifications and prices are included on the Model KEN-15, an enclosure for 12" and 15" speakers and multi-speaker systems, and also the Model KEN-12 for 12" units and systems. The folder graphically details the construction and design advancements incorporated in the line and explains

the advantages of assembling these kits.

AR-2 SPEAKER BROCHURE

Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass. has prepared a new four-page brochure on the AR-2 which it is offering without charge to interested persons.

The brochure includes a brief explanation of the patented acoustic suspension design, harmonic distortion and frequency response curves, and excerpts from press comments on the AR-2.

SPEAKER ENCLOSURE DATA

Able Wood Products Manufacturing Corp., 214 Franklin St., Brooklyn, N. Y. has available for distribution a colorful folder which describes its complete line of ten speaker enclosures.

The booklet pictures and describes a number of resonator, bass reflex, and infinite baffle type speaker housings as well as record changer and turntable enclosures. Most of the units are available either finished or unfinished.

Copies of this publication are available without charge on request. —30—

COOK RESUMES PRODUCTION

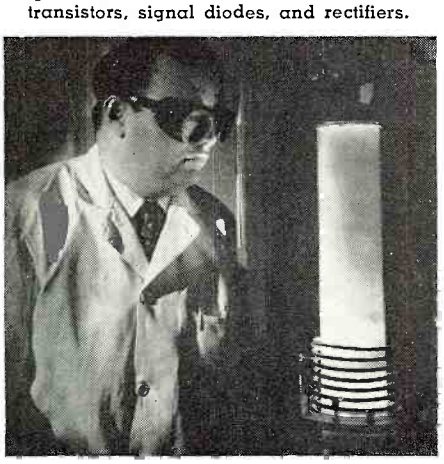
COOK LABORATORIES of Stamford, Conn., which was hit by a disastrous fire at its main plant in Glenbrook, Conn., has re-established its catalogue with a series of new disc releases and six representative numbers on stereo tape.

The three new discs are "Voices of the Sky" (1075) on modern aircraft; "From the Frontier of Space" (5021) which contains official recordings of radio signals from Sputniks I and II; and "King of Organs" (1150).

The stereo tape releases include "King of Organs" (1150S); Brahms' "First Symphony" (1060S), "Masterpieces of the Theater" (1064S), "Clambake on Bourbon Street" (1181S); "Speed the Parting Guest" (1041S); and "Jump-Up Carnival" (1072S).

Both tapes and discs in the re-established catalogue are being offered by direct mail to give dealers time to replenish their stocks. —30—

Molten silicon being pulled from crucible at Merck & Co., Inc. to form a single crystal, using high-frequency method of heating. Ultra-pure silicon is presently being used for the manufacture of transistors, signal diodes, and rectifiers.



Superior's New Model TW-11

STANDARD PROFESSIONAL UBE TES ER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, 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.

EXTRAORDINARY FEATURE

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 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 TD-55

TUBE TESTER FOR

The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the "top-cap."

Checks for shorts and leakages between all elements
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

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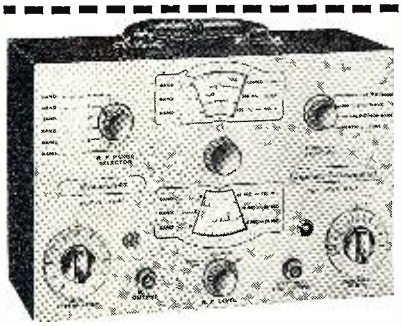

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

7 Signal Generators in One!

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R. F. SIGNAL GENERATOR: The Model TV-50 Genometer 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 Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. 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.)

BAR GENERATOR: The Model TV 50 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.

CROSS HATCH GENERATOR: The Model TV-50 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.

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

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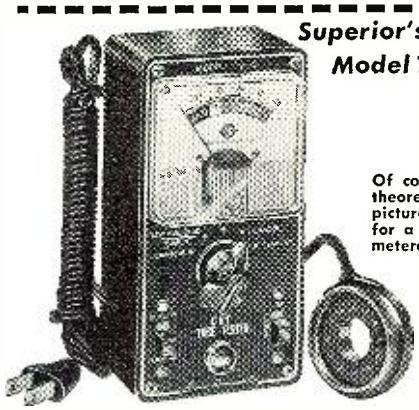

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C.R. Tubes and nothing else.

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

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Although the "*Q*" may be low enough in a particular circuit, that is not enough assurance by itself that bypass action is adequate. The center frequency of the series-resonant circuit should be in the center of the band to be bypassed, or nearly there. Otherwise the bypass action at extremes of the band (near sound and pix carrier, for example) may be different. Where necessary, the center frequency may be "adjusted" by moving the bypass capacitor to or away from the chassis. If this measure fails, the wire leads may be made longer or shorter. Be sure to do this ever so sparingly, observing the results after each change. Even paralleling one wire lead with another may be enough to lower the inductance and raise the frequency by a sufficient amount.

These hints should enable a service technician to handle the cases of trouble he may encounter with series-resonant bypassing. It is particularly advisable to have a few series-resonant bypass capacitors handy for cooling down hot radio sets not amenable to otherwise "kind" treatment. —30—

AMPLIFIER SWITCHING

By JAMES F. SUTHERLAND

WITH higher wattage hi-fi power amplifiers becoming more common, the ordinary methods of switching the system on and off with a switch incorporated in the volume control on the preamp panel may become inadequate.

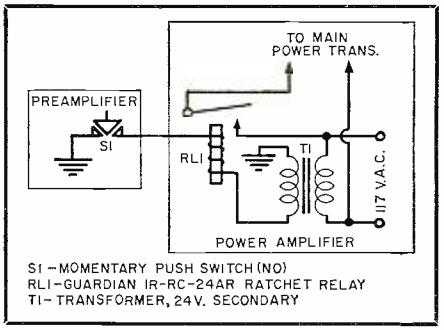
Even with elaborate shielding, well filtered plate-voltage supplies, d.c.-powered heaters, and a good ground, hum can be a problem due to the fact that all of the input a.c. power must pass through the "on-off" switch which is usually located close to the high-gain stages of the preamp.

An ideal switching system would eliminate all sources of hum noise in the preamp. One "humless" method of switching the incoming line current to the hi-fi power amplifier from a remote preamp panel is shown in the diagram below.

Closing the relay coil circuit momentarily with S_1 causes the relay contacts to energize the main power transformer. Pushing S_1 a second time turns the system off since RL_1 alternately opens and closes its contacts with each successive pulse.

The total cost of parts for this system is approximately $7.00. The small 24-volt transformer and ratchet relay can be mounted either under the power amplifier chassis or on a separate small chassis. —30—

Circuit for switching a high power hi-fi amplifier on or off without causing hum.



S1 – MOMENTARY PUSH SWITCH (NO)
RL1 – GUARDIAN IR-RC-24AR RATCHET RELAY
T1 – TRANSFORMER, 24 V. SECONDARY

nician must service, then it is high time he becomes thoroughly familiar with its possibilities, its limitations, and its general behavior.

"As far as transistors are concerned, I believe that time is right now. We both, of course, have kept abreast of the theory and general development of transistor circuits through the fine magazine articles that have been published on the subject, and we have had no trouble taking care of the few transistor radios that have drifted into the shop so far; but from here on in we can expect to meet transistors more and more often. Now is the time to get any special equipment needed to service transistorized equipment, and now is the time to start getting all the practical experience we can with transistors. What's happened to your beagle instincts? Over there on the end of the bench is a new transistor-tester you haven't even noticed yet!"

"Well so it is! I have read, though, that transistors fail very seldom as long as they are not abused. In fact, it is said that in a tube set that won't work, the first thing you suspect is a bad tube; but in a transistor set, the transistors themselves are the last thing to test."

"That's probably true, but I expect to use the transistor tester in a lot of ways. For one thing, it is often necessary to use matched transistors and this tester will allow us to select such matched pairs. Also it will permit us to sort through our stock of transistors —pretty limited, I'll admit, at present —and select the best transistors for particular jobs. For example, we can sort out low-noise units for the front end of amplifier circuits, save the high-gain transistors for places where gain is important, and so on."

"The whole discussion makes pretty good sense," Barney admitted. "I was reading the other day where a Mr. Fancher of *General Electric* said that while transistors are used in only about 12% of new electronic equipment built this year, they will go into 80% of the equipment built in 1967. Looks like it's time we got on the bandwagon."

"Check! I'm also collecting all the transistor data I possibly can from the various manufacturers," Mac said as he waved at a new shelf on the wall. "Every one of them puts out some printed information on their products and various applications. These vary from simple characteristic leaflets to complete booklets on the theory of transistors, suggested circuits, etc. Every time I see something new is published I order it."

"I see some books on that shelf that are not concerned with transistors," Barney observed.

"That's right. I'm trying to select a bunch of books that will help us with the 'dogs.' Each book covers just a specialized portion of a circuit or piece

of equipment. You'll find them on servicing sweep circuits, video circuits, a.g.c. systems, sync circuits, TV tuners, hi-fi systems, tape recorders, and record changers. When we get a real tough problem in the shop and know that the trouble must lie in a particular portion of the equipment, we need exhaustive information on the problem to make sure that we are not overlooking a possibility. That is where the books are well worth their cost. They provide a concentrated review of everything we should know about that particular circuitry or mechanism. I know from experience that leafing through one of these books can often spotlight a source of trouble I was completely overlooking. I intend to keep adding to that shelf. For example, I intend to get a book on color convergence procedures and another on industrial electronics as soon as I can."

"Good," Barney applauded. "I can see where reading through one of these books will be just like having someone say, 'Did you try this?' and 'Did you try that?' But where was your imagination when you built that shelf? Why didn't you build it in the shape of a dog house?" —30—

All About Audio

(*Continued from page 65*)

that horn loading is much more efficient than other forms because it squirts out more concentrated sound. It is rather like taking a shower bath; the available jet of water must be nicely spread out for comfort.

It should be explained that these tests were made with a front-loading horn, the output from the back of the cone being purposely absorbed. Results would have been quite different with a back-loading horn, where the output from the front of the cone plays straight into the room. The axial response curve above 1000 cycles, for what it is worth, would then be similar to Fig. 46 but it would *not* be horn loading.

For ordinary listening, I would say that, by and large, horn loading gives more output than reflex cabinets, offset to some extent by directional effects when tests are extended to higher frequencies and shorter horns, where open baffles would be used in preference to reflex enclosures. The over-all difference is nothing like the off-quoted 40% efficiency for horns with less than 10% for other systems.

Using the models of Figs. 46 and 47 as the bass end of a 3-speaker system, I liked the reproduction from either and found it difficult to express a definite preference.

Conclusion

We now reach a conclusion with which we can all agree, for I mean only that we have come to the end of the series. Mr. Cooke joins me in saying that it has been a great pleasure writing for RADIO & TV NEWS and we hope to have succeeded in expressing our views without treading on too many American toes. As a matter of fact, we think very highly of much of the American hi-fi equipment and business would undoubtedly be more of a two-way traffic if the dollar and the pound were only at par. May the day soon come! —30—

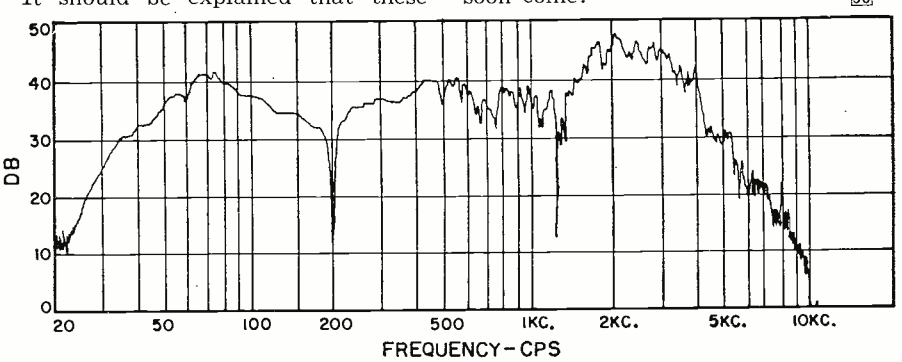
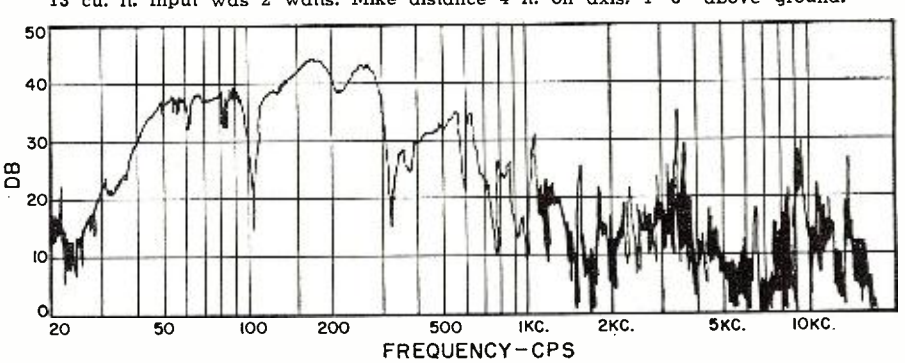


Fig. 46. Response curve of 15-inch loudspeaker unit in 9 cu. ft. corner reflex enclosure which has been constructed with sand-filled panels. The input level was 2 watts and the microphone distance was 4 ft. on axis, and 3 ft. above ground.

Fig. 47. Response of 15-inch speaker in folded corner horn having volume of about 13 cu. ft. Input was 2 watts. Mike distance 4 ft. on axis. 1' 8" above ground.



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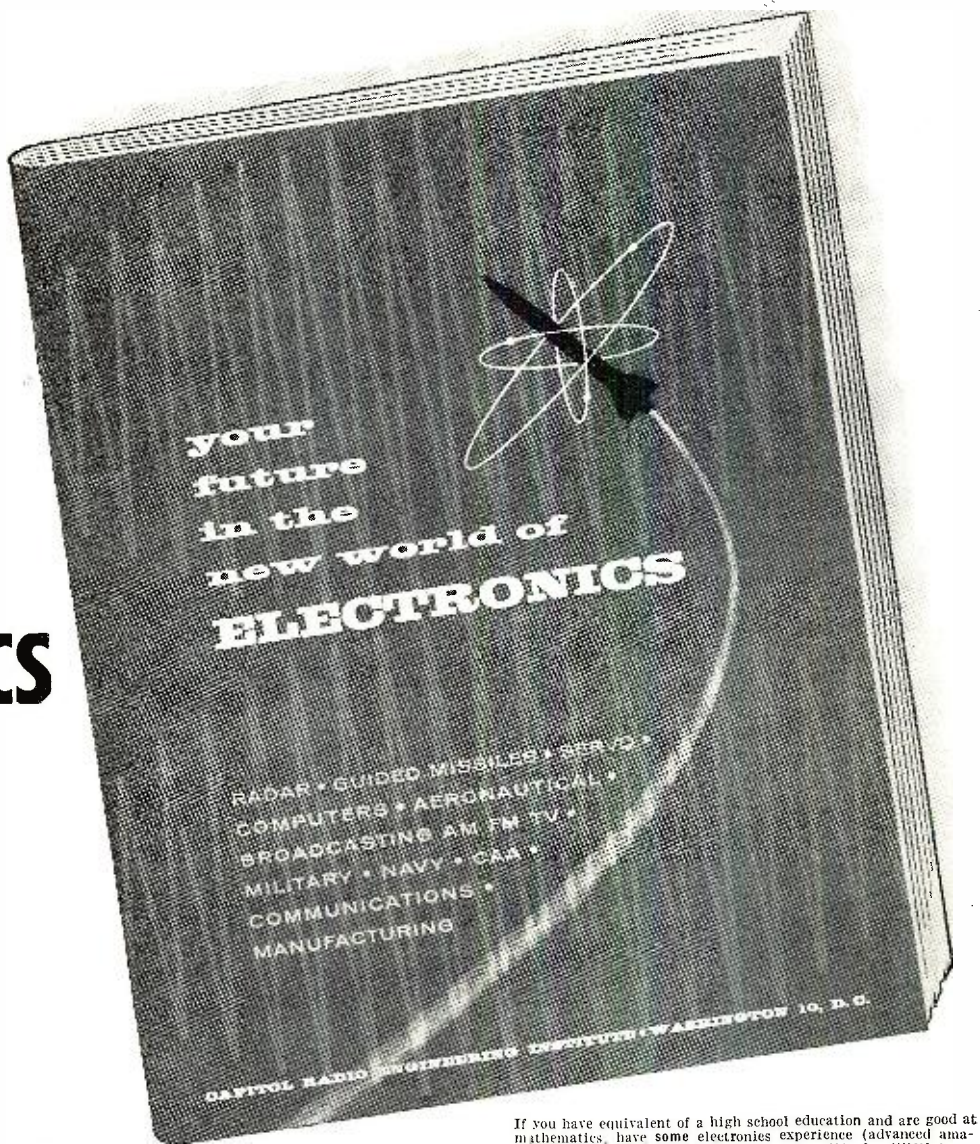

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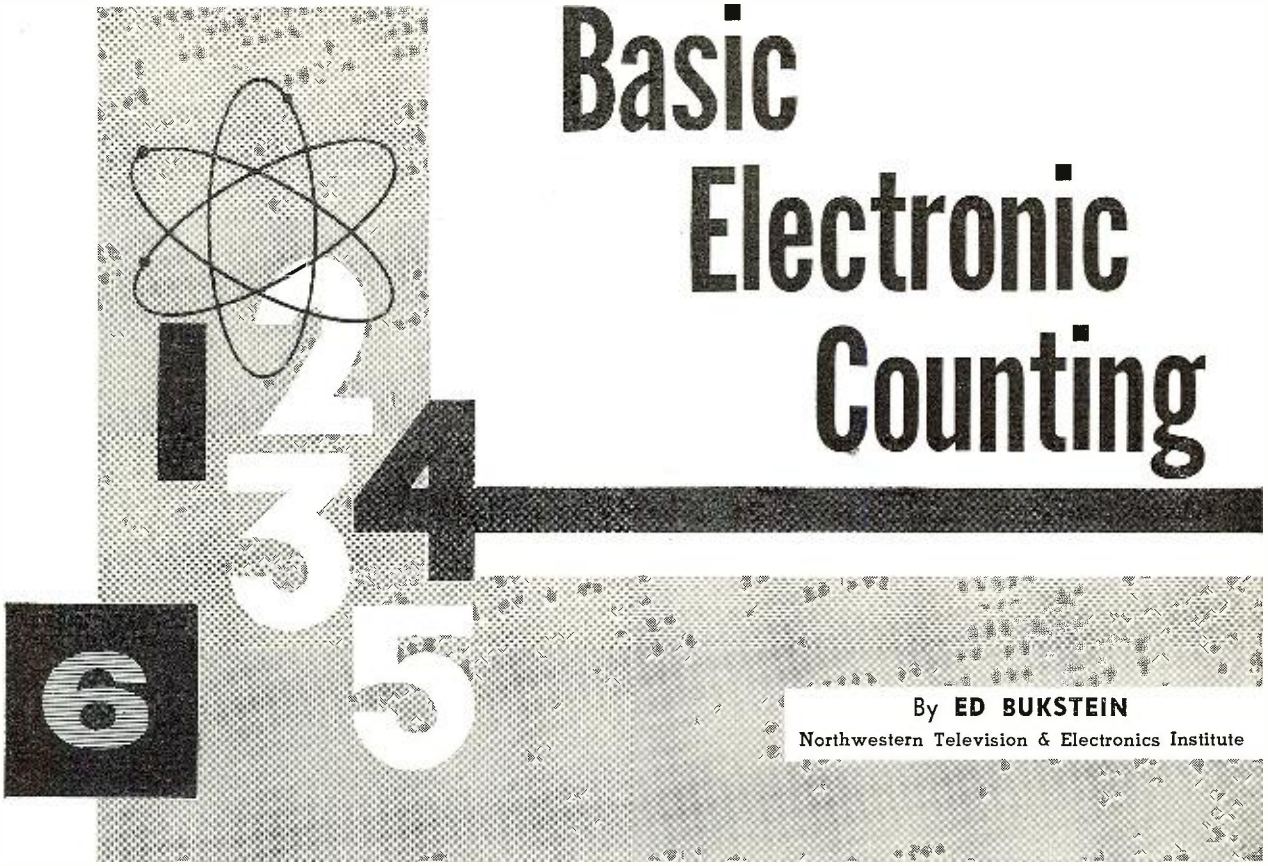


Basic Electronic Counting

By **ED BUKSTEIN**
Northwestern Television & Electronics Institute

A technician's introduction to binary notation, an important digital technique in computer work.

