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RADIO & TV NEWS

JANUARY
1958
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(See Pages 58 & 59)

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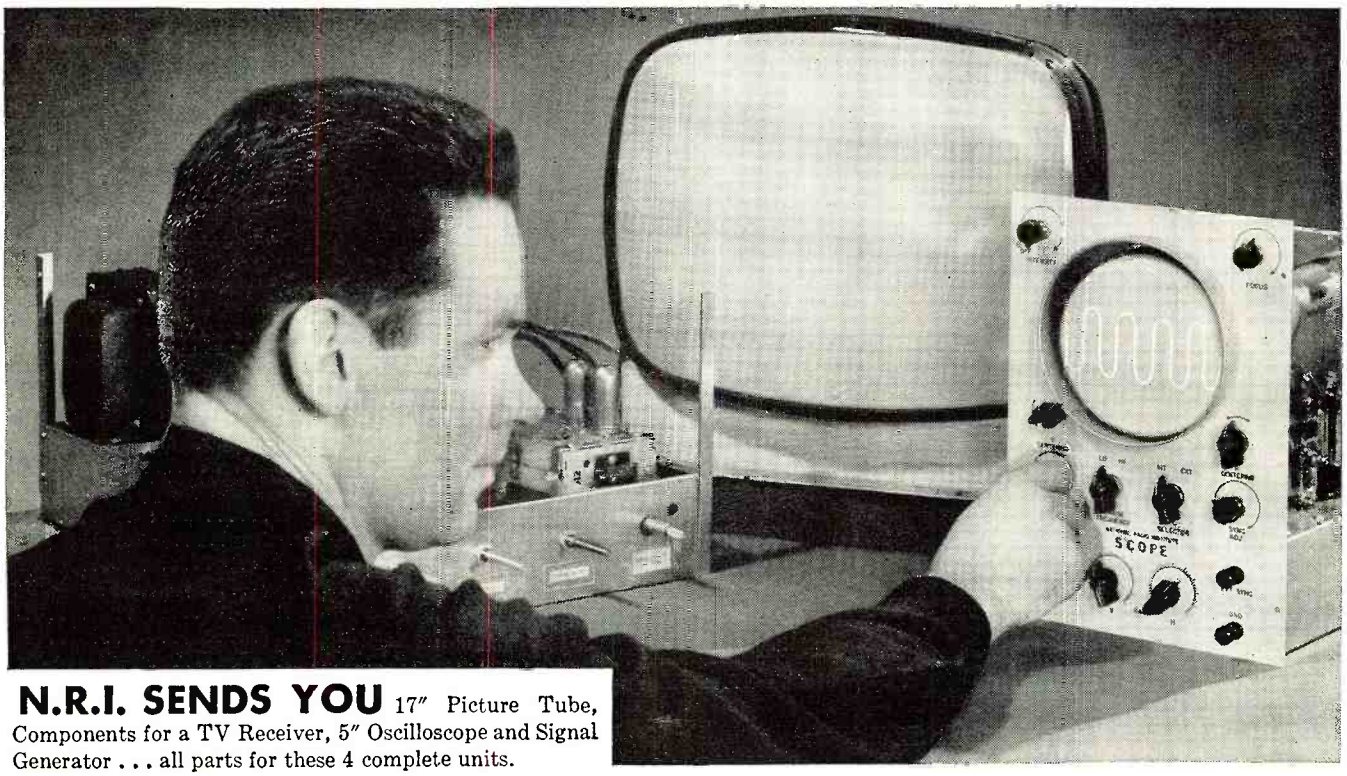

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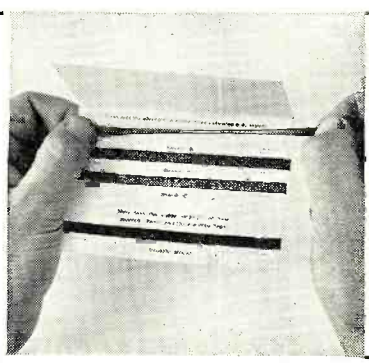
Rush me a copy of the free tape test kit:

Name_____

Street_____

City_____ Zone_____ State_____



Test its strength for yourself

Mail this coupon for your free test kit with sample lengths of all four extended play tapes. Pull each tape . . . hard! See . . . only "Scotch" Tensilized Double-Play Tape can stand the strain, just as it will even after years of use on your recorder.

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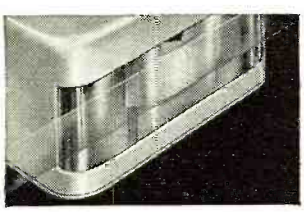
Like having two reels of tape on one! That's the miracle of new "Scotch" Brand Tensilized Double-Play Tape. A single reel of this remarkable super-thin magnetic tape actually gives you as much recording time as two reels of conventional tape. 100% more tape on a standard 7" reel. Enough to record an entire opera, radio concert or business conference on a single reel—without interruption! Right now your dealer has new super-strong "Scotch" Double-Play Tape in limited supply only—but more's on the way and well worth its slight extra cost. Look for it in its new, bright blue carton.



Enjoy "Scotch" Brand's built-in dry silicone lubrication

New "Scotch" Tensilized Double-Play Tape protects your recorder's head from wear with built-in silicone particles. Only "Scotch" Brand performs this vital lubricating job for you—reducing recorder head abrasion and eliminating tape squeal.

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For the RECORD

HAM PARTICIPATION IN IGY

AS A radio amateur, you have an exciting chance to contribute to scientific knowledge by participating in the International Geophysical Year. The period from July 1957 to December 1958 has been marked for the most concentrated assault on the unknown that man has yet attempted—and you, as an amateur, have been invited to assist in this all-out effort.

If you are wondering why you have been asked to play a part in conjunction with elaborately equipped "brain factories" staffed by highly skilled technicians and scientists—here is the reason. Your very number is the strongest factor behind the invitation, as well as the fact that hams are located in all corners of the nation. The cost of duplicating, with government monitoring stations, the thousands of hams capable of working as observers would be impractical. The average ham is also a self-trained observer with a highly developed instinct for interpreting the odd sounds heard on his receiver.

The Soviet satellites are but the first of many that will wheel through our skies—and while you read this the U. S. "Vanguard" satellite may be coming over the horizon.

The unheralded Russian launching caught the formal scientific world with its antennas down. The monitoring stations which were alerted found, to their dismay, that antennas and equipment designed for 108 mc. were ineffective on Sputnik's 20 mc. and 40 mc. frequencies. The higher frequency has been earmarked for all U. S. satellite transmissions. There is little doubt that the majority of listeners to Sputnik's hypnotic "beep-beep" during the first few hours following the announcement of Russia's successful launching were amateurs. Here, once again, was opportunity for you and countless other hams to show the way. A few did.

Satellite signals contain a variety of information such as temperature, meteor collisions, and cosmic-ray count. Most, if not all, are incomprehensible to the amateur observer. To recover this information it is necessary to have the proper type of telemetering equipment along with a knowledge of the telemetering "code" that is used. Although this just about rules out the ham, he can still play an important part since what is vital is the immediate, and accurate, determination of the orbit. Here is where the great number of amateurs and their ingenuity come into play. Follow-up observations are the next most important requirement.

Also, the possibility of ham assistance to astronomical observing groups —both amateur and professional—can not be overlooked. Several hams have been working closely with such groups and have been instrumental in aiding the visual sighting by alerting the astronomers when visual contact is most likely. Your offer of aid to "Moonwatch" groups will be accepted.

The first thing anyone wants to know after launching a satellite is—where is it? Visual sighting will most likely continue to follow the computation of an orbit as first determined by radio bearings. This involves no simple mathematics for the scientists and requires a great number of radio observation points. Hams, because of their random locations, are uniquely equipped to provide this initial data. Observations made throughout the "life" of a satellite may perhaps explain variations such as occurred in both Sputniks' timetables and about which everyone would like to know more. There was even some confusion as to the direction in which the first would next rise. The greatest possible number of observation points are desired as they will permit quick detection of orbital variations.

The system which will be used by scientists for complete data analysis of satellite signals has been designated "Minitrack.". Of very high cost, and beyond reach for individual or amateur group use, this system has been boiled down to a simpler and less costly one called "Mark II Minitrack." Here, too, the individual ham faces a task that only the cooperative efforts of a well-organized radio club would be likely to see completed. Two clubs known to be involved in elaborate projects are the Dayton (Ohio) Amateur Radio Club, and the San Gabriel (Calif.) Valley Radio Club. The latter has a Microlock system, which uses a fairly simple antenna along with a very high sensitivity receiver, in operation. Antennas several hundred feet apart are required for the Minitrack system, as well as extremely low-noise converters. By successfully putting Sputnik's signals on 50,000 feet of tape and ½ mile of paper, the SGVRC became the first amateur group to make a satellite recording and establish important data on its behavior. With such elaborate equipment necessary, how can you participate in the IGY without hocking the family chariot and inviting bankruptcy? If you can do any one of three relatively simple things—you can contribute to the observation program by providing the vital correlating data.

(*Continued on page* 142)

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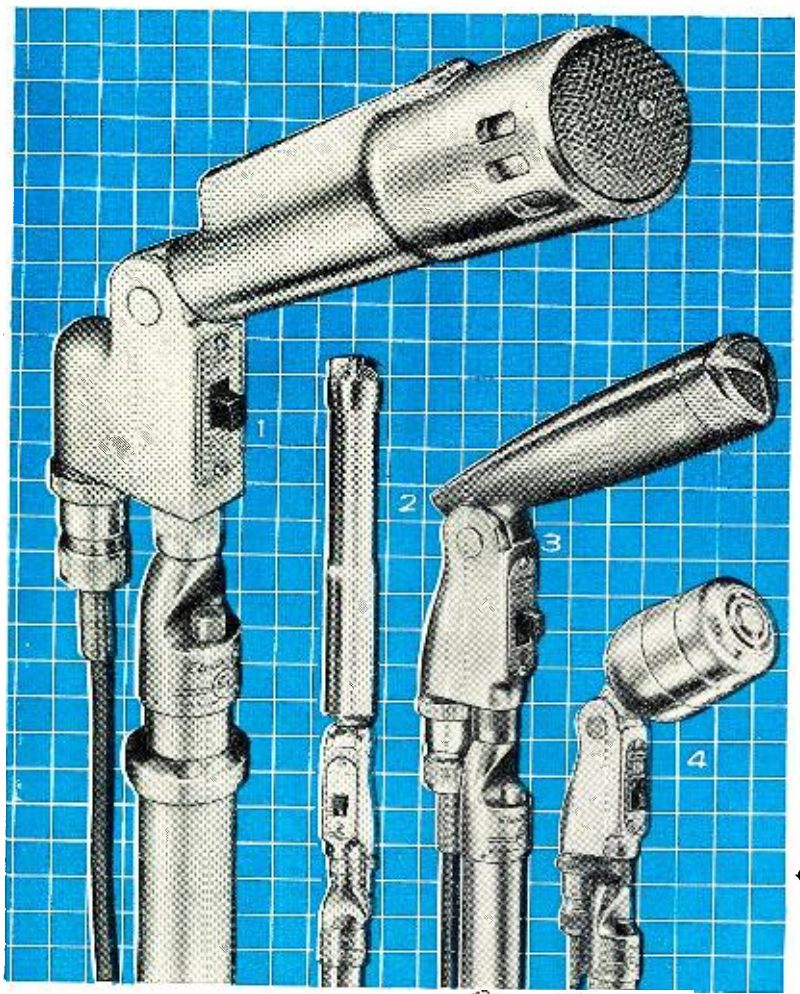

❶ E-V MODEL 664

Utilizing the revolutionary Variable D, this high-fidelity cardioid dynamic brings broadcast quality to tape recording and the P.A. and general purpose field. Proper placement of microphone stops unwanted sounds, gives accurate, natural pick-up of voice and music. Unprecedented ruggedness largely eliminates possibility of accidental damage.

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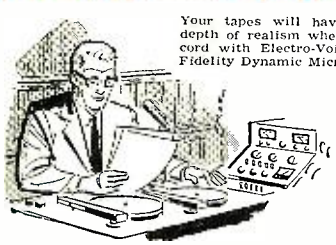
This model brings style and quality to the recording and public address fields. Slim and trim—only 1⅛″ in diameter x 10¼″ long — it greatly reduces recording staging problems. Frequency response: 60 to 15,000 cps, essentially flat. Adjustable impedance. Gold or satin chrome finish. On-off switch standard equipment. Net weight: 15 oz. List price Chrome Finish: $72.50 (less stand).

❸ E-V MODEL 623

Excellent for both speech and music, its small, slim size makes it inconspicuous and easy to handle. Swivel mounting permits tilting microphone through a 57° arc toward the sound source. Acoustalloy diaphragm. Frequency response: 60 to 12,000 cps. Satin chrome finish. Net weight: 1 lb. List price: $57.00 (less stand).

❹ E-V MODEL 630

This is similar to Model 623 in performance characteristics but is traditionally styled. Frequency response: 60 to 11,000 cps. Satin chrome finish. Net weight: 1 lb. List price: $52.50.



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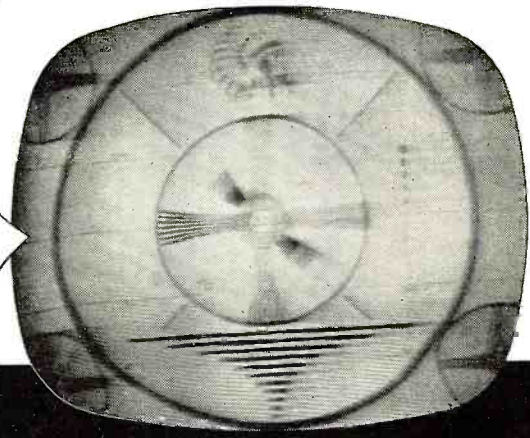
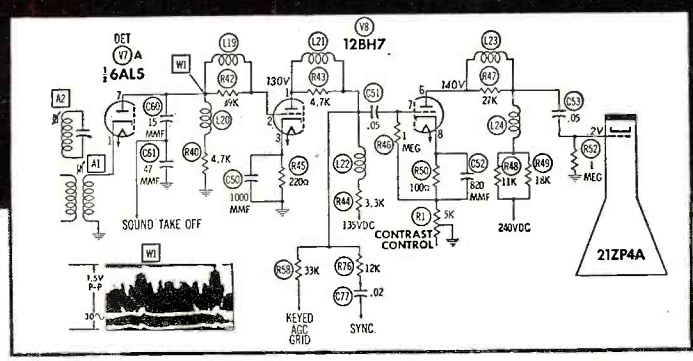
how long would it take you to solve this service problem?

SYMPTOM: Smeared Picture (showing black streaks trailing from blacks)



PHOTOFACT helps you lick problems like this

in just minutes for only *2½¢ per model!



(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

Let's take a look at this problem: A smeared picture such as illustrated above is caused by excessive low-frequency response coupled with poor high-frequency response. Look for the following possible causes:

1. Defective video amplifier, video output, or Picture tube
2. Low value of coupling capacitor C51 or C53
3. Low value of grid resistor R46 or R52
4. Open cathode bypass capacitor C50 or C52
5. Open series-peaking coil L23 or L21
6. High value of plate resistor R44, R48 or R49

With the applicable PHOTOFACT Folder at your fingertips, you trouble-shoot and solve this problem in just seconds. Here's how:

Check the Video Detector (V7) and the Video Amplifier (V8). Just refer to the Tube Placement Chart (you'll find it in every PHOTOFACT TV Folder) for quick location of these tubes. Tubes okay?—then: Check the waveform at pin 7 of V7. The correct waveform is shown right on the PHOTOFACT Standard Notation Schematic. Waveform correct?—then: Check the voltages in the Video amplifier and Video output stages to determine which part is defective. The correct voltages appear right on the exclusive Standard Notation Schematic, along with resistances (shown in easy-to-read chart form). Exclusive PHOTOFACT chassis photos with "call-outs" keyed to the schematic help you locate the faulty parts in just minutes.

Whatever the trouble, you'll locate it faster and easier with a PHOTOFACT Folder by your side. Be sure to use the complete Replacement Parts List to select the proper replacement for the repair.

Use the servicing method you prefer—checking of waveform, voltage or resistance—you'll find all the information you need at your finger-tips in PHOTOFACT. For only *2½¢ per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

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

By RADIO & TV NEWS
WASHINGTON EDITOR

TOLL TV's long-awaited trial-run rules and regulations to be followed—*if* Congress does not intervene before the March 1 deadline for formal action on applications and *if* the Commission green-lights the propositions offered by stations to set up the tests for pay-television—have been officially docketed in Washington.

Stations which agree to go along with the test schedules will be obliged to file an encyclopaedic report which will detail, in part, the methods of transmission which will be used, rates which will be followed, hours of transmission, programs which will be telecast, and whether or not sponsors will be involved.

In granting approval for the pay-see experiments, which would run for a period of three years and permit both high- and low-band stations to participate, the Commission said that it was, at this stage, unaided by . . . "any meaningful demonstrations of the service in operation . . . Nor are there available to the Commission precise blueprints of the manner in which the operation would be conducted. . . ."

The FCC noted that the proponents had indicated that it would be difficult to elaborate further on the basic proposals submitted . . ." until an announcement is made of the conditions under which subscription television operations would be permissible, thereby affording interested segments of the industry an opportunity to formulate specific plans . . ." Such a move, it was said, would permit negotiation of business arrangements and contracts which would govern the conduct of toll-TV operation. What is more important, Washington stressed, is a need to adapt initial methods in the light of experience as it is progressively gained to justify, and in fact, necessitate, flexibility in the initial operations. Accordingly, said the Commission, in circumstances which offer no fixed guideposts either in past experience or in crystallized future plans, the FCC is being called on . . ." to rule on petitions to permit a service about which the proponents and opponents have urged the most widely divergent views, in a debate which has necessarily been conducted more on the ground of potential implications of the service than on the basis of demonstrable facts. . . ."

This is beginning to shape up as an interesting fight.

EXPLAINING FURTHER ITS DECISION to authorize the tests, the Commission said that . . ." proponents, claiming large benefits to the public from the introduction of a broad new financial base and added programming resources into television broadcasting, urge the immediate, definitive authorization of subscription broadcasting . . . with a minimum of restricting condi-

NEW TELEVISION STATION GRANTS

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

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
New Mexico	Albuquerque	.....	5	76-82	2

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Florida	Orlando	WLOF-TV (Formerly WTLO)	9	186-192
Mississippi	Biloxi	WVMI-TV	13	210-216
Montana	Butte	KOPR-TV	6	82-88
South Dakota	Sioux Falls	KSOO-TV	13	210-216
Texas	Victoria	KMVA-TV	19	500-506

* ERP = (effective radiated power, kw.)

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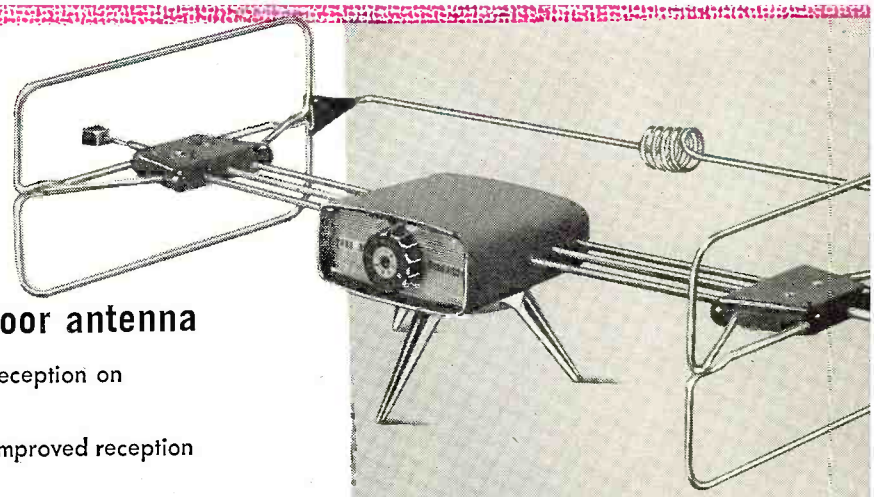

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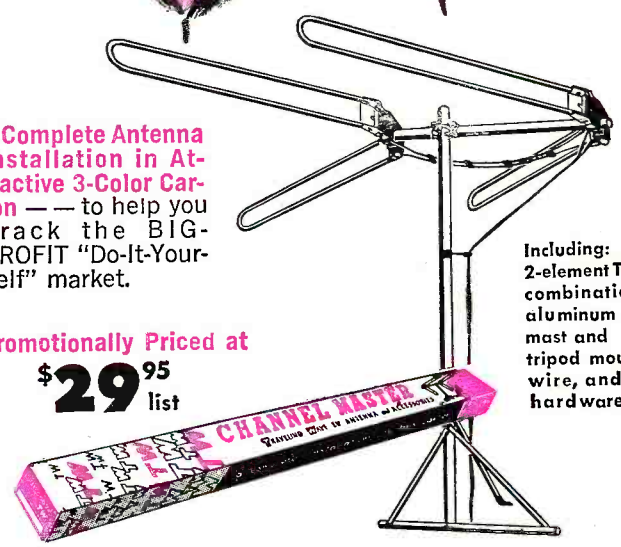

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tions . . ." Opponents however, it added, have raised the spectre of a . . ." gravely impaired free television service . . ." insisting that the only proper course for the Commission is to forbid the service or to refer the question to the Congress.

In the Commission's opinion, the proper course does not lie at either extreme. Believing that it has full jurisdiction in the matter, the FCC declared that it can find . . . "little justification for *carte blanche* authorization of the use of the broadcast frequencies for an untried service of this kind." But, on the other hand, it did not feel it could refuse a demonstration of any system's capacity to render a useful service, since it was up to the public to appraise its desirability and register its reaction—favorable or otherwise—to what the service may have to offer; and it was for the Commission to determine what legislative recommendations it may be desirable to submit to Congress concerning the appropriate methods for regulating the service, in the event a trial indicates it should be permitted on a continuing basis.

The Commission said that it was taking this test action because it was responsible, under both the Communications Act and the Administrative Procedure Act, to act on the proposals and delay in reaching a decision would not be consistent with its duties.

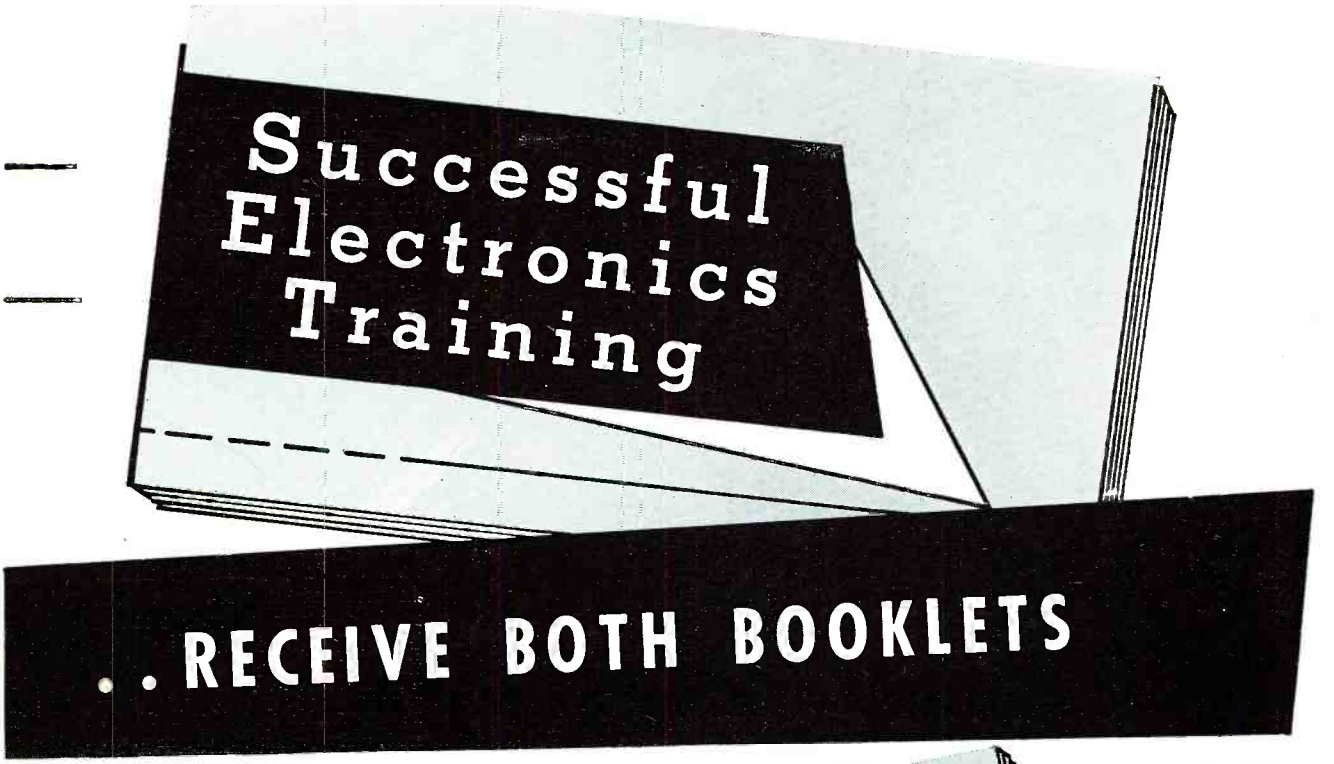
ACCORDING TO THE COMMISSION, there are five systems which might be used for toll-testing: Phonevision (*Zenith Radio*), Subscriber-Vision (*Skiatron*), Telemeter (*International Television Corporation*), Bi-Tran (*Blonder-Tongue*), and Teleglobe.

Phonevision. Subscriber-Vision, and Telemeter each contemplates the encoding or scrambling of both the visual and aural portions of the programs. All three of these systems also require the use of a decoding device attached to the receiver. Phonevision and Subscriber-Vision contemplate periodic billings, while Telemeter would require the deposit of coins in a coin box associated with the decoder. All three systems provide, in different ways, for the dissemination to subscribers of the information needed to activate the decoder and for the recording of payments and charges.

Teleglobe calls for the conventional transmission, in the clear, of the visual portion of the subscription-television programs. The aural portion would be transmitted by wire and made available only to subscribing members.

Bi-Tran envisages the simultaneous transmission, on a single TV channel, of two programs, one of which could be made available as at present without the payment of any charge and the other of which could be subjected to a charge if it were to be used for subscription operations. (See page 105 of last month's issue.)

DISSENTING TO THE TOLL-TV edict in a sharply worded statement, Com-



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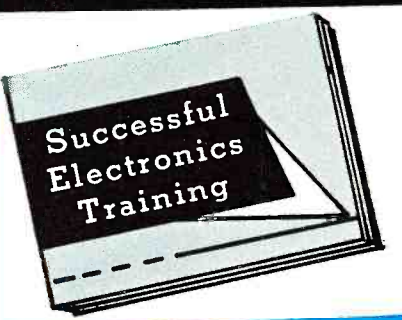

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missioner Bartley said that . . . "little, if any information has been submitted which would indicate how the proposed trial demonstrations would assist the Commission in resolving the basic issues in the case . . ." He then went on to note that the most critical gap in the record lies in the failure of the proponents to state the specific ways . . . "in which it is believed that the conduct of the proposed field demonstrations would assist the Commission in evaluating the effects, impact, benefits, and potential hazards or disadvantages of subscription television, if it were subsequently authorized on a more general scale."

This, the Commissioner stressed, is the . . . "crucial public interest issue upon which the determinations in this proceeding must be based." Unless, continued Bartley, the Commission is in . . . "a position to make a sound determination that the service warrants the use of scarce frequencies, it cannot go ahead in the absence of further administrative proceedings. One has only to recognize that most of the recommendations in the *report of the network study staff* stem from the insufficient number of hours of broadcast time available for effective use, to be aware of the impact and implications of imposing upon this already critically limited broadcast structure, another system which will deprive the general public of programs on their television sets unless they pay a fee. . . ."

It was his belief, the Commissioner declared, that if subscription television . . . "has the potential of public acceptance prophesied by the proponents, then . . . the cost of a wire system would be no bar to its success. . . . With the present shortage of time availabilities, all alternative methods should first be fully explored. . . . Time is not of the essence for a subscription service over television stations. If later, no alternative method proves practicable and such a service were to be found to be desirable, the television stations will still be there for use."

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(*Continued on page* 109)

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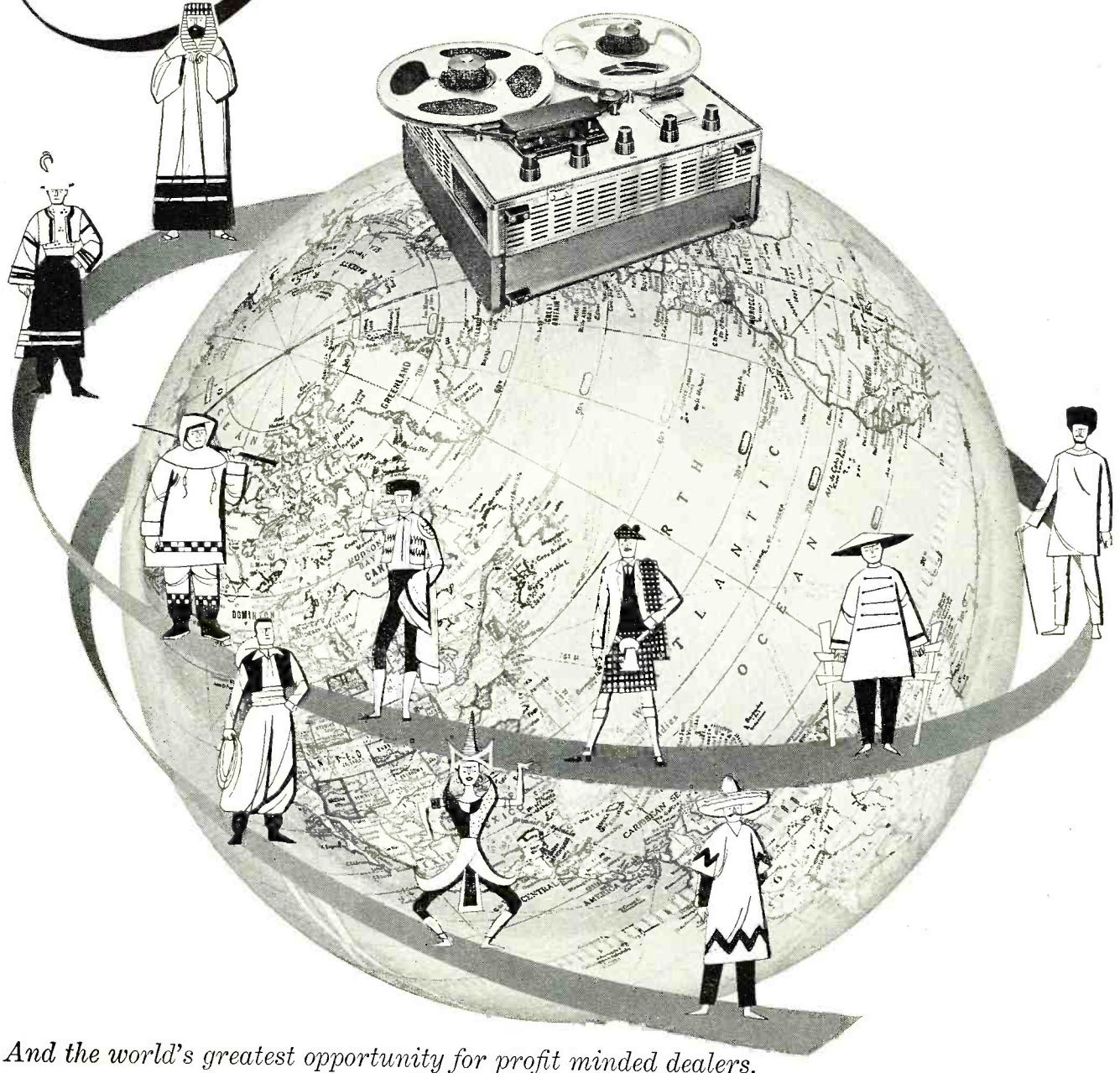

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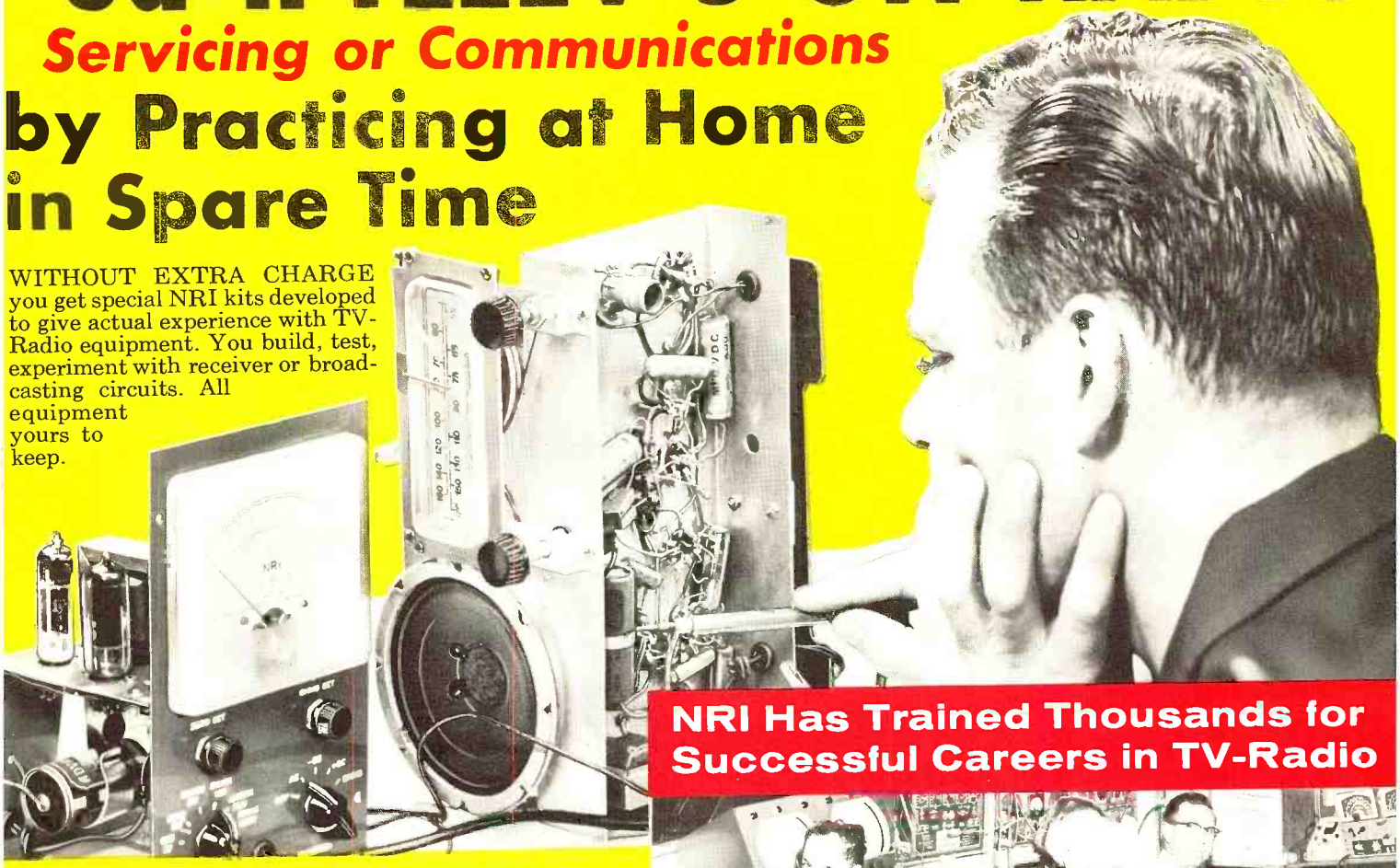

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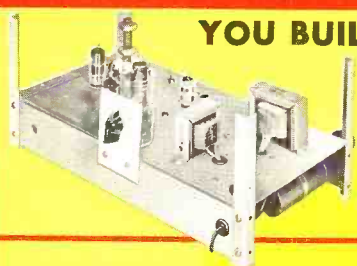

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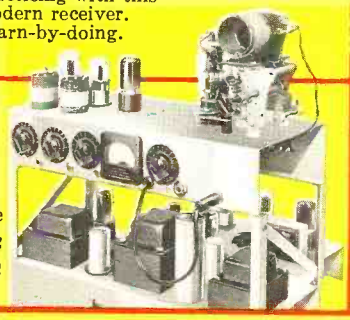

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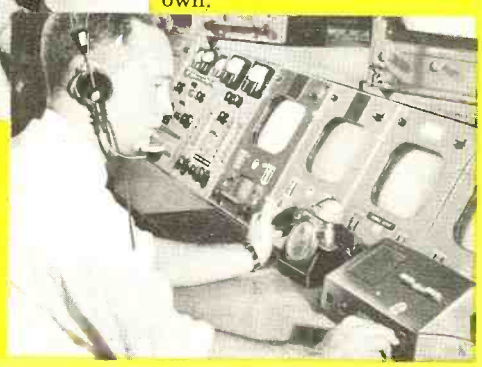

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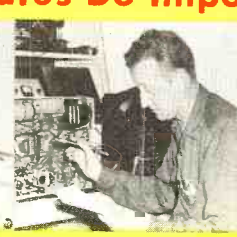

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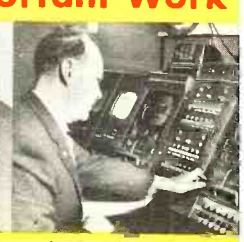

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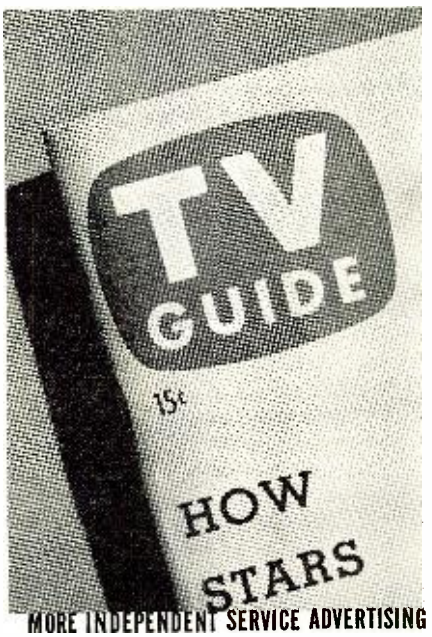

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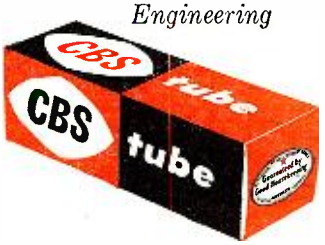

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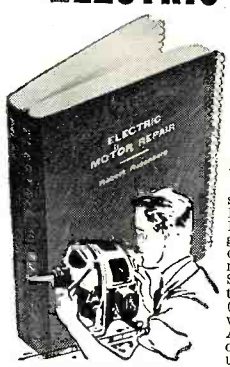

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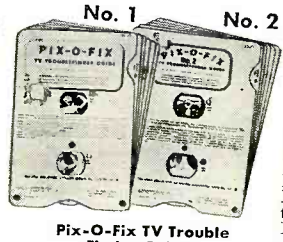


Pix-O-Fix TV Trouble Finder Guides
Only $2 for the two

Eliminate useless testing . . . Fix sets twice as fast

Just turn the dial of the handy, pocket-size Ghirardi & Middleton PIX-O-FIX TV Trouble Finder Guide. When the picture in the PIX-O-FIX window matches the screen image on the television set you're repairing . . . *presto! . . . you've got your clue.*

PIX-O-FIX then shows the causes of the trouble. Next it indicates the exact receiver section in which the trouble has probably happened. Then it gives step by step repair instructions.

The two PIX-O-FIX units No. 1 and No. 2 cover 47 different television troubles . . . just about anything you're likely to be called on to fix. No. 1 identifies 24 of the most common troubles and gives 192 causes and 253 remedies for them. No. 2 covers 23 more advanced troubles not included in No. 1. Together, they are a comprehensive guide to quick "picture analysis" servicing of any TV set . . . *AND THE PRICE IS ONLY $2.00 for the two.* Money refunded if you are not more than satisfied. ***Specify PIX-O-FIX in coupon.***

USE COUPON FOR *10-day Free Trial!*

RADIO EVER MADE FAST! EASY! R-I-G-H-T!

Cash in on HIGH-FI SERVICE and BUILDING

HIGH FIDELITY TECHNIQUES
By John H. Newitt
494 pages, 203 illus.
Price $7.50

A complete guide to better High Fidelity methods and results

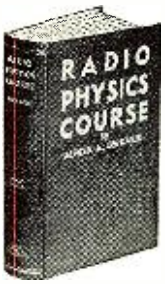
Get better results from "Hi-Fi" by having all the facts and latest ideas at your fingertips!

This big book brings you complete data on modern sound reproduction methods and equipment. It shows how to get better results at lower cost; how to build your own; how to service hi-fi equipment; discusses all details of components; compares different methods—AND IS CRAMMED FULL OF HOW-TO-DO-IT TIPS AND IDEAS.

Here are just a few of the many subjects! How to get the right hi-fi equipment for your needs; Hi-fi versus P.A. type speaker; Loudspeaker construction and performance; Adjusting bass-reflex cabinets; Controlling distortion; Getting rid of "hangover"; Selecting a woofer-tweeter; Sound-proofing materials; All about output transformers; Special hi-fi circuits; Ways to suppress noise; Negative feedback and how to use it; Amplifier construction hints; Minimizing tuner distortion; Avoiding chatter; Limiter-discriminator vs. ratio detector FM circuits; Avoiding record wear; Tips for custom builders; Bass-reflex charts; Acoustical horn design data; special installation problems; pre-amps and equalizers; pick-up resonance; a novel horn system . . . and literally dozens of other subjects.

Order High Fidelity Techniques in coupon today for 10-day FREE trial!

Here's How to Get Started in RADIO-ELECTRONICS!



RADIO PHYSICS COURSE
by Ghirardi
972 pages, 508 illus., 856 self-test questions
Price only $6.50

More service experts got their basic training from this big book than any other of its type!

Here's basic training you can *really* understand—written by A. A. Ghirardi who has probably trained more service experts than any other man living today! From start to finish, it is *practical* training that can help fit you for a BIG PAY job in *any* branch of radio-television-electronics work.

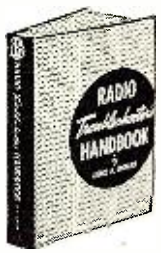
Ghirardi's RADIO PHYSICS COURSE is the oldest book of its kind—and still a best seller BECAUSE IT IS SO AMAZINGLY CLEAR AND COMPLETE. You can understand it, even without any previous radio or TV training!

36 COURSES IN ONE!

Starts with Basic Electricity. Then it takes you step by step through the entire field from basic circuits, components, instruments, etc. to their final application in radio-electronic equipment. You can buy newer, costlier training—*but you can't buy better training at anywhere near the price.* Ask the men who know!

Order RADIO PHYSICS COURSE in coupon.

DON'T THROW OLD RADIOS AWAY!



Covers every model made by 202 mfrs. from 1925 to 1942

Here's the data you need to fix old sets in a jiffy!

Just look up the how-to-do-it data on that old radio you want to fix.

Four times out of 5, this giant, 3½-pound, 744-page Ghirardi RADIO TROUBLESHOOTER'S HANDBOOK tells what is likely to be causing the trouble . . . shows how to fix it. No useless testing. No wasted time. Using it, even beginners can easily fix old sets which might otherwise be thrown away because service information is lacking. With a few simple repairs, most of these old sets can be made to operate perfectly for years to come.

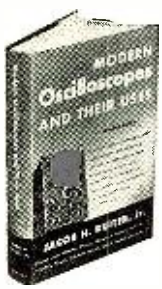
THE ONLY GUIDE OF ITS KIND!

Cuts service time in half!

Included are common trouble symptoms and their remedies for over 4,800 models of old home, auto radios and record changers. Airline, Apex, Arvin, Atwater Kent, Belmont, Bosch, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kolster, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Sparton, Stromberg and dozens more. Includes hundreds of pages of invaluable tube and component data, service short cuts, etc.

Specify RADIO TROUBLESHOOTER'S HANDBOOK in coupon. Price only $6.95. 10-day trial.

Here's everything you need to know ABOUT OSCILLOSCOPES!



The book that really teaches you how to use 'scopes on all kinds of electronic service

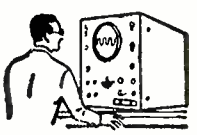
Oscilloscopes are "gold mines" if you learn to use them fully on every job. THIS BIG BOOK TEACHES YOU HOW!

Here, in a big, revised 2nd edition, is THE book that really shows you how to use oscilloscopes!

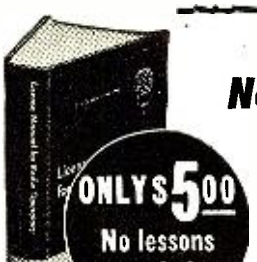
Clearly as A-B-C, MODERN OSCILLOSCOPES AND THEIR USES gets right down to "brass tacks" in telling you exactly when, where and how. You learn to locate either AM or FM radio or television troubles in a jiffy. Even tough realignment jobs are made easy. No involved mathematics! Every detail is clearly explained—from making connections to adjusting circuit components and setting the oscilloscope controls. And you learn to analyze patterns fast and RIGHT!

Includes latest data on use of 'scopes in color TV, industrial electronics, teaching . . . even in atomic energy work. Over 400 helpful pictures including dozens of pattern photos make things doubly clear. Price $6.50.

Practice 10 days free. Order MODERN OSCILLOSCOPES in coupon.



Oscilloscope experts get the BIG PAY jobs!



LICENSE MANUAL for Radio Operators

by J. R. Johnson (W2BDL)

A complete, practical study guide for getting your "ticket" as a commercial operator

Now! PASS FCC LICENSE EXAMS *easier! faster!*

Train for big pay in communication's most interesting jobs

Here, at last, is a guide to FCC License Examinations . . . written so you can easily understand AND REMEMBER it. Covers ALL EIGHT exam elements . . . not just some of them. Reviews almost 2200 typical exam questions with straight-to-the-point answers. *Includes full data on the recent changes in examination elements 1 and 2.* (Many folks do not even know these changes exist!) Covers all necessary examination data from electrical-radio fundamentals to navigation and related subjects. Anyone who has basic radio training will find Johnson's LICENSE MANUAL the ideal training book for making this all-important step ahead in his career! Price only $5.00. Use coupon.

TRY ANY BOOK 10 DAYS FREE!

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. . . on Ghirardi's Radio & TV Receiver CIRCUITRY AND OPERATION, and Radio & TV Receiver TROUBLESHOOTING AND REPAIR. Price only $13.00 for the two books plus postage. (Regular price $14.25 . . . *you save $1.25*). Payable at rate of $4 (plus postage) after 10 days and $3 a month for three months until $13.00 has been paid. If not satisfactory, return books in 10 days and owe nothing.

Check here to order INDIVIDUAL BOOKS

- ☐ Radio & TV Receiver CIRCUITRY & OPERATION.....$6.75
- ☐ Radio & TV Receiver TROUBLESHOOTING & REPAIR ..$7.50
- ☐ BASIC ELECTRONIC TEST INSTRUMENTS $4.95
- ☐ ELECTRIC MOTOR REPAIR $6.95
- ☐ PIX-O-FIX TROUBLE-FINDER GUIDES (Nos. 1 and 2) $2.00
- ☐ HIGH FIDELITY TECHNIQUES.....$7.50
- ☐ MODERN OSCILLOSCOPES AND THEIR USES.....$6.50
- ☐ RADIO TROUBLESHOOTER'S HANDBOOK.....$6.95
- ☐ RADIO PHYSICS COURSE.....$6.50
- ☐ LICENSE MANUAL for Radio Operators.....$5.00

If cash is sent with order, we pay postage—same 10 day return privilege. Otherwise, postage is extra.

To order OUTSIDE U.S.A.—Special combination offer, $14.00 for money-saving combination offer. For all other books, add 50c each to above prices for handling through customs, etc. Sold for cash only. Any book may be returned in 10 days and money will be refunded.

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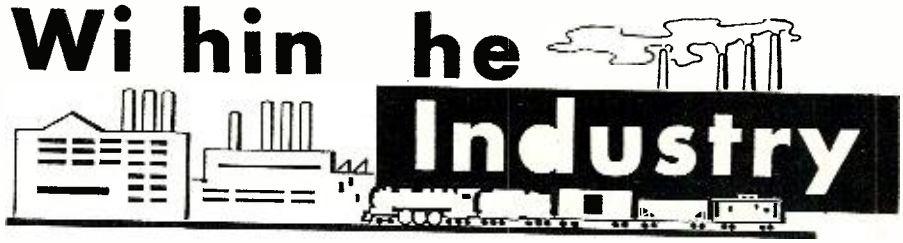
City, Zone, State.....

Within the Industry



FELIX T. TROILO has been appointed sales manager of *Circuit Instruments Inc.*, St. Petersburg, Florida. This company is a subsidiary of *International Resistance Company*, Philadelphia.

Mr. Troilo joined the parent organization in 1955 as office salesman and product monitor and was later transferred to the Chicago office in the post of sales engineer.

Prior to this, he was associated with *General Electric Co., Philco Corp., Waterman Products Co.*, and *Sharples Corp.*

* * *

EDWARD A. ALTSHULER, Los Angeles marketing consultant and West Coast Editor of RADIO & TV NEWS, has been named managing director of the Magnetic Recording Industry Association, a national organization comprising every important manufacturer of tape recorders and tape recording equipment in the United States.

Mr. Altshuler was formerly chairman of the public relations committee of the association and national marketing manager of the tape recording division of *American Electronics Corporation.*

The appointment was announced by Irving Rossman, head of the group and president of the *Pentron Corporation.*

The association's new national headquarters are at 6234 Scenic Ave., Los Angeles, California.

* * *

EUGENE F. GRANT has been promoted to the post of vice-president, engineering, of *National Company, Inc.*

The firm has stated that under Mr. Grant's leadership the organization's engineering division has substantially increased in size, stature, and reputation. Many important engineering and scientific achievements have resulted.

He joined the company in 1954 and in 1955 was appointed director of engineering.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION (formerly RETMA) has urged the Federal Communications Commission to broaden the eligibility base of private microwave licensees and to assure these users of "freedom of choice" in selecting a communications medium.

Contending that there is adequate spectrum space to provide a healthy private microwave communications industry, the association is scheduled to present a series of eight witnesses in connection with the FCC's fact-finding inquiry on the utilization of frequencies above 890 megacycles.

* * *

FRED B. SMITH, works manager of *Western Electric,* manufacturing division of *Bell Telephone,* has received a citation for his accomplishments in creating employment for the physically handicapped.

This citation was presented in behalf of the one hundred handicapped workers who own and operate *Paraplegics Manufacturing Company,* Franklin Park, Ill.

In presenting the citation it was noted that the firm gave the Franklin Park organization its first order, enabling the unusual enterprise to begin operations.

* * *

FRANK HADRICK has joined *Simpson Electric Company* as chief field engineer (test equipment).

He was formerly chief television field engineer for *Admiral Corporation* and was instrumental in developing its color television training program.

With over 14 years of experience, Mr. Hadrick has been active in dealer-distributor field contact work, technical writing, and supervising electronic product analyzing and investigations. In addition to electronic service experience, he has held positions as service manager, directing service operation at both wholesale and retail levels.

In his new position, Mr. Hadrick is expected to play an integral part in the design and development of new test equipment and will be available for consultation concerning television and other electronic testing problems encountered by the company's customers.

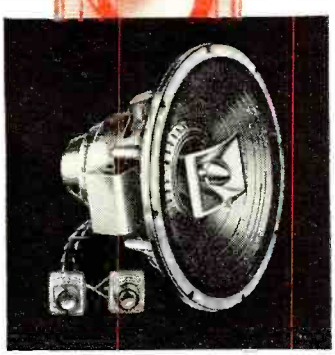
* * *

CLEVELAND INSTITUTE OF RADIO ELECTRONICS has opened two new offices. One is located at 906-908 Royster Building, Granby Avenue at City Hall Avenue, Norfolk, Virginia, and the second is at the Jones Building, Room 711, 1331 Third Avenue, Seattle, Washington . . . **TELEMATIC INDUSTRIES, INC.** announces the opening of its new and enlarged factory and office at 251 Lee Avenue, Brooklyn, N. Y. . . . **GENERAL ELECTRONIC LABORATORIES, INC.** has expanded into the rapidly growing FM multiplex communication field . . .

Indisputably the Finest!

UNIVERSITY'S NEW 315-C 3-WAY 5" DIFFAXIAL

This speaker protected by U. S. Patent nos. 2,641,329; 2,690,231; 2,751,996 and other patents pending.



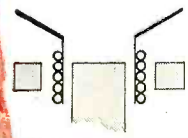
THESE ARE THE REASONS WHY

Exclusive self-stabilized woofer cone structure and dual spider construction ensure lifetime centering of moving system, for all extreme excursions.

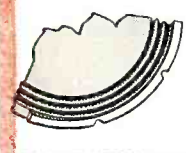
University-controlled processing of imported cone pulps results in consistently uniform, distortion-free response.

Exclusive, massive flux-contoured 6 pound Gold Dot Alnico 5 magnet provides efficient power drive for deepest low frequencies, free of transient distortion.

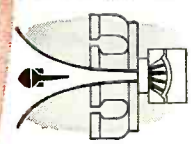
Extra-long voice coil ensures purity of maximum low frequency energy conversion during periods of extreme cone excursion.



Exclusive University-formulated long polymer lattice permeates rim suspension for effective acousto-mechanical rim damping.



True through-axial construction permits balanced tweeter, mid-range and woofer acoustic integration without design compromise.



Exclusive hypersonic tweeter incorporating radial phasing equalizer automatically balances all high frequencies for smooth, realistic reproduction.

Exclusive "reciprocating-flare" horn now has wave front equalizer for more uniform wide-angle treble coverage.

Exclusive multi-sectional Diffusicone provides controlled diffraction for linear mid-range response and dispersion.

Continuously variable dual control network integrates and blends mid-range and tweeter for concert realism regardless of room acoustics.

Response: 25 cps to inaudibility; **Power capacity:** 50 watts, integrated program; **Total magnet wt.:** 6½ lbs. Alnico 5; **Impedance:** 8-16 ohms; **Depth:** 12"; **User net:** $156.00.

UNIVERSITY LOUDSPEAKERS, INC., 80 SO. KENSICO AVENUE, WHITE PLAINS, N. Y.

LISTEN *University® sounds better*

HIGH FIDELITY

CHICAGO STANDARD TRANSFORMER CORP. is planning a 25,000 square foot addition to its Chicago plant. This addition will be devoted exclusively to the firm's catalogue division . . . **ACE ENGINEERING AND MACHINE COMPANY, INC.** just announced plans to move into its newly completed plant at Huntingdon Valley, Pa. The one-floor offices and plant enclose an area of approximately 18,000 square feet and will house the executive offices, engineering, design, manufacturing, and testing facilities . . . Another new section of **GENERAL ELECTRIC's** computer department recently began operation. Named the Computer Applications Laboratory, this latest facility is located on the campus of Arizona State College at Tempe . . . **UNITED ELECTRONICS COMPANY** has added 6000 square feet to its facilities in Newark, N. J. This space will be occupied by its engineering, research, and development administration . . . **RADIO RECEPTOR CO., INC.** has completed consolidating semiconductor production under one roof at its main plant at 240 Wythe Ave., Brooklyn, N. Y. . . . The newly expanded plant of **INSTRUMENT SPECIALTIES COMPANY,** Little Falls, N. J., is now in full production . . . **CGS LABORATORIES** has contracted to purchase six acres of property in Ridgefield, Conn. This is part of the company's planning for expansion and acquisition of modern facilities in pleasant surroundings.

* * *

FREDERICK H. GUTERMAN has been appointed general manager of the technical products division, *Allen B. Du Mont Laboratories, Inc.*

Mr. Guterman will be responsible for over-all sales and marketing of oscilloscopes and associated electronic test equipment, automotive test equipment, industrial television systems, and two-way mobile radio systems.

Formerly assistant vice-president, sales and planning, at *American Bosch Arma Corp.,* he was also associated with the *General Electric Company.*

He is a member of the Institute of Radio Engineers.

* * *

APPLIED RESEARCH, INC. has changed its name to **BOOZ, ALLEN APPLIED RESEARCH, INC.** The firm's headquarters have been moved to 430 Green Bay Road, Kenilworth, Ill. . . . The **WARREN MANUFACTURING COMPANY** has entered into a cross-licensing arrangement with **WESTERN ELECTRIC COMPANY, INC.,** New York . . . **FAIRCHILD SEMI-CONDUCTORS CORPORATION** has been formed in Syosset, Long Island for the development and production of silicon diffused transistors and other semiconductors. This was announced by **FAIRCHILD CAMERA AND INSTRUMENT CORP.,** the sponsoring organization . . . The impending merger of **MONROE CALCULATING MACHINE COMPANY** with **LITTON INDUSTRIES** has

Now Only $16.50

Electro-Voice

DIAMOND POWER-POINT*

NEEDLE-CARTRIDGE COMBINATION

POWER-POINT (U. S. Patents D108347, 2793254) is the unique miniaturized unit containing BOTH a *fresh* ceramic cartridge and jeweled playing tips. YOU can install a POWER-POINT in less time than it takes to read this sentence!

AND NOW A DIAMOND POWER-POINT IS YOURS FOR JUST $16.50!

Your dealer will install your choice of three POWER-POINT mounts. There are seven POWER-POINT models, color coded, from $3.95.

Look at these substantial savings!

Model 56DS, one 1-mil, diamond tip, one 3-mil sapphire tip.
Color code: Orange.
Was $21.50
NOW ONLY $16.50

Model 76DS, one 1-mil, diamond tip, one 3-mil sapphire tip.
Color code: Pink.
Was $21.50
NOW ONLY $16.50

SEE YOUR DEALER TODAY!

Electro-Voice®

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN

been announced. An offer to purchase the outstanding common stock of the calculating machine firm has been made and stockholders representing approximately 80% of the stock have already accepted the offer . . . Acquisition of the precision products division of **GRUEN INDUSTRIES** has been announced by the **KDI CORPORATION** of Rochester, N. Y. The acquired division will be known as the **PRECISION PRODUCTS CO. OF CINCINNATI,** a division of the parent corporation . . . **RCA** and **AMPEX CORPORATION** have signed an agreement for the exchange of patent licenses covering video tape recording and reproducing systems for both black-and-white and color . . . **ELTRONICS, INC.** has acquired **PARKCHESTER MACHINE CORPORATION** . . . **GEORGE RATTRAY & CO., INC.** has become a wholly owned division of **HARDWICK, HINDLE, INC.,** subsidiary of **AMERICAN SEAL-KAP CORP.** . . . **ELCO PACIFIC,** subsidiary of **ELCO CORPORATION,** has acquired **MACSON COMPANY** . . . The intended purchase of **MARYLAND ELECTRONIC MANUFACTURING CORP.** by **LITTON INDUSTRIES** was announced jointly by the two company presidents . . . **THE SINGLE CRYSTAL CORPORATION OF AMERICA** has just been formed. The purpose of the new corporation is to grow single crystals of various materials. The plant address is Saxonburg Blvd., Saxonburg, Pa.

* * *

A. L. (AL) PEZMAN has been named sales manager of the *Trio Manufacturing Company* of Griggsville, Illinois.

He has been associated with the company as legal counsel prior to assuming his new position.

Mr. Pezman brings to his new position a varied background in sales work. His experience includes everything from door-to-door selling to management of his own national sales organization.

In his new position, Mr. Pezman will direct the sales of TV antennas and other products fashioned from tube aluminum.

* * *

WALTER J. O'DONNELL has been elected vice-president in charge of purchasing for *Fisher Radio Corporation* . . . *Weston Electrical Instrument Corp.,* a subsidiary of *Daystrom, Inc.,* has announced the appointment of **EMIL NICHOLS** as manager of test equipment sales, **A. R. WALTHERS,** manager tachometer sales, and **PAUL M. HEILMAN,** distributor sales manager . . . **MARTIN I. ZWERIN** has been named special representative for market development of new products, *International Resistance Company* . . . **JOHN PRUTTON** has joined the capacitor sales section of *Centralab,* a division of *Globe-Union Inc.* . . . **GERALD E. POTTER** has been appointed director of field applications for *Filtors, Inc.* . . . **O. I. THOMPSON** and **WALTER W. ROSE** have been appointed vice-presidents of *DeVry Technical Institute* . . .

(*Continued on page* 145)

Clip and Mail the Coupon Below—Now!

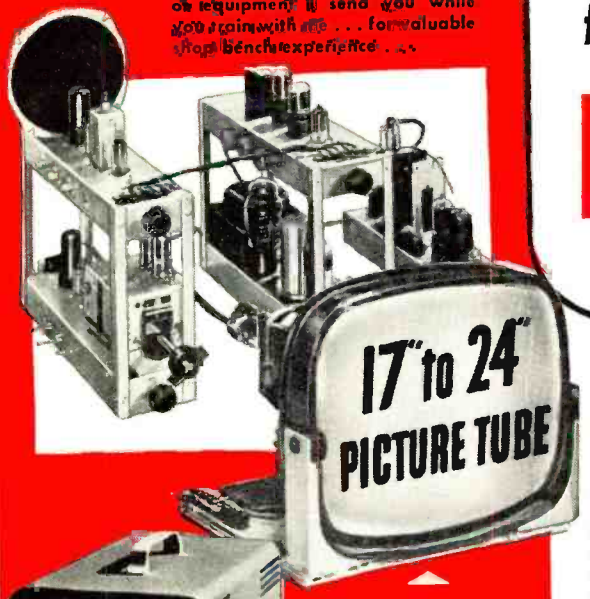
Train in Spare Hours at Home for the Best Jobs and Big Pay in

Radio-Television

—my new, faster way!

Learn PRACTICAL RADIO-TV with 25 BIG KITS

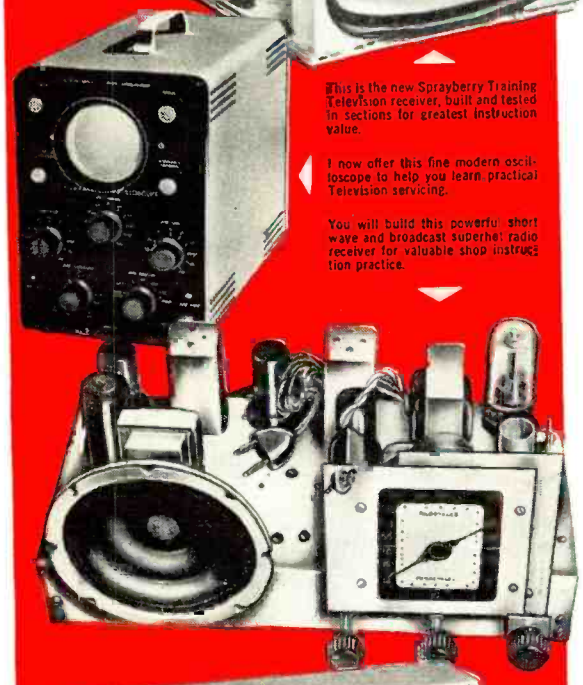
of equipment I send you while you train with me . . . for valuable shop bench experience . . .

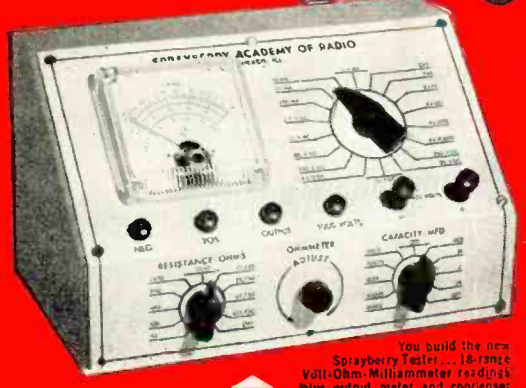


This is the new Sprayberry Training Television receiver, built and tested in sections for greatest instruction value.

I now offer this fine modern oscilloscope to help you learn practical Television servicing.

You will build this powerful short wave and broadcast superhet radio receiver for valuable shop instruction practice.





You build the new Sprayberry Tester . . . 18-range Volt-Ohm-Milliammeter reading; plus output meter and condenser and resistor substitution selector.

Average cost per lesson

ONLY $3.42

Including Kits and Equipment

Frank L. Sprayberry
Educational Director

Want Proof? Send for my big FREE CATALOG and Sample Lesson. Let the facts speak for themselves!

Why wait—get into Radio-Television fast! I will train you in as little as 10 months to step into the top paying Radio-Television field as a much-needed Service Technician! You will train entirely at home in your spare time . . . which means you can train as fast or as slowly as you like. You have a choice of THREE Sprayberry Training Plans . . . one *exactly* suited to your needs. My easier-than-ever payment terms make it possible for you to get set for the good jobs in Radio-Television without the slightest strain on your budget! Get the true facts . . . just mail the coupon for my big new 56 page fact-filled catalog plus actual sample lesson—both FREE.

REALLY PRACTICAL TRAINING—NO PREVIOUS EXPERIENCE NEEDED

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My graduates are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

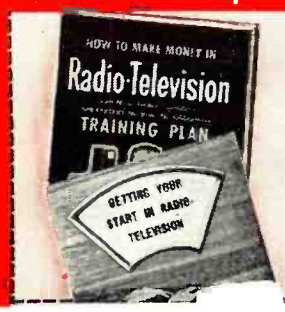
MAIL THE COUPON—See what's ahead in Radio-TV . . . No Salesman Will Call On You!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item in my training. With the facts in your hands, you will be able to decide. No salesman will call on you. The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO-TELEVISION

1512 Jarvis Avenue, Dept. 25C, Chicago 26, Illinois

Mail This Coupon For Free Facts and Sample Lesson



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Dept. 25C, 1512 Jarvis Avenue, Chicago 26, Ill.

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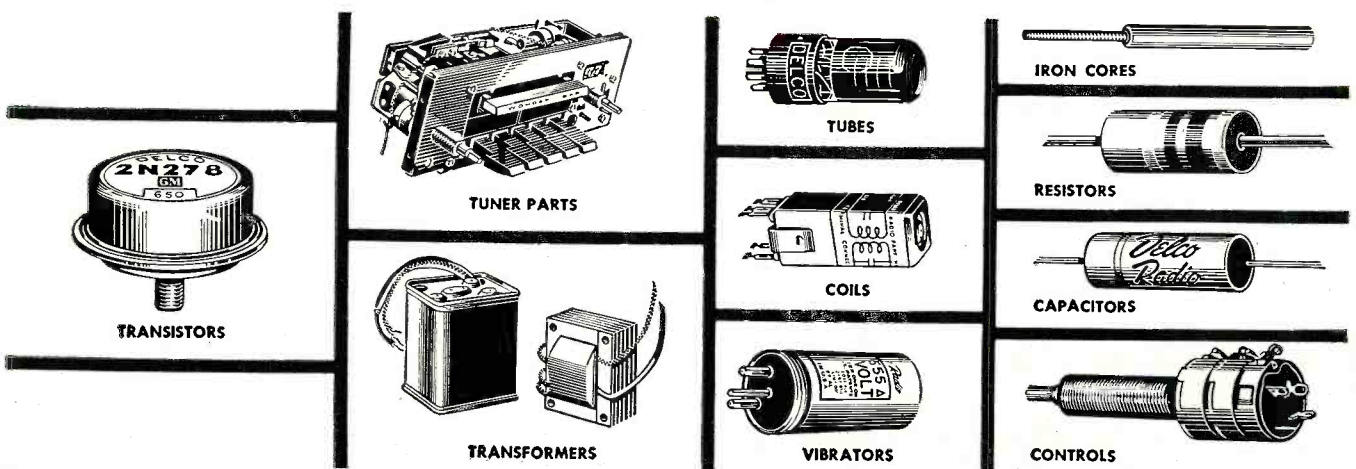

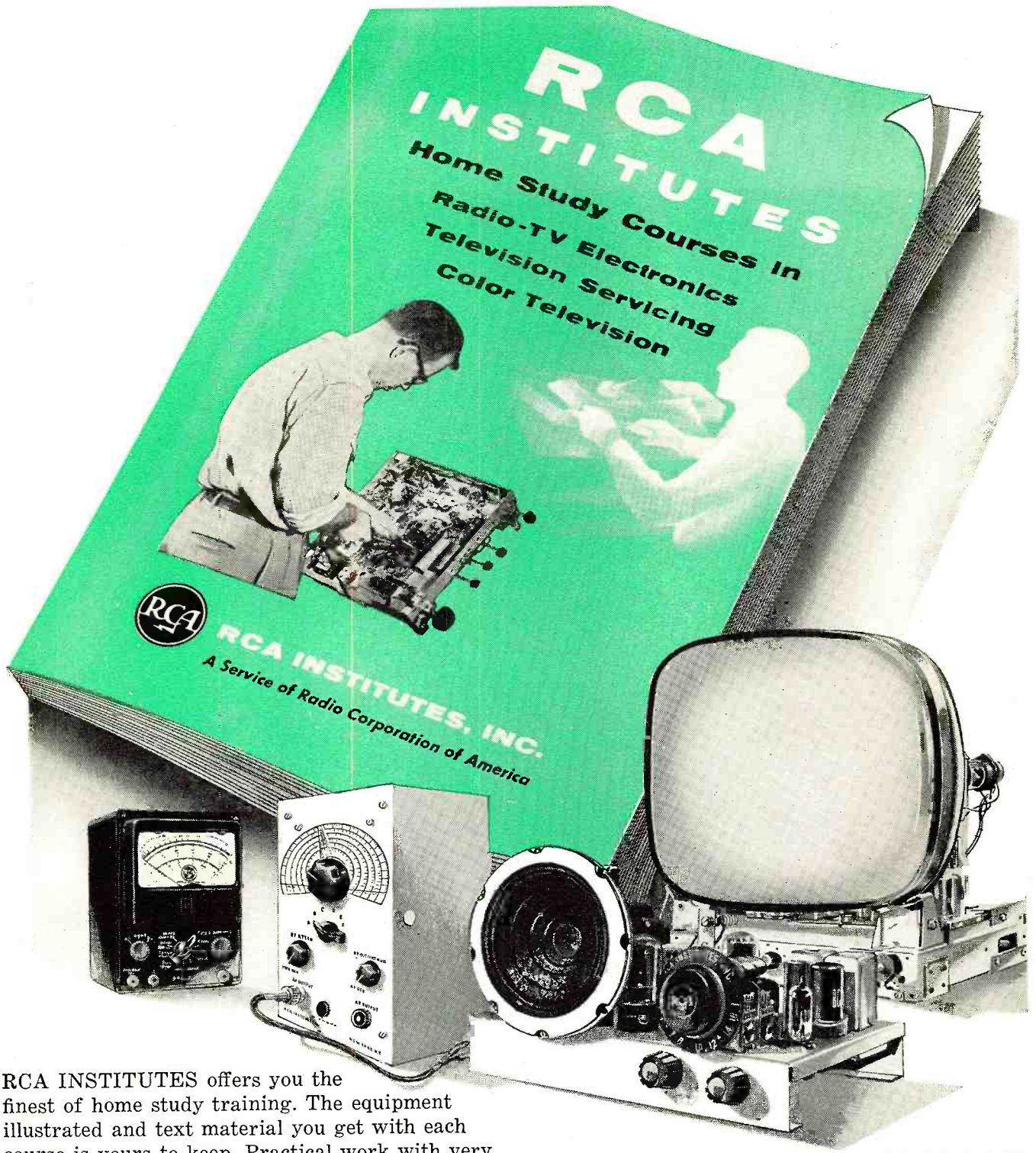

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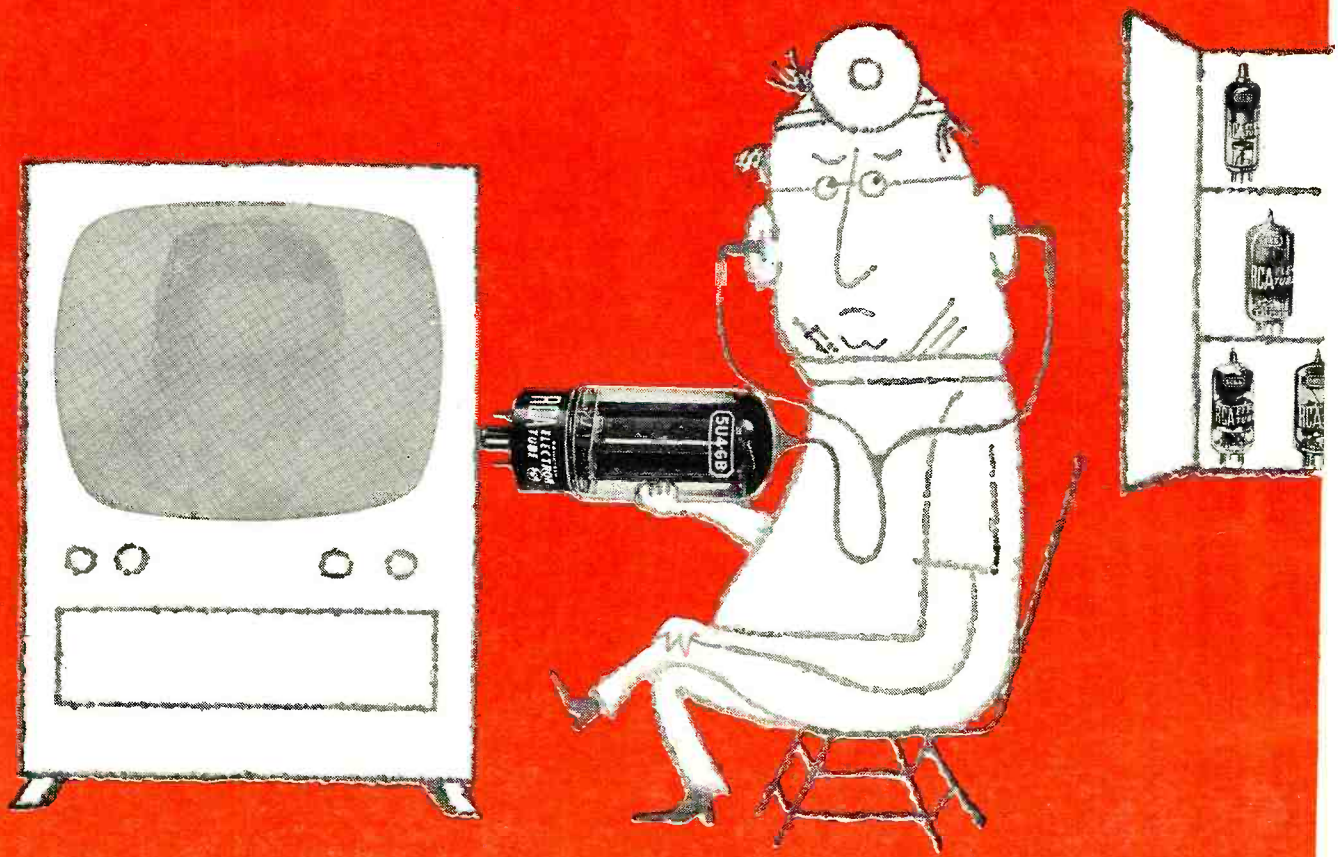
When the Diagnosis is "That WASHED-OUT Look"...



pep up the picture with RCA TUBES

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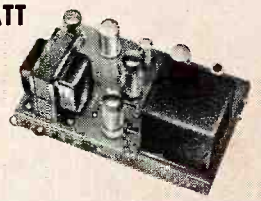
NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

with Preamplifier, Equalizer & Control Section

KIT $34.95 WIRED $57.95

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

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



HF50 KIT $57.95 WIRED $87.95

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

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

with Preamplifier, Equalizer & Control Section

KIT $69.95 WIRED $109.95

Combines a power amplifier section **essentially identical to the HF50 power amplifier** with a **preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching Cover **E-1 $4.50.**

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#HF61A KIT $24.95, WIRED $37.95

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

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

NEW

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

KIT $72.95 WIRED $99.95

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

NEW

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

KIT $49.95 WIRED $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; 2 **low-level inputs** for proper loading with **all** cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs.
Matching cover **Model E-1, $4.50.**

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

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

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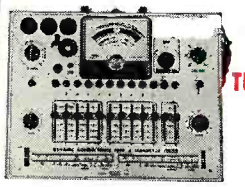
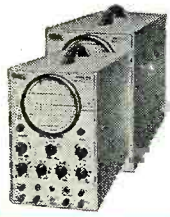


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

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



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

7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
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TUBE TESTER #625
KIT $34.95
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- tests 600 mil series string type tubes
- illuminated roll-chart

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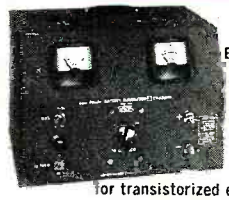
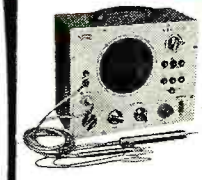


6V & 12V Battery Elim & Charger #1050:
KIT $29.95
Wired $38.95
for transistorized eqpt, #1060:
KIT $38.95, Wired $47.95



Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
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KIT 24.95
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NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

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

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

KIT $79.95 WIRED $129.50

• Features DC Amplifiers!

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

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

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

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

KIT $29.95 WIRED $49.95

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

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

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

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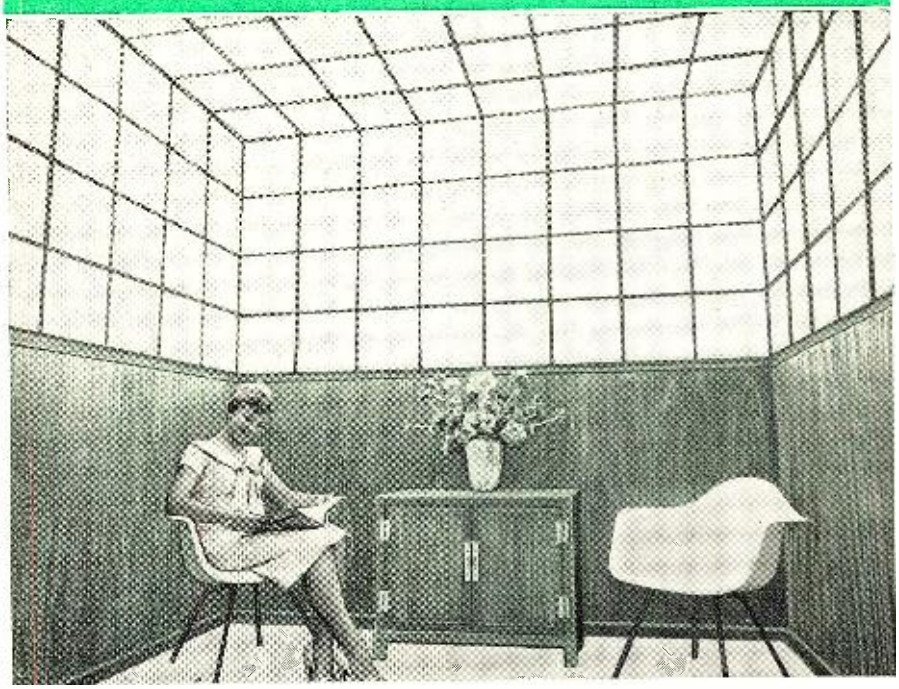
ELECTROLUMINESCENCE

-Light of the Future



Here is the world's first room with walls and ceiling made of light. Square panels are the Westinghouse "Rayescent" light sources.

By **PROF. A. V. J. MARTIN**
Carnegie Institute of Technology
Pittsburgh, Pennsylvania

Spectacular applications are in store for the next few years, perhaps even including the flat TV picture tube.

A NUMBER of solid materials, designated under the general (and improper) heading of phosphors, have the property of producing light when submitted to some kind of external excitation. They are said to be fluorescent. The oldest known way of exciting fluorescence is by means of x-rays; using a fluorescent panel, it is, of course, the basis of radioscopy.

Another way uses ultraviolet light. A number of solids fluoresce under ultraviolet excitation (black light); a very common practical application is fluorescent lamps, where the electric discharge in a tube produces ultraviolet rays; these rays hit a phosphor coating deposited on the inside surface of the tube and thereby excite its fluorescence.

A third way uses cathode rays or high speed electrons. The familiar application is the cathode-ray tube, where electrons shot by an electron gun hit the phosphor screen and produce light at the point of impact.

The fourth and newest way to produce light is to apply a strong electric field directly to the phosphor itself; it is called electroluminescence. Let it be pointed out right now that a strong electric field does not necessarily mean a high voltage; it can also be obtained with a low voltage applied over a short distance.

The theory of electroluminescence delves deeply into solid-state physics and is in its infancy. It is still a matter of widely different hypotheses and is highly controversial; at best, it may be said to be a rather hazy guess.

Fortunately, a large amount of experimental data is already available and increases rapidly, so that it may be hoped that a generally accepted and satisfying theory will be developed in the near future. Meanwhile, this absence of solid theoretical grounding does not prevent experimental exploitation of electroluminescence, and a number of interesting applications have already emerged, while some new

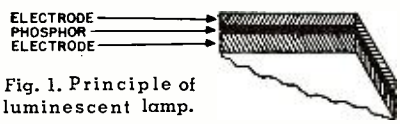


Fig. 1. Principle of luminescent lamp.

