SPECIAL AUDIO FEATURE ISSUE

RADIO & TELEVISION NEWS

NOVEMBER
1955
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IN THIS ISSUE

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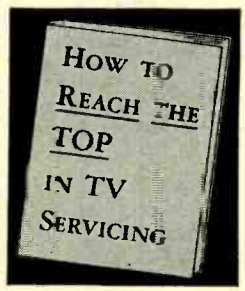

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COVER PHOTO: The vast strides made by the recording industry are exemplified by this reconstruction of a 90's living room at NBC. An Edison talking machine from Editor Oliver Read's phonograph collection is "starred". (NBC Photo by Jack Zwillinger)

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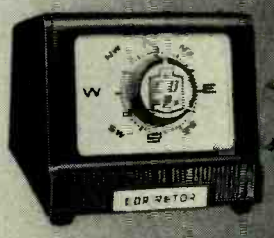
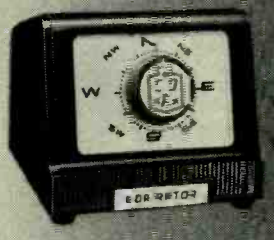


AR-2

Completely AUTOMATIC rotor with thrust bearing. Handsome cabinet, uses 4 wire cable.



AR-22

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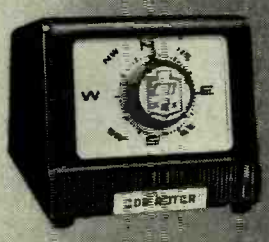
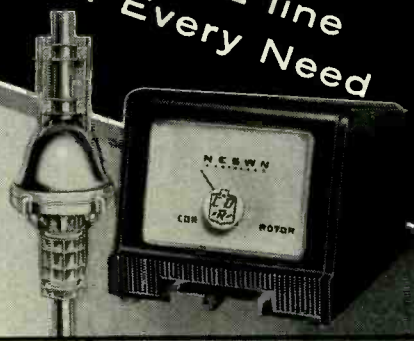


TR-2

The heavy-duty rotor with plastic cabinet featuring "compass control" illuminated perfect pattern dial. Uses 8 wire cable.

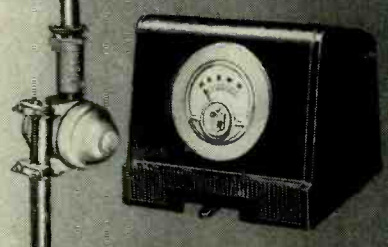
TR-4

The heavy-duty rotor complete with modern cabinet with METER control dial. Uses 4 wire cable.



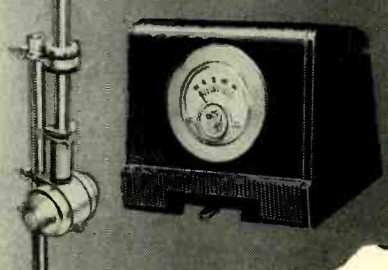
TR-11

The ideal budget all-purpose rotor with new, modern cabinet featuring meter control dial. Uses 4 wire cable.



TR-12

A special combination value consisting of complete rotor with thrust bearing. Handsome modern cabinet with meter control dial, uses 4 wire cable.



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BY THE EDITOR

TOLL TV AND THE SERVICE TECHNICIAN

ARGUMENTS pro and con on the question of toll TV are waxing hotter and hotter, and at this writing it appears that the FCC is no closer to a decision than when the case was first presented to it. In fact, it is very likely that at least some aspects of the problem will have to be submitted to Congress, with a clear-cut decision perhaps years away.

A new factor was injected recently with a proposal by *Jerrold Electronics* that toll TV be set up on a closed-circuit basis, somewhat like the present Community TV antenna systems. Such a basis would have obvious advantages from the standpoint of control, distribution, and billing, but might not be as advantageous from the economic standpoint as the three presently proposed systems (*Zenith, Skiatron,* and *Telemeter*). *Jerrold* has published a detailed cost analysis in which it claims that with 30% saturation, costs will be equivalent to any of the proposed three systems, and furthermore, that the cost per subscriber will decrease rapidly as saturation increases.

Service technicians everywhere have a definite stake in the final outcome of these arguments. If one of the scrambled systems is approved, someone will obviously have to install the unscrambler equipment at the receiver. This will require making some connections and perhaps some alterations within the receiver itself. It appears that this work would have to be done by factory-trained men rather than existing service organizations. Furthermore, once the set has been disturbed in this manner, the customer would be more apt to call on the toll TV company for future service than his regular service technician. This is logical, since in most cases the set would have been operating properly before installation of the toll TV equipment, and the customer would assume that any future difficulty resulted directly from such installation. Thus, widespread use of any of the three scrambled toll TV systems could result in a big decrease in available jobs for presently existing service organizations.

No such problem exists with the proposed wired system. No equipment is installed in the receiver, and no alterations are necessary. The signal is brought into the home by means of a coaxial cable and terminates in a box with terminals for connection to the receiver antenna terminals. Responsibility of the cable company is clear-cut. It must provide a suitable signal at the box terminals. If such a signal is present, any fault obviously lies in the receiver itself and the regular service technician will be called in for set repairs. Thus, this system does not pose any threat to existing service organizations.

Jerrold claims that its proposed system does not require FCC approval, and so it is going ahead with tests in four of its existing community TV systems, and in addition is completely wiring two large communities which already have adequate TV coverage. These tests will determine the economic feasibility of closed-circuit toll TV.

Another interesting aspect of the whole problem is the claim by *Jerrold* that it can break any of the scrambling codes used by the three other proponents of toll TV. If this claim can be proved, and if such code-breaking can be carried out easily on a large scale, the proposed systems would have to be discarded for lack of a means of effectively collecting tolls. *Jerrold* has challenged the three proponents and has asked the FCC to arrange for a test in the near future, whereby *Jerrold* engineers can prove their claim.

One proponent's answer to this claim is that, given sufficient time and money, *any code can probably be broken*. However, with a shift in the code every month or oftener, such a procedure would be highly impractical, and the dissemination of such information for pay would be illegal.

Two of the major considerations in setting up a code are to determine how much scrambling is necessary in the picture and sound and how complex the code must be to prevent unauthorized large-scale "pirating." These matters have been carefully considered by the proponents of scrambling, and they feel that they have arrived at satisfactory answers.

All of the parties involved have heavy financial interests at stake, with millions of dollars having already been spent in engineering and testing the various systems. Many others will be directly affected in one way or another by the ultimate outcome. With such big stakes, claims and counterclaims will be fired back and forth, and it may be a bit difficult to delve beneath the surface and determine what decision is in the best interest of the American public as a whole. The final decision will be awaited with a great deal of anticipation. . . . . O.R.

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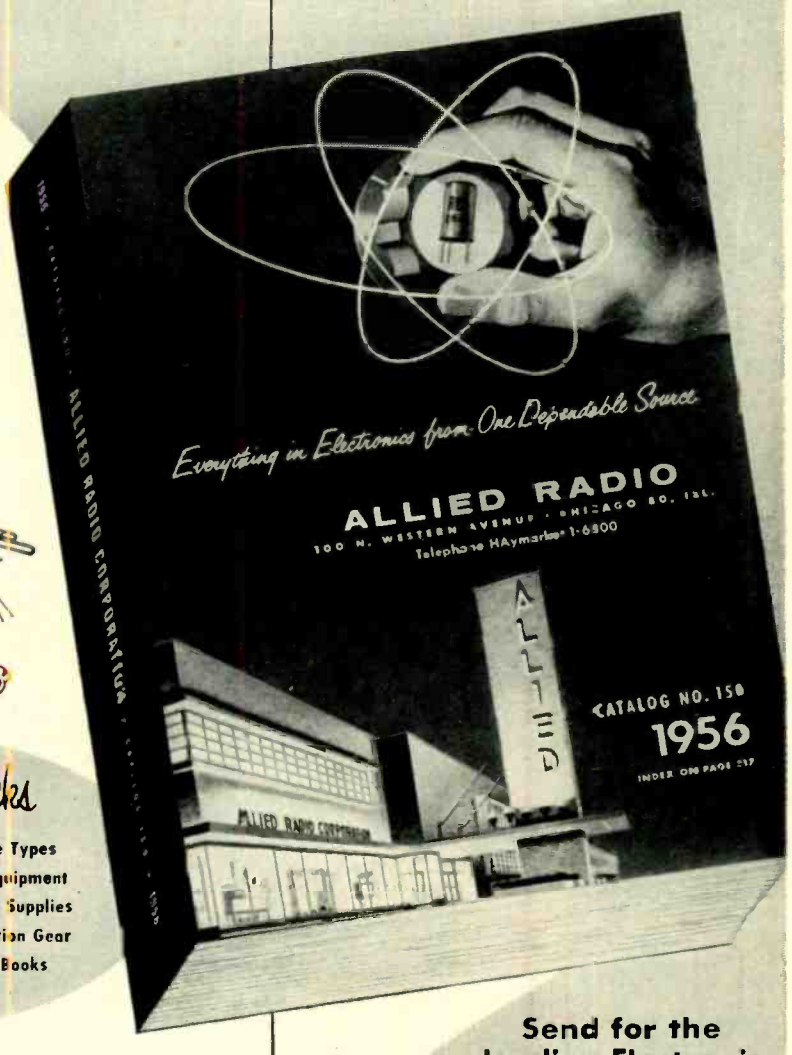