AT ONE TIME, binary numbers were relegated to an obscure little corner in the basement of mathematics and were of concern only to a few cloistered mathematicians whose interest in such numbers was largely academic. Today, the binary numbering system is used extensively in computers, electronic counters, and automation equipment.

In the decimal numbering system, each digit of a number may have any of ten different values: 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9. For example, 743,297 is a number expressed in the decimal system. In the binary numbering system, each digit of a number may have either of two values: 0 or 1. For example, 1101011110 is a number expressed in binary notation.

In the decimal system, the relative positions of the digits determine the value of a number. The right-hand digit represents "ones," the next digit to the left represents "tens," the next digit represents "hundreds," the next "thousands," etc. The decimal number 4632 therefore means 4 thousands, 6 hundreds, 3 tens, and 2 ones. In binary notation, the relative positions of the digits also determine the value of a number. The right-hand digit represents "ones," the next digit to the left represents "twos," the next digit represents "fours," the next "eights," etc. The value of each position is double that of the position to the immediate right. The binary number 10111 therefore means sixteen and four and two and one. This system of positional values is illustrated in Fig. 2. The binary equivalents of several decimal numbers are given in Table 1, for illustration.

In any machine used for counting or computing, each digit of a number is represented by a circuit or component. Fig. 3 shows how a group of switches, for example, can be used to represent either decimal or binary numbers. When the numbers are to be expressed in decimal notation, each switch (or circuit) must be able to represent any of ten different conditions, as in Fig. 3A. When binary notation is used, however, each switch (or circuit) need be capable of representing only two different conditions, as in Fig. 3B. The resulting simplicity of the required circuitry is the reason for preference of binary notation in computing and counting devices. Some computers are designed to work with decimal numbers, but even in these machines each digit of the decimal number is usually represented by its binary equivalent.

Manually operated switches like those shown in Fig. 3 are not often used in practice, because it is desirable to make the operation of the circuit as nearly automatic as possible. Relays and stepping switches are used only sparingly because they cannot operate at the speeds normally required. Each switch shown in Fig. 3 would therefore be replaced by an electronic circuit. A circuit to replace each ten-position switch shown in Fig. 3A would require ten tubes (with some refinements, the number of tubes could be reduced). Each binary switch of

EDITOR'S NOTE: *With the mushroom growth of computer technology, there has been a continuing demand for qualified personnel in this field on all levels. Unfortunately, of the meager sources of information in this area, most are quite specialized or on an advanced technical level. This article is a straightforward treatment of a system of counting, different from the one with which we are familiar, that has become a basic digital technique. It is used because it happens to suit those electronic circuits that can be adapted to counting. The basic counting circuit is also indicated. Are you interested in more articles of this type? Let us hear from you.*

Table 1. The binary equivalent of any decimal number is expressed as a series of "ones" and "zeros," as explained in text, with each "one" representing a given value according to its position. For illustration, several decimal numbers are given here with binary equivalents, showing derivation of the latter.

DECIMAL	BINARY	INTERPRETATION OF BINARY
5	101	1 + 4
7	111	1 + 2 + 4
12	1100	4 + 8
22	10110	2 + 4 + 16
35	100011	1 + 2 + 32
105	1101001	1 + 8 + 32 + 64

Fig. 3B however, could be replaced by a circuit using only one double triode. This circuit, the flip-flop, is shown in Fig. 1. This same circuit is sometimes referred to as a binary scaler, bi-stable multivibrator, or Eccles-Jordan circuit.

Like the two-position switch which it replaces, the flip-flop circuit has two conditions: off and on. When the left-hand triode is cut off and the right-hand triode is conducting, the circuit is said to be in the off or *zero* condition. When the circuit is in the opposite state—left-hand tube conducting and right-hand tube cut off—it is said to be in the on or *one* condition.

In many types of instruments, it is necessary to determine (without removing the instrument from its case) whether the flip-flop is in the *zero* condition or the *one* condition. For this purpose, a small neon indicator is mounted on the panel of the instrument and connected in the circuit as shown in Fig. 1. When the circuit is in the *zero* condition, the left-hand tube will be cut off and the neon lamp will be dark. However, when the circuit is in the *one* condition, the left-hand tube will be conducting and the neon lamp will glow.

In the flip-flop circuit shown in Fig. 1, each plate is coupled, through a resistor, to the opposite grid. It is for this reason that one tube will conduct when the other tube is cut off. If, for example, the left-hand tube is cut off, its plate voltage will be high. This high voltage, applied through the coupling resistor to the grid of the right-hand tube, causes the right-hand tube to conduct. If a negative pulse is now applied to the input, the right-hand grid will be driven to cut-off and the plate voltage of this tube will rise. This increase of voltage, applied through the coupling resistor, will now cause the left-hand tube to conduct. The circuit therefore reverses its condition each time it receives an input pulse. If the circuit is in the *zero* condition at the start, it will switch to the *one* condition when an input pulse is applied. A second input pulse will switch it back to the *zero* condition, a third input pulse switches it to the *one* condition again, and so on.

The circuit is quite similar to the cathode-coupled multivibrator used as the vertical or horizontal oscillator in many television receivers. In such sets, however, components are chosen to provide time constants that will alternately cause each of the triode sections to cut off and conduct, even when no pulse is applied. Thus, a free-running oscillator is obtained whose frequency depends on the time constants chosen. In the flip-flop circuits used for counting, the triodes retain their condition of cut-off or conduction until they are signaled to change by an input pulse.

It is apparent that a group of circuits like the single one shown in Fig. 1 can be used to represent a binary number. For example, the binary number 1011 can be represented (stored) in a group of four flip-flops with the first, second, and fourth circuits in the *one* condition, and the third circuit in the *zero* condition. (The first circuit corresponds to the right-hand digit of the binary number.) In computer work, a group or bank of flip-flop stages is known as a *register*.

The bank of six flip-flop stages shown in Fig. 4 can be used to store any binary number from 000000 to 111111. The six neon lamps in these circuits can be used to indicate the decimal equivalent of the binary number stored. This is accomplished by assigning a value to each light. These values are often printed on the panel of the instrument as shown in Fig. 4. The lights, starting with the first circuit, are assigned values of 1, 2, 4, 8, 16, and 32. The decimal equivalent of the binary number stored in the flip-flops is determined by adding up the assigned values of the lights that are on. For example, if the binary number 110101 is to be stored in the flip-flops, an input pulse would be applied to the first, third, fifth, and sixth stages, assuming that all stages started in the *zero* condition. The lights in these stages will now be on and their assigned values (1, 4, 16, and 32) add up to 53, which is the decimal equivalent for binary number 110101. —30—

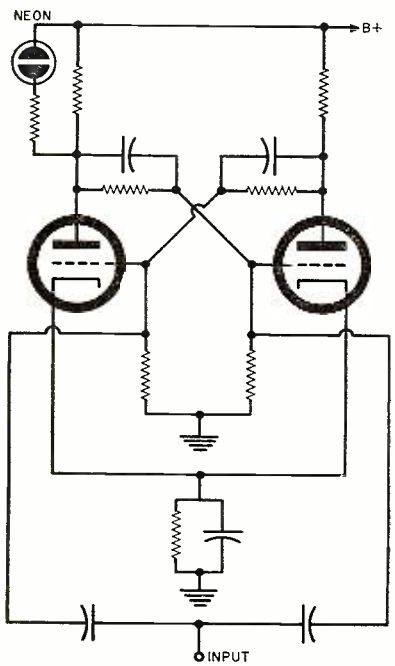


Fig. 1. In the flip-flop circuit, one tube is cut off while the other is conducting. Each pulse applied to the input reverses the circuit. When the circuit is in the "zero" condition (left tube cut off and right conducting), the neon light is off. The light comes on when the circuit is switched to the "one" condition.

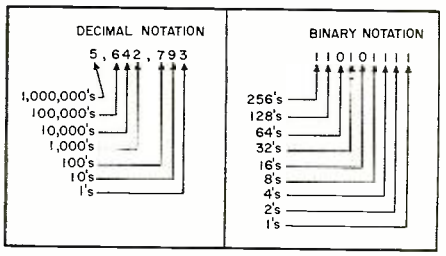


Fig. 2. In decimal notation (left), the digits represent, from right to left, ones, tens, hundreds, thousands, etc. In binary notation (right), the digits represent, from right to left, one, two, four, eight, sixteen, etc. The decimal equivalent of the binary number shown to the right is the sum of the quantities represented by the ones, which, in this case, total 431.

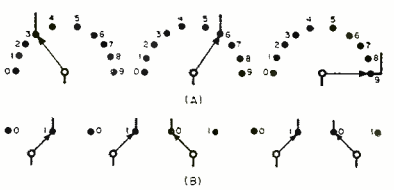
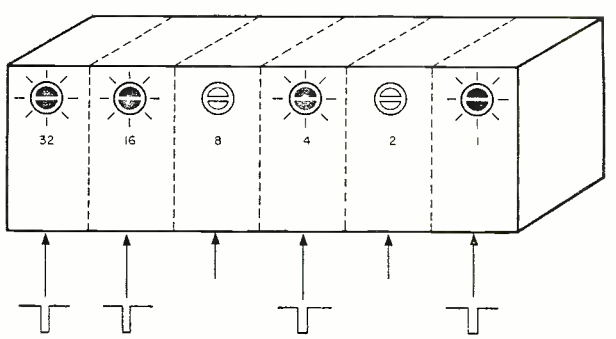


Fig. 3. By setting up switches in groups, it is possible to use them for representing and recording either decimal or binary numbers. However, in the case of decimal notation (A), observe that each switch would have to have ten positions. In the case of binary notation (B), on the other hand, the switches are much simpler, each one requiring only two positions. The switches in (A) are set to represent the decimal number 369. The switches in (B) are set to represent the binary number 11010, equivalent to decimal number 26.

Fig. 4. A binary number may be stored in a series of flip-flop stages. The binary number 110-101 (1 plus 4 plus 16 plus 32) is stored in the six flip-flops indicated. The assigned values of the neon bulbs that are lit add up to the decimal number 53. Numbers are recorded and stored by feeding pulses to appropriate stages. →



Facts about Vertical Sweep

(*Continued from page* 53)

pedance is concerned. When this discharge circuit is opened, the oscillator takes off at a much higher speed, sometimes as high as 1500 cps. It is such an unusual effect that if the technician has never encountered it, it is worth while clipping the circuit open on a set on the bench, just to observe the resulting confusion and make it more easily recognizable in the future. No amount of description is as effective as actually seeing it.

Poor Noise Immunity

The .01-μfd. capacitor connected to the junction of the integrator and the blocking transformer sometimes causes one of those faults which are so evasive that it isn't at all certain whether or not the trouble is really there at all. With this capacitor open, the set will often have better-than-normal lock when no electrical interference is present—but incoming pulses of noise easily cause the picture to jump or jitter vertically. Although this capacitor is a bypass device, it should not be replaced merely with one "at least as big" as the original. Experiment will show that, if the replacement is of too high a capacity, lock will not be satisfactory; whereas, if it is too small, noise immunity will be poor. If this unit is completely open, horizontal pulses may be picked up on the wiring between integrator and transformer. These will disrupt interlace.

Another capacitor which does a rather unobtrusive job is the bypass across the output winding of the vertical-output transformer. This component, too, is concerned with preventing pulses from the horizontal winding of the yoke being induced into the vertical winding, thus making interlace difficult or impossible.

Loss of Retrace Blanking

The .02-μfd. capacitor and 33,000-ohm resistor connected to the "hot" side of the yoke in Fig. 3 convey a pulse to the grid of the picture tube. This pulse momentarily drives the tube into cut-off while vertical retrace is occurring. If the circuit goes open, blanking is accomplished only by the blanking pedestal of the signal waveform. Then, if the contrast is adjusted lower than normal, faint white lines appear diagonally across the picture, often described by a viewer as "like telephone lines curving down across the screen." Some older receivers do not have a retrace-blanking circuit at all and it is a worthwhile improvement to add when the set is on the bench.

Use of the Blanking Bar

No discussion of the vertical section is complete without a reference to the appearance of the vertical blanking bar, and the ways in which it can be used by the technician.

Fig. 6. shows the appearance of a normal vertical-sync pulse in the blanking bar. Contrast has been reduced to make the pulse visible. Clean and regular shape of this sync pulse shows that a clean ghost-free signal is arriving at the antenna terminals and is being passed undistorted through the signal portions of the set right to the picture-tube input. If the set is in good shape in the sync section, the picture should lock positively and stay stable when the pulse looks like this. If, on the other hand, the sync pulse is unrecognizable due to smearing, ghosting, or white lines trailing the black, then, although the sync portion of the receiver may be in good condition, it may be impossible to lock the picture. It should be noted that trouble in the signal part of the set can obscure the pulse as displayed on the picture tube, even though a clean, sharp signal may be coming from the antenna.

It is well known that, in the absence of a test pattern, observation of the width of the blanking bar at different parts of the raster as the picture rolls will give a fair indication of linearity adjustment. Not so well known is the fact that, by advancing the contrast control until the blanking bar just obscures the sync pulse, the contrast can be correctly set up irrespective of whether or not the program material is of good contrast. The technician should remember that the blanking bar represents 100% black level. Knowledge of this fact will, for example, enable a technician to set up a receiver in a store window in full daylight, knowing his adjustment will be correct to show a perfect picture when the sun goes down. If it is known how to use the blanking bar to adjust contrast and brightness, it is not necessary to wait for a test pattern or for a well-transmitted program before attempting final adjustment when leaving a repaired receiver in the customer's hands. A little instruction to the viewer on this technique is not out of place, as it will help him avoid the common mistake of running his set with too much contrast, thus obscuring detail in the shadows of the picture.

Fig. 7 illustrates a case where the blanking bar shows contrast level to be correct, although there is nothing resembling black in the picture detail itself.

Another simple yet useful tip is that the blanking bar can be used as an easy-to-see indication that the picture is level, when setting up the yoke.

Complete absence of scan has not been covered here, as this is usually due to an obvious and straightforward type of failure, relatively easy to troubleshoot. It is, however, worthwhile to mention one fault which occurs sometimes when a minute break appears in the grid winding of a vertical blocking transformer, causing absence of scan when the set is cold. The set sometimes resumes normal operation when it is warm, due to expansion of the wire bringing the broken ends into physical contact. —30—

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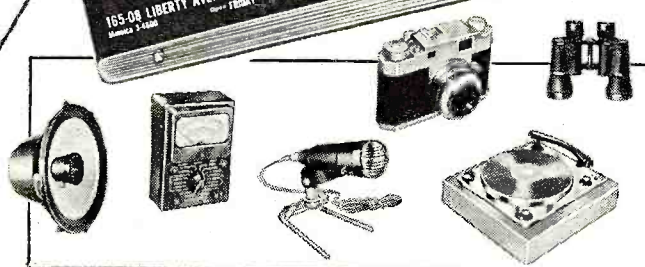

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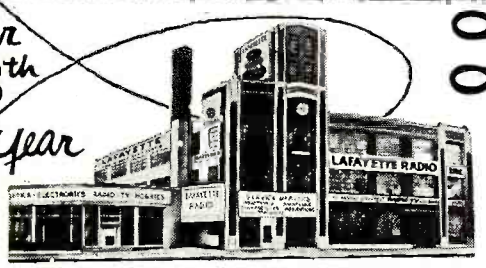

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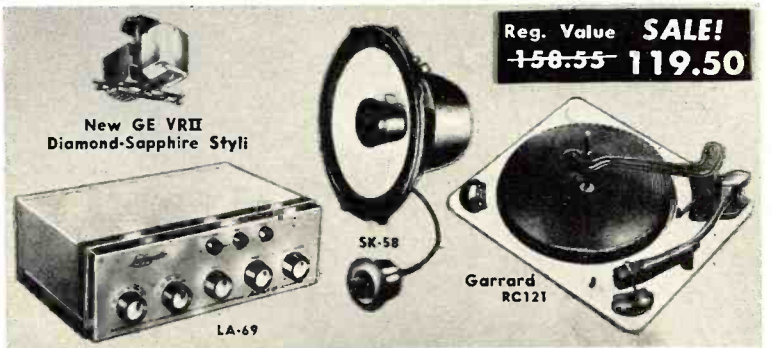

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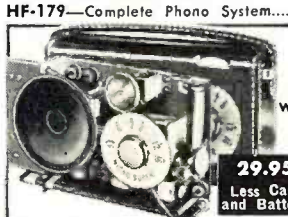

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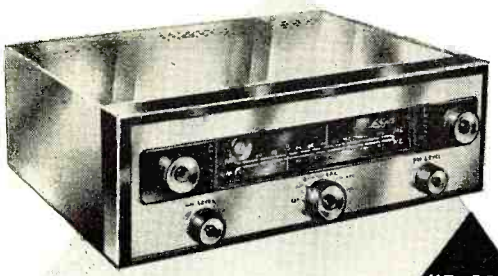

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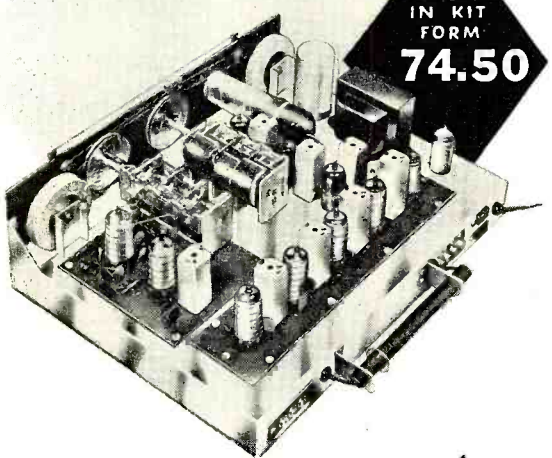

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8 kc bandwidth and frequency response 20-5000 cps ± 3 db.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

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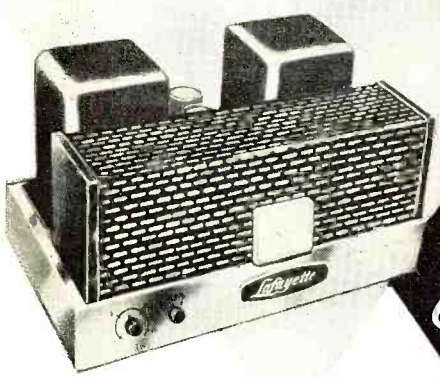

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LA-70—Same as above completely wired and tested with cage and instruction manual.
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What's New in Radio

COLOR TV MICROSCOPE

D. P. Bushnell & Co., Inc., 412 Bushnell Bldg., Pasedena, Calif. is now offering a versatile microscope for color TV service applications.