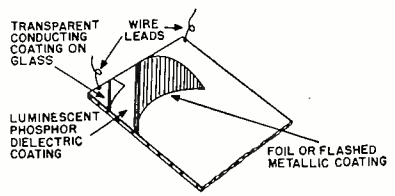
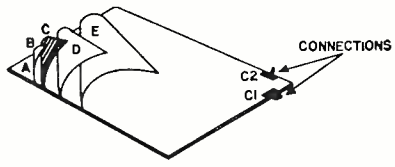


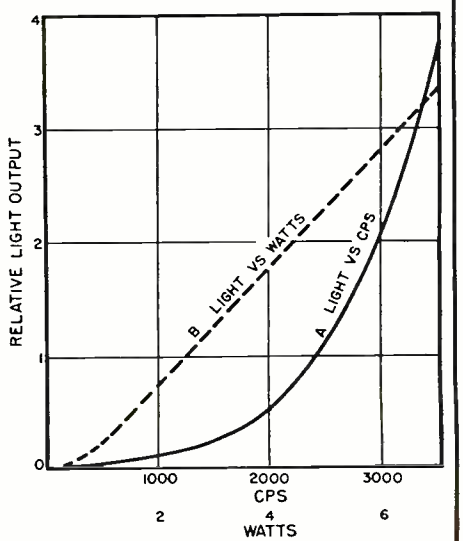
Fig. 2. Glass-backed lamp construction.

Fig. 3. Arrangement of Sylvania light.



A - STEEL BASE PLATE
B - CERAMIC DIELECTRIC
C - LUMINESCENT PHOSPHOR
D - TRANSPARENT CONDUCTING FILM
E - GLASS PROTECTIVE LAYER

Fig. 4. Graphs show the variations in the relative light output of electroluminescent lamps as the input power and the operating frequency applied are both increased.



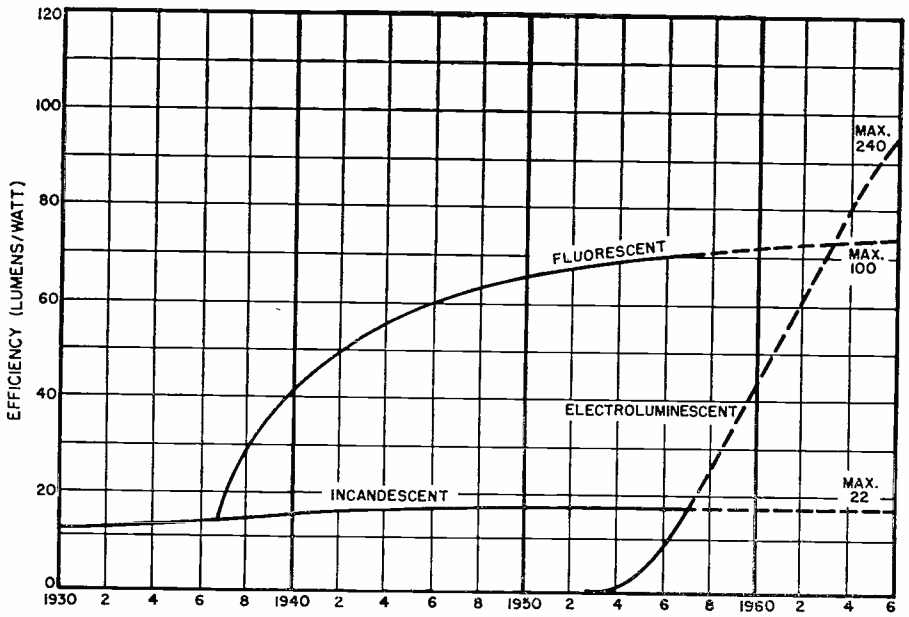


Fig. 5. Past and expected improvements in lighting efficiency of three light types.

ones may safely be predicted for the near future.

The first commercial application of electroluminescence is the production of luminous panels or "lamps." They will serve to illustrate the principles involved. Basically, such a lamp is simply (Fig. 1) a "sandwich," the luminescent phosphor being placed between two conducting plates or electrodes. This arrangement is very similar to that used in a plane capacitor, the dielectric of which would be the phosphor. In fact, the phosphor in an actual electroluminescent lamp is a powder suspended or embedded in a dielectric substance, either organic or ceramic.

When a d.c. voltage of sufficient value is applied between the two electrodes, a burst of light appears in the phosphor and dies away after a short time, thus exhibiting some remanence phenomenon. When the voltage is removed, the same effects are observed. This obviously points to the fact that the emission of light depends on the variation of applied voltage and leads directly to the use of a.c. instead of d.c.

When an a.c. voltage of sufficient value is applied to the luminescent capacitor, a burst of light occurs for each alternation of the voltage. If the a.c. frequency is high enough, the persistence of vision of the human eye makes the light emission appear to be continuous.

This is the basis for lighting applications of electroluminescence.

Construction of the Lamps

Evidently, for the light produced to be seen, at least one of the electrodes of Fig. 1 must be transparent. Several means can be used to this end. The simplest is to employ a glass plate (commercially produced by *Corning*) bearing a transparent conducting coating. Electroluminescent phosphor, suspended in a plastic binder, is then sprayed on the conducting coating. On top of this phosphor layer is placed another conducting layer, acting as the second electrode of the capacitor. A number of processes can be used to obtain that electrode, such as flashing or evaporating an aluminum film. Finally, two contacts are provided, generally through silvered areas, to allow connection to the two electrodes (Fig. 2).

This basic arrangement lends itself to a number of variations. Thus, the external conducting coating, or second electrode, can itself be transparent with the result that the lamp gives off light on both sides.

However, with such a transparent second electrode, there is no need for the glass base in the usual arrangement. It can be replaced by any conductor, such as a cheap metal, with subsequent improvements in the cost factor and ruggedness. Such a method has been adopted by *Sylvania*. Fig. 3 shows the construction of the "Panelescent" lamp. The base plate is made of vitreous enameling steel, usually 20 gauge. It serves as one electrode and provides mechanical strength and physical rigidity. A layer of solid ceramic material, similar to white porcelain, is fired onto this base sheet. Next, another layer of ceramic is applied; it contains the luminescent phosphor in suspension. Then a transparent conducting layer is applied. Finally, a protective layer of transparent glass is added to provide insulation and mechanical protection. The total thickness of all the layers applied to the metal is less than 1/50 of an inch.

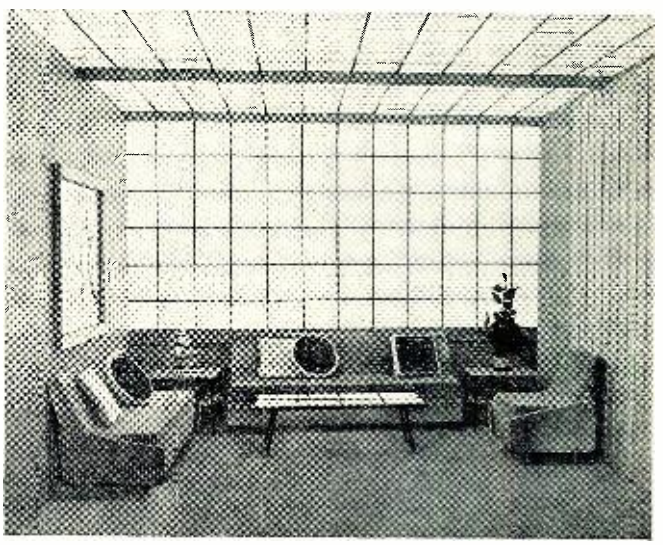
If an extra protection is necessary, the whole lamp may be embedded in clear plastic such as *Lucite* or *Plexiglas*.

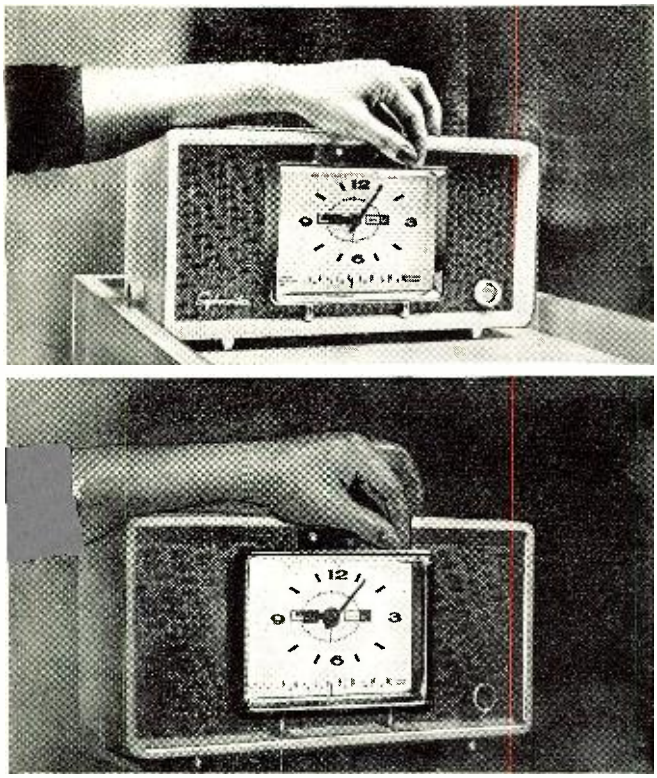
Luminous Output

The luminous output of an electroluminescent lamp increases with the applied electric field. In other words, a given lamp will have a brightness increasing with the applied voltage. This voltage is, however, limited by the breakdown of the dielectric. Thus, one of the sought-after characteristics

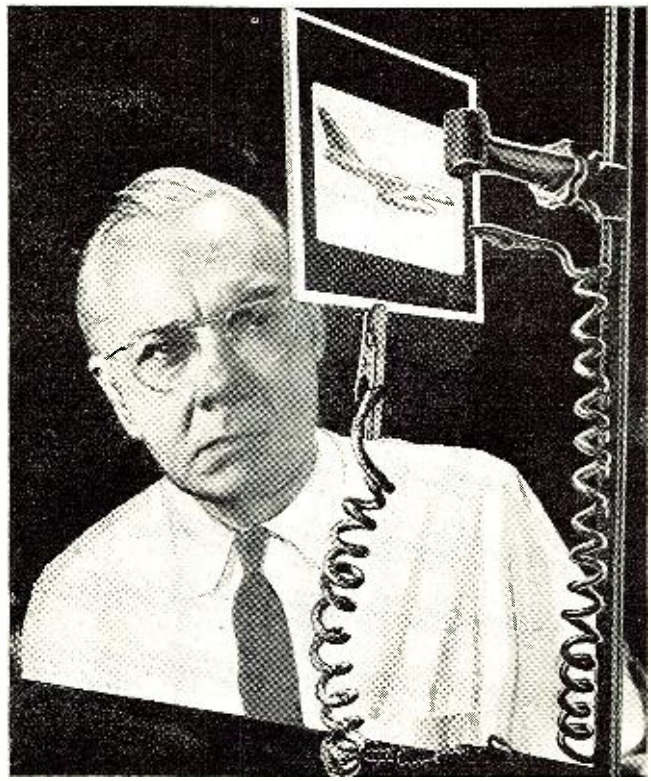
Electroluminescent coffee table changes color and brightness.

Model room has luminescent walls, ceiling, table, and mural.





A clock-radio that employs an electroluminescent lamp dial.



Electroluminescent panel, a "Sylvatron," can produce image.

of the ceramic dielectric was a high dielectric strength, the desirable minimum being on the order of 100 volts per mm. Present methods of production make for a nearly equal light output, at equal voltages, either for an organic or for a ceramic dielectric. However, the ceramic shows advantages in durability and temperature stability.

The transparent second electrode is made by spraying the heated phosphor layer with a tin salt solution. This produces a conductive tin oxide film with a light transmission factor of 80 per-cent or better.

The light output increases nearly linearly with the power consumption of the lamp. An interesting fact is that it also increases with the frequency of the applied voltage, this time very rapidly, and roughly following a parabolic law (Fig. 4). To exploit this property, however, a separate oscillator is needed to feed the lamp.

In the interests of simplicity and economy, practical lamps are designed to work off the 60-cycle power lines. In this case, typical light output is on the order of 2.5 footlamberts at 110 volts and 10 footlamberts at 220 volts. This can be compared with the roughly 40 footlamberts of a television screen or the 2000 foot lamberts of a fluorescent tube. It shows that the electroluminescent lamp is, for the time being, a practical and economical proposition only when the illumination levels are low.

But then, optimism is the keynote with *Westinghouse,* which exhibits the diagram reproduced in Fig. 5. It shows the improvements in efficiency which have been obtained for the three presently available types of lighting, namely incandescent, fluorescent, and electroluminescent.

Incandescent lighting exhibits a very slow rise towards a practical maximum of 22 lumens per watt.

Fluorescent lighting is presently far superior but further radical improvements are barred, the maximum expected efficiency reaching 100 lumens per watt.

Electroluminescent lighting is an entirely different proposition. While the present efficiency is only 10 lumens per watt, no theoretical reason limits the maximum before 240 lumens per watt, which is four times the present efficiency of fluorescent lighting!

Long before this figure is actually reached, electroluminescent lighting will have established itself on the market and probably replaced a good part of the older fixtures. The service technician will then find himself faced with rugged and practically unbreakable panels instead of the fragile bulbs and tubes of today. Brightness in excess of 2000 footlamberts has been exceeded in electroluminescence laboratory experiments. That is, the electroluminescent panel has already gone beyond the surface brightness of a typical fluorescent tube. The high theoretical efficiency of electroluminescence is due to the fact that electric energy is directly transformed into light. In the fluorescent tube, the efficiency of the discharge used is on the order of 50 per-cent only, and there is another loss of 50 per-cent in converting ultraviolet light into visible light. In the incandescent bulb, electric energy is transformed into heat to bring a filament to incandescence. The efficiency increases at high temperatures, but unfortunately the life then decreases, because the filament is operated near its melting point.

It must be added that the panel has the very practical advantage of being an area type of light source, whereas the fluorescent tube is linear and the incandescent bulb is practically a point source. This means that for the same level of general illumination in a room a bulb will be extremely bright, a tube will be bright, and a panel will be softly lighted.

Practical Life and Installation

Basically, the electroluminescent lamp is a capacitor and hence a rugged element, electrically and mechanically. As with capacitors, the most likely cause of failure would be a breakdown of the dielectric under excessive voltage. The resulting "puncture" tends to be self-healing and leaves a black spot on the luminescent surface. Repeated breakdown will reduce the useful light emitting area and bring the light output below a satisfactory minimum. This, however, should never happen if the lamp is operated at its standard rating or even with a reasonable amount of overvoltage. Under these conditions, the useful life is thought to be on the order of 25,000 to 40,000 hours of continuous operation, which constitutes an outstanding performance when compared to the other lighting processes.

The variation of light output with burning time is given by the curve of Fig. 6 for the *Sylvania* lamps. The initial light output has been taken as 100 per-cent reference point. It will be

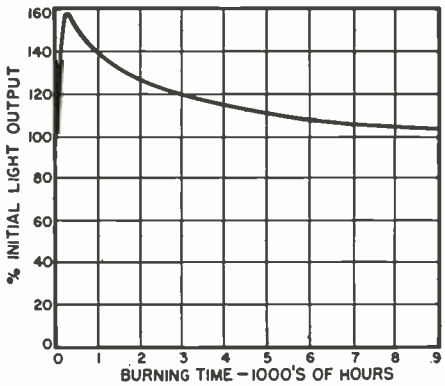


Fig. 6. Variation of light with time.

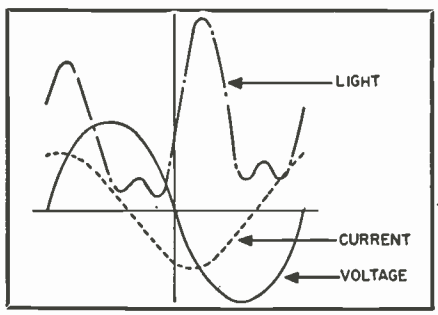


Fig. 7. E, I, and light for one cycle.

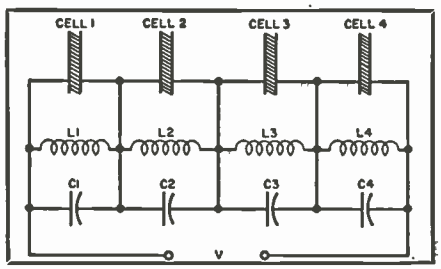


Fig. 8. Color shift multiple cell setup.

noted that the curve exhibits a marked rise of 60 per-cent during the first few hundred hours. Then the light output tails off gradually towards 100 per-cent after approximately 10,000 hours burning time.

"Panelescent"

Commercially, "Panelescent" lamps are available for 120, 220, and 600 volt operation. They operate satisfactorily on any a.c. supply with a minimum frequency of 25 cps; in particular, they can be connected to the 60 cps supply. A current limiting device, such as a simple resistor, should be inserted in series with the lamp to damp out any unwanted transients. The curves of voltage, current, and light output for operation at 60 cycles are given in Fig. 7. The burst of light is seen to occur for each alternation and is in-phase with the power absorbed by the dielectric. The phase between current and voltage is 80 degrees leading, and the luminescent capacitor has a 10 per-cent leading power factor. Below 120 volts, the current per square inch of lamp is then 0.1 milliampere, which corresponds to a wattage of 1.2 milliwatts per square inch. The total wattage is proportional to the area of the lamp, being, for example, 120 milliwatts for a 100-square-inch lamp.

The light output does not vary more than 10 per-cent for temperatures between 32° and 175° F.

Color and Frequency

Any type of phosphor can be employed, so that any color can be obtained. Practically, green, blue, and yellow are used on 60 cps and can be mixed to produce any intermediate shade, including white.

When the frequency of the applied voltage is increased, the light output increases, and there is a shift in color. With certain phosphors, this shift is very marked, and the same lamp will be, for example, green at 60 cps, and blue at 10,000 cps. Notice that an increase in exciting frequency shifts the light towards shorter wavelengths, *i. e.,* higher frequencies.

Red phosphor seems to be more difficult to excite and needs frequencies on the order of 10,000 cps.

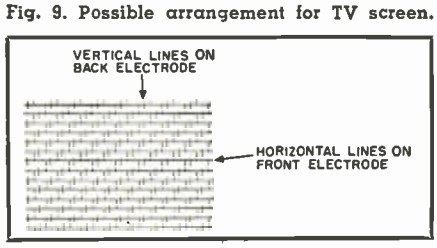
This dependency of color on exciting frequency opens up interesting possibilities. For example, four transparent electroluminescent cells can be stacked together one behind the other and connected through resonant circuits as indicated in Fig. 8. When one varies the frequency of the applied voltage, the color of the multiple cell changes. For example, at 8000 cps circuit L_1-C_1 is resonant and the voltage is applied across cell 1, which produces blue light. At 10,000 cps, circuit L_2-C_2 is resonant and cell 2 is excited and produces green. At 13,000 cps, circuit L_3-C_3 is resonant and cell 3 is excited and produces yellow. At 18,000 cps, circuit L_4-C_4 is resonant and cell 4 is excited and produces red.

Applications

The applications of electroluminescence to lighting, advertising, decoration, or information are evident and are, in fact, already being exploited.

More exciting are eventual possibilities, especially in the field of television. It seems that the luminescent panel could provide the answer to that long-sought goal, the flat TV screen with high brilliance. One immediate idea, although by no means the only or even the best one, would be to replace the continuous electrodes by a number of parallel lines, vertical on one electrode and horizontal on the other electrode. These lines can be made of transparent metalizing (Fig. 9). The vertical lines are switched on at point frequency rate and the horizontal lines are switched on at line frequency rate. The crossing point of the vertical and horizontal line switched on luminesces according to the applied voltage, which is the instantaneous video signal corresponding to that point. The switching makes the luminescent point scan the screen. Some parasitic effects occur; for example, points adjoining the illuminated point are capacitively coupled to the signal and receive 1/9th of the voltage, giving rise to a spurious kind of halo around the wanted point. This can be avoided by the use of suitable cancelling voltages of opposite polarities, or more simply by keeping the level of the spurious light below the threshold of annoyance.

Fig. 9. Possible arrangement for TV screen.



The switching is the difficult part of the idea. Even that can be solved by conventional means, using electronic delay, phase-, or beam-switching. Notice, incidentally, that the linearity of the panel scanning would be perfect for all practical purposes.

The next step, to color TV, does not seem to be a difficult one to make in view of what has been previously said about different phosphors and also the dependency of color on exciting frequency. Simultaneous systems can be solved at once by the brute force method, using several stacked transparent panels, one for each color. The registration of colors would be easy as far as the electroluminescent screens are concerned. Off-axis misregistration effects could be minimized by using thin panels.

Use of a single electroluminescent cell of color varying with exciting frequency would eliminate all registration problems. However, in view of the fact that the exciting frequencies now in use lie in the audio range, the switching of color would have to be done at a low rate.

The transition to three-dimensional TV does not seem to difficult either, since the stacking of a number of transparent cells readily provides the required third dimension. Simultaneous display of pictures corresponding to different depths can be resorted to. More economically and less simply, some kind of depth scanning and switching could probably be used.

Finally, "3D" and color TV can be combined to give the ultimate in entertainment value. Admittedly a "blue sky" or, at most, an advanced laboratory project presently, such a system might well be with us much sooner than most people think. But the entertainment field is not the only one where such possibilities can be exploited. In all probability, they will be first used in professional or military applications. To give an example, "3D"-radar is just behind the door (the same door probably bearing a large red sign: *TOP SECRET*) and color-radar for identification or coding purposes has already been openly discussed. In the same fashion, "3D" and color oscilloscopes can and will be developed.

The author wishes to thank *Sylvania* and *Westinghouse* for the data and illustrations on which this article was based.

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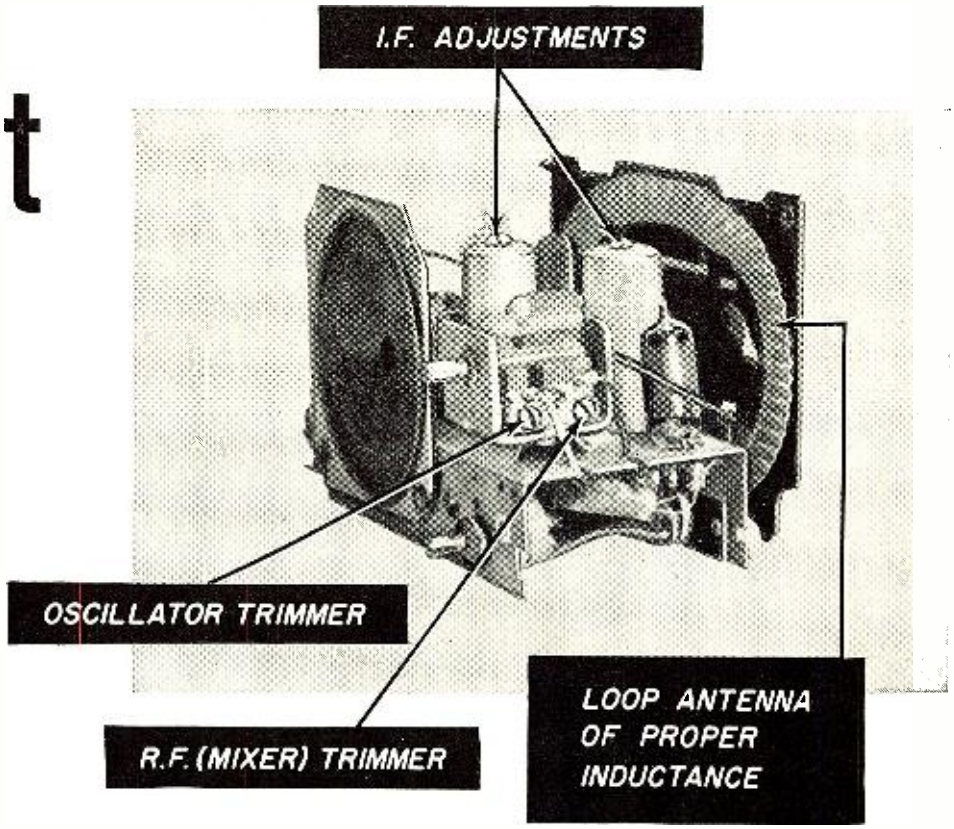
Alignment of Midget Radios



By J. RICHARD JOHNSON

Rapid, simple techniques produce "miracles" for small-set owners and profits for technicians.

THERE ARE many small, table-model radio receivers that are just waiting for a good alignment job to restore them to satisfactory operation. The owners usually don't realize how easily they can be fixed. In such receivers, alignment follows a set pattern. By featuring "overhaul" or "rejuvenation," the technician can build up a profitable adjunct to his ordinary run of TV and radio servicing. Let's review the highlights of alignment problems in "midget" sets.

Some symptoms of poor alignment are not much different from symptoms of other receiver defects; but, in most cases, you develop a "feel" for misalignment troubles and can smoke them out in short order. A receiver has to be severely misaligned to stop working altogether. Ordinarily the set works, but is subject to weak reception, interference effects, or incorrect dial readings. Table 1 shows the most common symptoms of misalignment. Of course, you will run across a few cases in which someone has "played" with the adjustments and there's no reception at all.

I.F. Alignment

The i.f. amplifier should be checked first because, if it isn't right, the other sections are harder to check. Usually there are two i.f. transformers ("coils") and each has two adjustments: primary and secondary. Whether the adjustment is a trimmer capacitor or an iron-core slug doesn't make any difference. In either case they must all be lined up on "the nose"; that is, you tune them for maximum output.

The conventional method is to use a signal generator which tunes to the i.f. (with modulation). Don't worry about fancy coupling to the i.f. amplifier. In most cases you can just lay the signal generator leads near the set, or connect them to the receiver's loop antenna and still get plenty of input. Some technicians like to use a separate loop antenna connected to the signal generator, which they couple to the receiver's loop. If the set has an i.f. trap, you may have to couple the i.f. signal through a capacitor to the grid of the mixer or the i.f. amplifier.

EDITOR'S NOTE: *If we may invert an old adage, many of us have difficulty seeing the trees for the forest. TV receivers have pre-empted the attention of the service technician to such an extent that he sometimes forgets that there are other trees in the forest—like ordinary AM receivers. Yet the latter continue to outsell and outnumber TV sets. With so many members of the service industry looking for that extra margin of business that will assure stability, we hope that articles like the one on this page will revive interest in the neglected broadcast receiver.*

If you use too much signal, you get into trouble with a.v.c. and can't get reliable output indications. In fact, it's best if you can just hear signal from the speaker with volume up at the start. Then it's easy to make each i.f. adjustment for maximum signal. You can use the attenuator on the signal generator to adjust amplitude as necessary, or you can vary the coupling to the receiver instead.

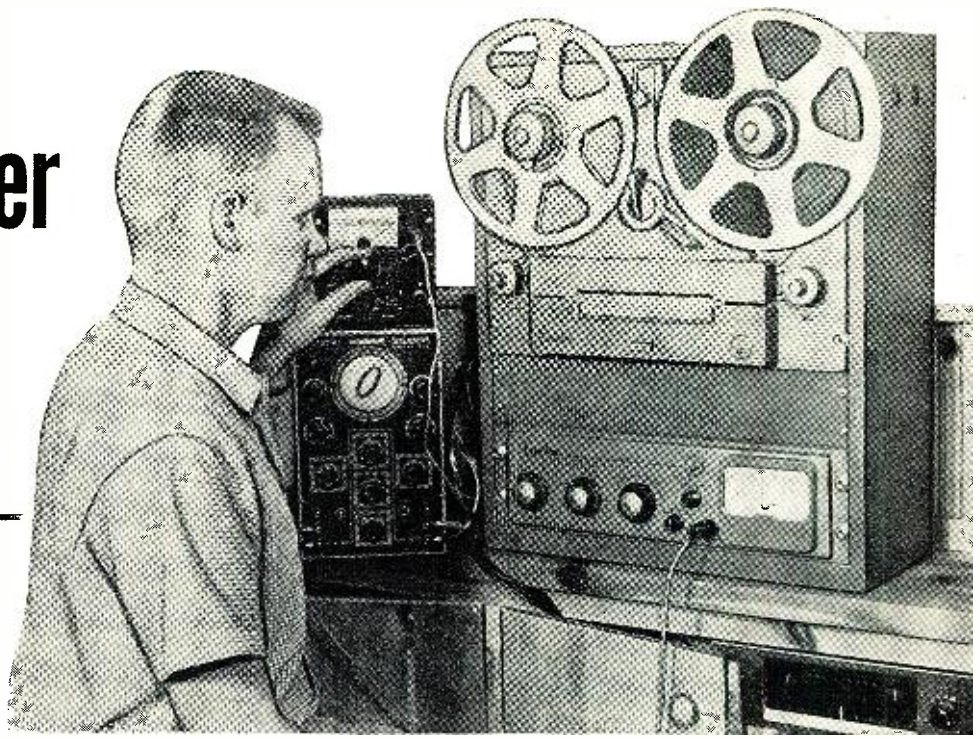
The frequency of the i.f. signal should be close to rated value, otherwise you can't get good tracking. If you're used to your own signal generator, you probably know how well it's calibrated. Otherwise you can check it by beating a harmonic of the intermediate frequency against a broadcast station signal. Use another receiver if necessary—however, as long as you know the transmitted frequency of the station you're beating against, it doesn't really make any difference whether the receiver is aligned or not for this test. For example, if you re-

(*Continued on page* 168)

Table 1. Most common symptoms of misalignment and where to look first for each.

TROUBLE	CAUSE
Dial readings incorrect or inconsistent	Misalignment of oscillator
Whistles on all stations	Misalignment of r.f. or i.f. stages
Weak reception	Misalignment of r.f. or i.f. stages; weak tube, poor antenna
Sensitivity varies too much over frequency range	Poor tracking
Interference from off-channel signals	General poor alignment

Measuring Tape Recorder Wow and Flutter



A typical equipment setup for the wow and flutter measurements described here.

By
RICHARD GRAHAM

Simple method checks changes in recorded pitch by means of an oscilloscope and audio generator.

JUST how bad is the wow and flutter in your tape recorder? Probably ninety-nine out of a hundred of us couldn't answer this question, except to refer to the manufacturer's original claim for the machine. At the moment, this figure can probably serve only as the low limit for the wow and flutter figure for your machine. The fact of the matter is that it probably is worse now than when the machine was factory fresh. This is only natural. Everything, including ourselves, wears out or needs an occasional adjustment. But the important thing here is that if you have or can borrow an oscilloscope and an audio signal generator, then you can determine the wow and flutter figure of your tape recorder.

Naturally, the method to be described isn't quite as convenient as using a commercially built wow meter but, on the other hand, wow and flutter measurements aren't taken every day, so a little inconvenience can be tolerated. The only other alternative is to take your machine to a repair shop having a wow meter, for which a fee can be justly charged.

The wow and flutter figure represents a good "figure of merit" of the mechanical condition of your machine. It will readily indicate any dirt or flats on the driving capstan, any looseness in driving belts or capstan tension. Similarly, any varying drag in the take-up or spooling motors will be reflected in a poor reading.

This speed variation can usually be corrected by cleaning the vital parts or an adjustment. However these speed variations, which result in wow and flutter, can increase in magnitude so slowly, that the increasing wow is not obvious. When it does become obvious it will really be bad.

Wow and flutter are two words used to describe the same effect. Basically it is a frequency deviation (as compared to the original recorded frequency) expressed as a percentage of the original recorded frequency. In other words wow is:

$$\text{Per-cent wow \& flutter} = \frac{100 \times \text{freq. deviation of a recorded tone}}{\text{Average recorded frequency}}$$

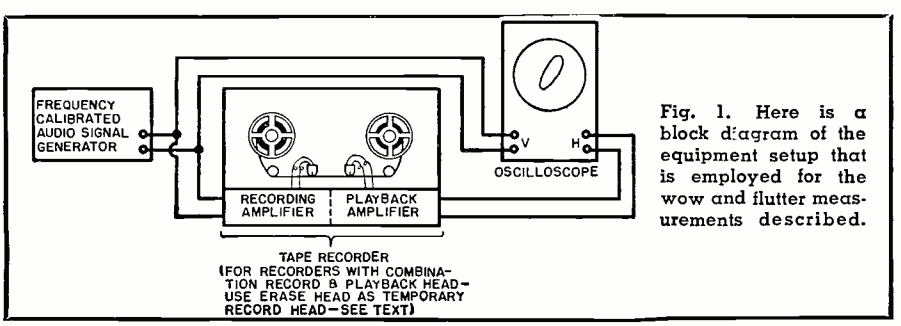


Fig. 1. Here is a block diagram of the equipment setup that is employed for the wow and flutter measurements described.

These frequency variations are quite obvious, too—even in the best recorders—including those with a price tag of around $1000. For doubters, it's only necessary to record a 1000 or 2000 cps note from an audio signal generator and immediately compare the signal from the signal generator with that from the recorded signal on tape. It will be pretty obvious during a listening *A-B* test that the frequency being played back has some wiggles that the original didn't have.

While wow and flutter have the same effect in a recorder, they are defined somewhat differently. In general, wow is a frequency deviation which occurs at a rate of .1 to 20 cps, while flutter is at a rate of 20 to 200 cps. In tape recorder performance characteristic data, they are classified together with no differentiation between them.

The method of wow and flutter measurement to be described is based on the fact that in a machine with wow (practically all of them) there is a frequency difference between the signal being recorded and the signal being simultaneously played back. See block diagram of Fig. 1. This method infers, then, that the machine must have separate playback and recording heads. This is only partially true. Separate playback and record heads are required, but since waveform is not important in this test, the erase head can be made to serve as the recording head for the purposes of this test. This will be the case in the majority of recorders since only some home-type and professional machines feature separate recording and playback heads.

To make the check, simply disconnect at least one lead from the erase head in the recorder and connect the audio signal generator across the two

erase-head terminals. For the remainder of the discussion, the erase head will be considered the recording head. The oscilloscope waveforms to be observed later will be somewhat distorted when using the erase head as the recording head because of the lack of high-frequency bias, but the distorted waveshapes do not have any effect on the test or its accuracy.

Now suppose we proceed to record a 750 cps tone from the audio signal generator shown in Fig. 1. If the tape speed is 7.5 inches per second, then each inch of recorded tape will have 100 cycles recorded on it. For the purposes of our discussion, let us suppose the record head and the playback head are two inches apart. Then if we were recording the 750 cycle tone, as before, at 7.5 ips, then the tape between the two heads will have exactly 200 cycles recorded on it.

Now let's turn our attention to the scope pattern which can be observed as the audio signal is being recorded. Fig. 1 shows that the signal being recorded is also applied to the vertical amplifier of the oscilloscope while the output of the recorder from the playback head is applied to the horizontal amplifiers of the oscilloscope. This pattern will be a familiar Lissajous pattern illustrating a phase shift of anywhere between 0 and 180 degrees. Fig. 2 illustrates the typical patterns which might be observed. The pattern you will get in this hypothetical tape recorder will depend on the frequency being recorded and the distance between heads. At low frequencies this pattern will be essentially stationary. Now as the frequency is increased, a characteristic of the waveform will be noted which is the basis of the wow test. The pattern will "rock" back and forth, in other words, the phase of the signal being recorded is not remaining the same as the signal being played back. This phase change actually indicates an instantaneous frequency change between the input and output. For example, a shifting phase shift pattern of 90 degrees means that there is, at times, one-quarter cycle more actually recorded on the tape between the heads as compared to the average number of cycles.

Now let's get back to the performance of our hypothetical tape recorder. Suppose at the recorded frequency of 750 cps, the pattern observed on the oscilloscope rocked from a sloped line in one direction, to a circle, then to a closed line in the other direction, and then back again. This would mean that a total phase change of 180 degrees has occurred between the input and output signals. Since there are 360 degrees in one cycle, this would mean that there is 180/360 or ½ cycle difference between the average number of cycles recorded on the tape between the heads and the maximum and minimum number of cycles recorded in the same distance, due to tape speed variations. This statement should be studied a bit if you wish

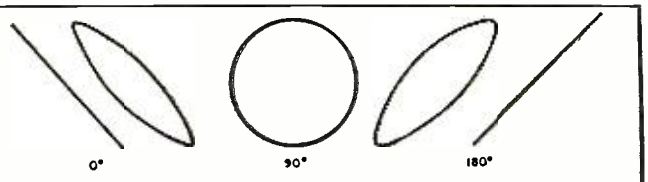


Fig. 2. Typical patterns to be expected with the setup of Fig. 1. Patterns will be stationary at low frequency, but will shift as generator frequency is raised.

to catch the real meaning of what you are doing when you perform this test. Since our hypothetical tape recorder had 200 cycles of the 750 cycle tone recorded on the two inches of tape between the heads, it follows that our tape speed variation was ½ cycle out of 200 or .25%. This is about par for most tape recorders. Expressed as a formula, this becomes . . .

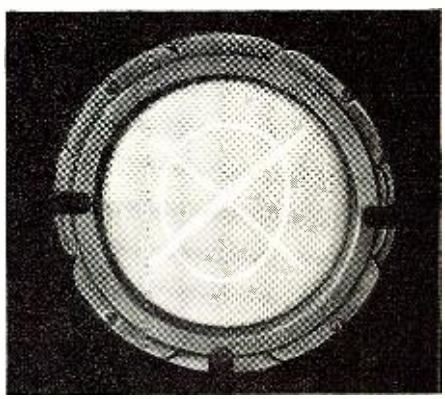
$$\text{Per-cent wow} = \frac{100 \times \text{Tape speed, ips}}{2 \times \text{recorded freq.} \times \text{distance, inches, between heads}}$$

This formula is valid only when the pattern "rocks" as described previously and it gives the total wow and flutter present in the machine. Many recorder manufacturers prefer to give the r.m.s. wow figures for their machines, which is simply the total wow figure just calculated multiplied by .707.

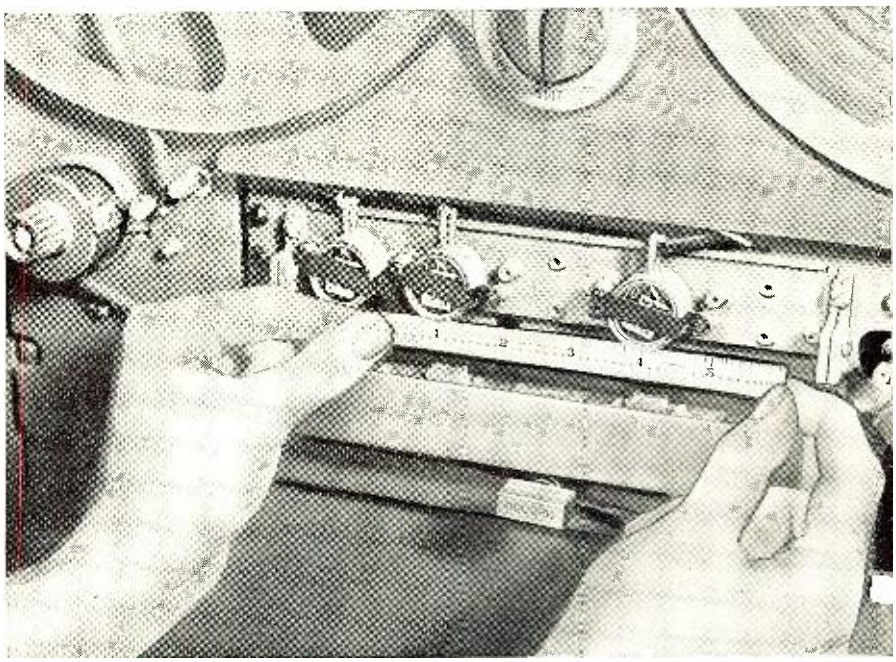
When making the test be sure to observe the rocking action carefully. Failure to observe the occasional, but sudden, change will result in a very pleasant but untrue wow figure. Commercial wow meters integrate or sum up these occasional wows and indicate their presence on a meter. We must do this visually. However the method is so basic, that it can't fail to give accurate results if the test is performed with reasonable care.

Of course, the accuracy of the test depends on the accuracy of the numbers used in the formula, which depends on the accuracy of the measurement of the distance between the recording and playback heads. The results also depend on the accuracy of the calibration of the audio oscillator. The amount of error in these measurements will be reflected directly as an error in the wow and flutter figure just determined. —30—

A triple exposure of the scope during a wow measurement. The audio signal generator was stopped when a circle pattern was formed. The circle shifted plus and minus 90 degrees to form the two lines as shown. This audio generator frequency was noted and used in the wow formula.

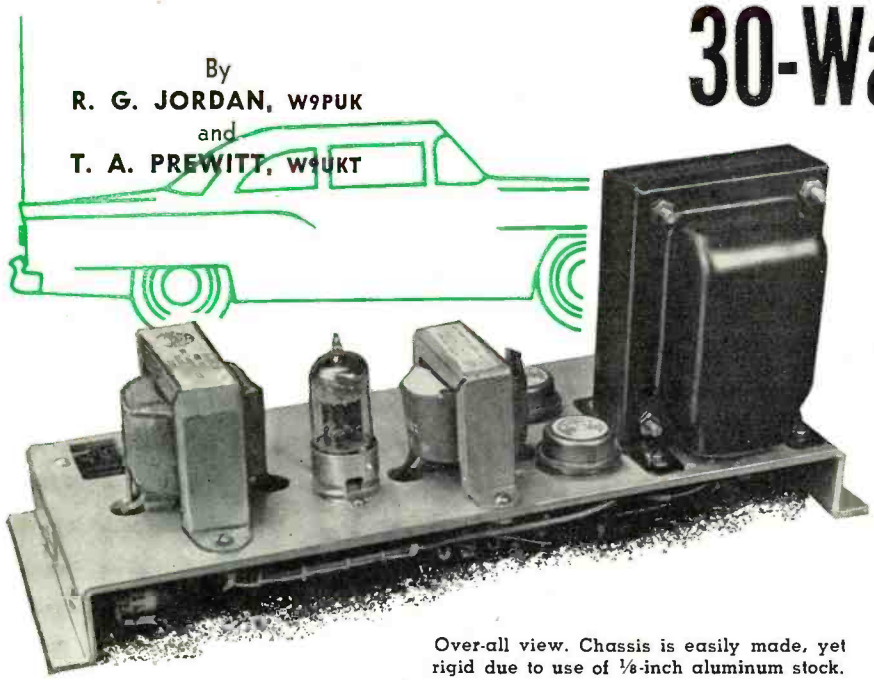


Measuring the exact distance between the record head and the playback head. An accurate measurement should be made between the gaps in the heads. Any error in the measurement will show up as error of similar magnitude in result obtained.

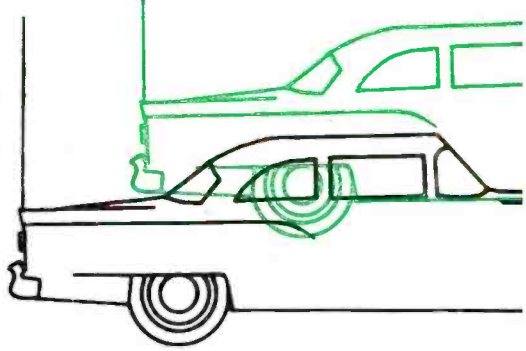


30-Watt Transistor Mobile Modulator

By
R. G. JORDAN, W9PUK
and
T. A. PREWITT, W9UKT



Over-all view. Chassis is easily made, yet rigid due to use of ⅛-inch aluminum stock.



Simple, well designed hybrid circuit of proven performance fully modulates 60-watt mobile rig.

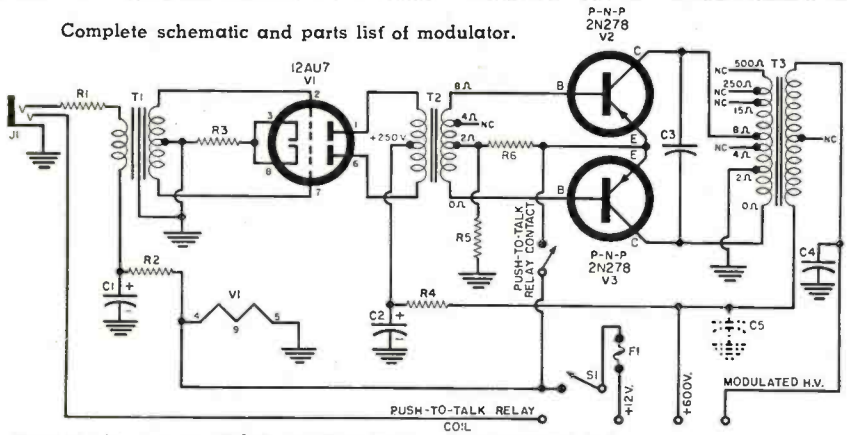
NOW that high-power audio transistors which will deliver more than thirty watts of audio power when operated in class B, push-pull are available, a transistor modulator may be made which is capable of fully modulating the largest transmitters commonly used in amateur mobile service. There are several advantages to such a modulator. In contrast to its vacuum-tube counterpart, it is far more economical of battery power, more dependable and rugged, and its ability to work directly from a 12-volt storage battery allows the use of a smaller vibrator pack or dynamotor to power the r.f. section of the transmitter. Alternatively, an existing power supply may be used to operate the transmitter at a higher plate input.

The saving in total battery drain is easily seen when the primary power requirements of the transistor output stage are compared with the requirements of a pair of 6L6 tubes, to which the transistors are equivalent in modulator service. When idling, as between words and syllables, the 6L6 tubes and their power supply will draw six amperes from the car battery, while a pair of power transistors will draw only ¼ ampere. At a power output of thirty watts, the tubes require 10.3 amperes; the transistors less than 4 amperes. This substantial saving may be accounted for by the fact that the transistors consume no heater power, neither do they require an inefficient power supply.

The modulator described in this article was built by W9UKT for use with the r.f. unit of a *Palco* "Bantam 65" transmitter. To match the 6146 final in the *Palco,* it was designed to deliver an audio output of thirty watts into a 5500-ohm load. With a different modulation transformer (see parts list) it will work into a load impedance of 6500 ohms for use with either an 807 or 1625 final. A similar modulator, which has been in use for several months in a 65-watt transmitter of W9PUK's design, has logged over 400 contacts to date. The unit as described here may be used only in cars having 12-volt electrical systems in which the negative battery terminal is grounded, which includes nearly all American-made models except a few produced by *American Motors.*

Although by now most hams have built one or more of the many useful pieces of equipment which may be made from r.f. and low-power a.f. transistors for use around the shack, few applications for power transistors in amateur work have so far appeared, and a word about their unique characteristics and the precautions to be observed in their use is appropriate here. The *Delco Radio* type 2N278 power transistors used in this modulator are germanium *p-n-p* units, intended for operation from a nominal 12-volt d.c. source. Being much smaller than vacuum tubes of equivalent power handling capability, yet at the same time less tolerant of temperature rise, they require special precautions in regard to cooling. A

Complete schematic and parts list of modulator.

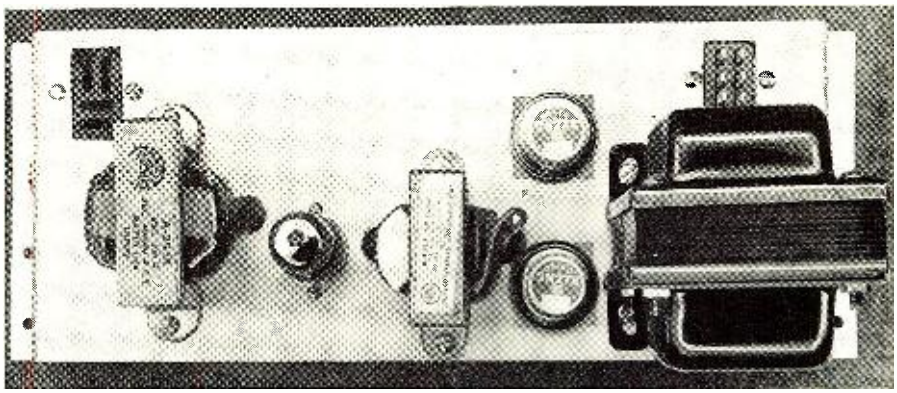


R1—330 ohm, 1 w. res. ("Gain Adj.," see text)
R2—470 ohm, 2 w. res.
R3—470 ohm, 1 w. res.
R4—20,000 ohm, 10 w. res.
R5—120 ohm, 2 w. res.
R6—1 ohm, 1 w. res.
C1—100 μfd., 15 v. elec. capacitor
C2—20 μfd., 500 v. elec. capacitor
C3—2 μfd., 100 v. paper capacitor
C4—500 μμfd., 2000 v. mica capacitor
C5—10 μfd., 600 v. elec. capacitor (not needed if transmitter is powered from dynamotor supply
S1—S.p.s.t. heavy duty switch
J1—Two-circuit jack
F1—5 amp. fuse
T1—Mic. trans., single-button microphone to push-pull grids (Merit A-2918)
T2—Driver trans., 10,000 ohms c.t. to 2, 4, 8 ohms (Stancor A-3831)
T3—Mod. trans. 5000 ohms c.t. to 2, 4, 8 ohms (Stancor TA-17, see text; Merit A-3131; or Merit A-3130, to match 807 or 1625)
V1—12AU7 tube
V2, V3—"p-n-p" high power audio transistor (Delco Radio 2N278. Available from local Delco distributors. Specify part #1221071 to obtain matched pair with mounting hardware)

vacuum tube, which can operate safely at higher temperatures, is cooled by radiation and convection from its much larger envelope; the power transistor, on the other hand, must be cooled by conduction into a large metallic surface called a heat sink which, in turn, is cooled by convection and radiation. Unlike small hearing-aid type transistors, which have insulated cases, a power transistor is constructed with the collector element at case potential to facilitate heat transfer to the mounting flange, which is machined smooth to provide a close fit with the surface of the heat sink. When used in other than a grounded-collector circuit, a power transistor must be insulated electrically from the heat sink, as will be explained later. Under no circumstances should a power transistor be operated at full power input unless it is firmly attached to a heat sink.

The modulator consists of two stages, a 12AU7 push-pull driver, followed by push-pull class B 2N278 transistors. Intended for use with a single-button carbon microphone, the modulator has ample gain and power output to modulate a 60-watt r.f. carrier 100 per-cent. The 12AU7 tube, which is operated from the same plate voltage supply used for the r.f. amplifier, at first seems out of place in a transistor modulator; however, its use here is desirable because suitable coupling transformers for it are more easily obtained than those required for a transistor driver stage. Perhaps more important, the tube, which requires the same warm-up time as the final r.f. amplifier, provides valuable protection by preventing the instant-heating transistor output stage from being operated without load either during the first few seconds after the transmitter is turned on, or in the event of a failure of the high-voltage power supply during operation. The output stage is operated class B for maximum efficiency, minimum battery drain, and minimum transistor heating. The slightly higher low-level distortion of a class B stage is of little consequence in this application since a modulator is always operated near its rated power output level.

In the circuit shown, the transistor stage has a power gain of 27 db, so a net driving power of 70 milliwatts is required for 30 watts of output. This level of driving power, plus losses in the coupling circuit, is well within the capability of the 12AU7, which is operated push-pull in class A for low distortion. The magnetizing effect of the 12AU7 plate current is canceled in the center-tapped primary winding of the driver transformer. To minimize distortion in the transistor stage, the driver transformer is matched to provide a low value of source impedance. A small amount of forward bias is used to increase the gain of the class B transistor stage and to minimize crossover distortion in the region near 0 and 180 electrical degrees in the operating cycle. Emitter stabilizing



Top view of modulator. Note square mica insulators used beneath transistors.

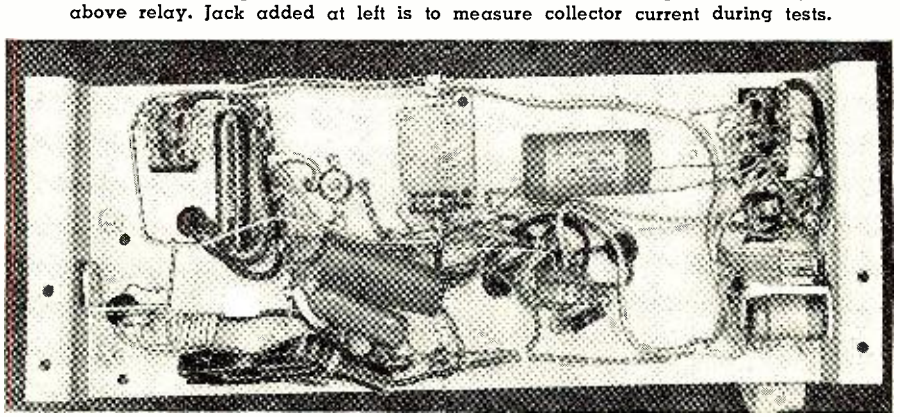
resistors, which are necessary in class A power transistor circuits to prevent thermal runaway under conditions of high ambient temperature, were omitted from this modulator in the interest of greater power output after a test had shown that the 50 square-inch heat sink provided adequate cooling. The operating condition considered most severe from the standpoint of transistor heating results from leaving the car in which the modulator is mounted standing in the mid-day sun for several hours, then commencing operation of the transmitter immediately upon entering the car. This was simulated in the test by heating the modulator in an oven to a temperature of +160° F., then carrying it to the car, where it was plugged in immediately and operated continuously for ten minutes at rated power output with no indication of overheating or instability.

If the modulator is to deliver the desired amount of output power, it must be matched carefully to its load. Since the highest peak-to-peak voltage which can be developed across the primary of the modulation transformer is limited to a value somewhat less than four times the battery supply voltage, the maximum output power of the modulator becomes an inverse function of its collector-to-collector load impedance. When operated in the car with the engine running and the generator delivering 14.4 volts, the modulator will furnish slightly over thirty watts of audio power if matched to an 8-ohm load. This value of impedance may be obtained easily by using as a modulation transformer a heavy-duty public-address output transformer which has secondary taps at 0, 2, and 8 ohms, and a primary impedance equal to the load impedance of the modulated stage. The 2-ohm tap is connected as a primary center-tap, and the 0- and 8-ohm taps, which are electrically symmetrical with respect to the 2-ohm tap, are connected to the collectors of the two transistors. When the high-impedance transformer winding, here used as a secondary, is terminated in its rated impedance, the transistors will work into a balanced 8-ohm load. The transformer used is a *Merit* A-3131, which was selected as most suitable for this application after an extensive search through all the available transformer catalogues. The *Merit* A-3130 should be used for a better match if an 807 or 1625 is used in the modulated stage.

The modulator is constructed on a ⅛-inch thick aluminum chassis measuring 4½x11 inches, which provides more room than actually needed for mounting the parts. However, the additional chassis area is desirable because it improves transistor cooling, and although the shape of the chassis may be changed at the will of the constructor, its total area should not be reduced unless cooling fins are added. When drilling the mounting holes for the transistors, care should be taken to ensure that all burrs are removed and the surfaces on which the transistors will mount are clean,

(*Continued on page* 144)

Bottom view. Relay at right is part of the control circuit. Microphone jack is just above relay. Jack added at left is to measure collector current during tests.



Taming Tough Dogs

By **HAL ROSEN**

Two technicians recall some memorable cases and discuss the lessons these puzzlers taught them.

THE YOUNG man entered the store and walked familiarly around the counter toward the rear, where the service department was located. He saw Ed, the owner, seated at one of the benches and walked over to him.

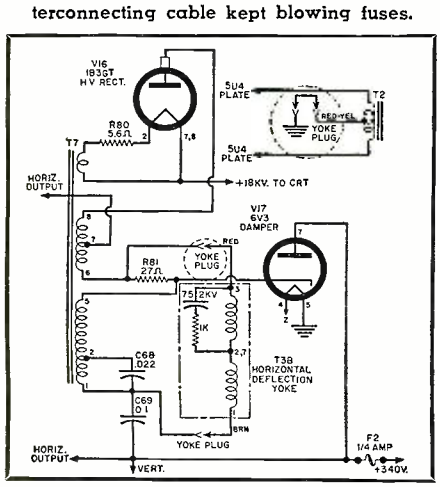
"Hiya genius," he greeted his friend, "I got your message that my set's ready."

"Ready it is," Ed replied, "and a real dog it was too. There it is over there." He gestured toward the 27-inch *Muntz* checking out on a bench. "All set to go."

"Well, what was it," Jerry asked anxiously, "what caused the fuse to keep blowing?"

"Here, let's take a look at the print," Ed replied as he strolled over to the set.

Fig. 1. Defect in the socket of an interconnecting cable kept blowing fuses.



"Come on now," the younger man pressed him, "you know how many hours I spent on that thing before I gave up and brought it over to you; so don't keep me in suspense. What was it?"

"My boy," Ed grinned at him, "there are just two rewarding moments when you're dealing with a tough dog: one is the presentation of the bill (which you will receive shortly), and the other is relating the step-by-step procedure to some other technician. Please don't deprive me of fifty per-cent of my pleasure, will you?"

"All right; all right," Jerry shook his head, "I should know you by now; let's get it over with."

"As a matter of fact," Ed went on, "I think I'll have *you* tell *me* what the trouble was, with just a few leading questions."

"I spent two days looking for it; what makes you think I'll pick it out now, Ed?"

"I have every confidence in you, lad, let's take a crack at it. Here, look at the schematic. (See Fig. 1.) High voltage comes on and in a few seconds the fuse blows. The oscillator is fed voltage from 'B+' and is oscillating—you determined that. You checked the output circuit—nothing wrong there. You decided the trouble was in the high-voltage circuit itself, right?"

"Right."

"You checked every component in that circuit; you changed the yoke and the high-voltage transformer; then you quit. Right?"

"Right."

"Well, you saved me quite a bit of probing by doing all that. Knowing that you're a pretty good technician, I assumed all your findings and replacements were correct."

"Were they?" Jerry asked in a worried tone.

"They were," Ed replied. "Told you you're a good man. Now, did you notice, each time before the fuse blew, the 6V3 would light up overly bright?"

"No, I didn't."

"You should have. What does that indicate to you?"

"Well," Jerry replied, "it's drawing too much current, probably conducting continuously."

"Good. What could cause that situation?"

"Let's see," Jerry went on, "if the cathode were grounded, with the plate at 340 volts, that would do it for sure."

"For sure," Ed echoed. "Where could it be grounded?"

"Well, I eliminated the yoke and the transformer. What else is there? Wires, sockets, that's it."

Ed laughed, "yes that's all that's left, and after carefully checking the wiring, I decided it had to be a socket. Notice that the yoke is plugged into a socket on the main chassis. Notice also, the center tap of the power transformer is jumpered to ground in the same socket. Now, the red lead from the yoke and the ground lead are on adjoining lugs. The socket probably crystallized between them, allowing an arcover, putting the boosted 'B+' at ground potential. I installed the new socket and it's been playing fine ever since."

"Now how in the world are you sup-

posed to find something like that?" Jerry asked. "Why you could spend days and days and not know what's causing the trouble."

"You find it just the way we found this one," Ed replied, "after you check all the usual suspects you start in on the unusual 'til you hit the right one."

"Yeah, 'til you hit it though, the dog can drive you crazy."

"That's true," Ed nodded, "however, this was a rare one; most dogs are not dogs at all; the technician makes them so. I've found there are certain rules to follow which will eliminate a good percentage of dogs and place them in the routine repair category. One of the first of these rules is to develop a set procedure for each circuit you work on. Follow it every time and you'll save many hours of hit-or-miss troubleshooting.

"Recently I learned a good lesson along those lines myself. A set came into the shop with no vertical sweep. (See Fig. 2.) I varied the vertical controls and changed the 6BL7, but there was no effect. Now, my system in troubles of this type is to feed a signal into the grid of the vertical-output tube to pin the trouble down to one circuit. I do this by clipping one end of a .05-μfd. capacitor to any one of the 6.3-volt filament connections, and the other end to the grid. If I can get a certain amount of vertical sweep, the trouble is in the oscillator section. If I still get none, the output circuit is at fault.

"In the set I was speaking of, I got no sweep when I jumpered in my capacitor, so I started taking voltage checks in the output circuit. The plate was high. The cathode and grid measured zero volts, which indicated the tube was not conducting. Voltage checks in the oscillator circuit confirmed this. Everything pointed toward the filaments, but they were lit. Right then and there I threw my system out the window and started checking parts at random. I went to the integrator circuit, then back to the oscillator and the output again, 'til finally I got up and walked away from it. This, incidentally, is another excellent rule when you run into trouble and start to lose confidence in yourself. Walk away from it. Grab a cup of coffee. Pull out a book and refresh your mind on the theory of the circuit you're working on. Then go back to it, rejuvenated and ready to lick it. That's what I did, I started in again and, when I came to the filaments, I decided to measure them even though they were lit. I measured a little under 4 volts. I soldered both ends of the coils, L_3 and L_4, in the filament circuit, and got my 6.3 volts—and, of course, my sweep. A poor solder joint added enough resistance to the circuit to drop the voltage to the point where the tube would light, but not quite conduct.

"It took me several hours, instead of about ten minutes. It proved a point once again: stick to your system, don't assume anything, let your test equipment give you the right answers."

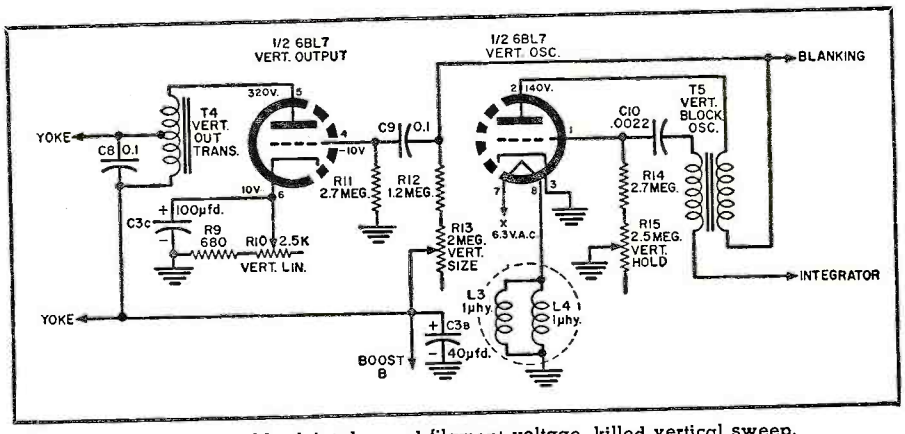


Fig. 2. Poor solder joint dropped filament voltage, killed vertical sweep.

"Yes that's a good idea," Jerry replied, "I mean about using the same approach every time. I know I waste an awful lot of time on sets jumping around from circuit to circuit. And another thing," he went on, "I find myself getting lazy when it comes to unbuttoning a capacitor or resistor to measure it. I wind up working around it for hours, chasing down false leads. Just as you said, I make a dog out of it myself.

"I did just that about a week ago on a 17" *Artone* I was working on. (See Fig. 3.) The complaint was distorted sound on medium and high volume levels. The video was kind of washed out too, and since it was one of those stacked 'B+' circuits where the i.f. voltage is taken off the audio-output cathode, I started checking voltages at that tube. The plate measured low, the screen was OK. The cathode, which should have been about 130 volts, was 50 volts. I measured the grid, which calls for 123 volts and got 10 volts. That seemed like a good place to start resistance measurements, so I checked R_{56}, C_{60}, R_{58}, C_{61}, and R_{57}. All measured about right. Then I went into the plate circuit and checked the filters and resistor. Still nothing. I checked the cathode resistance to ground to see if a high-resistance short might be dropping the voltage. Everything was normal. By then I'd used up quite a bit of time and was getting kind of hot under the collar; you know that helpless feeling that comes when you're getting nowhere with a set."

"I know it well," Ed replied, "You show me one man in this business who doesn't."

"Well when I get it," Jerry went on, "I usually start rechecking what I've already done. I went back into the grid circuit and started unbuttoning capacitors and resistors. When I measured R_{57}, it was wide open. A new 330,000-ohm unit cleared up the sound trouble and greatly improved picture quality. I could have kicked myself for being too lazy to open one end the first time I measured it. The in-circuit check measured the parallel resistance through the 180,000-ohm resistor to ground, and through the 350-volt 'B+' supply to ground. It had measured in the 200,000-ohm region of the meter, near enough to seem that it was OK."

"That's another one of my rules," Ed nodded, "if you suspect a part, open one end to check it if there's a parallel circuit. Oh, I know they wrap the leads around lugs and sometimes it's hard to get to, but do it anyhow; you'll save time and grief in the long run. Another thing: if you suspect a part, such as a capacitor or transformer, jump in a new one when you have an intermittent condition. It takes only a few seconds."

"I learned that lesson the hard way, too," Jerry nodded in agreement, "I fixed a *CBS-Columbia* with sound trouble that gave me quite a hard time. Here, let me pull out the print." He walked over to the schematic file cabinet and soon had the one for which he was looking (Fig. 4) spread out on the bench.

"When I first examined the set, it was smoking and there was no sound.

(*Continued on page* 170)

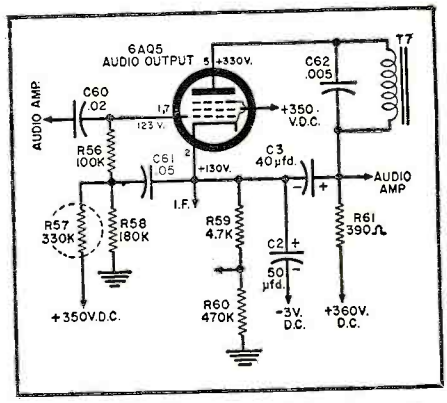
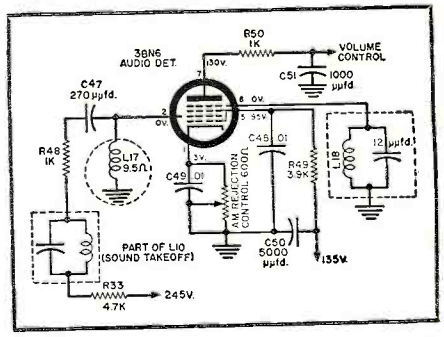
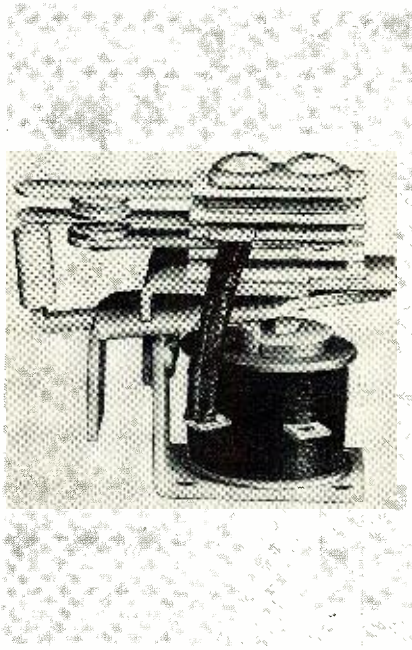


Fig. 3. Circuit measurements obscured the fact that the circled resistor, when measured in the circuit, was defective.

Fig. 4. Although its resistance remained unchanged, altered inductance of this grid coil deteriorated sound output.



Servicing Relays in TV Circuits



Note: To maintain clarity of detail, the relays of Figs. 1 to 4 are not shown to the same scale.

Finding increased use in TV and other home equipment, these components must now be handled by technicians.

REMOTE-CONTROLLED TV devices, model planes, boats, amateur equipment and home appliances are all relay users. The average service technician takes relays pretty much for granted, hardly ever expecting them to be defective and in need of servicing. This attitude is not so well founded as one might think because, especially in remote-controlled TV receivers, relays sometimes are set to operate at critical limits.

The reader may recall a recent article in this magazine on servicing remote controls which dealt with some of the radio-controlled TV receivers, such as the *Motorola* and *Hoffman* models. In these sets, relays are actuated by the plate current of tubes which, in turn, are controlled by preceding stages. It may be difficult sometimes to determine if the over-all receiver operation is at fault or if the relay is marginal.

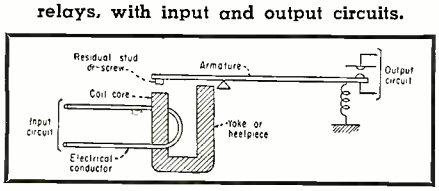
Although relays are designed for millions of operating cycles without failure, there are many different troubles that can occur. Most defects are caused by some failure in another part of the set, but sometimes the relay is to blame. A short circuit in the "B+" supply, for example, can damage the relay contacts through which the excessive current passes. Mechanical defects can cause contact or armature misalignments and similar troubles. Replacement with the identical relay is not always possible; besides, the relay itself often can be repaired. In this article we shall review the basic principles of relay operation, describe the important mechanical parts, and present some data about adjusting and repairing these devices. While there are some types of relays as small as transistors and others large enough to control entire power plants, the types discussed here will be of the commercial variety usually found in such electronic equipment as remote control units and other home devices.

The Basic Relay

Fig. 5 shows the basic components which every type of relay uses. The winding is shown as a single turn of wire, but the number of turns depends on the input signal which actuates the relay. For low-voltage relays, the number of turns will be low. For low-current applications, such as vacuum-tube plate circuits, the d.c. resistance of the coil may be as high as 10,000 ohms. This means many turns of fine wire.

In general, two types of coils are used, the voltage and the current-control type. For most electronic control operations, the voltage type is used and that type has rather high resistance. Some motor-control relays operate on 24 volts d.c. or less, and may require as much as 0.5 ampere, but this type is used only in cable-connected remote-control units. Power relays, such as control remote lighting in modern homes, are often also of the current type.

Fig. 5. Parts basic to electromagnetic relays, with input and output circuits.



The *yoke* or *heelpiece* forms the magnetic core of the coil, and attracts the armature when current flows in the coil. In some relay types, the armature is directly connected to the contacts, making the entire yoke "hot" and requiring insulated mounting. A typical example is the inexpensive model shown in Fig. 3.

Most relays have some insulation between the armature and the moving contact. Contacts are either mounted on insulating strips which are attached to the armature, or the armature simply moves an insulated bushing (shown to the left) against a contact spring of the unit shown in Fig. 1. In Fig. 5 there is a spring against which the coil power operates so that, when the coil is de-energized, the armature and its contact are pulled away from the yoke. This spring is often a flat piece of metal or a curved leaf but, in many relay types, a coil spring actually is used. To prevent the armature from going too far away from the yoke face, there is a backstop against which the armature rests when the coil has no current. The spring and the backstop are vital parts in the adjustment procedure, as will be shown later.

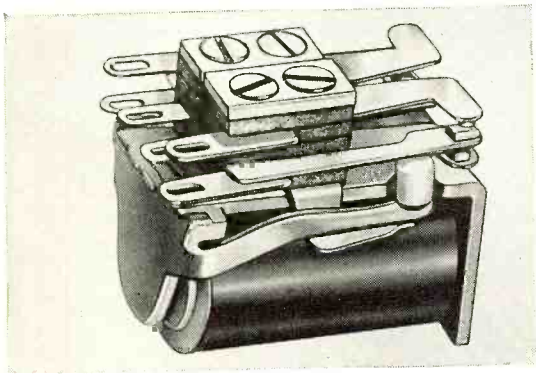
Contacts are another vital spot on the relay. The alignment of two contacts determines the manner in which the relay will control the power circuit. For example, if two contacts are poorly aligned, arcing or intermittent contact can occur. If contacts are dirty or worn, poor or no connection may result. If contacts are damaged due to excessive current through them, they can sometimes be cleaned and repaired, but it often happens that the contacts just cannot be used any more and either the entire relay or the set of contacts must be replaced.

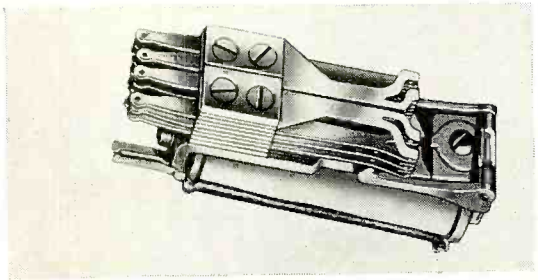
Relays are designed either for a.c. or d.c. While a.c. relays can be used for short d.c. pulses, things do not work out as well the other way around. On a.c., most d.c. relays will either chatter or fail to pull in at all, since the polarity of the yoke piece changes too rapidly. For a.c. operation, a copper shading ring or similar arrangement is used to avoid chatter.

One of the most popular relay types for electronic application is the telephone type shown in Fig. 6 in some detail. Fig. 2 is a miniature variety of this relay, and Fig. 4 shows a high-reliability type of telephone relay with a multiple contact stack. Note that, in this latter illustration, the contact leaves are split at the ends, providing a double contact for extra reliability.

← Fig. 1. The armature of this Potter & Brumfield unit moves an insulated bushing against the contact spring.

Fig. 2. A miniature version of the popular telephone type of relay for electric applications, by Comar Electric. ↓





↑ Fig. 3. This Potter & Brumfield unit has a "hot" yoke, with the contacts directly connected to the armature.

← Fig. 4. A high-reliability type of telephone relay with a multiple-contact stack, made by Automatic Electric.

In operation, the moving contact springs should exert enough pressure on either swing to deflect the stationary contact springs slightly. The spacing of the contacts, the bending of the springs and the adjusting of the back-up strips of dead, soft brass which are sometimes used to maintain proper spacing are all part of the adjustment procedure described in a later paragraph.

From the operating principles and the mechanical construction, it becomes obvious that no grease or oil should ever be permitted to enter the gap between the yoke and the armature. Sticking at that point would cause failure. Similarly, the armature spring should not be either too loose or too tight to prevent the full movement of the armature. The armature bearing must be free of obstruction and, in some relays, might even require lubrication. Dust or dirt in any of these spots or in the contact assembly can obviously cause defective relay performance. While some of the military type relays are hermetically sealed, most commercial types, at best, have a removable dust cover. Unfortunately on some smaller relays it is possible to damage the relay seriously if the cover is forced on the wrong way, or if the mounting bracket is bent to accept the cover. It is important that the delicate mechanical nature of relays be understood before any work is done on these devices.

Common Relay Defects

In remote-control units of any type, relay defects are usually suspected whenever the remote control does not work at all or if part of it operates.

By

WALTER H. BUCHSBAUM

Television Consultant, RADIO & TV NEWS

The obvious first steps are to check continuity between the remote-control button and the relay coil it normally energizes. In systems using ultrasonic or radio link, the reception of the remote signal should be checked by measuring grid and plate voltages of the control tubes.

Only after it is established that a signal reaches the relay coil can the relay itself be suspected. Then it is necessary to check the coil continuity and the voltage applied across the coil. Shorted turns in coils are conceivable, but very rare and therefore should not be suspected first. The failure of the relay may be due to mechanical rather than electrical causes.

If it appears that, with proper coil resistance reading and with the correct voltage applied to the coil, the relay does not pull the armature in, gently push the armature towards the yoke with an insulated tool while the relay is energized. This may be sufficient to permit the yoke to hold the armature or else the armature might fall back even though the coil is energized. Excessive spring tension may be the cause of this defect. In that case, if a flat spring is involved, loosen the screws holding it; if a coil spring is used unhook it. Sometimes the spring pressure may be adjusted. Adjustment should be attempted in small steps, and then only after the rest of the relay parts have been cleaned and, if necessary, lubricated.

Another defect may be failure to pull in initially although, once a gentle push aids the armature, the yoke will hold it in place. In this instance, the spring tension may not be too great, but some friction may cause the armature to move too slowly. Check the armature hinges for easy action, possibly lubricate *lightly* with a minute drop of fine oil or graphite, but be careful to keep oil or grease from the contacts and the yoke gap. Occasionally the mounting bracket or chassis has been bent, twisting the relay frame so as to increase armature friction. In some relays, it is possible that the connecting wires might bear against some moving part and impede the pull-in action. Slightly too much spring pressure or too great a gap may also cause this type of defect. In the latter case, check the position of the armature backstop as shown in Fig. 6.

When the remote-control unit fails to shut off or stop operation, then it is possible that the relay is stuck in the closed position. First check the circuits actually controlling the relay power and then the relay itself. Observe whether the armature drops out when no power is applied. If it remains closed regardless of the coil voltage, pry it off gently and check for either a broken spring blade or missing coil spring. If the spring is weak, the armature may be attracted to the yoke when less than the specified current flows through the coil. However, even a weak spring should pull the armature off when no current at all is applied.

Some relays have a small non-magnetic spacer between the yoke and the armature to prevent eventual magnetization of the armature. Other relays avoid this by setting the armature so that there is always a small air gap. However, some of the less expensive relays permit the armature to remain in direct contact with the yoke, and eventually the magnetization of the armature will cause the relay to pull in with less than specified current. Tightening of the spring tension slightly is the simplest remedy for this type of defect.

The symptom of failure to shut off

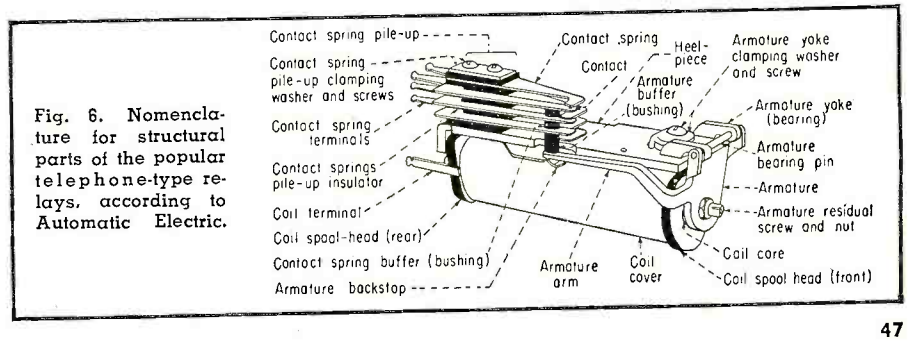


Fig. 6. Nomenclature for structural parts of the popular telephone-type relays, according to Automatic Electric.

can be caused by relay failure even though the armature moves correctly with current applied. Usually this type of defect is limited to one particular circuit and means that the contacts on the relay are stuck together. When a short circuit occurs and excessive current is drawn through the relay contacts, either of two things may result: the contact surfaces may burn off and afterwards make no contact or intermittent contact; or else the heat of the short circuit current may weld the contacts together. The repair of burnt or welded contacts usually requires that the relay be removed from the chassis, and that it be worked on carefully and precisely. Some of the methods possible to salvage such contacts are given later but, if at all possible, replacement of the relay is preferable. Often there are a set of unused contacts on the same relay, and the wires can be transferred accordingly. Repair of contacts should only be undertaken as a last resort.

To round out the most common relay failures, we should include the case of contacts spaced too far apart or too close together. In the first instance, the relay may appear to operate only after the unit heats up, or not at all, on some particular circuit. Occasionally, contacts that are spaced too far apart will arc over when the relay is actuated or operate intermittently. To check this condition, remove power and push the armature into position while observing the contacts. When they are too close, arcing may occur in the off position or else, after warm-up, the unit may start cycling by itself. The best way to determine whether the contacts are too close is to compare their spacing, while the power is off, with the spacing of other contacts on the same relay. If no other set of contacts is on the relay, some experimentation may be necessary.

Wrong contact spacing may be due to metal fatigue, tampering, or arcing due to overload. The latter effect can either remove or add some metal to the contact points.

Repairing Relay Defects

Repair of contacts should only be undertaken after it has definitely been established which set of contacts are defective and that it is not possible to switch the wires to an unused set of contacts. Many relay manufacturers advise against any tampering with contact springs or points, because these parts require accurate adjustment and great care. Contact points are usually made of coin silver or some special hard, protective plating. When this surface is scratched, the life of the contact is greatly reduced. Bending contact springs also is a delicate job requiring patience and know-how. Adjustment of the gap or armature travel similarly is likely to change the specified performance of the relay, and can result in damaging it or shortening its life. We therefore present the following relay repair methods for use only when a replacement unit is not readily available and when the technician is prepared to do a careful, patient job.

To clean contacts which appear to be dirty, use regular cleaning fluid or contact cleaner of the type used in tuner servicing. Pass a soft cloth or fine brush between the contact area after saturating it with cleaning fluid. Never use a file or sandpaper to clean relay contacts.

In the case of burned contacts, it may be necessary to pry them apart gently before cleaning can be started. To remove the charred metal and produce a good contact area, insert a piece of crocus cloth between contacts and gently rub it first against one side and then the other. As soon as the crocus cloth shows bright metal deposits, stop. Before attempting to space the cleaned contacts, observe their operation both when pushing the armature in manually and when power is applied.

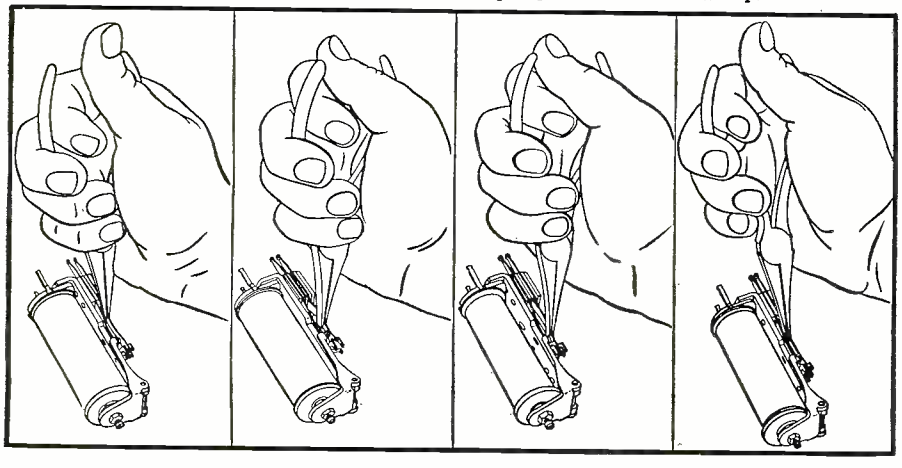
Adjusting contact arm spacing is a delicate job even for the relay expert. The technician can only do an approximate job unless he has the necessary service data, gauges and bending tools. Fig. 7 illustrates the use of duck-billed pliers in bending a contact spring. Gradual bending with only a very slight radius is required, since springs break easily when bent sharply. Many of the more expensive relays, especially telephone types, have a dead soft back-up piece underneath the actual spring; and it is this piece rather than the spring itself that should be bent. On other contact arms, this adjustment is best achieved by slightly bending the spring leaf at several places, thus distributing the bending pressure. In general, the correct gap in the off position is a contact spacing of at least 1/32 inch for most 117-volt circuits.