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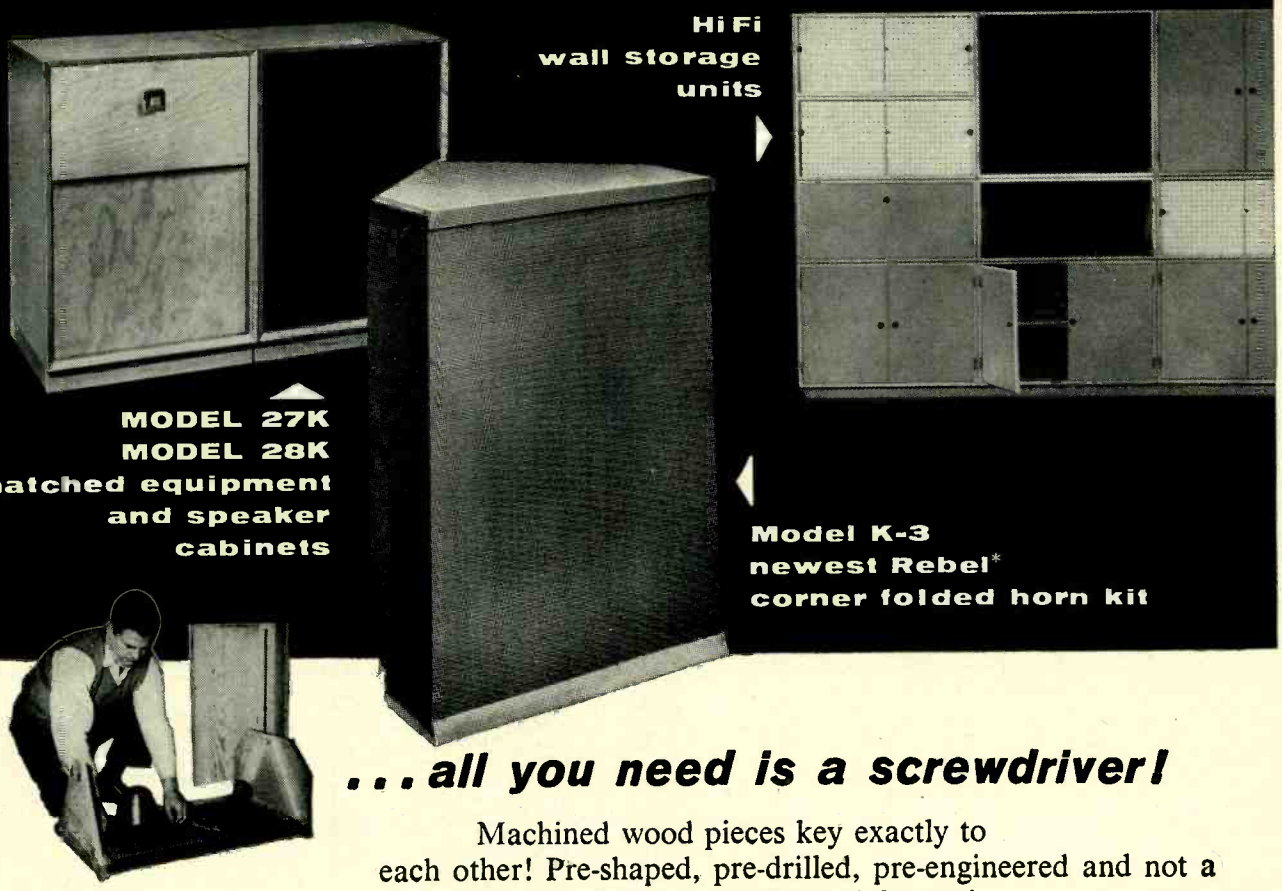

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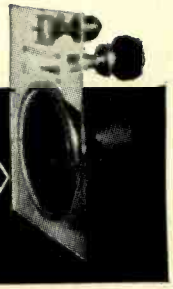

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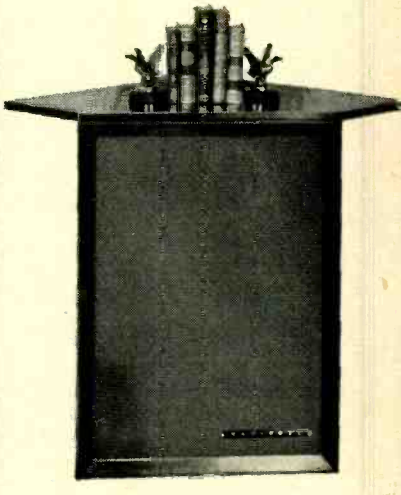

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GUIDE

AUTRONIC-EYE®

TRAINING COURSES MEAN MORE BUSINESS FOR YOU!

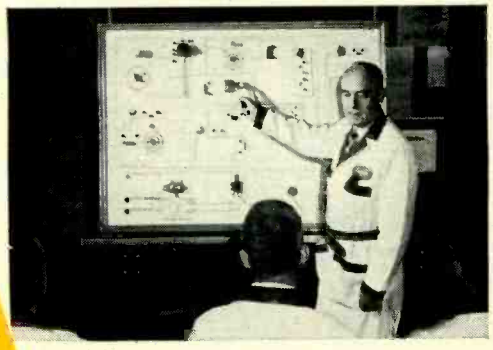
Courses for experienced service technicians provide latest repair information—enable you to do the job faster and more efficiently.

Quick, accurate circuit diagnosis and repair to factory specifications boosts your profits. That's why so many qualified auto technicians attend these Guide training courses at no cost other than transportation and living expenses.

The Guide Lamp diploma, awarded only to those who successfully complete the course, is proof that you're equipped to give more and better service to more people—and that means business.

If you're an auto radio service dealer, come yourself, or send your technicians. There's one of 30 GM Training Centers near you. Apply through your local United Motors Service Division Distributor or write

GUIDE LAMP DIVISION • GENERAL MOTORS CORP. • ANDERSON, INDIANA



Jumbo-size operational panel of Guide's Autronic-Eye Circuit puts all parts out front for better, more efficient instruction.

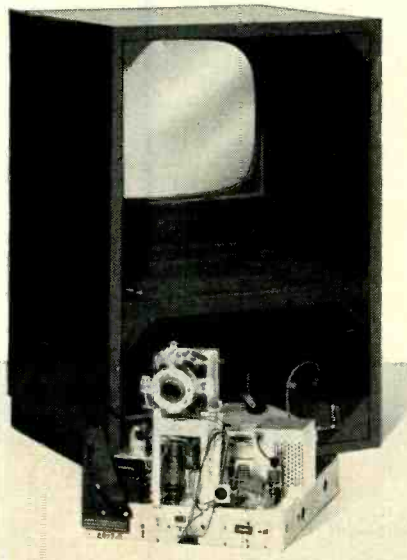
Thirty modern GM Training Centers offer newest equipment and latest service techniques. There's one nearby . . . no matter where you live.

She: *But, how do I know this is a good tube?*

You: *Because, this is a CBS aluminized Mirror-Back picture tube. There aren't any better.*

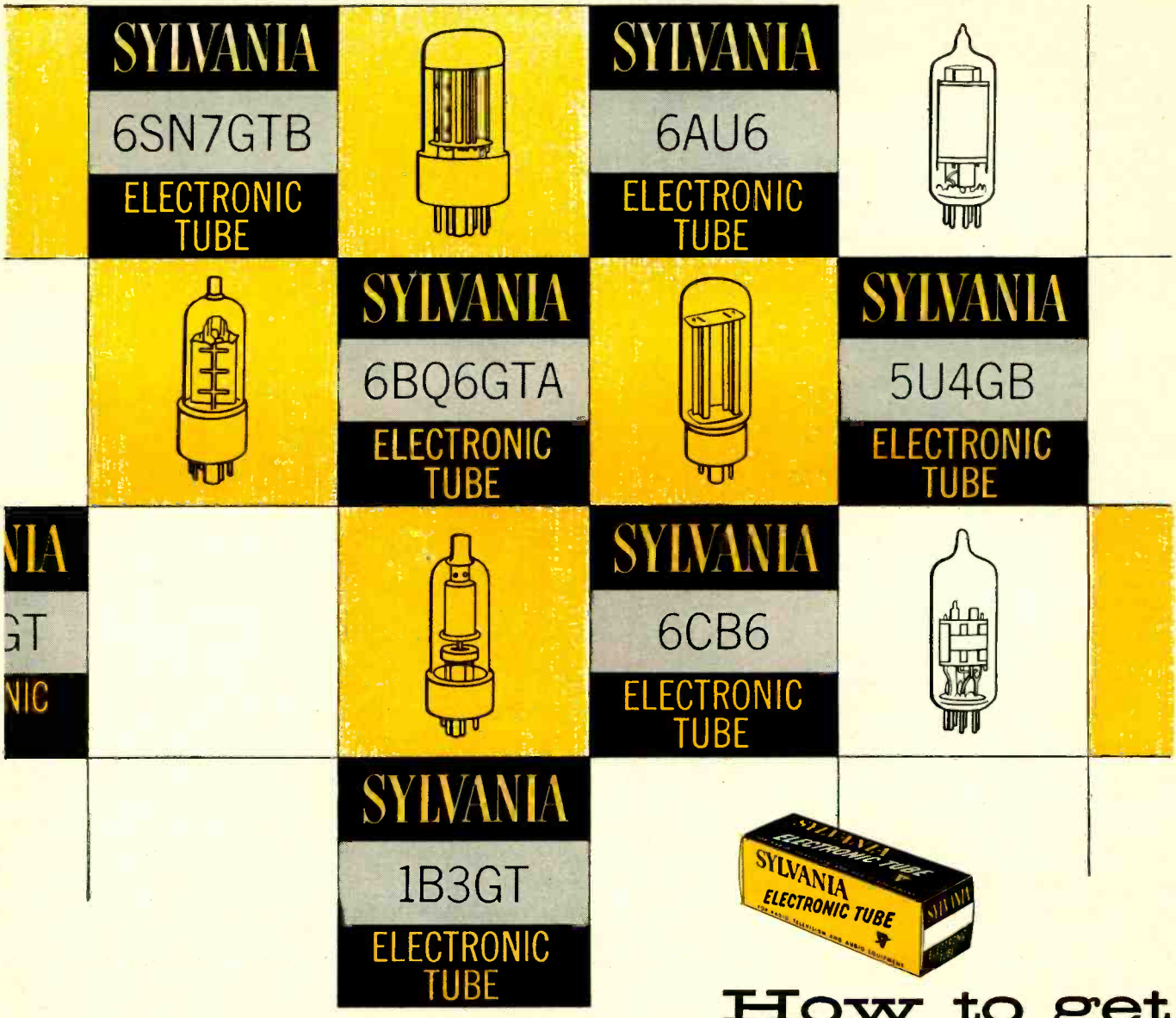
She: *And I see it has the Good Housekeeping Guaranty Seal, too. That's proof enough for me.*