Designed as a means of checking color convergence on the screen of a

color television tube, the new unit is extremely compact and only slightly larger than a pocket microscope. It has the comfortable working distance and rack and pinion focusing of a laboratory instrument, according to the manufacturer.

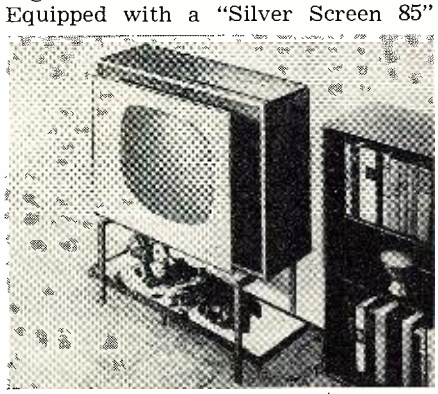
The extensible foot equalizes the effect of TV tube curvature and permits focusing to a depth of 70 mm. Interchangeable opaque and transparent bases allow the microscope to use either reflected or transmitted light.

The instrument weighs 5½ ounces, its closed height is 135 mm. and the height fully extended is 200 mm. A leather carrying case and one each opaque and transparent extensible bases are included in the modest price.

"SLIMMEST TV CABINET"

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. has gone into production on a 21" television console with a cabinet depth of only 10 inches, the slimmest ever developed for the commercial market, according to the company.

Known as the "Sylouette," the slim cabinet was achieved by means of the firm's "floating picture" design which reduces cabinet depth by projecting the picture and its surrounding lighting mask out from the cabinet. Equipped with a "Silver Screen 85"



picture tube, the set provides 249 square inches of viewable area. It is powered by a custom S-110 chassis that is 70 per-cent automated, providing full fringe area performance.

The receiver which measures 36⅛" high, 34" wide, and 10" deep is being offered in mahogany, limed oak, and walnut finishes.

"VIKING THUNDERBOLT"

E. F. Johnson of Waseca, Minn. is now offering a new linear amplifier with over 2000 watts peak envelope power input.

The most powerful linear amplifier any amateur operator can use, the new "Viking Thunderbolt" is designed to insure a dominant signal on all popular amateur bands, 3.5 through 30 mc. When used with any of the firm's drivers, power increases range from 3.8 to as high as 25 times.

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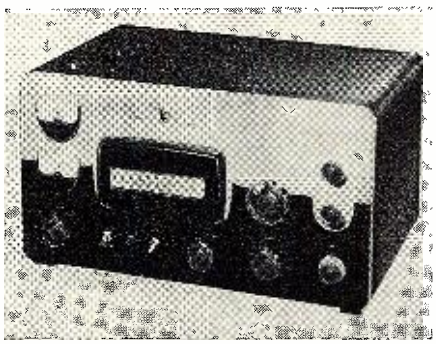


logue which includes complete specifications and a schematic of this new unit is available from the manufacturer on request.

GRID CIRCUIT TUBE TESTER

Seco Manufacturing Company, 5015 Penn Ave. So., Minneapolis, Minn. has just released the new Model GCT-8 grid circuit tube tester.

This compact instrument, which measures only 6½" x 2½" x 6½", has been designed to check the critical control grid condition of vacuum tubes and will provide as many as eleven simultaneous tests on a typical pentode such as the 6AU6. The presence of any or a combination of eleven faults will register as "bad" on the electron-eye indicators.

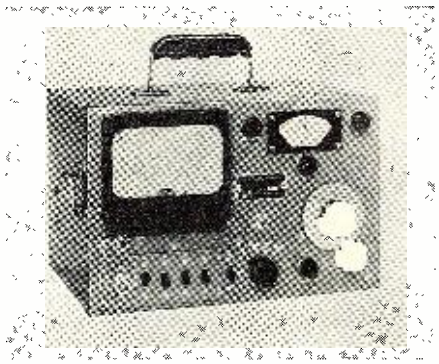
Write the company direct for full details on this new and patented unit.

FIELD STRENGTH METER

Blonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N. J. is now offering a new v.h.f. field strength meter as the Model FSM-1.

This battery-operated unit tunes continuously through the frequency range from 54 to 216 mc. to supply accurate, direct voltage readings. The bands covered are v.h.f. television, FM, aircraft, mobile, amateur, and other special services. A companion u.h.f. converter expands signal readings to the complete u.h.f. television range. Exact signal strengths can be read from 10 microvolts to 3 volts.

The meter includes a phone jack, front panel attenuator switches, pilot light, handle and carrying strap, db and percentage AM modulation scales,



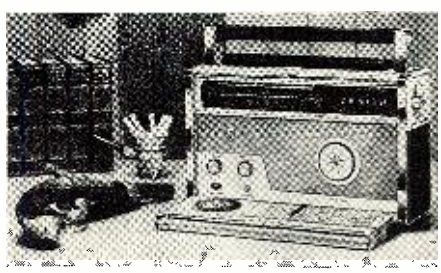
and a Model MB balun to handle 300-ohm inputs. The total weight, less batteries, is only 14 pounds.

The company will supply a data sheet, carrying full details, on request.

ZENITH TRANSISTOR PORTABLE

Zenith Radio Corporation, 6001 W. Dickens, Chicago 39, Ill. has recently introduced a transistorized version of its "Trans-Oceanic" portable which tunes eight wavebands to give reception of thousands of foreign stations on the international short-wave channels plus reception of ship-to-shore communications, Coast Guard weather broadcasts, and standard broadcast stations.

The set is housed in a chrome-plated cabinet trimmed in black leather. It weighs 13 pounds including batteries. The circuit features bandspread tuning, a time zone dial and world time zone map etched in metal, an



earphone connection for private listening, a phono jack, a dial light and separate volume and tone controls.

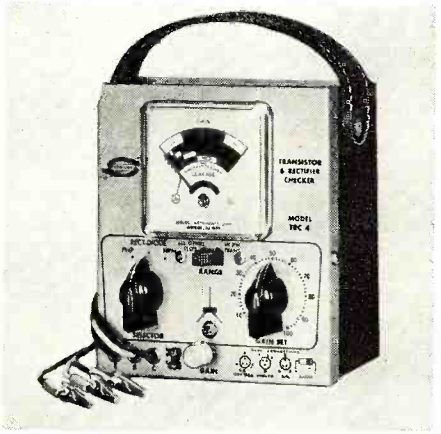
TRANSISTOR CHECKER

Service Instruments Corporation (Sencore) of 171 Official Road, Addison, Ill. has announced the availability of a new and improved transistor checker which also tests crystal diodes and selenium rectifiers.

The new model provides a more complete check on power transistors than did the firm's earlier unit, the Model TDC22. The addition of the selenium rectifier tests makes the new checker more versatile.

The TRC4 is the same size as the

older model. It will test for opens, shorts, current gain, and leakage on

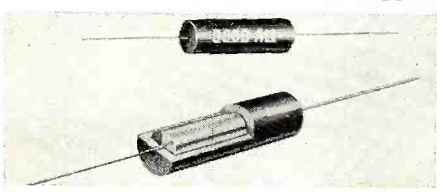


all transistors and forward-to-reverse currents on crystal diodes and rectifiers.

"CAPACITOR OF TOMORROW"

Good-All Electric Manufacturing Company, Ogallala, Neb. is now offering its 600-UE capacitor to the replacement market. Already widely accepted by original equipment manufacturers because of its good operating characteristics in humid climates, its low leakage, and high stability, the new capacitor uses a Mylar dielectric molded in epoxy resin.

The company engineers have developed a production technique which permits these two materials to be molded into a single piece, rugged,



space-saving capacitor. The unit is competitively priced. Write to the distributor's division of the company for full details on this replacement line.

360° CHASSIS CRADLE

As an aid to TV technicians, electronic equipment manufacturers, and installers, *General Cement Mfg. Co.,* 400 S. Wyman St., Rockford, Ill. has recently released a chassis cradle that rotates equipment 360 degrees to simplify repairs.

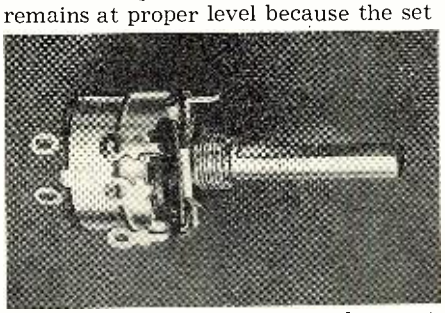
The cradle will handle any size chassis and hold it securely in place or rotate it 360 degrees for any angle of exposure. Speed clamps are provided which allow the chassis to be quickly mounted or removed.

CONTROL AND P-P SWITCH

The Distributor Division of *P. R. Mallory & Co. Inc.,* Indianapolis 6, Ind. is now marketing a volume control which incorporates a new type of a.c. line switch with push-pull action. This switching action, being featured in many new TV set models, gives extra convenience to the set owner and added life to the control.

The line circuit closes when the control shaft is pulled out, opens when

the shaft is pushed in. Volume always remains at proper level because the set



is turned on at the same volume at which it was turned off. Excessive wear on the low end of the element is thus eliminated.

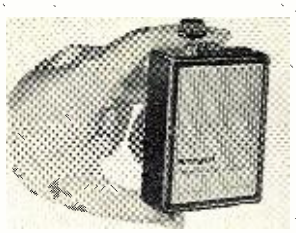
This feature is available on single- and dual-controls in ratings to match original controls in popular radio and TV sets.

"TRANS-MIDGE" RADIO KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has released a new, low-cost 1-transistor radio receiver in kit form.

Only slightly larger than a cigarette package, the "Trans-Midge" performs well over the standard broadcast band when used with headphones and an external antenna. The circuit uses a low-drain transistor, slug-tuned coil for high sensitivity and good separation of stations, external tuning knob, and impact-resistant plastic case.

According to the company, kit builders should be able to assemble this unit in a matter of hours. It comes complete with plastic case, all parts,



transistor, wire, solder, battery, and instructions. Write the company for details on Stock No. 83Y767.

HEADLIGHT DIMMER TUBE

The Industrial Tube Products Department of *RCA's* Electron Tube Division, Harrison, N. J. has designed a new short multiplier phototube of the nine-stage type especially for use in automobile headlight-dimming equipment.

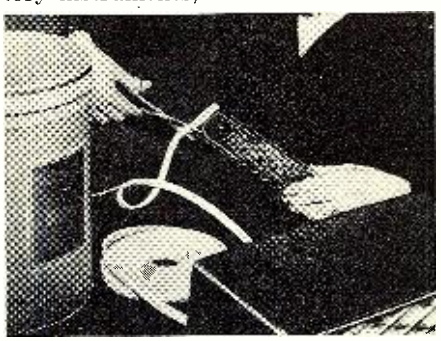
The new phototube (*RCA*-7117) has instantaneous response to meet the critical timing of headlight-control service and is capable of providing stable performance over long periods, according to the company. The high luminous sensitivity of the 7117 allows use of an amplifier with relatively low-impedance input and fewer stages than would be required by a less sensitive tube.

Spectral response covers the approximate range from 3000 to 6200 angstroms, with maximum response at about 4000 angstroms. When operated with a supply voltage of 1000 volts d.c., the 7117 has a median luminous sensitivity of 35 amperes per lumen.

PLASTIC-FOAM TAPE

United Mineral & Chemical Corp., 16 Hudson St., New York 13, N. Y. is handling the U.S. distribution of a new polyurethane plastic-foam, self-adhesive tape which is being made by *P. Beiersdorf Co.* of West Germany.

The new tape has a number of applications in the electronic and electrical fields. It can be used for cushioning and dust exclusion on dial faces; the prevention of vibration, shock, and shifting of sensitive laboratory instruments; eliminate resonance



and vibration in electric motors and relays; as well as acting as a shock panel in front of a television picture tube; an absorber under a turntable to reduce rumble; or at the contact edge of a speaker to prevent rattle.

The product is available in a variety of widths, thicknesses, and colors. For recommendations on "Tesamoll" for specific applications, write the U.S. distributor direct, outlining the problem to be handled.

NEW SILICON RECTIFIER

The Rectifier Division of *Audio Devices, Inc.,* 620 E. Dyer Road, Santa Ana, Calif. is now in production on the first silicon type rectifier in its line.

Designed to be used in radio, television, and electronic devices, the A750 is hermetically sealed, it will either screw into the chassis or plug into a holder, and is rated at 750 ma. at 400 volts.

This is the first of what is to be a complete line of silicon rectifiers which the company will offer. Contact L. B. Potter, sales manager of the firm, for full details and delivery data.

TRANSISTOR SOCKET

Grayhill, Inc., 561 Hillgrove Ave., La Grange, Ill. has designed and is marketing a new socket for use with the

new 3- and 4-pin "Jetec 30" transistors. The socket body is molded from mica-filled phenolic per MIL-M-14. Type MFE.

The beryllium copper contacts are wrap-around style, silver plated and gold flashed for good contact and corrosion resistance. Contact numbers, molded into the rear of the socket, make identification easy. The key mark is molded into the top of the socket for line-up with the transistor case tab. Either rivets or No. 2 screws can be used for mounting.

PROTO WIRE STRIPPER

Proto Tool Company of Los Angeles has announced the availability of a new type of wire stripper which has been designed with the needs of the professional user in mind.

The No. 299 is only 5" long, features a thumb-operated gauge, and will strip all commonly used insulated wire from 14 to 24 gauge without nicking or cutting. Even the larger sizes of wire can be handled with ease. Specially hardened edges facilitate the cutting operation.

INDUSTRIAL "ENGINSCOPE"

Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. has developed an oscilloscope engine analyzer for spark ignited industrial equipment.

Featuring multi-line presentation, cylinder-by-cylinder, the new "Industrial EnginScope" allows secondary signal information to be viewed. This multi-line presentation allows a mechanic to pinpoint troubles by cylinder comparison. Each cylinder operation, from the firing of the spark to the opening of the points, is shown on the instrument's television-like picture screen, one line below the other in the exact firing order of the engine. –30–

MARCH 16-21

Nuclear Engineering and Science Congress. Sponsored by IRE Professional Group on Nuclear Science and others. Palmer House, Chicago, Ill. Daniel I. Cooper, % Nucleonics, 330 W. 42nd St., New York City, program coordinator.

MARCH 24-27

1958 IRE National Convention. Sponsored by 27 IRE Professional Groups. Waldorf-Astoria Hotel and New York Coliseum, New York City. Exhibit will occupy all four floors at Coliseum with 850 exhibitors. A program of 275 papers will be presented in 55 sessions held at both convention sites. Additional details from E. K. Gannett, Institute of Radio Engineers, Inc., 1 East 78th Street, New York 21, New York.

MARCH 26-28

20th Anniversary Meeting of American Power Conference. Hotel Sherman, Chicago. Inquiries to R. A. Budenholzer, Mechanical Engr. Dept., IIT, 330 Federal St., Chicago 16, Ill.

Sound on Tape

By BERT WHYTE

NO DOUBT many of you have become aware that a number of attempts have been made recently to reduce the cost of stereo tapes. There are many tapes available now at anywhere from $4.95 to $8.95. This would certainly seem like a step in the right direction. And yet, this new pricing trend has already had some unexpected opposition. The story goes something like this. As you all remember when stereo tapes first appeared, they were pegged at astronomical levels, as high as $18.95. Early in the game, the companies manufacturing stereo tapes decided to sell them on a time basis. In other words, a tape costing say $12.95 would have a playing time of perhaps 28 to 30 minutes, while the $18.95 tape would play up to 46 minutes. Undismayed by these prices, the stereo market burgeoned rapidly but, as the market expanded, there was (and still is) a constant gripe about tape prices. The companies hit on the idea that by turning out some shorter tapes, they could get down in price where it is easier to extract 5 or 6 dollars from the customer, rather than the ten dollars and up for the longer works. This idea caught on rapidly and quite a few companies are following that practice today.

However, the picture has now come full cycle and many people are highly resentful about the shorter tapes. Why? Not because of the price itself, but because the tapes are of such short duration! Even though many of these shorter tapes are selling well today and probably will continue to sell for some time, it has been my experience that relative newcomers to the stereo field are the people who are buying them. After the first magic flush of stereo has worn a little and they are not just drunk with sound, it occurs to them, as it has occurred to the older stereo hands, that these short tapes are negating the advantages of tape. After all, most people are by now thoroughly used to the LP record and its up to 31 or so minutes of music *per side*. One of the really great advantages of tape and the development of the one mil and half mil long play tape in particular, is that entire symphonies can be played straight through without interruption. Maybe the modern American is just a lazy guy and perhaps it is also a reflection of general economic wellbeing, but in any case, while no one seems happy with stereo tape prices, they appear to be less concerned with price than they are with the bother and annoyance of tapes lasting but 10 or 12 minutes.