In the actuated position, the moving contact arm should not only touch the stationary part, but actually bend the stationary spring arm slightly. The bending action serves to wipe the contact a little, assuring good connection. Some relays use pin hinges, while others use a simple *V* hinge to mount the armature. When these hinges get dirty and stick, the relay can become defective as noted earlier. This condition can usually be cleared up by cleaning and possibly lubricating these points. Lubrication is frowned on by some relay manufacturers; however, in relays which are not of the continuous-operation type, some graphite on the hinges may be sufficient to insure operation for another year or more. No relay parts should be lubricated other than the hinges, and those only after cleaning them fails to restore proper operation.

Spring tension adjustment is again a very tricky job and should be done only as last resort. If the spring is broken, a direct replacement should be ordered if at all possible, else it may be simpler to install a new relay. Taking a spring from another relay, even one that has similar electrical specs, is not usually successful. In any instance where use of a new, untried spring is unavoidable, be sure to check relay operation at least a few dozen times. When a separate backstop is used, as in Fig. 6, excessive spring tension will result in no pull-in, but, in models where the force of the contact springs serves as backstop for the armature, excessive tension can deform these contact springs. When a coil spring is replaced, its tension can be increased by shortening it and pull reduced by adding wire connecting links. It is usually simpler to start out with a spring which is too long and which is then shortened in half-turn steps until it appears that the tension is just right. Flat springs cannot usually be replaced by anything except an exact duplicate, because they are formed and tempered to fit just one model of relay.

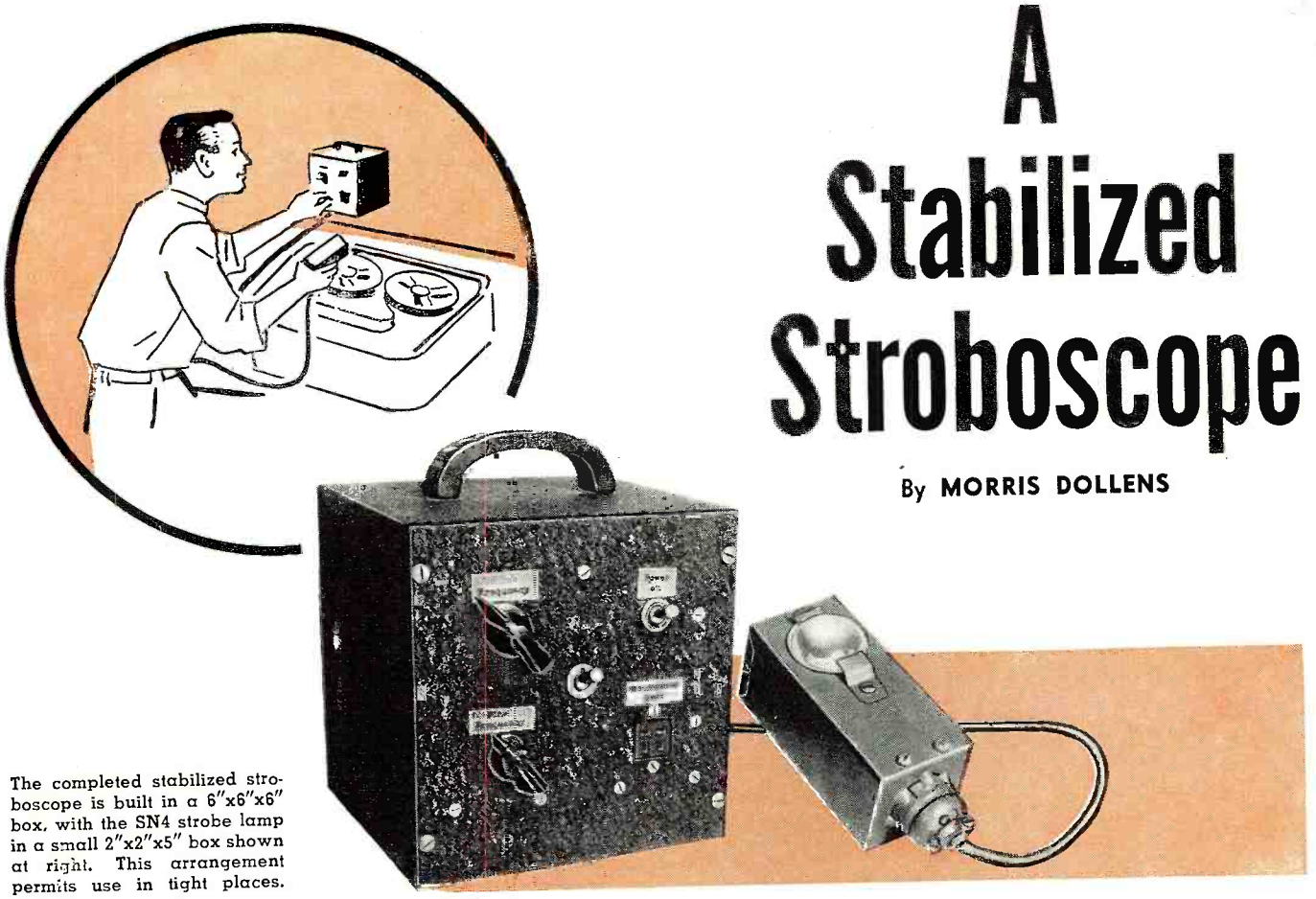
When relay chatter is due to excessive travel of the armature, it may be possible to adjust the backstop. This should be bent so that, in the unenergized position, the armature insulator rests slightly against the contact spring stack. The customer should realize that the relay is a component somewhat like a transformer or a tube in one important respect: often the simplest repair is to replace it. When the correct replacement is not available, servicing a relay can be done, but great care should be exercised in handling the delicate mechanical adjustment. —30—

Fig. 7. Technique for bending a contact spring with the duck-billed pliers.



A Stabilized Stroboscope

By MORRIS DOLLENS



The completed stabilized stroboscope is built in a 6"x6"x6" box, with the SN4 strobe lamp in a small 2"x2"x5" box shown at right. This arrangement permits use in tight places.

Unit with enough stability to permit checking speed variations in film and tape recorders.

ANYONE who has used a flashing stroboscope to "freeze" repetitive action need not have the advantages of the instrument explained in detail, and for the average use in studying the motion of motors, fans, turntables, etc., the simple circuits published in the past serve quite well. Our aim was to check instantaneous and slow speed variations in film and tape recorders and after building one of the aforementioned instruments,[1] we found a certain amount of hunting and creeping when viewing synchronous motors. Probably a number of causes combined to aggravate matters, such as varying line voltage, irregularities in gas density within the oscillating strobe tube, rectifier and filter capacitor defects, and poor supply regulation.

After replacing a number of parts to see if any improvement could be effected, with no positive results, we decided on a basic change in the circuit design. Originally the strobe tube (1D21-SN4) was used as a variable-frequency relaxation oscillator and, as such, seemed to be vulnerable to every slight variation in the accompanying circuitry.

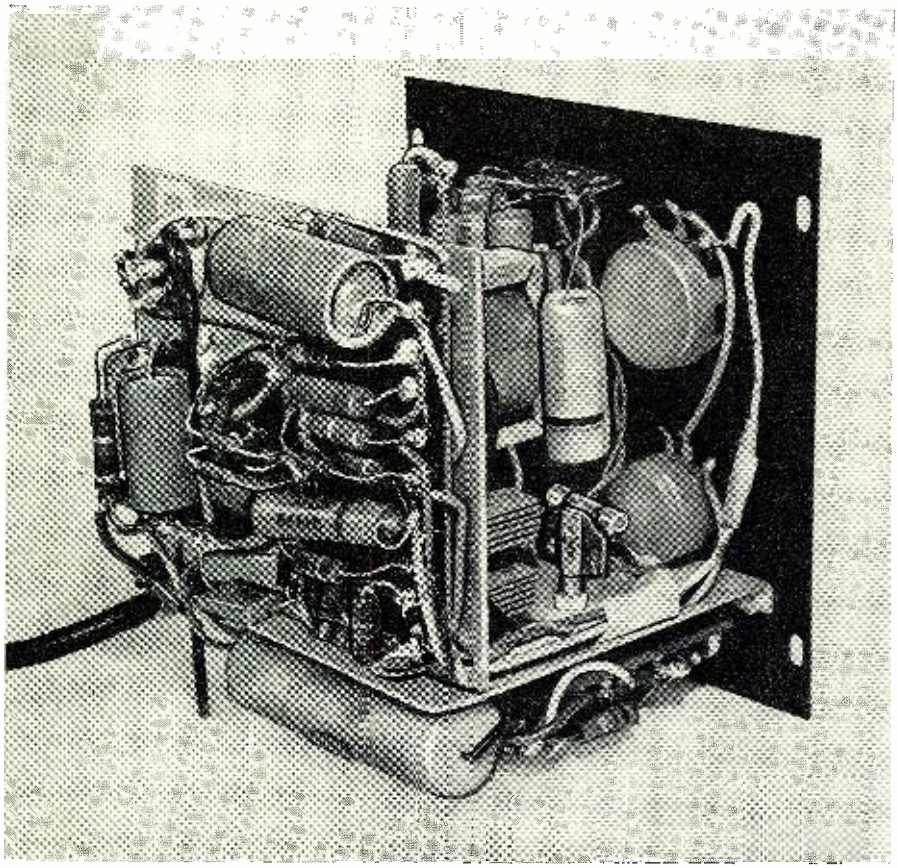
At the suggestion of a friend who had experimented with multivibrators and recommended a circuit previously published in this magazine, we decided that here was a more ideal method of pulsing our flashing light, although this would take some additional parts. Fortunately our 6"x6"x6" box was oversize for the original circuit; a slightly larger one would make assembly easier, especially if an isolating power transformer is desired, but there seemed to be little need for this, as no part of the circuit ever is connected to anything external. A 6-volt midget transformer supplies the heaters and this might be replaced with a small radio output transformer to step down the 117-volt a.c. to operate the heaters. A test under actual load would tell if the transformer would put out under the small .45 ampere load. We have several others in use this way, with good results; using the universal type allows the voltage to be adjusted. The tube types might be altered to allow series wiring direct from the 117-volt line, if desired.

The voltage doubler puts out about 260 volts d.c., varying somewhat at different flashing rates. Of course, a standard power transformer rated at 250-300 volts at 100 ma. would allow a conventional full-wave rectifier tube circuit and might prove more satisfactory, especially in voltage regulation, but a bigger box would be necessary and the added weight would be considerable. Hence the accompanying circuit design, to fit into our original box, was adopted.

In action, the multivibrator V_1 generates a square wave. The small .001 μfd. coupling capacitor C_6 passes only the high-frequency components resulting in a short pulse amplified by the 6C4 tube V_3, which through transformer T_1 and coupling capacitor C_9, triggers the firing of the 1D21 strobe tube at each cycle. The 0B2 voltage-regulator tube assures a fairly constant plate supply to the multivibrator, resulting in a much more stable operation than is obtainable with a simpler circuit.

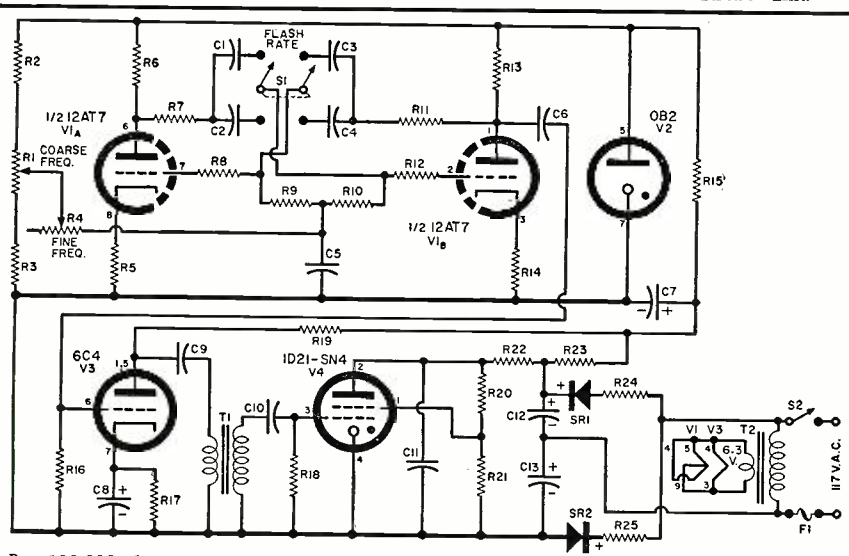
As seen in the interior photos, two 1/16" hard aluminum sheets have been mounted behind the front panel and at right angles to each other, about 1¼" from the bottom and back walls, allowing this space for terminal boards holding most of the smaller components. If it is necessary to use thinner metal, mount a pair of brackets from the top corners of the front panel to the top of the back panel.

The main central space holds the three small tubes, midget heater transformer, voltage doubler selenium rectifiers, and capacitors. On the front panel are mounted the coarse and fine tuning potentiometer controls, the 4-circuit *Jones* socket, and the power and range selector switches. The back interior panel holds the three sockets, one 9-pin and two 7-pin miniatures, a 6-



Left oblique view clearly shows the upright panel that holds the heater transformer and the mounting board with its resistors and capacitors. The selenium rectifiers may be seen near the bottom of the panel while the fuse is mounted directly in front of the rectifiers. The two frequency pots are also visible.

Complete schematic diagram and part listing for the stabilized strobe unit.



R1—100,000 ohm pot
R2—20,000 ohm, ½ w. res.
R3—10,000 ohm, ½ w. res.
R4—10,000 ohm pot
R5, R14—400 ohm, ½ w. res.
R6, R13, R17—3000 ohm, ½ w. res.
R7, R8, R11, R12—51 ohm, ½ w. res.
R9, R10—500,000 ohm, ½ w. res.
R15—1300 ohm, 1 w. res. (see text)
R16—100,000 ohm, ½ w. res.
R18—1 megohm, ½ w. res.
R19—50,000 ohm, ½ w. res.
R20—50,000 ohm, 1 w. res.
R21—12,000 ohm, 1 w. res.
R22—3000 ohm, 10 w. res.
R23—1000 ohm, ½ w. res.
R24, R25—10 ohm, 1 w. res.
C1, C3—.03 μfd., 400 v. capacitor
C2, C4—.1 μfd., 400 v. capacitor
C5—.02 μfd., 400 v. capacitor
C6—.001 μfd., 400 v. capacitor
C7—8 μfd., 450 v. elec. capacitor
C8—10 μfd., 25 v. elec. capacitor
C9, C10—.01 μfd., 400 v. capacitor
C11—1 μfd., 600 v. capacitor
C12-C13—20/20 μfd., 450 v. elec. capacitor
S1—D.p.d.t. switch
S2—S.p.s.t. switch
F1—1 amp fuse
SR1, SR2—100 ma. selenium rectifier
T1—Interstage trans. 1:2 or 1:3 ratio (see text)
T2—Fil. trans., 6.3 volts @ 1 amp.
V1—12AT7 tube
V2—0B2 tube
V3—6C4 tube
V4—1D21/SN4 strobe tube (Sylvania)

point terminal strip, and a terminal board, which could be replaced by two 10-point terminal strips mounted about two inches apart. A 1½" 6-32 screw through the back of the bottom panel acts as a leg to hold the base plate off the bottom wall of the box.

Under the bottom chassis plate are C_{11}, a small terminal board, and the midget coupling transformer. In mounting the bottom plate, be sure to allow room for this last item, as a substitute transformer may take more room than the original one.

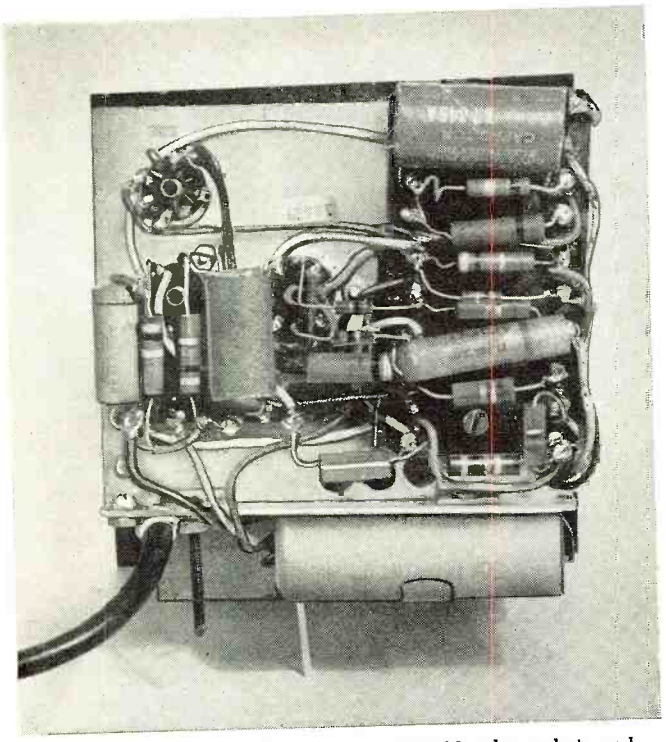
Switch S_1 changes the range of flashing rate, and potentiometer R_1 adjusts for coarse frequency control, while a finer adjustment can be made with R_4. The 0B2 tube holds the 12AT7 plate supply to around 105 volts, and could be replaced with two in series if using a power-transformer with a higher supply voltage. The value of R_{15} may have to be changed depending on the supply voltage and should be adjusted to greatest brilliance of the VR tube when the load is lightest; that is, when the flashing rate is slowest. Adjust R_{15} so that the VR tube stays lit even under heaviest load while the strobe unit is set for fastest flashing rate.

The coupling transformer, T_1 in our model, is a midget surplus 400-cycle power transformer with a 110-volt primary and two 141-volt secondaries in series. This boosts the pulse voltage, and allows transposing the secondary if necessary for proper phasing, as the 1D21 flashing grid requires a negative pulse to trigger it. Undoubtedly a small 1:3 step-up interstage audio or push-pull driver transformer would serve as well. At the plate voltage applied, it was not possible to obtain a high enough pulse output voltage from the 6C4 to operate the strobe tube without this transformer.

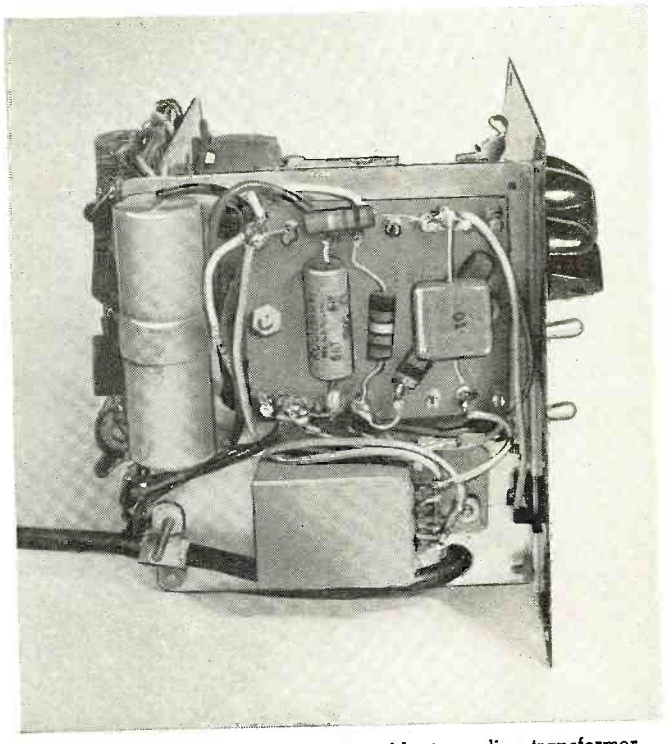
The strobe tube is mounted in a home-built box, approximately 2" x 2" x 5"; an *Amphenol* 4-prong tube socket and cap are attached to the bottom end with a few dabs of solder. *Flexi-Mount* and *Channel-Lok* supply aluminum boxes this size. With the difficulty of aluminum soldering, the socket would have to be attached with a tube mounting ring. A bulls-eye lens is clamped on the outside of a 1½" diameter hole opposite the strobe tube lighted area, projecting a lighted spot a foot or two away and obstructing the view much less than the usual large reflector. The box and socket are connected to the power supply box by a 4-wire cable and male *Jones* plug P-304-CCT, fitting into a female *Jones* chassis socket S-304-AB.

Labels were typed on cream-colored masking tape, twice over for a heavier impression and covered with transparent cellophane tape, the combined tapes stuck to a scrap of glass sheet and trimmed with a razor blade, and then stuck on to the metal box. Decals would serve as well, if available, and look a bit more professional. A plastic handle on top facilitates carrying the unit.

We decided that calibration was not necessary for our use, as for checking we had synchronous motors and ma-



Back view shows upright chassis panel with tube sockets and terminal board. The 12AT7 socket is at the center, while the 0B2 socket is at the top left with the 6C4 socket just below. The capacitor across the strobe tube is at the bottom of photo.



Bottom view of chassis shows the midget coupling transformer which is used to boost the pulse voltage and allows transposing the secondary if necessary for proper phasing to the strobe tube. Small terminal board is also seen here.

chines which ran at 24 and 30 revolutions per second to check our most desired frequencies and some multiples and fractions. Other users of this circuit may desire dial markings to determine number of revolutions. A simple method of calibration, using a phono-turntable strobe disc, was described recently[2]. A calibrated audio oscillator and oscilloscope would enable comparisons to be made. Small synchronous motors offer constant speeds, although they are not usually on hand in most home workshops. Even without calibration, the stroboscope is extremely useful in checking for instantaneous speed variations in sound movie projectors and cameras.

On tape recorders, an easy method is to take a two-foot length of 8 mm movie film, trim off a bit of the unperforated side to one fourth inch with a ruler and razor blade, splice into a loop, and run through the tape feed; the perforations will go by at about 26 per second at 3.75 ips, and at about 52 per second at the 7.5 ips speed. If the perforations tend to catch on the machinery, producing their own irregularities of motion, a more satisfactory but expensive material is the special tape sold by some camera stores with strobe stripes printed on the back, used normally to synchronize home movie projectors with tape recorders.

Other types of machines, such as those with reciprocating parts as clippers and razors can be stopped in motion. But a better way of analyzing movement is to set the strobe a little fast or slow, so that the apparent motion of the object being examined is slowed down to a crawl. We found that our jigsaw was bending the blade on the up-stroke, resulting in premature breakage, a situation corrected by adjusting the return spring.

For some of these latter simple analyzing jobs, a simpler strobe circuit would suffice, but we felt that it was worth the time and materials to build this more stable stroboscope which would cover our more exacting requirements.

REFERENCES

1. *Turner, Rufus P.: "A Portable, Lightweight, 1-Tube Stroboscope,"* RADIO & TV NEWS, *September 1948.*
2. *Pollack, Harvey: "Stroboscope for the Electronic Workshop,"* Popular Electronics, *September 1955.*

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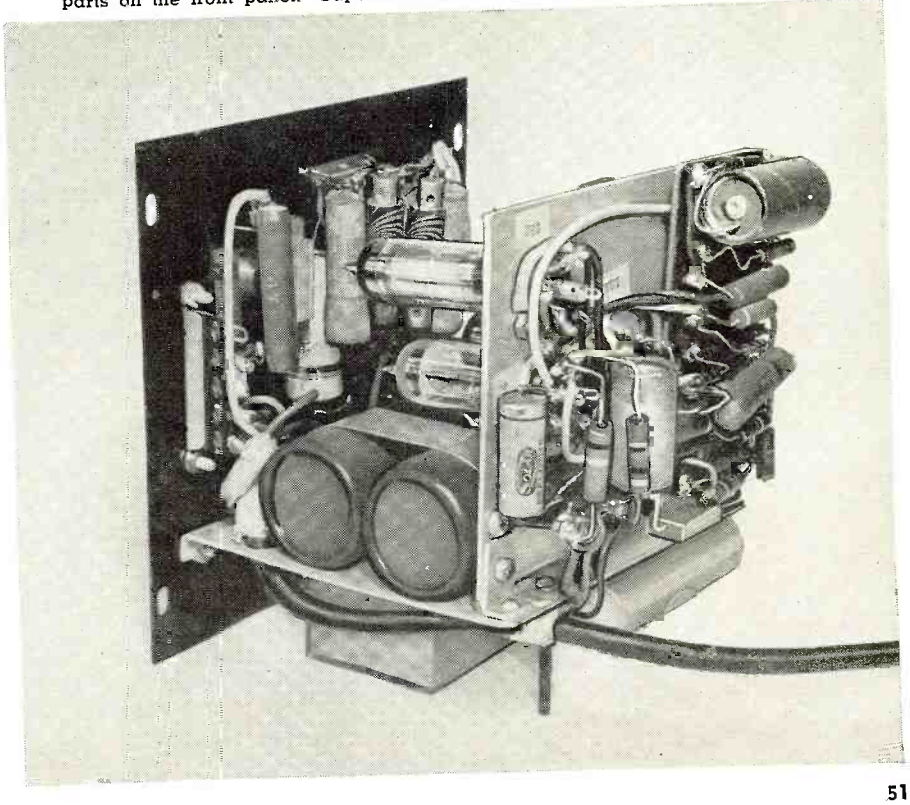
Right oblique view shows horizontal and upright chassis panels and the compact placement of parts. The 0B2 and 6C4 tubes may be seen as well as some of the parts on the front panel. Capacitors C_{12} and C_{13} are on the horizontal panel.



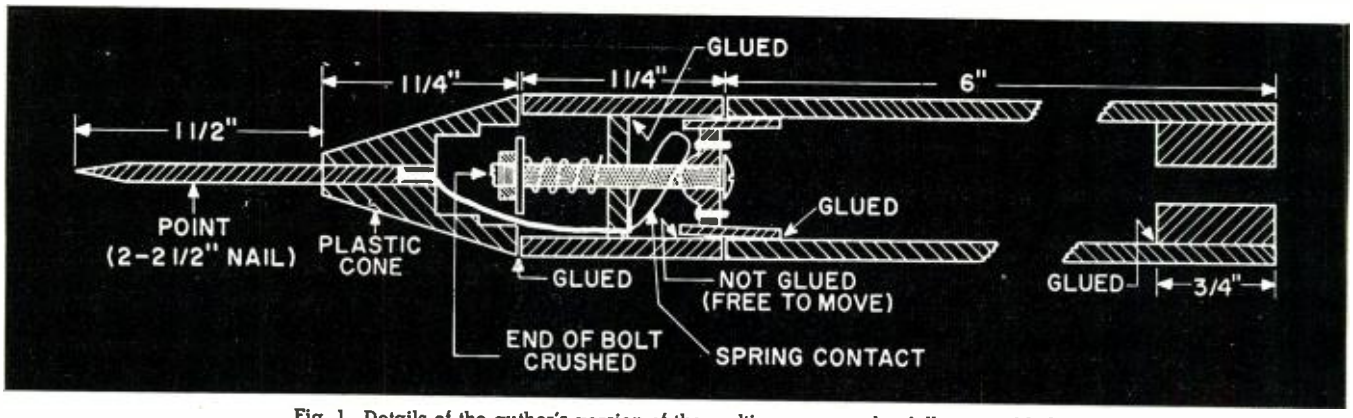


Fig. 1. Details of the author's version of the multi-purpose probe, fully assembled.

The Multi-purpose Scope Probe

By **BOB RUSSELL**

A single housing, carrying several switch-selected circuits, eliminates the bother of probe changing.

SOONER or later, every technician who wisely commits himself to getting the most use he can out of his oscilloscope, runs into the same problem: depending on the circuit in which he is applying the scope, he may need any one of several different types of probes. In some instances, the scope will be used direct. For certain alignment applications, a simple isolating resistor is advisable. A low-capacity isolating probe is preferred in certain other circuits that may be detuned or otherwise disturbed when the input capacitance of the scope is shunted across them. At least one type of detector probe will generally be desired. Before the technician is finished, he may find himself equipped with an impressive array of probes that may seem to be more of a hindrance than a help.

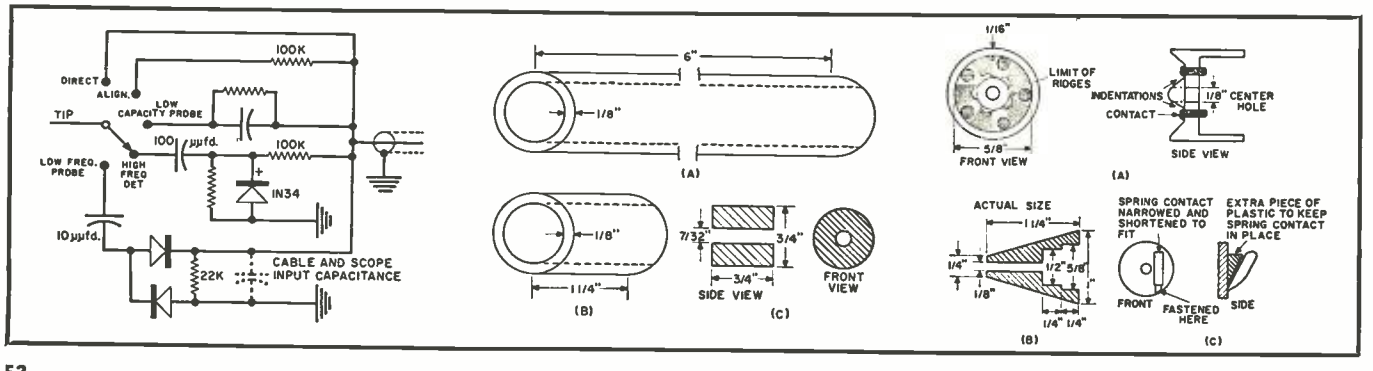
Aggravating the problem is the fact that, during a single troubleshooting sequence, it may be necessary to go through the business of changing probes more than once. The only solution seemed to be, instead of a set of probes, a single probe with the features of a whole set built into it. This solution could also be applied to the v.t.v.m. or other meter, as well as to the oscilloscope. A single probe case that actually will house several different probe circuits, any one of which may be selected at will, was successfully built.

As shown in Fig. 1, a probe casing 6 inches long has mounted to it a rotatable head that can be turned to select any of the available operations built into the probe. The author's version is a 5-position probe. Other builders may wish to vary probe length to accommodate their own circuits. In the body he was able to accommodate the circuits for the various probes shown in Fig. 2.

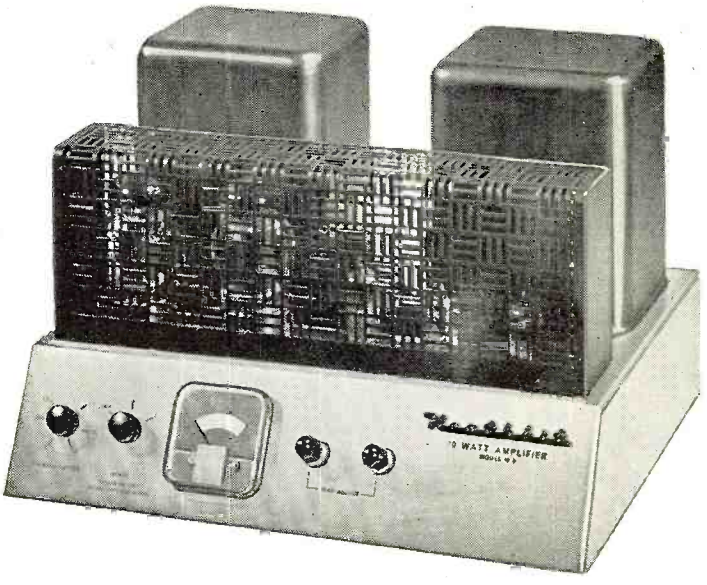
Values are shown for most of these circuits. Complete values are not given for several reasons. Sometimes they will depend on the characteristics of the scope. Also, different sources describing basically similar probes will give different sets of values. Still more important, the individual constructor will decide for himself exactly how many probe circuits he wants to incorporate in the single body and which

(*Continued on page* 134)

Fig. 2 (left). Probe circuits used by the author. Other constructors may use other combinations.
Fig. 3 (center). Detail of plastic parts used in constructing the main portion of the probe body.
Fig. 4 (right). Detail for the switch-selector assembly and the rotatable probe head.



70 Watts for Hi-Fi



Using 6550's in push-pull, this power amplifier kit will push out 70 watts of good, clean audio.

ONE of the most recent additions to *Heath's* line of high-fidelity kits is the W-6M power amplifier. If you are looking for a unit that will give you a lot of "sock," this certainly qualifies as one of the best on the market today.

One of the most unusual features of this power amplifier is that it uses the relatively new silicon rectifiers connected as a full-wave voltage doubler. They provide exceptionally good "B+" regulation thus contributing to very low harmonic and intermodulation distortion.

The circuitry of this power amplifier is simple and straightforward. A 12AU7 tube is used with one of its triodes as an input stage while the second triode operates as a phase splitter. The push-pull signal is then fed into the grids of a 12AX7 push-pull amplifier stage which, in turn, feeds a 12BH7 cathode-follower driver stage. Cathodes of this tube are then direct-coupled to the 6550 output tubes operating in class AB.

Variable damping is provided by means of a control mounted directly on the front panel. This control is a dual pontentiometer connected in the negative voltage - current feedback paths. As the control is rotated, the ratio of voltage feedback to current feedback changes, thereby changing the effective internal resistance of the amplifier and hence the damping factor. At the same time the total amount of feedback remains constant. This desirable condition holds for all load impedance taps. A "quick change" plug and receptacle are provided, for selecting the desired impedance taps on the output transformer. At the same time,

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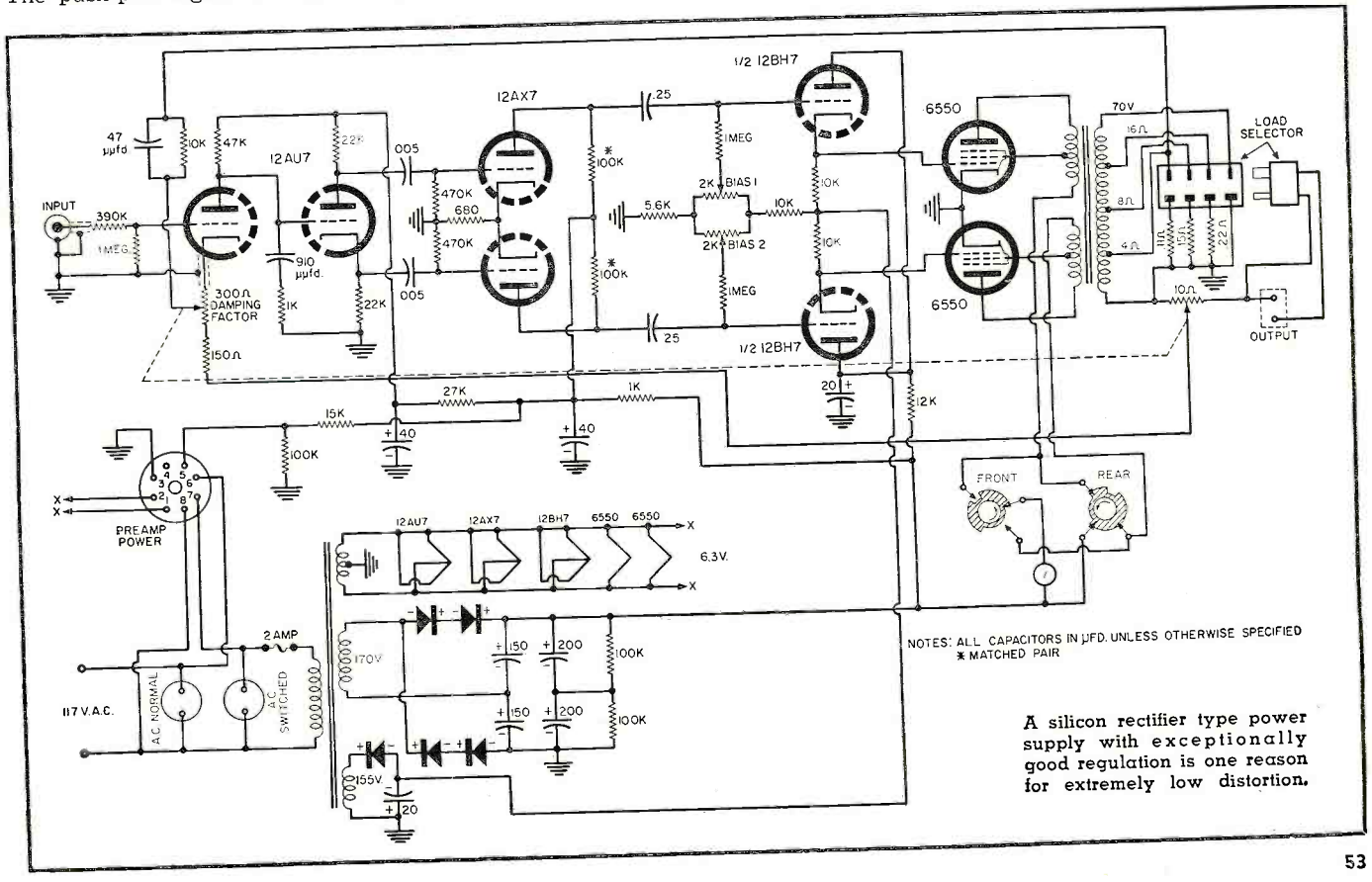
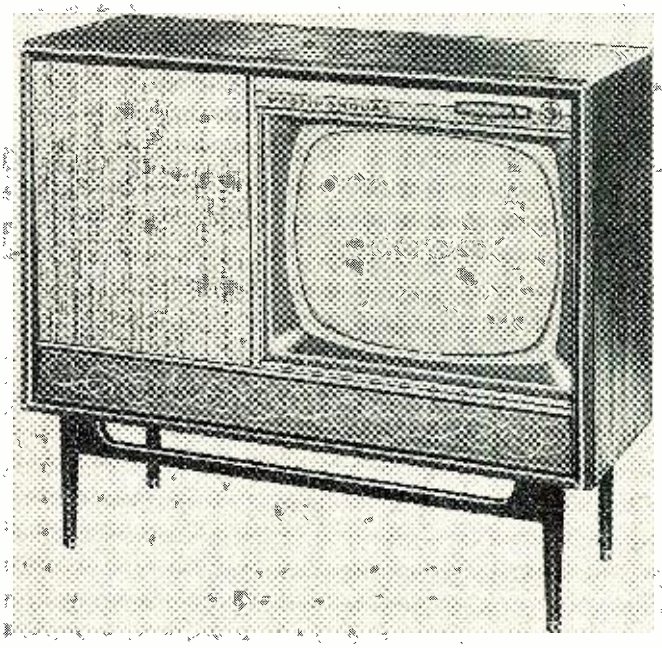


A silicon rectifier type power supply with exceptionally good regulation is one reason for extremely low distortion.

The "Picture Pilot," an optional extra, is a carrier-current, dual-function remote control.

New Westinghouse TV Circuits



The "Athens," in the Westinghouse custom TV line, provides push-bar channel selection along with automatic fine tuning.

Features include a new fine-tuning technique, automatic fine tuning, and a simplified remote control device that operates on carrier-current.

WITH TV receivers well out of the novelty stage, manufacturers have had to face up to the same problem that eventually confronts every consumer-goods industry: how does one persuade people to discard satisfactorily functioning equipment, replacing it with newer versions of the same thing? The new models, of course, must be dressed out with secondary "deluxe" features, not previously available, to entice the consumer. The principal "extra" of this type with the TV receiver of today is the remote-control device.

With remotely controlled receivers available from so many manufacturers, it is inevitable that a certain amount of similarity should begin to develop among all units. Nevertheless, *Westinghouse* engineers have managed to come up with a simplified remote device that merits special comment. In the process, they have introduced some complementary changes in the design of the receiver itself that are worth special attention.

A problem of no small import in achieving a truly convenient remote unit is that of providing accurate tuning. What good is accomplished, after all, by providing a means of coarse channel selection if the user must go to the set anyhow to clear up distortion in the picture or sound caused by mistuning? Yet this often happens, since remote fine tuning is no easy matter to arrange. A variable capacitor of very low value is the usual means of providing fine tuning: the sheer cable capacitance involved in placing this facility at some distance from the tuner oscillator is a forbidding problem. However, a new tuner by *Standard Coil* incorporates a useful development: the circuit is so designed that a variable resistance rather than a capacitance is used to vary oscillator resonance.

Using this tuner, the *Westinghouse* "Deluxe" line of receivers enables the use of a simple potentiometer, at some distance from the receiver, for accurate tuning. Going one step further, the designers of the set have taken advantage of the principle on which the tuner operates to incorporate a type of automatic frequency control circuit on the main chassis. This Automatic Fine Tuning feature, as it is called, has been included in the manufacturer's "Custom" receivers.

With the fine-tuning problem thus out of the way altogether, the remote unit can be relieved of one more task. The result is the "Picture Pilot" remote control, available as an extra accessory for the "Custom" sets. It provides only two functions—simple channel selection and sound muting—in a relatively simple-to-use, uncomplicated way. It also presents an interesting compromise between the two general classes of TV remote-control devices in widespread use, the cable-connected ones and the completely wireless units. Operating as a carrier-current transmitter, it need only be plugged into the power outlet nearest to the user. In this way, there is no inconvenient or movement-restricting cable between the viewer and the set. Wherever the viewer chooses to locate himself within reasonable range of the TV receiver, he only has to plug into the nearest available outlet to power the control, which then also uses the power line to send signal to the set.

In Electrical Fine Tuning, as it is being called, a fixed capacitor is shunted across the tuner oscillator tank circuit in place of the usual fine-tuning capacitor. A parallel combination of a crystal diode and a potentiometer is placed in series with this capacitor to provide effective control over its current. The three elements to which reference is made are shown as C_2, R_2, and the diode in Fig. 1B. To trace the operation of this arrangement, however, we start with the simplified circuit of Fig. 1A.

Across the oscillator tank of Fig. 1A, we find C_1 in series with R_1. The function of any capacitor in an a.c. circuit depends on the current passing through this capacitor and the effect the capacitor has on that current. If all current through the capacitor can be cut off, as when the component becomes open, the unit is effectively removed from the circuit. Thus, by placing R_1 in series with C_1, we can provide a way for very nearly taking C_1 out of the

circuit, electrically speaking, by using the maximum resistance of the control in series with it. If the control is rotated to its minimum position, however, C_1 is fully effective. Since the setting of R_1 determines the effective capacitance of C_1 across the oscillator tank, it provides us with the basic technique of being able to vary fine tuning without *directly* varying a capacitor.

Any device placed in series with the capacitor that controls the current through it may be used in an application of this sort in place of the resistor. In Fig. 1B, a crystal diode is used. Momentarily ignoring the presence of R_2 in the circuit, we can see that, once the circuit goes into operation, the diode will act as a half-wave rectifier for the oscillator output. This will hold true only briefly, however; for this conduction of the diode will quickly charge C_2. Fully charged, C_2 now places a negative charge on the anode of the diode. Since the diode can only conduct when its anode is more positive than its cathode, it is cut off. This prevents current flow through C_2, effectively removing it from the circuit.

By bringing the potentiometer back to the circuit, this time as R_2, we provide a discharge path for the capacitor. Varying the control also varies the time constant of R_2C_2. This is another way of saying that we vary the degree to which C_2 will be permitted to discharge during those alternate half cycles when the diode will not conduct in any case. Thus we vary the cut-off voltage applied by the capacitor to the diode during positive half cycles, and now have a means again for regulating current through the capacitor.

One may wonder why it was necessary to complicate the circuit by introducing the diode when the variable resistor, which is used nonetheless, could have provided the desired control by itself. However, having a diode about, whose degree of conduction may be varied by the application of a voltage, turns out to be quite handy when Automatic Fine Tuning must be applied. Before that is discussed, however, a simpler refinement may be added to the circuit of Fig. 1B: by shunting another potentiometer across the receiver-located fine-tuning control (R_2), a remote fine-tuning unit is obtained. This may be done conveniently through a remote socket located at the receiver. Since there will be interaction between these two controls in parallel, *Westinghouse* recommends placing one in mid-position when the other is to be used.

The "added control" of Fig. 1B need not be confined to a resistive control. As already noted in passing, a voltage introduced at this point, effectively across the diode, can bias the crystal so that it is cut off altogether, or this voltage can establish varying degrees of conduction. An AFT (Automatic Fine Tuning) circuit, shown in Fig. 3, is used in the receiver to develop such a control voltage.

If the tuner oscillator is adjusted so that, without benefit of the fine-tuning circuit, it tends to run too high in frequency, we have the starting point for automatic correction. Then, by shunting additional capacitance across the oscillator tank to the degree that it is needed, the oscillator can be tuned down until it is correct in frequency. To provide the voltage that will effectively produce this capacitance variation, a circuit is used whose operation depends on differences that may be sensed in the video detector and amplifier stages which, in turn, depend on whether tuning is correct or incorrect.

Let us begin with the case where the receiver, tuned to an inactive channel with its oscillator running slightly high, is suddenly switched to an active channel. Normally, the sound i.f. in this receiver should be 41.25 mc., and would occur toward the bottom of the right-hand slope of the i.f. response curve shown in Fig. 2A, just above the trapped-out frequency of 41 mc. The video i.f., normally 45.75 mc., would fall at about the center of the left-hand slope, and is also shown in Fig. 2A.

With the oscillator running too high, however, the beat frequencies will also be high. Let us say that the oscillator is 1.5 mc. above the desired frequency. The sound i.f. will then be 42.75 mc. and will occur high up on the curve of Fig. 2A. The video i.f. will be 47.25 mc. Also moving to the left, as the curve is drawn, it will drop down the left slope, effectively being attenuated out of action. With this signal lost, there can be no beat between it and the sound i.f., thus no 4.5-mc. intercarrier signal is developed. However, the 42.75-mc. sound i.f., of very great amplitude, will be rectified by the video detector of Fig. 3.

Since this detector is AM-sensitive

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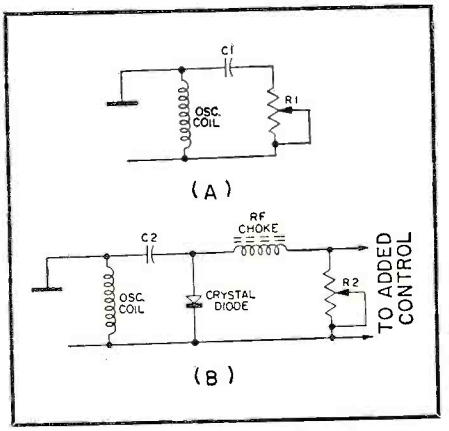


Fig. 1. The basic fine-tuning circuit.

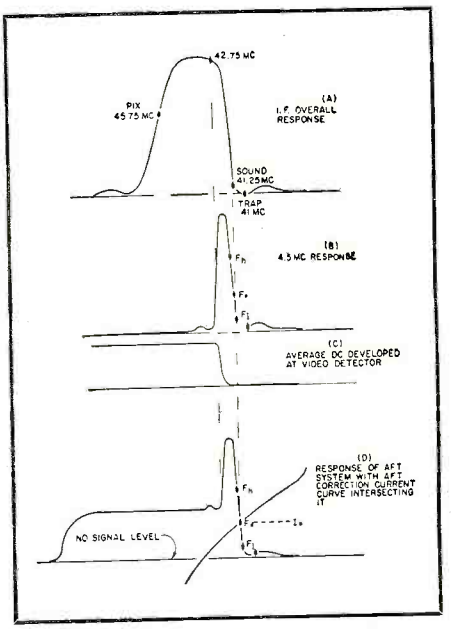


Fig. 2. Curves showing behavior of the automatic fine-tuning circuit (see text).

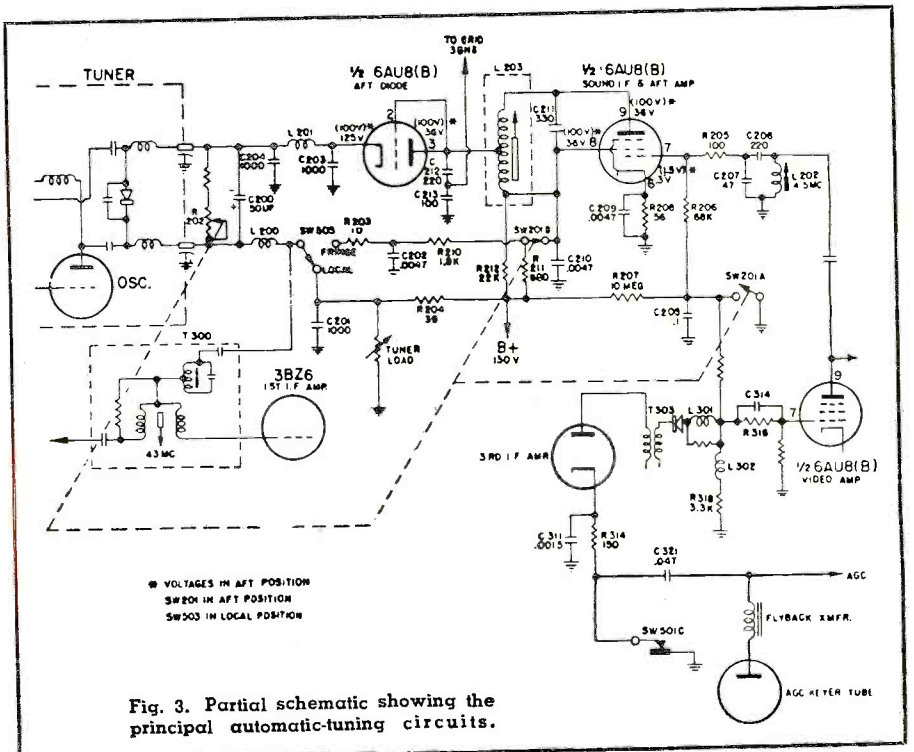


Fig. 3. Partial schematic showing the principal automatic-tuning circuits.

Stereo Control Center

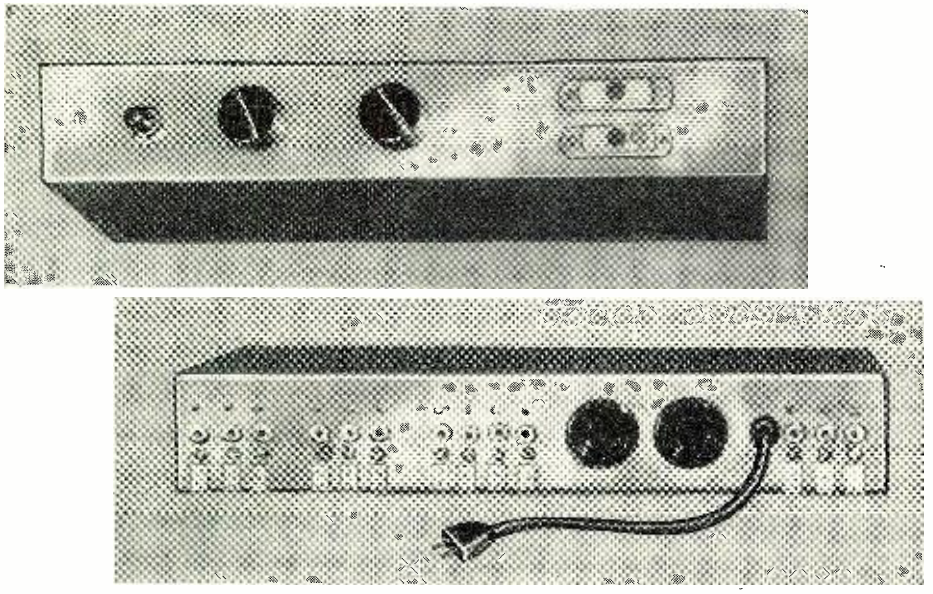
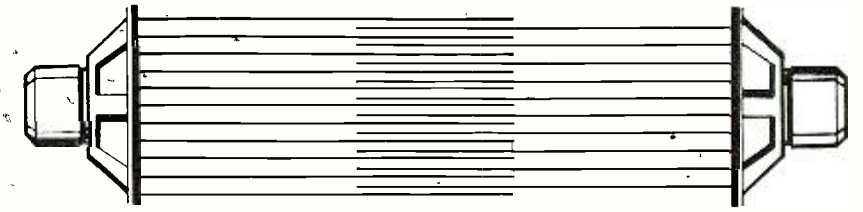


Fig. 1. Front and rear views of the stereo control unit described below.

By
IVAN FLORES



Only two controls to set up proper stereo inputs, connect speakers, turn on equipment, and provide gain adjustment.

WHEN the author first arranged his equipment for stereophonic operation, it was surprising how much trouble it was to get it set up properly. This is especially true if the equipment is not exactly centered between the two speakers. And how often is it possible to place it thus? It may not be a convenient arrangement for associated equipment, or your wife might object to this location.

At any rate, to balance a stereo system, it is necessary to adjust the volume of one of the two channels, step back to a central listening position, notice which side is louder, and return and re-adjust one channel. This is the procedure if the program material is of about equal volume on both channels. Sometimes a stereo broadcast is tuned in while the selection is in progress or during a solo. It is almost impossible to know just how to balance the two outputs in such a case as this.

Just suppose, after getting all set up, someone complains that the volume is too loud! Both channels must be reduced equally. This means an entirely new balancing procedure. When the "audiophobe" with the delicate ears leaves, another balancing process is required to restore the volume.

The device to be described will eliminate the balancing procedure. It is applicable to stereo tape deck output or a broadcast setup using two tuners. If you are lucky (or prosperous) enough to have both stereo tape and stereo broadcast systems, then this device will accommodate and equalize both systems. Of course, two complete amplifiers and two speaker systems are still required.

Some audiophiles derive a good deal of pleasure from the myriad of knobs, dials, and controls which require setting, even in a monaural setup. Stereo listening gives this person the added fillip of twice as many knobs and a complicated tuning procedure before proper listening can begin. On the other hand, if you belong to the "set and forget" school, if you derive more pleasure from listening than fussing, this simplification should prove very gratifying. If you would like to simply switch one knob and manipulate one control and thereby completely set up your equipment for stereo listening, then this is it!

Of special interest is the dual potentiometer for level control of both channels. By presetting various volume controls, this potentiometer may be used for controlling both channels, whether the source of the input is broadcast or tape.

The device described has four switching positions, each of which will be discussed separately.

Normal Monaural Operation

In this mode of operation, most of the equipment is controlled by the preamplifier. The choice of input is made at the preamplifier, which, in this case, has push-button control for monaural tape, television, microphone, phonograph, or the FM tuner. Selection of input also turns the power on for the respective apparatus. The main amplifier is also turned on and its output is fed, properly terminated, into both speakers.

AM Monaural

Since separate AM and FM tuners are used in this system, it is necessary to have a position on the selector which allows the AM power to be turned on and the AM tuner output to be routed to the "tuner" input of the preamplifier. The main amplifier and both speakers are on, as was the case before.

Broadcast Stereo

In this mode of operation, power must be fed to the main and auxiliary amplifiers. The output of the FM tuner is fed into the "tuner" input of the preamplifier while the output of the AM tuner is fed to the input of the auxiliary amplifier. The output of the main amplifier is now fed to the main speaker and the output of the auxiliary amplifier is fed to the second speaker.

Stereo Tape

In this mode of operation, power must be obtained externally for the auxiliary amplifier. Power for the main amplifier and tape recorder is supplied, as previously, through the preamplifier power receptacles. "Tape Track 1" of the tape recorder is fed to the tape recorder input of the preamplifier through the level control. It passes into the main amplifier and then to the main speaker. The second channel from the tape recorder is fed through the level control into the aux-

iliary amplifier and then to the second speaker.

A big part of the simplification achieved by this device is due to presetting of controls by indicating their proper position with little colored adhesive dots. Dots of red or green were placed on all controls which have to be preset before their use in the stereo setup. A green dot indicates control presettings for all equipment required for stereo broadcasts. A red dot indicates control presetting for equipment required for stereo tape use. The dots were also placed on the pilot lights which must be lit in order that the appropriate auxiliary equipment be on at the time. They also act as an indication of the position of the selector switch. No numerals or other indications are required about the periphery of the selector switch. Thus, when the pilot lights with the red dots on them are lit and all controls with red dots on them are set to those dots, then stereo tapes may be played. The "dots" are obtainable in small packages from a good stationery store. These dots have adhesive on the back and are useful in other applications. For instance, they may be used to distinguish among various types of recording tapes. One color could indicate half-recorded reels, while another would be for tapes to be permanently preserved, etc.

Physical Design

The unit was designed to fit into the decor of the writer's home. A cabinet houses the "hi-fi" equipment. The tuner and preamplifier each have individual open "cubby holes" to allow for ease of adjustment. The preamplifier cubby has some room yet unoccupied. This was used to house the stereo control center. Fig. 1 shows the front and rear views of the stereo control center. Notice the pilot lights with the dots on them. Dots are also used on the "tape" and "tuner" inputs of the preamplifier. Foam rubber strips were cemented to the outside of the cabinet to assure a tight fit in the "cubby hole." This is necessary so that the unit will not slip around when being switched.

The many input and output jacks are numbered with "wire labels." A similar label appears on each end of the connecting wires. This makes for ease of removal and reconnection. The three jacks on the right and the toggle switch on the front are not strictly part of the unit. They are used to determine whether the tape recorder records from the tuner or the preamplifier. Shielded leads were used in some cases, even though this is not absolutely necessary.

Components

The components used in the construction will be described in order to aid the prospective builder in duplicating the author's unit. For those who do not wish to make an exact copy of the author's unit, the operation shown should produce some useful ideas.

The phono receptacles used in the equipment are of the miniature variety since so many of them were required. Those seen in the photograph may be placed as close as five-eighths of an inch between centers. Instead of permanently wiring the auxiliary amplifier and the AM tuner into the setup, it was felt that by supplying a.c. receptacles for each, the equipment could be used more flexibly and could be more easily maintained. The switch used is a six-pole, four-position rotary switch. Each of its positions and poles will be described later. The volume control consists of two 500,000 ohm, 2-watt potentiometers ganged together. Each potentiometer should have the same taper and should be of the audio taper variety.

Two flat-type neon bulbs were used to indicate power for the additional tuner and amplifier since they were easily visible. Also, the dot labels adhere well. The chassis height was such that it would fit into just the amount of space left when the preamplifier, in its own little cabinet, was placed within its cubby hole. The chassis was made from aluminum. All the holes were drilled before the aluminum was bent. The chassis was then bent to break. (This may be done in a machinist's vise.) Before the components were put in place on the chassis, it was sprayed with a gold paint, which comes in a spray can and is available in any hardware store. This was done so that the "control center" would match the other equipment.

The block diagram of Fig. 2 indicates the various functions of the unit and how they are switched. The "X's" in this diagram indicate where switching is done.

The four positions of the switch in Fig. 3 are labeled as follows: *F* for the normal position using the FM tuner; *A* for the normal position using the AM tuner; *S* for the stereo broadcast position; *T* for the stereo tape position. The levels or poles of the switch are numbered from one to six. For example, the notation "A" indicates the third level in the normal AM tuner position. Fig. 3 gives, in compressed form, the entire diagram of the equipment. The "X's" in this diagram indicate that a closed circuit exists through the selector switch for the

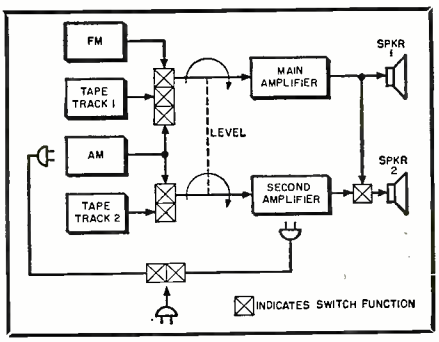


Fig. 2. Block diagram of entire system. The "X's" indicate where switching is done.

positions listed above and to the left of the "X." Thus, at the very top of the diagram, the first "X" has an "A" and an "F" above it. In these two positions a closed circuit exists through this contact. This occurs on level one. This is shown by the "1" which appears to the right of and above the "X" in the diagram. The first switching level is used to switch the second speaker from the main amplifier on monaural to the auxiliary output on stereo.

The second level is used to choose between the second channel of tape and the AM output on stereo operation. The arm of this level is fed to the rear potentiometer. The arm of this potentiometer, in turn, is fed to the auxiliary amplifier input.

The third switching level chooses between AM output, FM output, and the main tape output. This is applied by the arm of this level to the front potentiometer. The arm of this potentiometer is always connected to the tuner input of the preamplifier. Note here that during stereo tape operation the tape output is connected through the potentiometer to the tuner input of the preamplifier. This tuner input to the preamplifier, during stereo tape operation, should be open, as one would not use the tuner while listening to stereo tape; therefore, the connection is of no consequence.

Level four of the selector switch connects the tape input of the preamplifier directly to the tape output or connects it through the front potentiometer to the main output of the tape recorder. This is so because the level setting function is required for

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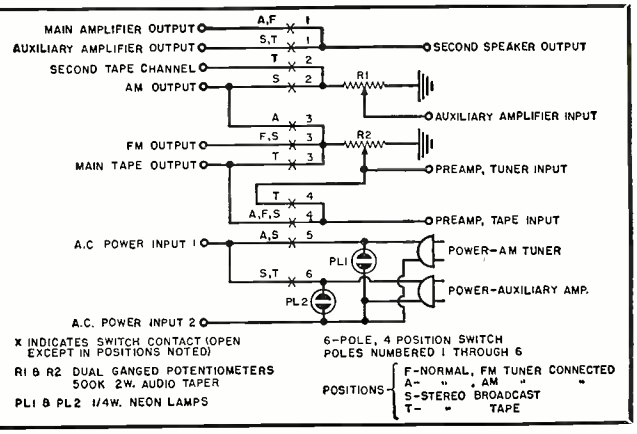
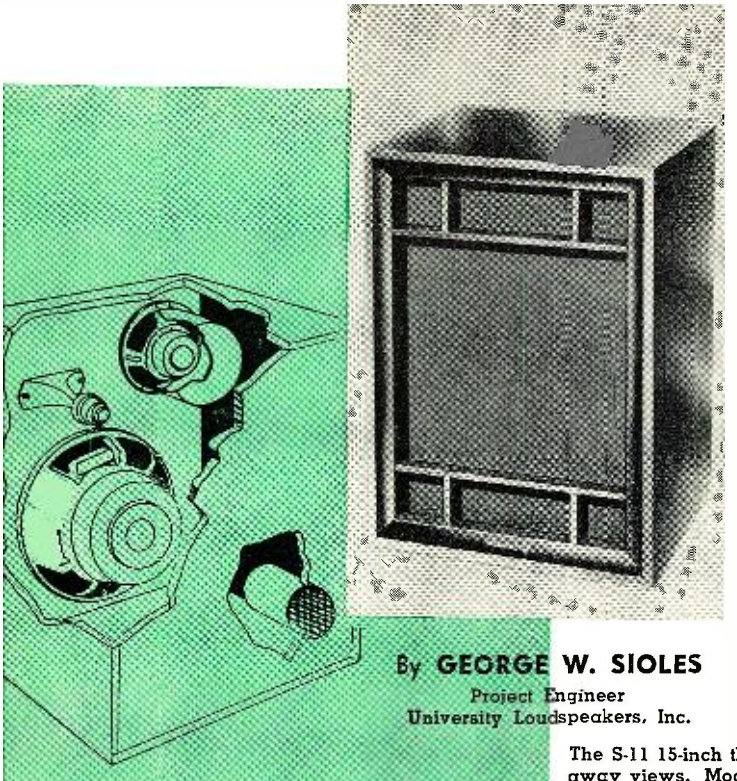


Fig. 3. Complete wiring diagram of the stereo control unit. A single 6-pole, 4-position switch is employed for the entire switching operation. A dual pot is used for gain control.

The "Ultra-Linear" Hi-Fi Speaker Systems



By **GEORGE W. SIOLES**
Project Engineer
University Loudspeakers, Inc.

The S-11 15-inch three-way system is shown in over-all and cut-away views. Models may be horizontally or vertically placed.

High compliance, low efficiency woofers used in compact ducted-port enclosures in new wide-range University units.

GOOD low-frequency response for high-fidelity systems is readily obtainable today with moderately large enclosures. Employing such enclosures, it is possible to design speaker systems utilizing a wide variety of complementary mid-range and tweeter units comprising good hi-fi systems.

However, there are many occasions when such enclosures are not adaptable to a particular small room, such as a den, alcove, or study and it becomes desirable to have a conservatively sized system.

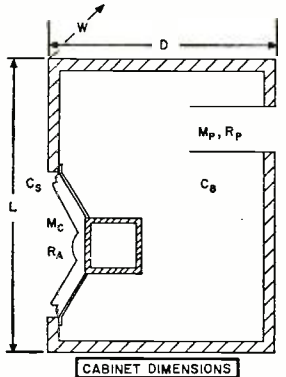
Whereas past practice has made it difficult to obtain good bass response from small enclosures, recent developments in the associated art of amplifier design have now made feasible small cabinet system designs with good bass response. This condition stems from the fact that with large amounts of clean amplifier power available, previous considerations of efficiency are of secondary importance. It now becomes possible to design systems utilizing new approaches to vented cabinets and woofer design where the former high-level, mid-frequency efficiency of these woofers is considerably reduced to a level compatible with the normally low-level, low-frequency output of woofers, and yet with the larger amplifier power available, useful sound output levels over the entire woofer range may be achieved.

This article will describe two new high-performance speaker systems of small dimensions, requiring no additional components for full-range reproduction. A cross-sectional view and equivalent circuit are shown in Fig. 1.

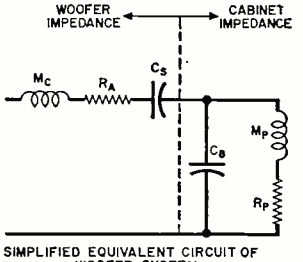
In these systems the linear bass extension is achieved, not only through the means of equalizing the mid-frequency sensitivity with the bass sensitivity, but through the additional principle of utilizing a modified vented cabinet to achieve more output over the extended bass range than would be possible with a sealed enclosure. These two systems, although of relatively low-efficiency, are more conservative of amplifier power than is the case with a totally enclosed box.

In the design of these systems it is recognized that full audible frequency range is not readily achieved from a single speaker and, therefore, they are designed to be multi-speaker systems. One of these is a 2-way system designed around a 20 cps-resonance 12" woofer with a crossover at 1500 cps, the other is a 3-way system designed around a 15 cps-resonance 15" woofer, with crossover points at 500 cps for the mid-range and 2000 cps for the tweeter.

As a consequence of the higher mov-

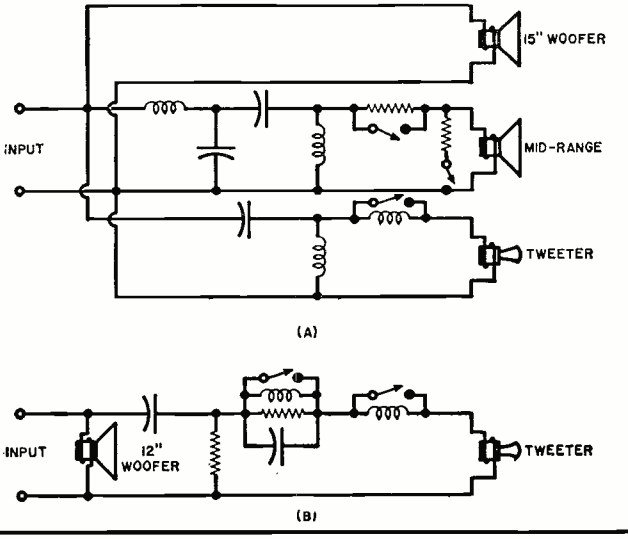


CABINET DIMENSIONS		
	12"	15"
L	25	26 7/8
W	14	19 1/2
D	14 1/2	17 1/2



SIMPLIFIED EQUIVALENT CIRCUIT OF WOOFER SYSTEM

M_C = TOTAL MASS OF MOVING SYSTEM
R_A = RADIATION RESISTANCE OF DIAPH.
C_S = COMPLIANCE OF SUSPENSION
C_B = COMPLIANCE OF ENCLOSURE
M_P = MASS OF PORT
R_P = RADIATION RESISTANCE OF PORT



(Top) Fig. 1. The woofer system along with equivalent circuit.
(Right) Fig. 2. Crossover networks for (A) 15", (B) 12" systems.

ing mass of the 15" woofer its mid-frequency response is attenuated, relative to the 12" unit, requiring a mid-range speaker to bridge the gap between the woofer and tweeter as shown in Fig. 3. The mid-frequency speaker is an 8" direct radiator tightly sealed in back to prevent its being driven by the high pressures inside the cabinet. The network schematics for both systems are completely shown in Fig. 2.

The cabinet designs are of the vented type, utilizing a tube whose mass in conjunction with the cabinet compliance results in a resonance frequency of 30 cps. (This will hereafter be termed the cabinet resonance, to distinguish it from the speaker free-air resonance which occurs at 20 cps or lower.) The use of a vented enclosure is advantageous from the point of view of maximum sensitivity and minimum distortion as will be explained shortly. The use of a duct or tube is dictated by the requirement of maintaining an adequate area of opening so that there will be no losses due to viscous effects. A simple aperture of the same area would require a larger enclosure to tune to the same frequency.

The reasons for choosing a system or cabinet resonance of 30 cps are many. The statistical distribution of program material is such as to make the range above 30 cycles more important than the range below 30 cps but by placing the system resonance at 30 cycles, we are, in effect, favoring the response at 30 cycles. The equivalent circuit shows that at the parallel resonance frequency between the port mass and the cabinet compliance (*i.e.*, cabinet resonance), we expect the circuit impedance to be high. Therefore, the amplitude of the cone motion will be small, thus reducing distortion. Since 30 cps is the lowest frequency we want to favor, it is logical to allow the cabinet to exert its maximum loading on the speaker at this frequency. It would be possible to design an enclosure to resonate at a lower frequency, such as 20 cps for example, with consequent reduction in 20 cps distortion. However, there is little, if any, useful energy there and by tuning to this frequency the 30 cps response would be compromised. In addition, tuning to 20 cps would reproduce more rumble.

The effective damping of the resonance just mentioned is accomplished electrodynamically. A full discussion of this solution to the damping problem involves consideration of flux density, coil mass, cone mass, and their effects in a more complete equivalent circuit than the one shown in Fig. 1. Clearly, such a discussion is not within the scope of this article.

It is interesting to note in the analogous circuit that if the inductance is open-circuited (this inductance being analogous to the port mass), we are left with a circuit having only compliance, which represents the case of a simple closed box. When this is done, the otherwise high parallel resonance impedance is removed and the cone am-

(*Continued on page* 60)

COVER STORY

HI-FI in the HOME

Attractive high-fidelity setup chosen with a view toward expansion into a full stereophonic system.

THIS month's cover photograph shows a nicely styled, yet compact high-fidelity system which is completely mounted atop a long, low coffee table. Although the system as it now stands is basically a monaural setup, some thought has been given to the expansion of the system into a full-fledged stereophonic arrangement. Evidence of this is the fact that a stereo tuner has been chosen as one of the program sources.

This stereo tuner (top unit at the far left) has both its AM output and its FM output fed into the complete amplifier unit. The amplifier, located beneath the stereo tuner, is of the popular flat type that matches the size of the tuner. The unit contains a complete preamplifier so that a separate unit is not needed for this function.

Also connected to the input of the complete amplifier is the output of a magnetic phono cartridge being used in conjunction with a precision turntable. A compact, 2-way speaker system, which is on the center of the table, is connected to the amplifier output.

Conversion to Stereo

In order to convert the system shown into a complete stereo setup, certain additional components must be included. The stereo broadcast program source, in the form of a stereo tuner, is already being used. But instead of using either the AM output or the FM output alternately, both outputs would be used at the same time for a stereo broadcast. This requires an additional complete amplifier, perhaps similar to the one already shown, to handle the additional channel simultaneously. What is more, an additional loudspeaker system, fairly similar to the one already in use, must be added for the other channel. The two speaker systems should be located according to the recommendations made by the broadcast station transmitting the stereo program.

Finally, if it is desired to add the facility for handling the ever-growing library of stereo tapes, it will be necessary to add a tape deck that will handle the stereo tapes. The two outputs from the stereo tape heads must then be connected to the two individual amplifiers and speaker systems.

The loudspeaker system being used is the new University "Ultra-Linear" S-10L. This is a two-way system using a low-efficiency, high-compliance 12-inch woofer and a wide-angle tweeter. A complete description of this new system and details of its operation and performance are to be found in the adjacent article.

The cartridge and tone arm used is the Shure "Dynetic." In this unit the cartridge and tone arm form one integrated design which has an optimum tracking force of only 1 gram and a compliance of 6×10^{-6} cm./dyne. A moving magnet in conjunction with a fixed coil are used in the head to produce the required output signal. For the complete story on the cartridge and tone arm, refer to the article on the "Dynetic" that appeared in our May, 1957 issue.

The turntable shown is the Rek-O-Kut "Rondine Deluxe" Model B-12H. This is a 3-speed, 12-inch precision turntable that uses a hysteresis synchronous motor driving a machined, balanced cast-aluminum table. Instant speed switching is used, and there is a built-in 45-rpm hub adapter. Turntable noise level is said to be 55 db below average recording levels.

The output of the cartridge is connected to the low level (high gain) magnetic input of the H. H. Scott Model 99-D complete amplifier. The unit comprises a 22-watt power amplifier in conjunction with a built-in preamplifier. The preamp has two low-level magnetic inputs and three high-level inputs. Built-in tape and record equalization, and the usual bass, treble, and loudness controls are provided in the amplifier.

The AM-FM stereo tuner is the H. H. Scott Model 330-C. This unit has completely independent AM and FM sections for receiving stereophonic broadcasts. The tuner features high sensitivity and high selectivity. Furthermore, the FM section uses special wide-band circuitry including 2-mc. detector bandwidth. In the AM section, three-position adjustable bandwidth is provided along with a 10-kc. whistle filter. Separate AM and FM outputs are available for stereo broadcast reception.

All in all, the complete system, as shown here, makes for top quality sound reproduction either from broadcasts or from records, with enough flexibility so that the system may be expanded, if desired, for stereo. (Photo by Ray Cicero)

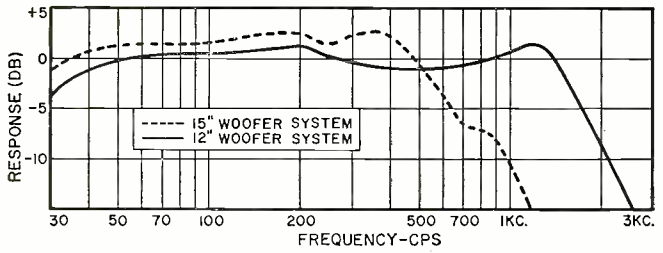


Fig. 3. Comparative response of 12-inch and 15-inch woofers.

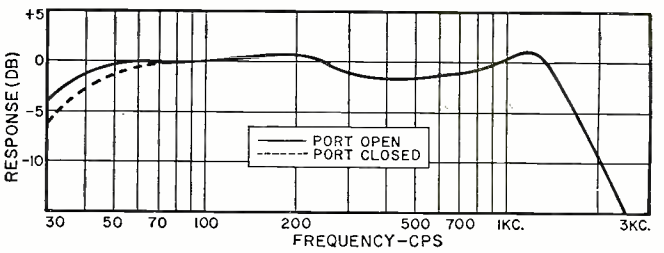


Fig. 4. Twelve-inch woofer with the port opened and closed.

plitude in the region of 30 cycles increases, with a consequent increase in distortion. In addition, the output drops because the loss of radiation from the port opening is not offset by the increased radiation from the cone. In short, with the port closed, the cone must work harder to deliver a given acoustic output and, consequently, its distortion for a given output will be higher. The performance of the vented enclosure design in conjunction with a woofer of *lower* resonance than the enclosure resonance, is illustrated in Fig. 4, which shows comparative response curves for the open port and the blocked port, indicating the increase in response due to the vented design, and in Fig. 5, which shows a plot of distortion at comparable output levels for the closed *versus* the open port. Curves shown are for the 12" woofer unit.

Fig. 6 shows a plot of the distortion as a function of frequency for different power levels. Note that the distortion is low for even relatively high power levels and that at normal listening levels, the distortion is practically negligible. The data shown is for the 12" woofer. The 15" woofer, naturally, has less distortion at comparable output levels.

An interesting phenomenon observed in our laboratory during listening tests on these loudspeakers was the velocity of air flow in the duct. When testing for pure tones at 30 and 40 cycles, such high power inputs were utilized that a ribbon placed in the vicinity of the duct was caused to stand out at a considerable angle due to the air velocity and matches were blown out with ease at a considerable distance from the port. With even these power levels, the output had very little harmonic content. On the other hand, during listening tests where music was the material that the speakers were reproducing, a ribbon hanging at the port opening fluttered only slightly even on heavy passages. This would indicate that most of the time the power input to the speaker at the low frequencies is considerably less than that power level at which the speaker was tested and found to be free from distortion.

With regard to the speaker mechanism itself, the design was based on achieving a minimum distortion and over-all sensitivity compatible with low frequency output. It should be mentioned that over rather wide limits of speaker mechanism design, the enclosure design is the primary determinant of sensitivity in vented enclosures over a particular low-frequency region, and the driver and enclosure together determine over-all flatness, distortion, and sensitivity.

Although the performance of these systems is a combined function of enclosure characteristics and speaker component characteristics, the woofers are of special design aimed at accomplishing the smoothest low-frequency extension. The woofers were designed with as high a compliance as was considered mechanically stable, two spiders being used on the 15" unit for more stability due to the heavier moving system. The desirability of a high-compliance suspension may also be seen from inspection of the equivalent circuit; since one of the main sources of nonlinearity is in the suspension, if its reactance is made negligible compared to the reactance of the rest of the system, the distortion will be very low.

The voice coil was designed to overhang the physical length of the magnetic gap so that there would be no change in the force on the voice coil with changes in its position as it moves in the gap. Thus little distortion results from variations in the driving force when the coil moves through rather large amplitudes.

The final consideration in the woofer design was to achieve a level of sensitivity at mid-frequencies equal to the sensitivity at low frequencies. To accomplish this, optimum moving system mass and magnet weight had to be determined for the specified cone diameter. For example, if a large magnet were used and if the cone were very light, the middle-frequency sensitivity would be too high relative to the low-frequency sensitivity. In addition, a resonance mode due to the cone mass and effective cabinet compliance (the latter modified by the shunt mass of the port) would occur at a rather high frequency in such a small cabinet. If the magnet weight were reduced to maintain equality of low- and middle-frequency sensitivity, this resonance would be underdamped with consequent excess output and ringing. If, on the other hand, a heavier cone were used, a large magnet would be required to maintain equal sensitivity over the whole range. The resonance mode occurs at a lower frequency and the use of a large magnet provides optimum damping, with the result that there is no excess response or ringing. Consequently, the woofer-driver design was evolved to utilize a high mass cone and a heavy magnet.

The basic difference in performance between the 12" and 15" systems is that the 15" size, having a larger enclosure, has somewhat greater sensitivity at the lowest frequencies and requires a trifle less power to drive it. The 15" design also has more undistorted power-handling capacity due to the fact that for a given acoustic output, its amplitude of cone movement is less than for the 12" system.

The remainder of the design was predicated on maintaining flat response to as high a frequency as possible. Due to the necessarily reduced sensitivity of the woofer sections as a consequence of the small cabinet size, it was found necessary to attenuate the response of the associated high-frequency components to put them in balance with lower frequencies. The result is a response which extends with smoothness to 20 kc.

Many of the design features found in these systems, such as the increased cone mass, are a consequence of the small cabinet size which is considered desirable in terms of the needs of a large segment of the buying public to purchase compact enclosures. —30—

Fig. 5. Percentage distortion of the 12-inch woofer unit.