Customer confidence really counts when it comes to the big tube. That's when CBS tube advertising helps you most. For CBS tubes have the Good Housekeeping Guaranty Seal and are nationally advertised to 76.9% of your customers . . . the women of America. And 53% of these women are influenced in their purchases by that seal of approval. You protect yourself and gain your customer's good will when you install a new CBS aluminized Mirror-Back picture tube.



Show her the CBS carton with the Good Housekeeping Guaranty Seal.

CBS-HYTRON, Danvers, Massachusetts . . . A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.



How to get the jump on call-backs in 6 easy moves

Here are six tube types called for most in your daily service work. Eliminate the call-backs from these types and your biggest share of headaches is over. It's easy to do just that, too, simply by getting into the habit of using only Sylvania tubes . . . in the familiar yellow and black carton.

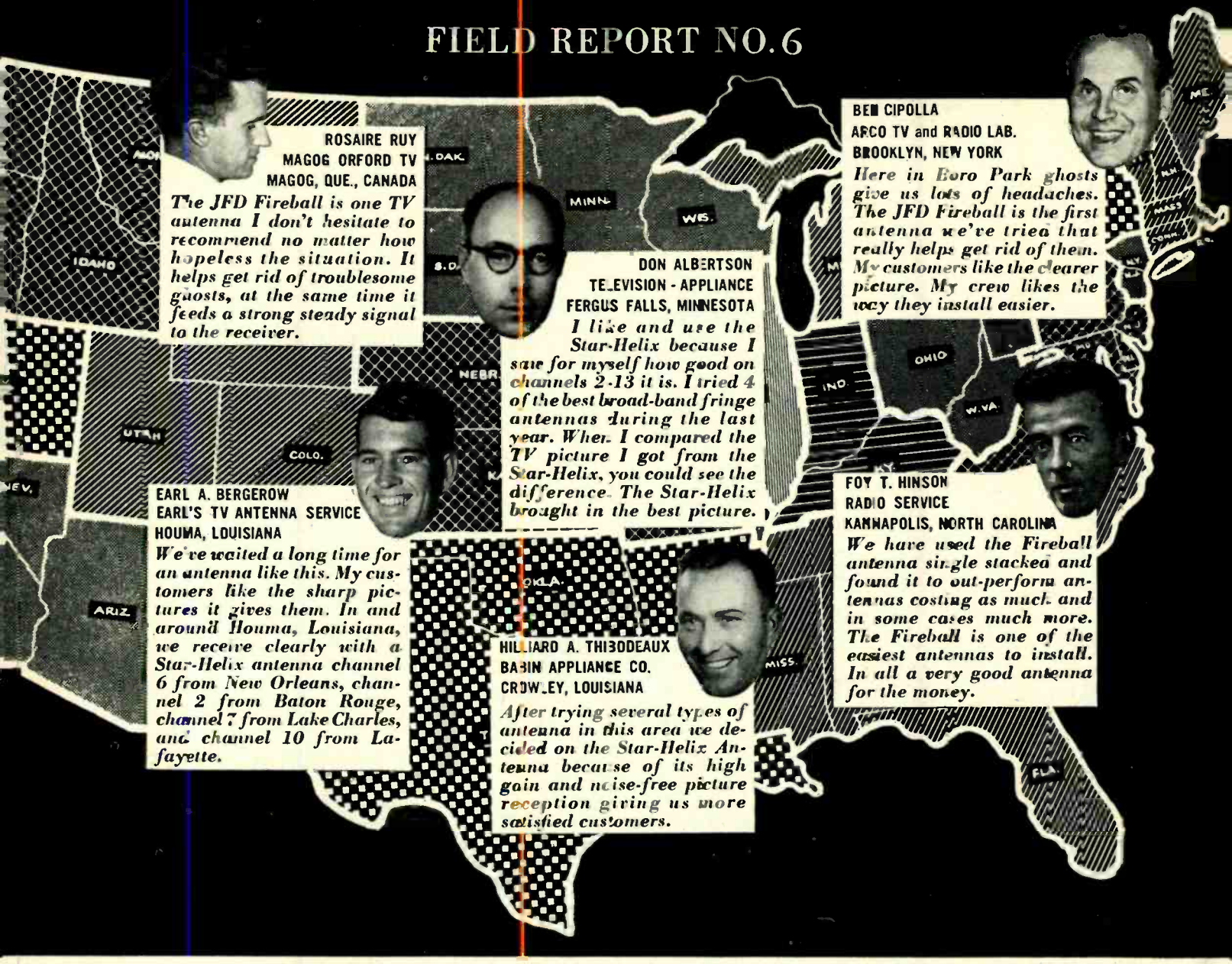
These 6 types alone incorporate over 14 design and production improvements to eliminate the most common causes for "quick failures" and costly call-backs. It's no wonder more and more servicemen consider the yellow and black carton their "calling card of top quality service."

SYLVANIA®

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Building, Montreal

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

FIELD REPORT NO. 6



ROSAIRE RUY
MAGOG ORFORD TV
MAGOG, QUE., CANADA

The JFD Fireball is one TV antenna I don't hesitate to recommend no matter how hopeless the situation. It helps get rid of troublesome ghosts, at the same time it feeds a strong steady signal to the receiver.

DON ALBERTSON
TELEVISION - APPLIANCE
FERGUS FALLS, MINNESOTA

I like and use the Star-Helix because I saw for myself how good on channels 2-13 it is. I tried 4 of the best broad-band fringe antennas during the last year. When I compared the TV picture I got from the Star-Helix, you could see the difference. The Star-Helix brought in the best picture.

BEN CIPOLLA
ARCO TV and RADIO LAB.
BROOKLYN, NEW YORK

Here in Boro Park ghosts give us lots of headaches. The JFD Fireball is the first antenna we've tried that really helps get rid of them. My customers like the clearer picture. My crew likes the way they install easier.

EARL A. BERGEROW
EARL'S TV ANTENNA SERVICE
HOUMA, LOUISIANA

We've waited a long time for an antenna like this. My customers like the sharp pictures it gives them. In and around Houma, Louisiana, we receive clearly with a Star-Helix antenna channel 6 from New Orleans, channel 2 from Baton Rouge, channel 7 from Lake Charles, and channel 10 from Lafayette.

HILLIARD A. THIBODEAUX
BABIN APPLIANCE CO.
CROWLEY, LOUISIANA

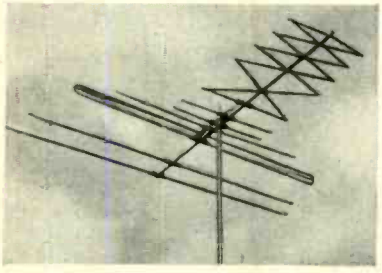
After trying several types of antenna in this area we decided on the Star-Helix Antenna because of its high gain and noise-free picture reception giving us more satisfied customers.

FOY T. HINSON
RADIO SERVICE
KANNAPOLIS, NORTH CAROLINA

We have used the Fireball antenna single stacked and found it to out-perform antennas costing as much and in some cases much more. The Fireball is one of the easiest antennas to install. In all a very good antenna for the money.

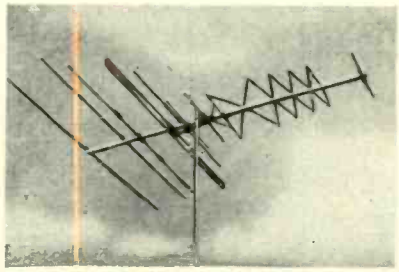
First Choice of Servicemen Everywhere!