To a lot of average people stereo has been worth the trouble of investing in new equipment and learning to handle tape, which even the most rabid stereo fan will admit is more difficult than plopping a disc on a turntable. Now compound this handling problem with short tapes requiring attention every 10 or 12 minutes and you've got the makings of a most unhappy fella! I've had any number of people tell me that the stereo tape prices they still don't like, but they would much rather the stereo companies issue longer tapes even though it's going to cost them more money. I hardly need add that the real problem and one that could become very acute when the stereo disc begins to appear, is the whole basic price structure of stereo tape. With the price of tapes tied to the present methods of duplication and the high cost of basic raw stock, the recorded tape companies have a tough nut to crack. It is to be hoped that responsible people in the tape companies are cognizant of this problem and are bending every effort towards its solution.

This column is being written just after the new year and there has been a seasonal lull and let-up, so that the new releases of most companies have not as yet reached your reviewer. So I'll have to dig around a bit for material and there may be a few "oldies" among them. I should have plenty of interesting new material in time for next month. (Unless otherwise indicated, all tapes are on 7-inch reels, play at 7½ inches per second tape speed, and should be equalized to conform to the NARTB tape equalization curve.)

OFFENBACH MELODIES
Boston Pops Orchestra conducted by Arthur Fiedler. Victor BCS50. Price $8.95

This should wake up your tired blood! This is one of the most gay, lighthearted, and thoroughly enjoyable stereo tapes in the catalogue. Offered here on this all-too-short tape, is the overture to "La Belle Helene" and an orchestral medley from "La Perichole." The music abounds with the typical Offenbachian zip and sparkle and it is particularly effective in stereo with much interplay and directionality. This sort of thing has been Fiedler's meat for years and with the superb backing of his Boston players, he gives a performance of unflagging verve and spirit.

This is one of the most close-up recordings of the Boston group *Victor* has issued in some time. This makes for

terrific instrumental detail and the strings fairly zing and the brass is bright and burly and the woodwinds chortle most realistically. As with much of Offenbach's music there is a good counterpoint of a low bass drum almost always in evidence. The sharp detail was leavened by considerable hall reverb which made for great liveness. There was good center fill and the music as a whole had a good forward projection. A real dilly of a tape!

SYMPHONIC SPECTACULAR
Concert Hall EX-61. Price $11.95.

This is an interesting tape as it affords the opportunity to compare the sound of three different orchestras in three different halls. First is heard Mozart's Overture to "The Abduction from the Seraglio" with Otto Ackerman conducting the Guerzenich Orchestra of Cologne. Then we have Berlioz's Overture to "Beatrice and Benedict" with Walter Goehr conducting the Netherlands Philharmonic, and finally we hear Wagner's Prelude to Act 1 of "Die Meistersinger" with Carl Bamberger conducting the Frankfort Opera Orchestra. Each is quite well done in its particular fashion. The Mozart work has a rather big sound, fairly closely recorded with a hall of fine spacious acoustics. Good orchestral detail, with especially fine string tone. Directionality was adequate to the score—of center fill, it was somewhat lacking. All in all, a rather opulent sound of convincing realism.

The Berlioz piece is far different than the Mozart in recording. Here is medium-close mike pickup, giving reasonable detail, and with a less spacious, somewhat "drier" hall sound, the two blend together quite well. Here, too, is good string tone, rather mellow brass and woodwind. Directionality proved good but center fill was virtually nil. Somewhat subdued dynamics here, the over-all impression being that the sound is occasionally almost formless and it could have been improved with a closer mike perspective.

"Die Meistersinger" is a big florid work and it should be played by a big orchestra. Such is not the case here. The players blow lustily and produce a sound of laudable size, but it just doesn't have that great weight that spells Wagner. The mike is pretty close up here, the saving grace that gave a lot of instrumental detail and lent at least an illusion of weight. The hall reverb is spacious but a mite on the hard side. Generally good strings here and blustery brass, which shows fine direction. As I said, an interesting tape which has much to recommend from the musical standpoint as well.

THEY'RE PLAYING OUR SONG
Billy Butterfield and his Orchestra. Victor BPS-77. Price $8.95.

This tape has a really corny title and the music doesn't deserve such maltreatment. Actually this is a very tasty potpourri of big band music, featuring that wonderful trumpet man, Billy Butterfield. Billy and the boys

sock out some highly arranged versions of such as "Goodbye Blues," "Time on My Hands," "Stormy Weather," and others. Very fine ensemble work here as well as notable rides by some of the stellar players in the orchestra. Interesting to hear this sort of stuff in stereo . . . it's obviously the type where multi-mikes are fed into a three-channel stereo recorder and then post-mixed for desired effects. Thus many of the effects that you hear are not normally present in the music, but are simply included for their "shock" or novelty effect. Here we have a vastly overdone acoustic spaciousness along with obviously contrived directionality. However phony it might be, it's all in good fun and the music is enormously effective.

AMERICA'S MOST DANCEABLE MUSIC

Griff Williams and his Orchestra. Mercury MDS2-7. Price $12.95.

Griff Williams leads a so-called "society" orchestra and in 20 years he has played at most of the plushier hotels and country clubs around the country. The numbers on this popular tape include such as "The Lady is a Tramp", "What is there to Say", "Thou's Swell", "It Had to be You", "There's a Small Hotel", and many others. In matters of sound this can't be recommended too highly. If this type of dance music is your dish of tea, I can assure you that you will hear it with unsurpassed realism.

Directionality is very obvious and excellent center-channel fill helps to spread an orchestra across the end of your living room. All the instruments are highly detailed, very clean and bright and reverb has been judiciously added to make the sound almost palpably "live."

VIENNA

Chicago Symphony Orchestra conducted by Fritz Reiner. Victory ACS-63. Price $6.95.

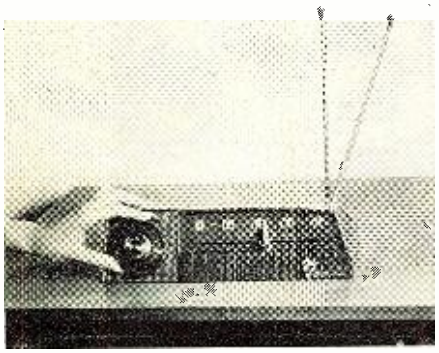
This is Fritz Reiner's contribution to the steadily mounting stream of stereo waltz recordings. This is another of those shortie tapes I have been talking about and actually contains but two numbers, Johann Strauss, Jr.'s "Morning Papers" and Josef Strauss' "Village Swallows." I do not know whether Vienna would quite approve of the massiveness of orchestration Reiner employs for these waltzes, but I can tell you that from a stereo standpoint, these are mighty effective.

I reiterate that Orchestra Hall in Chicago is one of the most superb halls in existence for stereo recording. The recording was closeup and highly detailed with excellent projection and, with those magnificent acoustics, the qualities of liveness are outstanding. The string sound is pure magnificence and the huge weighty brass must be heard to be appreciated and believed! Add a bass drum of noble proportions which whams away with great abandon and the wide frequency and dynamic range and these are waltzes for the stouthearted! —30—

SPICO "VISCOUNT"

Spirling Products Co., Inc., Henrietta St. and Duffy Ave., Hicksville, N. Y. recently introduced a new indoor television antenna which is being offered as the "Spico Viscount."

Combining new styling with patented electronic features, the company is

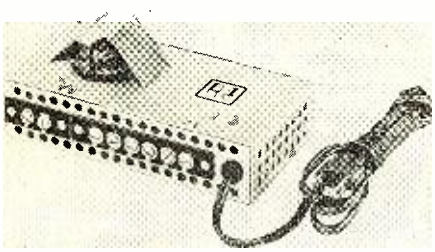


offering the unit in mahogany, ivory, or ebony finishes to match or contrast with any living room decor. Entire concealment of the "rabbit ears" is made possible by the telescoping of the dipoles into the cabinet of the unit. When extended during use, the dipoles are equal in length to standard antennas and may be oriented to any degree for the sharpest possible picture. Very light polished brass tubing used in their manufacture prevents the unit from becoming top-heavy when in use.

The circuit incorporates a "selectronic" tuner which permits the set owner to match the impedance or power of the antenna to his particular TV set. A 12-position phasing switch automatically provides a combination of circuits which, depending on location, delivers to each set the required circuit for maximum reception in the area. A fine tuner adjusts the capacity of the dipoles for maximum reception of a particular channel.

TWO-SET BOOSTER

Blonder-Tongue Laboratories, Inc., Newark, N. J., is now in production on its Model B-23 two-set booster. This



all-channel broadband amplifier is designed to improve reception on one, two, or three TV sets.

The Model B-23 permits operation of two or three TV receivers from one antenna. The unit amplifies signals

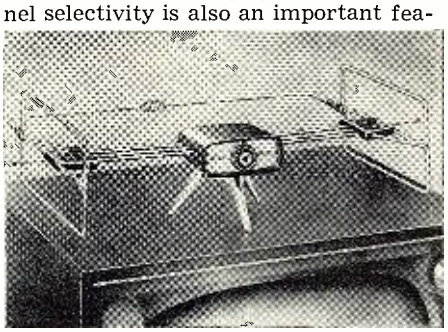
on one, two, or three sets, even when all sets are in operation at the same time. The circuit consists of a one-tube amplifier, 300-ohm input, and 300-ohm output to 1, 2, or 3 sets. Power requirements are 117 volts at 60 cycles. The device draws .12 amp. The booster is housed in a compact cabinet that measures 6¼"x3¾"x2½". It can be mounted out of sight or at the rear of one of the receivers. The device is designed for continuous operation.

"SUPER SHOWMAN"

Channel Master Corp. of Ellenville, N. Y., has begun the distribution of the "Super Showman" indoor TV antenna, a new and more powerful version of its "Showman."

The new antenna has two added design features to improve performance. A new disappearing dipole boosts low-band performance and a new parasitic reflector delivers extra high-band performance.

The 12-channel "Metro-Dyne" variable inductance tuning system for channel selectivity is also an important fea-



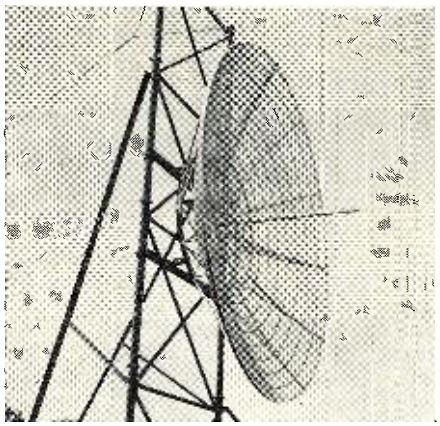
ture of this new antenna. By turning the knob to the same channel as the TV set, the picture is locked in sharp focus.

The antenna is available in either mahogany and gold or blonde and gold finishes.

PARABOLIC FOR COMMUNICATIONS

Technical Appliance Corporation of Sherburne, N. Y., has developed a series of 19-foot parabolic antennas which has been expressly designed for communications work.

Available in various combinations of mounts and feed systems, all using the same parabolic reflector, the model



will operate over a wide range of frequencies, depending on the feed system selected.

The reflector is made up of four pie-shaped sections to facilitate easy transportation to the installation site. The individual sections are readily assembled and result in an extremely rugged structure. The base of the antenna is a circular ring truss 8 feet in diameter. Pre-formed radial members fan out from the ring truss to the tips of the reflector. Circumferential tubing is Heliarc-welded to the radial members. A rigid ring surrounds the entire structure.

Complete electrical and mechanical specifications on a full range of dishes are available from the manufacturer.

COMMUNICATION ANTENNA

Andrew Corporation, 363 E. 75th St., Chicago, Ill. is now offering a new "radome" antenna for 450-470 mc. communication applications.

The Types 212 and 213 are omnidirectional with a measured gain of 10 db over a half-wave dipole. The Type 213 is designed for systems using pressurized air dielectric cable. The connection is a ⅞" EIA flange. The power rating is 250 watts. The Type 212 may be used for systems with solid dielectric lines. The input connection is a Type N plug. Power rating is 200 watts. Air dielectric cables are recommended when cable length is greater than 35 feet.

A data sheet on these new antennas will be supplied on request. —30—

Harvey Radio Company, New York's largest electronic parts distributor, has just opened a new ham center at 103 W. 43rd St. Completely modern display facilities provide enough space for every known piece of ham gear. A feature of the Center will be a plastic package service for ham licenses. Special incapsulation equipment makes this possible. Any ham can avail himself of this service by dropping in.

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1H4
1H5GT
1J6GT
1L4
1L6
1LA6
1LC5
1LH4
1LN5
1N5GT
1S4
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1T4
1U4
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1V2
1X2
2A7
2D21
2X2
3A4
3A5
3AL5
3AU6
3BC5
3CB6
3Q4
3Q5GT
3S4
3V4
4B27
4B97
5AM8
5AN8
5AQ5
5AT8
5AW4
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12AT6
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12AX4GT
12AX7
12AZ7
12B4
12BA6
12BE6
12BH7
12BY7
12CU6
12SA7
12SG7
12SH7
12SJ7GT
12SK7
12SN7GT
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14Q7
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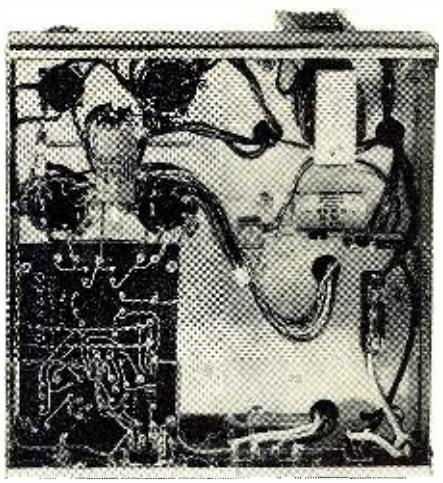
The "Mark III"

A wire cage over the tubes and a bottom plate are used to enclose the entire unit.

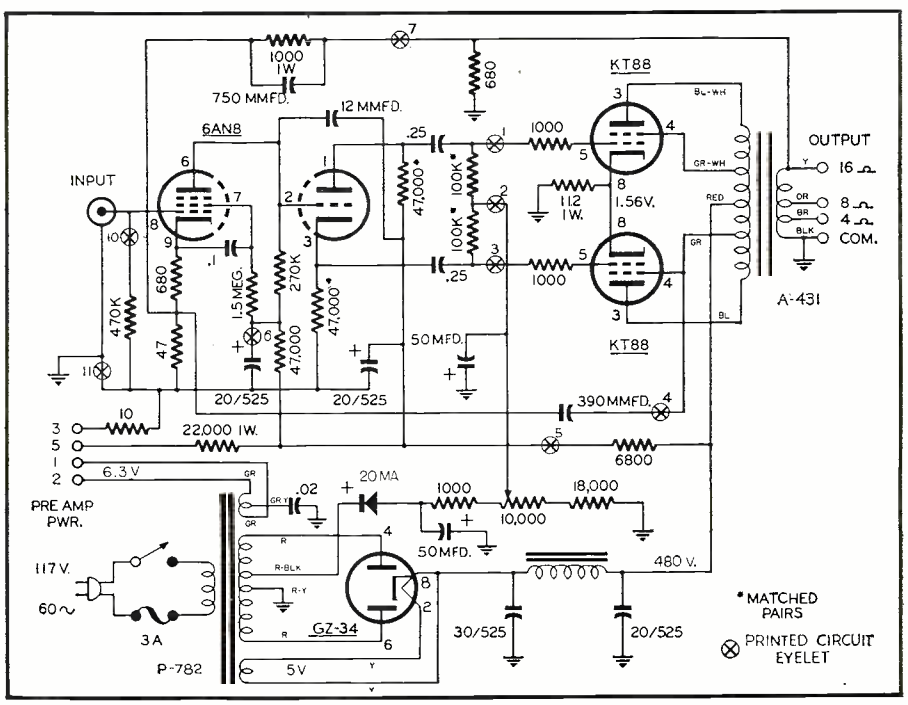


KT88 output tubes provide 60 watts of audio in this easy-to-build high-fidelity power amplifier.

LIKE almost everyone interested in high-fidelity, your editors always look forward to new items, components, or even circuits that will further improve the quality of sound reproduction. It hasn't been too long ago since the British-made KT88 output tube reached the American market. It has been received with so much enthusiasm that within a short period of time one will find many power amplifiers, produced in this country, equipped with this new tube. It is actually the "big brother" to the KT66 which most audiophiles will remember achieved its greatest prominence in the Williamson amplifier.

One of the first such amplifiers that has come to our attention for a performance check is the "Mark III," manufactured by the *Dyna Company* and marketed in kit form. The circuit does not differ, to any great extent, from the original 50-watt "Mark II" design. It does, however, include refinements in that component toler-

While diagram shows simplicity of design, circuit provides real hi-fi performance.



ances and circuit adjustments were given much more consideration, resulting in a power amplifier with extremely low distortion, even at 60 watts output. In addition, a 4-ohm output tap is provided for hi-fi loudspeakers with this value of impedance. Choke filtering is employed in this unit so that a lower hum level is produced than would be the case if simple resistance-capacitance filtering were used.

There are four tubes: a 6AN8, two KT88's, and a GZ-34 rectifier used in the design. The input stage, a pentode voltage amplifier, is directly coupled to a cathodyne phase inverter, driving the output tubes operating with fixed bias. The screens of these output tubes are operated from a 33% turns point on the output transformer, improving the regulation of this stage and making it comparatively uncritical to load impedance variations.

As to performance, listening tests showed extremely good quality, equal to that of better amplifiers on the market today. Yet, instead of going over the subjective performance of the unit, which would be merely personal opinion, let's review the actual performance report taken in our own laboratory:

Sensitivity: 1.55 volts r.m.s. input for maximum power output.

Hum and Noise: −78 db from 2 watts, open input circuit. −80 db from 2 watts, shorted input.

Frequency Response: 5 to 64,000 cps ± 1 db at 2 watts. 13 to 43,000 cps ± 1 db at 60 watts.

IM Distortion: With 60 and 6000 cycles (4:1 ratio) and equivalent sine-wave output of 2 watts, the intermodulation distortion is .048%. At maximum output of 60 watts under the same conditions, the IM distortion is .37%. These figures are extremely low, however, distortion does rise very sharply above 60 watts. Actually, at 62.7 watts, the IM distortion is 1%.

Harmonic Distortion: At 1000 cycles, 2 watts output, the harmonic distortion is .02% and gradually rises to 1% at 60 watts. At 20 cps, harmonic distortion of 2% occurs at an output of 54.5 watts. At the high frequency end (20,000 cps), this harmonic figure is obtained with an output of 51.5 watts.