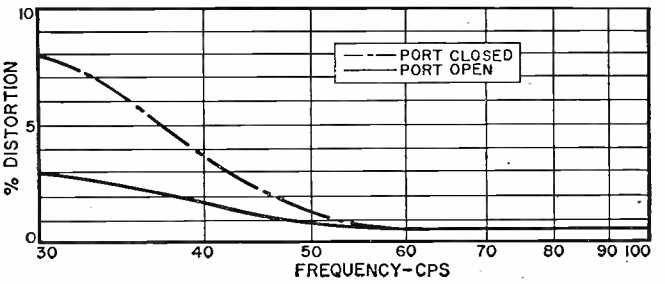
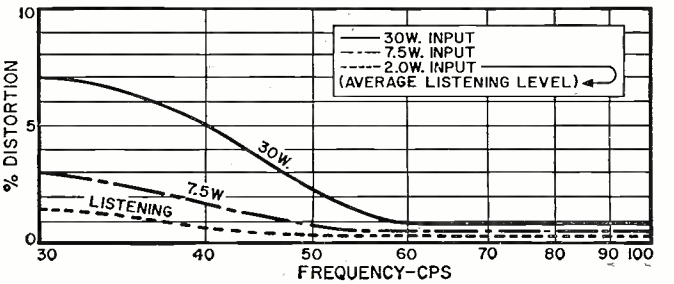
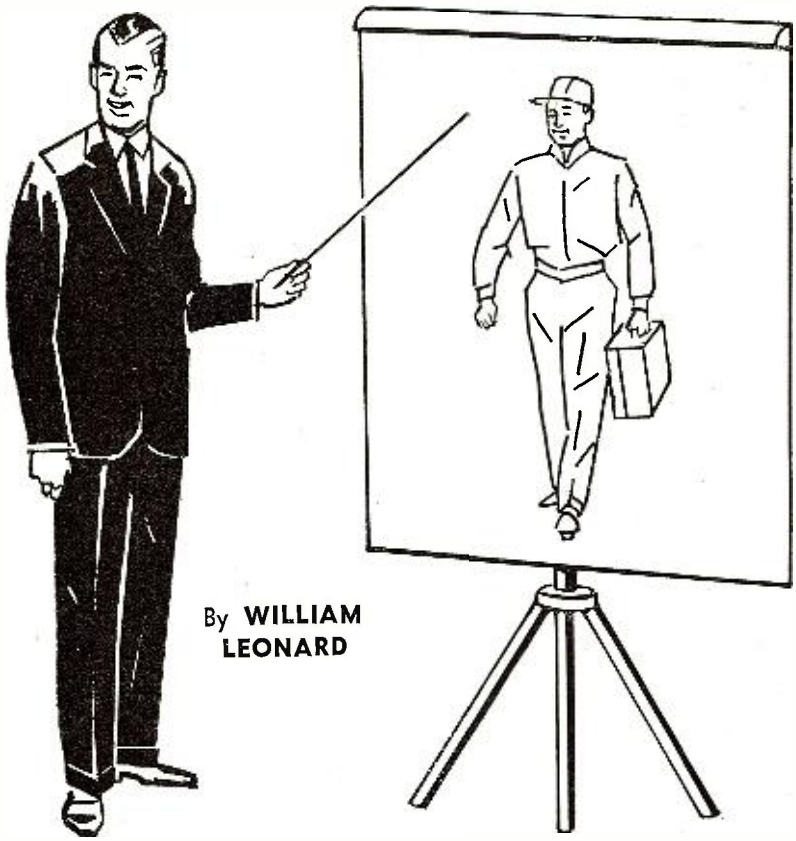


Fig. 6. Distortion of 12-inch unit at various power inputs.



Service and Public Relations



By **WILLIAM LEONARD**

The public's opinion of independent service controls the future course of the industry.

DAY AFTER day, thousands of TV set owners scattered across this broad land just ask for trouble when they phone shop after shop to inquire "How much do you get for a TV service call?" A lot of them end up in the clutches of free-wheeling service gyps who glibly quote the attractive price of two dollars for the "call" and then charge all the traffic will bear for "service."

Some alert dealers have won loyal customers for themselves by the manner in which they handle this type of phone call. The standard practice in one dealer's organization is to reply: "We can send an apprentice serviceman to check your set for $2.00. However, it will cost five dollars if you want us to send one of our experienced technicians." The response from most customers is "I don't want an amateur tinkering with my set. Send one of your experienced men."

In working out this plan for handling price shoppers, this dealer was aware of the fact that this type of customer always feels he did not receive adequate value for the money he had previously paid out for home service. The technician who had been called before probably dashed in, changed a couple of tubes, collected five dollars for the call plus the charges for the tubes, and was on his way in less than ten minutes. The customer, to whom nine or ten dollars is important money, felt he or she was the victim of a racket.

This dealer feels that it is his job as a businessman to adjust his business practices to suit the needs of the customers in his market. He cannot change set owners, so he trains his employees in how to deal with people and get along with them. Weekly meetings are held to discuss customer relations. As a result, customers feel they get honest value for the money they pay for service from his organization.

People are not analytical about how much it costs to provide service in the home. One dealer discovered the average housewife's attitude toward transportation costs when he tried to explain his charges by telling her how much it costs to operate service cars. "I don't see why you should expect me to pay for your cars," she said. "Everybody has to own a car just to get back and forth from work."

In questioning the fairness of the five-dollar service charge, this set owner brought up the fact that two technicians she had called previously had each charged her five dollars for the call plus the cost of the tubes. Neither had been in her home ten minutes to complete the service. She figured they were making six calls an hour for which they were collecting thirty dollars plus the profit on the tubes. At thirty dollars an hour, she reasoned, these men were making as much money in two days as her husband earned in a month—and he had to pay for his own transportation to and from work!

In another city, a set dealer who charges three-fifty per call, and freely admits he loses money on service, received an irate letter from a new customer about a $3.50 invoice for a service call.

"This charge is unfair and outrageous," the letter said. "Your man was in my house only a few minutes. My TV set did not need service. All it needed was an adjustment. While he was here you phoned and told him to call on a neighbor nearby whose set was out of order. I'm sure this neighbor paid your charges for the service call, so I don't see why you should charge me since there was nothing wrong with my set."

In discussing this experience, the dealer said:

"We are seriously at fault in the slap-happy way we handle service calls and in not making adequate charges for our time, knowledge, skills, and transportation. This man did not buy his set from us so there is no reason why we should be responsible for educating him how to adjust it. Yet he is unhappy over a charge that is less than our cost of operating. The fault is ours, of course, because our man did not make his efforts look as if they were worth the charges we had to have for the call.

"People are inclined to be unreasonable when it comes to paying for service," he continued. "We must recognize that and find ways and means to make them feel they are getting real value for the charges we must make. In my case, I must raise my charges. In doing that we are going to give a polished type of service that will really look like the money. All service dealers must do that if they hope to stay in business."

The report labelled "Buttonhook Service in the Push-button Age" in a recent issue of *Time* magazine served to emphasize the magnitude of the public-relations job that faces electronic service dealers and technicians. Although it took a crack at all types of consumer service, the *Time* article devoted most of its verbiage to TV service. Relying on "case histories" and cartoons that are hoary with age in this fast-moving era, the implications of the report are that independent service is not adequate to handle the task

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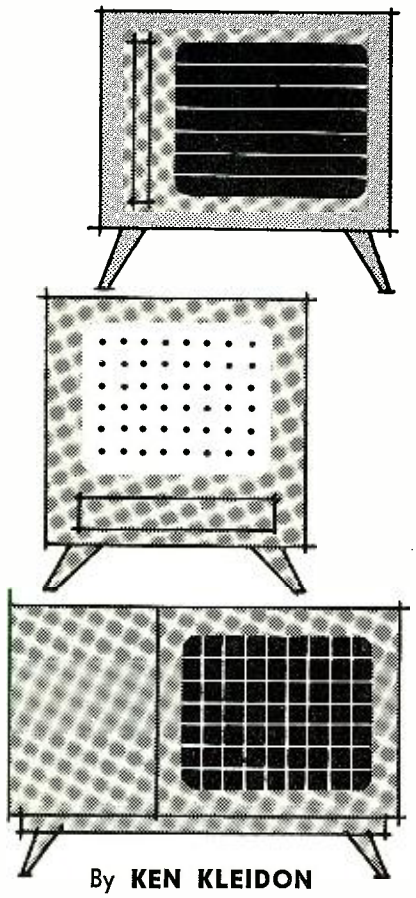
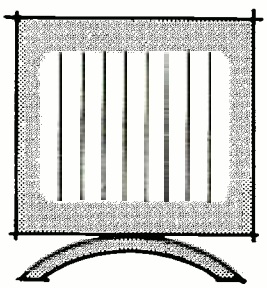


Practical Color TV for the Technician



By **KEN KLEIDON**
National Color TV Manager
Hycon Electronics

Part 6. The series concludes with techniques for localizing troubles in all parts of the color set.

NEW TYPES of test equipment involved in color service techniques were noted in the previous article. The techniques and procedures themselves will receive primary consideration here. The theme originally stated in the first article of this series is worth restatement here: in the compatible color receiver of today, those circuits which handle the monochrome signal closely parallel their counterparts in a black-and-white receiver.

Fig. 1, the block diagram of a production-model color set of recent vintage, illustrates this parallel. The seven blocks at the top of the diagram are the all-new circuits which deal exclusively with the color portion of the transmitted signal—color burst and chrominance information. The remaining 23 blocks are either identical with their cousins in monochrome sets or very familiar. Whatever new developments may occur in color-circuit design, the basic ratio of 80% familiar circuitry to only 20% new circuitry is not likely to change much.

Analyzing a color receiver in this manner enables servicing on a more realistic basis. A four-part division can easily be accomplished and will be a definite aid when troubleshooting. This four-part division, raster, picture, sound, and color circuits, is indicated by broken lines. A percentage figure is also indicated as a comparison among the four parts. These figures were based on the number of tubes and circuits in each part. The raster (40%), picture (30%), and sound (10%) circuits account for the familiar 80% of the circuits.

This fact can well be used to advantage by the service technician when attempting to isolate a problem in a defective color receiver. By analyzing picture and sound, a defect can be localized quickly. Fortunately the majority of the service problems encountered will be identical to those experienced in monochrome receivers or will lie in familiar territory. Also remember that the first requirement of a color receiver is to reproduce a good black-and-white picture before a normal color picture can be achieved. The monochrome circuits must be functioning normally before proper color reception can be obtained. Thus many faults that at first appear to involve defective color operation will quickly come into the category of the familiar, without the need to examine color circuits.

Raster Circuits

Just by analyzing the face of the picture tube and simultaneously using the station selector or tuning control, the technician can often narrow the location of the trouble. As an example, if the receiver is tuned to an unused channel and the face of the picture tube portrays a normal raster, the raster circuits of the receiver are functioning normally. If the raster fills the screen both horizontally and vertically, has adequate brightness and appears black-and-white, the raster circuits are in proper working order irrespective of the impression that may have been given by the face of the tube when a signal was being received.

If the raster does *not* appear black-and-white (appears bluish, greenish, or brownish), the balance controls, consisting of the individual electron-gun screen and background controls, require re-adjustment. If a discoloration is observed in one area of the tube's screen, the purity controls are not properly adjusted. Either condition would necessitate following the control adjustment procedure outlined in the receiver's service instructions by the manufacturers.

Such conditions as no raster, no vertical sweep, insufficient horizontal or vertical size, poor focus, blooming, insufficient brightness, pin-cushioning, and the like, are identical to monochrome service troubles and can be isolated by using the same techniques and procedures now employed for monochrome receiver service.

Picture and Sound Circuits

If the raster circuits are found to be functioning normally, the station selector control can again be used, this time to check the picture circuits. When the receiver is tuned to a channel providing a monochrome signal, the picture tube should portray a stationary black-and-white picture with sufficient contrast, detail, and acceptable convergence if the picture circuits are functioning properly. These include (Fig. 1) the tuner, i.f. amplifier, a.g.c., video, sync, and convergence sections.

If color fringing is observed at a distance of eight to ten feet from the face of the tube, the convergence controls require re-adjustment. The control adjustment procedure outlined in the receiver's service instructions should be carefully followed when correcting for misconvergence. Other possible troubles include: no picture, no sound-no picture, negative picture, smear, no horizontal or vertical sync, hum in picture, and the like. These are all familiar.

The sound circuits of a color receiver are also similar to the same circuits in a monochrome receiver and can be serviced in a like manner.

Color Circuits

This leaves only about 20% of the receiver to be checked. Again, by observing the face of the picture tube and tuning to a channel providing a color telecast (or by connecting a color-bar generator to the antenna terminals), it can easily be determined whether the color circuits are functioning normally.

Service troubles in the color circuits basically fall into three categories: (1) no color, (2) no color sync, and (3) improper color. Before considering steps to be taken to check color circuits, it is taken for granted that correct reproduction of a monochrome picture has been established, as noted; for even with these symptoms a "monochrome" circuit defect may be the cause.

1. *No Color:* In this condition, the face of the picture tube portrays a normal monochrome picture with no evidence of color even when the receiver is tuned to a color telecast or when a color bar generator is employed to provide the signal. This condition could actually be caused by a defect in any one of the seven color stages of Fig. 1. However, as an aid when attempting to isolate the defective stage, checking the color killer is the best starting point. This stage is a dividing point in the color circuitry. The bandpass amplifier, burst amplifier, and color-killer circuits are closely inter-related. When trouble develops in one of these circuits, unfortunately, the operation of the others is likely to be affected because of the action of the automatic chrominance control (a.c.c.) circuit. (Refer to Part 3 of this series in the October issue of this publication.) If trouble develops in either the burst keyer or burst amplifier, the color-burst signal will be lost. The keying voltage normally developed by the color burst and applied to the color killer will then be reduced and the color-killer stage will operate to cut off the bandpass amplifier. A loss of color on the face of the picture tube will result.

If the color-killer stage is checked and found to be operating (preventing the development of color information), the cause will usually be found in those circuits which process the burst signal, already noted. If the killer is found to be inoperative, as it should be when color signal is being received, then the circuit defect resulting in absence of color probably lies in the remaining color circuits: the 3.58-mc. oscillator, the bandpass amplifier, or the demodulators.

In either case, a wide-band oscilloscope is virtually an essential tool in localizing the defective stage. Probing from one stage to the next will indicate where the signal is lost or changed in shape or amplitude. For this procedure, a standardized signal is desirable in place of the constantly changing and unpredictable signal evident during an actual color broadcast. In cases where the mere presence or absence of signal is at issue, any signal will serve. However, there are the many cases where shape or amplitude is important and in these the standardized output from a stable generator, together with the typical oscillograms in the instruction booklet or in the set manufacturer's service data, will be of incalculable value.

There is always the possibility, when a no-color condition exists, that the defect is outside the color circuits even though a normal monochrome picture may seem to be in evidence on normal monochrome transmissions. Defects that are not immediately apparent may be altering frequency response in the monochrome circuits in such a way that color information is not being passed through these portions. Involved in such cases could be the antenna system, the tuner, i.f. amplifier, video detector, and video amplifier. The color-bar generator is useful in verifying or eliminating this possibility. First, the r.f. output of the generator is connected to the antenna terminals of the receiver. If color is now reproduced, the cause lies outside the receiver. If a proper color display does not appear on the face of the tube, the video output of the color generator should be connected directly to the video detector. Should color now be in evidence, the defect must lie somewhere in the tuner or i.f. circuits. Cases like these will not be usual however.

2. *No Color Sync:* This symptom will be encountered when the receiver is tuned to a color transmission. A normal-appearing monochrome picture will be portrayed on the face of the picture tube, but color information will appear as unstable stripes, generally diagonal, running through the picture. With the color information thus obviously out of mesh or out of synchronization with the monochrome portion of the picture, it is obvious that the 3.58-mc. subcarrier oscillator is not locked to the correct frequency. The defect, however, could be either in the oscillator itself or in one of the other circuits shown in Fig. 1 that process the burst signal.

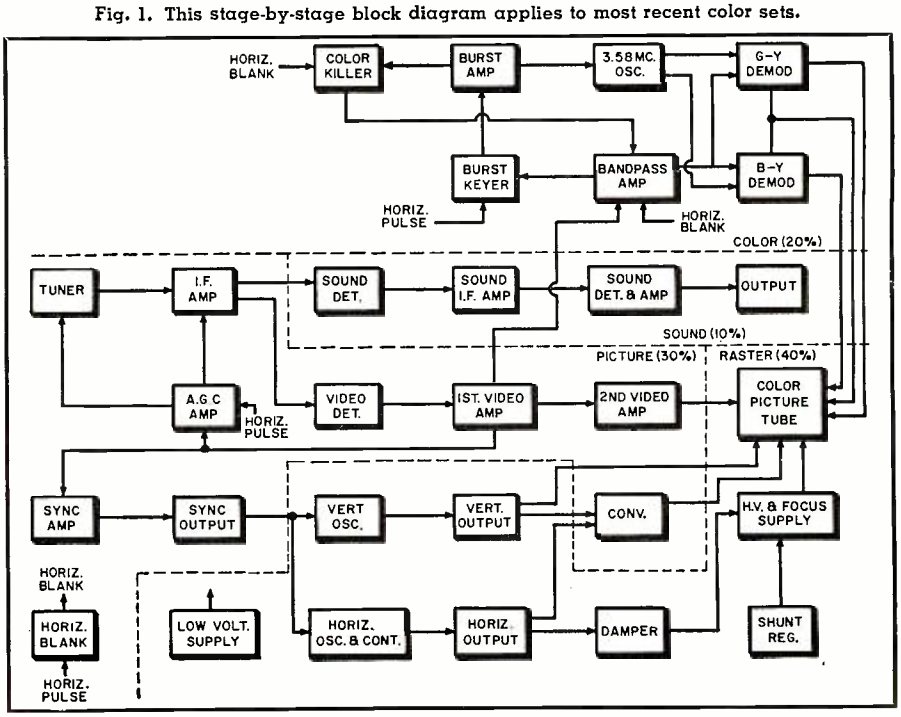
Again, the oscilloscope can be useful in signal-tracing the burst through the suspected stages. As a shortcut, the hue control (sometimes called the color-fidelity, phasing, or shading control) may be used to narrow down possibilities first. If manipulation of this control has some effect on the picture, the trouble is likely to be in those circuits prior to it; that is, preceding the oscillator. If no effect is evident, the oscillator, including the control, should be examined.

3. *Improper Coloring:* The widest variety of ills falls under this heading, and the differences in symptoms are the hardest to describe. Causes range from simple misadjustment of the hue control to failure of one of the demodulators. The first test point for localization is the demodulator circuitry itself. A color-bar generator is the best device to use for this test. After it is connected, the output from each demodulator is observed with the oscilloscope and compared to the reference pattern expected at that point. If both waveforms are correct, troubleshooting moves in the direction of the amplifiers following the demodulators (where they exist), to the matrix circuits, and to the grid circuits of the picture tube, or other circuits belonging to the separate guns. The possibility of a defective gun in the tube must also be considered.

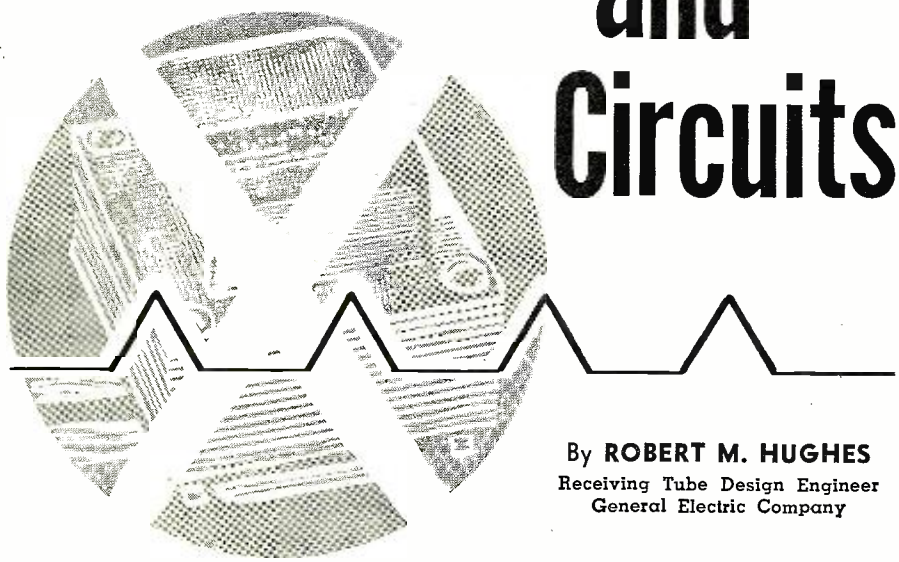
If one waveform only is incorrect coming out of the demodulators, then that demodulator is defective. If both waveforms are incorrect, then trouble ahead of the chroma detectors is indicated. The bandpass amplifier and the subcarrier oscillator or the output networks of these stages become suspect.

Obviously, not every type of fault that is likely to occur in a color receiver has been catalogued. However, the large majority will fall into the categories noted and will yield to systematic service techniques. Of course, the same could be said of monochrome service; but, after all, color circuits merely consist of vacuum tubes, resistors, capacitors, coils, transformers, and the like. All that they demand is an extension of present practical procedures. —30—

Fig. 1. This stage-by-stage block diagram applies to most recent color sets.



Series-String Tubes and Circuits



By **ROBERT M. HUGHES**
Receiving Tube Design Engineer
General Electric Company

This TV design is here to stay. Peculiar to it are certain service problems and test procedures.

WHEN A TUBE heater fails in a series string, it is traditional for the service technician to cuss because he has to "waste time" looking for the culprit—which, of course, is always the last tube he checks. This common attitude is somewhat short-sighted. After all, the increasing use of series-heater wiring is one of the more important of the money-saving, cost-reduction developments that has enabled the television industry to reach its present enormous proportions. Consequently, the use of series heaters may also be considered as a factor in the present size and volume of the service industry.

Whereas the first TV receivers were bulky, expensive instruments requiring a strong signal to produce a small, dim picture, today's receiver, costing and weighing perhaps a third as much, produces a brighter picture, four times larger, with half as many tubes. Series-string heater circuits have had a great deal to do with this remarkable change. Especially important has been the relatively new science of building special tubes, designed for just such use, stemming from the following simple premise: the "hot" resistance of a tube heater is roughly seven times that of the same heater at room temperature.

Neither technician nor manufacturer has been able to devise a simple, economical, and foolproof method of instantly spotting the one burned-out filament in a string. Nevertheless, improvements in the design of these tubes have yielded dividends for all. The best strategy for the alert technician is to soak up as much working knowledge as he can on the subject to fall back on in puzzling cases.

Tubes available for the early series-string circuits did not have identical heater currents and so required a complicated series-parallel heater circuit with current-adjusting resistors instead of a simple series circuit. Some circuits also used resistors with a negative-temperature coefficient of resistance to reduce the initial current surge when the receiver was turned on. This made the receiver warm up so slowly that it was well over a minute after the switch was turned on before a picture could be seen.

A common cause of tube failure in these early series-string circuits was heater burn-out, due primarily to surge voltage across individual tubes. Surge voltage was caused by unequal warm-up time of the heaters in these tubes.

If one tube warms up faster than the remaining tubes, this means that its heater resistance will increase faster than the resistance of the rest of the string. Since the current through the string is dependent upon the resistance of the string, this tube with a high resistance will have higher-than-normal voltage drop across it, resulting in a higher-than-normal power dissipation—and eventual burn-out. Therefore, for surge voltage to be eliminated and for the voltage across each tube to be constant during warm-up, the resistance of each tube must be in a constant ratio with that of the entire string. This requires that all tubes in the string take the same amount of time to warm up.

Series-string tubes usually have a higher-than-normal voltage between the heater and cathode. To prevent breakdown of the insulation between these elements, they must be designed to have a sufficient safety factor to withstand continuously this heater-cathode voltage. Also, in most early series-string circuits, a tube burn-out could cause an unbalance of current and subsequent damage to other tubes in the circuit.

Tubes designed specifically for series-string type heater circuits now feature (1) the same heater current in all tubes in a given line, (2) a constant warm-up time, and (3) an adequate heater-cathode voltage rating. The heater power required is somewhat dependent upon the picture tube size. In general, the 600 ma. line is intended for receivers with a 21" picture tube, while the 450 ma. line is for smaller receivers which use fewer tubes. By using the correct line, an efficient heater string using little or no extra dropping resistance is possible. Such an example is shown in Fig. 1.

There are construction features and testing methods used in the production of series-string tubes which were not found necessary in the production of regular tubes intended for parallel heater operation. For example, tubes must pass a "warm-up" time test. Warm-up time is defined as the time it takes the heater voltage across the tube to increase to a value equal to ⅓th of its rated value. This time should be approximately eleven seconds. Correlation tests show that the surge voltage that a tube will be subjected to in a series string is inversely proportional to warm-up time.

The warm-up time in a tube is controlled mainly by the mass of the heater. If the heater mass is low, the warm-up time will be short and if the mass is high, the warm-up time will be long. Tube manufacturers control both the heater wire and the insulating coating on the heater wire to a close tolerance to produce a reliable tube for series-string applications.

Whereas the current through one tube in a parallel arrangement will affect neither the voltage nor the current in other tubes in the same circuit, there is an interaction among tubes in a series string. For this reason, tube-testing methods, for the service industry as well as for the manufacturer, must be revised somewhat to take into account the fact that a tube's electrical characteristics, when it is tested in isolation, may not be the same as when it is tied into a string. Fundamentally, a tube's electrical characteristics depend on emission from the cathode. If emission is low, plate current and transconductance will also be low.

Now let us take the case of a tube with poor cathode emission whose heater also has somewhat lower resistance than it should. With a fixed voltage applied to this heater, current will be higher than normal; thus heater power will also be higher. This will

bring the cathode to a higher temperature than is normal for it, restoring the emission capabilities of the cathode. This tube would probably work adequately in a parallel circuit, and would also pass test in a conventional tube checker.

If, on the other hand, this same tube is placed in a constant-current circuit (as in series strings) instead of a constant-voltage circuit, the low heater resistance will cause a low voltage drop, causing a lower-than-normal heater power. This would further aggravate the poor emission. Thus, it can be seen that the poor-emission tube might not be rejected for series-string use unless the tube was tested with a constant-heater current, instead of a constant-heater voltage. Some service tube testers are equipped to test heaters with fixed current instead of fixed voltage. Where the technician does not own a checker of this type, he can avoid many puzzlers by keeping this point firmly in mind.

In most ways, the servicing of series-string receivers involves correcting the same type of faults that other TV receivers develop. There are, however, some problems which are peculiar to series-string sets.

Series-string sets may contribute an additional shock hazard in servicing. For greatest safety, an isolation transformer should provide power for the receiver and the chassis should be grounded.

In a receiver with parallel-connected heaters, all heaters are at ground potential at one end. Usually the most voltage which can be developed between any part of the heater and the cathode is the nominal heater voltage, usually six volts, plus whatever cathode voltage is developed across the bias resistor. However, there are some exceptions. For example, the damper tube, a cascode tuner tube, or an audio-output tube in a stacked "B+" circuit has a high voltage on the cathode. In a series-connected heater circuit, the voltage between the heater and the cathode also depends on where the tube is connected in the string, being low at the grounded end and as high as the line voltage at the high end. Note this progression from ground, at the bottom, to high a.c., at the top, in Fig. 1. It is this high heater-cathode voltage that may make a series-string set develop faults different from parallel-heater sets. Most set designers keep those tubes which would be most sensitive to heater-cathode leakage or hum at the low or ground end of the string, and put the tubes which are relatively insensitive to leakage or hum at the high end of the string.

Breakdown between the heater and cathode may be in the form of leakage or a relatively low-resistance short. Leakage may cause the set to perform poorly or not at all, but seldom causes any permanent damage elsewhere in the circuit. Heater-to-cathode shorts, however, may cause damage to other tubes or components.

Heater-cathode leakage will develop a voltage at power-line frequency on the cathode, the size of the voltage depending on the amount of the leakage, the resistance between the cathode and ground, and the position of the tube in the heater string. If the cathode is connected directly to ground, chances are that a great deal of leakage could pass unnoticed. There are some synchronizing and sweep circuits which have large values of cathode resistance. In these, a slight amount of heater-cathode leakage can cause picture distortion and synchronizing trouble. A slight amount of heater-cathode leakage in audio circuits will cause hum. Since tube testers may not indicate this small amount of leakage, it is sometimes necessary to determine whether a tube is offending in this way by replacing with one which is known to be good. In the servicing of series-string receivers, a careful analysis should be made of the circuit to determine whether heater-cathode leakage and the developed a.c. voltage in the cathode could cause the particular trouble being repaired.

When an outright heater-to-cathode short develops in a tube in a series string, other secondary troubles may show up as a result. On the one hand, this could be nothing more than a burned-out cathode resistor, as could occur in the cathode circuit of the 6CG7 in Fig. 2. However, things may not be so easy: in the same diagram, a similar short in the 12DQ6 horizontal-output stage would burn out a winding of the flyback transformer!

Another chain reaction could be set up if the heater-cathode short were to develop in the damper stage of many receivers. Note that the cathode of this stage may be connected to the "B+" supply. The direct short could put raw a.c. on the filter capacitors in the power supply, thus destroying them. Conversely, the high d.c. levels present at the cathodes of many damper tubes (boosted "B+") could very well overload other heaters in the string, once a heater-cathode short develops in the damper, and cause damage to these.

Heater overload need not occur only because d.c. is improperly impressed on the entire string through a short in one tube; a short of this type may damage other heaters because of excessive a.c., also. Consider what happens when the heater of a tube somewhere in the middle of a string is grounded. This might happen either because of a short in the tube itself or by the shorting of a filament bypass capacitor. Half the tubes in the string would be shorted out, and thus unlit. The others would be carrying increased current and voltage. One or more could thus burn out. Again, when components burn up, a careful study should be made of the circuit to determine cause before the obvious defect is repaired and an attempt is made to restore the set to operation. An embarrassing repetition might be avoided.

Particular care must be used in replacing tubes. Only those designed for series-string applications should be used, even though the six-volt prototype may have the correct heater-current rating; otherwise set reliability may be impaired.

Tube manufacturers generally provide well-engineered tubes for the special requirements of series-heater service. Accumulated field experience has indicated that the new tubes are considerably more reliable in such service than the older six-volt prototypes. With proper servicing methods by responsible technicians, the public will continue to enjoy the reliability now possible with series-string transformerless receivers. —30—

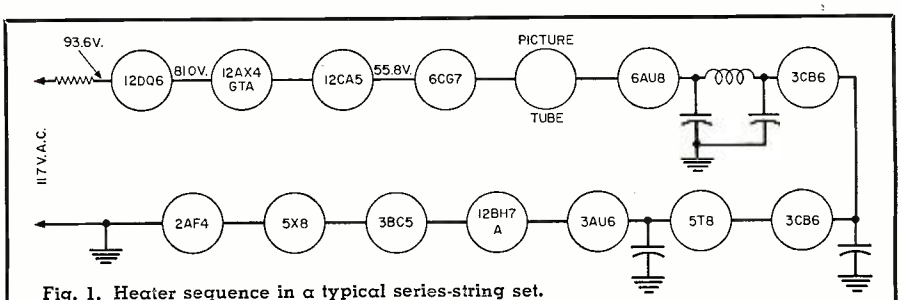
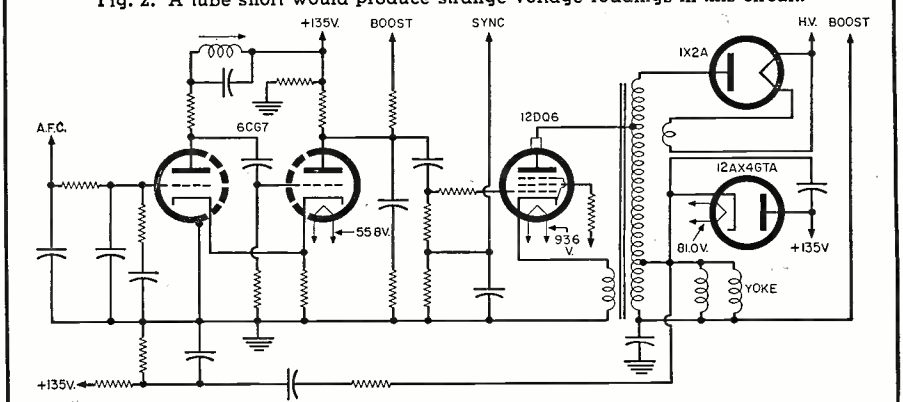


Fig. 1. Heater sequence in a typical series-string set.

Fig. 2. A tube short would produce strange voltage readings in this circuit.



How to Test and Adjust Chroma Circuits

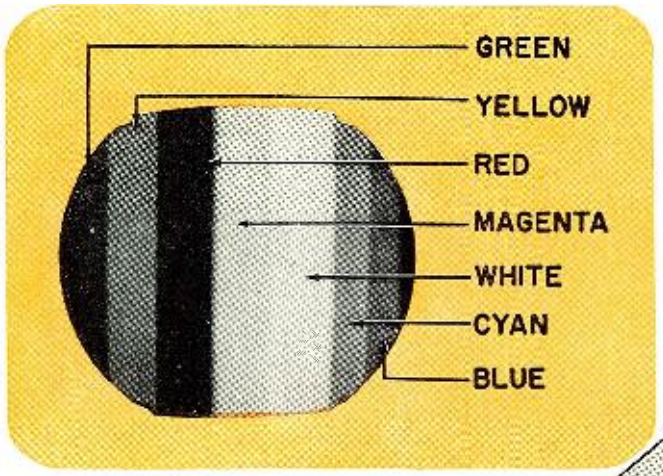


Fig. 1. Color-bar display produced by a standard color-bar generator.

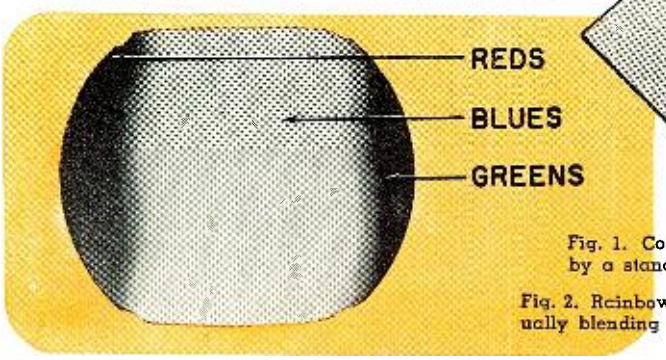


Fig. 2. Rainbow pattern comprises gradually blending reds, blues, and greens.

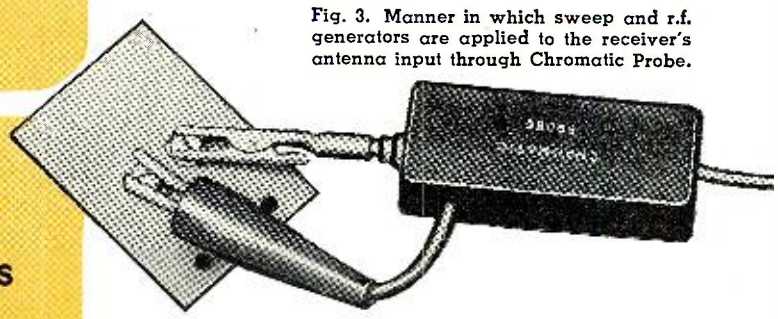


Fig. 3. Manner in which sweep and r.f. generators are applied to the receiver's antenna input through Chromatic Probe.

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

Generate your own color-difference signals to check bandpass amplifiers and other circuits.

ALTHOUGH a color-bar generator is an essential instrument in any busy color-TV service shop, beginners and experimenters sometimes wish to do color-TV test work with a minimum of equipment. You will find that conventional alignment generators will produce reasonably useful color patterns and signal waveforms, which find application in both installation and servicing of color-TV receivers.

One basic difference between a standard NTSC color-bar pattern and a color spectrum produced by alignment equipment is shown in Figs. 1 and 2. A definite sequence of individual color bars is obtained in the NTSC bar display; while the color spectrum or rainbow consists of a gradual progression and merging of various color-difference hues. The color-difference sweep seen in Fig. 2 does not display true colors, nor does it include many of the familiar lighter colors, such as yellow, pink, etc. Nevertheless, as we shall see, a color-difference sweep is a useful test signal.

This color-difference sweep to which we make reference is variously called a rainbow signal, linear-phase sweep, color-difference spectrum, side-lock signal, or offset color subcarrier. Some of the reasons for these various names will become apparent as the discussion progresses.

Getting a Rainbow Pattern

When the outputs from a sweep generator and a marker generator are applied to the antenna-input terminals of a color-TV receiver through a Chromatic Probe (Fig. 3) in a given way, a color-difference spectrum may be produced on the screen of the color-picture tube.

Such patterns provide much useful information concerning the operation of the r.f., i.f., and bandpass amplifiers, color detectors, and matrix section. Information is also obtained concerning color sync, burst gating, and quadrature alignment. Some of the tests involved are discussed here.

EDITOR'S NOTE: *Recent comparisons between the types of various color-signal generators currently available have tended to favor the instrument whose output is an NTSC type of bar pattern over the one that provides a rainbow. That each has its virtues is evident from the fact that some manufacturers make both types. Bob Middleton takes note of some of the things that can be done with a rainbow signal and also tells how one may be generated with existing equipment.*

The arrangement of the alignment generators with the probe is shown in Fig. 4. The Chromatic Probe is a non-linear mixing device using a crystal diode to permit the output from one generator to be modulated upon the output from the other generator. To adjust the generators and the receiver, first tune the channel selector of the receiver to a vacant channel. Advance the color-intensity control of the receiver to maximum, and advance the brightness control to approximately three-quarters of maximum.

In this application, the sweep or FM generator is actually operated as a standard signal generator: its sweep-width control is turned to zero and its blanking control is turned off. In fact, this entire procedure could be carried out with two standard generators that will tune the required frequencies; the sweep or FM generator is mentioned simply because it is most likely to be the only second generator available in many shops. In any event, this generator is first dialed to the frequency of the vacant channel to which the receiver is tuned. The technician can recognize when he is exactly on frequency by observing the screen of the picture tube: he will note a change in brightness when he is correctly in tune.

In the next step, the AM generator—the second one—is adjusted to provide output at the frequency of the 3.58-mc. color subcarrier, or 3.579545 mc., more closely. This signal is mixed in the probe with channel-frequency output from the sweep generator. As a result, the color circuits of the receiver are acted upon so that a solid field of color will appear on the screen of the picture tube if both generators are accurately adjusted to their correct frequencies. To achieve the correct display, it will probably be necessary to touch up the brightness control of the receiver and the tuning dials of both generators as well.

To obtain a rainbow pattern, the AM generator must now be carefully tuned down so that it is 15,734 cps below the frequency of the color subcarrier. Its frequency will be that of the so-called

offset color subcarrier, or 3.563811 mc. When this has been done correctly, a single rainbow of color will appear on the screen of the picture tube. This rainbow, shown in Fig. 2, can be used to set up the color-phasing (hue) control of the receiver quite successfully. As it actually appears on the screen the rainbow pattern begins with dim orange on the screen at the left-hand edge, merging into bright red. Blues are next in evidence, merging into greens at the right-hand edge. When the color-phasing control is misadjusted, the entire spectrum will shift horizontally on the screen. One example of this shift is shown in Fig. 7. Correct adjustment is obtained when the control is manipulated to produce the conditions shown in Fig. 2.

Certain unorthodox patterns may arise as a result of improper adjustment of the generators, but they are easily understood and corrected. For instance, if the AM or second generator should happen to be tuned *two* scan intervals (31,468 cps) rather than one below the 3.58-mc. color subcarrier, two rainbows would appear on the screen of the picture tube (Fig. 8) rather than one. If this lower-frequency generator were tuned to three horizontal scan lines below the color subcarrier, three rainbows would be displayed, and so on.

If the AM generator were to be inadvertently tuned so that it were 15,734 cps *above* the color subcarrier instead of being below it by the same amount, a single rainbow would also appear, but it would be turned around. That is to say that the color sequence would be the same, in reverse: greens would be on the left, blending into blues in the center, with the red group appearing to the right. Actually, any of the so-called unorthodox displays mentioned here could be used successfully, but, for the sake of simplicity and to avoid confusion, the standard rainbow is generally considered to be the one discussed in connection with Fig. 2, achieved when the AM generator is tuned to 15,734 cps below the subcarrier frequency.

Rainbow patterns do not have all the colors of the spectrum present, and those colors which are obtained appear somewhat dim, with blue predominant, as compared to the colors provided by an NTSC generator. The rainbow signal is incomplete, having no *Y* or luminance component. Since the luminance level is an important part of the "standard" colors that are produced by a generator whose output consists of separate bars of color, we can thus account for the difference in quality of color produced by the two types of generators. Nevertheless, a rainbow signal is an economical signal from which considerable useful information may be derived.

Scope Applications

When a scope is suitably applied in the receiver circuits, the rainbow signal provides additional useful information concerning the adjustment of the chrominance circuits. A vectorimeter pattern may be obtained by applying the output from the *R-Y* detector to the vertical amplifier of the scope, and applying the output from the *B-Y* detector to the horizontal amplifier of the scope, as shown in Fig. 5. The basic pattern obtained, with suitable adjustment of the vertical and horizontal gain controls of the scope, is illustrated in Fig. 6.

The vectorimeter pattern obtained from a rainbow signal is circular, except for a "bite" which is taken out by the chrominance blanking pulse. As the color-phasing control is turned, it will be observed that the position of the "bite" rotates around the pattern. The position of the chrominance blanking interval for normal operation is as shown in Fig. 6.

When the AM generator is not set very closely to the offset color subcarrier frequency, color sync is lost—the rainbow pattern "runs" on the screen of the color picture tube and the vectorimeter pattern on the scope screen becomes a rapidly rotating and confused display, as shown in Fig. 9.

Note that in the case of some color-TV receivers, the blanking pulse is displayed outward from the vectorimeter pattern, instead of inward. This type of display is illustrated in Fig. 10. Note also in Fig. 10 that the pattern is somewhat elliptical, and not quite circular—this condition brings up another point.

If the quadrature transformer in the color receiver is in proper adjustment, it will be possible to obtain a circular vectorimeter pattern by adjustment of the horizontal and vertical gain controls of the scope. In case a circular pattern cannot be obtained, it is indicated that the quadrature transformer is not correctly adjusted; an ellipse appears which cannot be brought into circular form by scope adjustment.

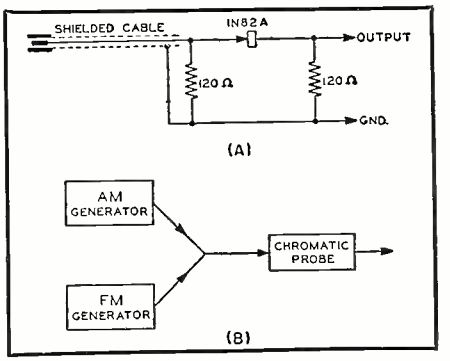


Fig. 4. (A) Schematic circuit diagram for the Chromatic Probe. (B) How both generators drive the set through the probe.

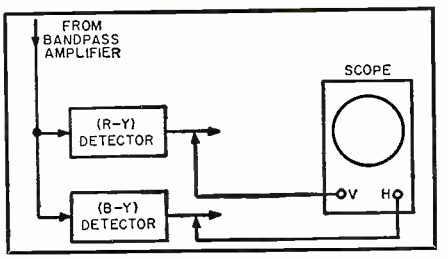


Fig. 5. A vectorimeter display is obtained by feeding the output from the R-Y detector to the scope's vertical input and the output from the B-Y detector to the scope's horizontal input.

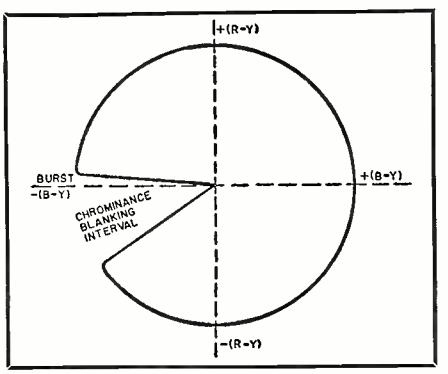


Fig. 6. Normal vectorimeter pattern obtained, after adjustment of scope gain controls, with the test hook-up to the detectors shown in Fig. 5.

Fig. 7. When the rainbow spectrum shifts horizontally on the screen, the color-phasing control is misadjusted.

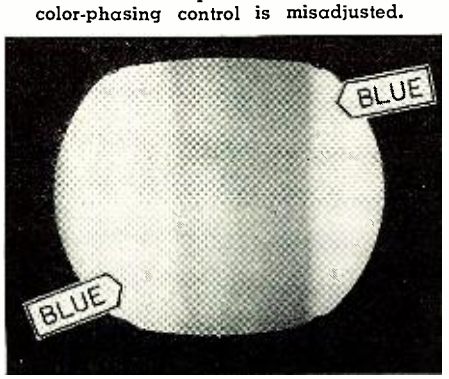


Fig. 8. Two rainbows will be displayed when the color-subcarrier signal is offset by two horizontal scan intervals.

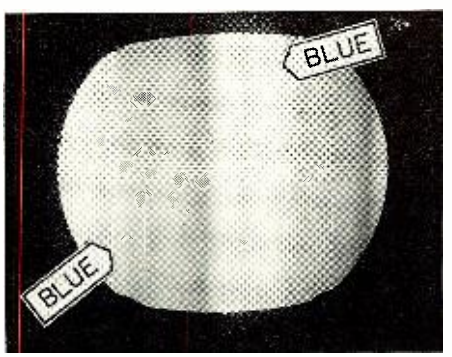
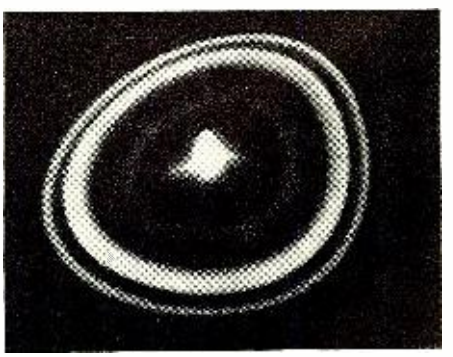


Fig. 9. When color synchronization has been lost, the vectorimeter pattern turns into this confused swirl.



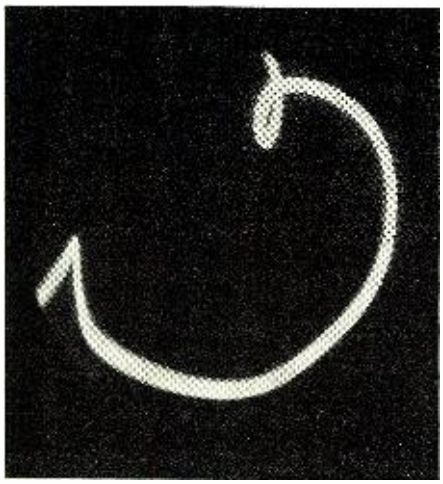


Fig. 10. In some receiver circuits, the blanking-pulse portion of the vectorimeter pattern will be displayed outward from the center of the circle, rather than biting in toward the center.

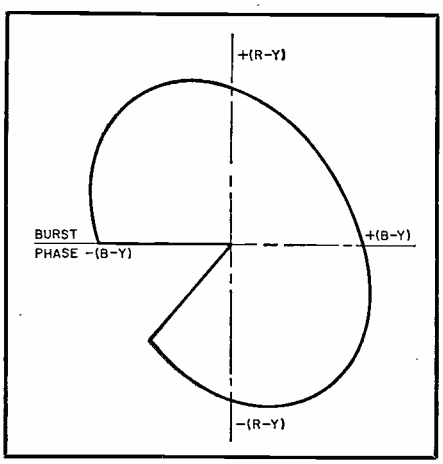


Fig. 11. An elliptical pattern after optimum adjustment of scope controls indicates the need for re-adjustment of the set's quadrature transformer.

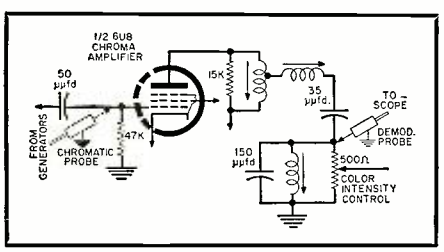


Fig. 12. Points for connecting generators and oscilloscope in making a response check of the chroma amplifier.

When an elliptical pattern appears, such as depicted in Fig. 11, the slugs in the quadrature transformer must then be adjusted to produce the circular pattern of Fig. 6. The elliptical pattern results from incorrect phase of color-oscillator voltages fed to the *R-Y* and *B-Y* detectors, and these phase errors are corrected by adjustment of the slugs in the transformer. There are other methods of checking the adjustment of the quadrature transformer with a rainbow signal, but this vectorimeter check is the simplest.

Another method, preferred by some, is to apply the output from one of the color detectors to the vertical-input terminals of a scope and to display the rainbow output signal on 15,734-cycle saw-tooth sweep. A sine-wave display with superimposed blanking pulse appears, as shown in Fig. 13. As the color-intensity (saturation) control of the receiver is advanced, the sine-wave pattern increases in height until the overload point is reached, when one or both peaks will start to flatten out, as illustrated in Fig. 14. Proper operation, of course, is obtained only below the overload point.

As the color-phasing control is turned, the position of the blanking pulse on the sine wave "slides" along the wave. When the quadrature transformer is properly adjusted, the pulses observed at the outputs of the *R-Y* and *B-Y* detectors will be 90° apart on the sine-wave displays.

Bandpass Amplifier Check

Good quality of color reproduction depends, in part, upon proper alignment of the chrominance bandpass amplifier. The frequency-response limits of this amplifier are typically from 3.1 to 4.1 mc., and the shape required of the response curve depends upon the circuitry used in the other signal sections of the receiver. A typical bandpass-amplifier response curve is illustrated in Fig. 15.

Tuning slugs are provided for contouring this curve, and the alignment procedure is somewhat similar to that encountered in i.f. alignment, except that the frequency of operation is considerably lower. Since many sweep generators provide some output down to 2 mc., the low signal frequencies handled in this receiver section can be swept directly for alignment purposes. However, in the case of the many sweep generators that do not have adequate low-frequency output, the very same Chromatic Probe discussed earlier may be used to extend sweep output downward in frequency to the point that it will be adequate for the sweep alignment of any circuit in a color receiver that is subject to such alignment.

In this sort of application, the two generators are fed into the probe in the manner already described, but they are set to approximately the same frequency and the probe acts as a heterodyning device. In this way, the output from one generator beats against the output from the other generator, with the output from the probe being the difference between them. Another difference between this setup and the one described earlier is that the sweep generator, in this case, continues to operate as a sweep generator, with the sweep-width control being set to cover a band of frequencies sufficient to the bandpass of the circuit under test. In other words, output from the probe is a sweep output that has been heterodyned down to be low enough in frequency for application to the circuit under test.

A typical test setup for checking the frequency response of a chroma bandpass amplifier is shown in Fig. 12. In this example, the low-frequency sweep signal is applied to the grid of the chroma amplifier tube from the Chromatic Probe. Note that a demodulator probe is applied at the output of the amplifier; its use is necessary in order to obtain a standard display of the frequency response curve, such as published in the receiver service manual. An undemodulated type of display can be obtained on a wide-band scope if the detector probe is omitted, but such displays are less conventional and less familiar.

Other Tests Are Possible

As the operator gains familiarity with his alignment equipment, he will find other useful tests to be made, such as use of a Chromatic Probe to check the rejection of the 920-kc. beat between color and audio carriers; use of the sweep generator as a low-frequency square-wave generator to test video amplifiers for phase shift; use of the sweep generator to determine the impedance match of a front end to a lead-in, and others. However, such procedures cannot all be explained in a single article. —30—

Fig. 13. Color-detector output when input signal is a rainbow pattern.

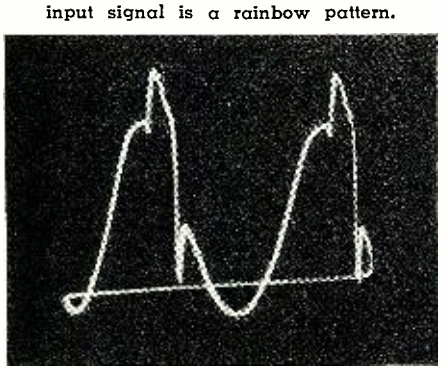


Fig. 14. The signal of Fig. 13 is shown overloading the color detector.

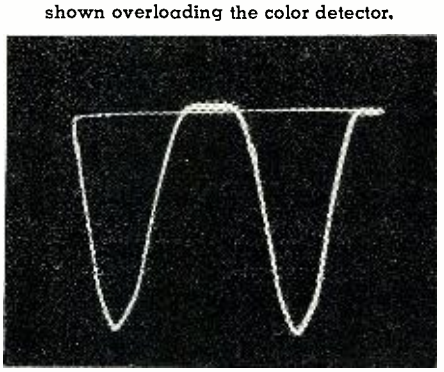
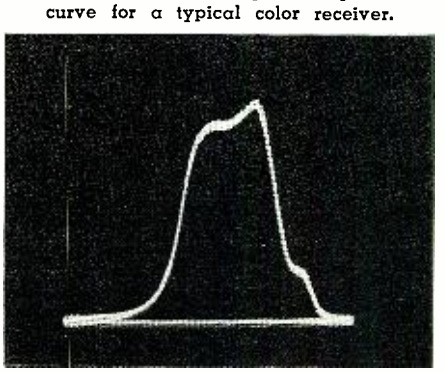
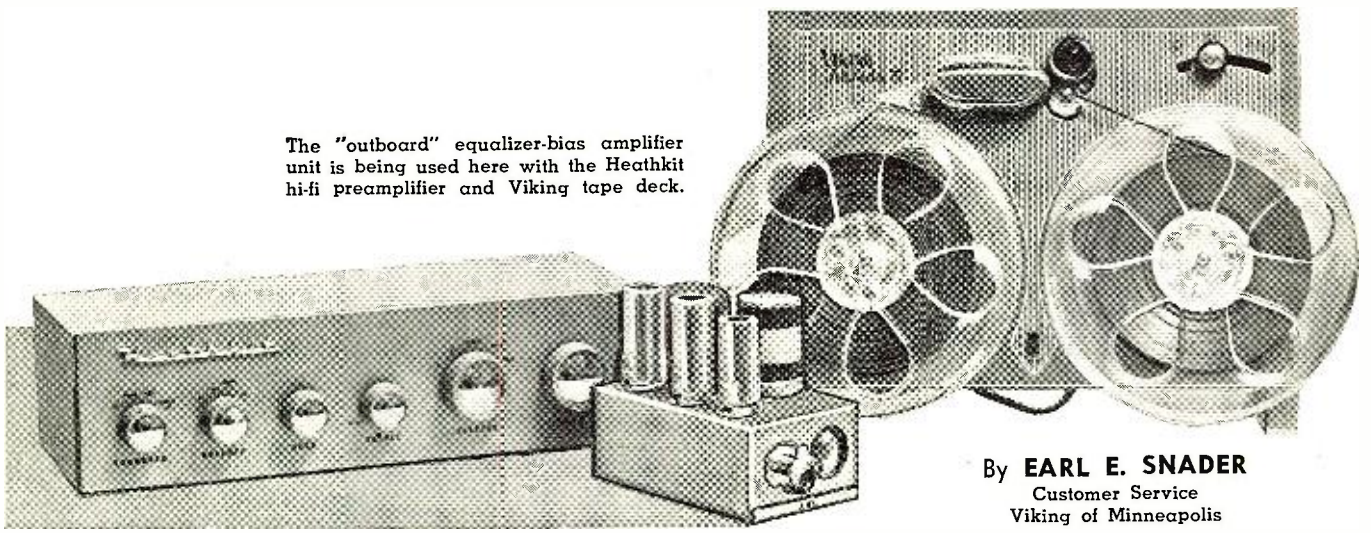


Fig. 15. Bandpass amplifier response curve for a typical color receiver.



"Outboard" Equalizer-Bias Amplifier for Tape Recording



The "outboard" equalizer-bias amplifier unit is being used here with the Heathkit hi-fi preamplifier and Viking tape deck.

By **EARL E. SNADER**
Customer Service
Viking of Minneapolis

Can you use your hi-fi preamp to make tape recordings? The answer is yes, with this unit that provides a bias oscillator, proper equalization, and impedance match.

UP UNTIL about a year ago high-fidelity, or extended range, tape recording was considered something for professionals who had the will and the means to invest in expensive equipment. Any other recorder was necessarily of the "utility" type—not too exacting as far as frequency response and fidelity was concerned.

With the advent of low-cost tape decks, such as the *Viking* FF75 series, capable of performance comparing favorably with expensive professional equipment yet priced within reach of the hobbyist, a new interest in tape as a hi-fi medium has been generated. Along with this new concept of tape recording came the equally new concept of using as much of a presently existing hi-fi system as possible. Excellent tape recording preamplifiers are now available in the low-priced field, designed to provide the necessary tone equalization, bias current, and impedance matching for a tape recording head.

But what about that nice preamp you now have with the suggestive label over one of the jacks on the back: "for tape recording" or "tape recorder output"? This poses the question, can the hi-fi preamp be used for tape recording? This is one of the questions most frequently received by *Viking*.

The answer is *no*—not without some extensive modifications that will destroy the resale value of your unit (if you should ever want to trade it for something better) or changing it to the extent that many of its present functions might be limited. A tape recording amplifier must: (1) include a bias oscillator, (2) provide the proper type of tone equalization for the magnetic tape medium, and (3) match the impedance of the record head accurately. Also, about 32 db of gain is necessary for recording from a .6 volt program signal source.

If you would like to use your hi-fi preamp for tape recording, you can do so with an "outboard" recording amplifier and your preamp. The unit about to be described has been designed for that purpose.

General Features

This "outboard" tape recording amplifier is designed for use with a commercial preamplifier unit such as the *Heathkit* WA-P2. As such, it provides the equalization, bias supply, has impedance matching for tape recording on a *Viking* FF75R deck. The same equalizer-bias amplifier can be used with any commercial preamplifier unit such as *MacIntosh, Fisher, Harmon-Kardon,* or any others which provide an output of at least .6 volt for tape recording.

The unit includes three triode stages, with one 6AV6 and one triode section of a 12AU7 operating as resistance-coupled amplifiers. The second section of the 12AU7 operates as a tone equalization stage providing NARTB equalization. A 12AV7 operating as a balanced push-pull oscillator provides erase and bias current at a frequency of approximately 60,000 cps.

A 6E5 "Magic Eye" tape recording level indicator is used because of its small size, low cost, and simplicity. Although it is not as accurate as a vu meter it is well adapted for use in a unit of this type. The correct impedance matching is provided for a *Viking* 75-1 half-track record/playback head or either section of a *Viking* 75-S2 in-line stereophonic record/playback head. Power requirements are 300 volts d.c. at 15 ma. and 6.3 volts a.c. at 1.2 amps. Details on a separate power supply, if required, will be given later. Connections to the erase and record/playback heads on the tape deck are made with 18-inch shielded leads. The unit, as constructed, is very compact, measuring only 6¼ inches long by 4¼ inches high by 3 inches wide over-all. It includes a recording level control and combination switch for removing the 300 volt d.c. plate supply when the amplifier is not being used for recording. All of the parts are standard with the exception of the special bias oscillator trans-

former which is available from *Viking of Minneapolis*.

A good hi-fi preamplifier becomes a high-fidelity tape recording amplifier when the "tape recorder output" jack of the preamplifier is connected to the input jack on this "outboard" recording amplifier unit. All of the normal inputs on the preamplifier can be used in the regular way. It is also possible to connect the output of a tuner or record player preamplifier to the input jack of this recording amplifier. This eliminates the necessity of going through an audio control-preamplifier first.

Fig. 2 shows the recording frequency response of this unit when connected to the "to tape recorder input" jack of a commercial preamplifier. The over-all frequency response of a record/playback cycle using an NARTB equalized playback system will be flat within ± 3 db, from below 30 to 12,000 cps.

A tape deck equipped with only one erase head and one record/playback head can be used. One disadvantage of such an arrangement is the necessity for changing leads in going from recording to playback, since no playback circuitry is included in the "outboard" recording amplifier. This disadvantage can be avoided, however, by using a tape deck equipped with a second record/playback head in addition to the erase head and one record/playback head normally used. A playback system can be permanently connected to the one record/playback head and this recording amplifier to the other. The *Viking* FF75RM deck can be used in this type of an arrangement.

Construction

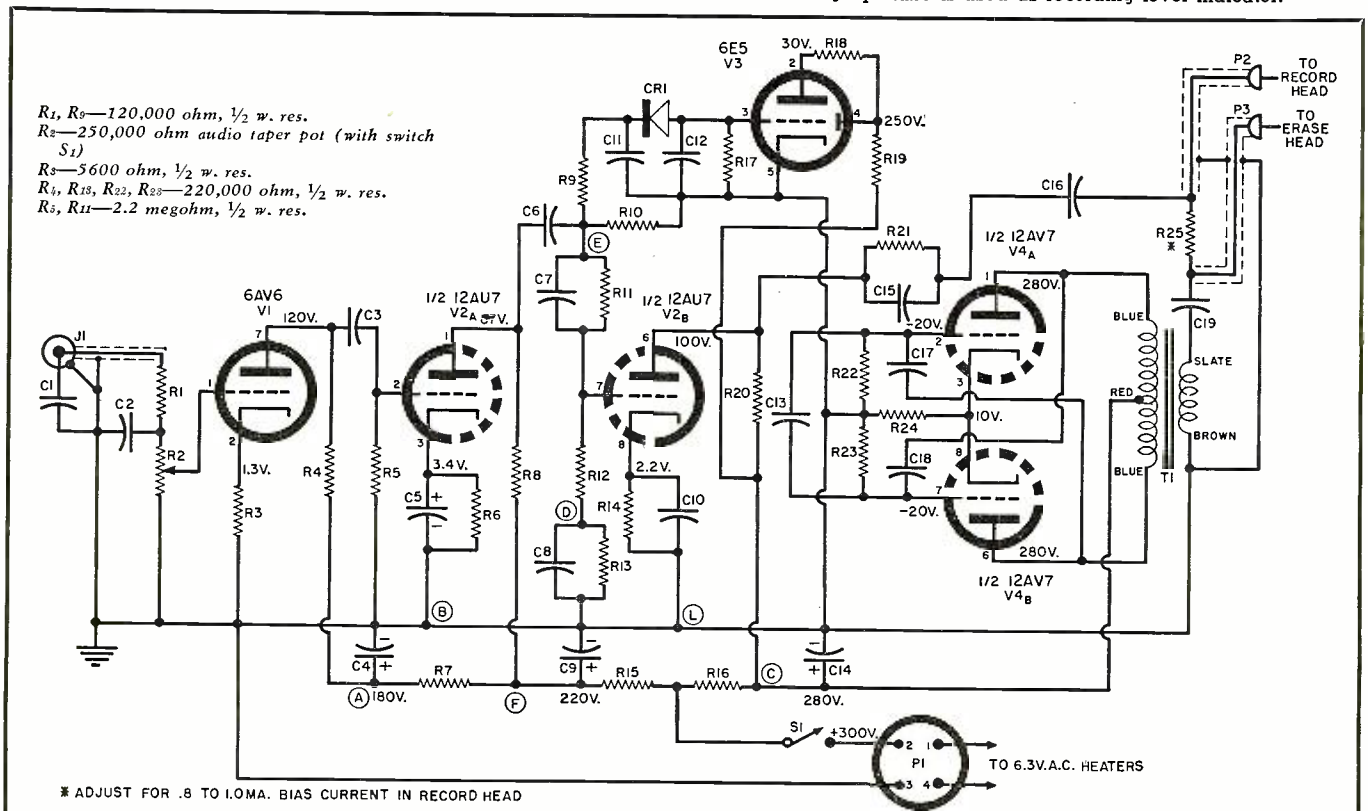
The chassis is an aluminum box 2⅛ inches high by 5¼ inches long by 3 inches wide. The front of this box serves as the front panel of the amplifier. The section with the small flanges at each end serves as the bottom.

Three of the tubes, the 6AV6, 12AU7, and 12AV7, are mounted in a straight line along the left-hand side with their centers ¾ inch in from the edge. The four-section filter capacitor is mounted with its center ⅞ inch in from the right edge and 1⅞ inches in from the front of the chassis. The bias oscillator transformer, mounted in the right rear corner, is centered with the filter capacitor and the 12AV7 tube socket. An extra 9/64 inch hole is drilled 7/16 inch in from the left edge of the chassis and centered between the 6AV6 and 12AU7 tube sockets. This is for one terminal strip. Another 9/64 inch hole is drilled on the tube socket center line and 11/16 inch in front of the 12AV7 tube socket center. This is to be used for a second terminal strip. Two 9/64 inch holes are drilled between the filter capacitor and the bias oscillator transformer to accommodate the small bracket which holds the 6E5 tube socket, inside the chassis.

The 6AV6 and 12AV7 tube sockets can be mounted using 4/40 x ¼ inch machine screws threaded into the top of the chassis. Since the 12AU7 *Vector*-type tube socket mounting screws cannot be threaded into the chassis because the shield base mounts from the top and the *Vector* socket mounts from the bottom, the holes for these screws are made a little larger.

The filter capacitor is mounted on an insulating plate to facilitate the use of a minimum number of chassis grounds when the unit is wired. It may be

Fig. 1. Schematic diagram of unit. The 6AV6 and one section of the 12AU7 are operating as resistance-coupled amplifiers. The second section of the 12AU7 is the tone equalization stage, while the 12AV7 operates as a balanced push-pull oscillator providing erase and bias current at a frequency of about 60 kc. A 6E5 tuning eye tube is used as recording level indicator.



R1, R9—120,000 ohm, ½ w. res.
R2—250,000 ohm audio taper pot (with switch S1)
R3—5600 ohm, ½ w. res.
R4, R13, R22, R23—220,000 ohm, ½ w. res.
R5, R11—2.2 megohm, ½ w. res.

R6, R14—2200 ohm, ½ w. res.
R7, R8, R12, R20—100,000 ohm, ½ w. res.
R10—250,000 ohm, ½ w. res.
R15—33,000 ohm, ½ w. res.
R16—2200 ohm, 1 w. res.
R17—4.7 megohm, ½ w. res.
R18—1 megohm, ½ w. res.
R19—10,000 ohm, ½ w. res.
R21—51,000 ohm, ½ w. res.
R24—1800 ohm, ½ w. res.
R25—33,000 ohm, ½ w. res. (value chosen to provide correct bias)
C1, C11—50 μμfd. ceramic capacitor

C2—100 μμfd. ceramic capacitor
C3—.022 μfd., 500 v. ceramic capacitor
C4-C5-C9-C14—15/50/15/15 μfd., 350/50/350/350 v. elec. capacitor (Mallory FP 419.9)
C6—.1 μfd., 300 v. ceramic capacitor
C7—25 μμfd. ceramic capacitor
C8—.047 μfd., 300 v. ceramic capacitor
C10, C12—.01 μfd., 300 v. ceramic capacitor
C13—1000 μμfd. ceramic capacitor
C15—.001 μfd. ceramic capacitor
C16—.5 μfd., 400 v. miniature tubular capacitor
C17, C18—500 μμfd. ceramic capacitor
C19—750 μμfd. ceramic capacitor

J1—Phono pin jack
S1—S.p.s.t. switch (on R2)
P1—4-pin plug
P2, P3—Shielded phono plug
CR1—1N294 crystal diode
T1—Bias-oscillator transformer (Viking Part No. D501. Available from Viking of Minneapolis, 9600 Aldrich Ave., South, Minneapolis 20, Minn.)
V1—6AV6 tube
V2—12AU7 tube
V3—6E5 tube ("Magic Eye")
V4—12AV7 tube

necessary to dress the hole made by a standard 1 5/32 inch punch so the capacitor mounting lugs do not touch the chassis.

The 6E5 level indicator tube socket is mounted on a small bracket. The end of this tube projects slightly through the 1⅛ inch hole in the front of the chassis and to the right of the level control. An *Amphenol* Type No. 78S6 socket, mounted on the socket bracket with a retainer ring, is used for the 6E5 tube. This bracket should be made from fairly heavy aluminum, both for maximum strength and also because a shim may be necessary to secure the socket and retainer ring if the metal is too thin. Mount the bracket on the chassis with its mounting flange forward. Pins No. 6 and 1 of the tube socket should be toward the outside edge of the chassis when the socket is being mounted.

A series of ⅜-inch holes is provided in the front to mount the level control and in the rear to mount grommets to pass the power cable and leads to the tape deck. A standard *RCA* phono jack is also mounted in the rear of the chassis, to serve as an input jack. This is toward the same edge of the chassis as the tubes and level control on the top and front respectively.

Mount a terminal tie point on the underside of the chassis and at the bias oscillator transformer lug in the center of the chassis.

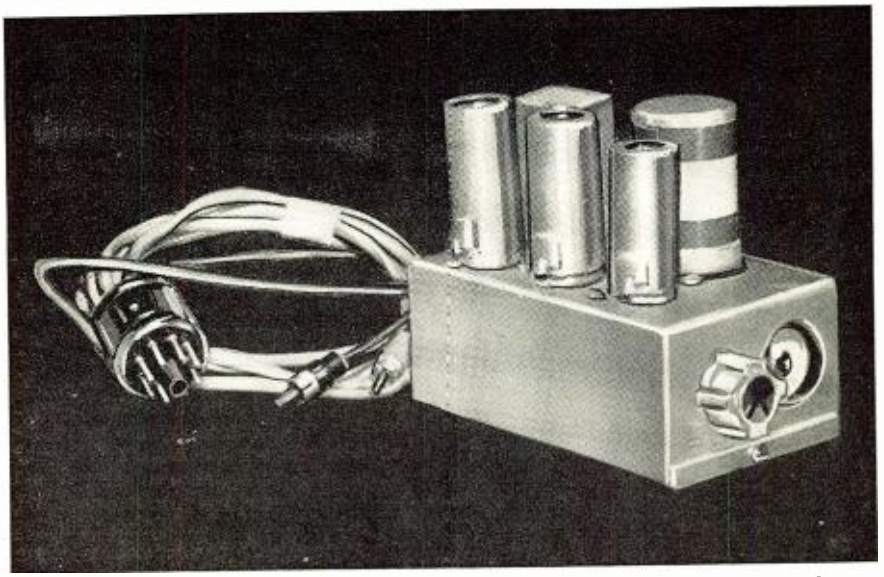
The following details should be kept in mind when mounting the parts: The three lugs on the level control should be toward the top of the chassis, nearest the 6AV6 tube socket. This tube socket is mounted with pins 1 and 7 toward the outside edge of the chassis. The 12AU7 and 12AV7 tube sockets are mounted with pins 1 and 9 toward the outside edge of the chassis.

Wiring

The wiring is not difficult even though the assembly is very compact. The *Vector* socket, for instance, can be completely wired before it is permanently mounted and this is a good place to begin.

Use a *Vector* socket that extends 1½ inches below the chassis and is equipped with six insulated lugs and one ground lug around the bottom. These lugs can be identified as follows: "A" below the No. 1 pin of the tube socket; "B" below pins 2 and 3; "C" below pins 4 and 5; "D" below pin 6; "E" below pin 8; and "F" below the space between pins 9 and 1. The ground lug "L" is below the space between lug "F" and "A."

Refer to the schematic diagram Fig. 1, where the various lug designations appear as circled letters. Starting with lug "A" we have resistor R_1, R_2, and the wire to one section of the filter capacitor. At lug "B" we have resistors R_5, R_6, and R_{13}, capacitor C_8, and ground wires to the center shield of the 6AV6 tube socket and ground lug "L." At lug "C" we have one lead from resistor R_{16}, R_{19}, and R_{20}, and leads to one section of the filter capacitor and to one of the terminal strips for connection to the



Over-all view of unit with level control and recording level indicator at front end. Shielded cables to record and erase heads and the power cable may be seen here. The tubes, filter capacitor, and bias-oscillator transformer are atop the chassis.

bias oscillator coil. At lug "D" we have the other end of capacitor C_3 and resistors R_{13} and R_{12}. At lug "E" we have R_9, R_{10}, and R_{11}; also C_6 and C_7. At lug "F" we have R_{15}, R_4, and the other end of R_7. A lead also goes to a section of the filter capacitor. No mention is made of the connections to the tube socket pins because this becomes obvious as the lugs are wired.

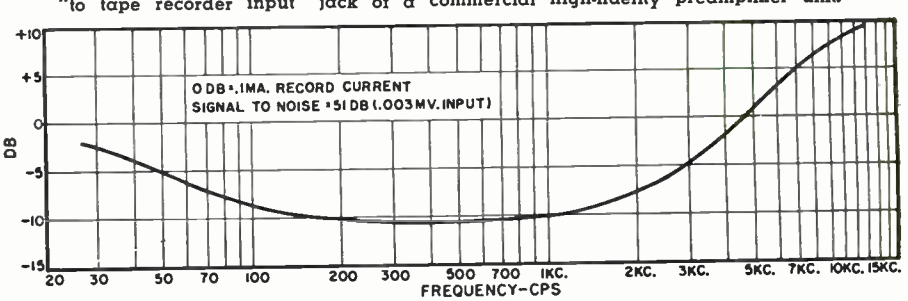
After the wiring has been completed on the *Vector* socket, it can be mounted and the filament string wired next. Then the rest of the wiring can proceed normally.

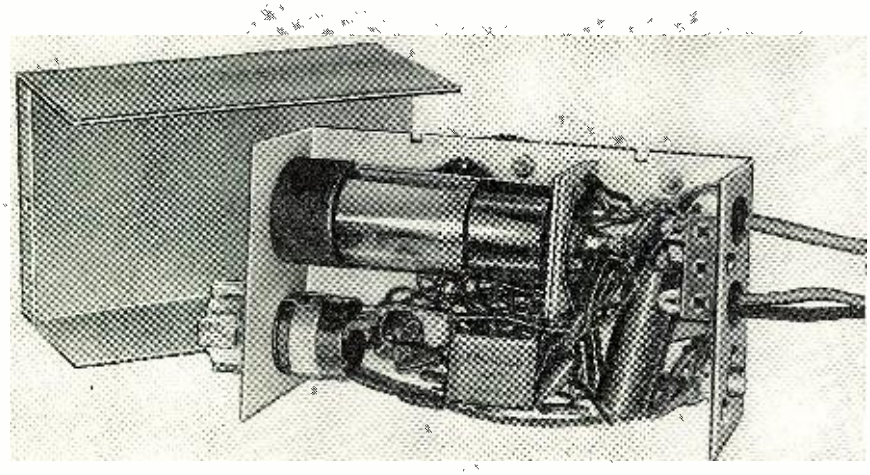
A terminal tie strip is used for connection between R_{15}, R_{16}, and the "B plus" lead from the switch mounted on the level control. One lug on the second terminal tie strip is used for connection between R_{21} and capacitors C_{15} and C_{16}. This is the lug nearest the edge of the chassis. The other lug is used for connection between R_9 and C_{11} and the 1N294 crystal diode. The end lug of the third tie strip nearest the 12AV7 tube socket is used for connection between C_{19}, R_{25}, and the center conductor of the erase head lead. The next lug is used for a common ground connection for the brown lead of the bias oscillator transformer, resistors R_{22}, R_{23}, and R_{24} of the bias oscillator circuit, the shielding braid of the record and erase head leads and the ground wire (black) of the four-conductor power cable. A ground lead is also connected between this lug and pin No. 5 of the 6E5 tube socket. The third lug on this terminal tie strip is used for the slate colored lead from the bias oscillator transformer and C_{19}. One lug of a fourth terminal strip is used for connection to the positive 300-volt lead (red) of the four-conductor power cable and a lead to the switch mounted on the level control. The other insulated lug is used for connection to R_{25}, C_{16}, and the center conductor of the record head connecting lead.

Capacitor C_{12} and resistor R_{17} are mounted between pins 3 and 5 of the 6E5 tube socket. Resistor R_{18} is mounted between pins 2 and 4 of the 6E5 tube socket. It is necessary to allow a slight amount of slack in the wiring to the 6E5 tube socket because this socket must be moved slightly to replace the 6E5 tube. Capacitors C_{13}, C_{17}, and C_{18} are mounted directly on the 12AV7 tube socket.

Shielded leads 18 inches long with standard *RCA* phono plugs on one end are used between the recording amplifier and the tape deck. Since it is sometimes troublesome to mount these phono plugs on the end of a lead, a good idea is to purchase commercial patch cords equipped with the proper type plugs on each end and cut them to the length desired. The plug to the erase head may be colored red and to the record head black. Ordinary shielded phono wire with a braided insulating

Fig. 2. The recording frequency response of the unit when it is connected to the "to tape recorder input" jack of a commercial high-fidelity preamplifier unit.





View of underside of equalizer-bias amplifier showing locations of some components.

covering is used between the input jack and the level control. The series resistor, R_1, can be fastened to the end of this lead at the level control and a short piece of spaghetti pushed over it. Capacitor C_1 is connected across the input jack.

These detailed suggestions do not complete the wiring. But from this point on it can be done in the conventional way and so specific suggestions are not being made. A lug is mounted at one of the mounting screws of the filter capacitor to provide a connection between the chassis and the electrical ground of the circuit. No other grounding to the chassis is necessary except where the input jack is mounted on the rear of the chassis. The shielded lead from this jack is grounded at the jack end only.

A 4-prong power plug is connected to the end of the 2-foot long power cord with the filament leads soldered to pins 1 and 4. The ground wire is connected to pin 3 and the positive 300-volt wire to pin 2.

Power Supply

A conventional power supply, capable of delivering 300 volts of well filtered d.c. at 15 ma. and 6.3 volts a.c. at 1.2 amps, can be used with the equalizer-bias amplifier with good results.

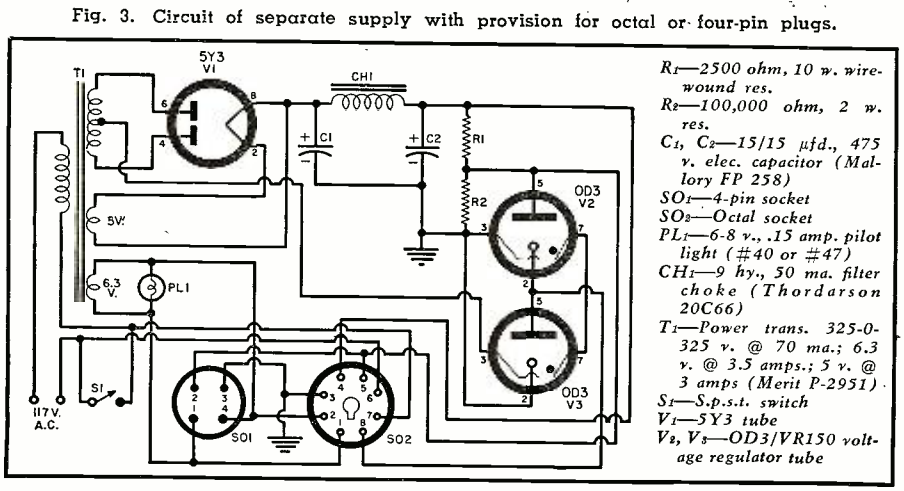
It is assumed that the equalizer-bias amplifier will be used with a preamplifier that is capable of delivering this amount of power to an auxiliary unit; or that the preamplifier is powered from the power supply of an amplifier that is capable of delivering enough power to supply the equalizer-bias amplifier in addition to the system preamplifier.

In cases where a separate power supply is required the circuit of Fig. 3 can be used. Voltage regulation is not absolutely necessary because the drain of the equalizer-bias amplifier is rather steady. If the VR tubes are omitted it may be necessary to increase the value of current limiting resistor R_1 to 8000 ohms or more. Two power plugs are provided, in case it is desired to use the power supply to power a commercial preamplifier in addition to the equalizer-bias amplifier.

Testing

After all the wiring has been completed and the amplifier is ready to test, a dummy load jack should be prepared. This can be a double phono jack with a 2-watt, 6800-ohm resistor connected across the jack for the red, or erase head, lead and a 2500-ohm resistor connected across the jack for the black, or record head, lead.

Fig. 3. Circuit of separate supply with provision for octal or four-pin plugs.



R_1—2500 ohm, 10 w. wire-wound res.
R_2—100,000 ohm, 2 w. res.
C_1, C_2—15/15 μfd., 475 v. elec. capacitor (Mallory FP 258)
SO_1—4-pin socket
SO_2—Octal socket
PL_1—6-8 v., .15 amp. pilot light (#40 or #47)
CH_1—9 hy., 50 ma. filter choke (Thordarson 20C66)
T_1—Power trans. 325-0-325 v. @ 70 ma.; 6.3 v. @ 3.5 amps.; 5 v. @ 3 amps (Merit P-2951)
S_1—S.p.s.t. switch
V_1—5Y3 tube
V_2, V_3—OD3/VR150 voltage regulator tube

Connect the power cable to a suitable power supply, preferably at the preamplifier unit, to minimize the chance of "ground loops" that might induce hum or cause other difficulties. The only modification that might be needed in your existing power supply arrangement is to disconnect the center tap of the power transformer filament winding or the hum balancing potentiometer, whichever the case may be, from ground and insert a small battery to apply a positive potential of 9 to 15 volts between the filament string and ground. Since there is no current drain through the battery, shelf life can be expected. If there is a power amplifier in the system with the cathodes of the power amplifier tubes operating at a potential of 9 to 15 volts or more above ground and these cathodes are bypassed with a capacitor of 10 to 15 μfd. or more to ground, it is good practice to connect the filament center tap to the cathodes. This will provide a positive potential for the recording amplifier filament string and is adequately bypassed to ground. A battery is unnecessary in such an arrangement.

The reason for applying the positive potential to the filament string is to minimize filament-to-cathode emission which can cause objectionable hum, particularly in the 6AV6 tube.

After the tube filaments have had a chance to warm up, advance the recording level control to switch on the high-voltage plate supply. The target of the level indicator tube should immediately show its normal glow, with a shadow deflection of about 90 degrees or slightly less. Check the potentials at each pin of the tubes in the recording amplifier, using a high impedance vacuum-tube voltmeter. These should correspond, within 15 per-cent, to the voltages given on the schematic diagram shown previously.