In area after area, alert servicemen are standardizing on *JFD* antennas. They know that regardless of *location* or *budget* there is a JFD antenna that does a *better*, more profitable job. *Now* is the time to put JFD engineering and promotion leadership to work for *you* building sales and customer confidence.



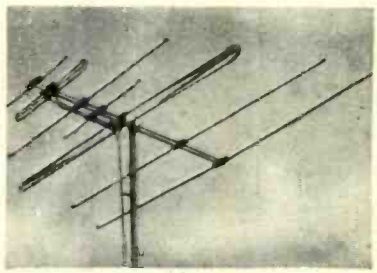
JFD STAR-HELIX

SX711	single	$25.50
SX711S	stacked	$52.50
SX711S-96*	96" stacked	$55.00



JFD SUPER-STAR HELIX

SX13	single	$35.00
SX13S	stacked	$72.50



JFD FIRE-BALL

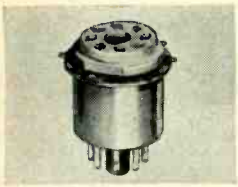
FB500	single	$17.35
FB500S	stacked	$36.65
FB500S-68†	68" wide stacked	$36.65
FB500S-96*	96" wide stacked	$38.60

†for areas with co-channel and cross-channel interference

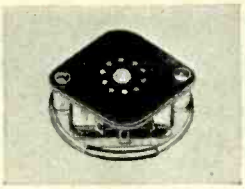
*for added channel 2-6 gain

JFD

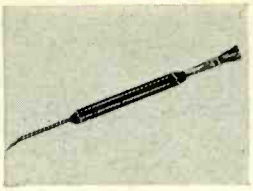
"Go Forward with JFD Engineering."
MANUFACTURING Co. Inc., BROOKLYN 4, N. Y.
INTERNATIONAL DIVISION, 15 MOORE ST., N. Y.



G-C 8-PIN OCTAL TEST SOCKET ADAPTER
Easier top-of-chassis tests.
No. 9248 NET $1.55



G-C HI-VOLT ANTI-CORONA TV SOCKET
Octal socket for 1B3 tube.
No. 9070 NET $0.36

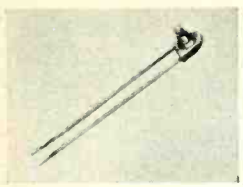


G-C HEAVY DUTY SOLDERING AID TOOL
Includes wire cleaning brush.
No. 9088 NET $0.99

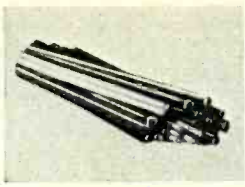
G-C TV KNOB SPRING KIT
Variety of springs and wedges.
No. 9133 NET $1.65

G-C "NO-STRETCH" COLOR TV DIAL CORD
Medium; .040 diameter; 25 ft.
No. 89-25 NET $0.90

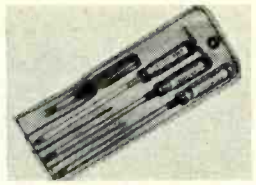
G-C "99" SOLDER LUG ASSORTMENT
Large quantity; all types.
No. 9116 NET $0.99



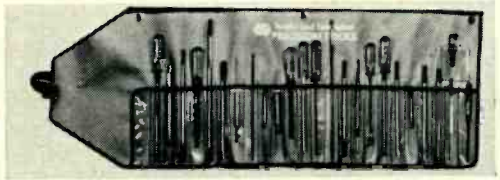
G-C ROTARY CANOPY SWITCHES
Brass knob; 125 V-250 V.
No. 9204 NET $0.30



G-C HI-VOLT PLASTIC TUBING ASST.
Bundle of various sizes.
No. 9177 NET $0.27

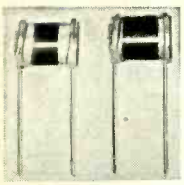


G-C ALL-PURPOSE TV ALIGNMENT TOOL KIT
Container and 4 basic tools.
No. 8457 NET $1.77



G-C MASTER DELUXE TELEVISION TOOL KIT
Roll type leatherette case and 25 tools.
No. 8283 NET $12.51

G-C SPRA-KLEEN PRESSURE SPRAY
Stops radio-TV control noise.
No. 8666 NET $0.99



G-C GLO-BAR THERMISTOR KIT
Pair for filament string TV sets.
No. 9135 NET $1.44

GENERAL

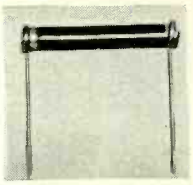
G-C

CEMENT

Ask For These

RADIO-TV SERVICE AIDS

...at Your Jobber

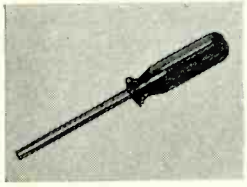


G-C GLO-BAR THERMISTOR
For GE fil. string replacement.
No. 9215 NET $0.96

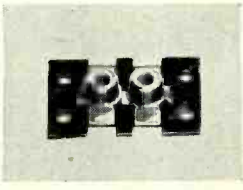
G-C RUF-KOAT SPRA-KOAT
Spray-on black wrinkle varnish.
No. 60-12 NET $1.83

G-C TOUCH-UP VARNISH SPRA-KOAT
Mahogany varnish stain.
No. 161-3 NET $1.83

G-C DE-OX-ID SPRA-KOAT
Electrical contact cleaner.
No. 19-6 NET $2.34

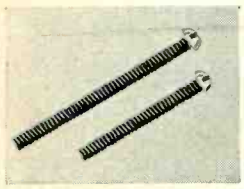


G-C TV & AUTO RADIO WRENCH
Special female slotted wrench.
No. 9211 NET $1.05

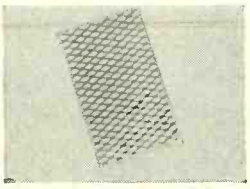


G-C DUPLEX PHONO CONNECTOR JACK
Fits standard and RCA plugs.
No. 9225 NET $0.13

G-C TV 3-WAY ANTENNA KLIP KIT
Plastic bag of 10 clips.
No. 9015X NET $1.17

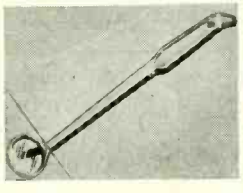


G-C SELENIUM RECTIFIER MTG. SCREWS
Set of 24 6-32 screws and nuts.
No. 9224 NET $0.36

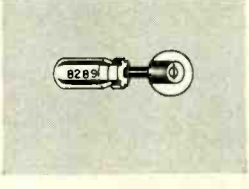


G-C ORNAMENTAL METAL GRILLE SCREEN
Heavy metal, 12 x 18 size.
No. 9252 NET $1.80

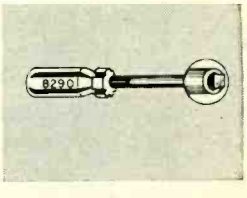
G-C "99" ELECTRONIC PART ASST.
Kit of hard-to-get parts.
No. 9122 NET $0.99



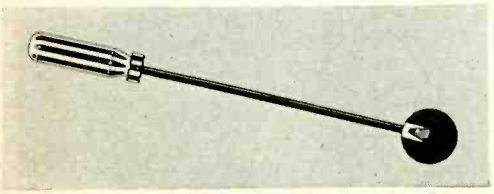
G-C ALL-PLASTIC INSPECTION MIRROR
No danger of shock or shorting.
No. 5090P NET $0.36



G-C "SHORTY" TV SCREWDRIVER
For hard-to-reach alignments.
No. 8289 NET $0.42

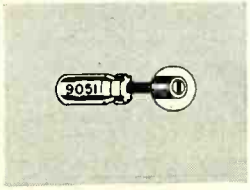


G-C UNIVERSAL SCREWDRIVER
Handy, all-purpose tool 7" long.
No. 8290 NET $0.60



G-C TV "X-57 PLASTIC LONG SLIM" SCREWDRIVERS
Practically unbreakable, all-insulated, super-tough tips.

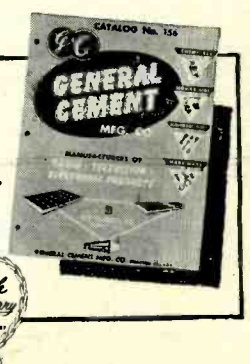
No. 8987	9½" long	NET $0.60
8988	14½" long	.90
8989	18½" long	1.20



G-C ZENITH-RCA ALIGNING TOOL
Plastic handle for better grip.
No. 9051 NET $0.45

G-C

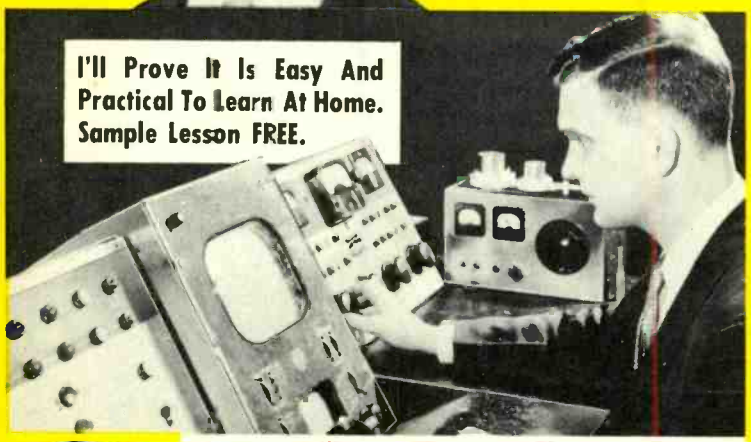
Free!
Your Copy of the G-C Catalog. Send postcard.