According to the manufacturer, the amplifier does not exhibit any bounce or flutter when pulsed. It is extremely stable irrespective of loudspeaker load and with any reasonable length of leads for remote speaker operation.

There was one particular point worthy of comment. The original model constructed had somewhat higher IM distortion at 2 watts (.42%) than called for by the maker's specs. It was found that the two 47,000-ohm resistors in the phase splitter were not matched close enough and after adjustment the results, as quoted, were obtained. The manufacturer immediately tightened initial inspection so that this should not be a problem.

—30—

FEEDBACK

By PAUL W. KLIPSCH
Klipsch & Associates

MUCH has been written on the application of feedback to compensate for speaker impedance variation. The height appears to have been reached in claiming to have extended the range of a speaker. (Refer to the article "A New Look at Positive Current Feedback" by Zink and Sanford in the November, 1957 issue of RADIO & TV NEWS.)

Feedback in an amplifier, to obtain lower amplifier distortion, or to maintain a low internal amplifier impedance (nearly constant voltage with varying load impedance) or some condition between that and constant current; all these are good or useful, depending on the application. But to make a speaker go an octave lower by means of the altered internal impedance of an amplifier can be shown to be a fallacy.

In testing a speaker, a certain voltage is applied to its terminals. Since at the given frequency the speaker exhibits a certain impedance, a certain current flows. There results a certain sound output. Now at that frequency it makes no difference whether the internal impedance of the amplifier is high, low, or negative. It is the current in the voice coil that produces the force and its resultant motion. Assuming the amplifier to be free from distortion, it makes absolutely no difference whether the amplifier has zero impedance, has positive feedback, or even if its power rating is high or low as long as the power rating is adequate to produce the stipulated volts and amperes. Hence if a speaker is tested at its optimum input volt-ampere conditions, we can not improve the speaker response with an amplifier of some peculiar internal impedance characteristic.

Now, of course, the feedback may cause an altered frequency response; since the speaker impedance is a complicated function of frequency one could apply feedback of a type to raise the amplifier impedance, say, making it approach constant current instead of constant voltage, with resultant peaking of speaker output by compounding high efficiency with high power absorption at high impedance peaks. But as for making a speaker deliver undistorted acoustic power outside its operating range, this is an operation bootstrap. It's nice to wish for it, but wishful thinking doesn't make it so. Some have claimed to have obtained 20-cycle output from a Klipschorn; sure it can be done but at minute amounts of power; try to equalize that output up to "useful" levels and all one gets is distortion. This can be said of any speaker.

What the feedback proponents are accomplishing is simply an equalization which becomes a function of speaker impedance, for better or worse. Equalization has long been thought of as a means of extending speaker range, but invariably it increases distortion.

Furthermore it would be useless if a speaker did produce a fundamental tone at 20 cycles. Experiments with a stethoscope and pistonphone capable of 140 db pure sine wave pressures down to 2 cycles per second were studied aurally. Below about 35 cycles most listeners heard pulses rather than sine waves and no one tested so far heard fundamentals below about 28 cycles. This type of test is not extensive enough to state these results as being general, but they appear to be usual. —30—

A Flyback Tester

(*Continued from page 48*)

normal length, as no boost voltage is being developed in the absence of a yoke.)

6. If r.f. is present, remove the test box. Disconnect everything except "B+" from the suspected flyback; re-connect the plate clip; and try for an arc from the rectifier plate cap. If no r.f. is present, there is a short circuit somewhere in the flyback. If r.f. does exist, the flyback is good (or there may be an open in the primary, which is easily checked).

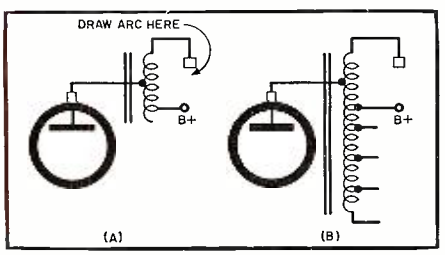
7. Now re-connect the original flyback leads in the set *one at a time.* The connection which kills the r.f. is the one leading to the circuit which contains the fault.

This little gimmick is so quick and easy to use that you will find yourself *beginning* the search with the flyback instead of *finishing* it there!

It pays to know how a piece of test equipment operates; so, for those not fully familiar with transformer operation, some explanation of the principle of the device will be interesting. The flyback is a high-*"Q"* transformer. One shorted turn can lower the *"Q"* enough to kill r.f. Even a single loop of wire around the core, not connected to anything else, can do this. By connecting the test box, we use the horizontal-output tube as an r.f. generator, as in Fig. 3A. The r.f. voltage is increased by the step-up ratio of the autotransformer, but is smaller than normal because no boost voltage is generated. With other circuits disconnected from the suspect transformer, the top part should work just as the test box did, as long as no internal shorts exist in the windings. See Fig. 3B. The lower portion of the transformer winding goes along for the ride—it contributes nothing but it does no harm. If a short exists anywhere in the winding, the *"Q"* is lowered and r.f. is inhibited. If a defect in an associated circuit is improperly loading the transformer to prevent the development of r.f., this circuit will be localized when its connection to the transformer is made (Step 7) and r.f. is cut off.

Try this simple little gadget. After you have used it two or three times, you will begin to feel that it is indispensable. —30—

Fig. 3. (A) Connection of the test flyback. (B) Re-insertion of 3 connections of the suspect flyback before auxiliary connections are restored, one at a time.



Transistor Heat Sinks

(*Continued from page 71*)

It makes little difference if the power is applied steadily to the chassis or in jerks. The average power is the quantity that is important. The chassis will not get hotter than what would be expected from its average heat flow—averages over two or three minutes.

This means in practice that the chassis will in fact be somewhat cooler than predicted using the peak power dissipation. We can use this fact to advantage and push the transistor a little harder without danger of burnout.

In many cases it is not easy to calculate the average power dissipation and this can be avoided by measuring the chassis temperature directly. This is most easily done with a thermocouple or thermistor.

It can also be measured with an ordinary thermometer provided care is taken to insure a good contact. Grease (such as is required for the mica washer) is helpful. Place a small heap of grease on the chassis *near the transistor* and lay the bulb of the thermometer in it making sure it is touching the chassis and surrounded by grease. Placing cotton or some other insulating material on top of the thermometer sometimes helps insure accuracy.

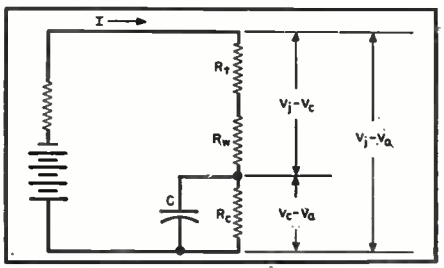
Whether the chassis temperature is measured or computed using the average power dissipation and the chassis thermal resistance by the formula: $T_c = T_a + \theta_c P_{av}$ it is now known. The junction temperature can be calculated now from the formula (remember the electrical analogue if you don't "see" this formula)

$$T_j = T_c + P(\theta_w + \theta_t)$$

The electrical analogue can be extended to include the thermal time constant of the chassis by merely adding a capacitor to the circuit. Fig. 5 shows the new circuit, with I again corresponding to P, R_c to θ_c, V_j to T_j, etc. The capacitor C is chosen to make the time constant CR_c just equal to the thermal time constant of the chassis.

Here the circuit is easy to analyze. If the current I is not steady, it has an average value. The voltage drop across R_c will be steady, because of the large value of the capacitor shunting it, and will be equal to the average current multiplied by R_c. The top voltage V_j is just this steady voltage V_c plus the two IR drops in the two re-

Fig. 5. C represents chassis heat capacity.



sistors R_w and R_t. This is just the result we found a minute ago, if we think back to the thermal situation.

A question that may be raised is, "Since the capacitor shunting R_c is due to the heat capacity of the chassis, and since the transistor mounting base must have some heat capacity itself, shouldn't there be a capacitor shunting R_t?" Yes, there should be. Its value should make the upper time constant equal to the so-called "junction time constant," which for modern transistors is a few milliseconds.

However, relying on this capacitor to smooth out the junction temperature is risky, for even moderate audio frequencies last long enough so that the capacitor is not too effective.

The resistor representing the mica washer should also have a capacitor shunting it, but this value will be very small.

When making an experimental circuit, it is often wise to use a very large heat sink and keep the peak power dissipation below the limit calculated from the data here. However, when the circuit is built up in final form, such a large heat sink is often unnecessary. By using the fact that the chassis heat capacity smooths out the short-term fluctuations in chassis temperature, you can get by in practical cases with a somewhat smaller chassis, and still be safe.

To account for unexpected conditions it is wise to plan to stay below the power rating you compute. Leave as big a "safety factor," or "factor of ignorance" as you feel will account for unexpectedly high ambient temperatures, current and voltage surges, etc.

—30—

CRYSTAL CARTRIDGE TEST

By PAUL MITNAUL

HERE is a quick and simple way to test crystal cartridges and, at the same time, put to good use some of those dust-ladened capacitor checkers which are to be found in many service shops.

Set the range switch of the checker to the 10-5000 μμfd. scale. Next disconnect the leads from the crystal cartridge. It is not necessary to remove the cartridge from the tone arm unless the leads are soldered directly onto the cartridge as in the old type of record changers.

Next clip the test leads of the capacitor checker onto the terminals of the crystal and adjust the checker for a balanced condition as indicated by widest deflection angle of the eye or whatever other device is used to indicate a balanced circuit. In other words, go through the same procedure as for testing a paper capacitor.

Now the needle should be plucked gently with the finger. If the crystal is good, the eye's shadow will flicker violently due to the generated voltage and the change of capacitance in the crystal, causing the unbalance in the bridge circuit. On the other hand, if the crystal is defective, little or no variation will be noticed.

Crystal mikes may also be tested by this method by speaking into the mike or thumping with the finger and noting the resultant eye movement. —30—

Service Industry News

ASSOCIATION member: have you sent in yet, on behalf of your group, a filled-in copy of the coupon below? It takes only a few minutes of your time, and it can be pasted on a postal card. It will help your association in two ways: it will directly publicize your group's activities, and it will assist you indirectly by giving you a picture of how other groups function.

The editors of service-association house organs have been steadily increasing their use of copy that encourages association members to examine critically their own business-operating and customer-relations practices. While they continue to throw the white light of publicity on industry practices and developments that, in their opinions, are not in the best interests of the independent service industry, there is a noticeable acceptance of the fact that some of the bad publicity TV service has received has been due to the bad business practices and poor customer-relations efforts on the part of many full-time, legitimate service dealers.

In a recent issue of "The Raster," the official publication of the Electronic Service Council of the Ozarks, Editor Wayne Lemons covered an important but touchy subject in an editorial titled, "Why Can't Technicians Pay Their Bills?" "Maybe the question should be," wrote Editor Lemons, "Why won't technicians pay their bills?"

"One of the things we hear regularly from distributors, is the number of slow accounts in their files. It's no secret that a great number of shop owners do not discount their bills by paying their accounts on time. This is a rather sad situation, not only from the standpoint of the distributor who needs the money to pay bills of his own, but also to the shop owner who could save himself enough in just one year to take an expense-paid vacation.

"Why the slow pay on the part of the shop owner? Well, we can't give the answers, or at least not all of them, but we believe we can put our finger on a few weak spots. First and foremost, we believe that some shop owners do not have the proper attitude toward the paying of their accounts. They assume that the distributor is made of money and more able to wait than the shop owner. This just isn't so! The distributor is caught in a giant squeeze, especially the legitimate one, who must nearly always wait for his money, coupled with the fact that the shop owner in general is rather disloyal when he owes money to a distributor. Quite often, when a shop owner gets in debt to a distributor, he will spend his cash with someone who will give him a slightly larger discount. There is always some distributor who will come along and give a longer discount if you pay cash but beware when you need merchandise replaced or other services that only the legitimate distributor will render!

"If you are in debt to a distributor, you are morally obligated to spend your cash with that distributor, much more so than if your account is paid up!

"Another fault that many shop owners fall into is that of not paying themselves a salary and then living on that salary. They carry all their money in the pocket and dish it out to the first creditor, or to the wife for something new, or for one thing or another, forgetting completely their obligation to the parts distributor. Every shop owner should pay himself a salary and have at least a simple bookkeeping system that will tell him when he is losing money, either by not charging enough or by having too many charge accounts, or whatever the cause may be.

"Shop owners must learn to make money *selling,* rather than by trying

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150-325 Kc; 325-695 Kc; 3.4-7 Mc. Complete with tubes, motor.

BRAND NEW . . . $26.95

Used, like new, incl. tubes and dynamotor. . $18.95

BENDIX DIRECTION FINDER

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.

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

AR8 NAVY RECEIVER-TRANSMITTER

Receiver 4 band 195-9050 Kc. Transmitter 3000-9050 Kc and 2300-4200 Kc. 28 V Dynamotor. ALL BRAND NEW, complete . . . **$88.50**

NAVY "HANDY-TALKY" TRANSCEIVER

Two way communication by voice or MCW up to 30 miles. Xtal controlled transmitter 140.58 Mc. Superregen. Receiver. Telescopic Antenna. Press-to-Talk Switch. Overall 15⅛"x2⅜" diam. Our low price, less batteries . . . each **$22.50**

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

BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Excellent Used **$11.95**

POWER SUPPLY for above, 117 V 60 Cycles AC. Excellent used . . . $16.95

Vibrator Supply for 6-12-24 Volts . . . 9.95

BC-221 FREQUENCY METER

Special Buy! Complete with operating manual. LIKE NEW . . . only **$119.50**

BC-221 FREQUENCY METER CASE

Aluminum Case for BC-221 or TS-164 Freq. Meters. Shock Mounted. BRAND NEW . . . **$3.99**

(add 50¢ for packing)

Original 1000 Kc Crystal for BC-221. BRAND NEW $8.45

LM FREQUENCY METER

Crystal calibrated modulated. Heterodyne. 125 Kc to 20,000 Kc. With Calibration book. **$49.50**

Exec. Cond. . . .

Less Calibration Book . . . $29.50

GOLD PLATED SPECIAL!
TS-1/ARR-1 TEST OSCILLATOR

Portable, complete with two 955 tubes, cavity and antenna. BRAND NEW, in metal housing 9¾" x 6¾" x 7" high. OUR LOW PRICE, each . . . **$3.95**

BRAND NEW SPECIAL PURPOSE TUBES

In Original Individual Packing

Type	Each	Type	Each	Type	Each
2C42	$4.95	813	6.95	2X2	.39
2C46	3.50	815	2.99	6A7	.35
5D21	4.50	826	.44	6AG5	.33
RK65	7.25	829B	7.50	6J6	.33
2J724B	.35	832A	5.95	12SA7	.34
VR105	.79	837	1.15	12SQ7	.33
VR150	.79	1625	.26	35Z5	.33
CRP-730A	3.45	1626	.16	50L6	.33

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

WILLARD 6-VOLT MIDGET STORAGE BATTERY

3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte . . . Only **$2.69**

2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery . . . $2.79

1—2V. 7 prong Synchronous Plug-in Vibrator . . . 1.49

1—Quart Bottle Electrolyte (for 2 cells) . . . 1.45

ALL BRAND NEW! Combination Price . . . $5.45

to save a few pennies *buying* from distributors who would be glad to sell the serviceman down the river for a few dollars.

"Finally, let us say, we have a moral obligation to pay our bills and to pay them as promptly as possible. If we cannot pay our bills for one reason or another, then we should borrow the money and pay the distributor. By any stretch of imagination, we cannot construe that a parts distributor is also a finance company."

In a similar vein, Gilbert P. Clark, editor of the "New England Service News," recently covered the subject of service-dealer loyalty to fair-dealing parts jobbers in a guest editorial in "The Hoosier Test Probe."

Under the caption, "A Buck Is a Buck," Editor Clark opened his editorial with the quote of a remark familiar to all distributor salesmen, "I'd like to buy from you, but I get an extra 10 off on tubes from the 'We Sell to Anyone Supply Company.'"

"The legitimate parts distributors would like to know," Clark continued, "who is going to subsidize their businesses if they sell you at their cost and keep the doors closed to retail trade, part timer, and the hi-fi-do-it-yourself traffic. How is the jobber going to stay clean if you don't support him?

"'I figured it out,' you might say, 'I can save $360.00 a year on tubes by taking the extra ten per-cent. After all, a buck is a buck.'

"Let's stop and analyze that $360.00 to see what you have really gained. But first, let's examine the source of income for a typical 'We Sell to Anyone' jobber: Industrial sales—50%; Service Dealers (You)—20%; Part-timers, etc.—30%.

"For the service-replacement market, you represent 40% of his business and *your* customers represent 60%. To this distributor, *your* business is less profitable than the over-the-counter trade in two respects. First of all, he gets top mark-up from this retail trade, and secondly, it is a cash sale; no billing, no waiting 60 to 90 days for payment, and no salesman's commission.

"Without any exaggeration, he makes *3 times* as much profit on your customers' business as he does on your business.

"Now let's get back to that $360.00 that you *thought* you saved last year. Assume that the $360.00 saving was on the purchase of about 300 tubes per month, or 3600 for the year. Your total profit from the sale of those tubes, including the $360.00, was approximately $4000.00. Had you paid the normal discount prices, your profit would have been about $3600.00. But *wait!* For every four tubes you buy (from the We Sell to Anyone Jobbers) your customers buy six over the counter!

"Had you kept just one out of those six sales, you would be ahead by the amazing figure of 900 tube sales, or almost three times the profit you were

so proud to cut from the 'hand that supplies you.'

"While we are being quite liberal with the specific application of these figures, the totals are the important consideration, and sadly, they are painfully accurate.

"Yes, no matter how you slice it, a buck is still a buck—but why slice it?"

In an article in the "Long Island Guild News" titled "Does Your Shop Pay for Itself?", Robert A. Larsen urges service dealers to add product sales to their service activities in order to survive. He pointed out that the cost of maintaining the shop in a business location is expensive. A large part of this expense he contends, can be recaptured through store sales of new products.

"Remember," Mr. Larsen concluded, "the television service business is one of the most competitive and least rewarding businesses today. If a shop is to succeed, the owner must use imagination and business acumen. Within the next few years many shops will go out of business, only the fittest will survive. If you use every means of making your shop a well run and profitable venture you will probably stay in business."

And A. N. Archie, editor of the "MTTTA News," is deeply perturbed over the wide range of tube filament voltages in the new series filament sets. In a recent editorial, he said:

"Is the independent service shop working for the TV manufacturers, the tube manufacturers, or trying to make a living for himself and his employees?