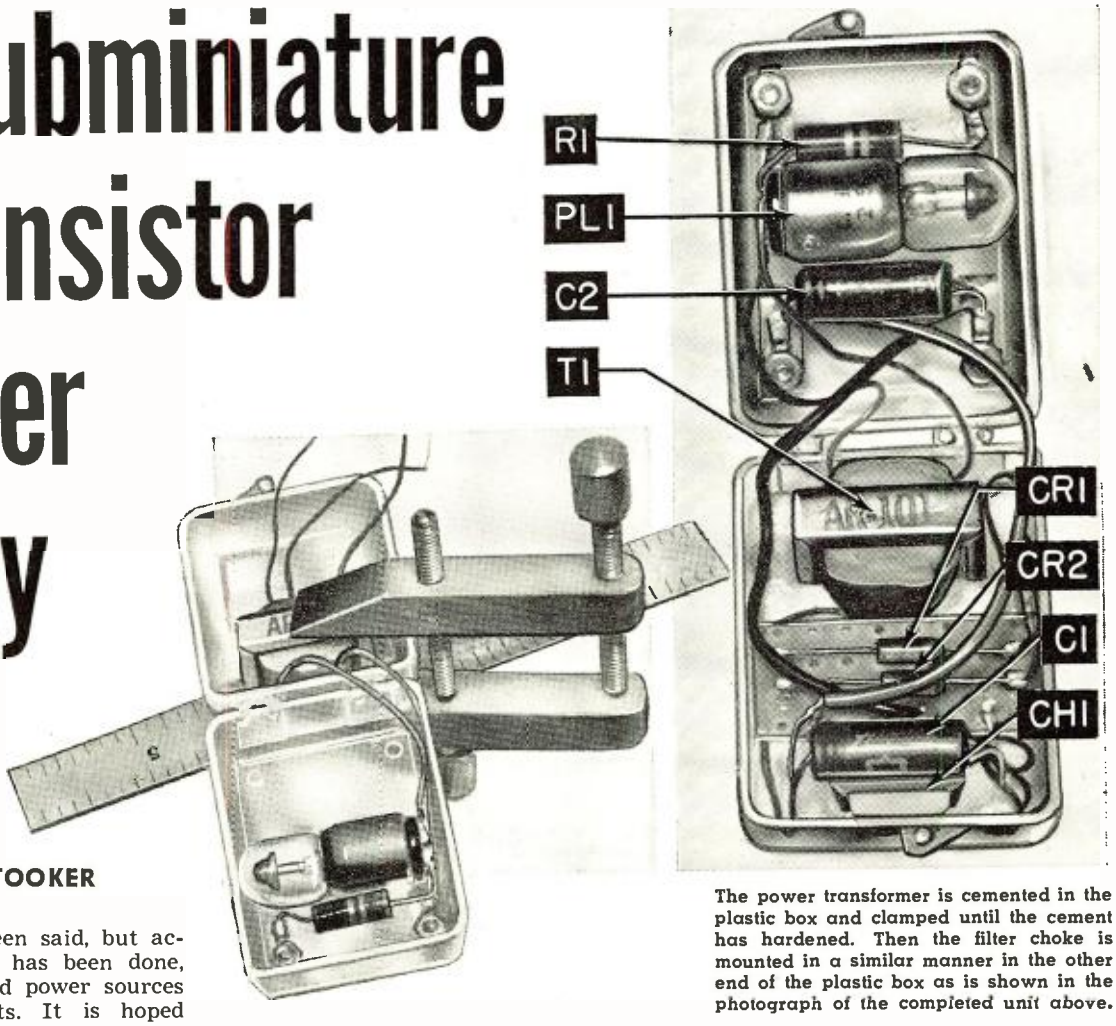
Short the input jack on the equalizer-bias amplifier. It should be possible to advance the recording level control all the way with no change in the recording level indicator shadow deflection, when the input is shorted. If the shadow is not centered, the 6E5 tube socket can be turned enough to center it. Any change in deflection when the level control is advanced with the input jack shorted indicates hum or other trouble in the recording amplifier.

Connect the output of an audio signal generator to the input jack and feed a 0.6 volt signal at 1000 cps into the input of the equalizer-bias amplifier. The recording level indicator shadow should close with no overlap when the level control is advanced a little less than one quarter of a turn.

The next step is to adjust the resistor R_{2S}, between the erase head lead and the record head lead, for the correct amount of recording bias current in the record head. If a *Viking* FF75 series tape deck is being used, this should be 0.8 to 1.0 ma. The manufacturer's specifications should be followed for any other type of head.

(*Continued on page* 127)

Subminiature Transistor Power Supply



The power transformer is cemented in the plastic box and clamped until the cement has hardened. Then the filter choke is mounted in a similar manner in the other end of the plastic box as is shown in the photograph of the completed unit above.

Tiny a.c.-operated battery substitute has very low ripple along with simple but effective regulation.

By

FRANK H. TOOKER

QUITE a lot has been said, but actually very little has been done, about a.c.-operated power sources for transistor circuits. It is hoped that the present article will start the ball rolling, and in the right direction.

Transistor power supplies apparently got off to a poor beginning when filament transformers were recommended as the voltage-stepdown unit. Filament transformers are capable of supplying considerably more current than transistor circuits require. Thus, they are bulky and out of step with the trend toward miniaturization that has accompanied transistor development. Actually, the answer to the size problem has been right under our noses for some time. A number of transistor audio transformers—principally those distributed by *Argonne Electronics Mfg. Corp.*—work very well as miniature power transformers, and they measure only 1" x ¾" x ¾"!

The full-wave power supply circuit shown in the schematic diagram, Fig. 1, is quite conventional in appearance, except for the 117-volt a.c. input. An NE-48 neon lamp (PL_1) and a 15,000-ohm, 1-watt resistor (R_1) are employed at this point as a regulator to wipe out line-voltage variations. The regulation that can be obtained through the use of these two simple components is more than adequate for the majority of applications. At 5 milliamperes d.c. output, for instance, the variation is on the order of ±0.1 volt d.c. when the line voltage is varied over the whole range from 90 to 130 volts a.c.

The d.c. output voltage and ripple percentage to be expected when various currents are drawn from this miniature power source are given in Table 1. Note that these are quite adequate to accommodate many different transistor circuits.

The Miniature Choke

The miniature choke, CH_1, can be made from any of the *Argonne* ¾" x ⅝" x ⅝" transistor audio transformers. Because *Argonne* winds its coils on little nylon bobbins, the procedure is simple and there's very little chance of any serious mishaps. Merely disassemble the transformer, *i.e.*, remove the mounting frame and all the "E" and "I" laminations which make up the core. Remove all the original turns of wire from the little nylon bobbin, and rewind the bobbin almost full with No. 38 *Nylclad* or *Formvar* magnet wire. It isn't necessary to count turns. Leave enough space on the bobbin for a couple of wrappings of plastic tape as an outer covering, and make sure none of the wrapping or the wire extends beyond the edges of the bobbin. Finish off the coil by using a couple of pigtail leads from the original transformer windings. Insulate the solder

(*Continued on page* 132)

D.C. OUTPUT		Ripple
Milliamperes	Volts	
0	6.6	....
1	5.2	0.03%
2	4.8	0.05%
3	4.5	0.10%
4	4.2	0.16%
5	4.0	0.23%

Table 1. Output voltages and ripple percentages for various load currents.

R_1—15,000 ohm, 1 w. composition res.
C_1—Miniature 20 µfd., 15 v. elec. capacitor (Lafayette CF-123 or equiv.)
C_2—Miniature 30 µfd., 15 v. elec. capacitor (Lafayette CF-124 or equiv.)
CH_1—Subminiature filter choke (see text)
PL_1—Type NE-48 neon bulb
CR_1, CR_2—1N295 crystal diode rectifier
T_1—Transistor audio trans., used as power trans. (Argonne AR-101, see text)

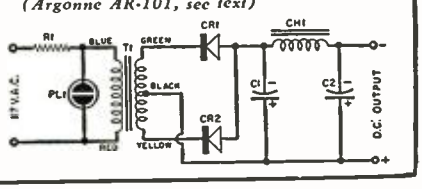


Fig. 1. Complete schematic diagram and parts list for the subminiature supply.

By JOHN T. FRYE

THROUGH THE SAFETY GLASS

A WINTER cold front had come through and swept all the clouds from the sky. The weather was clear, bright, and cold with a snap to it that set the blood tingling. Barney, who was very sensitive to changes in the weather, came bounding into the service shop in gay spirits to find Mac, his employer, holding a mysterious-looking black and chrome tube in his hands.

"Yo, ho, ho, and a bottle of rum!" Barney chanted. "What, if anything, are you doing with that sawed-off telescope, Boss?"

"As usual, you're about as wrong as you can get," Mac retorted as he slid the tubes together. "Instead of a sawed-off telescope, this is actually a long-range microscope. In fact, it's a 'TV Tubescope' manufactured by the *Edmund Scientific Corporation* of Barrington, New Jersey.

"What's this 'long-range microscope' jazz you're giving me?"

"This microscope is intended for viewing the dot pattern of a color kinescope through the safety glass. As you know, with the ordinary microscope, the object being viewed must be quite close to the front objective lens of the instrument, usually less than an inch away. But the safety glass keeps us from getting that close to the tube face, especially where it curves away at the edges. The working distance of this special job is 4¼" which is ample to allow us to focus on every portion of the tube screen."

"I don't need any microscope to see the dots put out by our dot generator."

"I'm not talking about those dots; I'm talking about the individual colored phosphor dots on the screen of the kinescope. On a 21" screen these are still only about 1/100th of an inch in diameter, and I doubt that even your 20/20 vision allows you to see them very clearly. But take a squint through this microscope at the screen of that color set going over there and you'll see what I mean."

"It's no use right now," Barney remarked; "there are no color programs on."

"You're forgetting something," Mac chided; "take a look."

Barney placed the front of the black anodized aluminum tube against the safety glass and pulled out the chrome draw tube until the microscope was in focus.

"Wow, that's beautiful!" he exclaimed. "When I look through the microscope at this perfectly white area, I see a wonderful mosaic of red, blue, and green dots. Of course, now that I think about it, I realize this is what I should expect to see. I know that white on a color receiver is produced by having these closely spaced red, blue, and green dots glow with just the right amount of relative brilliance. They are so tiny and close together that the eye cannot see them separately but receives a combined impression from them so that their primary colors are 'mixed' to produce white. As I say, I *know* this to be true; but you really have to see it to believe it. You're sure right about that!"

"The main use of the microscope is in establishing color purity," Mac explained. "In order to achieve the best possible purity, you want the beam to strike the exact center of each phosphor dot as nearly as possible, and you need a microscope to see when this has been accomplished."

"What's the power of this gadget?" Barney wanted to know.

"This particular model magnifies twenty-two diameters. Different eyepieces can be had to give 14X or 27X magnification, but this is the model, I am told, that most technicians prefer. Awhile ago I was looking at a ruler with it and the field of view seems to be about ¼". As with most microscopes, the image is inverted and reversed as to left and right."

"I can see a real need for it in color TV work, but color sets are still few and far between around here. How did you ever talk your Scotch blood into letting you buy such a specialized instrument?"

"It wasn't easy," Mac admitted with a grin as he returned the Tubescope to its leather case. "You'll probably be tickled to know I quizzed the manufacturer as to why it has to cost as much as it does. After all, it looks like a fairly simple optical instrument to me. He reports this microscope is expressly designed to do well the single job of viewing color TV dot patterns. That means a color-corrected achromat has to be used on the objective lens since simple lenses would distort and alter the color pattern. Moreover, that long-working-distance requirement makes it impossible to employ available optical systems."

"That explains why he has to charge more for it, but I still want to know how you persuaded yourself to buy it," Barney probed.

"Well, I convinced myself I could use it for other things around the shop than color TV. That long working distance makes it mighty useful for examining a stylus without removing it from the cartridge. Even when the arm will not lift up but a short distance, you can usually maneuver this microscope and the light so that the point of the stylus can be thoroughly examined. And let me show you another use for it I just found before you came in. The printed circuit chassis of this a.c.-d.c. set has a broken lead in it. I can make the set cut on and off by flexing the board. You know how hard it is to spot those hairline breaks with the naked eye, but take a look at this line right here where I have marked it with the crayon pencil. See that crack clear across the lead? Sticks out like the Grand Canyon when you look at it through the microscope, doesn't it?"

"Yeah, and so does the way you twist your own arm into buying something you want," Barney said with a smile. "You're Scotch, all right; but you simply can't resist a piece of interesting new equipment. Speaking of printed circuits, though, I see where one TV manufacturer is sending out literature saying that out of consideration for technicians his company is going to use no printed circuitry. He says it costs more to make a set without printed circuits but that doing it that way means greater operating dependability and fewer servicing headaches. What do you think of that?"

"Mostly I think it's interesting that the argument over the difficulty of servicing printed circuits has reached the manufacturers' level. We both know technicians have felt pretty strongly about this subject for some time. It's easy to see the advantages of the printed circuit from the manufacturing point of view. It's a natural for automation. Human error can be largely eliminated. It's easier to achieve identical behavior with printed circuits, especially where stray capacity, lead length, etc., are important. On the other hand, trying to trace a circuit through a printed circuit maze is a real headache, and replacing parts on a printed circuit board can be a nerve-wracking, and often disastrous, experience.

(*Continued on page* 162)

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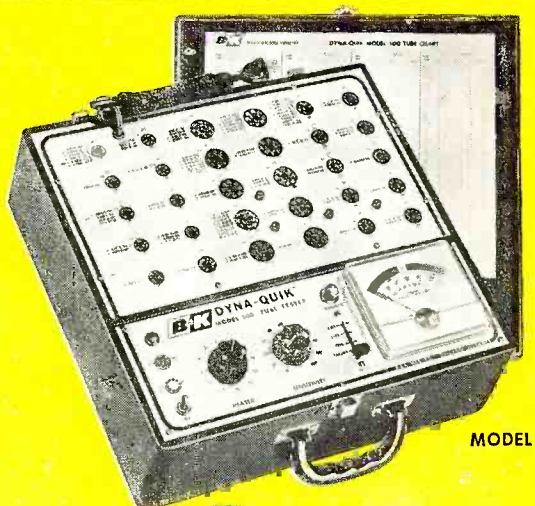

MODEL 500

MODEL 510

NEW MODEL 510 ACCESSORY SOCKET PANEL

Adds over 50% more sockets to the B&K Model 500 Dyna-Quik. Enables you to quick-check many more tube types, old and new. Fits inside the cover of the Model 500. The Model 510 Accessory Socket Panel comes completely wired, ready to install and connect. Net, **$29.95**

See your B & K Distributor, or write for Bulletin AP10-N

B&K

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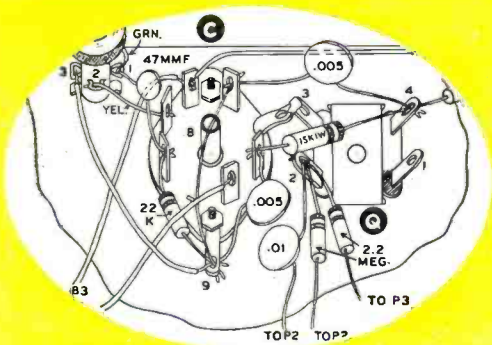
everybody's doing it!

FRANK PERKINS

Composer and arranger Frank Perkins listens attentively to his Decca hi-fi album "Music For My Lady" as its beautiful sounds are recreated with Heath high fidelity equipment. Music is a very important part of Frank's life, since his background includes composing and arranging musical scores for motion pictures, and for music publishers. Songs he has written include "Stars Fell on Alabama", "Emaline", "The Scat Song", "The Way I Feel Tonight", "After All These Years", and "Turn Back The Clock". Frank Perkins has discovered the beauty of Heath Hi-Fi sound . . . and the fun of "do-it-yourself" Heathkit construction. So, why don't you!



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!

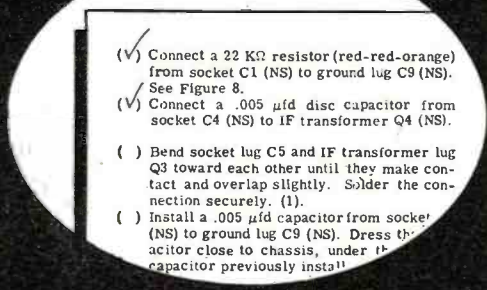
Heathkits®

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

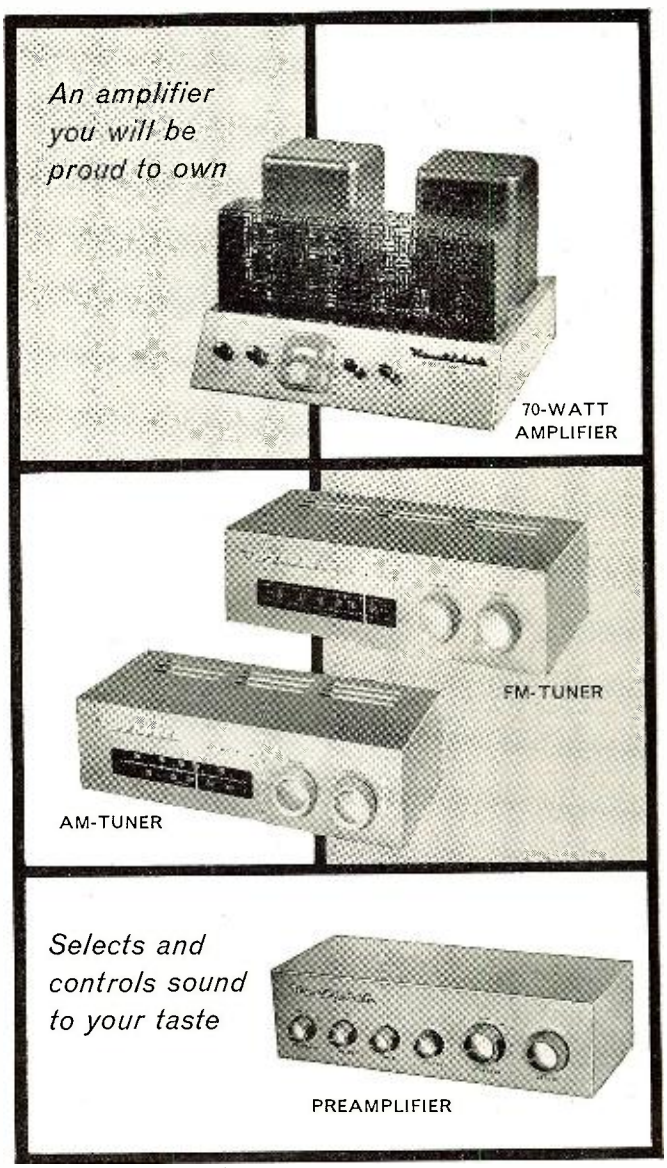
$25.95 (with cabinet)

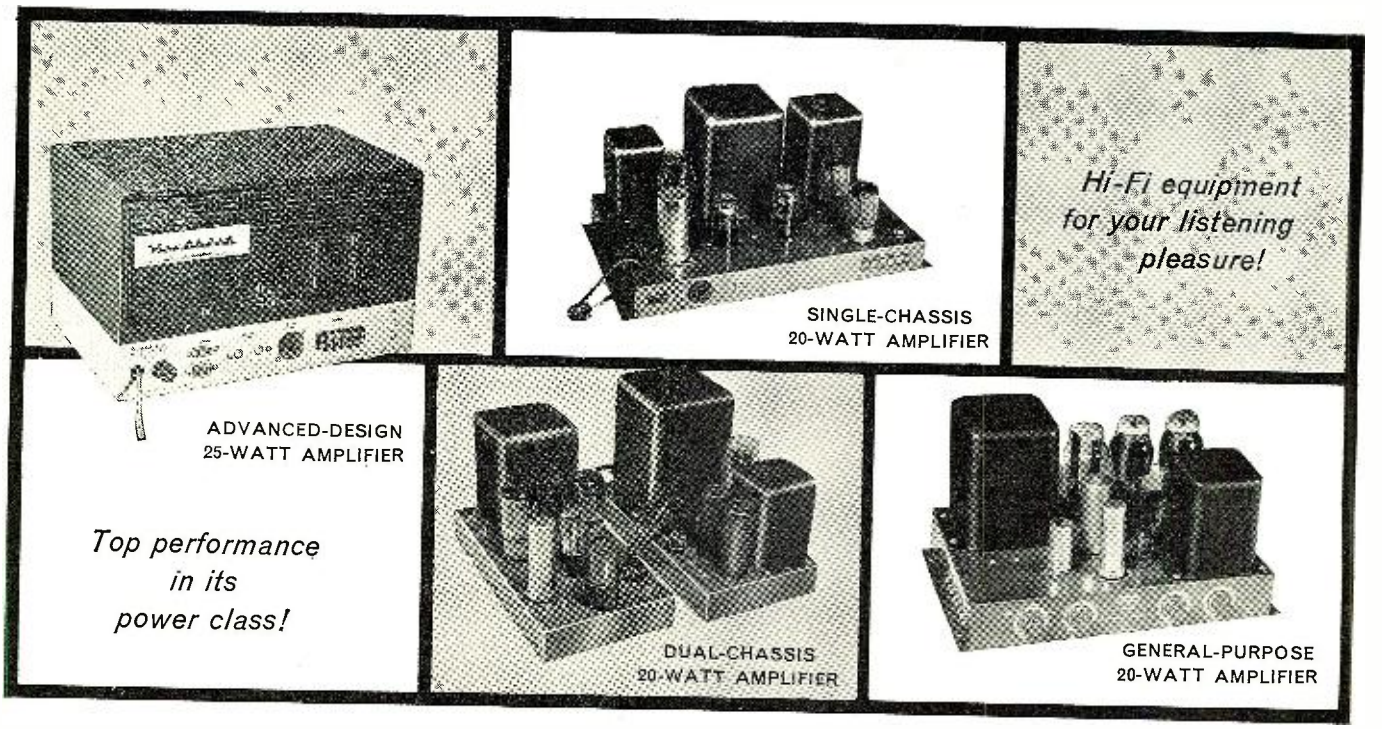
HEATHKIT MASTER CONTROL PREAMPLIFIER KIT

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)





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-5M
$59.75

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

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 W4-AM
$39.75

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

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-3AM
$49.75

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

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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

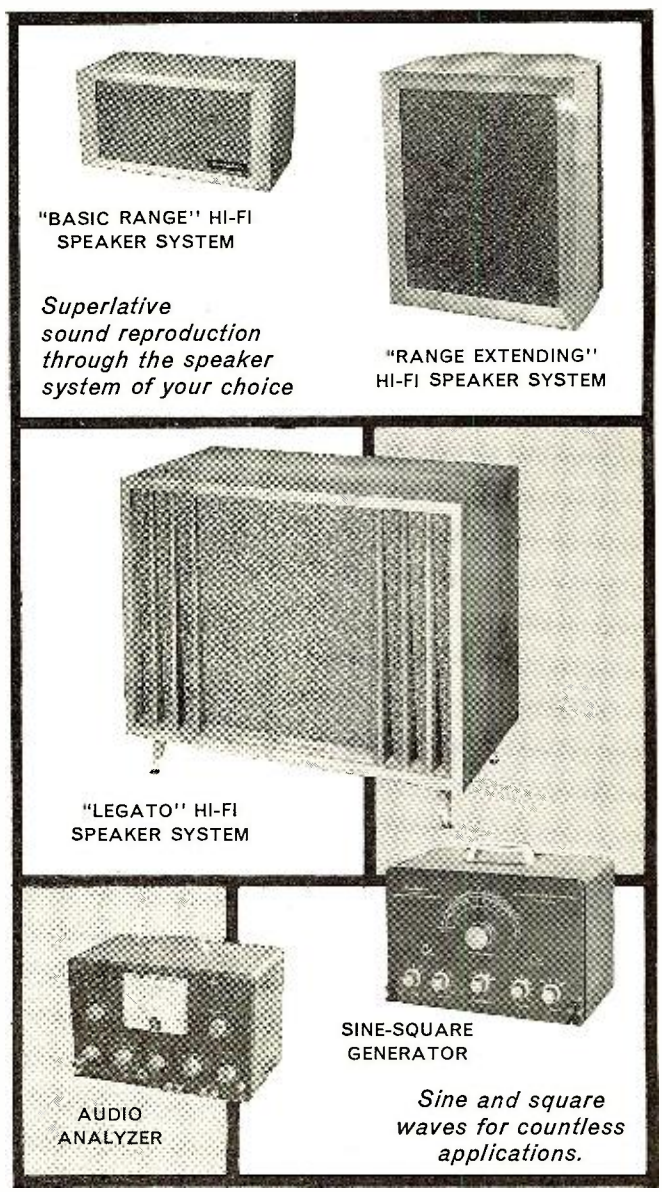
The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. 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.

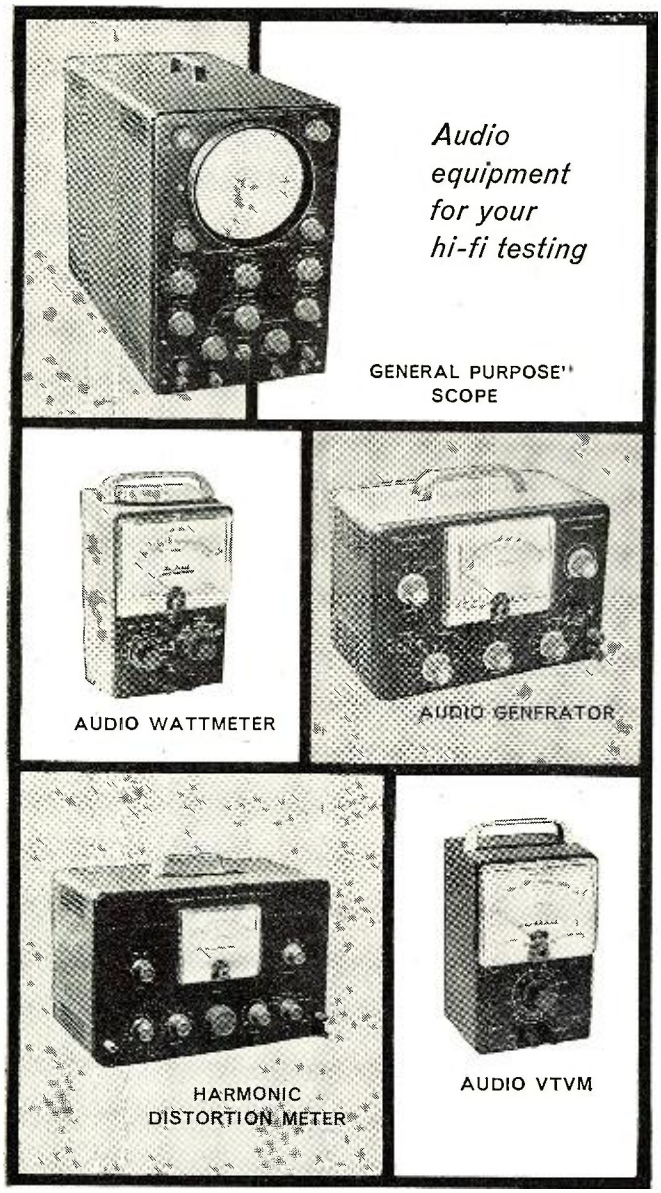
MODEL HH-1-C
MODEL HH-1-CM

$325.00

EACH



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



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

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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

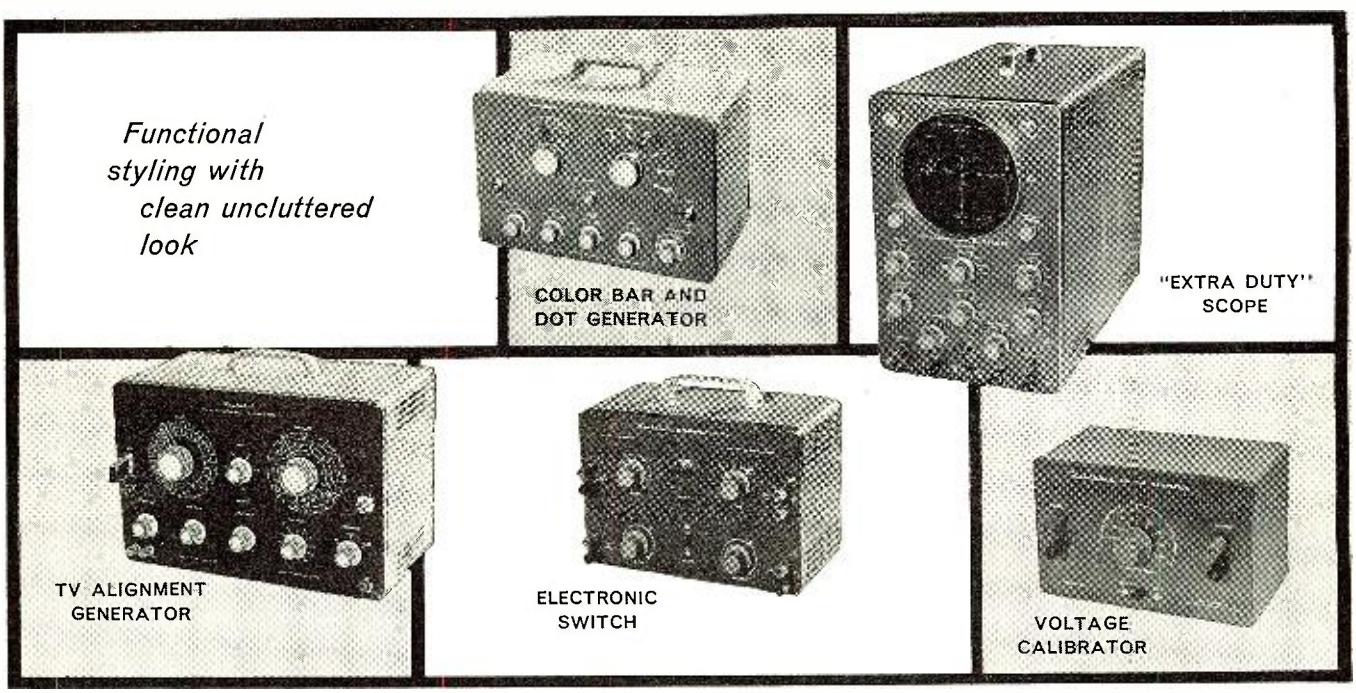
$21.95

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

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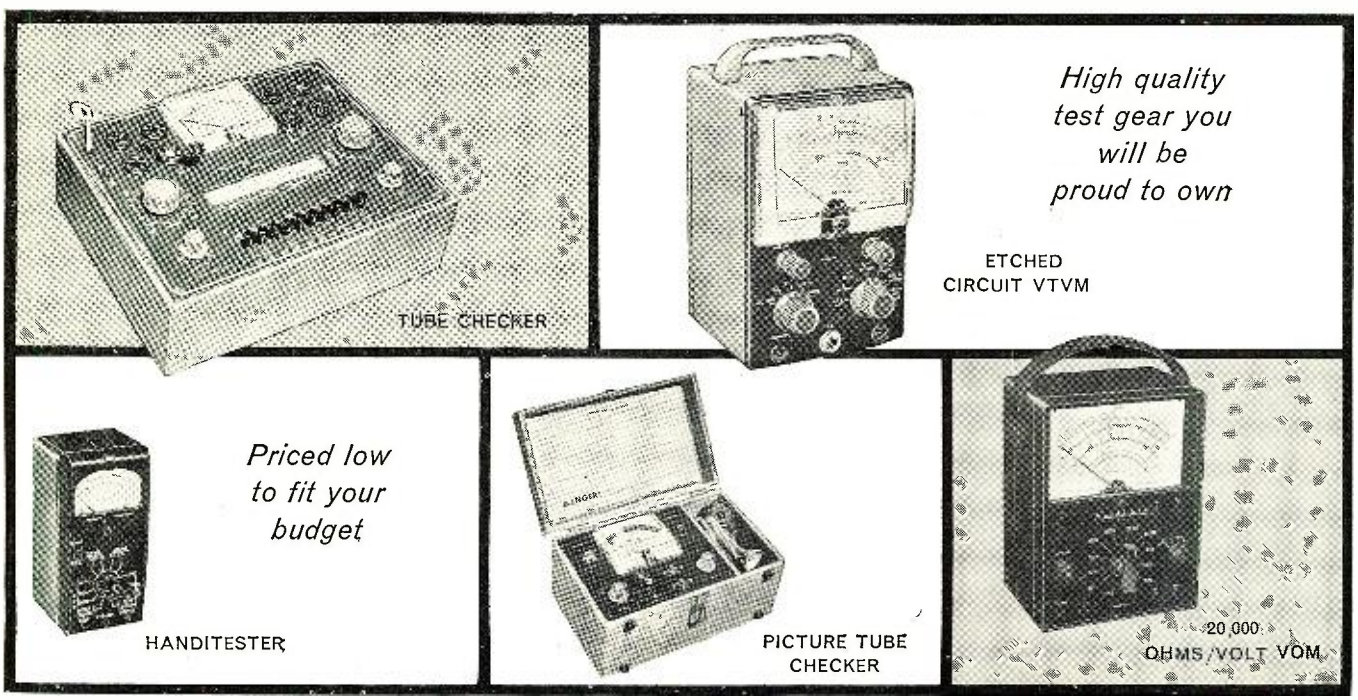
let you fill your exact needs from a wide variety of instruments

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

Heathkits...

By DAYSTROM

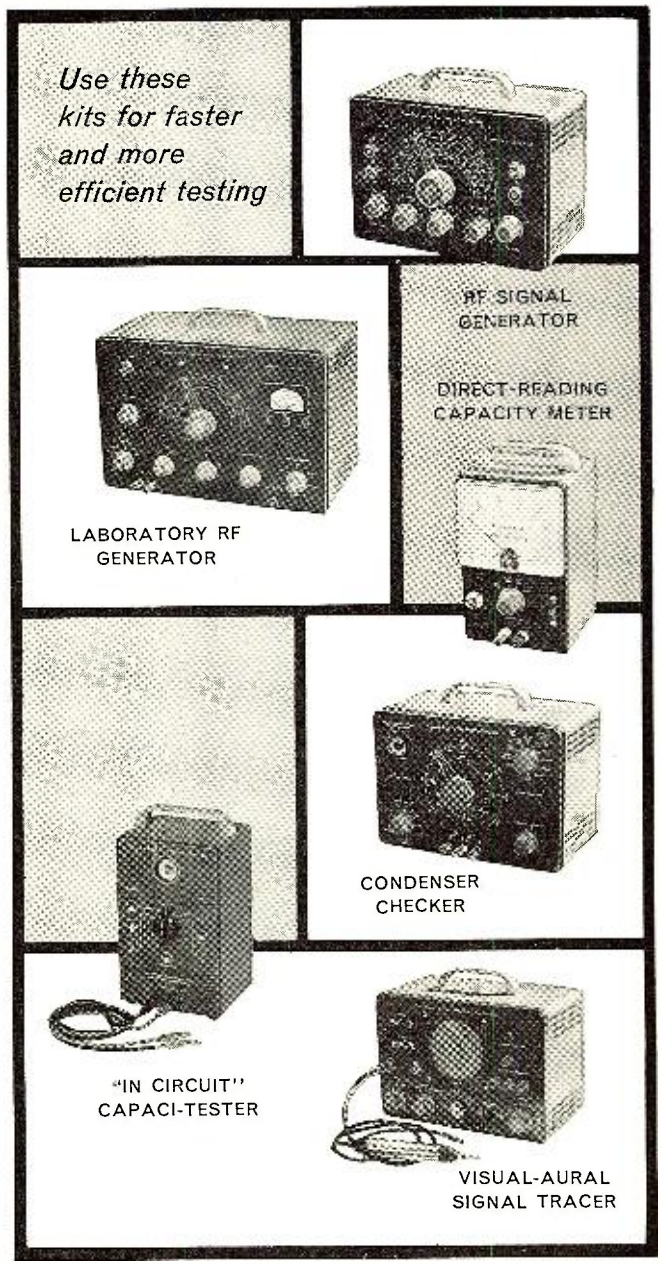
are educational
as well as functional

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

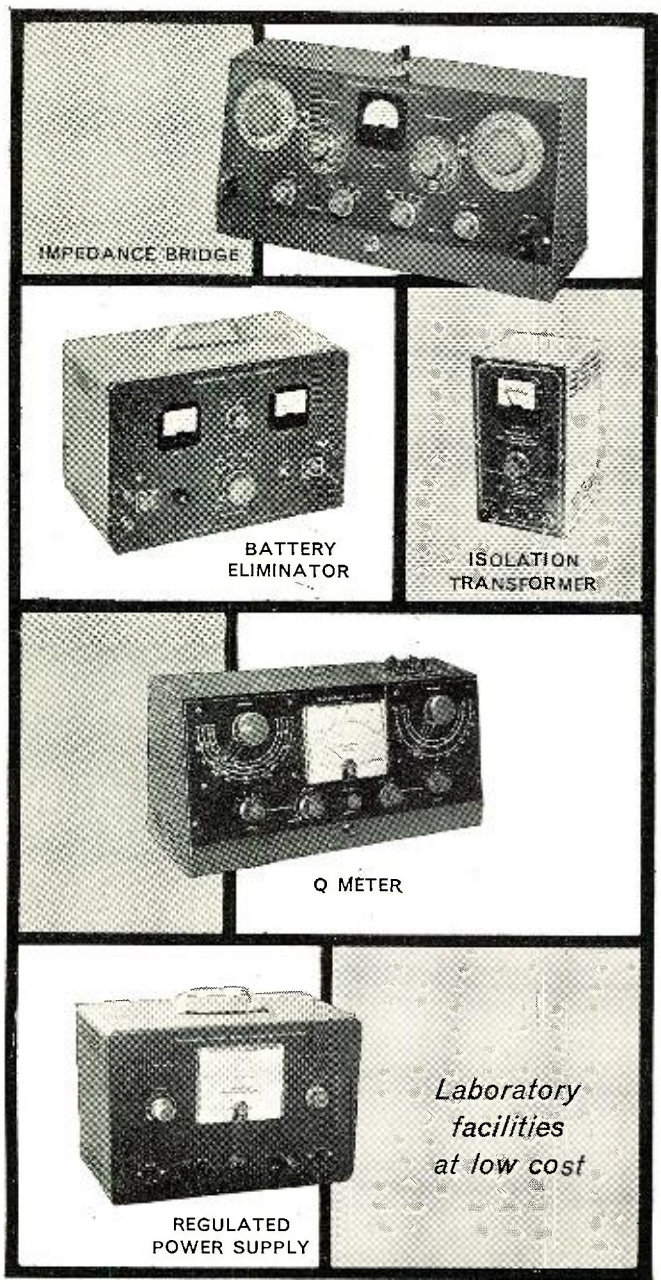
$39.95

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 millihenry, "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

Terrific values in amateur equipment!

DX-100 TRANSMITTER

DX-20 TRANSMITTER

DX-40 TRANSMITTER

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

Heathkits...

By DAYSTROM

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.

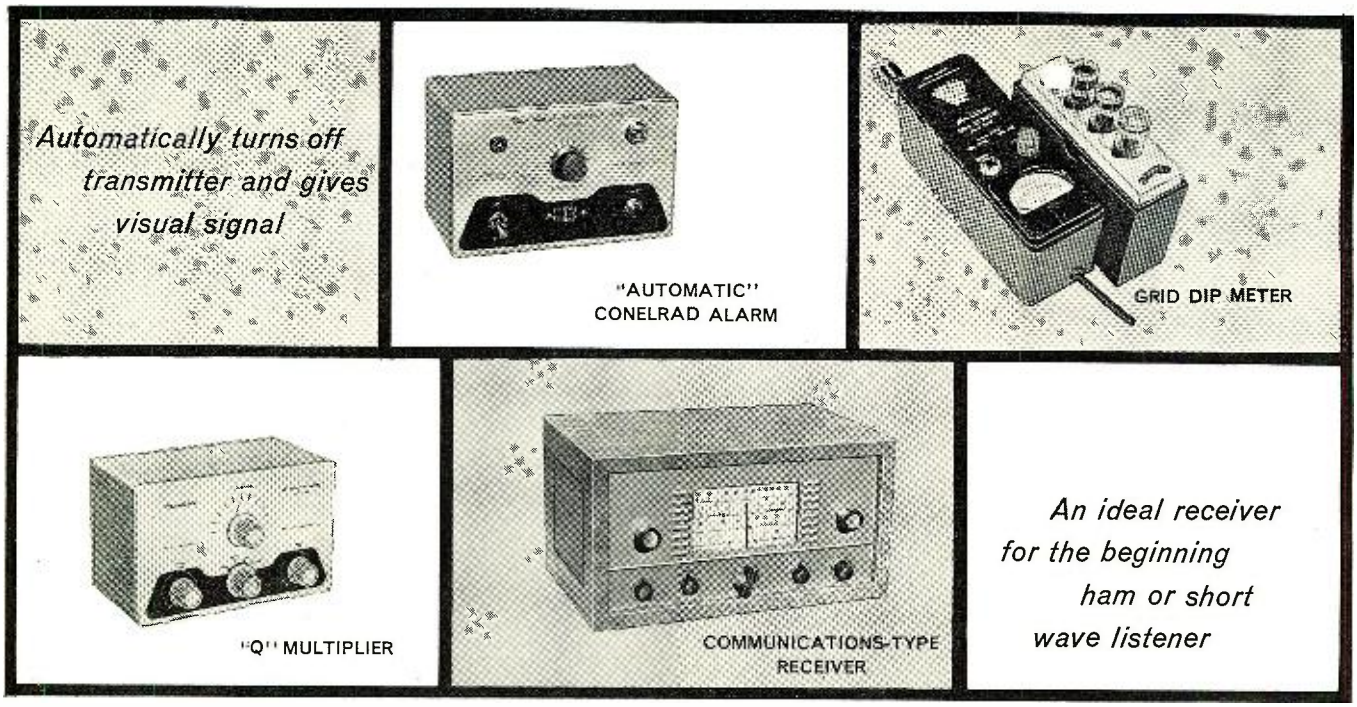
MODEL DX-100

$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.

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



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.

Heathkits...

By DAYSTROM

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

Heathkits...

By DAYSTROM

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

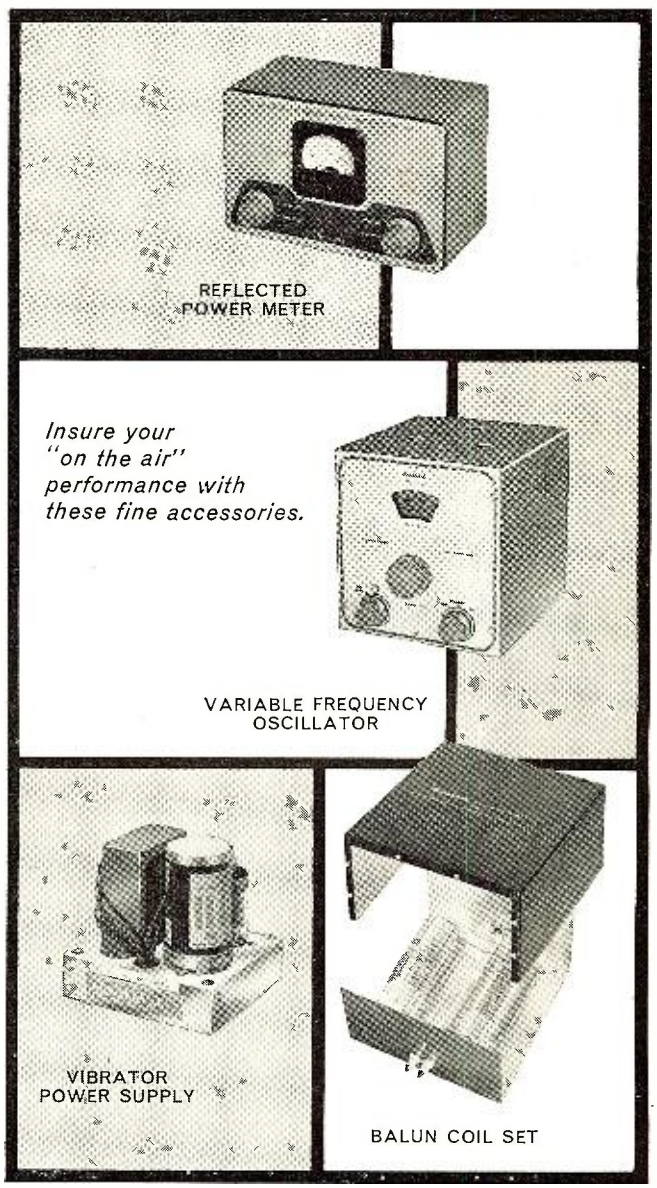
$8.95

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

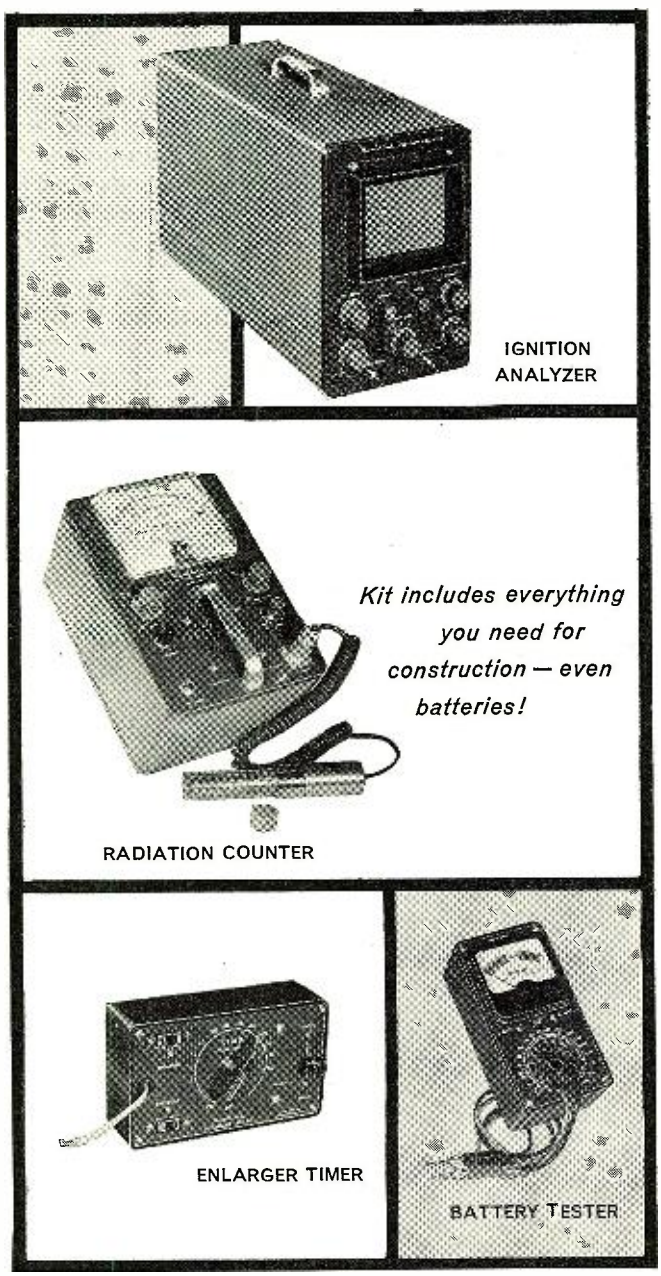
Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. 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)

HEATHKIT FUEL VAPOR DETECTOR KIT

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

Heathkits...

By DAYSTROM

now offer you completely modern marine equipment with outstanding design features

HEATHKIT TRANSISTOR RADIO DIRECTION FINDER KIT

The Heathkit Transistor Radio Direction Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit). The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 5 lbs.

MODEL DF-1

$54.95

TRANSISTOR
RADIO DIRECTION FINDER

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By DAYSTROM

are sold only by direct mail, passing middleman profits on to you

Pioneer in "do-it-yourself" electronics

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The Heath Company maintains a technical consultation service, should you experience some sort of difficulty in construction or operation. Although only a very small percentage of our customers ever have occasion to use this service (usually only beginners in electronics) it is still reassuring to know that technical help is available when needed. A service department is also available, should you wish a complete factory check of operation and alignment or repair. After you build your first Heathkit you'll realize how easy it is.

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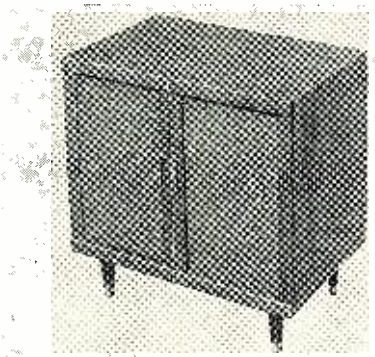
		TOTAL	

Hi-Fi-Audio Product Review

"ACCUSONIC" SPEAKER SYSTEMS

United Speaker Systems, 34 New St., Newark 2, N. J., has recently introduced two new speaker systems which retail in the moderate and low priced categories.

The "AccuSonic" Model X-200 employs two matched 8½" drivers coupled to an exponential horn with a mouth area of 4 square feet. High frequencies are reproduced by two integral 3" cone tweeters. Over-all frequency response is 37 to beyond 18,000 cps. Cabinets are of low-boy design suitable for either



corner or wall placement. Over-all dimensions are 28" x 37" x 16¼" and the enclosure is available in pewter walnut, African mahogany, or korina finishes.

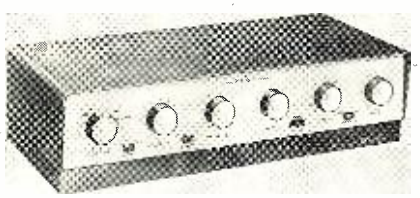
The Model X-100 has a single 8½" woofer plus a 3" cone tweeter and covers from 45 to 16,000 cps. Cabinets are made from ¾" furniture plywood with hand-rubbed finishes in African mahogany, Swedish birch, or pewter walnut.

Descriptive data sheets giving full specifications are available on either or both of these units.

STEREO-MONAURAL PREAMP

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., is marketing a new stereo-monaural preamplifier in its "Knight" kit line.

Designated as the KN-700, the new unit has been designed for use with any stereophonic or monaural hi-fi music system. It incorporates complete con-



trol facilities not only for stereo tapes and stereo broadcasts but for monaural tapes, records, and broadcasts as well.

The unit features two equalized tape head playback preamplifiers for use with any stereo tape deck. A fingertip control instantly switches the preamp from monaural to stereo operation and also reverses left and right channels. In addition to independent gain controls for each channel, a master volume control simultaneously controls both channels.

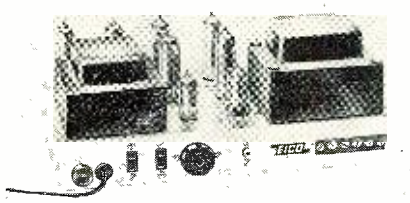
Inputs are provided for *G-E* and *Pickering* magnetic cartridges, ceramic phono cartridges, two tape heads, two auxiliary sources, microphone, tuner tape preamp, or crystal cartridge. The unit is listed as Stock Number 92 SX 406. For further details and price, contact the manufacturer direct.

EICO 30-WATT AMPLIFIER

Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y., has recently released a 30-watt power amplifier which has been designated as the *EICO* HF-30.

The circuit features four high-power EL84 output tubes in push-pull parallel, high stability margin, and high-quality output transformer. The power supply uses two EZ81 rectifier tubes. Performance characteristics are maintained under either resistive or speaker loads (including electrostatic type speakers).

At 30 watts the frequency response is ± .5 db from 15 to 50,000 cps and



± 1.5 db from 15 to 100,000 cps. Power consumption is 125 watts. The unit measures 5" x 12" x 7" and the shipping weight is 17 pounds. Both kit and assembled versions are available.

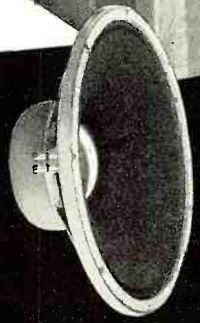
NEW FAIRCHILD CARTRIDGE

Fairchild Recording Equipment Co., 10-40 45th Ave., Long Island City 1, N. Y., has announced a new experimental cartridge, the XP-3.

The new unit has unusually high compliance and virtually no detectable IM distortion, according to the company. Part of the unit's performance can be attributed to the use of a subminiature coil of unusual construction. The coil is hand wound of special gold-plated wire so that the maximum electrical output can be obtained from its small physical size. In addition, the coil is Aero-V damped, a new method of

build with the best... JBL signature loudspeakers!

The careful work you do in building your high fidelity sound system will be shown off to best advantage if you use precision-made JBL SIGNATURE Loudspeakers. These are the most efficient units to be found anywhere, made with the most exacting care, meticulous attention to detail. Remember, it takes no more effort on your part to build with the best.



MODEL D130
15" Extended Range Loudspeaker

The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.

MODEL D208
8" Extended Range Loudspeaker

A precision transducer in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.

MODEL D123
12" Extended Range Loudspeaker

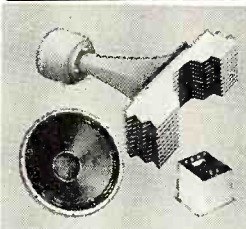
With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.

MODEL 075
High Frequency Unit

Another exclusive for James B. Lansing Sound, Inc., is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

MODEL 175DLH High Frequency Assembly

The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to life-like high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.



JBL Signature Two-way Systems Are Available As Kits

086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units—including the serpentine acoustical lens—which are used in The Hartsfield . . . units designed originally for installation in the most modern theaters in the world.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

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Please send me the following:

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TECHNICAL BULLETINS ON:
☐ D130 ☐ D123 ☐ D208 ☐ 175DLH ☐ 075 ☐ 375 ☐ 150-4C

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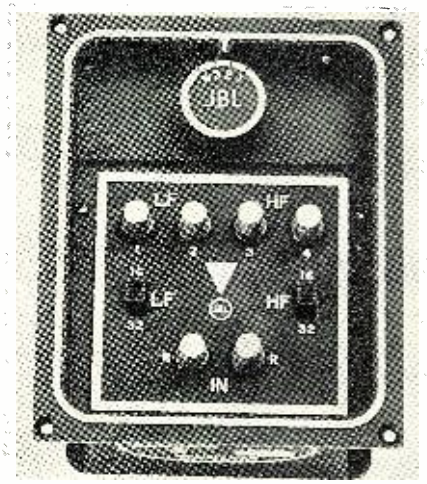
coil suspension developed by the company which is based on the cushioning properties of air.

Flat response from 10 to 20,000 cps within ± .2 db is obtained with virtually no trace of IM distortion. The XP-3 is supplied with a diamond stylus of .7 mil tip radius. The unit will track any commercial record at from 2 to 4 grams stylus pressure.

DIVIDING NETWORK

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif., has just issued its Model N2600 dividing network for audio applications.

Either set of output terminals can be switched from 16 to 32 ohms. Two 16-



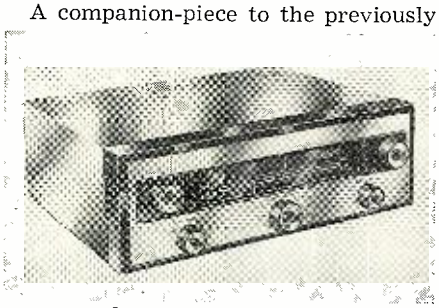
ohm drivers can be connected in series when the appropriate switch is in the "32" position. The assembly is centered in the network opening and secured by driving four screws into the outside panel surface when used with the company's standard enclosures.

Complete instructions are included with the unit. A catalogue sheet on the firm's dividing networks is available on request.

AM-FM STEREO TUNER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y., is catering to the do-it-yourself high-fidelity hobbyist by releasing its Model KT-500 AM-FM stereo tuner in kit form.

A companion-piece to the previously



announced Models KT-300 audio control center kit and KT-400 70-watt basic amplifier set, the three units form the heart of a stereo hi-fi system. Reception with the new tuner may be AM alone, FM alone, or AM and FM simultaneously. Separate cathode-follower outputs and volume controls are provided.

The tuner measures 13¾" x 10⅜" x 4½". It comes complete with two

printed circuit boards, all parts plus metal cover, step-by-step instruction manual with schematic and pictorial diagrams.

MOVING COIL CARTRIDGE

Grado Laboratories, 4614 Seventh Ave., Brooklyn 20, N. Y., has recently put a new electrodynamic, moving-coil cartridge on the market which incorporates a built-in static eliminator.

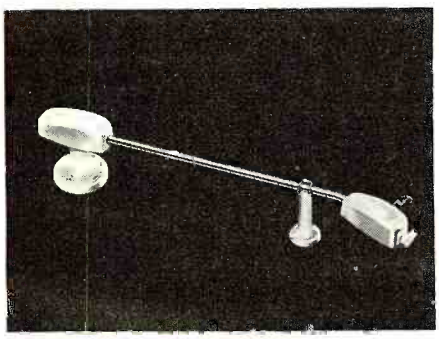
The coil is wound on a subminiature bobbin which is attached to a tempered steel shaft. The upper end of this shaft is a conical pivot and the lower end is a tapered pivot. The upper conical pivot turns in a stainless steel cone bearing which is threaded and adjustable. The lower tapered pivot has 360 degrees of contact with a special semi-solid damping material into which it is imbedded. This damping material is torsionally twisted rather than pinched or squeezed as in other systems.

Response is said to be 10 to 28,000 cps and the output is approximately 6 millivolts at 10 cm per second velocity. Impedance is 600 ohms throughout the audio range and the tracking force is from 2 to 7 grams. The static eliminator's half life is estimated at 1600 years! It is recessed for perfect safety.

A data sheet on this new cartridge is available from the company on request.

MODIFIED TONE ARM

Ronette Acoustical Corp., Lynbrook, N. J., has announced that the rear mounting post and rear arm rest of all of its "Fonofluid" high-fidelity tone



arms have been raised so that they may be used with any American or imported turntable. This applies to both the regular 12" and 16" transcription arms.

The new units eliminate the need for adapters.

AMPEREX MINIATURE PENTODE

Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, N. Y., is now in production on a new nine-pin miniature pentode which has been designed specifically for preamp and input stages having stringent requirements with regard to minimum hum, noise, and microphonics.

The EF86/6267 is a direct plug-in replacement for the older Z729. It is one of the new series of "preferred" types for high-quality audio applications. The low-frequency noise generated by the tube is equivalent to a voltage of 2 microvolts on the control grid in the bandwidth from 25 to 10,000 cps. The electrode structure is exceptionally rigid to keep microphonics to an abso-

NEW RECORD CHANGER ACHIEVES HIGH FIDELITY TURNTABLE PERFORMANCE

GLASER-STEERS GS Seventy Seven

offers fully automatic operation and added record and stylus protection

At last, the quality performance of a turntable has been combined with flawless record handling convenience. The result is — the new Glaser-Steers GS Seventy Seven. Wow and flutter are virtually non-existent. Rumble, for all practical purposes, has been eliminated, and automatic features such as the amazing 'SPEEDMINDER' mark the GS-77 as the most advanced record changer of our time.

'SPEEDMINDER' does your thinking — prevents you from using the wrong stylus with your records; selects the correct turntable speed . . . and intermixes and plays 33 and 45 rpm records automatically, without regard to size or sequence.

Another important GS-77 feature is that the turntable pauses during change cycles and doesn't resume motion until next record has come into play position and stylus is in lead-in groove. This eliminates record surface wear caused by grinding action of record dropping on moving disc — a common drawback in other changers.

Other GS-77 features include — CHANGE CYCLE — only 5 seconds — fastest in the field. MOTOR — 4-pole induction; dynamically balanced, hum shielded and shock suspended. ARM — acoustically isolated; has vernier adjustment for stylus pressure, and convenient finger lift for manual play, as well as indicator to facilitate location of stylus on groove; variation in stylus pressure between first and tenth record is less than 1 gram. MUTING SWITCH & R/C NETWORK — maintains silence except when record is being played. IDLER — automatically disengages in 'off' position to prevent flat spots. PRE-WIRED for easy installation, replaces most other changers.

The new GS-77 is absolutely jam-proof. A single knob controls all automatic and manual speed operations.

$59.50 less cartridge and base
(base illustrated, $9.60)

See and hear the new GS-77 at your local high fidelity dealer, or write for information.

GLASER-STEERS CORP.
20 Main Street, Belleville 9, N. J.

Please send me complete information on the GS-77.

NAME_____

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RTN-1

lute minimum. There are no appreciable internal resonances below 1000 cps and vibrations at higher frequencies are effectively damped out by the chassis and the tube holder.

STABLE AUDIO OSCILLATOR

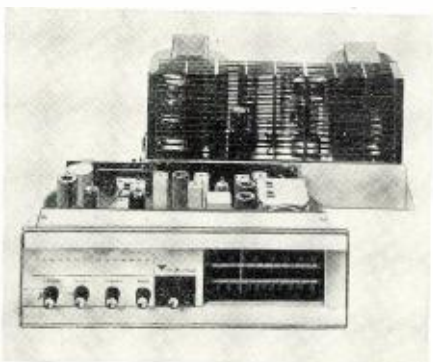
CG Electronics Corp., a subsidiary of *Gulton Industries, Inc.*, 212 Durham Ave., Metuchen, N. J. has developed an ultra-stable subminiature adjustable audio oscillator which can be used for energizing frequency sensitive relays in remote locations as well as serve as a remote frequency audio decoder.

Designed for plug-in applications, the units are available in frequency ranges from 200 to 1000 cps. Short period drift is .1 cycle and less than .5 per-cent drift over a range of 0 to 150 degrees F.

70-WATT AMPLIFIER

Sargent-Rayment Co., 4926 E. 12th St., Oakland, Calif., has added the "Super Seventy" 70-watt amplifier to its line of high-fidelity equipment.

Utilizing the new KT88 output tubes, which are designed for 100-watt application, the amplifier is able to loaf at



70 watts. A pair of GZ34 cathode rectifier tubes are used in the power supply. The circuit itself is an improved version of the British "Mullard" design. The input stage is an EF86 low-noise voltage amplifier which is direct-coupled to a 6SN7GTB cathode-coupled phase inverter which, in turn, feeds the KT88 output tubes.

Rated output power is 70 watts continuous and 140 watts peak. IM distortion is less than 1% at 70 watts (60 and 6000 cps @ 4:1); frequency response is 20 to 20,000 cps at any level from 1 to 70 watts. Damping factor is 15 and output impedances are 4, 8, and 16 ohms.

A brochure on this new amplifier is available from the manufacturer on request.

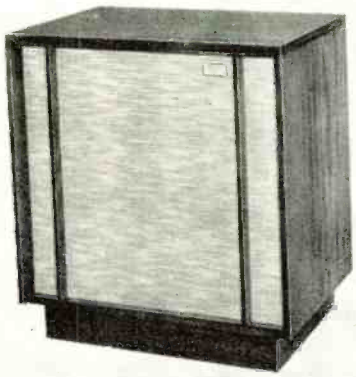
PILOT SPEAKER SYSTEM

Pilot Radio Corporation of Long Island City 1, New York, is now marketing a new loudspeaker system, the Model S-121.

The S-121 incorporates an acoustically matched, five-speaker, four-channel system consisting of a 12" woofer in dynamically vented baffle, 8" low mid-range and 6" upper mid-range speakers, and two 3" tweeters. It also features a separate treble balance control.

The main speaker enclosure is stur-

dily constructed and braced at seven key points. It is internally padded with acoustical material. It is designed in distinctive contemporary styling, using



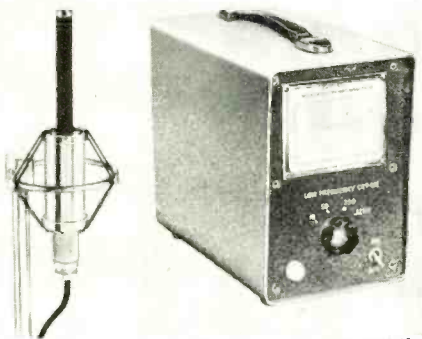
hardwoods, hand-rubbed to a lustre finish and harmonizing grille cloth. It is available in Cordovan mahogany, cherry mahogany, blonde mahogany, and American walnut. Dimensions are 27" x 23½" x 16".

Frequency response is 35 to 20,000 cps and maximum power handling capacity is 25 watts.

LABORATORY STANDARD MIKE

EV Instruments, a division of *Electro-Voice, Inc.,* Buchanan, Mich., is now in production on the Model 6100 laboratory standard microphone which has been designed for free-field pressure measurements between extremely wide limits of frequency, level, and ambient pressure.

The instrument consists of a transducer-cathode-follower probe assembly with removable shock mount, a preamplifier-power supply assembly, and all necessary interconnecting cables. Incorporating four barium titanate generating elements in a thickness mode



vibrating system, the transducer exhibits high sensitivity and an extremely flat frequency response characteristic to just below its high resonant frequency. The frequency range of the instrument is 10 to 50,000 cps.

Write the manufacturer direct for full specifications on this laboratory instrument and prices.

NEW SONOTONE CERAMIC

To mark its tenth year as a maker of ceramic cartridges, *Sonotone Corporation,* Elmsford, N. Y., has just introduced a new "5" series of low-cost, high-performance ceramic cartridges.

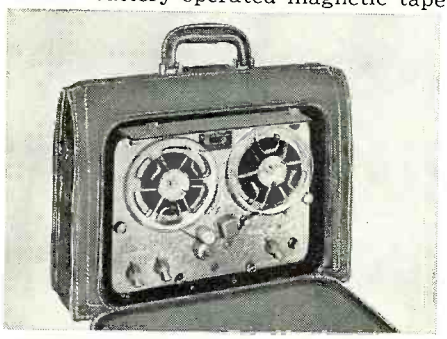
The new line incorporates all of the

features of the firm's "2T" cartridge—high output, self-equalization, trouble-free performance plus wider, more even response and greater compliance.

Two models are currently available, the "5T" a turnover model for both 78 and 45-33 speeds with sapphire needles and the "5P" single-needle model for either 78 or 45-33 speeds with sapphire needle.

"SECRET RECORDER"

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y., has put a new battery-operated magnetic tape



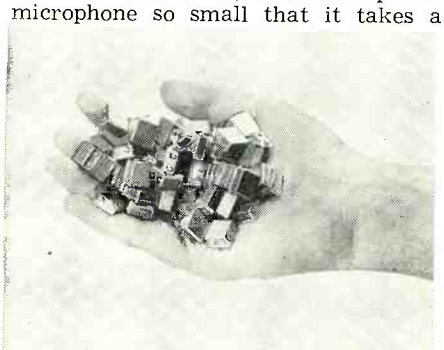
recorder designed for investigative work into full production after comprehensive field testing.

The "Secret Recorder" is completely self-contained, ingeniously camouflaged and concealed in a false compartment located in the central section of any average size leather briefcase. The recorder weighs only 11¾ pounds and measures 16" x 12½" x 4½". It is simple to operate. After the volume control has been preset, no further adjustments are needed. With the built-in microphone, normal speech may be recorded at a distance of 25 feet. The recorder is started or stopped instantly without tube warm-up delay by pressing a specially patented combination slide-lock and switch. Single- and two-speed models are available.

Complete technical specifications and descriptive literature on the new "Secret Recorder" are available from the manufacturer.

HALF-INCH-SQUARE MIKE

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill., has developed a microphone so small that it takes a



hundred of the units to make a handful.

Designed for use in hearing aids, tape recorders, and dictating equipment, the new MC30 measures only ½" x ½" by a little over ¼" thick. It weighs less than ⅛ of an ounce and is of the "controlled magnetic" type. Response rating is from 400 to 4200 cps. Output is

—76 db at 1000 cps and impedance is 2000 ohms at 1000 cps.

AUDIO CATALOGUES

PENTRON TAPE COMPONENTS

The Pentron Corporation, Chicago 24, Ill. has recently issued a four-page flyer which pictures and describes its line of tape system components for stereo and monaural applications.

Information is provided on three TM tape mechanisms, three monaural and stereo preamplifiers, a digital counter, a conversion kit for stereo, and an electronic mike and phono mixer. An ingenious chart shows the required components for various operational modes.

Copies of this publication are available without charge.

HIGH-FIDELITY HANDBOOK

Heath Company, 305 Territorial Road, Benton Harbor, Mich. is offering a new 48-page booklet which covers the subject of high fidelity in a practical, down-to-earth manner.

Entitled "The How and Why of High Fidelity" and written by Milton Sleeper, the new book answers the questions most often asked by novice and experienced audiophiles alike. In non-technical language the author explains the true meaning of high fidelity so that the reader can evaluate the performance of units under consideration for his own hi-fi system.

This lavishly illustrated booklet is available from the company for 25 cents a copy.

"ELECTRONIC PHONO FACTS"

A revised edition of Maxmillian Weil's popular booklet "Electronic Phono Facts" has just been published by the *Audax Division* of *Rek-O-Kut, Inc.,* 38-19 108th St., Corona 68, N. Y.

The booklet answers hundreds of questions about high-fidelity sound reproduction and covers such varied subjects as stylus alignment, peaks, turntable and record care, etc.

The brochure is equally useful to experts and amateurs. It also contains descriptions and illustrations of many types of equipment. The booklet is available for a nominal charge of 25 cents to cover the cost of mailing and handling.

PERMO "KEY" SYSTEM

Permo, Inc., 6415 N. Ravenswood Ave., Chicago 26, Ill. has introduced a new merchandising program which carries the firm's "Key Identification" system on its "Fidelitone" phonograph needles direct to the consumer.

The program is based on a handy booklet entitled "There is No Permanent Phonograph Needle." These leaflets illustrate 42 of the most popular tone arms in use today. The customer can determine, by direct comparison, just which arm he has. He is then in position to pass this information along to his hi-fi dealer when purchasing a replacement needle.

The company will supply a sample copy of this sales promotion piece on request. —30—

Stereo Control Center

(*Continued from page 57*)

the tape recorder only during stereo operation.

The fifth level supplies power to the AM tuner in AM monaural and stereo broadcast operation. The sixth level applies power to the auxiliary amplifier during all stereo operation.

Results

With a flick of the wrist or, at most, several flicks of the wrist, all controls are set up for the type of stereo listening desired. The controls are automatically set for proper balance. The levels may be set beforehand so that no blasting occurs when the power is turned on. Occasionally, a little trimming will be required of the "dot" set controls from one tape to the next or from one broadcast to the next, but that is about all. Interruptions in listening may be easily coped with, as both levels may be turned down or off by adjusting one knob.

Associated Equipment

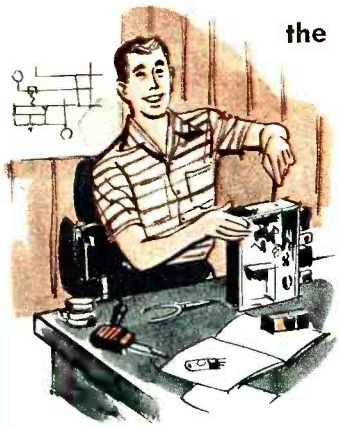
Now a word about the simplicity of setting the controls of the other equipment working into this selector. First, no gain control is required on the auxiliary amplifier. Second, the tuners do not require gain controls, since the preamplifier gain control may be used to equalize the tuners. In this particular setup separate controls were available for each tuner. These were used to equalize the inputs from the tuners with the other inputs and to equalize between the two tuners. Only one dot setting was required and this was made on the preamplifier to equalize the output of the two amplifier and speaker systems.

For the stereo tape orientation of the switch, no gain control is required on the separate tape outputs. Balance is obtained through the gain control on the preamplifier. In this application, where gain controls existed on the tape outputs, the "dots" were used to equalize stereo broadcasts and stereo tape. This means that one setting of the master level control will yield approximately equal volume from either stereo medium.

The auxiliary speaker, which is used for the second stereo channel is also used in monaural. The author has dubbed this "bimergent" operation. Bimergent operation takes the output of two different loudspeakers playing the same material from the same amplifier and merges them, through the room's acoustical coupling. An overall spacial effect is achieved which enhances the music. There is no need to use identical speakers; in fact, a better effect may be achieved with entirely different speaker characteristics. The addition of a second speaker, even a cheap one, makes a world of difference. To those who cannot afford stereo, this is the next best thing.

—30—

Build the Best— build ALLIED knight®-kits



the finest electronic equipment in money-saving kit form

LOWEST COST
ALLIED'S giant buying power passes biggest savings on to you—you do the easy assembly and your finished instrument equals the performance and appearance of equipment selling for several times the low KNIGHT-KIT cost. Your savings are BIG.

EASIEST TO BUILD
KNIGHT-KIT "Step-and-Check" instruction manuals with wall-sized picture diagrams are marvels of clarity—it's like having a good instructor at your side. No experience required—you can easily build any KNIGHT-KIT and get professional results.

LATEST DESIGN
Each ALLIED KNIGHT-KIT incorporates the very latest circuitry for top-quality performance. Tried and proved professional design and the use of premium quality parts throughout help insure your building success to bring you quality results.

COMPLETE KIT SELECTION:
- HI-FI
- HOBBY
- INSTRUMENT
- AMATEUR

MONEYBACK GUARANTEE. When properly assembled, KNIGHT-KITS fully meet published specifications or we refund your money in full.

EASY TERMS. If your KNIGHT-KIT order comes to $45.00 or more, you can make your purchase on our attractive Easy Payment Plan.

High Fidelity Everyone Can Afford

- World's Finest Hi-Fi Kits
- Easiest to Build Hi-Fi
- Custom-Styled
- Money-Saving

knight-kit High Fidelity FM-AM Tuner Kit

Model Y-787
$49.95
Only $4.99 down

- Latest Time-Saving Printed Circuit Design
- Flywheel Tuning
- Automatic Frequency Control
- 2.5 μv FM Sensitivity
- True High Fidelity Response
- Beautiful Custom-Styled "Space Saver" Case

The best-looking, best-performing FM-AM tuner kit your money can buy! Carefully designed for quick, easy construction—a tuner you'll enjoy assembling and be proud to own, both for its amazing musical performance and outstanding beauty. Covers the full AM broadcast band and 88 to 108 mc FM. On FM, *sensitivity is a remarkable 2.5 microvolts for 20 db of quieting;* hum and noise, —60 db; IF bandwidth, 200 kc at 50% down on curve; response, ± 0.5 db, 20-20,000 cps. On AM, *sensitivity is 3 microvolts for 10 db signal-to-noise ratio;* IF bandwidth, 8 kc at 50% down on curve; response, 20-8000 cps. Outstanding features include: Inertia Flywheel Tuning for effortless, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board (with most of the kit wiring already done for you) assures time-saving, error-free assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; rotatable built-in ferrite antenna for AM. Includes beautiful French-gray case with chrome-finished tapered feet, 4 x 13 x 8″. Ideal for use with 18, 20 or 30 watt KNIGHT-KIT amplifiers. Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Tuner Kit. Net only..... **$49.95**

knight-kit 18-Watt Complete Hi-Fi Amplifier Kit

Model Y-786
$39.95
Only $3.99 down

- The Last Word in Custom Hi-Fi Styling
- Full 18 Watts with Superb Hi-Fi Specifications
- 8 Inputs for Every Desired Signal Source
- Printed Circuit Switch and Printed Circuit Boards
- Full Equalization for All Record Types

Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at a price that defies comparison. Delivers full 18 watts output with wide-range, flat frequency response for true hi-fi reproduction. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. At full 18 watts output, distortion is only 0.5%; uses new RCA 6973 hi-fi output tubes. Frequency response is ± 1 db, 20-30,000 cps; tape head and magnetic cartridge sensitivity, 5 microvolts for 18 watts output; hum and noise level better than 60 db below 18 watts. Output taps for 4, 8 or 16 ohm speakers. Controls: Input and Record Equalization; Bass Boost and Attenuate; Treble Boost and Attenuate; Volume. Simplest assembly is made possible through the use of an exclusive printed circuit switch and two printed circuit boards—most of the kit wiring is already done for you. With custom-styled French-gray "space-saver" case on tapered feet finished in chrome, 4 x 13 x 8″. Complete with case, tubes, all parts, and step-by-step instructions, for easy, error-free assembly. Shpg. wt., 15 lbs.

Model Y-786. 18-Watt Hi-Fi Amplifier Kit. Net only..... **$39.95**

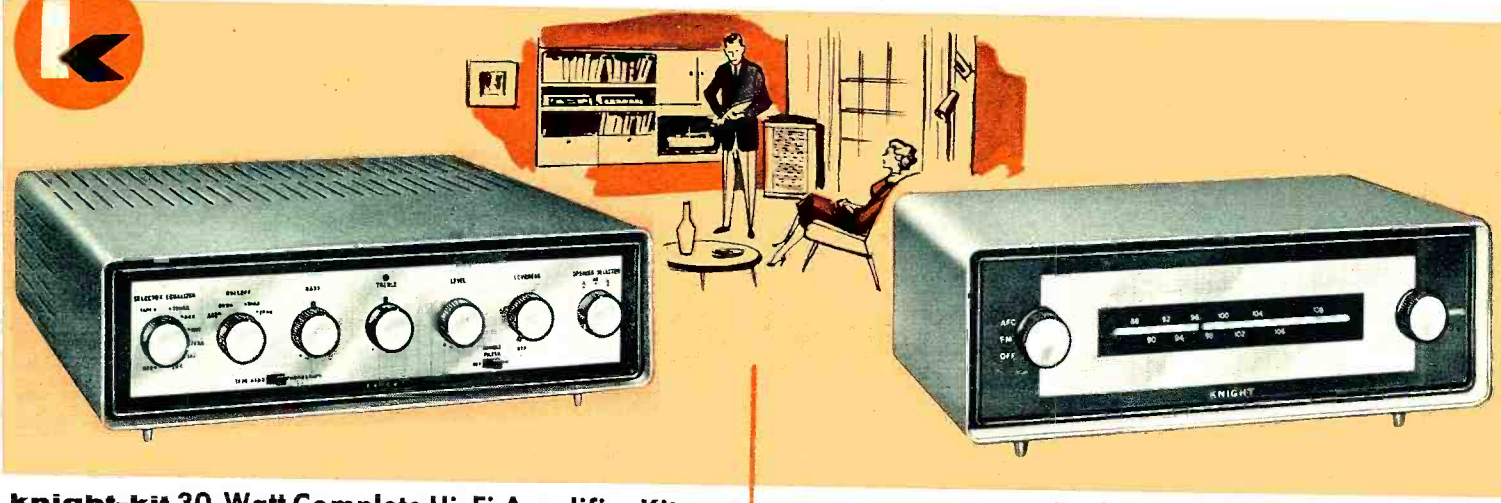
EASY TERMS TO FIT YOUR BUDGET. ALLIED KNIGHT-KITS may be purchased under our Easy Payment Plan. Your order need total only $45.00 or more—only 10% down, small monthly payments thereafter. No red tape—fast handling assured.

Our 37th Year

® Registered Trade-Mark of Allied Radio Corporation

ORDER FROM ALLIED RADIO 100 N WESTERN AVE. · CHICAGO 80, ILL

Now you can have Custom-Styled Hi-Fi in ALLIED



knight-kit 30-Watt Complete Hi-Fi Amplifier Kit

Model Y-762

$76.95

Only $7.69 down

- Full Equalization, ±½ db of Recommended Accuracy
- Printed Circuit Switches • Printed Circuit Boards
- 8 Inputs For Every Possible Signal Source
- Full 30 Watts Output • Custom-Styled Beauty

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Level Set control). Power amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts. Separate Bass and Treble controls; rumble filter switch; variable damping. Output, 8 and 16 ohms. With smart French-gray cabinet, 4 x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only.....**$76.95**

knight-kit High Fidelity FM Tuner Kit

Model Y-751

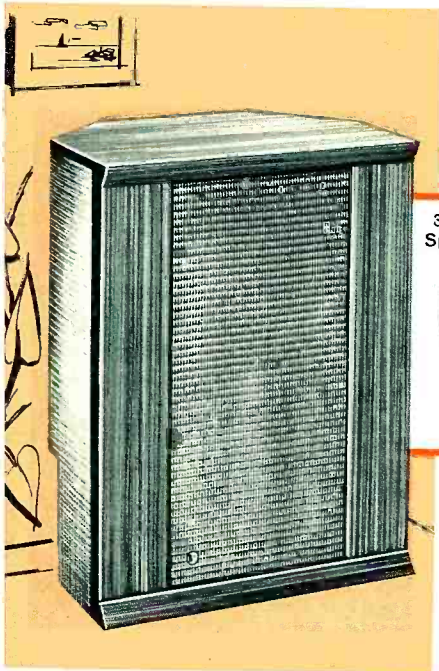
$38.95

Only $3.89 down

- Authentic High Fidelity FM Response
- Flywheel Tuning • Automatic Frequency Control
- Printed Circuit • Pre-Adjusted Coils and IF's
- 4 Microvolt Sensitivity Guaranteed

Here is top value in creative engineering, impressive hi-fi performance and distinctive design—a tuner you'll be proud to build and own. Covers the full FM band, 88 to 108 mc. Features Automatic Frequency Control (with disabling feature) to "lock-in" stations and prevent drift; Inertia Flywheel Tuning for velvet-smooth, accurate station selection; pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; neon bulb pointer. All critical wiring is already done for you in the form of a printed circuit board—assembly is simple. Sensitivity is 4 microvolts for 20 db of quieting across entire band; output, 2 volts at 1000 microvolts input; IF bandwidth, 200 kc; response, 20-20,000 cps. with only 0.6% distortion. Output jacks for amplifier and tape recorder; cathode follower output. Ideal for use with the KNIGHT-KIT amplifiers, or any amplifier with phono-tuner switch. Features custom-styled case in French-gray, with tapered chrome-finished feet, 4 x 13 x 8". Includes all parts, tubes and step-by-step instructions for easy assembly. Shpg. wt., 12 lbs.

Model Y-751. Hi-Fi FM Tuner Kit. Net only.....**$38.95**



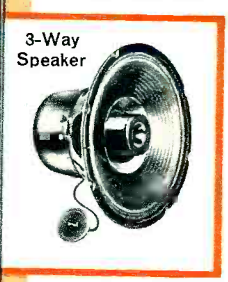
knight-kit Deluxe 3-Way Speaker System Kit

Model Y-937

$89.50

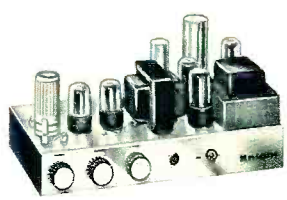
Only $8.95 down

- Pre-Finished "Quik-Craft" Corner Enclosure
- Klipsch Designed and Licensed
- Famous Knight 12" 3-Way Speaker
- Easy to Assemble—Top Hi-Fi Quality
- Choice of Enclosure Finishes



Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT "Quik-Craft" corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—*no finishing required*—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12" woofer cone for bass (full 1¾ pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 12" 3-Way speaker, prefinished enclosure panels, grille cloth, hardware and instructions. *Specify Korina blonde, mahogany or walnut when ordering.* Shpg. wt., 44 lbs.