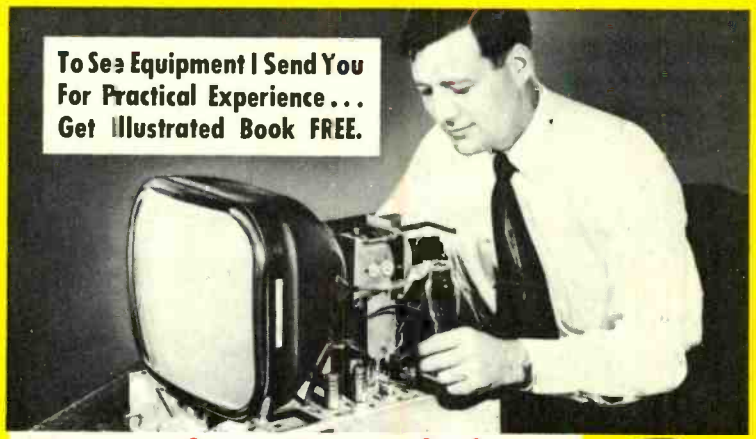


GENERAL CEMENT MFG. CO. 919 TAYLOR AVENUE • ROCKFORD, ILLINOIS

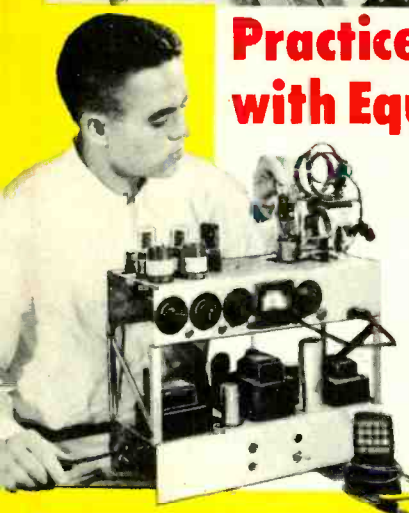
I Will Train You at Home
for Good Pay Jobs, Success in
RADIO-TELEVISION

J. E. SMITH
President
National Radio
Institute
Washington, D.C.
40 years of success
training men at
home in spare time.





Practice Broadcasting with Equipment I Send



It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build. Get FREE sample lesson.

Practice Servicing with Equipment I Send

Self-confidence, security, earning power come from knowing-how and from experience. Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester, use it in conducting experiments, fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build. Judge for yourself whether you can learn at home in your spare time.

Television Is Growing Fast Making New Jobs, Prosperity

More than 30 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets and to operate hundreds of Television stations. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity, get started now learning Radio-Television at home in spare time. Cut out and mail postage-free card. J. E. Smith, President, National Radio Institute, Washington, D. C. Over 40 years' experience training men at home.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs Good Pay — **See Other Side**

Get My SAMPLE LESSON and 64-Page Illustrated Book BOTH FREE

Cut out and mail card NOW!

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Mail card now!

NO STAMP NEEDED! WE PAY POSTAGE

Mr. J. E. SMITH, President
National Radio Institute, Washington 9, D. C.

Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

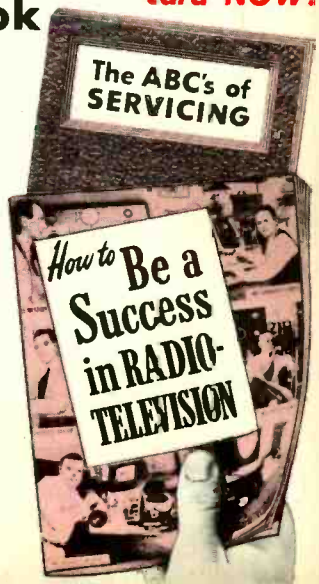
NAME.....AGE.....

ADDRESS.....

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

VETS write in date of discharge.....

K L M O P R



Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Television Broadcast Stations extend from coast to coast now with over 30 million Television sets already in use. Over 400 Television stations are on the air and there are channels for hundreds more. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc., is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

My Training Is Up-to-Date You Learn by Doing

Get the benefit of our 40 years' experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

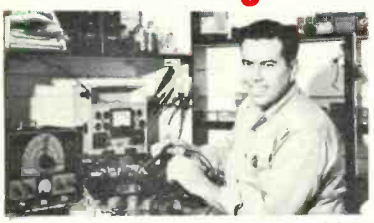
More and more Television information is being added to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About this Tested Way to Better Pay

Read at the right how fellows who acted to get the better things of life are making out now. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television," because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage-free card can be an important step in becoming successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. Training Men for Over 40 years. Approved Member, National Home Study Council.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets



Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. The day you enroll I start sending you special booklets that show you how to fix sets. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

I TRAINED THESE MEN

Lots of Spare-Time Jobs

"I do a lot of spare-time Radio and TV servicing. It was fun learning and I don't know how to thank you." B. Goede, Plainview, Minn.

Now TV Trouble Shooter

"I had only gone to 7th grade when I started course. Now have job as TV trouble shooter, also fix sets spare time." M. R. Lindemuth, Fort Wayne, Ind.

Engineer with WHPE

"Thanks to NRI, I operated a successful Radio repair store. Then I got a job with WPAQ and now am an engineer for WHPE." V. W. Workman, High Point, N. C.

NRI Course Can't Be Beat

"Am with WCOC. NRI Course can't be beat. No trouble passing 1st class Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." William F. Kline, Cincinnati, Ohio.

Extra Money in Spare Time

"I am a police captain and also have good spare-time service business. Just opened my new showrooms and shop." C. W. Lewis, Pensacola, Fla.

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician, Service Manager, Tester, Serviceman, Research Assistant. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **AVIATION RADIO:** Plane Radio Operator, Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **TELEVISION:** Pick-Up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman.

SAMPLE LESSON and 64-Page BOOK BOTH FREE

CUT OUT AND MAIL POSTAGE-FREE CARD

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D. C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
16th and U Sts., N.W.
Washington 9, D. C.

Have Your Own Business

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned in spare time. Joe Travers, a graduate of mine, in Asbury Park, N. J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

Auto-Radio Technicians:

DELCO RADIO

TRAINING COURSES MEAN MORE BUSINESS FOR YOU

Working in small groups under factory-trained Delco instructors, alternate lecture and lab periods keep radio technicians up to date on latest radio and repair developments at a General Motors Training Center Delco Radio course.

Typical of the thirty General Motors Training Centers across the country is this one at Tigard, Oregon, a Portland suburb. Ample parking areas help to make this center popular throughout the Northwest.

Week-long courses for experienced service technicians provide latest radio and repair information—enable you to do the job faster and more efficiently.

Quick, accurate auto radio diagnosis and repair to factory specifications boosts your profits. That's why so many qualified auto radio technicians attend these Delco Radio training courses at no cost for tuition, school supplies, or equipment.

Factory-trained instructors, using latest equipment and instruction methods, conduct these intensified week-long courses, designed to familiarize repairmen with modern auto radio developments and factory-approved repair techniques.

The Delco Radio diploma, awarded only to those who successfully complete the course, is proof that you're equipped to give more and better service to more people—and that means more business.

If you're an auto radio service dealer, come yourself, or send your technicians. There's one of 30 GM Training Centers near you. Apply through your local Delco Electronic Parts Distributor or write Delco Radio Division of General Motors, Kokomo, Indiana.

DELCO RADIO
DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

HERE'S THE COURSE OF STUDY — (1) Circuitry differences between home and auto radios. (2) Dead radio trouble-shooting procedure and lab. (3) Noisy radio trouble-shooting and lab. (4) Weak radio trouble-shooting and lab. (5) Distorted radio trouble-shooting and lab. (6) Intermittent trouble-shooting and lab. (7) Push-pull lock-up tuner lecture and lab. (8) Mechanical operation of Signal Seeking Tuner. (9) Electrical operation and trouble-shooting of Signal Seeking Tuner. (10) Autronic-Eye operation trouble-shooting procedure and lab. (11) Autronic-Eye installation and adjustment procedure. (12) Transistors and printed circuits.

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

ANOTHER DELUGE of boiling briefs on pay—see TV flooded the Commission's offices, as the final round in the paper hearings came to a close, shortly after the Labor Day holiday. Once again the networks scored the toll idea, calling it impractical and an imposition on the public, while the trio of code proponents and a few others called the idea the salvation of TV.

In the flurry of closing statements, toll opponents also warned the FCC that it had no authority to decide the issue under the present laws, and urged that the matter be referred to Congress to determine once and for all whether the subscription plan should be considered a common carrier, as the telephone companies, or broadcasting; or whether pay programs should be sent over leased wires.