"It seems that all of the new TV sets have a new line-up of tubes by each set manufacturer. We have been plagued by a rash of two, three, four, five, eight, nine, ten, seventeen, eighteen, and nineteen volt tubes at an average list price of $3.50.

"All of these tubes are used in the series filament sets and require the independent service shop to invest quite a lot of money for tubes that cannot be sold for at least ninety days, at a profit, since the set manufacturer gives that guarantee. Why should we be required to invest this money, when all of these tubes are duplicates of older tubes, with different filament and current ratings only? Why can't the set manufacturers get together and at least use the same type tubes?

"We have enough trouble with their printed circuits and their idea of trying to cram as many parts as possible into the smallest possible space without this extra investment.

"I may be wrong about this; what do *you* think?"

President Solomon Sagall of *Teleglobe Pay-TV* told an industry group that his company's system does not threaten independent service. The normally transmitted *Teleglobe* picture would be received conventionally on home sets. Available only through a direct-wire network, sound would be fed to a speaker that is independent of the set. —30—

Within the Industry

(*Continued from page 30*)

Co. . . . Filtors, Inc. has promoted **MALCOLM A. PELTON** applications engineer . . . *International Business Machines Corp.* elected **PAUL L. DAVIES** to its board of directors . . . **R. T. SILBERMAN** has been appointed president of *Cohu Electronics, Inc.'s Kin Tel Division* . . . The appointment of **JOSEPH A. GENTILE** as manager of marketing administration for *Motorola Inc.'s* semiconductor division has been announced . . . **JAMES P. DAVIS** and **WALTER W. BULLOCK** have been elected vice-presidents of *RCA Victor* record division . . . **JAMES F. TOOLE** has been named treasurer and **CHARLES ONDRICK** controller of *Sperry Rand Corp.* . . . **WILLIAM J. LEHNER** is now manager, automation engineering, for the radio and TV division of *Sylvania Electric Products Inc.* . . . **STUART R. HENNIES** has been named manager of applications engineering for *Granger Associates* . . . *Polytechnic Institute of Brooklyn* announces the election of **DOCTOR ERNST WEBER** as the Institute's sixth president . . . **A. C. "BUD" KNUDSEN** has been appointed to the post of product line manager, controls, *Beckman/Systems Div.* . . . **WALTER W. FINKE** has been elected a vice-president of *Minneapolis-Honeywell Regulator Co.* . . . The appointment of **CARL N. REIFSTECK** as manager, general quality control, *RCA Victor* television division, has been made known . . . **NATHANIEL M. MARSHALL** has been appointed to the new post of associate director for sales of the industrial products division at *General Precision Laboratory Inc.* . . . **WILLIAM MELANSON** is now vice-president of *Cambridge Thermionic Corp.* . . . **RUSSELL W. McFALL** has been named a vice-president of *Litton Industries* . . . **HENRY F. FRAILEY** has been appointed operations manager for power and special purpose tubes, *Westinghouse Electric Corp.* . . . **PATRICK E. HAGGERTY,** executive vice-president of *Texas Instruments Inc.,* has been notified by the board of directors of the Institute of Radio Engineers of his election as a Fellow of the Institute . . . **THOMAS M. MERRICK,** former general manager of *Adleta Company,* passed away recently . . . **HARRY F. RANDOLPH,** manager, receiving tube operations, *RCA* electron tube division, died recently of a heart attack . . . **BASIL M. GOLDSMITH,** material control manager of the industrial tube division of *Allen B. Du Mont Laboratories, Inc.,* died suddenly at the age of 49.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION has come to the defense of the nation's radio and television service technicians against charges of unethical practices which appeared in articles written for two nationally circulated magazines. The association stated that the "vast majority of these people are sound, ethical businessmen and are technically competent."

EIA said it deplored the type of publicity which places emphasis on the "comparatively rare but more sensational examples of unethical practice," instead of "praising the less newsworthy but vast majority of competent, honest service."

According to the association, the two publications carried rare and sensational stories about unethical servicing practices but eliminated reference to the "work which service associations and industry have done and are doing to help improve the competency, ethics, and business practices of servicemen."

* * *

HAROLD W. ARLIDGE has been appointed manager of the audio and Recordata division of *American Electronics, Inc.*

Prior to joining the firm, Mr. Arlidge was executive vice-president and general manager of *G & M Equipment Co.,* directing the company's sales, contacts, and organization of its representatives and distributorships throughout the United States.

From 1951 to 1954 Mr. Arlidge was associated with *Advance Electric & Relay Co.* as general manager in charge of manufacturing, sales, and finance.

In his present capacity he is responsible for coordination of the division's products and sales, extension and growth of its product line, and general supervision of the plant.

* * *

NATIONAL ELECTRONIC DISTRIBUTORS ASSOCIATION'S board of directors voted unanimously to change the method of electing its executive committee.

Acting on a proposal from the Ways and Means Committee, the board approved "the more democratic way" of choosing the group. The new method divides the nation into six districts of no more than six NEDA chapters each. At the May Parts Show in Chicago, directors of chapters in each of the six districts will select one of their number for the executive committee.

* * *

FRED SPEAKS has been named to the new post of assistant director of marketing for research and development, *Eitel - McCullough, Inc.*

He joined the firm in 1954 and in 1957 was named assistant director of research and development. In his new capacity he will be responsible for the sale of research and development services and new products developed in the laboratory.

Prior to joining the organization he was employed as a civilian production specialist on electronic components and systems with the San Francisco District Office of the U.S. Air Force. Be-

fore this he served on classified research and development at the Livermore, California, laboratory of the Atomic Energy Commission.

* * *

NATIONAL SCIENCE FOUNDATION has announced that it will accept proposals from universities and colleges interested in sponsoring In-Service Institutes for secondary school teachers of science and mathematics during the academic year 1958-59.

The institutes will offer work in science and mathematics with the sessions held outside of regular school hours so that teachers may attend and still continue their full-time teaching assignments. A typical institute might meet two hours each week for thirty weeks.

Additional details on setting up such a course and how to obtain NSF grants to implement the program are available from Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D. C.

Universities and colleges are invited to write promptly. -30-

Communication Radio Service

(*Continued from page 47*)

ment, however, the signal must be fed to the receiver input. To prevent interference and consequent difficulty in aligning the receiver, a shielded room may be needed. If you plan to do much work of this type you should build such a room. It is easy to do if you use 2" x 4" lumber as the framing and then spread fine-mesh screen over the entire surface, including the bottom. A 7' x 9' compartment is generally large enough. Incidentally, be sure to use filters in the power leads going to the "shielded room."

Most common meters used in service shops are entirely satisfactory for use as output indicators and, in many cases, the receiver "S" meter will give all the indications needed. If a separate indicator is used, it can be connected in any one of the three ways shown in Fig. 2. The method shown in Fig. 2A is best since it allows the audio gain control to be turned down during alignment.

I.F. Crystal Filters

Two adjustments of each trimmer are required in aligning an i.f. amplifier using a crystal filter: the first with the crystal switched out of the circuit and the second with the crystal filter adjusted for maximum selectivity. In the second group of steps, the signal generator is adjusted to the crystal frequency which may be slightly different from the frequency specified for the i.f. adjustments.

First, let's clear up a misconception that exists among some technicians. The crystal in the filter circuit is *not* removed and connected in a simple oscillator with the signal from that oscillator used to align the i.f. strip. In the first place, the oscillator action might be erratic, or the crystal might be damaged. Second, the crystal frequency would be subject to change when the crystal was not connected in the receiver circuit. Therefore, do not remove the crystal from the receiver during alignment.

Assuming that the i.f. stages are completely out of alignment, which is always the correct starting point, adjust the signal generator to the i.f. value specified in the service information. Connect the signal-generator output to the point specified. Turn the a.v.c. off, the b.f.o. off, and the r.f. gain all the way up. The setting of the audio gain control does not matter unless you are using the audio signal as an output indication. If you are, turn this control all the way up. Adjust the individual i.f. trimmers for peak output. Go *through* the peak in each case and then come back to be sure you have absolute maximum.

After the i.f. trimmers are set to approximately the right frequencies, set the selectivity control to the sharpest crystal position. Set the phasing control to "0"—the point

where it has no effect. Vary the signal-generator frequency slightly to each side of the original point. At some frequency, there will be a sharp peak in the response. This is the crystal frequency. Re-set the signal generator to that frequency, and peak all the i.f. trimmers.

The procedure just described is given only to acquaint you with the over-all method. In servicing a particular receiver, always follow the specific procedure given in the service information.

"Q" Multiplier Alignment

The "*Q*" multiplier is a tunable device that can be aligned to match the receiver i.f. Basically, the procedure involves adjusting the frequency-sensitive control of the multiplier so that the response frequency matches the i.f. when the frequency control is set to the center position. To do this, it may be necessary to remove and reposition the knob or adjust a tuned circuit in the "*Q*" multiplier. Remember that some of these circuits, particularly the "outboard" type, have *two* tuning adjustments. Check the alignment instructions. After the unit has been aligned, check each function by comparing the operation with the service notes.

Oscillator, Mixer, and R.F.

Bandswitching in communication receivers can be done in either of two ways: by disconnecting one set of coils and substituting another or by connecting additional coils in series to obtain successively lower frequencies. Also, a combination of the two methods can be used. With separate coils for each range, the order of alignment is unimportant in most cases; with series-connected coils, the highest band must be aligned first, the next highest second, and so on. Even though this is the basic rule, you should always follow the instructions in the service information *exactly*. Otherwise, you may align one band perfectly, and then "de-align" it in the next step. Perhaps the only exception to this rule is found in aligning receivers for hams who want maximum sensitivity on the ham bands rather than at some arbitrary point near the high end of the dial.

Servicing communication receivers can become an important part of the work done in a service shop. It is sometimes difficult to get these sets repaired simply because many service technicians will not touch them. If you are interested in building up your business in this field, study the schematics of the older receivers and also the schematics of the newer ones as they are published. If there is a ham club in your area, attend a few of the meetings and make it known that you service the sets. Many wholesalers who handle parts for hams have a "swap-and-shop" bulletin board for the convenience of their ham customers. A small advertisement or announcement placed there should help. —30—

Service Notes

KAYE-HALBERT SOUND TUNING

When receivers using chassis 253 are picking up weak signals, it may be found that sound tuning is quite critical. This sharp characteristic is due to the fact that the sound i.f. circuits operate at high gain on weak signals, with some regeneration occurring. An easy remedy for this condition is to cut down the regeneration by reducing gain in the audio i.f. strip slightly. This is accomplished simply by detuning the 1st i.f. transformer somewhat, just enough to eliminate the sharpness in tuning.

RASTER RINGING, MAJESTIC

If excessive ringing should develop along the side of the raster due to insufficient damping in chassis 99 through 103 and 105, check balancing capacitor C_{71}, across one winding of the horizontal-deflection coils. If the value of this unit is 75 $\mu\mu$fd., replace it with a unit whose value is 39 $\mu\mu$fd., 1500 volts. If a capacitor having the latter value is not readily available, add another 75-$\mu\mu$fd. unit in series with the one already in the circuit.

CATHODE-HEATER SHORT IN CRT

A great many *Stromberg-Carlson* receivers in the Model 24, 119 series have had picture tubes replaced because of the development of cathode-to-heater shorts. Since there is a potential between cathode and heater in the earlier chassis of these series, the nuisance and expense of this replacement is deemed necessary in the field to restore a satisfactory picture. However, the cathode and heater circuits in these receivers may be modified so that normal operation will continue in

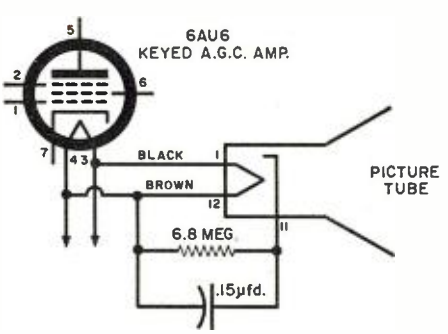


Fig. 1.

the presence of a heater-cathode short.

As shown in Fig. 1, the modification involves deliberately tying the cathode to the heater externally. The black and brown picture-tube heater leads are disconnected from their present ground and filament-voltage points and reconnected to the heater terminals (3 and

4) of the keyed-a.g.c. tube, a 6AU6. Effectively, this means that heater voltage is being taken from the separate F_2 winding on the power transformer. The cathode and suppressor grid of the 6AU6 (pins 7 and 2) are disconnected from the heater. Effectively this means severing the connection between pins 2 and 3 on the 6AU6 socket. The parallel combination of a 6.8-megohm resistor and a .15-μfd. capacitor is then inserted, as shown, between the cathode of the CRT (pin 11) and the heater (pin 12).

ZENITH SOUND IMPROVEMENT

In fringe areas, the sound output of receivers in the following chassis series may tend to be noisy: 20H, 20J, 21J, 22H, 23H, and 24H. This will occur because, in the interests of good fidelity, only a moderate degree of high-frequency de-emphasis has been designed into the 6BN6 detector circuit. The circuit will tolerate additional roll-off quite well, if necessary. In areas where the sound tends to be noisy, therefore, the value of the .001-μfd. capacitor from plate to ground of the 6BN6 can be increased

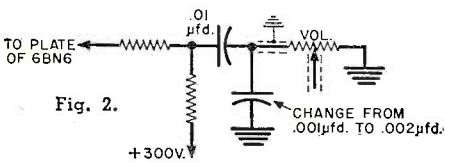


Fig. 2.

to .002 μfd. (Fig. 2), either by removing the present unit and replacing with a new one of the recommended value, or simply by shunting another .001-μfd. unit across the existing one.

Other measures for improving fringe-area sound include touch-up adjustment or instrument check of the sound take-off coil, the buzz control, the grid coil of the 6BN6, and the quadrature coil. All of these adjustments may be performed using conventional procedures without removal of the chassis from its cabinet.

If the recommended change has been made and some improvement is still desired although all sound-channel adjustments and alignment are correct, deliberate detuning of the co-channel i.f. sound trap may be helpful. If the slug is turned farther into the trap, the resonant frequency will be lowered, permitting the sound-carrier level to rise. However, if this trap is detuned too far, 4.5-mc. grain interference may become evident, especially on the stronger channels. The best procedure is to detune the trap *slightly* while the set is tuned to the weakest channel to the point where sound improvement is noted. Then the receiver should be accurately tuned to the strongest channels to determine whether grain is beginning to appear in the picture. If no grain is evident, and if further improvement in the sound is desired, it is then possible to return to the weakest channel and to detune to obtain the best sound output possible on the weakest channels short of deteriorating the picture quality on strong channels. —30—

Satellite Signals

(*Continued from page* 38)

play is normally only exceeded in length by the long calibration and identification channel C1.

The second type of solar Lyman-alpha radiation signal transmitted represents an orbital peak or maximum value (channel F). Marked increases in solar Lyman-alpha radiation are expected to take place during periods of solar flares. Solar flares take place infrequently and at random and are of relatively short duration. While possible, it is quite unlikely that a solar flare will take place as the satellite is passing over a primary recording station. While leaving much to be desired, correlation between visually observed solar flares and orbital peak values of Lyman-alpha signals will permit collection of valuable data. Two magnetic memory units will be used in storing and transmitting peak orbital values of these signals. One memory unit will be storing information on the current orbit while the second memory unit is transmitting the peak value stored during the immediately preceding orbit. Once each orbit, on transition from darkness to daylight, a light-sensitive device is used to interchange the function of the two memory units. The unit which has been transmitting has its previous memory cancelled and begins to store data during the next orbit. Simultaneously the unit which has been storing information starts to transmit its stored data. Since the technique used permits the transmitted signal to change only once each complete orbit, adequate utilization of this data is expected from official recording stations. Two calibration curves are shown for peak Lyman-alpha data in Fig. 5. Different frequency ranges are used for readout of the two memory units. This permits individual calibration as well as a check on proper functioning.

Opportunity does exist for amateur observers to make a major contribution to the solar Lyman-alpha radiation experiment. Valuable indeed would be a properly prepared amateur recording showing instantaneous values of Lyman-alpha radiation during the progress of a solar flare. Recordings of interest would be any showing an electrometer current in excess of 200 microamperes. By use of the calibration curve for channel A of Fig. 5, this can be translated into a telemetry signal frequency. Thus, it can be seen that recordings of value would be those in which the frequency in any Lyman-alpha burst momentarily drops *below* 10 kc.

Precise measurement of these signals requires elaborate equipment. Amateur observers can make reasonably accurate determinations from simple listening tests. A little practice will permit rather easy identification of the Lyman-alpha signal burst channel. This information is distinguished as the first and longest of the often repeated rhythmical alternation between channels A and B. It should be pointed out that recordings played back at reduced speed will have the desired signal frequencies correspondingly reduced. Thus a tape played back at one half of the recording speed would be of interest if the Lyman-alpha burst frequency dropped below 5 kc. It is suggested that a comparison test tape be prepared for ease in identifying valuable signals. An audio oscillator would be used to record a 10 kc. signal at the same tape speed planned for recording satellite signals. This tape would then be played back at the same speed used for listening tests. This procedure provides automatic compensation for changes in tape speeds.

Solar Aspect: A silicon solar cell located on the satellite equator will provide information on the orientation of the satellite with respect to the sun. This data is required by the Lyman-alpha experimenters for detector sensitivity calibration. It will also provide accurate information on satellite spin and spin damping. This signal is presented six times each telemetry frame on channel B. Calibration is shown in Fig. 5.

Surface Erosion Experiments: Erosion of the surface of the satellite will be studied by means of small erosion gages attached to the outer shell. These gages consist of small glass plates on which a thin-film metallic resistor has been deposited. The telemetry system will detect the wearing away of this metallic film by monitoring changes in resistance during this process. Reference to Fig. 5 shows two types of gages are used for different sensitivity ranges. Thus a polar erosion gage providing information on channel A1 consists of a very thin film having an initial resistance of 20,000 ohms. Thicker films on gages represented by channels E1 and F1 provide an initial resistance of 2000 ohms. Resistance of all gages will increase as erosion takes place. At anticipated erosion rates, ample information is expected from primary receiving stations. Thus the resistance values are expected to undergo only minute changes during intervals between official observations. Properly spaced amateur recordings could provide vital information in the event of early complete breaks in the metallic film. Amateur recordings could, under these circumstances, provide the only source of information to distinguish between an abnormally high but uniform erosion or collision with a single particle(s) of sufficient size to result in destruction of gages on first impact.