Model Y-937. 3-Way Speaker System Kit. Net only.....**$89.50**



knight-kit 10-Watt Hi-Fi Amplifier Kit

Y-753

$23.50

$2.35 down

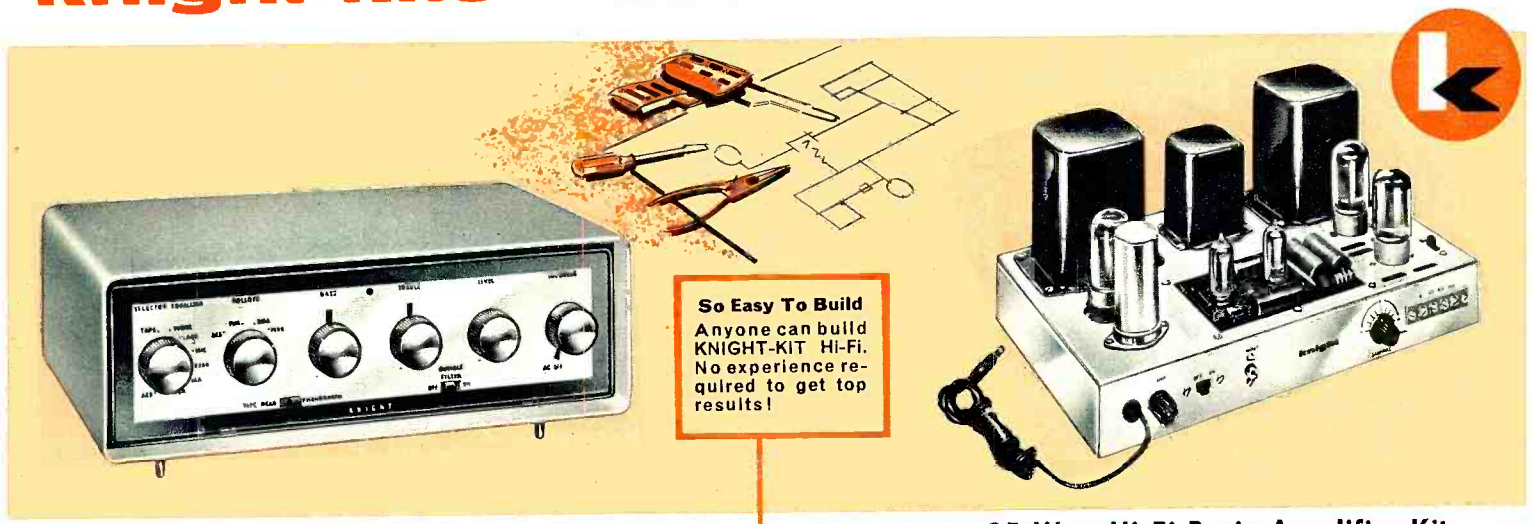
Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 30-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phono. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only 1% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6". With all parts, tubes and instructions. Shpg. wt., 13 lbs.

Model Y-753. Net only..**$23.50**
Y-235. Preamp Kit.....$ **3.10**
Y-757. Metal Cover....$ **3.95**

ALLIED RADIO *America's Pioneer in Electronic Kits*

knight-kits

THE VERY FINEST MUSICAL QUALITY—SO EASY TO BUILD
MONEY-SAVING HI-FI EVERYONE CAN AFFORD



So Easy To Build
Anyone can build KNIGHT-KIT Hi-Fi. No experience required to get top results!

knight-kit High Fidelity Preamplifier Kit

Model Y-754
$39.95
Only $3.99 down

- Exclusive Printed Circuit Switches and Boards
- Equalization ±½ db of Recommended Accuracy
- 8 Inputs Including Tape Head
- Self-Powered
- DC on All Tube Filaments
- Custom-Styled

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within ½ db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps. Includes exclusive new KNIGHT-KIT printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AY7 and ECC82 tubes. Frequency response, ± 0.5 db, 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phono; Pickering Phono; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preamplifier at the lowest possible cost. Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8″. With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12½ lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only.....**$39.95**

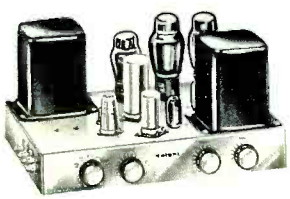
knight-kit 25-Watt Hi-Fi Basic Amplifier Kit

Model Y-755
$44.50
Only $4.45 down

- Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
- Only 0.15% Distortion at 30 Watts Output
- Printed Circuit Wiring Board
- Chrome-Plated Chassis
- 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

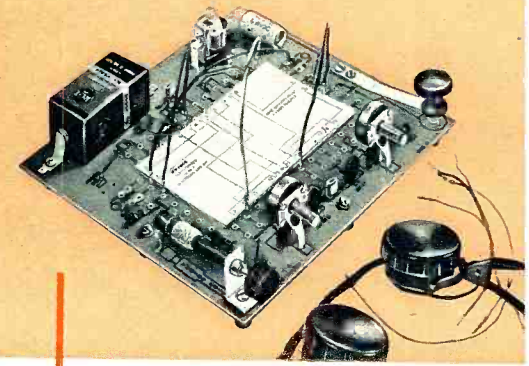
- Easy to Assemble—Pre-Finished Enclosure
- High Fidelity Response, 45 to 14,000 cps
- 12″ Woofer and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

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

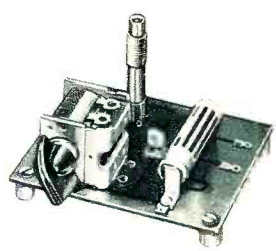
knight-kit 5-Transistor Superhet Personal Portable Radio Kit

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 7½x3⅜x1¾". 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

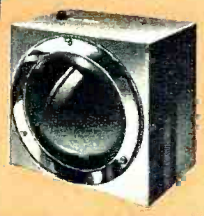
$9.50 Play music or make announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set. Shpg. wt., 3 lbs.

Model Y-705. Net only $9.50

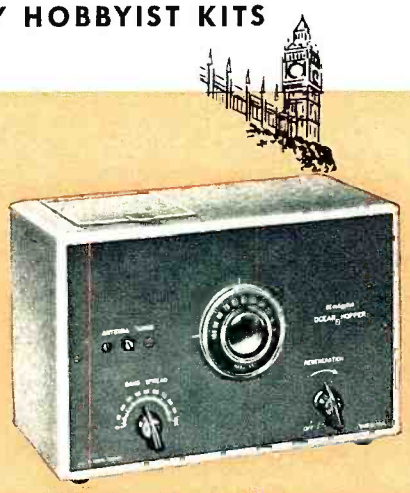
ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. · CHICAGO 80, ILL.

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

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."

knight-kits 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.

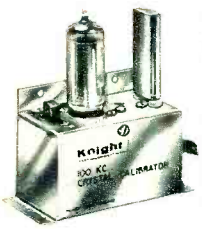
Model Y-255. 50-Watt Transmitter Kit. Net only..... **$38.95**

Model Y-725
$28.50
Only $2.85 down

knight-kit Self-Powered VFO Kit

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**

Model Y-253
$5.85

knight-kit Amateur RF "Z" Bridge Kit

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 .....

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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.

Spot Radio News

(*Continued from page* 16)

readers for dot codes were found to be the answer and several types have been developed.

In explaining the code system, the Bureau said that the operator reads the address on the envelope and operates a keyboard similar to a typewriter keyboard. By following certain fixed and simple rules of abbreviation, the operator imprints on the back of the envelope, in dot-code form, a standardized abbreviated version of the address on the envelope. The degree of abbreviation depends upon the volume of mail that is normally sent to the address in question. Post offices, streets, and individual addresses which receive very large volumes of mail can be given unique single-character codes to save the coding operator's time.

The same machine can sort either incoming or outgoing mail simply by changing the information stored in its memory. Changes in the distribution system do not require altering the dot code. Only the information in the memory—which can be modified—need be changed to keep abreast of a growing postal delivery system.

IMMEDIATE IMPROVEMENT IN AIR-TRAFFIC control at major cities throughout the country is now being accomplished through the use of an electronic air-traffic control simulation device by the CAA Technical Development Center at Indianapolis, Indiana.

The studies at the center apply only to the technical air-traffic control problems involved and do not include other items of major importance, such as the economic impact on the Washington area community, proximity to the community, noise, engineering matters such as terrain and soil conditions, effect on the residents of the locality involved, cost of land, and other factors.

The CAA operational simulation facilities has already been used to provide improvement in many important high-density traffic areas, such as New York, Dallas, Fort Worth, and San Francisco. Substantial increases in air traffic capacity have resulted.

Dynamic simulation is also used in other day-to-day CAA problems, such as airspace conflict, designation of federal airways, predetermination at minimum cost of the location of air-nagivation round stations, such as *vortac*.

The CAA's role in this project, through the use of its simulation devices, is not to select actual sites for airports or air navigation stations, but to provide pertinent technical data in regard to air-traffic control and flight operational problems.

A NUMBER OF EXTREMELY HELPFUL booklets on air-electronic controls have appeared recently in Washington.

In one issue, an 88-page flight-information manual, published by the CAA, there is a detailed report on the radar advisory service now available, explaining what it is, who can use it, and how to use it. This manual, on sale at the U. S. Government Printing office, Washington 25, D. C., is priced at 50 cents.

PROCEDURES AND PHRASEOLOGIES used in radar air-traffic control are outlined in another CAA booklet titled "United States Standard Manual of Radar Air Traffic Control Procedures."

Designed to standardize radar control by personnel of the CAA, Army, Navy, Air Force, and the Coast Guard, the text covers the methods by which radar control can be used by controllers, radar separation standards, radar identification and approaches, and departures.

The material in this booklet will be incorporated into the ANC manual "Procedures for the Control of Air Traffic Control." At present this booklet is also available from the Government Printing Office, for 15 cents.

MERGERS, rather than station authorizations, have dominated the hearing rooms of the Commission during the past weeks.

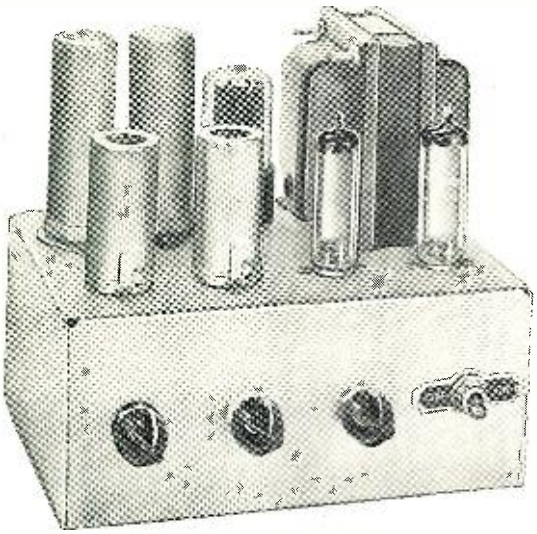
To relieve economic pressure in the Wilkes-Barre (Pa.) area, two pioneer ultra-high stations — WARM-TV (Scranton) and WILK-TV (Wilkes-Barre)—asked for permission to merge the facilities and channel into a single outlet. If approved, WARM-TV channel 16 would use the 1.5-megawatt power of WILK-TV, and new call letters—WNEP-TV—would be adopted for the amalgamated stations.

At press time, the authorizations and call changes noted on page 12 of this issue, were approved.

THE TALOS (supersonic surface-to-air missile) demonstrated recently features a number of outstanding electronic developments.

One advancement is a traffic-light test system that tells when the weapon is ready for firing. Another is a beam-riding control for the missile, which is about 20 feet long and 30 inches in diameter, and weighs about 3000 pounds; and is accelerated to supersonic flight by a solid-fuel booster rocket about ten feet long; the latter is jettisoned when the missile reaches cruising speed.

Two stages of guidance give the Talos system the capability of high firepower, as well as high accuracy at long range. The first, or mid-course range, carries the missile from launcher to the vicinity of the target. It is at this point that the beam-riding or radio system is used. Intelligence for the beam-riding phase is received by the missile directly from the take-off point. As the Talos closes in on target, a second or homing guidance system in the missile senses the exact location of the *bull's-eye*. . . . Once more electronics has demonstrated its remarkable abilities. . . . . L. W.

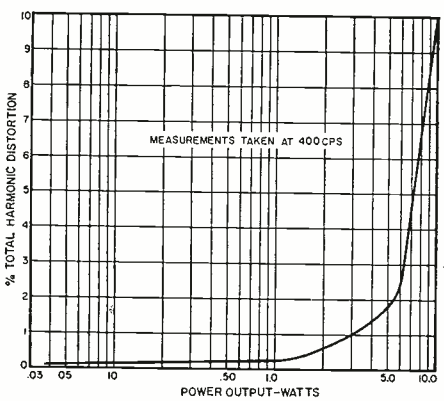


Over-all view of the low-power amplifier, showing the volume, bass, and treble controls, along with the power switch on the front of the chassis. Both 12AX7 and 12AU7 tubes are shielded and mounted in front of the two electrolytics. The 6AQ5 power output tubes are to the right and in front of the power transformer.

COMPACT Hi-Fi Amplifier

By
LEON A. WORTMAN

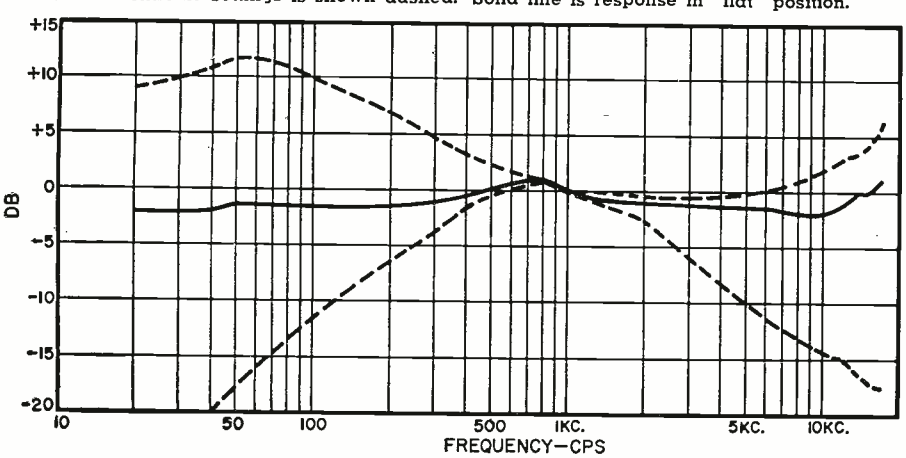
Get started in hi-fi with this simple low-power audio amplifier which includes its own preamp and power supply, all constructed on one 5" x 7" x 3" chassis.



REMEMBER the "old world craft" of building low-power amplifiers? In case you don't, there was a time when 10 watts of audio power would have been considered adequate for an auditorium. But, now the advertising emphasis seems to be on high-power jobs on the order of 50 to 100 watts.

← **Fig. 1. Percentage of total harmonic distortion versus output power taken at a frequency of 400 cps. Note that the distortion is 1 per-cent or less at power levels of 3 watts and below. At 5 watts output, the distortion is just under 2 per-cent, while at a power output of 10 watts, distortion is 10 per-cent.**

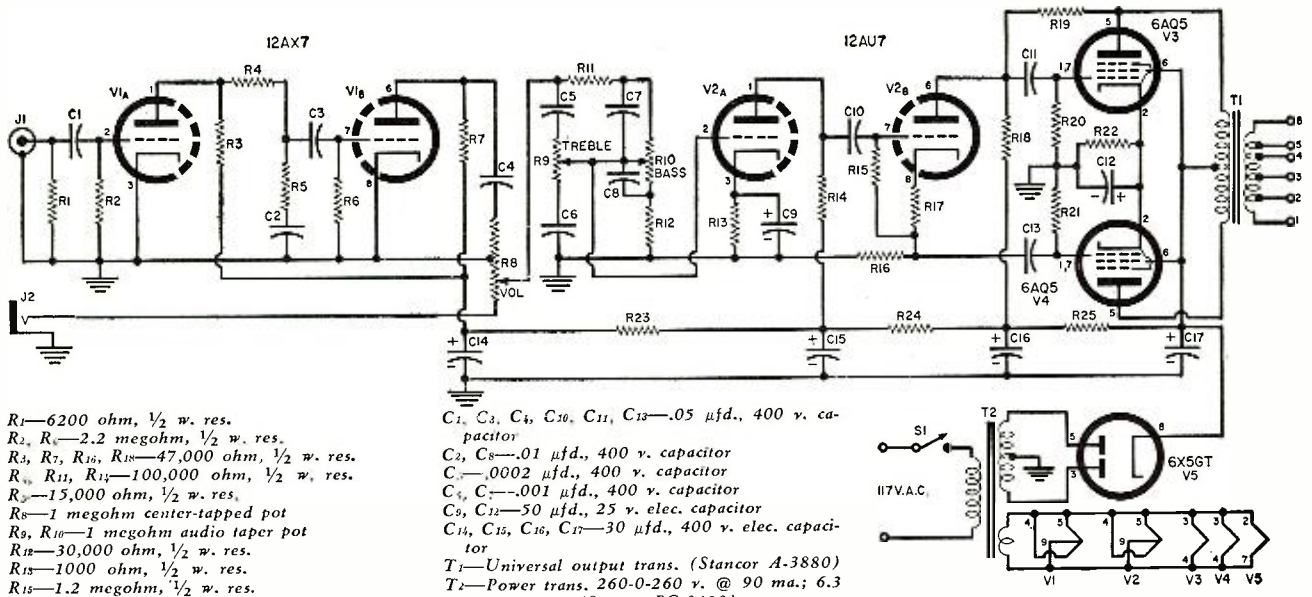
Fig. 2. Over-all frequency response of the low power amplifier with tone controls at their extreme settings is shown dashed. Solid line is response in "flat" position.



However, statistics continue to justify the sales efforts many of the large hi-fi equipment manufacturers put behind their small-power amplifiers. Possibly it is because so many music lovers still must live in close-quarter city apartments. Perhaps it's that ever-present problem of economics. Whatever the reason, many continue to buy and build, and enjoy immensely, the delightful sounds that the smaller units can reproduce.

Here is a 10-watt unit consisting of a preamplifier, power amplifier, and power supply, all on one 5"x7"x3" aluminum chassis. It offers dollar-economy and many excellent listening hours. It is, too, a perfect starter-unit for those who want to "taste" the new experience called "high-fidelity listening."

Two signal-input jacks are provided at the rear of the chassis. One is a standard microphone-type jack for high-impedance, high-level signal sources such as provided by high-output microphones, cathode follower from a tuner, or a crystal phono-cartridge. The other is a phono-tip jack for lower impedance, low-level signal sources, such as from a reluctance or magnetic phono-cartridge. A 12AX7 dual-triode tube serves as the preamplifier for the low-level cartridge. Compensation is provided for the characteristic bass deficiencies of the popular reluctance cartridges by C_2, R_4, and R_5, in Fig. 3.



R_1—6200 ohm, ½ w. res.
R_2, R_6—2.2 megohm, ½ w. res.
R_3, R_7, R_{16}, R_{18}—47,000 ohm, ½ w. res.
R_4, R_{11}, R_{14}—100,000 ohm, ½ w. res.
R_5—15,000 ohm, ½ w. res.
R_8—1 megohm center-tapped pot
R_9, R_{10}—1 megohm audio taper pot
R_{12}—30,000 ohm, ½ w. res.
R_{13}—1000 ohm, ½ w. res.
R_{15}—1.2 megohm, ½ w. res.
R_{17}—1500 ohm, ½ w. res.
R_{19}—470,000 ohm, 2 w. res.
R_{20}, R_{21}—470,000 ohm, ½ w. res.
R_{22}—270 ohm, 2 w. res.
R_{23}—27,000 ohm, ½ w. res.
R_{24}—2200 ohm, ½ w. res.
R_{25}—5100 ohm, ½ w. res.

C_1, C_3, C_4, C_{10}, C_{11}, C_{13}—.05 μfd., 400 v. capacitor
C_2, C_8—.01 μfd., 400 v. capacitor
C_5—.0002 μfd., 400 v. capacitor
C_6, C_7—.001 μfd., 400 v. capacitor
C_9, C_{12}—50 μfd., 25 v. elec. capacitor
C_{14}, C_{15}, C_{16}, C_{17}—30 μfd., 400 v. elec. capacitor
T_1—Universal output trans. (Stancor A-3880)
T_2—Power trans. 260-0-260 v. @ 90 ma.; 6.3 v. @ 4 amps (Stancor PC-8420)
J_1—Phono tip jack J_2—Phone jack
S_1—S.p.s.t. switch
V_1—12AX7 tube
V_2—12AU7 tube
V_3, V_4—6AQ5 tube
V_5—6X5GT tube

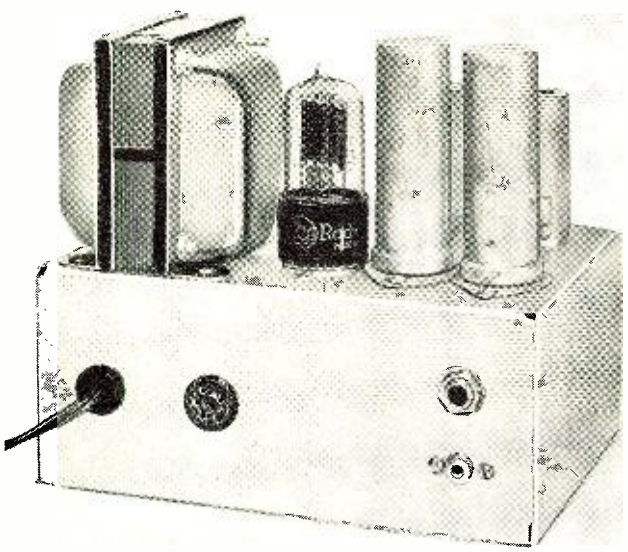
Fig. 3. Complete schematic diagram and part listing for the low-power amplifier.

The volume control is a center-tapped potentiometer. With one shaft and one knob it provides separate control of volume for both signal-input jacks. This is done by connecting the center tap to ground, one end of the resistance element to the output of the preamplifier tube, the other end to the high-impedance input jack, and the wiper arm to the grid of the next tube. Thus, when the wiper arm is at the midway point the grid of the tube is actually grounded and volume is off for both jacks. Rotating clockwise or counterclockwise of center gives the choice and control of volume for either of the two jacks.

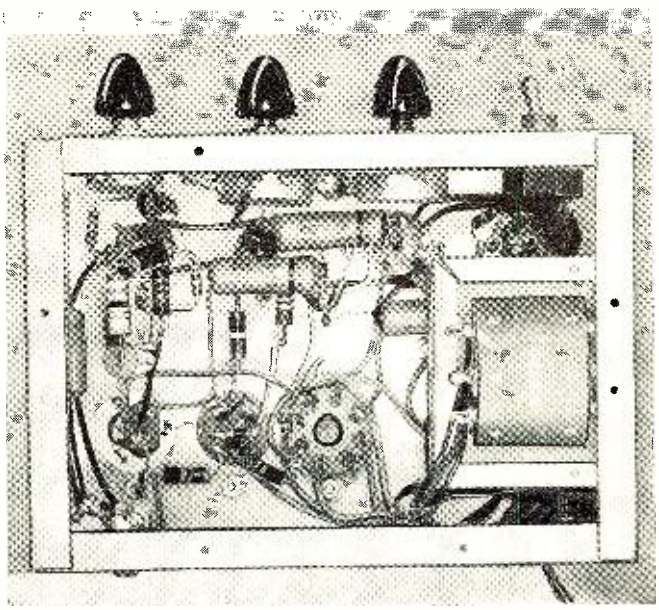
The separate bass and treble controls are wired before the first and second triode-sections of the 12AU7. The first section serves as a stage of additional amplification to make up for the voltage losses incurred by the bass-treble controls. The second section functions as a phase inverter feeding the separate control grids of the two 6AQ5 power-amplifier tubes. A medium-price 10-watt output transformer is used. It has a universal secondary, allowing one to connect to a wide range of load impedances, speakers singly connected, or connected in series or parallel arrangements. Inverse feedback is provided by R_{10} and stabilizes the operation and improves the distortion *versus* power characteristic. As can be seen from an examination of the circuit shown above, no unusual or trick circuits are used.

Frequency response curves are given in Fig. 2 and distortion *versus* power curve in Fig. 1. Measurements were made with an *RCA* audio-signal generator, *Hewlett-Packard* distortion meter, and a *Simpson* vacuum-tube voltmeter. Statistics are not as good as many of the commercial audio-giants you can buy ready-built. This one costs less than about $25 to build, however. It gives quite a bit of the same pleasure potential and that's an excellent reward for building it. —30—

The 6X5GT rectifier can be seen between the power transformer and two electrolytic filter capacitors. Top phone jack is for high level input, lower phono jack will accommodate magnetic phono pickup. Multiple-pin socket is speaker connection.



Bottom view of the low-power hi-fi amplifier is shown here. The universal output transformer can be clearly seen mounted at the right side of the chassis shown here. The construction and wiring is straightforward and presents no problems.



HOW FAR CAN YOU GO IN ELECTRONICS WITHOUT A DEGREE?

LESS THAN TWO YEARS AGO, 20-YEAR-OLD TIM WICKHAM HAD ASKED HIMSELF THIS QUESTION. Today, firmly established as a Computer Units Field Engineer with IBM, Tim knows some of the answers. His story of how he assumed important engineering responsibilities on one of our country's biggest electronics projects makes encouraging reading for every technician who feels himself handicapped by lack of a formal degree.

"I always wanted to be an electronics engineer," Tim says, "ever since I first tinkered with hi-fi in my high school days. But my formal education ended when I entered the Marines in 1953. In spite of the excellent radar training I received in the Service, I still had doubts as to how far I could go in my chosen field without a degree."

HEARS ABOUT IBM—AND SAGE

A few months prior to his discharge, Tim began to look into the opportunities for a civilian career. He heard about IBM, learned that IBM was willing to invest thousands of dollars training the right men to assume engineering responsibilities in the Project SAGE program. "Could I do it?" Tim asked himself. To be brief, Tim could—and did. Two months later Tim reported to Kingston, N. Y., to begin training as an IBM Computer Units Field Engineer.

SAGE—PROJECT OF NATIONAL SIGNIFICANCE

SAGE—for which Tim was trained—means Semi-Automatic Ground Environment. It is part of America's radar warning system—a chain of defense that will ultimately ring our country's perimeter. At the heart of this system are giant electronic computers, built for the project by IBM. These computers receive data from Texas towers, picket ships, reconnaissance planes, ground observers—analyze the data for action by the Strategic Air Command and other defense units. "These computers are the largest in the world," Tim points out. "Each contains 58,500 vacuum tubes plus 170,000 diodes."

BECOMES FIELD ENGINEER

"My five months' training at Kingston were a revelation," Tim remembers. "Here were top-notch courses in advanced electronics, taught by instructors who really knew their business—and had a personal interest in your progress. We had classroom lectures in which we learned about basic computers, logic, programming, general machine operation—how everything worked together. Instead of a lab, we worked in actual test areas, along with the regular test area personnel. Incidentally, IBM went out of its way to make our stay at Kingston pleasant. They helped us with housing accommodations and we received a living allowance over and above salary during our training period."

INSTALLS WORLD'S LARGEST COMPUTER

His training completed, Tim was assigned to the Project SAGE site at Newburgh, N. Y. "The giant computer was ready for installation," Tim recalls, "but before it could be moved into its new building, 300 miles of cable had to be laid. Then we made interconnections and brought in the power. Next came the testing phase—a long procedure, as you may imagine for a computer of this size. Then we set

up the auxiliary equipment. Finally, when everything was ready, the Air Force ran its acceptance tests—a stiff trial with no if's, and's or but's permitted. I'm happy to say we got an unqualified OK.

"My present work," continues Tim, "is in the Tape Section of the computer. I'm responsible for the maintenance of the Central Computer Tape System which includes eight tape drives (a means of storing information) and two tape adapter frames which adapt information for admittance into the Central Computer. A Computer Units Field Engineer like myself works about three months in each of the computer's three sections, giving him a chance to learn the whole computer."

A NEW ENGINEERING DIMENSION

"IBM has proved to me," Tim says, "that a degree is not the only measure of a man's ability, or the only indication of what he can do when given the opportunity. Around me at the site I see a lot of men who were once considered 'just technicians'—men who have had a new engineering dimension added to their careers—all because IBM will spend time and money to train technicians for engineering responsibilities. I know this better than ever, now that I'm on the job. I'm on the Education Committee at the Newburgh site and I see what IBM will do to train men. My job on the committee is to find out what the men want. Then, IBM supplies courses, instructors, classrooms—everything that's needed."

YOUR CAREER OPPORTUNITY WITH IBM

Since Tim Wickham joined IBM and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance and IBM will invest thousands of dollars in the right men to insure its success.

If you have two years' education and/or experience in electronics—gained through technical schooling or military service—you can become a member of this important, permanent, expanding project as a Computer Units Field Engineer.

You'll receive twenty weeks' training at Kingston, N. Y., with full pay, plus living allowance, before assignment to a permanent location. You'll receive salary, not wages, plus overtime pay. And, of course, you'll receive the liberal IBM company-paid benefits.

WRITE TODAY TO:

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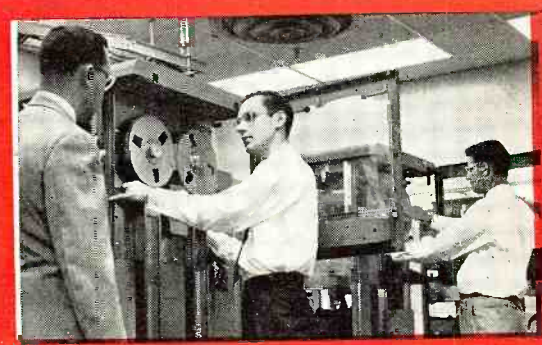
Room 650M
Military Products Division
IBM Corp., Kingston, N. Y.

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States if your résumé of experience and education indicates you have the qualifications.

Checking panel wiring of Simplex console

Trouble-shooting a computer frame



Discussing a problem in computer magnetic tapes

Working on SAGE magnetic input drums

Classroom lecture in computer logic

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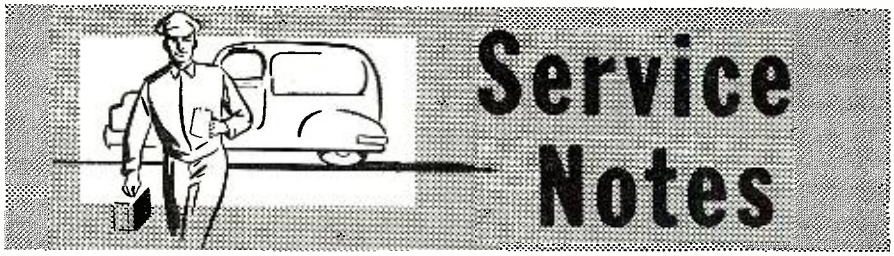
SPECIAL ENGINEERING PRODUCTS • SUPPLIES • TIME EQUIPMENT



IMPROVED SYNC, SENSITIVITY

In the absence of specific defectiveness in the sync circuits, sync stability may be somewhat critical in some *Midwest* receiver chassis whose code numbers begin with the following letters: DJ, DM, DMA, DR, DX, DXA. The change noted here will also be useful where some increase in sensitivity is desired. The improvement is achieved by increasing "B+" voltage to the tubes in the tuner and the video i.f. section; and this is done by shunting an additional resistor across one section of the *Candohm* resistor used in the power-supply voltage divider. The end section of this resistor, between the terminal supplying 215 volts and the terminal supplying 100 volts, is the one to be shunted. A 5000-ohm, 10-watt resistor is placed across these terminals to effect the desired improvement in the sync circuit.

INSTABILITY AND ARCING

Irregular, dark patches in the picture and erratic horizontal sync, when these symptoms appear in the large number of *Pacific-Mercury* receivers using the horizontal-output circuit shown in Fig. 1, may be attributed to arcing, but the question still remains as to where the

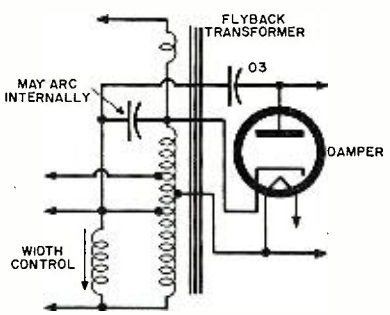


Fig. 1.

actual arcing is taking place. A likely culprit, if no other detectable evidence can be found elsewhere and the symptom persists in eluding the investigator, is the indicated capacitor in the cathode circuit of the damper tube. In many receivers, this 100-$\mu\mu$fd. unit is a mica capacitor with a rating of 1500 volts. This type has a tendency to arc internally. Since this condition in the capacitor in question is very difficult to detect, it should be replaced whenever the noted symptoms occur, with no other apparent cause. It is also recommended that, to avoid possible repetition of the symptom, replacement be made with a ceramic tubular type having the same nominal capacitance, but with a rating of 2000 volts. In later production, in fact, the manufacturer has exercised this very precaution by making use of the ceramic tubular capacitor himself.

Another troublesome component in the same circuit (Fig. 1) is the .03-μfd. capacitor at the plate of the damper. When it shorts out completely, there is no "B+," but partial failure produces such less definite and less detectable symptoms as a lowering of "B+" and reduction in picture size. These difficulties are likely to arise in those sets where this capacitor is a 400-volt unit. To replace, use a molded capacitor rated at 600 volts for the extra margin of safety.

YOKE LOAD NEEDED

When chassis in the Model 50-T series of *Philco* TV receivers are removed for service, it is customary to leave the picture tube, including the yoke assembly, in the cabinet. In some cases, the chassis is then operated on the service bench without a yoke. Since disconnecting the yoke removes the load from the 6BG6 horizontal-output tube, this circuit is likely to be disturbed. Excessive screen current will result, with probable damage to the screen dropping resistor. To avoid complications, it is advisable to load the circuit by tacking a yoke in place while the receiver is on during service. A complete picture-tube assembly is not necessary to provide the desired operation involving the horizontal-output stage and its transformer in this model receiver.

DARK SPOT ON CRT

On some 21-inch receivers made by *Stewart-Warner,* a condition which superficially appears to be ion burn on the picture-tube screen is actually due to another cause, and may be eliminated without replacement of the CRT. A round, dark spot, about 4 inches in diameter, appears at the center of the picture-tube screen. This spot may easily be the result of the fact that the picture-tube face is too close to the safety glass. What happens is this: an electrostatic discharge to the safety glass at this center spot where the tube is close to the glass reduces the screen voltage just in this area, with the dark spot as a result. If there is any question as to whether ion burn has actually occurred, removal of the set from the cabinet will provide a definite answer, as the spot will disappear if it was caused by proximity to the safety glass. The remedy is simple: the chassis should be pushed back away from the safety glass in the cabinet as far as it

will go. This may be done after loosening the mounting bolts holding the chassis to the cabinet.

BUZZ REDUCTION, SEARS

Predominantly 60-cycle buzz may appear in the sound output of a TV receiver from either of two sources. True intercarrier buzz will appear only when the receiver is tuned to an active channel. Buzz may also occur when the output from the vertical-sweep circuit is picked up directly by the audio circuits. In the latter, manipulation of the vertical-hold control will vary the pitch of the buzz. In *Sears-Roebuck* chassis in the 478 series, buzz pick-up may be of either kind. In the case of intercarrier buzz, improvement is attainable by adding a component to the grid circuit of the ratio-detector driver, shown in Fig. 2A. The 15,000-ohm resistor is added, as shown, between the top of the 4.5-mc. sound take-off trap and ground, shunting the trap. Also, the cathode resistor of the driver stage should be changed from 100 to 180 ohms. It will then be necessary to realign the primary of the ratio-detector transformer.

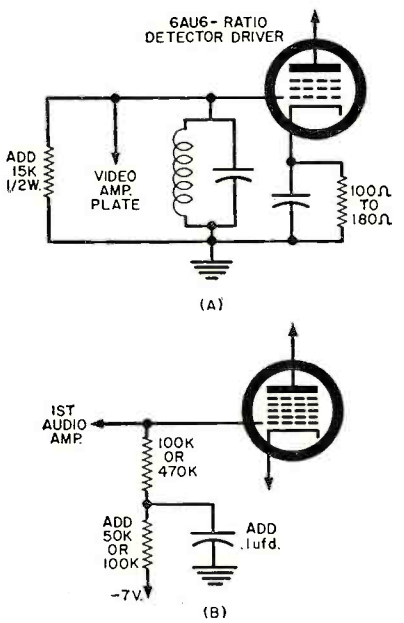


Fig. 2.

Where pick-up is from the vertical-sweep circuits, a 50,000-ohm resistor should be added, as shown in Fig. 2B, between the end of the 100,000-ohm resistor that is farthest from pin No. 5 of the audio-output tube and the −7-volt supply. A .1-μfd. capacitor is then connected between the junction of these two resistors and ground to complete the change. This procedure is followed exactly if the audio-output tube is a 6V6. In some receivers, however, it is a 6K6. In that case, the resistor connected to the grid will be 470,000 ohms instead of 100,000 ohms. The added resistor, then, will be 100,000 ohms instead of 50,000 ohms. The remainder of the remedy is the same as that for the 6V6 circuit. —30—

New! SICO Streamlined TUBE TESTERS

Superior's New Model TD-55
EMISSION TYPE

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.

• **You can't insert a tube in wrong socket.** Separate sockets are used, one for each type of tube base. • **"Free-point" element** switching system 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.** 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. • **Elemental switches are numbered in strict accordance with R.M.A. specification.** The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: 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.

Model TD-55 comes complete with operating instructions and charts and streamlined carrying case.

$26.95 NET

Superior's New Model TV-40

PICTURE TUBE TESTER

Not a Gadget—Not a Make-Shift Adapter, but a Wired Picture Tube Tester With a Meter for Measuring Degree of Emission—at Only $15.85

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!

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.

- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (ion trap need not be on tube). Throw switch up for quality test ... read direct on Good-Bad scale. Throw switch down for all leakage tests.

Comes absolutely complete — nothing else to buy. Round cornered molded bakelite case. Only ...

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Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- 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. **All elements are numbered according to pin-number in the RMA base numbering system.**
- Model TW-11 does not use 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. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects 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

TRANS-CONDUCTANCE TUBE TESTER

The new Model TV-12

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Model TV-12 housed in handsome rugged portable cabinet sells for only

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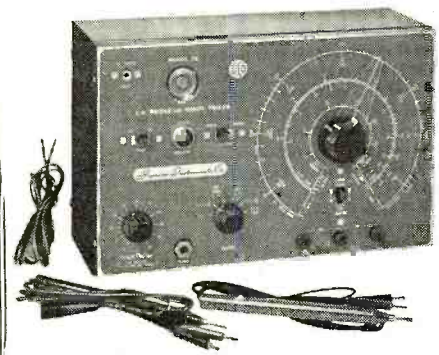
ALSO TESTS TRANSISTORS!

EXAMINE BEFORE YOU BUY!
USE APPROVAL FORM ON NEXT PAGE

New! SICO Superior's New Model 76

IT'S A **CONDENSER BRIDGE** IT'S A **RESISTANCE BRIDGE** IT'S A **SIGNAL TESTER** IT'S A **TV ANTENNA TESTER**



√ **CAPACITY BRIDGE SECTION**
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

√ **RESISTANCE BRIDGE SECTION**
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

√ **SIGNAL TRACER SECTION**
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

√ **TV ANTENNA TESTER SECTION**
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads .....

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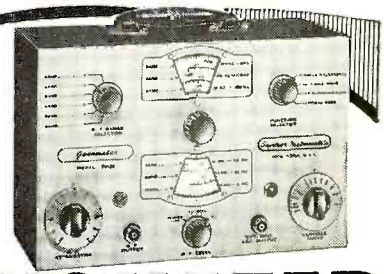
NO C.O.D.



SICO

Superior's new Model TV-50

GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- ✓ R. F. Signal Generator for A.M.
- ✓ R. F. Signal Generator for F.M.
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Audio Frequency Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

Only $47.50 NET

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New Tube Tester Data

Owners of Sylvania or Weston testers will want to save this listing on recently released tube types.

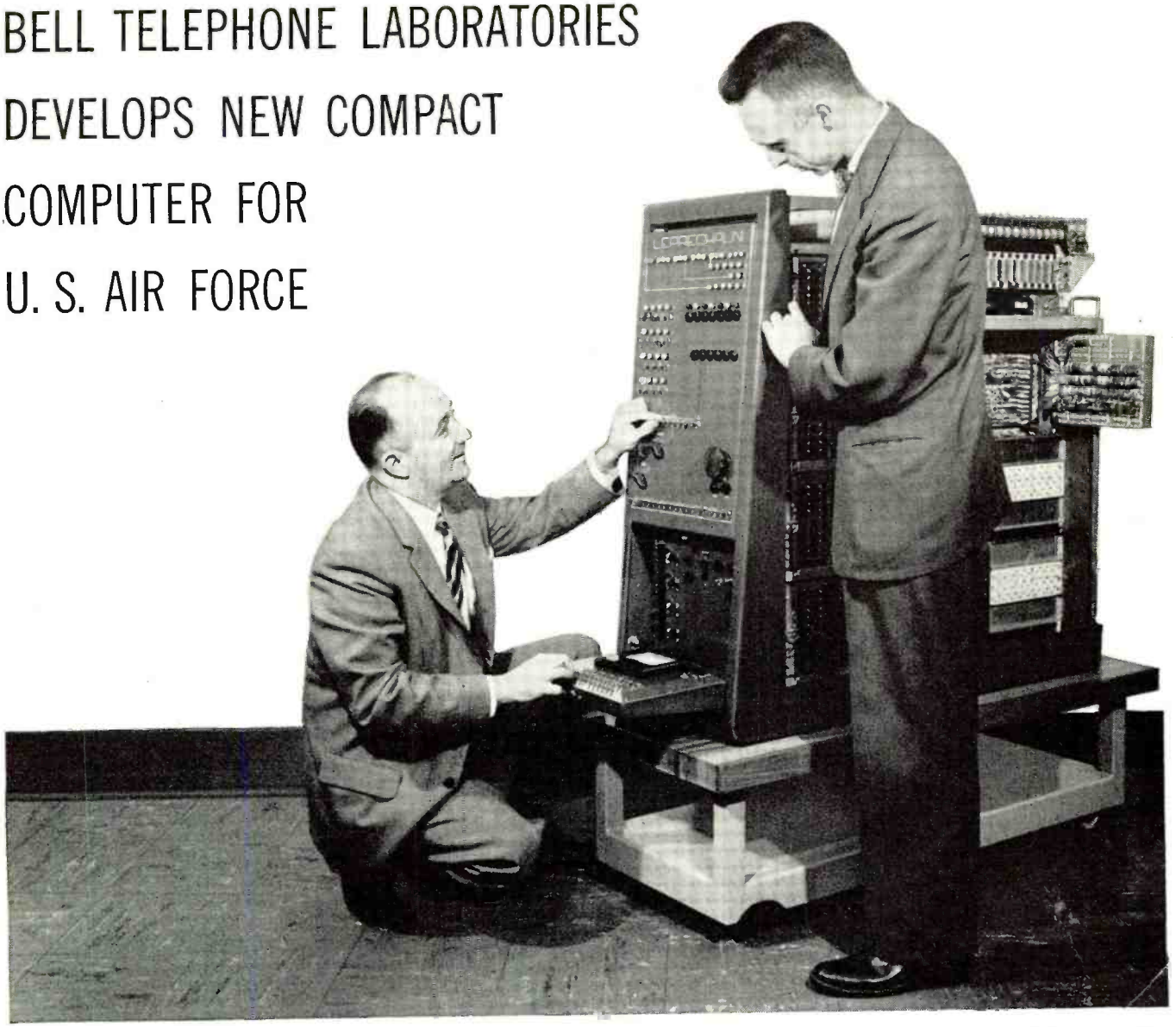
SYLVANIA MODELS 139 AND 140

TYPE	A	B	C	D	E	F	G	TEST
1G3	1.4	0	2457	0	8	—	37	V
3CY5	3.3	0	4	0	4	36	41	U
	3.3	0	2	0	4	36	41	U
4AU6	5.0	0	—	0	4	36	32	W
4DT6	5.0	0	—	0	4	36	61	T
6AN6	6.3	2	48	4	0	—	49	T
	6.3	2	48	4	1	—	49	T
	6.3	2	48	4	4	—	49	T
	6.3	2	48	4	7	—	49	T
6BK4	6.3	0	—	0	3	—	55	T
6CY5	6.3	0	4	0	4	36	40	U
	6.3	0	2	0	4	36	40	U
8CN7	7.5	0	5	0	8	7	47	T
	3.3	7	15	3	1	—	46	T
	7.5	0	5	0	1	—	46	T
	7.5	0	5	0	2	—	46	T
8SN7GTB	7.5	0	678	1	7	5	36	W
	7.5	0	278	1	3	3	36	W
12CN5	12.6	0	5	0	3	26	51	T
	12.6	0	2	0	3	56	51	T
12CS7	12.6	0	—	0	1	6	21	W
	12.6	0	—	0	3	7	59	Y
12DW8	12.6	0	—	0	1	3	47	T
	12.6	0	—	0	3	7	47	T
	12.6	0	—	0	4	—	47	T
12EL6	12.6	0	—	0	1	3	55	X
	12.6	0	—	0	4	—	55	T
	12.6	0	—	0	5	—	55	T
12U7	12.6	0	5	0	1	3	48	T
	12.6	0	5	0	3	7	48	T
	6.3	0	5	3	3	7	48	T
17BY7	12.6	0	45	0	6	39	35	Y
	12.6	0	45	4	6	39	34	Y
25AV5GT/GA	25	0	—	0	3	57	20	Y
25CA5	25	0	5	0	3	26	26	Y
	25	0	2	0	3	56	26	Y

WESTON MODEL 981, TYPE 3A

TUBE TYPE	FIL.	MULT.	BIAS	SELECTORS	SENS.	EP	REJ. PT.	REMARKS
2C50	13	2	31H	531GP-K760	37	F	970	$P_1G_1K_1$ & $P_2G_2K_2;X_2$
3CE5	.6 a.	8	11L	51763-4K00	41	D	1010	$P_e;X_5$
5CG8	.6 a.	4	17L	00076-3415	40	D	1020	Pent;X_3
	.6 a.	8	8L	53176-0000	43	C	770	Tri;X_5
6BA8	.6 a.	8	27L	00076-1543	40	D	1200	P_e; X_5
	.6 a.	2	23H	15376-0000	31	F	900	Tr; X_2
6BL4	6.3	R	——	00103-0760	18	E	——	——
6CE5	6.3	8	11L	51763-4K00	41	D	1010	Pe; X_5
6CG8	6.3	4	17L	00076-3415	40	D	1020	Pent;X_3
	6.3	8	8L	53176-0000	43	C	770	Tri;X_5
6CN7	6.3	1	27L	00076-1530	38	F	800	Triode
	6.3	D	——	3P176-0000	38	A	——	P_1 & P_2
12CT8	13	8	16L	00076-3451	45	D	1170	Pent;X_4
	13	4	12L	35176-0000	40	D	1090	Tri;X_3
CK6485	6.3	8	15L	52763-4100	40	D	1170	

BELL TELEPHONE LABORATORIES DEVELOPS NEW COMPACT COMPUTER FOR U. S. AIR FORCE



J. A. Githens, B.S. in E.E., Drexel Institute of Technology, and J. A. Baird, Ph.D. in E.E., Texas A. & M., check the control panel of Leprechaun, a new high-speed computer which solves extremely complex problems in one-tenth of a second. Small size and low power are made possible by new design principles and Bell Laboratories' invention of the transistor.

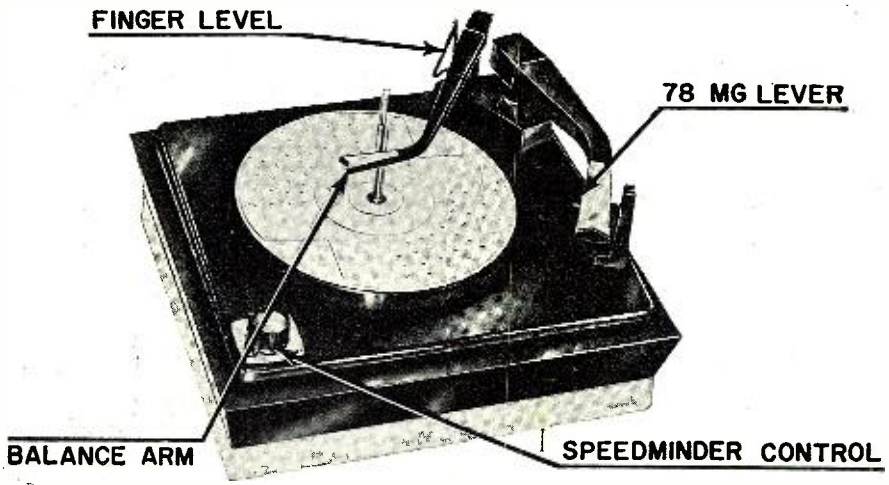
The United States Air Force assigned Bell Labs an interesting assignment: develop a new kind of electronic computer. The major requirement was greater simplicity. Of course, no computer is simple, but this one (known as "Leprechaun" to its designers) is much smaller and simpler than most of the computers currently in use.

It has only some 9000 electrical components; 5000 of them are transistors. As a result, Leprechaun has less than one-third the components of conventional computers. This facilitates testing, experimentation, assembly and service.

Even in its experimental state, Leprechaun is a stimulating example of great strides in the simplification and miniaturization of circuitry . . . a problem of profound interest to all Bell Laboratories researchers as they develop radically new equipment for your future telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



Novel Features Highlight New Record Changer

A most unusual mechanical type change cycle is incorporated in this four-speed record player.

A NEW record changer known as the "GS Seventy-Seven," manufactured by the *Glaser-Steers Corporation* of Belleville, N. J., attracted considerable interest at the recent New York Hi-Fi Show. Its most unusual features are in its mechanical design and automatic change cycle operation.

With the standard groove stylus in operating position, the changer will automatically operate at 78 rpm.

With the microgroove stylus in operating position, the changer will automatically operate at 33⅓ or 45 rpm depending upon record size and it will automatically intermix and play 33⅓ and 45 rpm records without regard to size or sequence.

The turntable comes to a complete stop during a change cycle. It will resume motion only after the next record has come into play position and the stylus is in the lead-in groove of the record. This operation automatically eliminates any record surface wear that would normally be caused by the grinding motion of a record dropping on a moving disc.

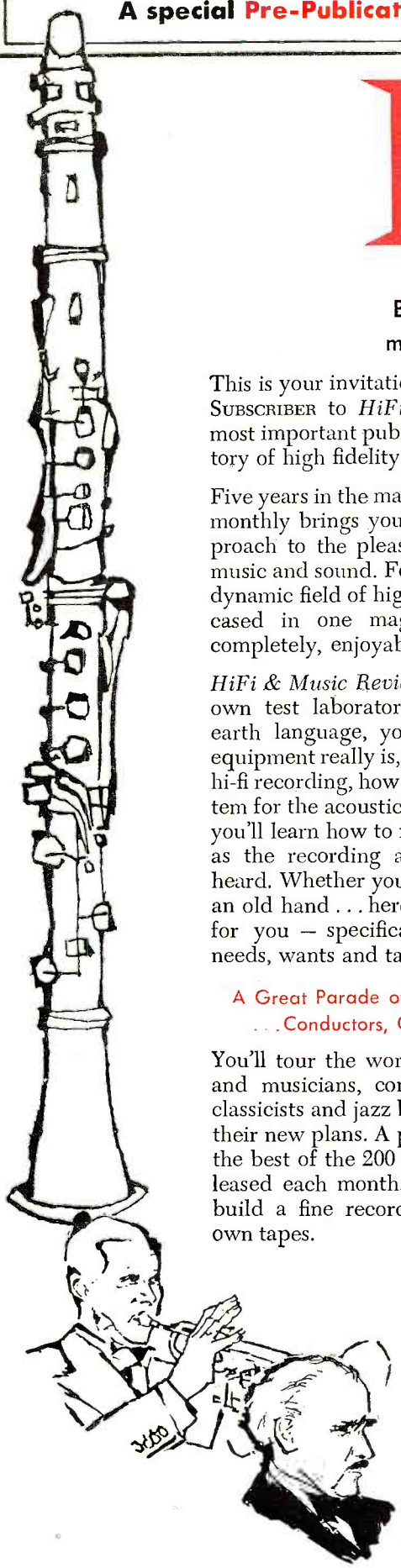
Referring to the photograph above, the 78-microgroove lever when away from the arm post (microgroove stylus in operating position), permits 33⅓ or 45 rpm operation. When the standard 78 rpm stylus is in play position, this lever then is rotated 180 degrees and trips a lever within the post permitting only 78-rpm operation. The finger lever moves back and forth when tripped by the dropping of various sized records and its motion automatically determines whether or not 33⅓ or 45 rpm operation is desired. For any size record other than seven inch, it will automatically choose the 33⅓ rpm operation. When a seven inch record drops, the finger lever automatically chooses the 45 rpm rotation.

The balance arm normally rests on top of the records when in automatic operation and when it is rotated to the right over the tone arm, the record changer is in manual position. The operating control has its normal "on-off" operating switch, "Speedminder" position (for automatic operation), and the normal manual operation of 16⅔, 33⅓, 45, and 78 rpm.

The pickup arm has been isolated from acoustic feedback by shockproof grommet mounting. Stylus pressure is adjustable by means of an easily accessible knurled wheel, and variation in stylus pressure is less than .9 gram between the first and the tenth record on the turntable. The tone arm, whether or not the changer is in automatic or manual operation, can be physically moved back and forth without any possible damage to the mechanism.

The over-all design of the unit is, of course, attractive. Its electrical operation is more or less conventional. It employs a four-pole hum-shielded motor with balanced rotor for smooth, constant speed, shock-mounted operation. The unit incorporates a muting switch and *RC* network which maintains silence at all times except when a record is being played. The rumble, wow, flutter are all at a very low level. The changer shuts off automatically after the last record has been played and a kit of parts is provided for mounting almost any popular type of cartridge. —30—

A special Pre-Publication Offer to readers of RADIO & TV NEWS



HiFi & MUSIC REVIEW

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This is your invitation to become a CHARTER SUBSCRIBER to *HiFi & Music Review*, the most important publishing project in the history of high fidelity!

Five years in the making, this new Ziff-Davis monthly brings you a completely fresh approach to the pleasure-filled world of hi-fi music and sound. For the first time, the vast, dynamic field of high fidelity music is showcased in one magazine – authoritatively, completely, enjoyably.

HiFi & Music Review will take you into its own test laboratory. In simple, down-to-earth language, you will learn what hi-fi equipment really is, how to recognize a truly hi-fi recording, how to select and place a system for the acoustics of your home. In short, you'll learn how to reproduce sound exactly as the recording artist intended it to be heard. Whether you're a beginner in hi-fi or an old hand . . . here at last is the magazine for you – specifically designed for your needs, wants and tastes!

A Great Parade of Classical and Jazz . . . . . Conductors, Composers, Performers

You'll tour the world of music. Composers and musicians, conductors and arrangers, classicists and jazz buffs discuss their works, their new plans. A panel of experts analyzes the best of the 200 recordings and tapes released each month. You will learn how to build a fine record collection, make your own tapes.

From jazz groups to string quartets . . . the New York Philharmonic to the big band of Kenton . . . the mood music of Gleason to the etudes of Chopin . . . Brubeck . . . Erroll Garner . . . Mantovani . . . Scarlatti . . . Satchmo . . . Beethoven . . . Stravinsky . . . stereo tape or 33⅓ rpm—whatever in the incredible world of music and sound interests you most – you're sure to find it in *HiFi & Music Review*.

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Because we believe that you are the kind of person who will best appreciate a magazine of this scope and caliber—you are cordially invited to become a CHARTER SUBSCRIBER at the special rate of 8 months for only $2. Upon publication, *HiFi & Music Review* will cost 35¢ a copy, but this special pre-publication offer saves you more than 28% over single-copy costs . . . brings you 8 big issues at only 25¢ each.

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First Issue: January, 1958.

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Please enter my Charter Subscription to HI FI & MUSIC REVIEW to start with Vol. 1, No. 1, in January, 1958—at the special rate of 8 months for only $2. Also send my Charter Subscription Certificate.

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Name _____

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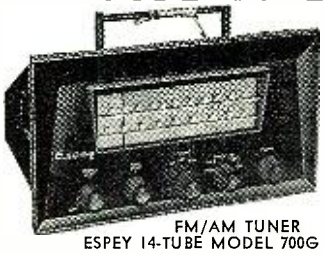
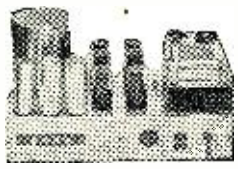
22 TUBE ESPEY FM-AM HI-FI TUNER-AMPLIFIER

SALE PRICE $99.95

A REGULAR $199.50 NET VALUE COMBINATION FOR $99.95



FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



ESPEY 24 WATT
MODEL 501G AMPLIFIER

MODEL 700G FM-AM TUNER AND MODEL 501G AMPLIFIER

SPECIAL SALE PRICE BOTH FOR $99.95

ATTRACTIVE LEATHERETTE TUNER CABINET $7.95 EXTRA

McGee offers you both the regular $119.50, 14 tube Deluxe FM-AM tuner and the regular $79.50, 8 tube audio amplifier for the special sale price of only $99.95. The Model 700G Espey tuner has its own built in power supply. Performance features are: Sensitivity 3mv on AM, 5 mv on FM for 30 db quieting. AM selectivity 10kc at 6 db. FM 240 kc at 6db. Audio response flat from 20 cps to 20,000 cps., with less than ¼ percent distortion with one volt audio output. Chassis is 14" long, 8½" high and 10" deep. Features a one-piece, molded, gold color plastic front which makes a custom installation both extremely attractive and easy at the same time. Full tuned RF stages-AFC on FM with defeating switch for easy FM tuning. Built-in preamplifier for GE or other popular variable reluctance cartridges. Three position equalizer switch for LP, AES or European records. Separate bass and treble tone controls with 23db boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Has built-in ferrite loop antenna for AM broadcast band and 300 ohm input for FM band. This fine quality FM-AM tuner is second to none. It has all of the features that you might expect of a tuner that would cost as much as $200. All of the controls are on the front panel. This is a most desirable feature when the tuner is used in conjunction with a good audio amplifier, such as the 501G which was designed with no tone control or preamplifier circuits.

The model 501G, 8 tube ultra-linear high fidelity, 24 watt audio amplifier is made to match the 700G tuner. This amplifier features less than ½ percent distortion with high fidelity response from 10 cps. to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size, 12"xS"x8". Output tubes: 4—6V6GT in push-pull Williamson circuit. 6SN7GT phase inverter and 2—5V4G rectifiers. Has an 8 pound potted case output transformer with specially made grain-oriented iron core. Output impedance taps of 4, 8 and 16 ohms. This output transformer alone is a $20.00 value.

Buy both the 700G FM-AM tuner and the matching 501G amplifier for only $99.95. Tuner shipping weight 20 lbs. Amplifier shipping wt. 22 lbs. See the special deals of the 700G-501G tuner-amplifier combination with record changer and GE cartridges for extra money saving values. Also, special discount on speakers and speaker systems when ordered with your Espey tuner and amplifier.

ESPEY DEAL—1A

Espey 700G-501G tuner with 24 watt amplifier plus VM-956 GE 3 speed VM on metal base—1 Mill Diamond Needle $10.00 extra. Net **$124.95**

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net **$144.95**

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net **$174.95**

SPEAKERS RECOMMENDED

Order any of the following speakers with your Espey tuner and amplifier:

12" coaxial PM, CU-14Y—$10.00 extra
15" coaxial PM, P15-CR—$20.00 extra
Imperial IV system—$15.00.
Imperial VI system—$25.00.
Norelco 9762—12" regularly $59.50 at $30.00 extra.
EV84—15W system—$150.00 extra.

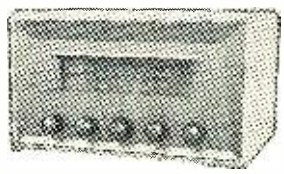
ESPEY—MODEL HF-250C. A FULL HIGH FIDELITY AUDIO AMPLIFIER AND FM-AM TUNER—ALL ON ONE CHASSIS

REGULAR $119.50 VALUE

★ TWIN CONE CONTROLS
★ INPUTS FOR CRYSTAL OR V.R. PHONO, TAPE OR TV
★ WILLIAMSON TYPE CIRCUIT
★ ULTRA-LINEAR RESPONSE

SALE PRICE **$69.95** LESS SPEAKER AND CABINET

Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt audio. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Ultra-linear output used in Williamson type circuit gives frequency response of 10 to 22,000 cps. Output taps of 4, 8, and 16 ohms. Separate RF stages for FM and AM assure high sensitivity. Temperature compensated FM front end for minimum drift. Separate bass and treble tone controls. Pre-amp for all types of magnetic cartridges. 2nd input for crystal phono, tape recorder or TV. 3 position equalizer for accurate reproduction of all records. Built-in antennas for both FM and AM. Response plus or minus 1 db from 10 to 22,000 cps. Harmonic distortion less than 1%. Sensitivity: FM, 8 mv for 30 db quieting; AM, 75 mv for 6 db signal to noise ratio. Off-on-volume and equalizer are combined on a concentric control. Has 2 AC outlets on rear of chassis. Beautiful edge lighted flywheel inertia slide rule dial. Size: 7¾"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable). Model HF-250C Sale price, $69.95. Espey chassis with our P15-CR, 15" coaxial PM speaker, both for $89.95. Espey chassis with $54.95 list, model 9760M, 12" Phillips speaker, both for $89.95. Espey chassis with $99.95 list, model 9762M, 12" Phillips speaker, both for $104.95.



LEATHERETTE COVERED CABINET $7.85 EXTRA

Beautiful moderntone tan leatherette covered cabinet to house the HF-250C Espey chassis for custom installations. Also, will fit the 500Q Espey tuner shown on the opposite page. High quality, sturdy plywood cabinet expertly covered with modern tan leatherette material. Size, 15" long, 8½" high and 10⅜" deep. Stock No. LEC-50. Custom leatherette covered cabinet. Ship. wt. 7 lbs. Order with your Espey chassis for only $7.95 extra.

HALLICRAFTERS S-78A

11-TUBE FM-AM HALLICRAFTERS

REGULAR, $89.50 VALUE! SALE PRICE **$49.95**

WITH MONARCH 4-SPEED RECORD CHANGER, 12" COAX. SPEAKER

$132.40 VALUE ALL FOR **$86.95**

Now, buy a complete FM-AM chassis with push-pull audio built-in, at less than you would pay for a tuner without audio amplification. We offer you this nationally known Hallicrafter S-78A, 11 tube FM-AM radio chassis complete with escutcheon plate and knobs, to be put in your own cabinet or mounted in your recreation room wall. Features a 11 tube power transformer operated superhet circuit with automatic frequency control on FM, push-pull 6K6 audio gives up to 12 watts peak output with response to 15,000 cps. Use with a good Hi-Fi PM speaker or speaker system. Output matches 3.2 or 8 ohms. Full bass boost tone control. Chassis size: 7⅜"x12½" long and 11" front to back. Input for record changer with crystal cartridge. (Self powered pre-amplifier for G.E. variable reluctance cartridge available at $2.95 extra). Model S-78A, 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price, $49.95.
S-78A chassis with our CU-14Y, 12" coaxial PM speaker, both for $59.95.
S-78A chassis with our P15-CR, 15" coaxial PM speaker, both for $69.95.

VM HI-FI CHANGER. SALE PRICE $29.95 LESS BASE LESS CART.

VM-936HF
$32.95

COLLARO
456 - $34.50

MONARCH
UA8H $27.95

$45.90 WITH GE RPX-052A

4 Speed Monarch SALE PRICE **$27.95** with 222 Ronette Ceramic Cart. Diamond 1 Mil Stylus $10.00 Extra

New offering of VM Hi-Fidelity, 3 speed record changer with or without metal base. A large special purchase makes this low sale price possible. Reg. net on VM-935 less cartridge was $38.97. Reg. net on VM-936 less cartridge was $45.47. The VM-935-936 Hi-Fi Series changers are equipped with two plug-in tone arm heads which will hold popular G.E. single or dual play cartridges. Both have 4-pole motors for constant speed, hum free operation with a VR cartridge. Plays all 3 speeds and all 3 sizes. Will intermix 10" and 12" records of same speed. Shuts off after last record plays. Switch silences pickup during change cycle. Furnished with large 45 RPM spindle. Chassis size 13½ x 13¼ x 8½" high, 4½" above plate. Ship. wt. 12 lbs., with base 18 lbs.
VM-935HF, 3 speer Hi-Fi changer, less cartridge and base, only $29.95.
VM-935HF-GE with G.E. RPX-050A VR cartridge, $35.90.
VM-935HF-GED with "Golden Treasure" RPX-052A VR cartridge; 1 mil diamond and 3 mil sapphire stylii, only $45.90.
VM-936HF, 3 speed Hi-Fi changer with metal base, less cartridge, Sale price, $32.95.
VM-936HF-GE with G.E. RPX-050A VR cartridge, $38.90.
VM-936HF-GED with G.E. RPX-052A "Golden Treasure" cartridge; 1 mil diamond, 3 mil sapphire stylii, only $48.90.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.
McGee's new 15" Junior coaxial PM speaker. 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker, Sale price, $16.95.

4-SPEED COLLARO

Latest 1957 model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. Base size; 13½" wide, 12" deep. 4½" above motor board and 3" below. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus. Sale price, $46.95. 45 RPM spindle, $3.30 extra.

New Model UA8, Monarch 4 speed imported High Fidelity record changer. Features a high fidelity 4 pole motor, 9" turntable with molded rubber pallet. Balanced tone arm will accept any of the popular Hi-Fi cartridges. Plays all 4 speeds and all 3 sizes. Intermixes 10" and 12" records of the same speed and shuts off after last record plays. Size, 10⅞" x 12¾". Ship. wt. 15 lbs. Spindle for 45 RPM records, $1.88 extra.
Model UA8-H with ±222 Ronette Hi-Fi flipover ceramic cartridge, $27.95.
Model UA8-HD, same as above but with 1 mil diamond stylus, $37.95.
Model UA8-U with ±500 Goldring variable reluctance cartridge, $29.95.
Model UA8-UD, same as above but with 1 mil diamond stylus, $39.95.

4-SPEED WEBCOR

New, 4 speed Model 152, Webcor "Magic-Mind" automatic record changer. Complete with G.E. RPX-050A variable reluctance cartridge. Plays all 4 speeds 16, 33, 45 and 78 RPM automatically. 7", 10" and 12" LP records can be inter-mixed. Magic-Mind feature will switch speeds automatically between 33 and 45 RPM depending on the size of the record. Has heavy 4 pole motor and 8" turntable with rubber pad. Shuts off after last record plays and has neutral position to prevent flat spots on drive wheels that cause wow and flutter. Base size, 13⅜"x12", Ship. wt. 13 lbs. Sale price, $31.95. Large 45 RPM spindle, $2.94 extra.

FAMOUS 12" NORELCO PM SPEAKER

MODEL 9762-05 REGULAR NET WAS $59.97 — McGEE SCOOP PRICE **$29.95**

McGee Scoop. Genuine Norelco 9762-05 extended range high fidelity 12" PM speaker. 11,000 gauss. Heavy 37 oz. Alnico V magnet. Rated 20 to 30 watts audio. Response 35 to 18,000 cps. Regular $60.00 net value. Has extended range bakelite dispersion feature built-in center of core to extend high frequency range. Never before have we had such a terrific value on this genuine Norelco 12" speaker. Made in Holland. Stock No. 9762-05. McGee's Sale Price, $29.95.

3 SPEED HI-FI COLLARO

Model RC-54, 3 speed (33⅓ 45 and 78 RPM) Collaro record changer. A late model High Fidelity record changer with a ceramic crystal cartridge (no pre-amplifier required). Features diamond 1 mil and sapphire 3 mil needle, 4 pole motor. Base size, 12" x 13¼". For 110 volt, 60 cycle AC operation. These changers were intended for use only by a nationally known Hi-Fi set manufacturer. McGee bought them at a substantial saving. Our bargain passed on to you. Stock No. RC-54 Collaro changer with crystal cartridge, equipped with diamond 1 mil and sapphire 3 mil needle. McGee Sale Price, $27.95. **$27.95**
Attractive tan leatherette covered wood motor base, 13 x 14½ x 3⅞", shipped separate at $3.65 extra.

SAVE UP TO 75% ON GENUINE R.C.A. RADIATION COUNTERS


WF-10A


WF-12A

MODEL WF-10A *Regular $119.50* — McGEE'S PRICE — $29.95

RCA Model WF-10A, Radiation Geiger counter for amateur and professional use. Explore for Uranium or check for atomic fall-out radiation. Complete with test sample. Simple to use, weighs only 5 lbs. In aluminum case, 7¾"x8½"x3½". Indicates presence of radioactivity in 3 ways, by meter, neon light and headphones. Requires 2—67½ volt Burgess XX45 "B" batteries and 3 =2 flashlight cells. Battery kit, $5.29 extra. 3 sensitivity ranges, 0-100, 0-1000 and 0-10,000 counts per minute. A terrific value from McGee. RCA Model WF-10A with tubes and headphone, less batteries, $29.95. Battery kit, $5.29 extra.

MODEL WF-12A *Regular $149.50* — McGEE'S PRICE — $34.95

RCA Model WF-12A, Radiation Geiger counter. Similar to WF-10A, except has an external probe. Priced with tubes and headphones at $34.95, less batteries. Kit of 2—XX45 Burgess "B," plus 3 =2 flashlight cells, $5.29 extra.

MODEL WF-11A *Regular $154.50* — McGEE'S PRICE — $37.95

RCA Model WF-11A, Radiation Geiger counter. Explore for Uranium or check for atomic fall-out. Uses extra sensitive Bismuth tube. Test sample included. Simple to use, weighs only 5 lbs. Weatherproof case 7¾"x8½"x3½". Indicates presence of radioactivity 3 ways, by meter, neon light and headphones. Requires 2 Burgess XX45 "B" batteries and 3 =2 flashlight cells. Battery kit $5.29 extra. 3 sensitivity ranges, 0-200, 0-2000, 0-20,000 counts per minute. A terrific value from McGee. RCA Model WF-11A. Sale price, $37.95 with tubes and headphone. Battery kit, $5.29 extra.


WF-11A

Model WF-15A

RCA REG. $475.00 SALE PRICE **$99.50**

COMPLETE WITH 10 SENSITIVE TUBES

RCA Model WF-15A, Radiation Geiger counter for schools, labs, professionals, etc. A super sensitive Geiger counter with 10 Geiger counter tubes. Three counting ranges, 0-1000, 0-10,000 and 0-100,000 counts per minute. Special features include background control, battery test. Weighs only 8 lbs. Price includes all tubes, headphone and leather carrying case. Measures 11"x47/8"x7½". Requires 2 Burgess XX45, 67½ volt "B" batteries, plus 3 =2 flashlight cells and 1 pen cell. RCA Model No. WF-15A, with test sample. McGee's Sale price, $99.50, less batteries. Battery kit, $5.37 extra.

Model WF-16A

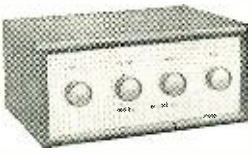
RCA REG. $750.00 SALE PRICE **$149.50**

COMPLETE WITH 10 BISMUTH TUBES

RCA Model WF-16A is the most sensitive of all, having 10 super sensitive Bismuth tubes. Measures up to 200,000 counts per minute in 3 ranges; 0-2000, 0-20,000 and 0-200,000 CPM. 2 step switch permits fast or slow meter indication. A professional Geiger counter that was priced at $750.00. Now offered by McGee for only $149.50. Weighs 8 lbs. 11"x47/8"x7½". Requires 2—XX45 Burgess 67½ volt "B," plus 3 =2, 1½ volt flashlight cells and 1 pen cell. A terrific value for $149.50, with tubes and headphone, less batteries. Battery kit, $5.37 extra.

McGEE'S 1958 MODELS OF HIGH FIDELITY AMPLIFIERS—SPEAKER SYSTEMS

FACTORY WIRED AT KIT PRICES—



SLIM LINE SL-20

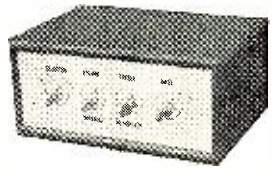
16 WATTS PUSH PULL EL-84 **$34.95**

RESPONSE 15 CPS TO 22,000 CPS

ORDER WITH A SPEAKER AND SAVE

★ WITH CU-14Y 12" COAX $44.95 ★ WITH B-125X SPEAKER $51.95
★ WITH P15-CR 15" COAX 54.95 ★ WITH B-347 SPEAKER 69.95
WITH NORELCO 12" 9762-M $69.00

New, 1958 model Imperial Slim-Line 16 watt high fidelity amplifier (20 watts peak), with built-in pre-amplifier. Full range audio response from 15 to 22,000 cps. Dual tone controls; full 18 db bass and full 15 db treble boost. Input for radio tuner, tape recorder and phono. Input compensation for the new 1958 model, 4 gram General Electric variable reluctance cartridges, as well as the famous G.E. RPX-050, RPX-052 and crystal phono cartridges. 5 position selector switch selects inputs and record compensation. Compensation for AES and RIAA phono records. A factory built amplifier at less than kit prices. Output impedance matches 8 or 16 ohm high fidelity PM speakers. Price includes tubes: 2—12AX7, 1—12AU7, 2—EL-84 and 5Y3GT. Modern multi-color leatherette covered wood cabinet at no added cost; matches blond or mahogany finish speaker systems. Size: 5¼" tall, 11¼" wide, 8" front to back. Ship. wt. 15 lbs. Model SL-20 Imperial, List price, $69.50. McGee's Sale price, $34.95.



SLIM LINE SL-10

12 WATTS PUSH PULL 6V6 **$24.95**

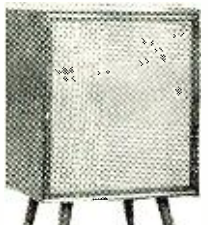
RESPONSE 20 CPS TO 17,500 CPS

ORDER WITH A SPEAKER AND SAVE

★ WITH CU-14Y 12" COAX $34.95 ★ WITH B-125X SPEAKER $41.95
★ WITH P15-CR 15" COAX 44.95 ★ WITH B-347 SPEAKER 59.95
WITH NORELCO 12" 9762-05 $49.95

New, 1958 model Imperial Slim-Line, 12 watt high fidelity amplifier (16 watt peak), with built-in pre-amplifier. Full range audio response from 20 to 17,500 cps. Dual tone controls, full 12 db bass boost and full 15 db treble boost. Input for radio tuner or tape recorder and phono. Input compensation for the new, 1958 model 4 gram General Electric variable reluctance cartridge as well as RPX-050, RPX-052 and crystal phono cartridges. Compensation for AES and RIAA phono records. A factory built amplifier at a price you might pay for a kit that actually included less material. Output impedance matches any 8 ohm high fidelity PM speaker. Price includes tubes: 2—12AX7, 2—6V6GT and 5Y3GT. Modern multi-color leatherette covered wood cabinet, matches blond or mahogany finish speaker systems. Size: 5¼" tall, 11¼" wide and 8" front to back. Ship. wt. 12 lbs.
Model SL-10 Imperial, List price, $49.50. McGee's Sale Price, $24.95.

COMPLETE SPEAKER SYSTEMS IN BAFFLES



MODEL H-4H. 4 SPEAKER SYSTEM IN BAFFLE $39.95

MODEL Z-4Z SYSTEM $49.95

New, 1958 Hollywood 4-speaker systems are designed to give realistic reproduction from your Hi-Fi amplifier or FM-AM radio. Juke box full bass with variable brilliance control. Genuine LC crossover network built-in. Ideal for use with our Slim-Line 12 and 20 watt high Fidelity amplifiers, as well as our Espey and Hallicrafters chassis. Small in size to be attractive, yet large enough to baffle properly. Fully enclosed and acoustically lined. 35" tall, 19" deep, 25" wide. Take $3.00 discount if you order with any amplifier or the Espey chassis. Specify mahogany, walnut or blond when ordering, otherwise we will ship mahogany.

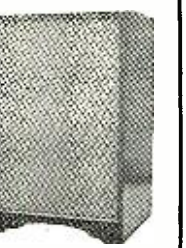
MODEL H-4H SYSTEM $39.95

Model H-4H Hollywood 4 speaker high fidelity speaker system. 20 watts, response 20 to 17,500 cps. Choice of Mahogany or Walnut or Blond finish enclosure. Features a 12" General Electric 6.8 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance L-C crossover network. Model H-4H, Ship. wt. 55 lbs. Price, $39.95.

MODEL Z-4Z SYSTEM $49.95

Model Z-4Z, Hollywood 4 speaker high fidelity speaker system. 25 watts, response from 18 to 17,500 cps. Choice of Mahogany or Walnut or Blond finish enclosure. Features a 15", 21½ oz. Alnico V Utah heavy duty woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance. L-C crossover network. Model Z-4Z, Ship. wt. 57 lbs. Sale price, $49.95.

Either of above systems can be ordered in larger baffle shown at right for $5.00 extra.



IMPERIAL 80 SPEAKER $69.95

IMPERIAL 90 SPEAKER FULL 10 CU. FT. $89.95

Choice of Blond, Mahogany or Walnut, speaker enclosure used with the 2 Imperial systems described below. Size 39" high, 24" wide and 23½" deep. Over 10 cu. ft. of volume in this fully enclosed speaker cabinet. Beautiful finish with matching grill cloth covering entire front. Speakers are mounted on a heavy plywood baffle. Enclosure is lined with an acoustical material. Speakers and crossover network are wired up, ready to connect to 8 ohm output. Mahogany shipped if no color is specified.

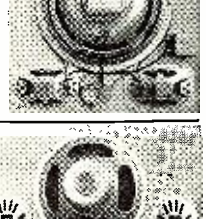
IMPERIAL 80 $69.95

25 watts response, 18 to 20,000 cps. A complete speaker system in the above described enclosure, ready to connect to your Hi-Fi amplifier. Built-in L-C, 3 way crossover network. Speakers included are 15", 21½ oz. Utah woofer, 8" 6.8 oz. mid-range and horn type Pioneer PT-3 tweeter. 8 ohms impedance. Stock No. Imperial 80, speaker system. Ship. wt. 80 lbs., Sale price, $69.95.

IMPERIAL 90 $89.95

Imperial 90, 30 watt speaker system with 5 speakers. Response, 18 to 20,000 cps. A complete speaker system in the above enclosure, ready to connect to the 8 ohm output of your high fidelity amplifier. Includes the 21 oz. Utah 15" woofer, two of the 8", 6.8 oz. mid-range speakers and two of the PT-3 Pioneer horn type tweeters. Built-in L-C type, 3 way crossover network. Imperial 90, speaker system. Ship. wt. 90 lbs., Sale price, $89.95.

TREMENDOUS McGEE VALUE
NEW 1958 HI-FI SPEAKER SYSTEMS ON BAFFLE BOARDS



Model B-12S-X, high fidelity 15-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" High Efficiency woofer, 2—4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in LC crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-12S-X, 5-way, 15-watt Hi-Fi speaker system. AUDIOPHILE VALUE $30.00. SALE PRICE $18.95. SALE PRICE **$18.95**

Model B-347, high fidelity 30-watt, 5-way speaker system, mounted on an 30" x24" baffle board. Has 15" UTAH 21½-oz. woofer, 2-new high fidelity extended range 6 x 9" speakers, plus 2-5" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 22 lbs. Stock No. B-347, 5-way, 30-watt Hi-Fi speaker system. AUDIOPHILE VALUE $59.95. SALE PRICE $39.95. SALE PRICE **$30.95**

Mount these Hi-Fi speaker systems in your own cabinet or use for custom installation. Ideal for use with any radio or amplifier. Completely wired, with only 2-wires to connect to any 8-ohm output. (Take 10% discount if ordered with any radio or amplifier listed hereon.) Grill cloth, 75¢ extra.


8"—9750 $15.95 8"—9770 $7.95 12"—9762-M 12"—9760

World Famous Hi-Fi Imported From Holland

12" Model 9762-M	reg. $59.97	Sale Price	$39.95
12" Model 9760	reg. $32.97	Sale Price	$19.95
8" Model 9750	reg. $22.17	Sale Price	$15.95
8" Model 9770	reg. $ 9.90	Sale Price	$ 7.95

NORELCO Model 9762—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice Coil imp. 8 ohms—new Alnico VI magnet gives 11,000 gauss. Regular $59.97 net, on sale at McGEE for only $39.95.
NORELCO Model 9760—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice coil imp. 8 ohms—new Alnico VI magnet gives 8,000 gauss. Regular $32.97 net, on sale at McGEE for only $19.95.
NORELCO Model 9750—8" wide range Hi-Fi PM speaker, res. 50 to 20,000 cps at 10-watts. Voice coil 6 ohms—New Alnico VI magnet gives 13,500 gauss. Regular $22.17 net, on sale at McGEE for only $15.95; or 2 for $30.00.
NORELCO Model 9770—8" Hi-Fi PM speaker, res. 75 to 19,000 cps. Alnico VI magnet gives 11,000 gauss. Reg. $9.90 net, at McGEE for only $7.95; or 2 for $15.00.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

SENSITIVITY:	
1.05 volts for 70 watt output	
HUM & NOISE:	
—63.6 db from 2 watts with input open circuited	
—74.4 db from 2 watts with input short circuited	
FREQUENCY RESPONSE:	
±.25 db from 10 to 100,000 cycles with 2 watts output and damping factor minimum	
±.05 db from 10 to 100,000 cycles with 2 watts output and damping factor maximum	
±1 db from 10 to 100,000 cycles with 70 watts output and damping factor minimum	
±1 db from 10 to 78,000 cycles with 70 watts output and damping factor maximum	
DAMPING FACTOR:	
Variable: .60, 1.05, 1.66, 2.9, 7.1, 13.3 from minimum to maximum	
IM DISTORTION:	
.12% at 2 watts	
.81% at 70 watts	
For 1% IM distortion, output rated at 80 watts	
HARMONIC DISTORTION:	
.03% at 1000 cycles, 2 watts	
.21% at 1000 cycles, 70 watts	
For 2% distortion at 20 to 20,000 cycles, output rated at 65 watts	

Table 1. Performance characteristics of power amplifier as taken in our laboratories.