Thus, with so muddled a situation facing them, plus over seventy volumes of pounding verbage to sift, the Commission has quite a chore ahead of it. A number in industry and on the Hill has indicated that the best way to handle the affair from now on would be to issue a call for public hearings and listen to oral testimony. Such sessions, which would feature cross examinations, could resolve a number of the basic *pro* and *con* arguments, and also clarify the picture for any possible Congressional action.

One of the most caustic rebuttals came from *CBS,* which said that the claims of pay-TV proponents were so vague and general, that they should be disregarded. The American system of telecasting, noted *Columbia,* is by universal admission the best in the world. And that is why those who foster the cause of toll television, they added, have just . . . "polished the glitter . . ." and simply glorified the gamut of presentations possible under coin TV, when actually, such programs are now

NEW TV STATIONS ON THE AIR

(As of October 25, 1955)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
California					
Sacramento	KCRA-TV	3	60-66	16.06	100
San Jose	KNTV	11	198-204	4.93	20
Florida					
Daytona Beach	WESH-TV	2	54-60	17.8	1.26
Georgia					
Thomasville	WCTV	6	82-88	11.8	100
Illinois					
Chicago	WTTW†	3	60-66	16.06	56.2
Kansas					
Wichita	KARD-TV	3	60-66	16.06	100
Louisiana					
Shreveport	KTBS-TV	3	60-66	16.06	100
Missouri					
Kirksville	KTVO	3	60-66	16.06	100
Nebraska					
Hastings	KHAS-TV	5	76-82	12.74	100
North Carolina					
Washington	WITN	7	174-180	5.61	316
Texas					
Fort Worth	KFJZ	11	198-204	4.93	200
Lufkin	KTRE-TV	9	186-192	5.25	26
Virginia					
Roanoke	WDBJ-TV	7	174-180	5.61	316
West Virginia					
Huntington	WHTN-TV	13	210-216	4.65	316
Territories					
Mayaguez, P. R.	WORA-TV	5	76-82	12.74	1.48
Canadian Stations					
St. Johns, Newfoundland	CJON-TV	2	54-60	17.8	21.04
Barie, Ontario	CKVR-TV	3	60-66	16.06	14

WWOR-TV, channel 14, Worcester, Massachusetts, has gone off the air. KTVU, channel 36, Stockton, California, is now back on the air. WTVH-TV, channel 19, Peoria, Illinois, has changed its call letters to WTVH. †Educational.

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 466 (116 of which are u. h. f.).

Prepare for a Good Paying Job—Or Your Own Business

"I Will Train You at Home in RADIO-TELEVISION On Liberal No Obligation Plan!"

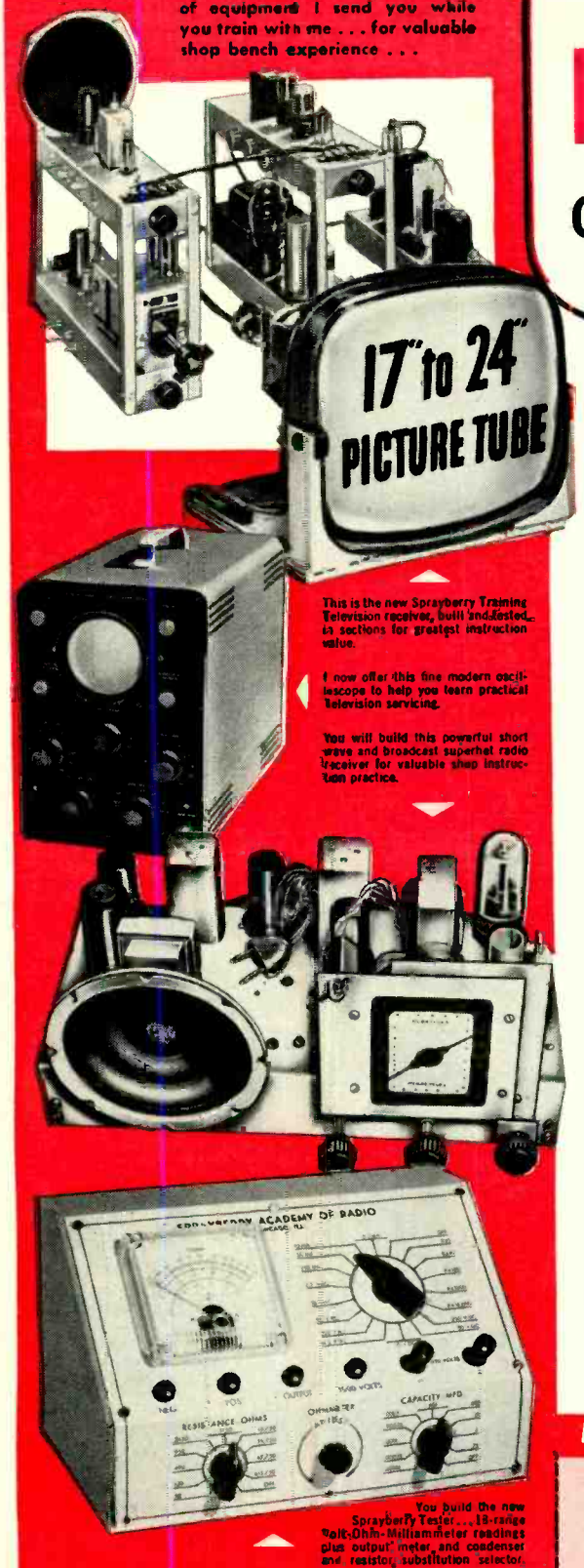
Frank L. Sprayberry
President, Sprayberry
Academy of Radio

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my big new catalog . . . YOURS FREE . . .
JUST MAIL COUPON!

I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train *without* signing a binding contract . . . without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours . . . you train as fast or as slowly as you wish. You'll have your choice of THREE SPRAYBERRY TRAINING PLANS . . . planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today . . . just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both FREE.

Learn PRACTICAL RADIO-TV with 25 BIG KITS

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



In addition to modern lesson training, I also give you plenty of home practice on actual Radio-Television equipment . . . you will build and use the units shown here plus many more. All this equipment is yours to keep . . . keep everything you need to set up your shop.

Train the Practical Way—with Actual Radio-Television Equipment

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 students are completely trained Radio-Television Service Technicians.

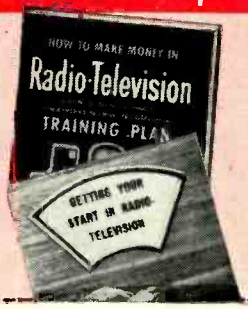
NEWEST DEVELOPMENTS
Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

See for Yourself . . . Make Your Own Decision . . . Mail Coupon Today!

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 I include 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
111 North Canal Street, Dept. 25-E, Chicago 6, Illinois

Mail This Coupon For Free Facts and Sample Lesson



SPRAYBERRY ACADEMY OF RADIO
Dept. 25-E, 111 N. Canal St., Chicago 6, Ill.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that *no salesman will call upon me.* Include New Catalog and Sample Lesson FREE.

Name_____ Age____

Address_____

City_____ Zone____ State____

available and coming . . . "to the American people in improved quality and from more diversified sources every day that goes by."

The network viewed the pay program as one which would subvert the present system and subject televieweers to a . . . "system of charges more onerous than any system of Government tax . . . ever contemplated . . ."

The idea that the toll plan should be given a trial was also hit, for such a move, said *Columbia,* would only prove, at best, that there is a minority who could afford to and would pay for programs. All that this test would prove, added *CBS,* is that if someone received the right to . . . "charge admission to what hitherto had been a public picnic grounds, enough hungry people might need a place to eat badly enough to make the enterprise . . . an extremely profitable one . . . This would be true even though fewer people could use the picnic grounds, and even though the people who were excluded from it might be those who needed its facilities the most."

One brief, filed by a Philadelphia manufacturer of community-TV equipment, re-emphasized an earlier stand that all toll codes could be broken and therefore all of the proposals were senseless. All systems, it was noted, feature basic decoder designs that are common, even though some principles of circuitry and their mechanical complexities vary. According to this manufacturer, the three decoders were similar in the following respects:

Video information from the receiver must be obtained in order to operate the decoding devices. This requirement necessitates the use of a switch to break into the video portion of the teleset, when the decoding mechanism is in operation, or if normal programs are to be observed, a switch in the decoder is necessary in order to complete the drive circuit, thereby restoring the receiver for normal operations. In addition, audio information is necessary for the operation of the decoders. Such signals are obtained either from the output of the FM discriminator, or, if the receiver has insufficient audio fidelity, it then becomes necessary to obtain an audio intermediate-frequency drive signal from a stage prior to the FM detector. The audio, after decoding, is re-routed back to the receiver to a point in the audio amplifier section. Also, information is necessary from the horizontal output circuitry, as well as from the vertical output stage.