Cadmium Sulphide Meteor Detector: Another type of detector for meteoritic collision experiments uses a cadmium-sulphide cell covered by an opaque layer. The cadmium sulphide is photoresistive in that its electrical resistance decreases when exposed to light. This cell is initially protected from sunlight by the opaque cover. As

meteorites puncture the protective layer, sunlight will be permitted to reach the sensitive element. When the satellite is in sunlight, the resistance change will reflect the amount of the opaque layer removed. The photoresistive element is of a selected type having a long time constant. Thus the resistance changes will take place only slowly so as to minimize effect of satellite spin. This information is displayed on telemetry channel F2. No calibration for this channel is given in Fig. 5. This channel will initially be at its high resistance value presenting a burst spacing of about 11 milliseconds. As the opaque layer is punctured this interval will become progressively shorter during the sunlit portion of each orbit.

Amateur recordings could provide much valuable information for this experiment. Adequate coverage could provide accurate timing of collisions detected. Such recordings could also permit the distinction between single collisions with large particles and multiple collisions with small particles removing the same area of cell cover material.

Skin-Puncture Experiment: This experiment is designed to detect collision with particles of sufficient collision energy to puncture the outer shell. Two pressure-tight zones are incorporated into the satellite outer shell. Prior to launching, these two zones are initially pressurized to significantly different pressures. A single differential pressure measurement made between the two zones can indicate the puncture of either or both zones. With both zones intact, the differential pressure gage would indicate the initial value. When either zone becomes punctured its internal pressure will equalize with the near perfect vacuum of the satellite environment. Thus with either one of the two zones punctured, the differential pressure measurement will display the pressure of the zone remaining intact. When both zones become punctured, the differential pressure will be zero since both zones will be evacuated to ambient atmospheric conditions. Amateur recordings could assist in more precisely determining the time at which punctures occurred. If both zones were punctured in an interval between primary recordings, amateur observations would be the only potential source of information to permit determining whether separate punctures occurred or if a single particle punctured both zones. This data is presented on telemetry channel B1.

Meteoritic Collision Experiment: Sensitive microphones attached to the outer shell of the satellite are used to detect collision with small particles in space. Magnetic memory units in the satellite are used to store and continuously transmit information on the cumulative number of such counts detected. Three channels of the telemetry system serve to provide counting

(*Continued on page* 156)

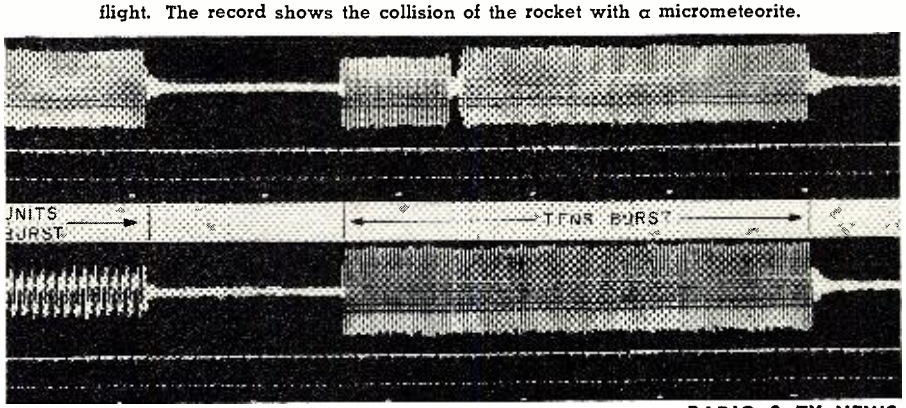
data in the form of three decimal digits. Consider, for example, the telemetry channel C which provides units-count data. As can be seen from Fig. 5, the frequency in this burst increases from about 5 kc. to 12.5 kc. in discrete intervals. One such frequency change is made for each input count up to nine. Upon arrival of the tenth count, channel C returns to 5 kc. ("zero" units count) while the frequency in channel D makes the appropriate increase to indicate the tens count; *i.e.,* the number of times the unit count has returned to zero. Similarly, channel E frequency will present hundreds digit information by advancing one "count" for each reset of the tens digit counter. This can be seen to be similar to the operation of the mileage indicator of an automobile speedometer. The units counter advances one digit for each mile traveled. For each ten miles the units digit returns from nine to zero while one count is added to the tens digit. The nature of these signals can be further illustrated by reference to Fig. 6. The two oscillograms show similar portions of two successive telemetry frames. Both display the final portion of the units count and the complete tens count burst. The signals shown were extracted from records made during a rocket flight in which satellite instrumentation equipment was being test flown. The brief interruption of the tens burst is the equipment "dead time" which occurs whenever a count is being received. This interruption is many times shorter than the shortest burst spacing and would not be confused by a practiced observer. The upper trace thus shows a time interval including an actual collision of the rocket in flight with a meteoritic particle. The unit count burst in this upper trace is at its highest (12.5 kc.) frequency representing a count of "nine," while the tens count starts at a slightly lower (12 kc.) frequency representing a count of "eight," thus indicating a cumulative count of 89. The hundreds count is not shown but is unimportant in this illustrative discussion. Following this collision the frequency of the tens count burst has increased to 12.5 kc. representing a count of "nine" in the tens digit. The bottom oscillographic trace shows indeed that the units count has returned to its low (5 kc.) frequency to indicate a "zero" units count while the tens count remains unchanged at its "nine" count for a cumulative count of 90.

No really satisfactory estimates are available as to the number of such collisions to expect from a satellite in orbit around the earth. Counts of a few hundred or less per orbit can be studied by means of the difference in cumulative count between recording periods. The information transmitted presents total counts only up to 999 before returning to 000 to begin a new sequence. Therefore, high counting rates extending into thousands of counts per orbit cannot be studied in this way. Such large counting rates would be studied by change in total count over shorter time intervals, such as the signal reception interval for a single receiving station or occasional satellite transits which provide less than full orbit intervals between recordings.

Many potential contributions could be made by amateur observers in the study of collision between the satellite and micrometeorites. For example, in a single orbit, a series of amateur records from properly distributed geographical locations could establish whether particles are distributed at random or clustered in clouds. Amateur recordings would also be of great value in the event of unanticipated high counting rates. Ample data could also provide clues as to the possible origin of such particles. Study of micrometeorites by means of satellites is a new field with most meager background information upon which to base estimates and plan experimental techniques. The subject is expected to be much better understood after the present satellite experiment has been completed. Extensive useable records from a single successful satellite would provide a sound basis for an exhaustive scientific study and analysis.

Skin-Temperature Experiments: Measurements of the temperature of the outer shell of the satellite are made at two points. One temperature sensing element is located near one satellite pole; *i.e.,* near the spin axis. The second sensing element is located near the equator of the satellite; *i.e.,*

Fig. 6. This is a portion of the telemetry record obtained from a rocket flight. The record shows the collision of the rocket with a micrometeorite.



the plane perpendicular to the spin axis passing through the center of the sphere. Data on these two measurements are transmitted as burst spacings on channels D2 and E2 respectively.

Virtually all heat transfer to and from the satellite in orbit will take place by the process of radiation. Ambient atmosphere at satellite altitudes is so rarefied as to make negligible any aerodynamic heating or heat transfer to or from this atmosphere. The satellite will be heated by radiant energy received primarily from the sun and the earth. Some heating will also be derived from power dissipation of internal instrumentation equipment. The satellite will be cooled by radiating energy into space. Satellite temperatures can be controlled to a certain extent by means of coatings applied to the outer surface. These coatings permit selective control of the ability of the satellite to radiate heat into space and its ability to absorb radiant energy. Thus a satellite which was an efficient radiator and a poor absorber would tend to run cold and *vice versa*. Precise temperature control is not possible since coatings are applied prior to launching on the basis of assumed values of many factors which affect the satellite temperature. For example, heating of the satellite due to radiation from the sun will depend upon the length of time the satellite remains in sunlight in each orbit. Variations in orbit can cause a variation of nearly two to one in the absolute time per orbit which the satellite remains in sunlight. As one further example, the energy radiated by the earth will undergo radical changes with the amount of cloud cover. In spite of the many unpredictable factors, it is expected that mean orbital temperatures of the outer shell will lie between 0° C and 60° C (32° F and 140° F) under most unfavorable conditions. Outer shell temperatures during any orbit will vary from ±5° C to ± 15° C from the orbital mean value as the satellite heats up when in sunlight and cools when in the earth's shadow.

Ample information on temperatures are expected from primary recording stations for any satellites of a normal active life. Recordings made by amateur observers would be of great value in the event of unexpected temperature extremes which could result in early equipment or battery failures.

Instrumentation-Compartment Temperature: Airborne electronic equipment is located in an internal instrumentation compartment. This inner compartment will be thermally isolated from the outer shell so that heat exchange will be a very slow interchange by radiation. This tends to isolate the internal equipment from orbital temperature variations. The instrument compartment temperature will thus remain relatively stable at a value a very few degrees above the mean orbital temperature of the outer shell.

It can be seen that many potential contributions are possible from recordings of satellite scientific signals prepared by amateur observers. The necessary equipment is available to many now and could be prepared by others by inexpensive modification of present equipment. Preferable tapes would be made on "stereophonic" tape recorders with the satellite signal on one track and a reliable time base on the second track. Suitable time base would be obtained from a stable oscillator or recording of signals from WWV including a time announcement.

To be useable, any tapes must be accompanied by certain basic information as follows:

(1) Name and address of the observer if tapes and their interpretation are to be returned.

(2) Make and type of recorder on which tapes were prepared.

(3) Tape speed in inches per second at which recording was made.

(4) Number of channels and signals recorded on each.

(5) Date on which recording was made.

(6) Exact time at which recording was made including a.m. or p.m., time zone (or Greenwich time), and whether daylight or standard time.

(7) Exact location at which recording was made, preferably including latitude and longitude.

(8) Any special scientific data the record may be believed to contain.

All correspondence relative to programs for receiving satellite signals or available tapes should be addressed to U. S. Naval Research Laboratory, Washington 25, D. C., Attention: Code 4105. Recorded tapes should not be mailed without further instructions.

Any tapes prepared early in the life of a satellite should be carefully preserved until the fate of the satellite and its scientific experiments have been determined. Such recordings could be of great value. —30—

When the one millionth Bogen amplifier rolled off the production line in Paramus, N. J. Lester H. Bogen, president of David Bogen Company, Inc. was on hand to receive it and congratulations from Irving Olson, president of Olson Radio Warehouse, Inc. (left) and Mortimer Sumberg, district sales manager for the audio firm, which is now celebrating its 25th anniversary.

Five Months of IGY Disclose Space Secrets

First summary report shows new data on the ionosphere.

A SUMMARY of the first five months of the U. S. International Geophysical Year (IGY) program was released by the American Association for the Advancement of Science. By Hugh Odishaw, Executive Director of the US-IGY Committee, the report describes a wide range of early scientific results of this 18-month, international research program of our earth and its environment. The findings cover each of the dozen fields in which IGY programs are being conducted and reflect the work of hundreds of scientists and many institutions. They demonstrate also the construction participation of many other nations.

The results range from the recovery of living organisms from record ocean depths to the reception of radio signals sent curving two or three earth radii out into space to test whether a sparse medium actually fills the void between earth and sun. Probings into the upper atmosphere with the aid of rockets have corroborated the belief that radio "blackouts" are caused by an "extra" layer of ionized particles which occurs during solar flares in the upper atmosphere 10 to 12 miles below the lowest portions of the ionosphere. Another rocket experiment has established that this layer is caused by the sun's x-ray emissions.

Observatories located on Pacific islands have confirmed the probable existence of an "electro-jet," a narrow equatorial electric current which circles the earth in the high atmosphere. This is one of three hypothecated currents of perhaps several hundred thousand amperes circling the earth. The others girdle the North and South magnetic poles.

The Northern and Southern lights occur simultaneously and with some symmetry, according to preliminary findings by British scientists. These have since been supported by polar radio data obtained in the U. S. program.

University of Chicago specialists have pinpointed a "cosmic ray equator" by systematically flying and sailing instruments around the world. Since this line departs considerably from the geometric equator, the conclusion is that there are important magnetic fields in space which deflect incoming cosmic rays. -30-

FM Receiver Conversion for U.S. Satellite Signals

By **C. B. HOUSE**

U. S. Naval Research Laboratory

An inexpensive FM tuner kit can be adapted to permit monitoring of the 108 mc. amplitude-modulated signals.

IT CAN BE a comparatively easy matter to listen to the telemetered signals from the Lyman-alpha earth satellite on your own FM receiver. The signal which will be transmitted is an amplitude-modulated carrier of 108 mc. frequency, so a method of detecting carrier amplitude variations must be incorporated into the receiver.

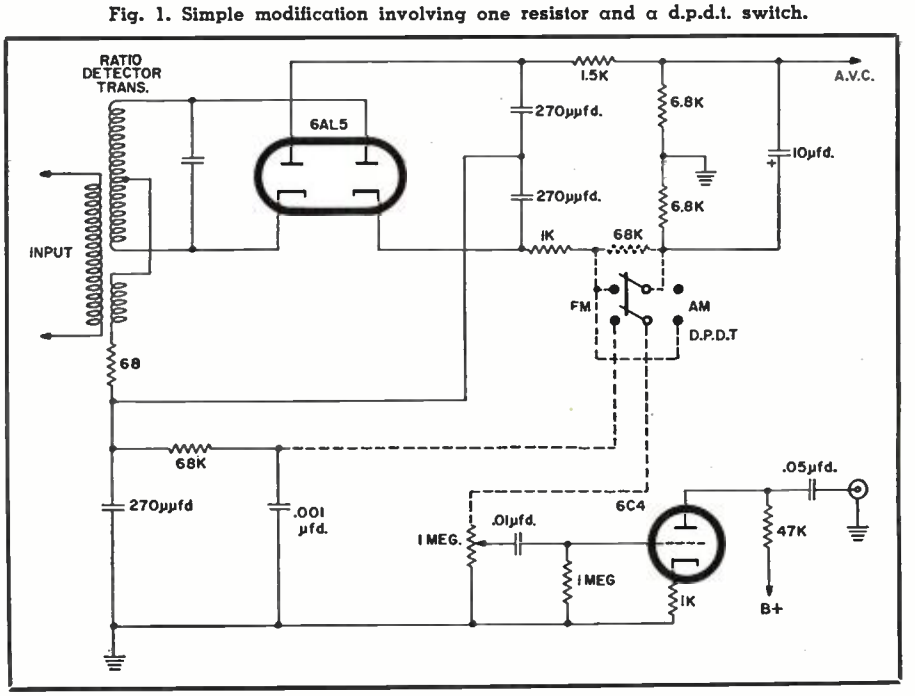
If you already own an FM radio or tuner with a ratio detector, it is a simple matter to convert it to an AM detector for the small cost of one resistor and a d.p.d.t. switch. If you do not already own an FM receiver, there are several inexpensive kits on the market which can very easily be converted for satellite listening.

Even though it may be inexpensive, the modern tuner has a great deal of gain. This could be surmised from the practice of manufacturers of quoting figures for quieting with a signal strength of only a few microvolts. A limitation of this type of receiver at small signals is its wide passband which will not cut out the atmospheric or thermal noise as well as the special receivers designed for receiving this signal. On the other hand, noises are of a much smaller amplitude at the higher frequencies than at the lower broadcast and amateur frequencies. According to calculations, the received signal strength during the closer satellite transits should be large enough to overcome this ambient noise level in most tuners. Naturally a high-gain antenna will improve the reception and extend the range.

The tuner chosen for conversion was one of the most inexpensive of the nationally advertised tuner kits. Others in this same category would probably give equivalent performance and follow the same general principles for conversion. The original tuner circuit incorporating the changes is shown in Fig. 1. The conversion to AM output essentially consists of inserting a 68,-000-ohm resistor in series with the rectified output and taking the audio-frequency amplitude variations from the high end of this resistor. The double-pole, double-throw switch enables the detector to be returned to normal FM operation when desired.

The ratio detector is inherently easy to convert from FM to AM detection because the rectifier diodes are in

Fig. 1. Simple modification involving one resistor and a d.p.d.t. switch.



series across the output of the ratio detector transformer secondary and the amplitude variations are normally summed across the two load resistors in parallel with a large capacity. By inserting the 68,000-ohm resistor in series with the rectified output and taking the audio signals from the high end, four aims have been accomplished simultaneously: (1) Most of the signal amplitude variations now appear between the high end of this resistor and ground; (2) the large capacitor is effectively disconnected so that audio-frequency voltages are not filtered out; (3) the a.v.c. is effectively disconnected since the percentage of amplitude variations appearing across the top 6800-ohm resistor is small; and (4) the "*Q*" of the transformer secondary is increased.

The output from the detector is applied directly to the audio gain potentiometer to eliminate the degeneration of the higher audio frequencies caused by the de-emphasis circuit built into FM receivers. The elimination of this de-emphasis circuit is of considerable importance since the 75 μsec. time-constant filter causes an attenuation of 17 db at 15 kc. and there will probably be frequency components near this value in the telemetered signal. After conversion of this tuner, recognizable signals were produced with an AM carrier input of a fraction of a microvolt.

The conversion described was made with the ratio detector since this was used in the tuner purchased. However, the general principles should be applicable to discriminator detectors if one rectifying diode is disconnected and the limiter action disabled.

After conversion of this receiver, the audio enthusiast who possesses a tape recorder will be able to record the telemetered signal from the satellite and compare the changes in tones and burst durations arising from variations in the measured data between successive satellite passages. Also, conditions might arise where events of scientific importance occur when out of range of the regular receiving stations and the recorded information on this event might be of interest to the participating scientists.

Editor's Note: For complete information on the nature of the telemetered signals that are to be transmitted by the U. S. artificial earth satellite, we refer our readers to the article. "Receiving U. S. Satellite Signals" by Whitney Matthews which appears in this issue. The article also gives specific information as to how our readers may assist in the scientific program by making their own recordings and observations.

It is presently expected that a number of scientific satellites will be launched in the near future. Therefore from time to time we will be publishing information describing some other methods that may be used to receive the signals that are due to be transmitted.

—30—

Upgrading the Amplifier

(Continued from page 51)

of changing the plate resistors in two triode stages to a substantially higher value inasmuch as triodes operate in more linear fashion as the plate load resistor is increased. At the same time, the cathode resistors had to be increased to maintain proper grid bias. As a means of keeping noise down, *Allen-Bradley* 1-watt resistors were employed, although on the basis of heat dissipation ½-watt ones would have been more than enough.