70 Watts for Hi-Fi

(*Continued from page 53*)

with this arrangement, the proper current-feedback resistor is automatically placed in the circuit for the particular speaker impedance desired.

Another feature which is a convenience item to the user is the inclusion of a plate-current balancing meter mounted on the front of the chassis. This meter, with its associated switch, permits the user to quickly and accurately adjust for proper current balance in the output tubes.

As is the general practice with units of this type, a standard kit was built and tested in our own laboratory. Details on the performance of this particular unit are given in Table 1.

The sensitivity measurement is taken at 1000 cycles and the hum and noise figures as indicated are for two conditions, with the input grid open- and short-circuited.

In taking measurements of the frequency response, we noted that there is a variation for minimum and maximum positions of the damping factor control. Frequency response for both 2- and 70-watt output are listed. The IM distortion (for equivalent sine-wave power) was taken with 60 and 6000 cycle signals at a ratio of four to one. If one were to assume that the 1% IM distortion figure is a criterion for determining power output of an amplifier, we would have to class this unit as an "80 watter."

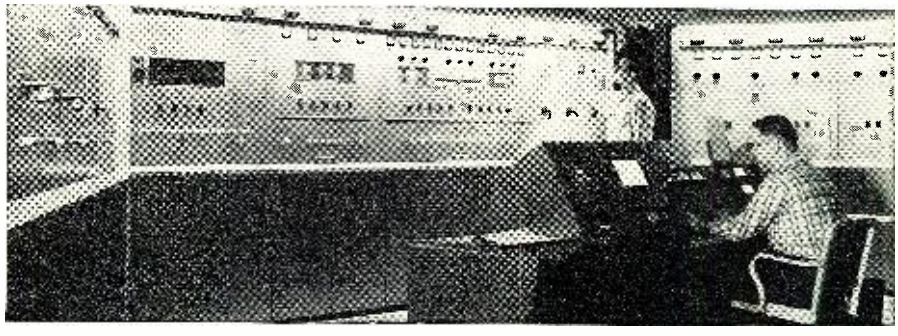
The harmonic distortion is being reported for both 2- and 70-watt conditions at 1000 cycles. Again, if one were to consider 2% distortion as being a criterion for determining the power output of an amplifier, one would have to class this as being approximately 65 watts.

According to the manufacturer, this amplifier shows no ringing and negligible overshoot in the presence of a 10 kc. square wave and that the overshoot amplitude is well below that of sustained oscillation. This unit should be able to tolerate shunt capacities up to 1 microfarad without oscillation, with no other load connected.

All-in-all, the characteristics as obtained in our laboratory are in almost all cases slightly better than those published by the manufacturer. The only point of discrepancy is in the harmonic distortion characteristics at the 2% level for 20 to 20,000 cycle coverage. Our figure is slightly below rating.

The actual construction of the unit is extremely simple and in view of the use of a balance meter indicator, this power amplifier can be built and put into operation without the use of any test equipment whatsoever. —30—

This giant u.h.f. broadcast transmitter is at the nation's most powerful TV station—WDAU-TV, channel 22 in Scranton, Penna. The G-E transmitter has an output of 45,000 watts which, when coupled to the high-gain antenna, can radiate 2 megawatts.



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. . . but you can't qualify because you lack

ADVANCED TECHNICAL KNOWLEDGE . . .

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It's crammed with facts and data — containing a time-proved plan to make you ready for the big jobs and a high-salaried career now being offered in

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The want ads above are real ones . . . they appear almost daily in magazines and newspapers—all over the country. They show how desperately the electronics industry needs trained men. On the other hand, they give you a good idea of what opportunities await you—if you get advanced technical training now. And no wonder trained men are needed! Look what's happening in "astronautics," of which the earth satellite is just the most recent, but by no means ultimate example. Computers, Radar, Aeronautical electronics—all are booming—all need trained electronics men. Top manufacturers sold upwards of 13.5 billions of dollars worth of electronic equipment in 1957. By 1965 it's expected the radio-electronics industry will do about 22 billion dollars of business per year.

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You are needed—for development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, servicing. But you can qualify only if you take time to advance your knowledge . . . if you take 2 minutes right now to write for the free CREI booklet, with no obligation.

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If you follow the plan outlined in our *free* booklet, you will be in line for promotion and pay increases in short order. Read what these typical CREI graduates have to say:

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By method, experience, and personnel—CREI is equipped to teach you what you will need when you translate your study into work. As proof that CREI knows what industry wants, many leading companies recommend CREI training for their own personnel. Among them: United Airlines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Douglas Aircraft Co., The Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp., and U. S. Information Agency (Voice of America).

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A CREI diploma itself is ample proof to many leading companies that a man is worth hiring. Moreover, employers contact us regularly for graduates to fill good jobs. Our placement bureau cannot keep up with the demands.

What do you want? To pass FCC exams? Start your own business? CREI has helped others reach these goals, and can help *you*. Or, do you want to go after good-paying electronics jobs, secure, permanent careers like those advertised above? *Whatever* your choice, CREI can help you as it has helped thousands of men—provided you have the ambition to follow the plan.

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(R. E. Feb. 58)

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Equalizer-Bias Amplifier

(*Continued from page 72*)

An excellent way to determine the amount of bias current in the record head is to insert a 100-ohm resistor in series with one side of the record head lead. Use a high impedance v.t.v.m. to measure the a.c. voltage across this resistor. A reading of .08 or 0.1 volt indicates a bias current of .8 or 1.0 ma.

The recording amplifier is ready for use after the testing has been completed and the bias current adjusted to the right volume.

Operation

Let us assume that the recording set-up is to include a tape deck such as the *Viking* FF75R-LP with one erase head and one record/playback head and that the "outboard" equalizer-bias amplifier is to be used with a hi-fi preamp that is equipped with a "to recorder input" jack to provide a minimum of 0.25 r.m.s. from any normal program source.

Connect the leads from the equalizer-bias amplifier to the erase and record/playback heads on the tape deck. Run a short patch cord from the "to recorder input" jack of the system preamplifier to the input jack on the "outboard" equalizer-bias amplifier. Connect the output of the preamplifier to the system power amplifier and speaker in the normal way. Connect the power plug of the equalizer-bias amplifier to a socket provided for the purpose. It is assumed that a tuner, record-player, or other program source is connected to the system preamplifier.

Turn on the system in the normal way and adjust the signal level to the power amplifier and speaker. This will function as a monitoring amplifier during recording, because most commercial preamps are designed to provide the normal output signal when the "to recorder input" is being used.

Advance the equalizer-bias amplifier level control to apply plate power to that unit. Then adjust this control for a setting which closes the recording level indicator shadow on program material peaks, with no overlap. Once the proper setting has been found it should not be changed, except to "fade in" and "fade out" at the beginning and end of a recording. Tape such as *3-M* No. 111 will be recorded at approximately 12 db below saturation with the level control adjusted as described. If the hi-fi system preamp does not seem to be delivering enough signal to close the level indicator shadow on peaks, even with the control turned on full, it may be necessary to increase the input level at the hi-fi preamp or audio control unit. Most commercial preamps are equipped with an independent input level adjustment for each channel.

If you are using a hi-fi preamplifier or audio control unit which includes tone equalization controls between the input and the "to recorder input," these controls should be set for flat response. If experience indicates that a different setting is desirable, they can be changed accordingly.

Always be sure to turn the equalizer-bias amplifier off before disconnecting the lead to the erase and to the record/playback head. Also, do not forget to turn it off before playing back a tape, otherwise the tape will be erased.

Troubleshooting

If the unit has been wired correctly and the bias level carefully adjusted for the value specified by the manufacturer of the particular recording head used, there should be no trouble in recording.

Hum can result from a noisy tube, improper grounding of some part of the system, an inadequately filtered power supply, or an error in the filament wiring.

Any tendency toward "motorboating" can be corrected by the use of a decoupling filter in the high-voltage power supply lead. This can consist of a 2-watt, 2500-ohm resistor with a 15 or 20 μfd. capacitor connected between the load end of this resistor and ground. The capacitor should have a rating of 300 volts or better.

Distortion is most frequently caused by overloading or incorrect bias current in the recording head. Proper settings of the level controls in the system will usually eliminate overloading. Generally speaking, it is best to keep the input signal level down to the minimum required for satisfactory operation, rather than feeding a strong signal into the system and attempting to cut it down after two or three stages of amplification.

The recording bias current adjustment is very critical. Severe "breaking up" of the recorded program material indicates a low bias condition. Low-frequency distortion, generally low output, and extended high-frequency response can be the result of low bias. Reduced high-frequency response may be the result of excessive bias. For good over-all frequency response the bias oscillator should operate at a frequency around 60,000 to 70,000 cps and provide good waveform output. Make sure the two triode sections of the 12AV7 bias oscillator are operating in a balanced condition as indicated by grid, cathode, and plate voltages and the output waveform as observed on an oscilloscope.

The crystal diode should be checked first in case of trouble in the recording level indicator.

When this unit has been completed and connected to a good tape deck and your hi-fi system, it will produce recordings that match the original program material so closely it may be difficult to tell them apart. An "outboard" equalizer-bias recording amplifier such as this is an excellent answer to the need for professional quality recording equipment at considerably less than professional cost.

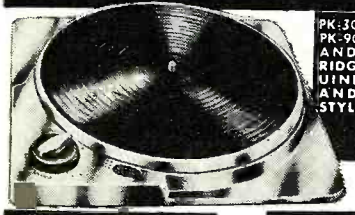
Your dream of a good tape recording system can now become a reality through the maximum use of your present hi-fi system and this "little gem."

—30—

Exclusive Lafayette Money-Saving Values

PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM

THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE



PK-300 TURNTABLE, PK-90 TONE ARM AND G.E. CARTRIDGE WITH GENUINE DIAMOND AND SAPPHIRE STYLI.

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PK-300

ILLUMINATED BUILT-IN STROBOSCOPE & VIEWER

COMBINATION DEAL

PK-90

LATEST IMPROVED MODEL PK-300 TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-300 ..... Net **49.50**

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-300 with matching finish. Shpg. wt., 2½ lbs.

PK-90 ..... Net **11.95**

PK-160

TRANSCRIPTION MANUAL PLAYER

with TONE ARM and TWO PLUG-IN HEADS

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
- ACCOMMODATES ALL POPULAR CARTRIDGES
- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM

All the important features of professional transcription players have been incorporated in this precision turntable. Extremely smooth and quiet heavy duty 4-pole motor plays 78, 45 and 33⅓ RPM records. Exclusive magnetic brake, controlled by knob on base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included checks speeds. Speed selector safety switch protects mechanism by making it necessary to pass through OFF position when switching from one speed to another. 10" weighted turntable has rubber traction mat.

Mounting plate has pickup rest and ON-OFF switch. Size 12-15/16" left to right. 10⅞" front to rear. Requires 2¾" clearance below motor board and 3" above. With AC line cord, 2 plug-in heads, output cable, 45 RPM adapter. For 105-120V., 60 cycles AC. Shpg. wt., 12 lbs. *(NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)*

PK-160—Less cartridge and base ..... Net **25.95**

PK-164—Same as above except equipped with new genuine GE VRII Triple Play Magnetic Cartridge with diamond-sapphire cartridge ..... Net **37.50**

PK-162—Wood base for PK-160. Shpg. wt., 5 lbs. ..... Net **3.95**

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Compare it with instruments at twice the price!

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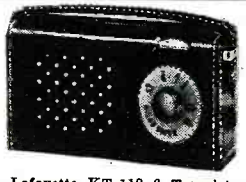
FACTORY WIRED AND TESTED

The Lafayette LSG-50 is a factory-wired and calibrated precision instrument for fast alignment of IF and RF stages of TV and FM receivers. Accurate, linear electromagnetic sweep system covers 3MC-120MC and 140MC-260MC. Sweep width continuously variable 0-12MC. 3 volts RMS, 60 cps sine wave (for oscilloscope) available from front panel. Marker covers 3MC-225MC in 4 ranges. Combination of crystal and variable marking. Marker calibration accuracy better than 1%. 4.5MC crystal mounts on front panel and accurate to 0.002%. Extra input for external marker. The built-in marker may be used independently of the sweep. RF output 100,000 microvolts. controlled by 3-step (X1, X10, X100) and continuously-variable fine adjustment attenuators. Output impedance 75 ohms, unbalanced. CONTROLS: Sweep Width, Horizontal Phase. Retrace Blanking with Off position. Marker Amplifier, RF Attenuators, Sweep Range Selector, Marker Range Selector. Crystal socket, pilot light, external marker input also on front panel. 2-5" easy-to-read dials with vernier-driven dial pointers. Sturdy gray wrinkle metal cabinet with handle. Complete with tubes, 75 ohm output and external marker input cables, 4.5MC crystal. Size 9" x 13½" x 6". Shpg. wt., 20 lbs.

MODEL LSG-50 ..... Net **79.50**



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- 100% SUBMINIATURIZED
- SENSITIVE, SELECTIVE, STABLE
- PUSH-PULL OUTPUT — PLENTY OF POWER
- AN INCOMPARABLE VALUE

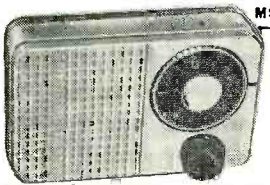
The Lafayette KT-119 6 Transistor Superhet Transistor Kit provides superior commercial quality with maximum sensitivity, selectivity and stability. The circuit features 6 selected transistors and crystal diode, a specially matched set of 3 IF's, Oscillator coil, high Q loop, and audio transformer coupling. Has efficient 2¾" speaker and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis and easy to follow step-by-step instructions. 6½" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case & Battery ..... Net **29.95**

BATTERY RCA VS300 ..... Net **1.23** **BURGESS P6** ..... Net **.77**

MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119. Shpg. wt., 1 lb. ..... Net **2.95**

MS-366—Sensitive matching earphone Net **1.29**



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- A TRUE POCKET SUPERHET RECEIVER
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A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case. The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors battery, case, dial and easy to follow step-by-step instructions. 4⅛" x 2⅝" x 1-1/16". Shpg. wt., 1 lb.

KT-116—Complete Kit, less earphone ..... Net **16.95**

MS-260—Super Power Dynamic Earphone ..... Net **3.95**

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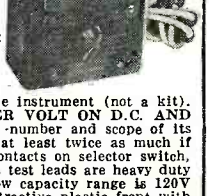

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts—**A.C. Volts:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts—**Resistance:** 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—**D.C. Current:** 0.60 Microamp; 0-6; 0-60; 0-600 Milliamps—**Decibel:** —20 to +17 db (0db—0.774V)—**Capacity:** .0001-.01; .005-.15 mfd—**Inductance:** 20-2000 millihenry—**Output Ranges:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts.

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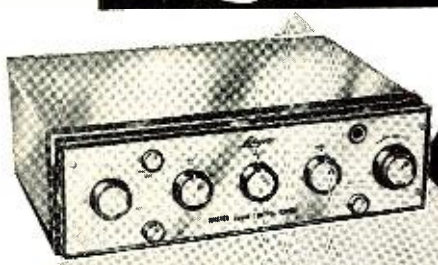

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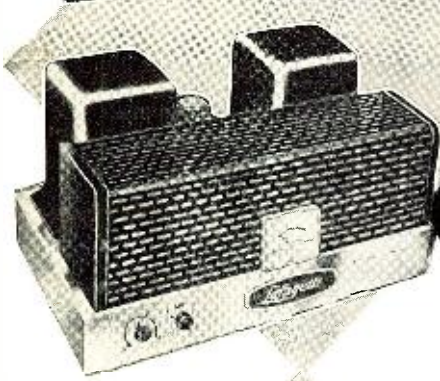

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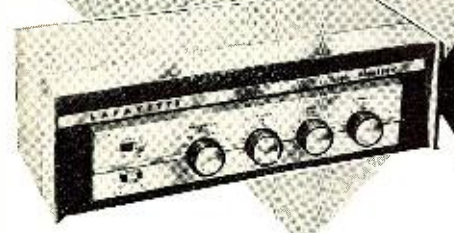

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Addi ional Notes on "Testing FM Tuners at Home"

More information along with some limitations on the alignment instructions given in November, 1957 issue.

OUR recent article "Testing FM Tuners at Home" (November, 1957 issue) by Julian D. Hirsch has received some interesting comments which your editors feel have enough value and importance to bring to our readers' attention. The purpose of the original article was to help the owners of FM tuners perform a simple alignment without using elaborate test equipment. It was not expected that the owner of a properly operating, factory-aligned tuner would attempt to improve on its performance. We believe that most of our readers know when to "let well enough alone." After all, a good many of our readers who are professional technicians, know full well the havoc that can be wrought by the "screw diddler" who decides to service his own set by tightening up all the screws he sees. But in those cases where misalignment is clearly indicated, we feel that the information presented produces a definite improvement in operation that is certainly worth a trial.

This is not to say that the method described (which is, essentially, peak alignment) will produce results that are better or even equal to those obtained from an exact factory alignment using elaborate instruments. As a matter of fact, if we were to take a tuner that had just been accurately factory-aligned and change the alignment in accordance with the suggestions made in the article, the performance would certainly be impaired. But there are some tuners that are given just a cursory alignment at the factory, others that may have gone out of alignment after a period of use, and still others that may have been built by their users. All these may be improved by using the suggestions given in the original article.

Perhaps the author of our article was guilty of not having stressed strongly enough the limits of the simple method he described. We are indebted to D. R. von Recklinghausen, Chief Research Engineer of *H. H. Scott, Inc.* for having enumerated these in a recent letter. Following is a resumé of some of Mr. von Recklinghausen's comments.

Limits of Simple Method

It is always a noble thought to try to test equipment in the home. The more suitable equipment that is used the better the results of the test will be. The difficulty is that when trying to adjust or change the performance of an FM tuner there is grave danger ahead. It is one of the easiest things in the world to perform a misalignment.

Before any alignment is attempted, tubes should be checked and replaced where necessary. The presence of a single weak tube may so impair the tuner's performance as to make the user believe mistakenly that a realignment is needed when such may not be the case at all.

The use of a built-in tuning meter or eye may be a *cause* of misalignment. The indication given on these devices depends on signal strength, tuner sensitivity, line voltage, performance of indicator, and other factors. As such they are intended for use as tuning indicators having only a short time stability.

The use of radio stations as alignment signals may pose many problems. Reception from a weak station should be used in order to get peak performance. But the signal strength of such a station may vary rapidly over a range of as much as 100 to 1. Hence these would be quite difficult to use properly in any alignment procedure. Signals from local stations are too strong for alignment and even these vary over a period of time.

It is necessary that whoever performs the alignment knows exactly what he is doing and knows all the pitfalls of trying to connect various types of equipment to a tuner. It is very easy to find some form of misalignment just because a voltmeter lead happens to be draped along the wiring side of the tuner. Feedback of signal occurs through that lead from some high-level circuit to a low-level circuit. There are hundreds of other ways to have apparent malfunctioning of the tuner only because some piece of test equipment was not connected properly to the tuner.

If it is felt that alignment of a tuner is necessary, then the manufacturer's suggested alignment procedure should be followed as closely as possible.

The editors wish to thank Mr. von Recklinghausen for his interest and comments and for his reminder that most present-day hi-fi FM tuners are precision units that are designed to operate very close to the theoretical limits of sensitivity. —30—

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AM section has narrow band (3 kc) and wide band (8 kc) reception. Sensitivity 2μv for 20 db AGC. whistle filter, response 20-8500 cps. Cathode follower output with level control. Self powered. 10 tubes plus rectifier. 40 watts. 12 lbs. Complete with cover.

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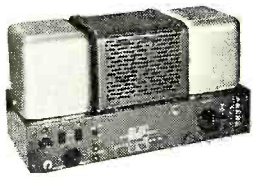

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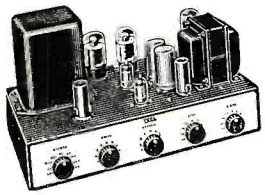

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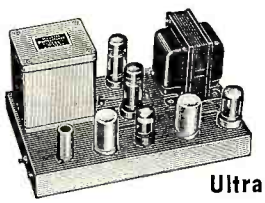

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With Acro TO-330 Output Transformer

KIT $72.95 WIRED $99.95

Rated power output: 60 w (130 w peak). **IM Distortion:** less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier. Input level control.** Both **bias** and **DC—balance** adjustments. Std octal socket provided for preamplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 $4.50.**

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Subminiature Power Supply

(Continued from page 73)

connections between the coil and these pigtails, and wrap a layer of the plastic tape over the whole thing. The d.c. resistance of the finished coil should be about 115 ohms.

The method by which the laminations are restacked in the core has considerable influence on just how well the choke will work in the d.c. circuit. The author's transformer had a total of 14 "E"-type laminations and 12 "I"-type laminations. These were reassembled into a core by the combination of interleaved and butt stacking shown in Fig. 2. The material used in making these laminations has a permeability variation of such nature that neither 100% interleaved stacking nor 100% butt stacking will produce the best results in this particular choke. Thus, the configuration of Fig. 2 consists of 3 butts of 4 laminations each, arranged in interleaved fashion, with a single "E"-type lamination at each end to fill out the core and to help hold it together until it is re-assembled into the frame. After re-assembly, the choke is squeezed moderately in a vise, in a direction from top to bottom, to pull the butting ends of the laminations snugly together. Removal of most of the wax from the laminations and the mounting frame will make reassembly considerably easier. Give the completed choke a couple of heavy coats of clear plastic spray over-all, to improve its appearance and to seal out moisture.

Assembling the Supply

The miniature battery-substitute shown in the photos was assembled to demonstrate how very little space the unit occupies. It is built entirely in one of the little 2¼" x 1¾" x 1¼" plastic boxes in which the *Argonne* transformers are supplied! It is actually smaller than the battery it replaces—especially if the life of the battery-substitute and the battery are taken into consideration.

Miniature *Fahnestock* clips are used for the positive and negative terminals and for the two 117-volt a.c. input terminals. The supply runs cool, even over extended periods of operation. Of course, assembling a unit of this size requires a certain amount of dexterity and considerable patience. If you are not so inclined, you can assemble your supply in a somewhat larger box or even breadboard style. In many instances it will be most convenient to make the power supply a part of the device with which it is to be used.

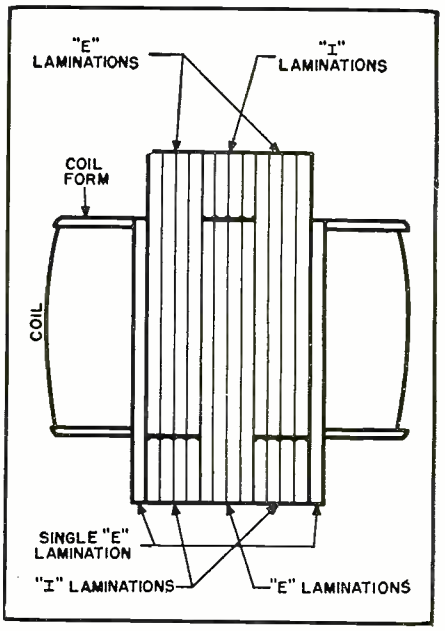

Fig. 2. A combination of interleaved and butt stacking of "E"-type and "I"-type laminations is used for the construction of the miniature choke that was made from one of the author's transistor transformers.

As a result of a certain amount of capacitive coupling across the transformer windings, plus stray fields, the ripple percentage across the d.c. output terminals may change with the way the a.c. power plug is inserted in the outlet, especially when small currents are being drawn from the supply. In this case, the plug should be rotated for minimum hum. At maximum current, *i.e.,* 5 milliamperes d.c. output, this effect may not be quite so noticeable.

Table 2 lists the characteristics and the approximate maximum d.c. output voltage to be expected when various *Argonne* transistor audio transformers are used as miniature power transformers in the full-wave center-tapped circuit of Fig. 1, and also in half-wave and bridge rectifier circuits.

In using a power supply of this construction, it should be kept in mind that the transistor transformers were not originally assembled for operation on 117 volts a.c. Thus, the primary-to-secondary insulation may not be quite up to all it should be for this type of service. Nevertheless, the author has made hi-pot tests at 300 to 500 volts r.m.s. across a number of these transformers, and no breakdowns have been obtained to date. —30—

Table 2. Characteristics of three transistor transformers which the author used as power transformers in half-wave bridge and full-wave rectifier circuits.

Argonne No.	Nom. Imped. Pri.	Nom. Imped. Sec.	Primary Connection	OUTPUT (Volts D.C. Max.) Half-Wave/Bridge	OUTPUT (Volts D.C. Max.) Full-Wave C.T.
AR-101	100K	3000 c.t.	Neon Lamp Regulated	13.0	6.6
AR-102	100K	1500 c.t.	" "	8.0	4.0
AR-145	100K	2000 c.t.	" "	10.0	5.0

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The Multi-purpose Probe

(*Continued from page 52*)

ones are important to him. The primary interest of this article is the mechanical casing that will hold the chosen circuits and provide the basic convenience, without regard to what the particular circuits are. Suitable circuits have appeared many times in manufacturers' service literature and in many magazine articles.

(EDITOR'S NOTE: *For a comprehensive treatment of probe types and circuits, refer to such texts as "How to Use Test Probes," by Ghirardi & Middleton, published by John F. Rider, "Probes," by Zucconi & Middleton, published by the Gernsback Library, or "How to Understand and Use TV Test Instruments" published by Howard W. Sams. Other information on special types of probes can frequently be picked up from service literature or from test equipment instruction books.)*

In the main, the probe is made of various lengths of plastic tubing. Two pieces of tubing having a 1 inch diameter are used. One piece is 6 inches long (the body of the probe, shown to the right in Fig. 1 and again as Fig. 3A); the other piece is 1¼ inches long. This latter length is part of the rotating head, shown as the center portion of Fig. 1 and shown separately in Fig. 3B.

Two pieces of solid plastic rod having ¾ inch diameter are also needed. One is also ¾ inch long, used to seal up the tail of the probe body. This is shown in Fig. 1, to the extreme right, and in Fig. 3C. The other length of ¾ inch diameter rod is ⅝ inch long. It is shaped to form the stationary member about which the movable probe head rotates. Details are shown in Fig. 4A. This shaping will be discussed later. Another piece that requires some tricky shaping is the conical tip, detailed in Fig. 4B. It is shaped from a length of plastic rod having 1 inch diameter and 1¼ inches long. The length of rod in Fig. 3C used to close up the end has a hole drilled in it large enough to accommodate the coaxial cable that will be used.

The solid piece ⅝ inch long, having a diameter of ¾ inch, is brought to the desired shape (Fig. 4A) as follows: first, a hole with a ⅝ inch diameter is drilled in one end to a depth of ⅜ inch. Through the center of the remaining portion, another hole, ⅛ inch in diameter, is drilled. The other end must be shaped with a file. It will have a wavy or hill-and-dale shape, with the number of hills and depressions corresponding to the number of circuits that will be incorporated. Since the author's version used the five circuits noted in Fig. 2, he shaped out five hills and five valleys. These must be smoothly rounded to permit ease of switching and the metal contacts are placed in the valleys to go through to the body of the probe. The author used five contacts from the channel strips in an old TV tuner, but small round-head screws would do.

To make the conical head, the solid piece of 1 inch plastic, 1¼ inches long, should be brought to a conical shape before any holes are drilled. This is best done on a lathe with a chisel. Dimensions are given in Fig. 4B. Then holes of ⅝, ½, and ⅛ inch diameters are drilled through the center to the depths shown. The narrowest hole is to accommodate the probe's contact tip, which can be made from an ordinary nail.

A ⅛ inch thick slice of a ¾ inch solid plastic rod, with a hole ⅛ inch in diameter drilled through its center, is shown in Fig. 4C. This is used to support the spring contact (which may be salvaged from a tuner) against the contacts in the valleys of the selector mechanism, as shown in Fig. 1. As shown in Fig. 4C, an extra wedge of plastic may be used to hold the contact spring firmly in place.

A hole should also be drilled toward the rear of the probe to accommodate a common ground connection, possibly terminating in an alligator clip.

Each of the individual probe circuits should be tested before final assembly of the probe. Assembly should begin with the hill-and-dale contact plate shown in Fig. 4A, with each of the circuits being connected to one of the contacts. Then a ⅛ inch bolt is inserted through the center of this piece in the position shown in Fig. 1. This bolt is also passed through the plastic disc shown in Fig. 4C. Spring, washer, and nut are then added to the bolt. Destruction of the last two or three threads after the bolt is tightened is to prevent future loosening.

The length of wire from the spring contact shown in Fig. 4C to the metallic tip of the probe is then soldered securely to the spring contact, with the other end free.

The section of tubing shown in Fig. 3B is then slipped over this assembly and the center disc is positioned inside the tubing and glued in place. Ideally, there should be a sufficient wait between each gluing operation and the next to permit drying. A quick-drying glue will help.

Next, the free end of the contact wire is securely soldered to the metal contact tip and the plastic cone may be glued to the 1¼ inch section of tubing.

Work now proceeds in the other direction: with the circuitry fed into the probe body, the contact plate shown in Fig. 4A is glued to the main probe tube. The piece used to close off the end of the probe (Fig. 3C) may be slipped on the end of the coaxial cable used to the rear of the probe and slid up to position, then glued in place. Then, whatever type of connector is most suitable to the user is affixed to the coaxial cable.

Although some careful work is necessary to assemble this probe, the great time-saving it enables when it is in use more than makes up for the effort. Increased use of the scope is the worthwhile result. —30—

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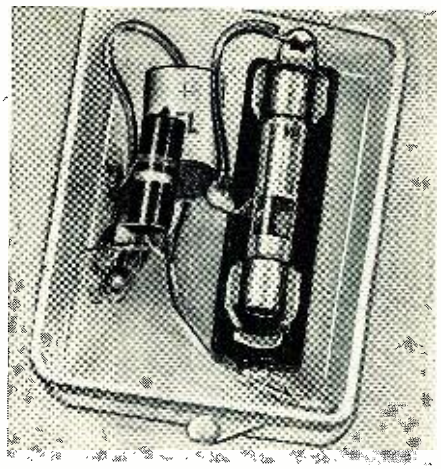

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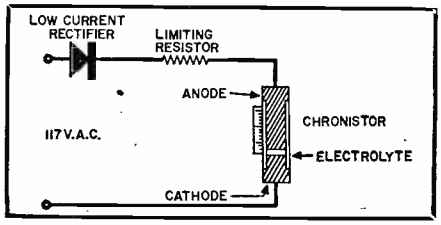
Subminiature unit shows equipment operating time as a direct scale reading.

A SUBMINIATURE elapsed time indicator which operates on the electroplating principle has been introduced recently by *Bergen Laboratories,* 247 Crooks Ave., Clifton, N. J. It can be used for indicating the total number of hours during which any electrical instrument, appliance, or component has been in operation. The indicator itself, called a "Chronistor," is a miniature electro-plating bath, the size of a glass cartridge fuse, containing an anode, cathode, and electrolyte. When a d.c. current of about 1 ma. passes through the unit, metal ions are carried from anode to cathode, which will then change in length with time. A time scale alongside the anode can then be calibrated directly in hours. Ranges up to 2000 hours are available.

The small current required by the "Chronistor" may be obtained from the equipment whose operation is being timed. Or the company has available a "Chronistat," made up of a "Chronistor," a rectifier, and limiting resistor that may be connected directly across the 117-volt a.c. power line. —30—

Circuit diagram of the Chronistat timer.



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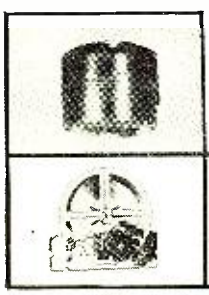

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Westinghouse TV Circuits

(*Continued from page 55*)

only, the frequency-modulated sound i.f. will appear to be a full-strength, continuous-wave signal of high carrier amplitude. The negative d.c. voltage developed by this signal at the output of the detector will thus be high. Since this voltage is directly coupled to the grid of the AFT amplifier in Fig. 3, the latter stage is cut off, permitting its plate voltage to rise. This high d.c. is coupled to the plate of the AFT diode, permitting that tube to conduct. The voltage developed at its cathode by this conduction is then applied across the reactance circuit (crystal) in the tuner's oscillator to be used for fine tuning in the manner discussed earlier.

This correction process, however, is not permitted to go all the way through to complete retuning because other things happening in the receiver must be taken into account. As the sound and video i.f. carriers begin to approach their correct frequencies, moving to the right in Fig. 2A, the sound i.f. goes down the right side of the response curve, reducing in amplitude, but the video i.f. moves up the left side, increasing in amplitude. The latter now becomes strong enough to beat with the former to produce a 4.5-mc. output. At the same time, the average d.c. developed at the detector by the decreasing amplitude of the sound i.f. is also reducing, as shown in Fig. 2C. This voltage change is coupled to the grid of the AFT amplifier, which begins to conduct. However, the 4.5-mc. beat signal, amplified by the video amplifier, is then also coupled to the AFT amplifier (as Fig. 3 indicates, this is quite natural since the AFT amplifier is also the sound i.f. amplifier).

While this 4.5-mc. output is principally intended to be passed on to the FM detector, some of it is tapped off by the AFT diode, which rectifies it, filters it, and then passes it on as a d.c. control voltage to complete the retuning of the local oscillator. The relative strength of this 4.5-mc. beat output at different conditions of oscillator tuning is shown in Fig. 2B.

The composite response of the AFT system, shown as Fig. 2D, is influenced by curves *A*, *B*, and *C*, where, superimposed over it, we also have the curve showing the correction current applied to the fine tuning circuit by the AFT diode. The circuit is adjusted so that, with the oscillator at the correct frequency (F_o), the current applied to the crystal fine-tuning circuit, or reactance circuit, is just enough (I_o) to keep the system in equilibrium. If the oscillator should begin to creep up in frequency (F_h), then the influence on relative amplitude of i.f. signals (curve *A*), amplitude of the 4.5-mc. beat (curve *B*), and amplitude of the developed d.c. voltage at the output of the video detector can be seen, as well as the over-all influence on the AFT system (curve *D*). Correction current increases, tuning the oscillator downward.

If oscillator frequency should tend to move downward, say, to F_l, correction current is reduced, permitting the oscillator frequency to rise.

With the critical function of fine tuning thus entrusted to an automatic circuit, a great stride is made in the direction of simplifying remote operation. To keep this operation from becoming an elaborate affair, reliance is placed on a pre-set volume control and the a.g.c. circuit to take care of sound-level and brightness-contrast differences. Also contributing to this uniformity from channel to channel is an indexing wheel on all remotely controlled, power-tuned receivers. Adjustments can be made on this program wheel for individual channels to compensate for differences in signal strength.

The "Picture Pilot" has thus been simplified to handle only two tasks. One is the obvious job of switching channels. The other is that of reducing sound level by a fixed amount, either when the receiver is being turned to another channel or, independently, when it is merely desired to reduce volume. Accordingly, the simplified control has a two-position switch. In the "select" position, the channel-selecting mechanism is actuated and sound is muted as well. In the "soft sound" position, only the sound level is reduced.

The hand-held control, which is plugged into the nearest a.c. outlet for power, contains a single-stage 3V4 oscillator. This may be permanently adjusted to any one of four operating frequencies, to avoid mutual interference in the event that another receiver using the same device is nearby. In the "select" position, the output from the oscillator is an unmodulated (c.w.) r.f. signal, which is coupled back into the power wiring. In the "soft" position, some of the 60-cycle a.c. from the power line is applied to the oscillator, and a modulated r.f. signal results.

A 3-tube carrier-current receiver in the cabinet of the TV set picks up these signals from the power wiring, processes them, and feeds them to two relays.

Adjustment of the relays and the circuits in which they are located is such that the sound-muting relay is more easily triggered than the channel-selector relay. When detected, an unmodulated r.f. signal will produce a higher average d.c. voltage than a modulated carrier, since the unmodulated signal is of constant strength, whereas a modulating signal will correspondingly reduce carrier amplitude to conform to its shape. Thus, the modulated r.f. signal will activate only the more sensitive muting relay, whereas the stronger, unmodulated signal will activate both relays.

When tripped, the muting relay shunts a fixed resistor across the receiver's volume control. The channel-selector relay operates the power tuning mechanism at the set. —30—

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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. BRAND NEW, our low price, less batteries....each **$22.50**

ASB-5 RECEIVER FOR 420 Mc BAND!

Complete with ten tubes: 2—955, 1—6H6, 5—6AC7, 1—6AG7, 1—6B6. OUR LOW PRICE..... **$14.95**

Tuning Knob for ASB-5 Receiver.....**$1.29**

BRAND NEW SPECIAL PURPOSE TUBES

In Original Individual Packing

Type	Each	Type	Each	Type	Each
RK65	$7.25	829B	$7.95	6A7	$ .35
2J724B	.35	832A	5.95	6AG5	.33
VR105	.79	837	1.15	6J6	.33
VR150	.79	1625	.26	12SA7	.34
717A	.29	1626	.16	12SQ7	.33
CRP-730A	3.45	1629	.27	35Z5	.33
815	2.99	8002R	5.95	50L6	.33
826	.44				

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

LORAN APN-4

FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Indicator and receiver complete with all tubes and crystal.

INDICATOR ID-6B/APN-4, and **RECEIVER** R-9B/APN-4. BRAND NEW..only **$48.49**

Complete Kit of Accessories for Above: PE-206 inverter, Set of Plugs, Visor for Indicator, Operation Manual, ALL BRAND NEW..... **$49.50**

SPECIAL APN-9A LORAN Receiver less tubes, NEW (demilitarized) Indicator, **$29.50**

BC-221 FREQ. METER

Special Buy! Complete with operating manual, LIKE NEW.....only **$119.50**

BC-221 FREQ. 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**

Exc. Cond.....

Less Calibration Book..... **$29.50**

2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery **$2.79**

1—2V. 7 prong Synchronous Plug-in Vibrator **1.49**

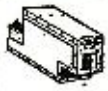
1—Quart Bottle Electrolyte (for 2 cells)..... **1.45**

ALL BRAND NEW! Combination Price.... $5.45

WILLARD 6-VOLT MIDGET STORAGE BATTERY

3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte.....Only **$2.69**

ARC-5/R28 RECEIVER



2-meter Superhet, 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **$20.45**

BRAND NEW.....

110 V AC Power Supply Kit for above **$9.75**

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. BRAND NEW..... **$19.95**

SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. BRAND NEW, less tubes.....**$7.95** Excellent Used, less tubes.....**$5.95**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal..... **$12.45**

FAMOUS BC-645 TRANSMITTER RECEIVER

BRAND NEW

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** **$29.50**

Shpg. wt. 25 lbs.....

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) .....only **$7.95**

UHF ANTENNA ASSEMBLY, for BC-645....**$2.45**

Complete set of 10 Plugs for BC-645 ..... **$5.50**

CONTROL BOX for above.....**$2.25**

SHOCK MOUNT for above..... **1.25**

CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **$2.50**

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 **POWER SUPPLY** for above, 117 V 60 Cycles AC. Excellent used..... **$11.95** **$16.95**

BC-603 FM RECEIVER, 10-channel push button tuning or continuous tuning, 20-28 Mc. Complete with speaker, tubes, squelch, 12-V Power Supply. Exc..... **$14.95**

BC-683 same as above except 27 to 38.9 Mc..... **$24.95**

RADIO RECEIVER NAVY TYPE RAY-3

Model AN-PRGN is for 14V DC operation. These receivers are supplied complete with built-in dynamotor, 11 tubes. Weston output meter on front panel, as well as coax antenna and output connection, phono jack, on-off switch.

WHILE THEY LAST.....Our Price **$13.95**

234-258 MC RECEIVER

AN/ARR-2, BRAND NEW, tubes included: 7—9001, 3—6AK5, 1—12A6. Schematic included. Complete with 11 tubes, our low price..... **$9.99**

With 28 V. 1.6A Dynamotor, complete...**$12.98**

110 VOLT AC POWER SUPPLY KIT for above **$9.75**

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only..... **$2.95**

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special..... **$3.95**

HI-LO IMPEDANCE MATCHING TRANSFORMER for headphones, 600 ohms to 8000 ohms. With plug and jack. Instructions included. BRAND NEW. **97c**

Hi-Fi DYNAMIC HEADSET with Cushions

Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW**..... **$6.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike.....	$5.45	$7.95
T-30	Carbon Throat Mike...	.39	.79
T-45	Army and Navy Lip Mike...		1.33
RS-38	Navy Type.....	2.45	4.95
T-24	Carbon Mike.....		5.95
TS-9	Handset.....		4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance.....	$2.25	$4.95
HS-33	Low Impedance.....	2.79	4.95
HS-30	Low Imp. (featherwt.).	1.49	2.25
H-16/U	High Imp. (2 units)...	3.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack.....		.99

SCHEMATIC DIAGRAMS For any equipment on this page, each.. **50c**

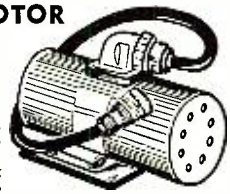
Please include 25% Deposit with order—Balance C.O.D. 50c Handling Charge on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C.

G & G Radio Supply Co.

Telephone: CO 7-4605

51 Vesey St., New York 7, N. Y.

RADIO DYNAMOTOR



DY-25/AXT-2

Input:
26.5 V.D.C. @ 25 A.

Output:
775 V.D.C. @ .225 A.
405 V.D.C. @ .035 A.
—53 V.D.C. @ .050 A.
18.3 V.A.C. @ 3.7 A,
95 cy.

Complete with mounting base, cable and plugs, BRAND NEW in original packing..... **$7.95**

Weight 26 lbs.

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES Type	Description	Excellent Used	Brand NEW
BC-453	Receiver 190-550 KC...	$12.95	$16.95
BC-454	Receiver 3-6 Mc.....	8.29	11.95
BC-455	Receiver 6-9 Mc.....	7.95	11.95
BC-456	Modulator	3.45	4.95
BC-450	3-Receiver Control Box.	1.49	1.95
BC-451	Transmitter Control Box	1.25	1.49
BC-696	Xmtr 3-4 Mc (like new)	6.95	8.88

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.88**

BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW..... **$7.88**

BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. BRAND NEW..... **$11.95**

ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal..... **$8.88**

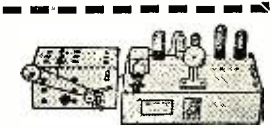
110 VOLT AC POWER SUPPLY KIT

For All 274-N and ARC-5 Receivers

Can be assembled quickly and easily, on predrilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. Complete kit of parts with metal case, instructions. Factory wired, tested, ready to operate **$7.95** **$11.50**

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. **Only**..... **49c**

McElroy Automatic KEYER



Suitable for keying transmitter, or for code practice. Has photoelectric cell and sensitive relay. Variable speed motor operates on 110 volts 60 cycles AC. complete with tubes, excellent cond., your cost..... **$16.95**

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. **$8.88**

BRAND NEW.....

Brand New, less tubes.....**$5.95**

USED, with tubes.. **5.95** USED, less tubes.. **2.95**

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.

COMBINATION.....**Special** **$33.33**

Receiver only, with all tubes.....**$19.50**

Transmitter Only, with all tubes.....**$22.25**

Accessories for above available.

DYNAMOTOR VALUES!

Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	2.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	....	7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24

BD-77C DYNAMOTOR, input: 14 V DC @ 39 A. output: 1000V DC @ .35 A. With Filter. Like New! **Special**..... **$22.50**

RADAR ANTENNA AS-N/AP-3

18" reflector, complete with 24 V.D.C. motor, position indicator and wave guides. BRAND NEW. Our low price..... **$12.95**

BC-442 ANTENNA RELAY

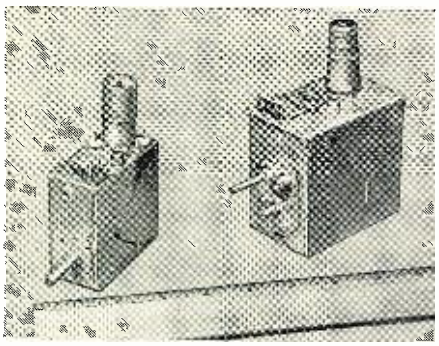
Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator), 0-10 scale. Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW..... **$2.49**

FL-5 FILTER.....**79c**

What's New in Radio

NEW MINIATURIZED TUNER

The *F. W. Sickles Division* of *General Instrument Corporation,* Chicopee, Mass. has announced the development



of a new miniaturized tuner which offers the advantages of reduced-cost u.h.f. sets and greater standardization of production.

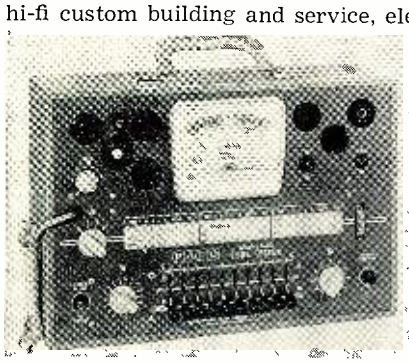
The unit is designed to be used in either black-and-white or color receivers in any size set down to the smallest portable. According to the company, the tuner eliminates the problem of drift in u.h.f. receivers and reduces interference-causing tuner radiation.

The new device measures 2 11/16" square and 1⅜" deep and weighs 13 ounces. It includes compensation for temperature rise as the set heats up. For full information on the new Model 204, manufacturers are invited to write the company direct.

TUBE TESTER KIT

Paco Electronics Co., Inc., a division of *Precision Apparatus Co., Inc.,* 70-31 84th St., Glendale 27, New York has recently introduced a new tube checker in kit form, the Model T-60.

The new unit is expected to find wide application in radio and TV servicing, hi-fi custom building and service, elec-



tronic hobbies and amateur radio, schools, and industrial plants.

The checker features a free-point lever selector system; an extra-large 5" acrylic cased meter; illuminated, high-speed, brass-geared three-column roll chart; a rugged, ripple-finished steel cabinet; and a two-color panel with contrasting knobs. It will handle all new AM-FM-TV tubes, including series-string types.

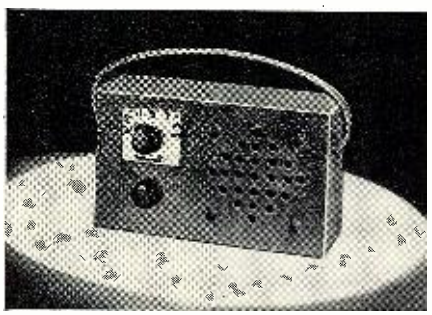
Dimensions are 10½" x 15¼" x 4¾". Accessories available include a standard picture tube test cable, 110 degree picture tube adapter, and a matching, hinged removable cover to make the instrument portable. Write the company for prices.

TRANSISTOR RADIO KIT

Superex Electronics Corp., 4-6 Radford place, Yonkers, N. Y. has just announced a new transistor radio kit, the Model TR4-K.

Featuring four of the latest type transistors, a diode, and the company's exclusive flat transistor Loopstick, the receiver offers exceptional sensitivity and power.

The kit comes complete with tran-



sistors, portable case, and all parts including a pre-punched printed circuit board and 2½" loudspeaker. Other features include a jack for private listening, simplified assembly instructions, and low battery consumption circuitry.

PC ROTARY SWITCHES

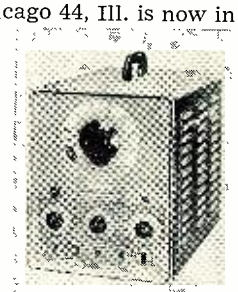
Knight Electronics Corporation, 210 S. Desplaines St., Chicago 6, Ill. is now offering its recently announced plug-in printed circuit rotary switches to the trade as individual components for use in computers, test instruments, hi-fi gear, and any other electronic circuits requiring multiple switching.

Consisting of a standard rotor and XXXP phenolic wafers, the new switches differ from conventional rotary units in that they eliminate manual wiring and soldering of each individual contact terminal. This saving of time and labor is achieved by using etched foil on the wafers to connect the contacts to the terminal prongs on the base of each wafer. Since the contacts are the same as those used on conventional switches, they are applicable in any circuit where rotary switching is required.

The line can be supplied in either 8- or 12-position types in single or ganged assemblies to meet specific requirements. Write the company direct, giving specifications required.

COLOR BAR GENERATOR

Simpson Electric Company, 5200-18 W. Kinzie St., Chicago 44, Ill. is now in production on a new color bar generator of the type which produces a true, 100% saturated NTSC signal.



Designated as the Model 430, the unit will handle any color TV receiver irrespective of age or design, including future models. All standard outputs are provided, plus *G-Y* at 90 degrees, which is essential to effectively test the new color sets.

An important feature of the new unit is a single master control by means of which outputs are selected. Each position on this control is identified by a color picture of the actual pattern which would appear on the screen of a properly adjusted receiver.

In addition, the Model 430 has a hinged side panel which gives quick access to internal controls for fine adjustment and maintenance. The side panel also allows the instrument to be operated on either a shelf or bench.

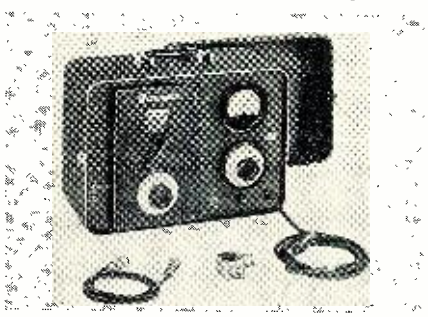
NEW ERIE "PAC" UNITS

Erie Resistor Corporation of Erie, Pa. has widened the field of application for its "PAC" modular system by using ¼ and ½ watt deposited carbon resistors.

These pre-assembled components consist of interconnected capacitors automatically assembled into a unitized module for quick, easy installation by the set manufacturer. The company will supply full details on the new units to those writing direct.

GENERATOR FOR MOBILE WORK

The Communications and Industrial Electronics Division of *Motorola Inc.,* 4501 W. Augusta Blvd., Chicago 51, Ill., has announced the availability of a



new, moderately priced r.f. signal generator which has been especially designed for servicing land mobile communications systems.

Providing complete coverage of all land mobile communications bands presently used for two-way mobile and base station radio operation, the instrument features six individually cali-

brated direct-reading scales covering the 25-54, 140-175, 400-470, and 890-960 mc. bands.

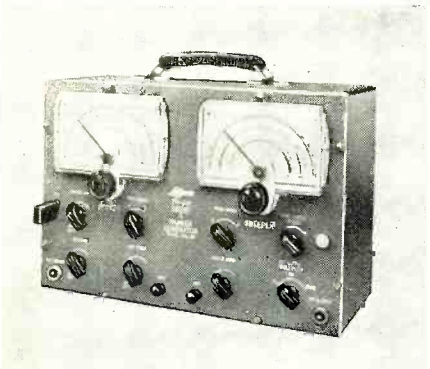
The new signal generator weighs 26 pounds and measures only 10" x 14" x 7¼". In portable applications, the face of the instrument is protected by a sturdy drawn aluminum cover having a black wrinkle finish to match the rest of the case.

Further information on the Model TU576 will be supplied by Dept. SG of the company on request.

ALL-PURPOSE SIGNAL GENERATOR

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering a new all-purpose signal generator for alignment of TV and FM receivers.

The Model LSG-50, imported from abroad, provides a range of sweep frequencies of 3 mc. to 260 mc. in two bands and marker frequencies of 3 mc. to 225 mc. in four overlapping bands. The linear and shielded electromagnetic sweep provides a continuously



variable sweep width of 12 mc. or more. Built-in variable retrace blanking is also provided.

A 4.5 mc. crystal with accuracy of .002% is supplied with the generator and plugs into the front. The crystal provides a means of checking generator calibration accuracy and also provides a second marker for r.f. or i.f. alignment as well as a 4.5 mc. signal for alignment of intercarrier sound channels.

The instrument is housed in a grey wrinkle metal cabinet which measures 9"x13½"x6" and weighs 20 pounds. A convenient carrying handle is also provided. Write the company for complete specifications and price.

CAPACITOR ANALYZER

Sprague Products Company, North Adams, Mass. has developed a new "Tel-Ohmike" capacitor analyzer which is being marketed as the Model TO-5.

Designed for TV service work, the instrument measures capacitance, power factor, leakage current, insulation resistance of capacitors, as well as the turns ratio of iron-core transformers.

Compact and easy to use, the new Model TO-5 has many unique features designed to facilitate servicing operations. It has push-button range selection, extended capacitance ranges from 1 $\mu\mu$fd. to 20,000 μfd., direct meter reading of insulation resistance up to 20,000 megohms, direct leakage cur-

(*Continued on page* 163)

Ham Participation in IGY

(*Continued from page 8*)

With simple receiving equipment you can easily determine the starting and ending times of satellite transmissions. These should be established as accurately as possible, and the use of an auxiliary receiver, tuned to WWV, would be highly desirable in arriving at this schedule.

Accurate amplitude readings of signal levels would be most useful in indicating a satellite transmission or pass over your meridian of longitude. For this purpose, a signal strength meter calibrated in microvolts may be rigged to your receiver in lieu of the exisiting S-meter. Such a simple project is well within the technical means of countless amateurs. Again, these readings should be correlated with WWV to fix, precisely, the time of maximum signal strength. If you have a home tape recorder, your contribution can be even more valuable. With it, you can freeze, for evaluation by scientific groups, the complete record of each pass the satellite makes within range of your station. Tapes may be sent to the Naval Research Laboratory, Washington 25, D. C. If possible, WWV time-signals should be superimposed on the tape. It is anticipated that your tapes will be returned to you after the information has been extracted.

Other than these essentials, the only piece of equipment needed that might not already be in the shack is a converter or receiver that will operate on 108 mc. Amateur literature contains many descriptions of designs that may be adapted and there is a great deal of latitude here for the experimenter to improvise. Practically any two or six meter converter can be modified to cover the satellite transmissions.

For the advanced ham or amateur radio club seriously interested in tracking the earth satellite, project "Moonbeam" has been set up by the Naval Research Laboratory. Requests for technical information and consulting assistance on equipping, establishing, and operating stations in the "Moonbeam" volunteer radio network should be directed to the Satellite Office, IGY Committee of the National Academy of Sciences, Washington, D. C. For complete details on the two amateur tracking systems mentioned above, address Mr. Roger L. Easton, Naval Research Laboratory, Washington 25, D. C. regarding Minitrack Mark II; or Dr. H. L. Richter, Jr., Jet Propulsion Laboratory, California Institute of Technology, Pasadena 3, California regarding Microlock.

The American Radio Relay League, national amateur radio organization, operating under a contract with the U. S. Air Force, has established a program to collect v.h.f. data on a worldwide scale. If you experience freak operating conditions above 50 mc., you have another opportunity to aid in furthering knowledge in this part of the spectrum. All observations of an unusual nature should be reported to Mason Southworth, W1VLH, ARRL-IGY Project Coordinator, 530 Silas Deane Highway, Wethersfield, Connecticut. Amateurs interested in taking an active part in this program may register now. A monthly bulletin containing news of the IGY and reports of special interest will be sent to participating amateurs.

Amateurs living in the Southwest have an unprecedented opportunity to aid in one of the most imaginative experiments yet conceived. Operation "Smoke-Puff" has as its goal the creation of an artificial ionosphere—the necessary ingredient for long distance communication. Success in this area could point the way to the eventual control of the one factor that dictates when hams, and the commercials too, are likely to work DX. Previous work has indicated that it is possible to create ionized "patches" by releasing chemicals from high-altitude rockets shot into the upper atmosphere. Future experiments will attempt to determine how far communication might be extended by this means and for what length of time. Interested amateurs living in Wyoming and states to the south, may contact O. G. Villard, W6QYT, Radio Propagation Laboratory, Stanford University, Stanford, California.

Any ham tired of working DX or pounding brass need look no further to find again that grand feeling of doing something as new as tomorrow. Why not join in the IGY—man's greatest scientific endeavor?

Satellite Stories

Since RADIO & TV NEWS is so vitally interested in the entire IGY program and especially the important part that can be played by the radio amateur, we are inviting all our ham readers to report to us on any unusual experiences and activities encountered pertaining to satellite tracking or other phases of the IGY program. We are also interested in feature articles on equipment that can be used in the program, such as a good 108-mc. converter. If you have any worthwhile information to pass along, let us hear from you.

Integrated Speaker System

In our editorial that appeared in the December, 1957 issue we promised our readers a further report and additional information on the *Integrand* servo-speaker system that was first introduced in our October issue. Unfortunately we have not as yet heard a demonstration of the unit so that we cannot report further on it. As was to be expected with such a new product with its highly specialized design, the manufacturer has had some difficulty in obtaining suitable parts that would match the design of the transistorized circuits. We intend to keep our readers informed of any further developments. . . . . W.S.

Service & Public Relations

(*Continued from page* 61)

and the consumers' hope lies in the expansion of direct manufacturers' service.

While the natural tendency is to rise up in righteous wrath and "tell the editor off" when articles like that appear, such venting of personal displeasure does nothing to solve the problem of bad public relations. It is a big problem that must be studied realistically by every set dealer and by every service dealer. The way it is handled and the extent of the dealer cooperation in a program to improve public relations will play a vital part in shaping the entire future of independents in the electronics distribution and service fields.

Contrary to the *Time* statement that dealers are glad to be "relieved of the expensive burden of service,"—a statement apparently picked up verbatim from the dealer-promotion material of one large manufacturer—TV-appliance retailers have found that sales are geared directly to service. They have discovered that, when they farm out their service work, they cut loose from their most important contacts for new business.

Service shops, too, have discovered that sales and service are Siamese twins. In a recent issue of the "Hoosier Test Probe," service dealers were advised that "Strictly service shops are becoming a thing of the past. If you don't trade that customer into a new piece of goods when he's ready, some smart service dealer will, and walk off with your customer. Remember, when the old set blows up, you're the first man on the scene."

It is well known throughout the industry that well managed, competently staffed, independent service shops can provide more economical and efficient service than either distributor- or manufacturer-controlled service depots. However, competent service talent and equipment transported to the home for on-the-job servicing is expensive, and home owners must be educated in the realities of maintenance costs in push-button homes. The virtually fool-proof, maintenance-free gadgets visualized in the *Time* piece may be a reality someday, "when and if," but, until that time, home owners had better be prepared to pay adequate charges for the service of products produced by profit-minded manufacturers competing for their favor and business.

The thousands of set retailers and service dealers represent a tremendous, latent force. If their public and customer relations efforts could be welded together in a common program, the entire sales and service atmosphere would improve immeasurably. Until such time as a common program is developed, each service dealer will have to solve the problem of public relations on an individual basis in his own community. —30—

Transistor Modulator

(*Continued from page 43*)

flat, and smooth. The transistors are insulated from the chassis by 0.002-inch mica spacers, which will be found in the mounting hardware kit furnished with the transistors. A drop of silicone oil or a small amount of silicone grease (such as *Amphenol* 53-307) should be placed on both sides of the mica insulators for better heat transfer to the chassis. Use great care in handling the mica insulators during assembly as they break very easily. Assemble the transistors to the chassis, using shoulder washers on the underneath side of the chassis to center the transistors in their mounting holes. Tighten the mounting nuts to about ten inch-pounds of torque, then place solder lugs on the mounting studs. A second nut on each stud completes the assembly. Before connecting any transistor leads, make an ohmmeter check for shorts between all terminals and ground. When wiring, remember that the collector terminal is the solder lug attached to the mounting stud. The base lead is green, and the emitter lead yellow. The leads may be soldered directly into the circuit, using normal soldering procedures.

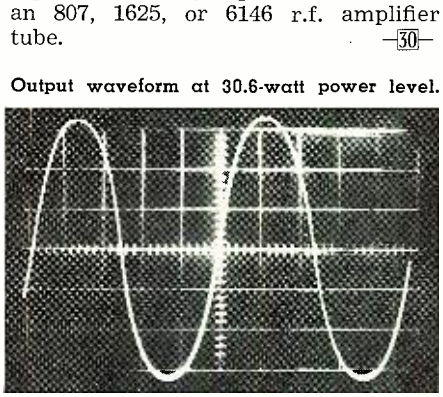
After the wiring is completed, double-check the transistor stage for wiring errors before applying power, paying particular attention to the base and bias circuits, since shorts or opens here may damage the transistors. Also, before connecting the modulator to the power source, be sure that the load is connected and the battery polarity is correct. Performance may be checked on the bench by disconnecting the secondary circuit of the modulation transformer from the high-voltage supply and connecting a test load consisting of two 2500-ohm, 20-watt resistors in series across the secondary. *Do not at any time operate the modulator without a load connected to its output.* Temporarily break the primary center-tap lead of the modulation transformer and insert a 0-5 ampere meter between center-tap and ground, with its negative terminal grounded. Remove the 12AU7 tube from its socket and apply 12 volts d.c. from a storage battery to the modulator. The ammeter, which reads total collector current, should indicate between 0.10 and 0.25 ampere idling current. If there is no reading, or a high reading, turn off the power immediately and recheck the circuit for wiring errors or defective components. If the current is only slightly outside the limits given, and you are certain your ammeter is accurate, correct it by changing the value of R_3, reducing it to increase the current and *vice versa*. The exact setting is not critical in this application. After the collector current has been set, plug in the 12AU7 tube and speak into the microphone. The collector current should rise to 2 amperes or more on sustained voice peaks. If an audio oscillator and oscilloscope are available, apply a 400-cps sine-wave test signal through a capacitor to the microphone jack and observe the waveform between either collector and ground. Normal operation is indicated by a clean sine wave which increases in amplitude as the input is increased, finally clipping on both peaks at about the same time. The peak-to-peak amplitude of the signal at the point of clipping should be slightly less than twice the battery voltage, and the collector current should be between 3 and 4 amperes. While testing, avoid touching the 2500-ohm load resistors, since a peak voltage of over 500 volts will exist across them. While bench testing the modulator, it is well to operate it into the dummy load for several minutes at full power, while checking the temperature of the transistor cases at frequent intervals. When operated at normal room temperature from a 12-volt source, the transistors should not become too hot to touch with the bare hand.

After completion, the modulator should be installed temporarily in the car and the transmitter loaded to rated plate input. Make a check of modulation percentage, using the method of measurement best suited to the equipment on hand. Reduce the gain if necessary by increasing the value of R_1 or omit it entirely if maximum gain is required for the operation of a low-output microphone. Once set correctly, the gain of the circuit should remain constant over long periods of time.

If a vibrator pack is to be used as a power supply for the r.f. portion of the transmitter, another capacitor, C_5, should be added as shown in the schematic. Its purpose is to decrease the rate of change of the d.c. current in the secondary of the modulation transformer when the push-to-talk switch is released, thereby reducing inductive voltage spikes which might exceed the maximum voltage ratings of the transistors. It may be omitted if a dynamotor power supply is used.

At the last moment, the authors have obtained and tested samples of a newly announced *Stancor* modulation transformer, designated as type TA-17. Developed especially for use in this circuit, the *Stancor* transformer has an 8-ohm center-tapped primary winding and secondary taps to match either an 807, 1625, or 6146 r.f. amplifier tube. —30—

Output waveform at 30.6-watt power level.



Within the Industry

(*Continued from page 28*)

The appointment of **ROLLAND V. ROBISON** as product manager, semiconductor sales, for *Sylvania Electric Products Inc.* has been announced . . . **EDWARD ALPERT** has been advanced to the position of communications field sales administrator and **JOSEPH J. SEDIK** to the post of communications product planning manager for *Raytheon Manufacturing Company's* commercial equipment division . . . **DONALD HAMILTON, JR.** has been named president of *The Audograph Company* . . . The appointment of **ALVARO D. BIAGI** as executive engineer at *Federal Telecommunication Laboratories* has been announced . . . **ROBERT BURNS** has been appointed sales manager of the catalogued products division of *Chicago Standard Transformer Corp.* . . . **SEYMOUR WINUK** has been promoted to the post of assistant sales manager for selenium rectifiers, semiconductor division, *Radio Receptor Co.* . . . **JOSEPH L. HELLER,** sales manager of *Todd Products Co. Inc.* and its affiliate *Todd-Tran Corp.,* announced his resignation as a director and officer . . . **ROBERT J. HIGGINS** has been appointed to the newly created position of advertising supervisor, high-fidelity phonograph and radio, *Sylvania Electric Products Inc.* . . . *Allen B. Du Mont Laboratories, Inc.* has appointed **ROBERT E. RUTHERFORD SR.** and **KENNETH F. HOAGLAND** staff assistant to the vice-president, tube operations, and director of engineering, respectively . . . **DR. G. H. BROWN** has been named chief engineer, industrial electronic products, *RCA* . . . *Atlas Precision Products Co.,* division of *Prudential Industries, Inc.,* has appointed **JERRY CUMMINS** general sales manager . . . **LEON KNIZE** has joined *Stromberg-Carlson* as sales manager of high-fidelity components . . . **ROBERT J. REIGEL** has been elected vice-president in charge of sales of *Adorn Plastic Specialists, Inc.* . . . **JOHN ANDERSON** has been elected vice-president of *National Electronic Plastics, Inc.* . . . **MARVIN KULLBACK** has joined *CGS Laboratories* as a project manager in the engineering department . . . **DR. RAYMOND L. GARMAN** has been elected to the office of vice-president, engineering and research, *General Precision Equipment Corp.* . . . Announcement has been made of the appointment of **DON WERTER** as purchasing agent for *Clary Corporation* . . . **ERNEST L. HALL** has been named staff assistant to Benjamin Abrams, president of *Emerson Radio and Phonograph Corp.* . . . **JOSEPH W. LEWIS** has been appointed an assistant to the president of *Beckman Instruments, Inc.* . . . **E. L. BRAGDON** has been named to the newly created position of trade news editor, *Radio Corporation of America* . . . **M.T.E. GOLDUP** of *Mullard Ltd.* has been elected president of the British Institution of Electrical Engineers for 1958. He is a specialist in tube design. —30—

Sound on Tape

By BERT WHYTE

IF YOU will read the introduction to my record column, you will know that a stereo disc is on the way. Well, friends, no sooner did the news of the stereo disc come out than the prophets of doom were busy. "Stereo on tape is dead," they cried . . . "the tape machine boys have had it," and other similar junk. They figured that the stereo disc would most likely retail for the old LP price of $5.95 and tape simply would not be able to compete. During the show I talked to most of the tape machine manufacturers and the stereo tape producers. For people who were supposed to be going out of business they had a most cheerful mien. As far as I could determine, almost without exception the tape people feel that the stereo disc will help, not hinder and that it will stimulate stereo on tape. Most felt that co-existence was certainly possible and probable. After all, one party said to me, tape is still inherently the best medium for stereo and there will always be people who want their stereo in the specialty class.

If any real threat should arise, the tape people won't be caught napping. In the works are new oxide formulations that will enable today's frequency response at 7½ to be reproduced at as little as 1⅞ ips. This would obviously bring stereo tape costs down. Also in prospect is the idea of dual-track stereo, in other words, a total of four stacked heads, two per each half of tape. This would double playing time of stereo tapes and also result in lower prices. It is claimed that the smaller gap areas of these heads will be able to maintain as good a signal-to-noise ratio as presently exists. Of course, in any final showdown, tape always holds the ultimate trump in that they can always go to true three-channel stereo, something the disc cannot!

Unless otherwise noted all tapes reviewed herein are stacked stereo recorded at 7.5 ips on 7″ reels according to NARTB standards.

SCHUBERT
SYMPHONY #8
Philharmonic Symphony Orchestra of London conducted by Artur Rodzinski. Sonotape SWB8024. Price $11.95.

This tape arrived in one of *Sonotape's* handsome new packages which are much easier on the eye than the previous containers. The second performance of the "Unfinished" to appear on stereo tape, this has the virtue of Rodzinski's deft, sympathetic conducting and exemplary sound. This is recorded less close-up than most *Sonotapes* and, with the use of a moderately "live" hall, gives a fairly broad acoustic perspective. Detail is somewhat sublimated to the achievement of what you might call a "25th row" effect . . . a musical spaciousness that is quite natural. Probably won't appeal to all tastes and for those who want a more massive, more detailed sound, we urge a listen to the Munch/*Victor* tape.

Stereo effects here were excellent, with good instrumental separation, and good directionality including that which emanated from the "ghosted" middle channel. Add wide dynamics and a reasonable signal-to-noise ratio as plus virtues of this fine tape.

MOZART
CONCERTO FOR CLARINET AND ORCHESTRA
Benny Goodman, clarinetist. Boston Symphony Orchestra conducted by Charles Munch. Victor DCS39. Price $12.95.

Every once in a while the "King of Swing," Mr. Benny Goodman, invades the classical field and the results are invariably interesting and most often musical. Here Benny crosses swords with Mozart and while he cannot honestly be compared to a Reginald Kell, for instance, neither is there much in his playing of this concerto to criticize. His technique is very assured and his tone clean-lined throughout the score. In short, a good performance lacking somewhat in warmth but wholly honest in presentation.

Of course there is the matter of stereo to reckon with and the sound produced by Benny and the Boston Boys is really gorgeous. Very full, highly detailed recording, with excellent projection of all orchestral elements. Acoustics here are spacious, but not to the full extent of the Boston Symphony hall, in keeping with the "smaller-boned," classical nature of the score. The Boston string sound is smooth and clean whether it be first violins or celli. Benny's clarinet is heard quite bright, perhaps overshading the orchestral support a mite. Benny plays just left of center and, happily in this tape, there is little of the "speaker jumping" that is the bane of so many concerto recordings. All-in-all a very live-sounding tape with wide dynamics and low hiss level.

CARPENTER
ADVENTURES IN A PERAMBULATOR
Eastman-Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MDS5-2. Price $12.95.

This tape, in terms of totality of stereo effect, is quite the most outstanding yet issued. This is a rare and happy combination of the right kind of music, performed by an orchestra and conductor most sensitively attuned to the demands of the music, in a hall where the acoustic perspective is so perfect for the music as to seem almost contrived, and recorded with such mirrored faithfulness as to give the term "high fidelity" new meaning.

The music itself is turn-of-the-century "modern," by American John Alden Carpenter . . . meaning that it isn't self-consciously full of atonalities and dissonances and is really very easy to assimilate. At any rate it is thoroughly delightful and entertaining.

Howard Hanson and the Eastman-Rochester Symphony seem to be as entranced by the score as this writer and their performance embodies a true virtuosity. From the moment you first hear this recording, you instinctively sense that you are going to have an exciting musical experience. The piece opens with woodwind and celli very obviously emanating from the right channel and with some "ghost" center-fill as well. A moment later the first violins steal sweetly onto the scene from the left and thus begins a work where the stereo interplay between the various choirs and instruments is about as pronounced as you can find. Yes, directionality is most evident here but at the same time the score is such that with the hall reverb, there is a sense of superb sonic proportion, a sort of lovely-sounding blend.

This concert-hall "bloom" is enhanced by the sharp instrumental detail and the very big and forward projection of the sound. The tonal pallette here is tremendously varied, from the soft, pastel colorings of the woodwind, to the brazen brilliance of the brass, the strings both sharp-hued and soft, the dark and weighty accents of the percussion. Yes, here is stereo the way it should be with all its vaunted spaciousness and its ability to convey the very soul of musical meaning.

Frequency and dynamic range on this tape were extremely wide. I might add in this connection that the low-frequency response of many stereo tapes is quite poor, probably due to a combination of poor recording technique to begin with and poor dubbing. The really low stuff, big bass drum for example, just doesn't have the proper *sock* to it. Not so in this tape where in the "policeman" section there is a bass drum of awesome sonic proportions.

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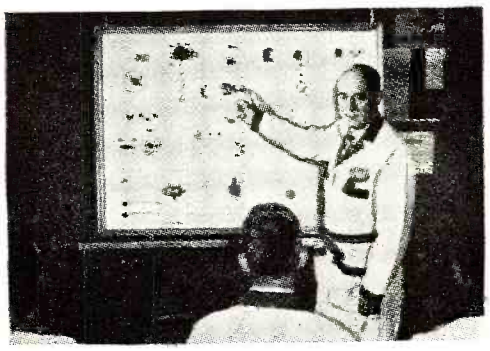

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If you are one who has yet to be convinced of stereo's merits, listen to this tape over a reasonably good system and, brother, you should get the message . . . loud and clear!

TCHAIKOVSKY
FRANCESCA DA RIMINI
Boston Symphony Orchestra conducted by Charles Munch. Victor DCS51. Price $12.95.

Munch has always had a way with this flamboyant music and to hear him and the Boston Symphony in this stereo version, literally "full cry," proves that he still enjoys the exercise. Surprisingly few hi-fi fans are aware of this score which is one of Tchaikovsky's most bing, bam, and purple passion epistles. If this is a frenetic experience on a monaural disc, the fury of the stereo version leaves one speechless. In the finale, the hysterical ululations of brass, woodwind, string, and percussion as the lovers descend into the Inferno is a nerve-shattering thing and has to be heard to be believed!

This is big music and it's played by a big orchestra, in a big hall. As you might expect, such massive sounds are particularly effective in the stereo medium. Good direction throughout, with fine center-fill . . . very forceful projection of the sound into the huge acoustic liveness. Close-up recording gave excellent detail and afforded tremendous orchestral impact. Wide dynamics and good signal-to-noise ratio were notable features of this tape. If you enjoy Tchaikovsky's "Romeo and Juliet" and "1812 Overture," this is your dish of tea!

IBERT
ESCALES (PORTS OF CALL)
Boston Symphony Orchestra conducted by Charles Munch. Victor ACS-57. Price $6.95.

Another work with which Munch has enjoyed considerable success, Ibert's lovely "Ports of Call." This is surely the other side of the coin from the "Francesca" described above! This is obviously programmatic music telling of the composer's visits to various Mediterranean ports. Each port is depicted in music suitable to its character, thus we have a very sensuous, dreamy sort for Palermo, a busy quasi-oriental clatter for Tunis, and the fiery dance of Valencia. Good stereo recording here, with fine directionality, crisp instrumental definition, and a "liveness" afforded by the superb Boston acoustics. Wide dynamics, especially in the finale. Recommended to those who like a touch of the exotic in their music.

MUSIC FOR HI-FI BUGS
Pete Rugolo and his Orchestra. Mercury MDS3-1. Price $12.95.

Here is a tape in the pop vein, this time *Mercury* style. Pete Rugolo is of course the formidable talent who was responsible for the fabulous arrangements of the old Stan Kenton band. He is holding down both arranger and conductor spots, on this tape and you can hear the weird and wonderful things he has done with such old favorites as "Once in a While," "These Foolish Things," "Snowfall," and others.

By far the most unique is his treatment of the title song, "For Hi-Fi Bugs." Blasting out of your right hand speaker you will hear the doggondest battery of baritone and bass saxes ever, playing in a very low register with power so tremendous, they're almost palpable! Then come massed sharp staccato trumpets and away we go! Brass and percussion on this tape are shattering. The whole was recorded *via* the new multi-mike, three-channel stereo setup being used by some firms to give exaggerated liveness. Here, however, the projection in this close-up recordings is fabulous. The orchestra is literally sitting at the end of your listening room, albeit almost blowing you out of it! You will also find a tricked up directionality on this tape, but if you will accept it as part of what really is a new musical medium, you can do nought but enjoy this tape.

-30-

STEREO TAPE "CONCERTS"

THE Stereophonic Sound League Inc., Steinway Hall, 113 W. 57th Street, New York City has announced the inauguration of a stereo tape demonstration service whereby the general public may audition a variety of recorded tapes from all manufacturers.

The concert demonstration room, Suite 1007, is specifically designed in size and decor to create the exact atmosphere of the living room. The music played is reviewed by the League's editor and guests' questions and comments are invited.

In connection with the demonstration service, interested persons are invited to enroll as members of the League without charge. The following gifts and benefits accrue to members: Free dustproof tape storage albums for every two tapes purchased; a complete tape catalogue four times a year; a subscription to the monthly house organ, "The Inside Track," wherein the new tapes are reviewed; and up to $50.00 worth of tapes with the purchase of a tape recorder or stereophonic player.

Demonstrations are held daily from 12 noon to 2 p.m. and in the evenings by appointment.

Stereophonic enthusiasts in the New York area are invited to contact the League for further information. -30-

AR OPEN HOUSE

ACOUSTIC RESEARCH, INC., maker of the AR-1 and AR-2 speaker systems, will hold open house at its factory from Monday, January 20th through Wednesday, January 22nd.

Visitors to the plant at 24 Thorndike St., Cambridge 41, Mass. will be welcome and tours through the plant conducted at 11 a.m. and 2 and 4 p.m.

Laboratory, university, and other groups are welcome to visit the plant at any time providing arrangements are made, in writing, prior to the trip.

This "open house" is primarily for individuals and others interested in seeing speaker systems made and tested.

-30-

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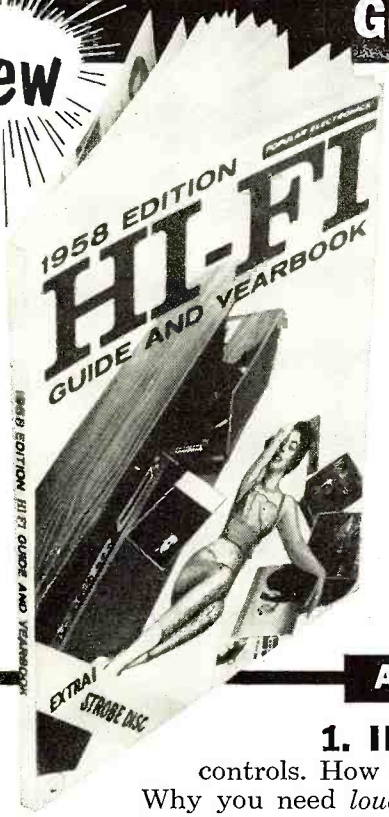

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3. GETTING INTO STEREO. What stereo is. Latest *advances*. What the different stereo *systems* are. What stereo equipment is *available*. How to *add* stereo to your present rig. *Merits* and drawback of different systems. What they *cost*. *Tricks* of the trade.

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Many thousands of hi-fi fans knew a good thing when they saw the first edition of the *Hi-Fi Guide and Yearbook*. Newsstands were cleaned out in a matter of days and the book became a collector's item.

The new *1958 Edition* of the *Hi-Fi Guide and Yearbook* will go on sale soon. It contains completely new material on every facet of high fidelity . . . from an advance report on 16-⅔ rpm ("The Fourth Speed"), to guidance on adding stereophonic sound to your present set-up.

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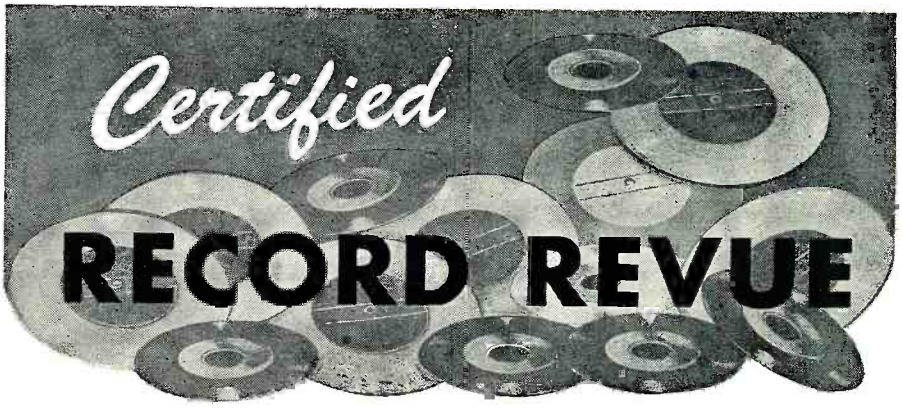


By BERT WHYTE

MY GOSH, it's January already! Yessir, another new year and a year which will probably be one of the most significant in the hi-fi era. The publishing business being what it is, this is the earliest time available to report on the recent New York Hi-Fi Show. Or perhaps it should have been called the stereo show, for stereo was everywhere. There were new stereo tape transports, packaged stero amplifiers, stereo preamps, stereo tuners, etc., etc. The crowds were huge . . . too huge in fact for the overtaxed facilities of the Trade Show Building. Many prospective hi-fi-ites were observed looking aghast at the milling throng and muttering to themselves, "t'aint worth it."

The Institute of High Fidelity Manufacturers has a king-sized problem on its hands trying to figure out where it can hold this annual show, to cope with the crowds, and yet provide adequate demonstration facilities. The huge New York Coliseum would be fine except that there is no compartmentation or individual sound control facilities.

Like many shows, the matters of real moment went on behind the scenes. In this case, stereo was being shown everywhere . . . stereo on tape, that is . . . but unbeknown to the public, stereophonic sound on disc was being demonstrated to the select few. The *Westrex Corp.* a subsidiary of *Western Electric* used the concurrent sessions of the AES Convention at the New Yorker Hotel to introduce its version of the stereo disc, and at the downtown offices of *London Records,* their stereo disc entry was being shown by invitation only. Thus, as I have predicted for some months in this column, stereo discs of the monogroove variety are finally on the scene. Did they work? The answer is a great big resounding "yowsah"! The *Westrex* system uses an adaptation of the vertical/lateral system its parent company tried so hard to perfect way back in the early '30's. Essentially, the stereo cutterhead drives a stylus connected in a unique fashion to two moving coils, so that a cut is made with groove walls at a 45 degree angle to the perpendicular. Each of the groove walls carries a "sum and difference" vertical and lateral modulation. On playback, a single stylus picks up the modulations from both sides of the grooves and, depending on the set-up, translates the information into a stereo signal, or a balanced compatible monaural signal.