To obtain video information requires two connections; an encoded video input to the decoding device, and a decoded video output from the decoding device. Two connections were also said to be required to obtain audio information; an audio or an audio intermediate-frequency input to the decoding device, and a decoded audio output from the decoder. This quartette of connections, plus the vertical and horizontal connections, add up to a

(*Continued on page* 140)

L. C. Lane, B.S., M.A. President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

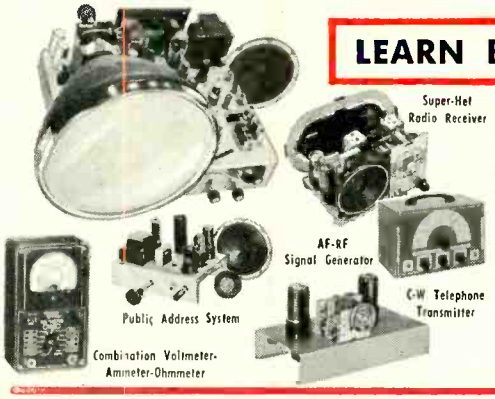
VETERANS - - NON-VETERANS

LET ME HELP YOU EARN TOP MONEY in TELEVISION

— as I've helped these men —

LEARN TELEVISION AT HOME IN YOUR SPARE TIME

Now, while demand for trained men is rising, you can prepare for a top-pay, lifetime career as an electronic technician, television repairman, or studio technician . . . or set up your own profitable business. You don't need any experience whatsoever to add your name to my list of hundreds of successful graduates.



LEARN BY DOING As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a BETTER-PAY TV JOB. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

STUDY NEWEST DEVELOPMENTS

My training covers all the latest developments in the fast-growing Television-Radio-Electronics industry. You learn about FM — RADAR — COLOR TV — TRANSISTORS — PRINTED CIRCUITS, etc.

CHOOSE FROM THREE COMPLETE COURSES

covering all phases of Radio, FM and TV

1. Radio, FM and Television Technician Course — no previous experience needed.
2. FM-TV Technician Course — previous training or experience in radio required.
3. TV Cameraman and Studio Technician Course — advanced training for men with Radio or TV training or experience.

EXTRA TRAINING IN NEW YORK CITY AT NO EXTRA COST!

After you finish your home study training in Course 1 or 2 you can have two weeks, 50 hours, of intensive Lab work on modern electronic equipment at our associate resident school, Pierce School of Radio and Television. THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER!

FCC COACHING COURSE

Important for BETTER-PAY JOBS requiring FCC License! You get this training AT NO EXTRA COST! Top TV jobs go to FCC-licensed technicians.

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training with spare time earnings . . . start their own profitable service business.

FREE! I'll send you my new 40-page book, "How to Make Money in Television - Radio - Electronics," a Free sample lesson, and other literature showing how and where you can get a top-pay job in Television.

Radio Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

VETERANS

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

AIRCRAFT INSPECTOR

"With RTTA training and through repairing radios and televisions for the right people at the right price, I was able to make the right contacts. I am now an Inspector for Douglas Aircraft at about $125 a week."

Hugh Maddox, Los Angeles, Calif. 4/30/54

$60 A WEEK IN SPARE TIME

"I have the skill and know-how to do the work I love best and to enjoy better things in life, thanks to RTTA. I am now working at TV servicing and making $60 a week spare time."

Harold Gimlen, Flint, Mich. 6/21/54

ASSISTANT MANAGER

"I am Assistant Manager of Day and Nite TV Service."

Ronald W. Curry, Tulsa, Okla. 1/3/55

EARNS EXTRA MONEY

"RTTA training gave me a chance for my own business, extra money earned, and more things that the price of the course could never equal."

Bryce Ruttle, Peterborough, Ontario, Can. 4/2/55

FEELS FULLY QUALIFIED

"With your training I feel fully qualified to get out and compete with all radio mechanics in this area. I have over $1,500 invested in test equipment, $1,000 in tube stock and $200 in miscellaneous equipment. Since I haven't had one complaint in 9 months I have been servicing sets, your school must have done a good job."

Jim Martin, Collinsville, Ill. 3/27/55

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. T-11C, 52 East 19th Street, New York 3, N. Y.

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

(PLEASE PRINT PLAINLY)

Name_____ Age_____

Address_____

City_____ Zone____ State_____

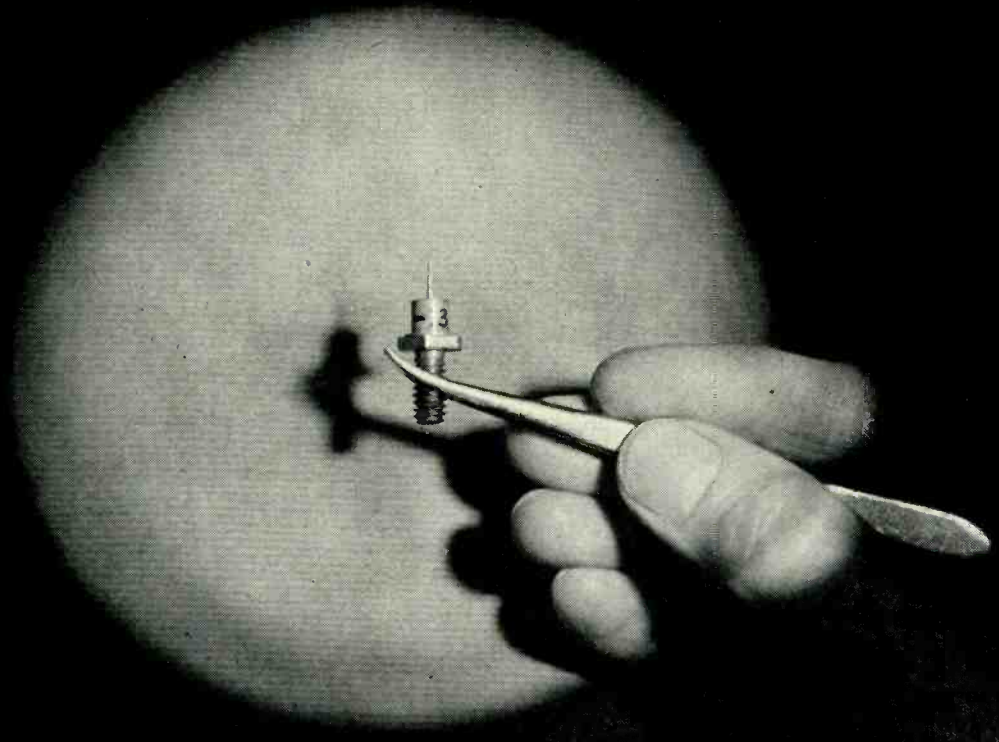
I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Technician Course

VETERANS! Write discharge date

NO SALESMAN WILL CALL!

A GIANT FOR ITS SIZE !

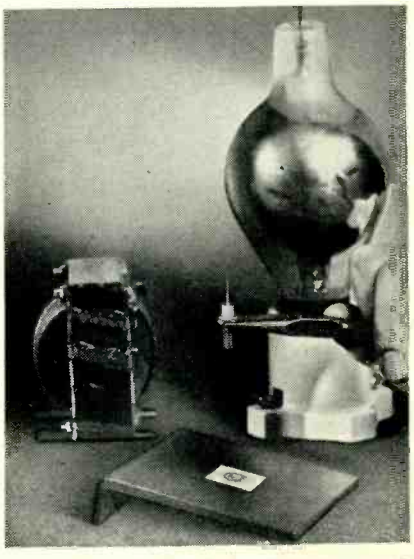


Telephone science produces an important new rectifier

At Bell Laboratories one line of research is often fruitful in many fields. Latest example is the silicon power rectifier shown above.

Product of original work with semiconductors—which earlier created the transistor and the Bell Solar Battery—the new rectifier greatly reduces the size of equipment needed to produce large direct currents. It is much smaller than a tube rectifier of equal performance and it does not require the bulky cooling equipment of other metallic rectifiers.

In the Bell System the new rectifier will supply direct current more economically for telephone calls. It can also be adapted to important uses in television, computers, industrial machines, and military equipment. Thus, Bell Telephone Laboratories research continues to improve telephony—while it helps other fields vital to the nation.



Above, new rectifier (held in pliers) is contrasted with comparable tube rectifier and its filament transformer, rear. Mounted on a cooling plate, lower center, the new rectifier can easily supply 10 amperes of direct current at 100 volts, that is 1000 watts—enough to power 350 telephones.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

Six months from today Which Will You Hold?

this - REGRET TO ADVISE YOU FAILED YOUR FCC EXAMINATIONS -

or this 1st CLASS RADIO TELEPHONE OPERATOR'S LICENSE

Add Technical Training
To Your Practical Experience -

GET YOUR FCC LICENSE IN A HURRY!

Then use our Amazingly Effective
JOB-FINDING SERVICE

Money-Making FCC Commercial Radio Operator LICENSE Information

TV ENGINEERING INCLUDED IN OUR TRAINING & COACHING

Get This Valuable Booklet FREE!

● TELLS HOW -

Here Is Your GUARANTEE

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

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—amateur, Army, Navy, radio repair, or experimenting.

● TELLS HOW -

Employers make JOB OFFERS Like These to Our Graduates Every Month

Letter from nationally-known Airlines, "Radio Operators and Radio Mechanics are needed for our company. Periodic wage increase with opportunity for advancement. Both positions include many company benefits such as paid vacations, free flight mileage allowance and group insurance."

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

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

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY With OUR Coaching AT HOME In Spare Time.