Upon checking frequency response of the control unit, it was found that the high end had been adversely affected somewhat, being about 4 db down at 15,000 cps at mid-setting of the volume control, which is the position where the greatest treble losses, due to circuit capacitance, take place. The deterioration resulted from increasing the plate load resistor in the output stage, with a consequent increase in output impedance and greater loss of high frequencies due to cable and other capacitance. (The control unit was built before the days when it became *de rigeur* to employ cathode followers in the output stage.) However, the situation was quickly corrected by using a .02 μfd. instead of a .01 μfd. cathode bypass capacitor at V_4 in Fig. 2. This maintained response flat within 1 db to 15,000 cps.

The final step was to coordinate the input signal level to the control unit and the input signal to the power amplifier. Both units have input level-set controls and the problem of coordinating them is as follows. If the level control of the power amplifier is set high, this has the advantage of requiring less signal from the control unit, which means less distortion produced in the latter. The disadvantage, however, is greater amplification by the power amplifier of noise and hum generated within the control unit. To the extent that the input level set of the power amplifier is turned down to reduce noise and hum from the control unit, the input level of the control unit must be turned up in order to provide adequate drive to the former. The higher the input level setting of the control unit, the more the distortion generated therein.

First the gain control of the control amplifier was rotated to about three-quarters position to represent the maximum volume likely to be used; thus a reasonable volume reserve was maintained for special occasions. The input level-set of the power amplifier was backed down slightly so that the noise and hum heard through the speaker was imperceptible except within a couple feet or so. (Any listening done within a few feet would hardly be with the gain control at an advanced position.) Then the input level-sets of the control amplifier for each source (phono, FM, TV, tape) were adjusted so that, when typical program material

Say you saw it in RADIO & TV NEWS

was fed in, the maximum level ordinarily desired was obtained at three-quarter setting of the gain control.

This procedure made it impossible to hear any noise or hum at moderate gain control positions and of course at advanced positions the signal would drown out the increase in noise and hum (chiefly noise). It may be added that the control amplifier is mounted so as to make the level-sets readily accessible for adjustment in the event a very weak signal source is used. In fact, the control amplifier is sufficiently sensitive so that, with input level set full on, a dynamic microphone can be accommodated by any one of the high-level input channels.

The final results can only be determined by ear and it is not too easy to be sure, especially when the equipment was not really poor to begin with. However, particularly when good program material is available, such as a first-rate tape recording or, better yet, live FM, it seems that the reproduction has gained ease and clarity and that listening fatigue has been set back another notch. Whereas the 50-watt comparison amplifier had a definite edge before the changes, afterward the Williamson seemed at least as clean. It was not feasible, with the efficient speaker system used, to introduce levels into the listening room where the superior power capacity of the 50-watter made a difference, as it would of course under outdoor, auditorium, or other large-area conditions at realistic levels of reproduction. —30—

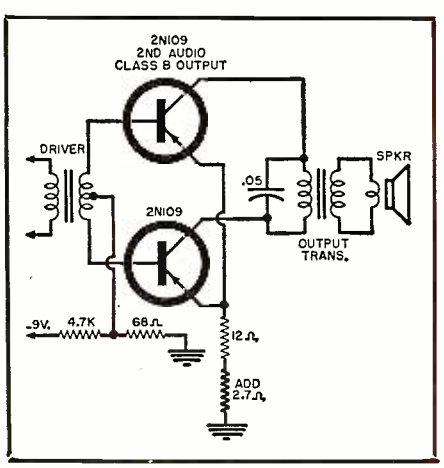
LOW-LEVEL AUDIO DISTORTION

By JAMES A. McROBERTS

PERFORMANCE of the DeWald Model K-701 was satisfactory during loud music and speech passages but was distorted on low levels of sound.

This effect was due to the nonlinearity of the transistor characteristic curves at low input levels. This necessitates emitter bias in addition to base bias to correct.

The 12-ohm resistor in the circuit, see partial schematic below, accomplishes this. The 12 ohms was insufficient in this particular application so a 2.7-ohm resistor was added in series to increase the emitter-to-ground resistance and emitter bias. This corrected the trouble. —30—



Sales Aids

GARGANTUAN "NIPPER"

The newest addition to the Albany, N. Y. skyline is a four-ton, 25½-foot high statue of "Nipper," the *RCA Victor* dog trademark which stands atop

the new four-story warehouse-office of *R.T.A. Distributors, Inc.*, the *RCA* distributor in the area.

Built by *W. L. Stenagaard & Associates, Inc.* of Chicago, the statue is reputed to be the largest of its kind in the world. It has a skeleton of steel joists, angle irons, and steel rods covered with wire mesh. The "skin" consists of several layers of glass fiber composition covered with a coating of pigmented resin. The dog can be seen for a distance of five miles and an airline warning light on the right ear serves as a guide for pilots.

* * *

SARKES TARZIAN "KIT-PAKS"

The Rectifier Division of *Sarkes Tarzian, Inc.*, Bloomington, Ind. is merchandising two of its most popular silicon rectifiers in eye-catching "Kit-Paks."

Twenty M-500 conversion kits for television or twenty M-150 replacement kits (for radio) are packed in a three-color display carton which is easily

spotted on the jobber's shelf. The individual clear plastic kits have been completely redesigned for better product visibility and compactness.

Electrical ratings are plainly shown on the display cartons and complete installation data and ratings are included in each kit. Service technicians who have been using these two silicon rectifier types as replacements in tele-

vision sets, radios, and electronic equipment will find it practical to buy them by the carton.

* * *

ATR'S "SILENT SALESMEN"

American Television & Radio Company, 300 E. 4th St., St. Paul 1, Minn. is now offering two unique "Silent Salesmen" racks which have been especially designed to display the firm's battery chargers and inverters to best advantage.

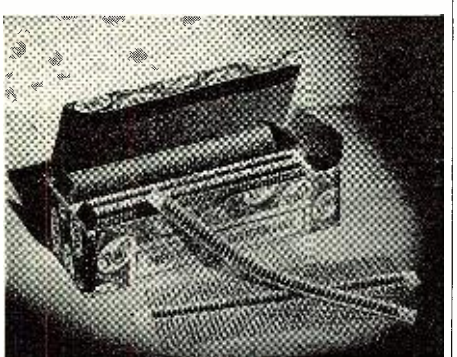
The racks, which are made of heavy-gauge steel wire, stand 5-feet, 6-inches high and take up no more than 4 square feet of floor space. They are light and portable and when empty can be folded and moved from one location to another with ease. The top of the racks have suitable product identification to tie in with whichever of the firm's products is being featured.

* * *

PACKAGING FOR AUTOMATION

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. has developed a new method of packaging its fixed composition resistors to facilitate automatic assembly operations in manufacturing plants.

A flexible strip holds the resistors



securely in place, equally spaced, and at right angles to the strip. A cutting machine can be used to trim leads on the strip without displacement of the units. Leads cannot be bent when withdrawing the strips from their box nor can the units be accidentally dislodged by twisting, inversion, flexing, etc.

At the present the "Grid Strip" packaging is being used for Type BTS ½-watt fixed composition resistors. Other value units may be offered to manufacturers at a later date.

* * *

NEW RAY-O-VAC PACKAGING

Ray-O-Vac Company, Madison 10, Wisc. has adopted a new integrated product and packaging design program for its entire line of lighting type batteries.

The company's trademark with red cloud, yellow background, and blue upswing panel has been simplified for a cleaner, fresher, "straight line" design with more merchandising appeal.

To complement the new trademark design, the company has adopted a complete color packaging design for the line. This includes a new retail display carton, dealer unit pack, and an outer standard shipper. —30—

"ELEMENTS OF TAPE RECORDER CIRCUITS" by Herman Burstein & Henry C. Pollak. Published by *Gernsback Library, Inc.,* New York. 216 pages. Price $2.90. Soft cover.

This is not an operator's manual for home tape recorders but rather an analysis of the circuitry that goes into such devices and a handbook of features and components which make up tape recorders suitable for home use. The audiophile with some electronic background as well as the service technician will find this manual helpful. Of special value and importance is the fairly extensive treatment of the subject of equalization requirements and circuits. The care with which this section particularly was prepared along with the amount of useful material included make this portion alone worth the entire price of the book.

The text is divided into ten chapters dealing with the elements of a tape recorder, characteristics of a quality unit, head characteristics, tape characteristics, bias current, equalization requirements, equalization circuits, oscillators, record-level indicators, and how to minimize noise and hum.

The text material is amplified by the lavish use of line drawings, graphs, schematics, and photographs of commercial units. A working knowledge of simple algebra would be helpful but is not entirely necessary for understanding of the text material.

* * *

"INDUSTRIAL ELECTRONICS HANDBOOK" by R. Kretzmann. Published by *Philosophical Library,* New York. 296 pages. Price $12.00. Second Edition.

This is a basic reference text written especially for design engineers, maintenance technicians, and engineering students. In this second edition, the material included in the earlier volume has been revised, amplified, and brought up-to-date.

The first half of the volume is devoted to a thorough discussion of the principles and properties of the various classes of electronic tubes, together with typical applications and circuits. The balance of the volume is divided into separate chapters dealing with the main types of application, *i. e.,* electronic relays, counting circuits, timers, industrial rectifiers, dimmers, speed and temperature controls, resistance welding controls, motor controls, inductive and capacitive heating, and special purpose devices.

Data on some of the *Philips* industrial tubes, a subject matter index, and a bibliography complete the text. A working knowledge of math at the college level is prerequisite to an understanding of this text.

* * *

"SOUND" by Dr. Alexander Efron. Published by *John F. Rider Publisher, Inc.,* New York. 69 pages. Price $1.25.

This volume is another in the "Basic Science Series" being issued by *Rider* for the benefit of students, the study-at-home group, and those interested in elementary data on scientific subjects.

Written by the chairman of the physics department of one of New York City's largest high schools, this volume covers hearing, speech, and music, with a full discussion of the wave nature of sound. The physics of sound, including such topics as sources of sound energy, the ear, perception of pitch, loudness, quality, standing waves, interference, and resonance, are also covered.

The text material is lavishly illustrated by line drawings, photographs, graphs, and charts.

* * *

"TECHNIQUES OF MAGNETIC RECORDING" by Joel Tall. Published by *The Macmillan Company,* New York. 453 pages. Price $7.95.

This book is for those in any field where magnetic recording is or can be used to advantage. The author outlines and suggests many uses for this versatile equipment, devoting whole chapters to specialized applications requiring unusual techniques.

The entire volume is divided into twenty chapters which cover the historical and modern development of magnetic recording, theory, recording media, drive mechanisms, erasing, fundamentals of recording, recording sound in nature (written by Dr. Peter P. Kellogg of Cornell University), maintenance of tape recorders, spurious printing, editing, re-recording and copying techniques, radio broadcasting practice, motion picture and television techniques, information recording, magnetic recording in the medical field, magnetic recording in education; home uses and telephone recording; entertainment, advertising, and warning methods; legal uses and their limitations, and communication applications.

* * *

"HOW TO READ SCHEMATIC DIAGRAMS" by David Mark. Published by *John F. Rider Publisher, Inc.,* New York. 145 pages. Price $3.50.

From the number of requests received by this magazine for pictorial wiring diagrams on equipment whose schematics have appeared in articles, it is a safe guess that there are a number of persons interested in electronics who haven't mastered the technique of

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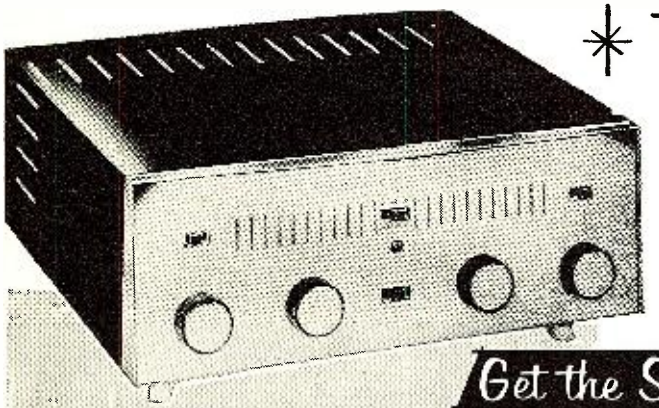

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15 WATT AMPLIFIER
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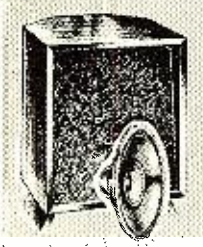

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Employs the famous "Folded-Horn" design. Engineered by University to deliver maximum fidelity and realism. Constructed of heavy 3/4" wood and braced internally. For corner or wall use. Beautiful hand rubbed mahogany finish.

The University Speaker employed is the approved 12" Diffaxial with the Diffusicone high-frequency element, 1000 cycle crossover. Mid-range and treble notes are extended. Low frequencies are reproduced by a woofer diaphragm. Superb reproduction across entire audio range. 25 watts output. Magnet is full pound Alnico V. 8-16 ohms. Size 21" high, 15-1/2" wide, 12-1/2" deep. Shipping weight 31 lbs.

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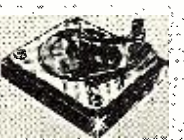
Individual components may be ordered separately. Every unit is fully guaranteed by the manufacturer and Olson.



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- **Bogen DB115 Amp.**
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"AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT" by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 226 pages. Price $3.95. Vol. 9 (AA-9).

The ninth volume in this publisher's series on audio amplifiers presents complete photo coverage, standard notation schematics, parts lists, voltage and resistance values, and servicing information on fifteen amplifiers, three preamps, twelve tuners, and five custom radios which were released during 1956.

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* * *

"MOST-OFTEN-NEEDED 1958 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications,* Highland Park, Ill. 192 pages. Price $3.00. Soft cover. (Vol. TV-14.)

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As with the previous volumes, in each instance information on alignment, waveshapes, circuit diagrams, chassis views, voltage charts, and factory changes is given for the individual receiver. An index by make, model, or chassis number is also included. –30–

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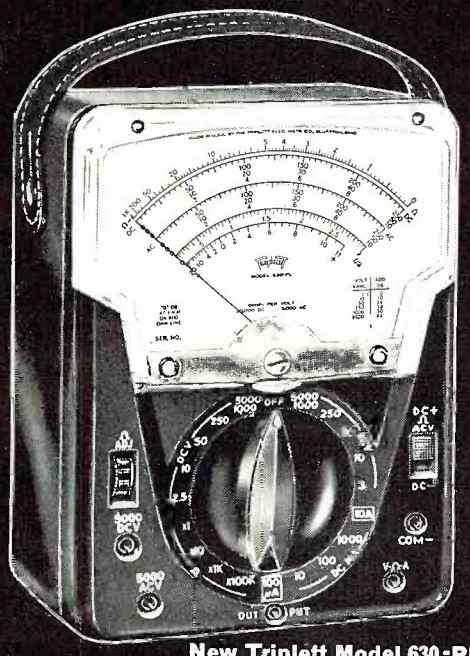
the mighty nine plus two!



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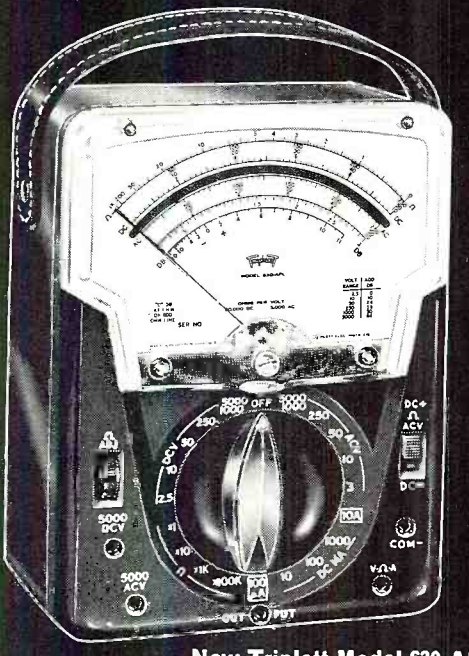

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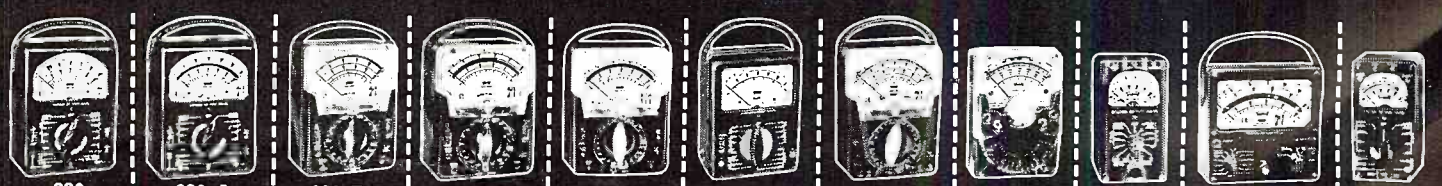

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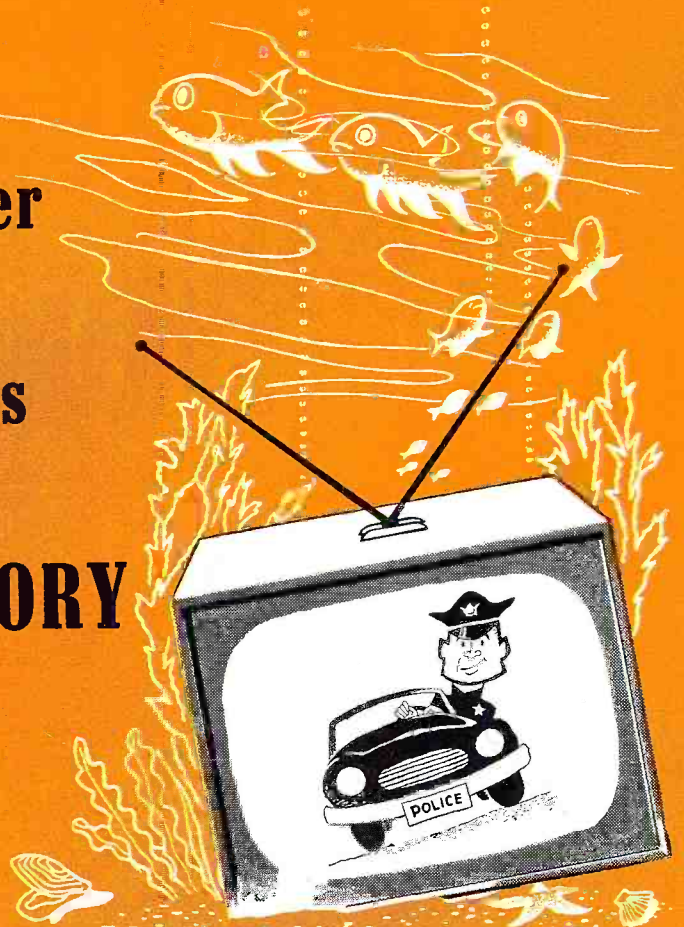

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