Let me elucidate a little further. In a straight vertical/lateral system, a person using an ordinary conventional 1 mil pickup cartridge, magnetic or otherwise, would get from the stereo disc only the lateral modulation. Therefore he would be getting just the left channel and would be "off axis" or unbalanced. In the *Westrex* system both vertical and lateral information is picked up and the monaural user thus has a balanced signal. The *London* system was a straight vertical/lateral system, but varied from the recent *Sugden* version in that a magnetic cartridge was used as a pickup rather than a crystal or ceramic. In the *London* system, the pickup is said to be "compatible" in that it will play the special stereo discs and play regular monaural discs as well. The *London* people claimed a cross modulation figure of better than minus 30 db, which is more than adequate for stereo usage and a hearing seemed to support this figure. The stylus on the pickup is of the half mil variety and stylus pressure is on the order of 2 to 3 grams. Record wear is evidently a factor in both systems as low stylus pressure was emphasized.

Which system sounded better? Under the conditions which they were shown, which was a long way from ideal, the *London* system had the edge. It had definitely a cleaner, more musical sound probably in large part due to the excellent demo material *London* had available. The stereo effects were excellent and I can tell you that *London* stereo when it comes, in whatever form, will be a very potent, top-notch product in keeping with its reputation on monaural discs. In all fairness to *Westrex,* its demo was held in the very large ball room of the New Yorker, a room with abominable acoustics. The demonstration was convincing and it showed that the stereo effect was working very nicely. Unfortunately, there was noise and distortion on the discs, occasioned by the necessity of high levels necessary to cover such a huge room. And not being a record company, their demo material was not the equal of the *London* discs.

The significant thing, of course, is that both systems worked. And for once, the record industry is determined to establish a standard of stereo recording, rather than precipitate a situation analagous to the "speed war" in the early days of LP. The attitude of all parties is most commendable. *London Records* says, "We have a workable stereo disc . . . use it if you like . . . but we are in the record business and whatever system of stereo disc is adopted, we will make our stereo records to conform." Incidentally, *London* spokesmen revealed to me that they have well over 400 stereo masters "in the can," as they have been recording everything in stereo for some years.

As of this writing, the *Westrex* cutter has been purchased by *Victor, Columbia, Capitol,* and *Decca.* This does not necessarily mean adoption of the system, since the *Westrex* cutter is a versatile instrument which can cut either its own "45-45" stereo or straight vertical/lateral stereo. It does mean that these companies are cutting both types ex-

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

perimentally with their own material and the evaluation of this will determine which system, (or other possible systems) will become the industry standard for stereo discs.

What does all this mean to the record consumer? The consensus is that stereo discs of the monogroove variety will probably be available within a year's time. The most educated guesses on the cost of a stereo disc pickup lie somewhere between 45 and 60 dollars. One thing is fairly certain and carries its own warning . . . because the stereo pickup will have to be very compliant vertically, it will of course emphasize rumble which is a vertical noise component. Therefore turntables for stereo use will have to be quite free from rumble and people using changers will probably have a major headache with this probelm.

Another stereo development not shown to the public was the arrival of multiplex FM stereo. As you probably know, multiplexing is a method of super-imposing or "piggybacking" a subcarrier FM signal on top of a prime FM signal. In stereo usage, the prime signal would carry the left channel and the subcarrier would furnish the right channel. The problem up to now has been that a monaural listener is "off axis" and gets an unbalanced "left-channel only" signal. Actually all AM-FM stereo broadcasts are unbalanced in the ear of the monaural listener and presumably the FCC just "looks the other way" as a gesture toward progress. Another problem of AM-FM stereo has been the degraded quality of the AM channel, with its noises and restricted frequency range. Naturally a double FM signal obviates the quality problems, but until the disclosure of the *Crosby* multiplex stereo system during the Show, the compatibility factor for the monaural listener was the drawback.

In the paper presented by Murray Crosby, inventor of the system, a method was described in which the monaural listener received a balanced "left-right" signal, and the stereo listener the necessary separated channels. With this obstacle removed, the stereo multiplex was ready for commercial exploitation and Mr. Crosby announced to the convention that New York FM station WBAI had purchased the system and it was expected to be in operation by March of next year. Adapter units for picking up the multiplex signal are expected to be on the market by that time.

Whew! This stereo business is fascinating in its fast moving developments and one could yak on and on about it! But space just won't permit, so I'll clam up.

BEETHOVEN

SYMPHONY #9 (CHORALE)

Frances Yeend, soprano; Martha Lipton, mezzo; David Lloyd, tenor; Mack Harrel, baritone, with The Westminster Choir. New York Philharmonic Orchestra conducted by Bruno Walter. Columbia ML5200. RIAA curve. Price $3.98.

This is an extraordinary recording in many ways. As a whole the recording is quite a few years old. But the first three movements are older than the choral finale which was recorded separately some years later! Now the entire recording has been remastered and the engineers have managed to get it all on a single LP and *Columbia* has made it a monumental bargain by pricing it at $3.98! Sonically it is still not equal to the best of today, but the quality is more than acceptable and with the superb performance of Bruno Walter it is a highly desirable item. Those music lovers who have cherished their old LP's of this performance will find that $3.98 is a small price to pay for the greatly improved sound quality. Getting the 9th all on one LP involved a slight diminution of dynamics,

but with the aid of modern variable groove cutting the sonic integrity of the recording is well maintained.

BRAHMS
SYMPHONY #2 IN D MAJOR
Berlin Philharmonic Orchestra conducted by Karl Bohm. Decca DL9933. RIAA curve. Price $3.98.

Before you say "who needs a seventeenth recording of the Brahms 2nd," and pass this by . . . pause a little and take a listen for this has much to offer. For one thing Bohm remembers what many other conductors seem to forget . . . this is the quiet Brahms, the amiable Brahms, and thus this symphony hardly needs the tension and the drive so many conductors impose on it. Bohm essays a leisurely tempo in the opening movement and hardly varies throughout the rest of the score. He lets the work carry on seemingly under its own impetus, yet underneath there is a firm hand . . . he is never sloven of detail, realizing its importance in this score.

Above all he manages to elicit from the Berliners, playing of great warmth and rich expression. Couple this gemutlichkeit approach to the score with a lushly sonorous "big hall" type of recording and you have a Brahms 2nd symphony of uncommon merit. The *Deutsche Grammophon* engineers, past masters of acoustic perspective, have afforded a recording with just the right balance between the various orchestral choirs, the proper leaven of instrumental detail and the whole richly caparisoned in just the right amount of reverb.

GRIEG
HOLBERG SUITE
MOZART
LES PETITS RIENS (Ballet)
Stuttgart Chamber Orchestra conducted by Karl Munchinger. London LL1685. RIAA curve. Price $3.98.

Here is a treat for lovers of the string orchestra, a rarely heard ballet of Mozart and Grieg's fresh and charming "Holberg Suite." Both are highly listenable and the prelude to the "Holberg Suite" has a melodic phrase in it that is exquisitely beautiful. Munchinger revels in this type of repertoire and his performances show his obvious relish. The orchestra displays its superbly smooth, well-balanced string tone and the *London* engineers have afforded a recording that excels in clean crisp, definition and yet with an acoustic liveness that limns the strings with great "presence."

DUKAS
THE SORCERER'S APPRENTICE
LISZT
LES PRELUDES
STRAUSS
DANCE OF THE SEVEN VEILS (SALOME)
WEINBERGER
SCHWANDA POLKA AND FUGUE
New York Philharmonic conducted by Dimitri Mitropoulos. Columbia ML5198. Price $3.98.

A real mixed bag this, with one thing in common . . . they are all display pieces for conductor Mitropoulos. This is the sort of repertoire he can sink his teeth in, and if you have ever seen the athletic Mitropoulos in action you know what I mean! There is nothing definitive here . . . but one can truly say that Mitropoulos never fails to hold your interest.

The "Sorcerer" is quite good, the most straightforward of the group . . . his "Salome's Dance" is taken at breakneck speed, surely fast enough to exhaust Salome herself! "Les Preludes" is grandiose, with very forceful dynamic expression . . . and Schwanda stomps out his Polka with typical Mitropoulos-ian vigor.

The recorded sound throughout was excellent with especially sonorous brass, clean string tone. Recorded quite close-up but with judicious reverb to smooth things out. Level of sound on the disc is very high for a classical recording. A little more bass definition would have been helpful. A good value for the money and a fine record for hi-fi neophytes.

THE ORCHESTRA
Symphony Orchestra conducted by Leopold Stokowski. Capitol SAL8385. RIAA curve. Price $3.98.

I have listened to this recording at least three times in its entirety and some of the sections must have been heard at least six times. Why such extended listening? Frankly, I wanted to be very sure of my ground before I spoke. I most carefully checked my equipment, changed pickups and speakers several times just for a possibly different appraisal. Even though this is Stokowski's first recording under the *Capitol* label and would ordinarily demand close listening, I would not have gone so far unless I felt something was amiss. Other critics have waxed lyrical about the quality of this recording. While I will admit there are some remarkable sections in this record, in much of it I was not just disappointed . . . I was astonished that Dr. Stokowski approved of it.

Way back in the dark ages of stereo, in 1951-52, I had the pleasure of meeting Dr. Stokowski and I recorded him in stereo with several orchestras in a variety of works. I know what an expert ear he has for tonal balance, how meticulously the orchestra was set-up to achieve the proper balance. And of course, I realized that his knowledge and ability had come from long years of experience and experiment. His passion for balance and especially the pains he took to achieve the proper bass sonorities can be heard in his old 78 rpm recordings with the Philadelphia Orchestra . . . recordings that are remarkable even today.

Knowing this, I can't fathom what has happened in certain sections of this recording. My criticism is that where there should be a huge, full, rich, orchestral sound it is texturally very thin. Tonal balance seems to favor middles and highs at the expense of really low bass sonorities. The really inexplicable thing is that this seems to happen most with Stokowski specialties . . . works with which he has been long associated. Occasionally some piece will sound all right . . . it is very variable and only tends to cloud the issue further. To give specific examples found on this disc . . . Barber's "Adagio for Strings," simply beautiful, very full lush string tone, plenty of dark sonority in celli and contrabassi. Faberman's "Evolution," in the percussion section is a terrific feast of transients, recorded with exceptional clarity and dynamics. Tympani and bass drum here have plenty of "sock." Then we come to Vaughn Williams scherzo from his 8th symphony . . . very small-boned . . . thin . . . then the "Perischetti March" . . . again very thin, no body, no real drive, not the robustious work that it is. Finally the full orchestra in Mussorgsky's "Pictures at an Exhibition." Some very fine sound here, but . . . no huge sonority, no great brazen brass sounds, no soul-satisfying thud of really low percussion.

In still another new Stokowski/*Capitol* recording, the Maestro performs his famous transcription of the Bach "Tocatta and Fugue." This one really shocked me. It seemed all middle and high strings, the contrabassi which in the old Philadelphia recordings made such a magnificent full-bodied, richly resonant swell of sound, were greatly subdued, a pallid shadow of the remembered substance. On some numbers in the same

recording, the sound was excellent. What's the answer? I profess I just don't know. Maybe the Maestro has changed his ideas of balance in the last few years, but I doubt it. I do know I have checked everything carefully at my end. I know that what I described to you I heard and other ears of known merit concur with me on this matter. An unusual review, I know. . . . I felt I had to take issue with those critics who praised this recording unreservedly and mentioned nothing of that which disturbed me deeply. I'd be interested in hearing anyone's ideas on this problem.

HIFI A LA ESPANOLA

Eastman-Rochester Pops Orchestra conducted by Fred Fennell. Mercury MG-50144. RIAA curve. Price $3.98.

The ubiquitous Freddie Fennell is at the helm of his "Pops" orchestra once again and this time he is on a "south of the border" kick. This disc is a collection of numbers of Latin derivation and includes such well-known items as the "Ritual Fire Danse," "Malaguena," "Goyescas Intermezzo," "Jamaican Rhumba," "The Bullfighter's Prayer," and others. Now let it be known that this is no hackneyed warmover of these works. Fennell is too original and too good a craftsman to espouse such treatment. Each work was carefully arranged or modified for maximum orchestral color. Each gets the full symphonic treatment and the results are phenomenal. The "Goyescas Intermezzo," for instance, is played with searing intensity and the climactic moments are heartbreakingly beautiful. The "Malaguena" begins with the most simple plucking of a guitar and before it is finished it is a blazing swirling riot of orchestral color.

The dynamics on this disc are really fantastic, almost frightening through a big speaker system. In a number called "Batuque," the dynamic range probably approaches 50 db. Needless to say with these works of Latin persuasion there is brass aplenty and a greatly enhanced percussion battery. Hi-fi fans can have the demonstration ball of the year with this one! There are myriads of hard sharp high percussives and low percussion in profusion including a bass drum with an awesome *whump* recorded at very high level on this disc.

Fennell takes the complexities of these works as easily as he drives his MG. He elicits from his orchestra playing that is not only almost metronomically precise, but playing full of heart and great high spirits. I think one of the reasons for Fred Fennell's success is the enthusiasm he is able to impart to the musicians in his orchestra. It is easily apparent that these musicians aren't just sitting down to a recording session at so much per, union scale . . . one listen and you know these men are enjoying themselves. Don't miss this one! —30—

DISC SIZE STANDARDS

RIAA has prepared a new set of dimensional standards for phonograph records which supplements the electronic standards promulgated in 1954.

Such dimensions as outside and center hole diameters, thickness of playing and label surfaces, and recording groove contour are included in the new standards covering 33⅓ and 45 rpm discs.

Dimensions are also recommended for such reproducing equipment as the pickup stylus: ideal tip radius, angle of stylus, and pressure applied to disc surface in playing.

The RIAA, numbering 54 members, represents 80 per-cent of the total record industry sales volume. —30—

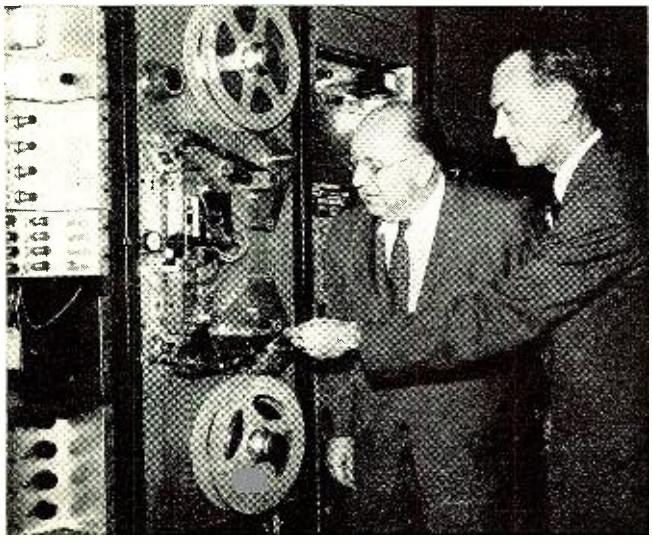
Color TV Programs on Tape

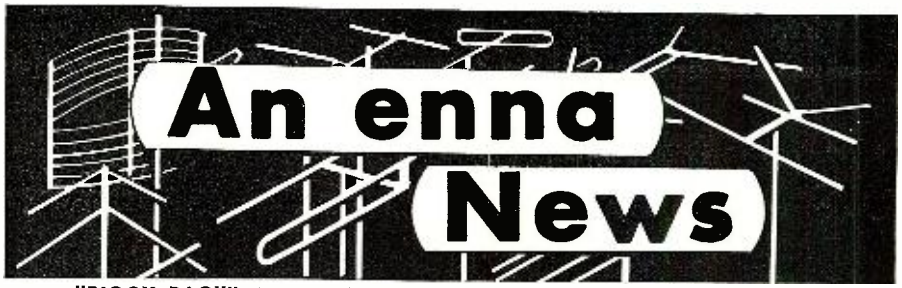
New RCA system for color broadcasting ready for market by the end of 1958.

THE use of magnetic tape as a practical method of telecasting color programs was demonstrated recently by the *Radio Corp. of America*. The recorded programs can be re-broadcast the instant they are taped, without any processing required. The demonstration consisted of a program of video tape recordings of a recent network color show, transmitted by closed circuit from *RCA's* Camden, N. J. broadcast engineering studio to an audience in New York. It was produced by an engineering prototype of a color video recorder which *RCA* plans to start making commercially by the end of 1958. Meanwhile, construction of several additional prototypes is under way. The tape recorder, which records the sound signals along with the color signals, will permit broadcasters to store color programs for use any time they desire. In the system demonstrated, an hour-long program can be stored on, and played back from, a 12½-inch reel of 2-inch tape.

The tape speed used is 15 ips, which is the speed employed in standard sound tape recording systems. In order to record the high video frequencies required, a special head mechanism consisting of four separate heads is used. These are placed at an equal distance from one another on the perimeter of a narrow disc or wheel placed at right angles to the tape. As the disc rotates, the four heads pass, one after the other, across the two-inch width of the tape, as the tape itself moves past. The resultant magnetic tracks then extend from one edge of the tape to the other, rather like the arrangement of rungs in a ladder. The TV signals are fed to the tape through the head that is in contact with the tape at any given instant. As a head approaches the bottom edge, the signals are also fed onto the tape through the next head as it begins its sweep from top to bottom. A slight overlapping insures recording of all of the pictures. In playback the process is reversed. The disc carrying the heads rotates at 14,400 rpm, so that each head crosses the tape 240 times each second. During each crossing a single head records slightly more than 16 lines of a color TV picture. —30—

T. A. Smith (right), Executive Vice-President of RCA Industrial Electronic Products, and Dr. G. H. Brown, Chief Engineer of Industrial Electronics, examine the color tape recorder below.





"PIGGY BACK" ANTENNA

Clear Beam Antenna Corporation, 21341 Roscoe Blvd., Canoga Park, Calif., is now offering a new indoor antenna which eliminates the necessity of having an antenna on top of the TV set.

The new antenna, which has been tradenamed the "Piggy Back," attaches to the back of the TV set and is completely out of sight when not in use. The dipole elements, which are raised for reception, are constructed of four, highly plated, telescopic sections, mounted in a pivot-ball base for adjustment to any length or angle.

The Model #PB4 is housed in a reinforced polystyrene case and is available in either a mahogany or blonde finish. It comes complete with lead-in wire and mounting screws.

TV FRINGE ANTENNAS

Telco Electronics Mfg. Co., 400 S. Wyman St., Rockford, Ill., is marketing a new type TV antenna which has been especially designed to operate in v.h.f. fringe areas and u.h.f. primary areas.

All-aluminum construction is incorporated to permit ease of handling and installation. Tradenamed "Invader," the antenna utilizes the uni-plane design to facilitate sharp directivity. Available as single or stacked two-bay models, the antennas come completely preassembled and feature the new snap-lock construction.

The manufacturer will supply additional details and performance specifications on request.

AMPHENOL'S INDOOR ANTENNA

Amphenol Electronics Corporation, Chicago 50, Ill., has announced the availability of a new indoor TV antenna featuring "slender line" styling and marketed as the "Vi-Fi."

The trim modern shape of the new antenna was made possible by a new and compact electrical design. A "slide rule" tuner inductively matches the antenna to channel frequencies for fine picture adjustments. Transformer coupling matches the "Vi-Fi" to the impedance of the TV set. The antenna is said to eliminate TV ghosts and snow from the picture in many areas.

A compact, three-color countertop display carton is provided to help dealers merchandise the antenna. Mailers and ad mats are also being offered. The antenna is available in v.h.f. and v.h.f.-u.h.f. models. It can be mounted on top or behind the set. It is offered in cloud grey, sandalwood, and black marble finishes.

SEMI-REMOTE LOOP

Kaar Engineering Corporation, Middiefield Road, Palo Alto, Calif., has developed a unique loop extension kit for boat owners with a space problem and heavy metal-work interference.

The new kit permits the user to mount his DF receiver against the overhead and extend the loop through the cabin on a 14" support column. This puts the top of the loop a total of 32 inches from the bottom of the receiver cabinet.

Complete installation directions are furnished with the new 8230 kit, along with the necessary hardware and water-tight bushing for the exterior mounting.

ANTENNA-TOWER CATALOGUE

The 2-Way Mobile Radio Division of *Communication Products Company, Inc.,* Marlboro, N. J., has just issued a 40-page catalogue which lists an extensive line of mobile radio antennas, accessories, and towers.

Catalogue No. 457 includes photographs, specifications, and polar patterns on a complete line of antennas, antenna mounting clamps, styroflex cable connectors, whip insulators and feed cable assemblies, swivel base mounts, vehicular spring mounts, commercial antenna towers, etc.

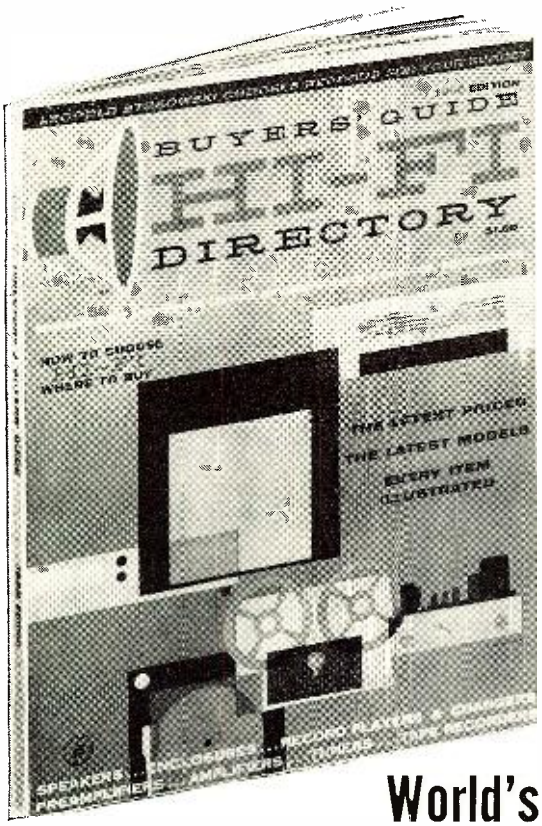
Operators of mobile communication equipment, law enforcement agencies, etc. are invited to write for a copy of this new catalogue.

NEW CDR ROTOR

The Radiart Corporation, 3455 Vega Ave., Cleveland 13, Ohio, is now offering two new rotor models which feature several unique construction features of interest to both service technicians and customers.

The Model TR-16 comes complete with thrust bearing and handsome modern-design plastic cabinet that features a meter control dial with fingertip lever. The Model TR-15 is the same as the TR-16, without the thrust bearing, but with all the other improved features. Both models are newly designed and engineered, and feature a quick-mounting antenna mast collet

JUST PUBLISHED!



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Ziff-Davis Publishing Company
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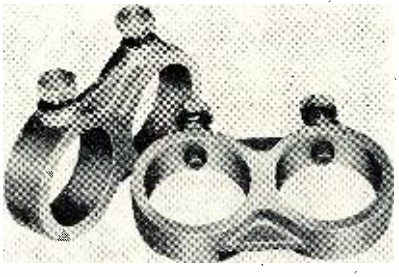
for speedy installations with no loose parts to assemble; take antenna masts up to 1½" o.d. with self-centering sawtooth clamps; provide instant locking; will not drift; and have mechanical brakes that are released magnetically. In addition, the rotor is instantly reversible and makes a complete revolution in 45 seconds.

The rotor comes in a choice of mahogany or blonde finish. Write the manufacturer direct for full details on these two new models.

HELIX MAST GRIPPERS

Helix Rotor Company, Marlin, Tex., is now marketing a new line of mast grippers for use in antenna installations.

These lightweight clamps are designed to be used in pairs. They instantly convert any 1¼" tubing into a slidable trombone mast. With them, one man can easily raise, lower, or turn an antenna, while having control of the mast and antenna at all times. Their use adds extra strength to the mid-section of tall installations permitting from 25 to 28 foot heights to be



attained using the grippers and three ten-foot sections of 1¼" tubing.

Shaped like a reinforced figure-8, the mast gripper is made of strong, weather-resistant, cast aluminum alloy 3½" x 2⅛" x ⅝" with rust-resistant set screws.

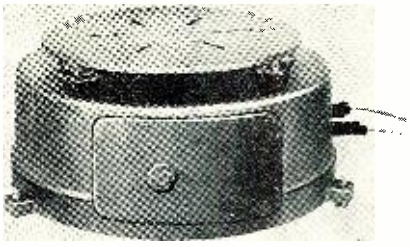
TWO-SET COUPLER

Snyder Mfg. Co. of Philadelphia has recently released a handy two-set coupler which can be attached quickly to a windowsill, inside a closet, or a TV set.

The new coupler (Model AC-700) is wafer-shaped and made of gray Bakelite. Lead-in terminals are clearly marked so there is no chance of connecting the unit incorrectly. The unit is only 3" in diameter and provides maximum gain for each receiver while minimizing interaction.

ANTENNA POSITIONING TABLES

Scientific-Atlanta, Inc., 2162 Piedmont Road, N.E., Atlanta, Ga., is now offering a series of rugged, weather-



proof, remotely controlled antenna positioning tables which have been especially designed for use in making antenna pattern measurements.

The Series 411 antenna positioners are designed to support loads up to 800 pounds with a maximum unbalance of 2000 foot-pounds. The positioner is driven in azimuth by a variable speed reversible motor. Synchro output signals are provided for driving remote indicators and antenna pattern recorders. Remote control and indicator units are also available. Other positioner models include azimuth over elevation rotation and elevation over azimuth.

For more information on these units, manufacturers are invited to write the company direct.

GOLD ANODIZED "COLORTENNAS"

JFD Electronic Corporation, 6101 Sixteenth Ave., Brooklyn 4, N. Y., has announced that a new line of gold anodized "Colortennas" is now in production. The line includes all of the eleven "Helix Colortennas" as well as the single and stacked "Fireball" models.

The new gold anodized arrays are said to be impervious to weathering and fading. The process employs a selected electrolyte to obtain a dense adherent coating of aluminum oxide. The hard transparent coating, as initially formed, has a minutely porous structure to accept the gold impregna-

INSURANCE FOR TECHNICIANS

THE Raytheon Manufacturing Company has just announced a rather novel good-will plan which provides group life insurance to all its registered bonded electronic technicians. Administered and underwritten by one of the country's largest life insurance firms this new program will be made available to Raytheon's bonded dealers through the company's receiving tube distributors who sponsor them under the company's bonded dealer program.

This group life insurance program is of special interest to the service dealer trade in that it is the first ever made available nationally for service dealers. The insurance is provided at no added cost to the technicians. All who qualify under the Raytheon "Bonded Dealer Program" and by preference use the firm's tubes are eligible to obtain this valuable protection. One of the many important features of the program is that coverage is provided without medical examination.

Complete and specific details regarding this insurance program are available from the local Raytheon "Sponsoring Bonded Distributors" who meet the necessary requirements for establishing a Group Life Insurance Plan in each area.

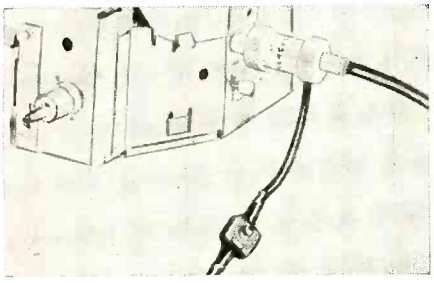
—30—

tion. When gold absorption has been attained, the coating is completely and permanently sealed rendering it impervious to staining, spotting, tarnishing, fading, and corrosion, according to the company.

A set of bulletins on this new line, providing complete engineering and installation data, is available from the company's distributors.

BOOSTER FOR CAR ANTENNA

Wren Products, Inc., 915 E. Jefferson (Suite 140), Detroit, Mich., has developed an antenna booster which is



claimed to double the normal range of reception of a car radio receiver.

The MV2 is housed in a machined and knurled aluminum case and comes with 64 inches of shielded antenna wire and rubber insulated capacitor. Installation is a five-minute job with a screwdriver the only tool required. The original antenna lead wire is pulled out, the MV2 is plugged in, and the antenna is plugged into the booster socket. Detailed instructions for trimming the radio and the booster capacitor are included on the package in which the unit is housed.

The carton containing six packages makes a colorful and eye-catching counter display. A bulletin is available for distributor and dealer counter catalogues. Write the manufacturer direct for full details and literature.

TWO-IN-ONE B.C. ANTENNA

The Broadcast and TV Equipment Department of *Radio Corporation of America,* Camden, N. J., is now offering a two-in-one broadband FM radio antenna designed for use in both standard and multiplex FM broadcast service.

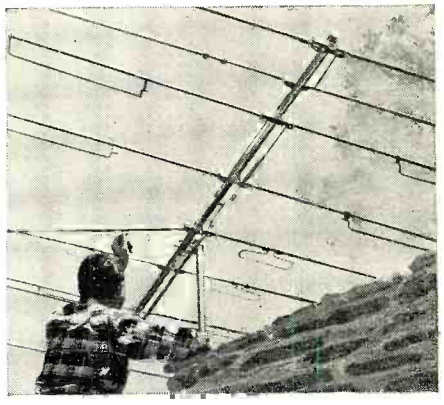
Engineered to provide low standing-wave ratio over the entire 200 kc. channel, the new antenna assures perfect match essential for eliminating cross-coupling between standard and multiplex channels.

The antenna features sectionalized construction and can be erected with as many sections as are required for a given application. Each section, measuring 12" high, consists of four spaced stainless steel collars 13½" in diameter which are mounted on 3⅛" coaxial line. When mounted, the individual sections are spaced approximately one wave length apart.

The two-in-one antenna operates over the frequency range of 88 to 108 mc., has an input impedance of 50 ohms nominal, features a power input rating of 3 kw. per section, and provides a power gain approximately equal to the number of sections stacked.

TACO "TOPLINER" PROMOTION

Technical Appliance Corporation of Sherburne, New York, has developed a complete promotion kit to stimulate



the sale of its new "Golden Topliner" antenna line.

Included in the kit are envelope stuffers, cloth banners, a decal for truck or window, golden balloons, counter easel, posters, catalogue sheets, and golden aluminum chips to demonstrate the antenna's finish.

Various "Treasure Chest" offers are being made. —30—

ASSOCIATION SLIDE FILM

The Association of Electronic Parts & Equipment Manufacturers, Inc. has a hit on its hands with its slide film, "What Beats Competition."

The film dramatizes the role played by each member of the distributor's organization to contribute to a sale and a satisfied customer.

Letters from distributors who have been using the film at sales meetings attest to the value of the film and many have suggested that a sequel or follow-up film be produced. Contact S. I. Neiman, 1 N. LaSalle St., Chicago, Ill.

* * *

NEW COUNTER DISPLAYS

Two dramatic single can displays have now been made available to all dealers for the "No-Noise Volume Control and Contact Restorer" and the "No-Noise Tuner-Tonic" products.

These attractive, two-color counter pieces are certain to prove valuable attention-getters and the manufacturer, *Electronic Chemical Corporation,* 813 Communipaw Ave., Jersey City, N. J., is hopeful that they will aid dealers to actually treble the present sales of both products.

* * *

BUSINESS BUILDER PROGRAM

A completely new and unique "Good-Will Business Builder Program" has been announced to independent service dealers by the officials at *Raytheon Manufacturing Company's* tube distributor division. The program has been designed to assist the independent service dealer in the stimulation of service business.

This specially created package is provided with a collection of personal and useful promotion items available at low cost and supplied with each service dealer's personal imprint. Along with the knowledge and skill offered by dealers to their customers, distribution of these items after making service calls creates a good impression and aids in assuring repeat calls.

Complete information regarding the program may be obtained by writing to the company, Good-Will Builders Supply Station, Post Office Box 30, Milford, Connecticut.

* * *

DISTINCTIVE TAPE BOX

The announcement of a brand new box for the "Irish" acetate-base long-play tape has been made by the manufacturer, *ORRadio Industries, Inc.,* Opelika, Ala. According to the firm, this is a new concept in recording tape box design in that it associates the product with its primary use—the recording and reproduction of fine music.

The design utilizes sheet music as a background for reels of recording tape. The box is an attractive grey with the firm's brand name blazoned across the face in green. There are 24 square inches of indexing space on the back of the box which also carries a convenient playing time chart.

The distinguishing RETMA seal (now EIA) also appears on the back of the box as does the company's "guaranteed" warranty. This warranty reads: "Irish tape is 100% guaranteed against defects in manufacture, labeling, and packaging. This guarantee warrants replacement of merchandise which does not meet specifications of the manufacturer."

* * *

TAPE INDUSTRY PROMOTION

Dealers who stock recording tape are being given a new opportunity to expand sales with a big "Tape It Off The Air" promotion which is sponsored by the recording tape industry.

ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. has found that the biggest consumers of tape are music lovers and hobbyists who record on tape such things as operas, FM broad-

casts, and TV spectaculars. This promotion is aimed particularly at this group.

In order that dealers may take advantage of this widening interest in new uses of tape, special kits are now available. They include a two-color easel display card with pocket containing detailed instructions on recording programs off the air, a two-color window streamer identifying the store as "Tape It Off The Air" headquarters, and promotional literature showing how the dealer can increase his own tape and tape recorder business by cooperating in this promotion.

Dealers may obtain these kits by writing to the above-mentioned firm or by contacting any of the sponsoring manufacturers.

* * *

NEW SOLDERING AIDS

CBS-Hytron Inc., Danvers, Mass., has introduced two miniaturized soldering aids for printed circuits.

The new tools—one with straight tip, the other with angled tip—are especially designed for servicing the compact and delicate printed boards of modern miniaturized equipment.

Both tools offer features of the company's original standard soldering aids. The fork end, like two tiny metal fingers, easily disconnects soldered joints. The spade end reams solder from lug

holes. Many other uses include probing, scraping and cleaning, positioning wires, lugs, contacts, and parts. The tips are of tool steel tempered to withstand heat and hard-chrome plated to shed solder.

These aids are now available from the firm's tube distributors.

* * *

NEEDLE THAT REMEMBERS

Duotone Co., Inc., Keyport, N. J. has come up with a completely different method of needle merchandising.

This new type of merchandising aide actually reminds the person using it when it is time to check or change his needle. When the retailer sells the firm's "Needle That Remembers," the customer receives, inside the box, a card which he fills out and returns to the company's home office. Six months or a year later the customer receives in the mail a reminder card advising him to bring his needle in to his dealer and have it checked for wear condition. On the card is the actual number of the customer's needle so that the dealer need only check the number when the customer brings in the card.

A complete merchandising kit is available to dealers. —30—

Mac's Service Shop

(*Continued from page 74*)

"But now they have the production problems whipped, some of the manufacturers are turning their attention to methods of making these printed circuits easier to service. Plainly marking key test points on the board is one helpful step ahead. Knowing just where you can pick off an a.g.c. voltage or a sync signal makes for faster servicing. Another innovation has been the printed circuit tube sockets recently introduced by one manufacturer. From the top side of the printed board each of the pin connections on the socket can be reached through a guide opening. Now there's something you can't do with the sockets in a conventional wired circuit!"

"I notice, too, that some of the manufacturers are starting to use thicker circuit boards," Barney remarked; "and they are mounting the heavier parts at points where the weight will not flex the board."

"That's right. I'll admit that some of the printed circuit equipment on the market is junk to begin with and terrible to service; but I'm not ready to say printed circuits are a failure from the service point of view yet. I've got a hunch manufacturers realize the service technician can be their best salesman and that they're going to make these printed circuits far easier to service. After all, wire has been around for a long time, but the printed circuit is just a baby. Let's give it time to grow a bit before we judge it."

"Say, Mac, not to change the subject, but I had an interesting chat with one of our competitors at the bowling alley last night. It was 'C. W.' who does the shop service over at *Acme*. He was telling me about a real queer job they had just got out. It seems the complaint on this TV set was something wrong with the horizontal circuit. After the set was on for a few minutes, the horizontal sweep would conk out altogether; but if you let the receiver cool down, the sweep would come back for a short time.

"Before they pulled the chassis, C. W. noticed something mighty funny: every time he got near the cabinet he could feel the hair on his arms lifting up the way it does when you get close to high voltage. This happened even when he was close to the side of the cabinet. He called in the boss, who experienced the same thing. They even placed pieces of paper on the side of the cabinet, and they would stick right there until the receiver was turned off.

"The picture tube was supposed to have around 12,000 volts on it, but when the high voltage was measured with a probe it was found to be 25,000 volts. They checked and double-checked to make sure they were not seeing things. After all the other components seemed to be all right, they replaced the horizontal output transformer, and everything reverted to normal. What do you suppose happened to that transformer to hop up the voltage like that?"

"It's hard to be sure, but I'd guess an insulation breakdown had shorted out a portion of the primary winding and changed the turns ratio drastically. I know if we had the job I'd return the transformer to the manufacturer for his examination and request that he let me know what he found. That would satisfy my curiosity, and it might help the manufacturer. In the past I've done that with other components that failed in some puzzling manner, and I have always received an appreciative letter from the manufacturer. In fact, in a couple of cases, although I did not expect it, I've received new components. But I think we've killed about enough time for one day. Let's go to work!" —30—

DROP RADIO GUARD ON 2670

EFFECTIVE January 1, 1958, the First Coast Guard District Stations will discontinue its present guard on 2670 kc. During the years prior to 1947, the Coast Guard made available to the boating public the U.S. Coast Guard calling frequency of 2670 kc. for use in the event of disaster, potential distress, or reporting aids-to-navigation outages.

This was done since no national or international radio frequency existed for these purposes. In conformance with the agreement at the Atlantic City Convention of the International Telecommunications Union in 1947, the international radiotelephone calling and distress frequency, 2182 kc. has been slowly implemented by the boating public in accordance with the rules and regulations of the FCC. As a result, all newly licensed and replacement shipboard transmitters authorized by renewal of license after January 1, 1955 must be capable of transmitting on 2182 kc.

It is now deemed that the shift to 2182 kc. by the boating public has advanced to the point where the radiotelephone guard on 2670 kc. by First Coast Guard District ship and shore stations is no longer necessary after January 1, 1958.

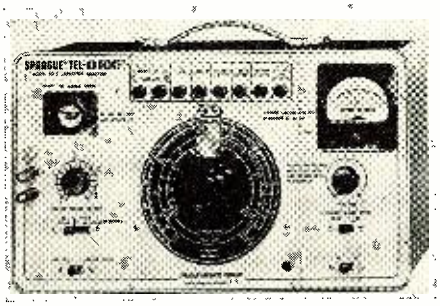
In lieu, thereof, Coast Guard Radio Stations Boston (NMF) and Argentina (NJN), practically all lifeboat stations, and vessels of 125 feet and over while underway or at anchor, will maintain continuous watch on 2182 kc. for receipt of calls from the boating public. —30—

Walter Toscanini, son of the late Maestro, received the Audio Devices' "Golden Reel" award in recognition of his outstanding work toward preserving and helping prepare for release recordings of the NBC Symphony conducted by his father. To preserve the recordings and edit them into final form, Mr. Toscanini and his staff are transferring the recordings onto magnetic tape.

What's New in Radio

(*Continued from page 141*)

rent ratings of electrolytics at rated d.c. working voltage, and a three-range power factor measurement of electrolytics. In the interest of safety, all capacitors are automatically discharged upon release of the range selector push-buttons.

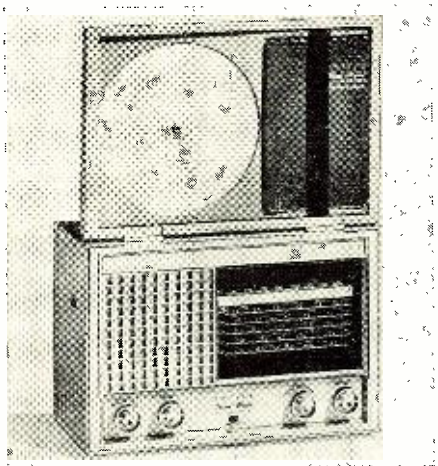


The unit which weighs 12½ pounds is housed in a sturdy two-color gray cabinet measuring 8⅞"x14⅝"x6⅛".

The manufacturer will supply additional details and information on price and distribution on request.

7-BAND TRANSISTOR RADIO

Philco Corporation of Philadelphia has recently introduced an all-transistor, short-wave receiver which operates entirely on ordinary flashlight batteries. The unit covers the six most frequently used short-wave bands as well as the standard broadcast band. The T-9 "Trans-World" portable weighs less than 20 pounds and uses a total of



nine transistors, five of which are of the surface-barrier type.

The design features an exclusive oscillator circuit, stabilized for both current and voltage. Four of the flashlight batteries power the r.f., i.f., and audio circuits while two power the oscillator circuit. The volume output is 250 milliwatts. The total range of the loudspeaker and audio amplifiers extends from 100 to 8000 cps.

The set covers two general coverage short-wave bands (2-4 and 4-8 mc.) and four high-frequency short-wave spread bands; 31, 25, 19, and 16 meters.

—30—

Technical Books

"COMMERCIAL RADIO OPERATOR'S LICENSE GUIDE—ELEMENTS 1 & 2" by Martin Schwartz. Published by *American Electronics Co.*, 1203 Bryant Ave., New York 59. 48 pages. Price 75 cents.

This is the first of an announced new series of study guides covering the elements of the FCC commercial radio operator's license examination. The first volume covers elements 1 and 2 and gives complete answers for each of the FCC's study questions as well as FCC practice examinations using the FCC-type multiple choice questions.

The advantage of this type of presentation is that the prospective operator need buy only the texts covering the elements in which he expects to take his license exams.

* * *

"STEREOPHONIC SOUND" by Norman H. Crowhurst. Published by *John F. Rider Publisher, Inc.*, New York. 115 pages. Price $2.25. Paper bound.

Readers of this magazine have long been aware of the author's early and continuing interest in stereophonic sound and have enjoyed his interesting and enlightening articles covering new developments in this field.

The book, said to be the first in English devoted exclusively to stereophonic sound, covers the existing field fairly extensively and even "projects" the art into probable future uses. The style is informal yet informative. Any interested audiophile will find much material of use in guiding his choice of stereo equipment and/or in making the original decision to convert to stereo sound in his own home.

The lavish use of diagrams supplemented by numerous photographs of available commercial units comprising stereo setups add to the over-all picture which should be valuable to those who like their "fidelity" high and realistic.

* * *

"CLOSED CIRCUIT TV SYSTEM PLANNING" by M. A. Mayers & R. D. Chipp. Published by *John F. Rider Publisher, Inc.*, New York, 242 pages. Price $10.00.

The staggering impact of closed-circuit television on the economy—ranging in scope from the introduction and promotion of new products to the training of future doctors and the protection of plants engaged in classified work—has generated a need for some definitive work covering the things that closed-TV can and cannot do and how it can be applied for specific tasks.

This is not a handbook for the technicians who will install and service such systems but rather a source book for management, school boards, hospital administrators, the executives of retail establishments, offices, banks, etc. to help them decide just how closed-circuit television could increase efficiency, speed work, reduce losses and rejects, etc.

The text is divided into three sections covering possible applications of such systems, a non-technical explanation of how closed-circuit TV works, and the equipment required. Actual installations and commercially available units are shown in a series of excellent photographs. Appendices covering closed-circuit producers, syndicators, and service organizations; manufacturers of equipment; and cost data complete the treatment of the subject.

* * *

"RCA VICTOR 1957-58 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Ill. 95 pages. Price $1.50. Paper bound.

Technicians whose work involves the installation and servicing of a great number of *RCA Victor* television receivers will find this compact compilation of service data on the firm's 1957-58 line helpful and handy.

As is this publisher's custom, each unit is pictured, controls are located, special test and adjustment points are identified, and rear and front chassis views are given in addition to the usual schematic and troubleshooting hints on the particular chassis model under discussion.

* * *

"PROFITABLE TELEVISION TROUBLESHOOTING" by Eugene A. Anthony. Published by *McGraw-Hill Book Company, Inc.*, New York. 466 pages. Price $6.95.

Radio service technicians and students wishing to make the transition to television receiver work will find the "learn-and-use" method adopted by the author a real time and money-saver in obtaining their objectives.

Written by a consultant to *General Electric's* Product Service Department, the author having started more than 17 years ago as a technician himself knows whereof he speaks. The contents are presented progressively so that by the time the student reaches the third chapter he has already acquired "saleable" information on TV servicing. The introductory chapter on the opportunities in television is quite heartening to the individual technician who questions the advisability of competing with the larger service organizations. He points out the many facets of the service industry where sheer size is no guarantee of success and the areas in which the individual or operator of a small shop

cannot only compete successfully but excel.

The technical scope of the book is inclusive and carries the technician all the way through television receiver circuitry up to and including the latest color sets. We believe this book will receive the enthusiastic support of the service industry it deserves.

* * *

"BASIC ELECTRICITY" by Rufus P. Turner. Published by *Rinehart & Co., Inc.*, New York. 377 pages. Price $6.50.

Students, whether attending schools or pursuing a do-it-yourself program of learning, will find this book helpful in providing a springboard for the later transition to electronic theory and circuitry.

Although the author has not ducked mathematical treatment where required, the text on the whole avoids rigorous mathematic derivations. Of necessity, the material covered is familiar but the author has approached these basics from a little different angle from other writers with the result that some students may find the subject easier to grasp in this form. Near the end of the book, the author begins a transition to electronics with a brief introductory chapter covering vacuum tubes and the elements of radio reception and transmission.

Over 300 photographs are used to illustrate and amplify the text material.

* * *

"ELEMENTS OF MAGNETIC TAPE RECORDING" by N. M. Haynes. Published by *Prentice-Hall, Inc.*, New York. 380 pages. Price $7.95.

This is a specialized volume on one of the fastest-growing segments of the audio field. Written by a man who has been intimately associated with the magnetic recording industry for over 20 years, the text is both complete and authoritative.

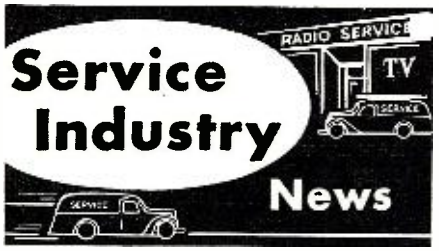
The book is divided into four general sections covering background and introductory material, the principles of magnetic recording, the apparatus for handling tape, and circuits used in or with tape recorders.

This book is not for the non-technical owner of a tape machine who uses his unit to record Junior's first words for posterity but for the serious audiophile, the would-be recording engineer, or those whose careers are intimately associated with the capturing of sound in permanent form, this volume is invaluable. The lavish use of photographs, line drawings, and graphs contributes to the "source book" aspect of this excellent volume. —30—

KOREA CONTACTS OKED

THE FCC has received notice from the International Telecommunication Union that Korea no longer prohibits amateur radio communications.

This modifies the December 17, 1956 public notice of the Commission which recapitulated the international radio regulations concerning communication between amateur stations and transmission of third party traffic by amateurs. —30—



THE LATEST annual Elmo Roper survey of the attitude of set owners toward independent service technicians revealed an excellent record of performance on the part of independent service shops, according to E. C. Cahill, president of the *RCA Service Co., Inc.*

The Roper survey, sponsored by the *RCA Service Company,* indicated that 91 per-cent of the TV set owners are pleased with the work performed by independent technicians. Eighty-nine per-cent said their service calls were answered immediately; 84 per-cent were satisfied with the prices they paid for service; and 91 per-cent said the technicians were pleasant and courteous.

A study of the Roper surveys since they were started about five years ago reveals a steady improvement in the public's attitude toward the independent service industry. The earlier surveys revealed that set owners are primarily interested in fast service. When they can get rapid service, they are willing to pay reasonable charges. When calls were made promptly after the customer requested service, there was a high degree of satisfaction with the price the set owners had to pay.

The work of associations in stressing the importance of handling service calls promptly and in the improvement of customer relations is reflected in the higher percentages shown in these categories of the survey.

The Television Service Association of Michigan is extending an invitation to all service associations to send representatives to its Midwest Electronic Forum which will be held in Detroit, Michigan, on February 8, 9, 10, and 11, 1958. TSA Directors recently approved a substantial budget to advertise this forthcoming event, which they claim will be "the largest, the best, and the most unusual service gathering ever held any place at any time."

The Forum will feature a balanced program of technical and business lectures and demonstrations. The technical lectures will be unusual because of the number of dynamic displays that will be used in the presentations. The business lectures will deal specifically with subjects involved in the management of electronic service businesses and will include some unusual presentations of business promotions that are paying off. Service dealers who are interested in attending the TSA Midwest Electronic Forum should write to TSA-Forum, 8225 Woodward Ave., Detroit 2, Mich., for information.

A recent issue of the Long Island "Guild News" called attention to the fact that a number of radio and television service technicians were looking for jobs. Immediately after the issue was distributed, dealers in the area employed all of the men known to be available. This experience inspired the Guild officers to contact local newspapers to let them know about the need in that section for competent service technicians. Two of the papers incorporated this information in news stories dealing with layoffs at local defense plants.

The re-adjustments in the defense program may make a substantial number of competent technicians available. Since current economic conditions make it very difficult for a technician to start a service business without substantial cash reserves, there may be a steady increase in the number of competent men available to dealers.

The threat of Pay-TV to the businesses of TV set dealers and service shops is of deep concern to most dealer and service associations. The forebodings of independent service dealers were epitomized in an editorial in a recent issue of the "Guild News," published by the Radio & Television Technicians Guild of Florida, Inc. The editorial, titled "Pay TV Is a Strangler," said:

"*Skiatron* has arrangements nearly completed to start operations in the State of California. If you have been keeping up with newspaper reports, you will remember reading recently where the Giants Baseball Club was paid one million dollars and will receive another million dollars in December for an exclusive contract with *Skiatron* to broadcast its games *via* Pay-TV closed circuits. Two million bucks for just one franchise. Peanuts to this large and powerful outfit. They are prepared to spend 20 to 40 million dollars for franchises, equipment, and facilities in order to cash in on the free air waves of these United States. First run movies, prize fights, and special events will be their meat—and *you,* the TV technician, what will all this monopolistic closed-circuit TV do to your business?

"This will be far worse than captive service. This is Captive Viewers!

"The first thing you know they will require that only their Techs can service the sets connected to their gadgets. Then they will be selling service maintenance contracts and they will be renting out the sets, maintaining them, and finally supplying the closed-circuit service. All this in one package deal and then where will you be, Mr. Service Technician?

"If you value your business and your livelihood, now is the time for you to let yourself be heard. Take the time right now and write a letter to your Congressman or the FCC and let them know how you feel about Pay-TV. The RTT Guild has already forwarded a letter to the FCC voicing its objections, and since we represent only a portion of you fellows, we need your added weight in numbers, to stop this Pay-TV before it becomes the strangler of your business."

The Maryland Electronic & Television Association, Inc., is the name of a new trade group set up in Baltimore to combat malpractices in the TV repair business in that area. Working in cooperation with the local Better Business Bureau, the association is said to be planning an extensive cooperative advertising campaign to educate the consumer about the industry and, particularly, to counter misleading advertising.

It is claimed that the program will be aimed at a number of unethical practices said to be current in that area. Some of these include the use of a free estimate as a "come on"; statements to the consumers that can be interpreted as meaning that no set has to be removed from the home to be repaired; and for violations of the state, city, and county electrical codes.

Harry Johnson of *Johnson Electronics Co.,* Baltimore, was elected president of the new Maryland Association. Officers named to serve with him include William Rothmann of *Rothmann's Television Service,* vice-president; Edward Kernan of *Stange Radio & Television Sales & Service,* secretary; and Paul Warrenfelz of *Paul's Radio & Television Service,* treasurer.

The five directors named were Clarence Rudolph of *Parkville Television Service,* and David Werba of *D. H. W. Television Service,* both for two-year terms; Charles Schlesser of the *Television Co. of Essex,* Casimir Pelczynski of *Kenwood Television Service,* and Thomas Paige of *Fidelity Appliance Co.,* were all named for three-year terms.

Richard J. Kelso, partner-owner of *Modern Radio & TV Sales & Service* of San Jose, Cal., was recently elected president of the Radio Television Association of Santa Clara Valley at a special meeting of the Board of Directors of the association. Kelso succeeded Quentin W. Muchow, partner-owner of the *House of Video* of San Jose.

Named by the Board of Directors to serve with Mr. Kelso for the 1957-58 term were W. I. "Bud" Smith, partner-owner of *Harvey-Johnson* TV of Palo Alto as vice-president, and Harold L. Kelley Jr., owner of *Bay Cities TV Service Co.,* of Mountain View, secretary-treasurer.

An interesting counter-measure against captive service, launched in the Detroit area of Michigan, will bear watching; it keeps service in the hands of local independents, yet gives set manufacturers the goals they seek through captive service. Local service dealers have banded together to form a financially responsible corporation, *Telectro Service Associates.* (Although members of the local Television Service Association carried out the concept, TSA could not itself be used because it is a non-profit association.) *Philco* and *Sylvania* have already signed contracts for factory-sanctioned service with the responsible corporation. Service will thus continue to be performed by local independent dealers who are participating in the *Telectro* plan. —30—

Alignment of Midget Radios

(*Continued from page 39*)

ceive a broadcast station on 910 kc., you should get a beat signal with it when the generator is set to 455 kc. and is coupled to the receiver. Broadcast stations must keep their carriers within a few cycles per second of assigned frequency; thus, if the generator is set so that its second harmonic is "zero beat" with a 910-kc. broadcast signal, it must have its fundamental right on 455 kc. If there isn't a 910-kc. station receivable, use another signal near that frequency, and note what correction of the signal generator dial is necessary. (Of course, if the receiver's intermediate frequency is not 455 kc. you set the generator accordingly, but the idea is the same.)

Use a modulated signal, and, as we said before, keep the signal input down to a barely audible level. Then you can tell by ear when all i.f. adjustments are tuned for maximum. Of course, if you want to be fancy, you can connect a v.t.v.m. to the a.v.c. bus and tune for maximum a.v.c. voltage, but the ear is usually plenty good enough with this type of receiver.

Oscillator Tracking

Although the oscillator must provide at least a minimum injection voltage, its main function is to determine, by its own frequency, what frequency is to be accepted and processed by the receiver. It must usually provide a signal whose frequency is equal to the received-signal frequency plus the intermediate frequency. If the tuning dial says "1000 kc." (or "100," as usually calibrated), the oscillator signal should be 1455 kc. Also, this relation should be maintained over the entire tuning range—which is what is meant by "tracking." Well-designed receivers track well when the oscillator frequency is correlated with dial reading in two places (600 kc. and 1400 kc. for most sets). If you try to extend the tuning range, or if you try to shift dial readings, you usually wind up by sacrificing the best tracking possible; also, you end up with much more sensitivity over one part of the tuning range than over the rest of this range. In a well-designed, well-aligned receiver, sensitivity is reasonably uniform across the entire band. (Before attempting a check of tracking, make sure that the dial pointer has not slipped out of its intended position. If it has, the false readings that result will complicate attempts to adjust for proper tracking.)

Of the two frequencies used to adjust for proper tracking—600 kc. and 1400 kc.—the second one mentioned is the first for which adjustment is made. Set the receiver dial at 1400 kc. first. Then set the signal generator to the same frequency. Rock the receiver dial a little each way to see whether the signal comes in at 1400 on the dial. If it doesn't, adjust the oscillator trimmer (on the oscillator section of the tuning capacitor, as shown in the photo at the beginning of the article), until it does.

Now change the dial of the receiver and the signal generator frequency to 600 kc. The 600-kc. signal should come in at 600 (60) on the dial. If it doesn't, what you do next depends upon the type of receiver. If it is more elaborate than most midget receivers, it has either a series padder capacitor or slug-tuning of the oscillator coil, in which case you adjust this until the 600-kc. signal comes in at the right place on the dial. However, in most table-model receivers, there is no padder capacitor or slug to adjust. Then you look for a "split plate" on the oscillator section of the tuning capacitor. The section of the outside plate which meshes only when the capacitor is almost closed (low-frequency portion of range) is the one you adjust, by bending it closer to or farther away from the remaining plates. If the 600-kc. signal falls too high on the dial, bend the plate farther away.

R.F. (Mixer) Alignment

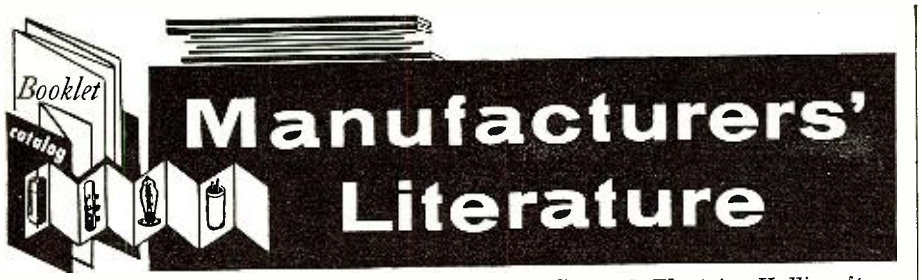
When the oscillator has been set to the proper frequencies at the "60" and "140" dial readings, check to make sure that other dial readings, for stations you know, are reasonably correct. For midget receivers, don't expect precision dial readings! Now you're ready for r.f. alignment.

Most of the small radios that we're talking about don't have r.f. amplifier stages. However, for those that do, the tuned circuit for this stage is adjusted in the same way as is the mixer circuit. The mixer circuit is simply peaked up on the received-signal frequency at the same two frequencies used for oscillator tracking.

This operation is quite simple. You already know that the oscillator tracking is OK; so, when you set the signal generator to 1400 kc. and the receiver dial to the same frequency, you hear the signal coming through. Once again, it's important to adjust signal-generator output for minimum audible signal to avoid confusion from a.v.c. action. Then just align the mixer trimmer to maximum signal position.

Remember, in midget receivers the mixer (antenna) coil is the *loop antenna* itself. If the loop has become damaged or some turns have been removed, you won't get a peak within the range of the trimmer; or if you do, you can't get good tracking. Sensitivity goes to pot for one portion of the tuning range but gets very good for another. Your loop just *must* have the right inductance or alignment can never be right!

And that brings up something else. If you're replacing a loop antenna, remember that it has inductance, and that this value is important in the input circuit. Stock replacements may be supplied with extra turns, but deciding how many to remove for a good match is a knotty problem, so try to stick to an exact replacement. —30—



WRL'S 1958 CATALOGUE

World Radio Laboratories, 34th & Broadway, Council Bluffs, Iowa, has just issued a comprehensive 200-page catalogue listing hundreds of items of interest to radio amateurs, professional service technicians, hobbyists, experimenters, and audiophiles.

In addition to listing and describing the firm's own line of amateur gear, the new publication carries specs and photographs of audio components, test gear, parts, antennas, technical books, tools, tubes, batteries, transistors, kits, and commercial mobile and SSB equipment.

Copies of Catalogue 18 will be forwarded without charge upon written request to the company.

COMPOSITION RESISTORS

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa., has issued a 12-page technical data bulletin on its redesigned, re-engineered, and re-evaluated fixed composition resistors.

Information on the Type BT units includes data on construction, characteristics, solderability, terminations, heat dissipation, color coding, tolerances, power and voltage ratings, temperature rise, matched and balanced pairs, etc. Detailed charts and graphs are also included.

Write the manufacturer direct for copies of Bulletin B-1C.

RESISTOR DATA

General Resistance, Inc., 577 E. 156th St., New York 55, N. Y., has recently issued an 8-page catalogue which covers its complete line of custom-made precision wirewound, encapsulated resistors and rugged, hermetically sealed resistor networks.

Incorporated in this compact catalogue are easy-to-read charts and graphs, illustrations, drawings, and specifications. The wirewounds available in the line include axial, lug, printed circuit, and radial lead versions of microminiature, miniature, and standard size models.

For further information on the line and a copy of the catalogue, write the manufacturer direct.

TV REPLACEMENT GUIDE

Thordarson-Meissner, Seventh and Bellment, Mt. Carmel, Ill., has issued a new TV Replacement Guide Supplement, #9-57.

The supplement features all of the new flybacks and yokes which the company introduced in 1957 and covers the following TV receiver manufacturers: *Admiral, Airline, Crosley, DuMont, Emerson, General Electric, Hallicrafters, Magnavox, Motorola, Muntz, Philco, Raytheon, RCA, Sentinel, Silvertone, Sylvania, Westinghouse,* and *Zenith.*

Copies of this replacement supplement will be supplied without charge on written request.

"RADIO-ELECTRONIC MASTER" OUT

United Catalog Publishers, Inc., 60 Madison Ave., Hempstead, N. Y., has announced publication of the 22nd edition of "The Radio-Electronic Master," containing 1584 pages.

The industry-wide reference volume lists over 150,000 items made by some 350 manufacturers. Detailed descriptions, specifications, and prices are given on standard stock items, more than 11,500 of which are illustrated.

The 1958 edition includes tubes, test equipment, capacitors, resistors, relays, coils, antennas and accessories, transformers, recording and p.a. systems, hi-fi equipment, hardware, tools, transmitters, communications receivers, wire and cable, speakers, microphones, rectifiers, converters, amateur gear, switches, volume controls, etc.

As usual, the new edition will be obtainable from electronic parts distributors. Write the publisher for a listing of the firms handling this book.

TUNG-SOL SEMICONDUCTORS

Tung-Sol Electric Inc.'s Semiconductor Division at 95 Eighth Ave., Newark 4, N. J., has issued a 4-page technical data sheet covering its germanium transistors.

The publication, which is printed on heavy paper stock so that it can be posted on a wall, if desired, carries maximum power rating curves, a listing of standard transistor symbols, and a conversion chart for forward current transfer ratio, switching characteristics at specified bias, and provides data on d.c. measurements.

RADIO SHACK FLYER

Radio Shack Corp., 167 Washington St., Boston 8, Mass. and 230 Crown St., New Haven 10, Conn. has issued a 24-page flyer which lists a wide variety of radio, electronic, and gift items at special prices.

Included are transistor radios, a comprehensive assortment of audio components (speakers, turntables, arms, cartridges, etc.), complete record players and changers, amplifiers, transistor kits, records, tools, ham gear, test equipment, and a.c.-d.c. radios.

Copies of this money-saving flyer are available without charge. Make your request direct to either office of the company. —30—

Taming Tough Dogs

(*Continued from page 45*)

R_{48} and R_{33} were charred and had changed value. I replaced them and checked resistance to ground. It was low, so I checked C_{47} and found it was shorted. After replacing it I turned the set on, and, although the resistors were no longer running hot, there was very little sound. I changed the 3BN6, varied the AM rejection control, and checked voltages on the different pins of the stage, but everything was normal. L_{17} was in the line of the original short so I checked its resistance and found it also was normal. I tapped the plate of the 3BN6 with my screwdriver and got sound through the speaker, so I figured the output circuit was OK. Next I tried aligning the coils in this circuit and got more volume, but it wasn't enough and sound was garbled. I then went back into the audio i.f. stage, but could find nothing unusual there. As a last resort, I installed a replacement for L_{10}, figuring some of the turns might have shorted and changed its resonant frequency. It was a good theory but it didn't cure the trouble. I was now at my wits' end and ready to toss in the dropcloth; however, my theory sounded so good, I decided to apply it to L_{17}. It had measured OK resistance-wise, but again a change in resonant frequency could cause the trouble. I ordered a replacement, installed it, and breathed a sigh of relief: the sound came in loud and clear. A little touch-up on the alignment had it playing as good as when it was new. If I hadn't tried jumping in new parts, as you suggest, I'd never have found it."

Ed picked up his pipe, lit it, and nodded knowingly. "A few more tips: when you're stuck on a set, check your production changes. A lot of fellows throw them out when they come in the mail. Don't do it. The fellows that recommend them know what they're doing; they start running into the same trouble repeating on the same model, so naturally they recommend a change. A lot of your dogs are repaired for you right in these publications.

"Another thing: don't be afraid to call your local set distributor when you're up against the wall. Pick up the phone and ask for technical information. You'll get the service manager. Tell him you have a problem with one of the sets his company handles and describe the symptoms. Have all your data handy so as not to tie him up too long. Quite often he's run into the condition and can give you the answer right off. Most of these fellows are quite willing to listen to you and will make an effort to help you if they can.

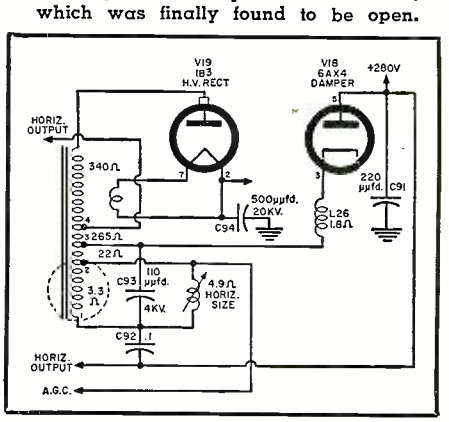
"About the only other thing I can think of," Ed went on, "is to build your own tough dog file." He walked to the schematic cabinet and patted it affectionately, "Here's a complete set of prints on just about every set made." He pulled several out at random. "You'll find all sorts of marks and notes on most of them. I wouldn't sell these prints for anything because they couldn't be replaced. Every tough job (and a great many of the simple ones) we've ever run into, in this shop, is listed right on the schematics. Here, take a look at how we do it," he beckoned to Jerry. "After the trouble is found, I circle the defective part with a red pencil. Then, at the bottom of the page, I make a brief footnote describing the symptoms. That way I'll never spend too much time on the same thing more than once. Look at this one here." He pointed at the red circle on the *Stromberg-Carlson* print he had opened (Fig. 5). "What a time this one gave me.

"It started out with no high voltage. A new fuse gave me a raster, but it had a thick drive bar down the middle. I tried the horizontal output and the damper tubes, as well as the drive control, with no result. Likewise the horizontal output and saw-tooth forming circuits. I jumped to the damper circuit next, and checked voltages: no luck. Then I checked C_{91}, L_{26}, C_{93}, C_{92}, and the horizontal-size control. Everything measured OK and produced the same abnormal raster when I replaced them.

"While I had the size control open, I decided to check the winding of the high-voltage transformer that it bridges. As you can see by the red circle, it was a most fortunate decision; the winding was open. In view of the fact that I had plenty of high voltage, it would have been a long time 'til I decided to check that transformer. However, the main point is that it happened to this set and it can happen again to others like it. If it does, this print will spill the beans to me as soon as I open it."

"That's a darn good idea," Jerry agreed, "and since your schematics are not for sale, I'm going to get me a big red pencil and start a file of my own." He rose and walked over to get the set he had come for: "I'm going to try your system; it sounds real good. I may not be able to get the act on television, but maybe I can become a dog tamer too." —30—

Fig. 5. The presence of high voltage diverted suspicion from the indicated winding of the flyback transformer, which was finally found to be open.



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Nobody Gives More
Service, Quality, Low, Low Prices

45 Piece "Powerhouse" HOME WORKSHOP

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Reg. $69.95

$33.71

YOU GET ALL THIS

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- 4" Tilting Steel Table Saw Attachment
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You save over 50% on this complete home workshop. ALL BRAND NEW—Shipped in factory sealed cartons—backed by Olson's guarantee. Operates on 110-120 Volts, 60 cy. AC.

Shield Brand Plastic RECORDING TAPE

Chosen by actress Jayne Mansfield and Chief Radio Operator of Moore-McCormack Steamship Lines. Holds up perfectly under all kinds of adverse conditions. Mirror polished red-oxide bonded to smooth strong plastic. Response 50-15,000 cps. Low distortion, uniform output. Standard 1/4" width. 7" dia. reels—individually boxed.

1200 Ft. Reel	1800 Ft. Reel	Fully Guaranteed NEW MYLAR 2400 Ft. Reel
Stock No. X-249 **$1.59** Doz. ea.	Stock No. X-583 **$2.45** Doz. ea.	Stock No. X-692 **$3.69** Doz. ea.
Lots of 6 ea. $1.79	Lots of 6 ea. $2.59	Lots of 6 ea. $3.79
Single ea. $2.19	Single ea. $2.99	Single ea. $3.99

TELEGRAPH KEY

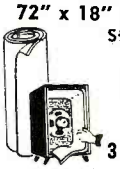
Stock No. X-679

$1.26 Ea.

Ideal for beginner or ham. All parts plated with base of molded phenolic. Full knob size, adjustable arm and tension spring. Coin silver contacts.

ACOUSTIC FOAM

72" x 18" x 1/2" ROLL
Stock No. CA-62



$3.02 PER ROLL
3 Rolls for $8.50

Sound absorbing sponge rubber padding for lining Hi-Fi speaker enclosures. Easily cut to any size cabinet.

New VM 4 Speed Automatic RECORD CHANGER

- Two Precious tipped Styli
- Ronette Cartridge
- 9" Weighted Turntable
- Heavy Duty Motor
- Manual Play Position
- No Preamp Required

Plays all three sizes of records. Shuts off after last record has played. Has storage position on speed selector to save idler wheel when not in use. Has needle guard built onto turntable chassis. Finished in rich brown and cream. Only four wires to connect. Operates on 110 volts 60 cy. AC. Size: 11 3/4" x 13 1/8". Height above turntable 4 5/8". Below 3 1/4".

Stock No. RP-105 **$25.87 Ea.**

Accessories for Above
Mounting Base—Stock No. CA-65.....$4.07
45 RPM Spindle—Stock No. RP-106.....$2.79

DRILL SAW Converts to 1/4" Drill

Entirely new drill saw combination that converts from saw to 1/4" drill in 1 minute. Rugged die cast frame, heavy duty motor, trigger switch with lock button for continuous operation. Saw has individual finger tip adjustments for depth of cut and angle of cut. Cuts angles 0 to 45° maximum depth of cut 1 1/2", 4 1/2" saw blade included. Large comfortable grip enables one hand operation. Ball bearing construction. Fully guaranteed. Saw cuts through wood, plastic, masonite, hard rubber, non-ferrous materials, tile, plaster, etc.

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Stock No. TL-164

HAND NIBBLING TOOL

Stock No. TL-161

$3.85 Ea.
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A hand tool that will cut squares, circles or complex designs in 18 gauge steel, 1/16" aluminum, copper or plastic. Metal edges remain flat and smooth after each cut.

Replacement Punch for Above
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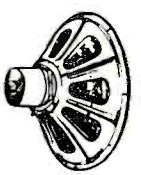
Complete with Crystal Earphone

Stock No. RA-277

$3.63

A completely assembled radio featuring germanium diode detector, iron core antenna coil, variable condenser, antenna lead-in and ground wire. Size 3 1/4 x 2 1/2 x 1".

New Magnavox 15" HI-FI SPEAKER



Stock No. S-287

$15.83 Ea.
3 for $45

A genuine Magnavox 15" PM Speaker with a 1 pound Alnico 5 Magnet. Delivers beautiful wide range fully rounded tones. Frequency response 30-15,000 cps. Voice coil diameter 1 1/2". Impedance 8 ohms. Power handling capacity 18 watts.

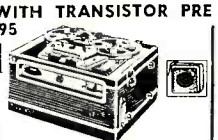
Wilcox-Gay TAPE Recordio

Brand New 1958 Models

FIRST WITH TRANSISTOR PRE AMPLIFIER

Reg. $229.95

$129.81



Stock No. AM-80 Model 772

Own this beautiful two tone Tape Recorder at less than dealer cost. Fantastic tonal quality delivered by transistor preamp coupled to 8 watt amplifier which drives a 5 x 7 dual cone extended range speaker and high frequency tweeter. Features Dual speed, (7 1/2 & 3 3/4 ips) dual track. Transistor preamp. Push Pull Amplifier. Dual speakers. Records up to 4 hours. Automatic Shut Off. "Normal" & "Overload" level indicators. deluxe tape timer, 2 input jacks and "Prest-O-Matic" keyboard—just press keyboard buttons to perform all functions. Can be used as PA system same time as recording. Complete with mike, 5" reel of tape, empty 7" reel and Roving speaker. Frequency response 65-12,500 cps. Size 14 1/2 x 15 x 10". Weighs 37 lbs. Operates on 110-120 V. AC., 60 cycles.

Reg. $129.95

$79.37

Stock No. AM-79 Model 732

At this low price you can't go wrong in buying even TWO recorders. Easy to use, just push buttons for record—play—fast forward—fast rewind. New thumb silhouette volume, bass and treble controls. Dual speed (7 1/2 & 3 3/4 ips) dual track for up to 4 hours recording on 7" reel of 2400 ft. long play tape. Frequency response 85-8,000 cps. Features include: Transistor preamp, Record lock button, Record-Phono-TV input jack and automatic erase. Can be used as PA system. Complete with microphone, 3" reel of tape and empty 5" reel. Operates on 110-120 V. AC., 60 cycles. Size 14 1/2 x 14 x 9". Weighs 26 lbs.

Stethoscopic HEADPHONES

Stock No. PH-13

$1.88 Ea. — 3 for $5.00

High impedance crystal headphone with ear plugs used with office machines, aircraft equipment, etc. Light weight, flexible plastic construction. With 36" two conductor, twisted, pliant cord.

WIRE STRIPPERS

Deluxe Automatic Model

$3.71 Ea.

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Olson Radio Warehouse

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AKRON 8, OHIO

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				3	4	5
					11	12
					18	19
					25	26

CALENDAR of EVENTS

JANUARY 6-8, 1958
Fourth National Symposium on Reliability & Quality Control. Sponsored by IRE and AIEE. Statler Hotel, Washington, D. C. M. M. Tall, Radio Corporation of America, Moorestown, N. J., general chairman.

JANUARY 16
Seventh Annual Sylvania Television Awards Presentation. Plaza Hotel, New York, N. Y.

JANUARY 22-24
EIA Conference on Automation. Sponsored by the Engineering Department of EIA (formerly RETMA). Arizona State College, Tempe, Ariz. Additional details from J. A. Caffiaux, EIA, 11 W. 42nd St., New York 36, N. Y.

FEBRUARY 9-15
National Electrical Week.

MARCH 16-22
Nuclear Congress. Sponsored by IRE, AIEE, ASME, and other professional groups. International Amphitheater, Chicago, Ill. Contact International Atomic Exposition, 304 Architects Bldg., Philadelphia 3, Pa. for further information.

MARCH 27-29
Ninth Biennial Electrical Industry Show and Fifth Electrical Maintenance Conference. Shrine Exposition Hall, Los Angeles. Paul H. Henrichs, Southern California Edison Co., chairman of conference committee.

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THE COVER

Our thanks to the following organizations for lending the attractive "props" used in this month's cover setting: Pillows—Leonard M. Schur; Flowers—Ruth Joyce; Painting "Remnants of Still Life" (Gadbois)—The Little Studio, Ltd.; Model's Ensemble from the "At Home" Collection—Greta Plattry; Furniture — Smilow-Thiele; and Lamp — Lightolier.

CLASSIFIED

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COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 18 or 21 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

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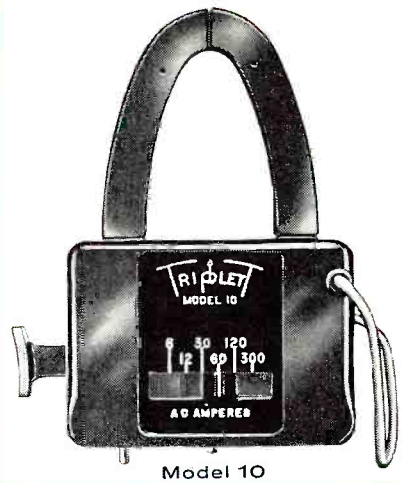
JANUARY 1958

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

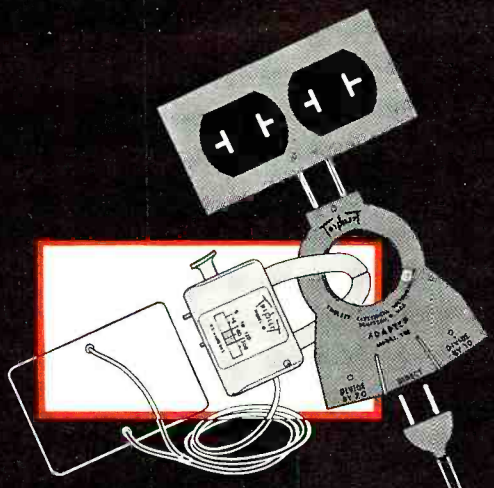


Model 10

Here is a real value—much more value than in any other clamp-on ammeter. Remember, in Triplett Model 100 you get not only a clamp-on ammeter but a genuine Triplett complete Volt-Ohm-Milliammeter with which you can measure AC volts, DC volts, AC and DC current, and Ohms.

BURTON BROWNE ADVERTISING

triple news from triplett



1st news: Triplett Model 10 Clamp-On Adapter

Just plug into any Triplett Model 310 Miniature VOM it becomes an AC clamp-on ammeter to measure AC amperes without cutting or opening current carrying wires. The split transformer yoke opens at the touch of a lever to fit around a single conductor or bus-bar for direct readings of AC amperes from 6 to 300 in 6 steps. Model 10 $14.50 net.

The Model 10 can be separated from the Model 310 as shown in the drawing at left by No. 311 lead attachment. This permits readings in difficult locations. No. 311 leads $1.90 net.

2nd news: Triplett Model 101 Line Separator

Serves to plug in at outlet to divide 2 conductor cords for clamp-on measuring. Makes accurate, rapid-testing of radio and TV sets, phonographs, appliances, motors, etc. possible without opening or splitting double conductors. Also serves to increase ammeter sensitivity 10X and 20X, if desirable, for easier reading. Model 101 $5.50 net.

3rd news: All four parts are available conveniently packaged in one handy, durable, high-quality carrying case. This complete package is known as Triplett Model 100 and is priced at $61.90 net.

Model 100 consists of Model 310 VOM, Model 10 Clamp-On Adapter, Model 101 Line Separator, No. 311 leads and carrying case with provision for all parts.

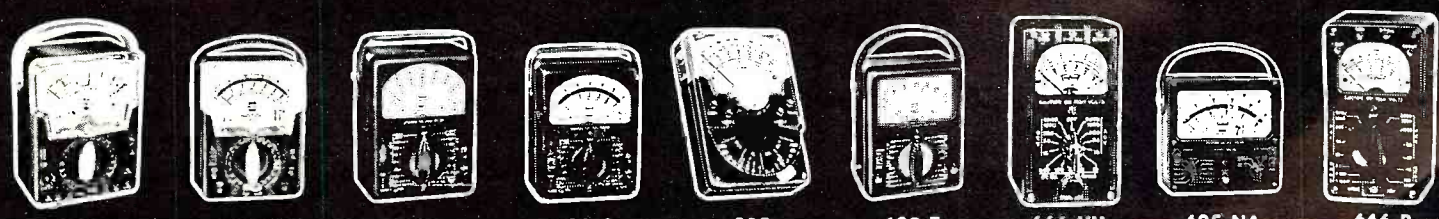
TRIPLETT

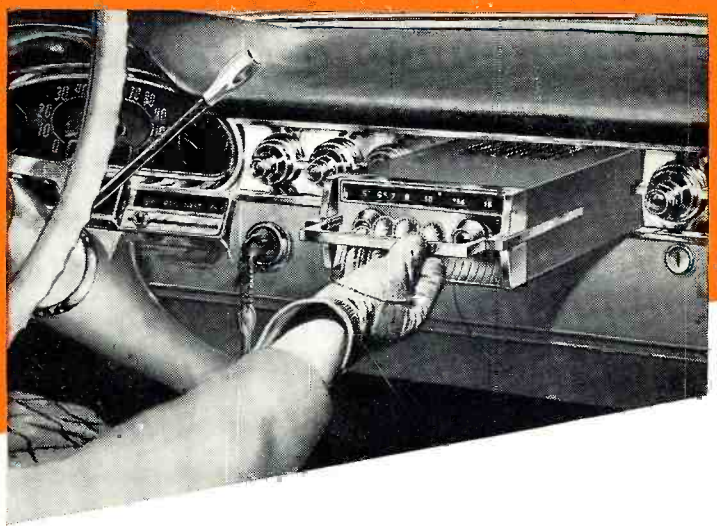
Triplett Electrical Instrument Company
Bluffton, Ohio

53 years of experience

In addition, to use with the Model 310, the Model 10 Adapter also can be used as a Clamp-On Ammeter with any Volt-Ohm-Milliammeter having a 3 AC volt scale at 5000 Ohms per volt such as Triplett Models 630, 630-A, 630-NA, 631, etc., by employing Triplett No. 611 leads, $1.90 net.

Triplett Model 100 gives you the world's most flexible test equipment for all electrical and electronic applications.





A new market for you!

Mallory Mercury Batteries *for* New Portable Car Radios

Many 1958 cars will have a new kind of radio that fits into the dash, yet slips out and plays anywhere on its own batteries. *Only* Mallory-developed Mercury Batteries meet the tough battery specifications of the new sets:

High temperature: Withstand the 190° F temperatures often developed under the auto dash.

Leak-free: Won't leak from heat, old age or short circuits . . . never damage a customer's valuable radio.

Constant Voltage: Provide uniform operating efficiency without audio distortion.

Long Life: Last longer on your shelf or in the customer's radio . . . reduce the nuisance of frequent battery changes.

That's why Mercury Batteries, pioneered by Mallory, are your best bet for service profits and customer satisfaction. Only Mallory manufactures a complete line of both zinc-carbon and mercury batteries for all applications.

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• Rectifiers • Power Supplies • Mercury and Zinc-Carbon Batteries