Name and Address	License	Lessons
A/1C Ronald H. Person St. Louis 20, Mo.	1st	25 weeks
Carl Verboomen Wrightstown, Wis.	1st	18 weeks
Marvin F. Kimball Lafayette, Ind.	2nd	21 weeks
L. M. Bonino Harlingen AFB, Tex.	2nd	16 weeks
John E. Hutchison Bluefield, W. Va.	1st	27 weeks

An Approved Member

Carl E. Smith, E.E., Consulting Engineer, President
CLEVELAND INSTITUTE OF RADIO ELECTRONICS
DESK RN-82, 4900 Euclid Bldg., Cleveland 3, Ohio

● TELLS HOW -

EFFECTIVE JOB-FINDING SERVICE HELPS CIRE TRAINEES GET BETTER JOBS

Here Are Just a Few Recent Examples of Job-Finding Results:

BROADCASTING

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitting Engineer at WMMT."
Elmer Powell, Box 274, Sparta, Tenn.

CIVIL SERVICE

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable position."
Charles E. Loomis, 4516 Genessee Ave., Dayton 6, Ohio

AIRLINES

"Due to your Job-Finding Service, I have been getting many offers from all over the country, and have taken a job with Capital Airlines in Chicago as Radio Mechanic."
Harry Clare, 4537 S. Drexel Blvd., Chicago, Ill.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

Your FCC Ticket is recognized by employers as proof of your technical ability.

GET ALL 3 FREE! MAIL COUPON NOW

Cleveland Institute of Radio Electronics
Desk RN-82—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to Avoid Delay)

Please send at once, without obligation, your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License); a sample FCC-type lesson and the important new information booklet, "Money-making FCC License Information." Be sure to tell me about your Television Engineering Course.

PLEASE PRINT CLEARLY

NAME..... AGE.....

ADDRESS .....

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

FOR PROMPT RESULTS, SEND AIR MAIL
Special tuition rates to members of the U.S. Armed Forces
Electronic Training also available to Canadian Residents

Within the Industry

JOHN B. GRAY, for many years a member of the technical staff of *Hughes Aircraft Company,* has been named chief engineer of *Berlant Instruments* of Los Angeles, manufacturer of "Berlant" and "Concertone" tape recorders.

The new appointment was announced by *American Electronics, Inc.* of which *Berlant* is a wholly-owned subsidiary.

Mr. Gray was formerly assistant project engineer for *Sperry Gyroscope Company.* He served in the Navy for 3 years as an officer and is a member of the Naval Reserve. He is a graduate of the Stevens Institute of Technology, a senior member of the IRE, a charter member of AES, and a member of the Acoustical Society of America.

* * *

WILFRED L. LARSON, president of *Switchcraft, Inc.,* Chicago, was recently elected chairman of the Association of Electronic Parts and Equipment Manufacturers, trade group composed of 120 Midwest electronics firms.

J. Wayne Cargile, sales manager of *Permo, Inc.,* was elected vice-chairman and Helen Staniland Quam of *Quam-Nichols Company, Chicago,* was re-elected for her eighteenth annual term as treasurer.

* * *

MICHAEL P. FUMAROLA has been named publicity director for all of the divisions of *JFD Manufacturing Co., Inc.* of Brooklyn.

He will coordinate all promotional and publicity programs for the antenna, rotator, and capacitor divisions and work in close association with Ed Finkel, sales manager, on marketing problems from the public relations standpoint. He will prepare information on the company's technical and merchandising developments as well as plan public service operations for parts jobbers, dealers, TV stations, and consumer publications.

* * *

LAWRENCE C. FULLER, JR. has established a new manufacturers' representative firm at 32 Rittenhouse Place in Ardmore, Pa. to service the Middle Atlantic area . . . **ARROW SALES, INC.** of North Hollywood and Chicago has merged with **G. L. ELECTRONICS, INC.** of Los Angeles. This merger now offers buyers two sources from which to order by mail and three locations where in-person purchases can be made. Mail orders are handled at P.O. Box 3878, North Hollywood, California and 2441 S. Michigan Avenue, Chicago 16, Illinois while stores are maintained in Chicago; at 2005 Empire Ave., Burbank, California; and 1632 Venice Blvd., Los Angeles 6, California.

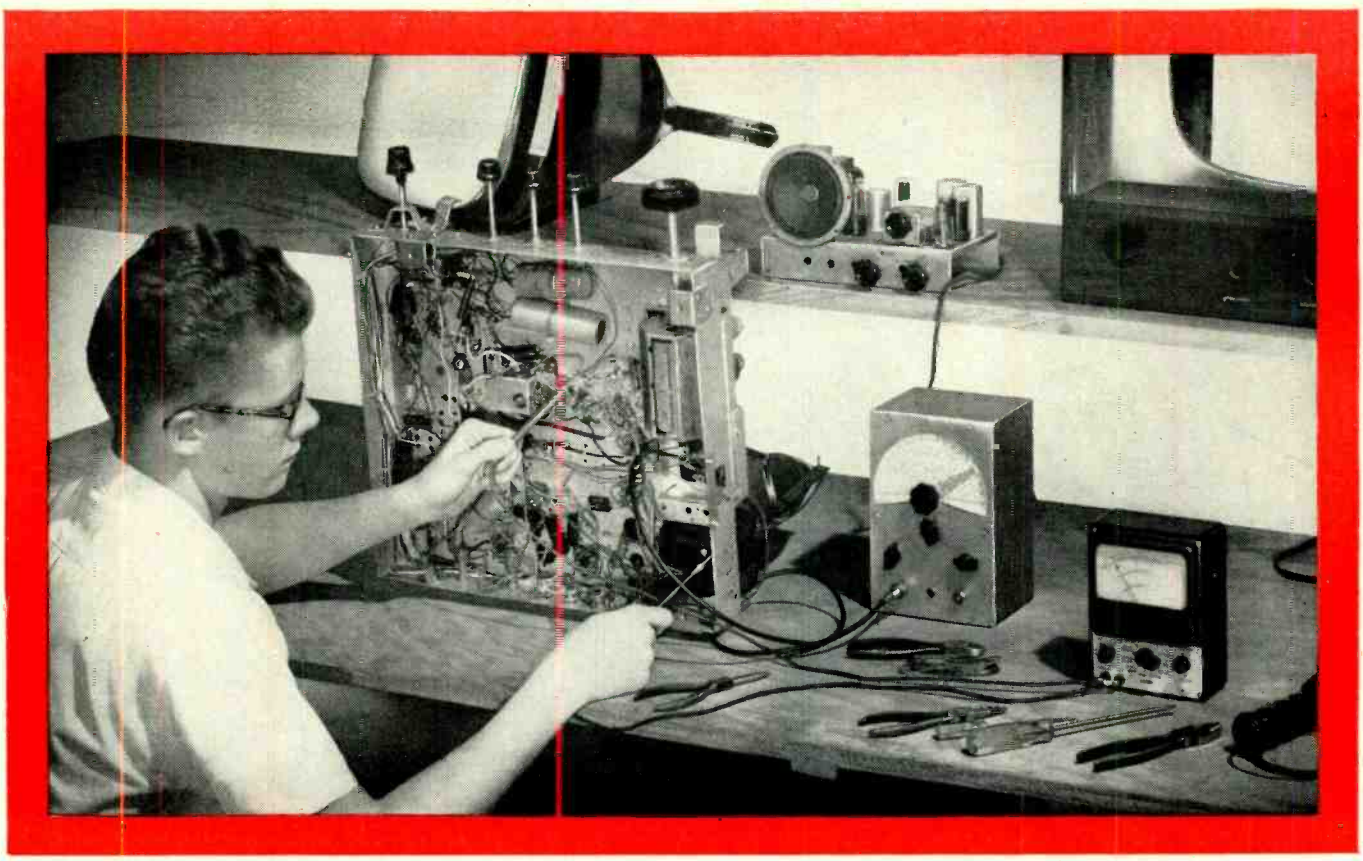
* * *

MILTON J. SHAPP has been re-elected president and chairman of the board of *Jerrold Electronics Corp.,* Philadelphia manufacturer of equipment for master television antenna systems.

Also re-named vice-president by the board was Henry J. Arbeiter who has served as chief engineer since 1948. Two new vice-presidents were elected; Donald Kirk, Jr. to be vice-president in charge of research and development, and Caywood C. Cooley who will direct the field service organization of the firm. Simon Pomerantz, controller of the company was elected treasurer while James J. Fuld was named secretary.

* * *

ELGIN NATIONAL WATCH COMPANY has established warehouse and distribution facilities in Elgin, Illinois for two of its West Coast electronics plants, **AMERICAN MICROPHONE CO.** and **ADVANCE RELAY CO.** A large stock of parts will be carried at the new warehouse . . . A Mid-America regional marketing office has been opened at 7001 W. North Avenue, Oak Park, Illinois by **TEXAS INSTRUMENTS INCORPORATED.** The company's line of semiconductor products and electronic components will be marketed from the new facility . . . **BERLANT-CONCERTONE** has named **ELECTRONIC CORPORATION OF AMERICA,** 104 Somerset St., New Brunswick, N.J. as its factory parts exchange warehouse on the east coast . . . Production of electrical devices, plastic products, and electronic components is now under way in the new **SIERRA ELECTRIC CORPORATION** plant at Gardena, California. Five separate locations in the Los Angeles area have been consolidated at the new site . . . **EASTERN PRECISION RESISTOR CORP.** has moved to a new and enlarged plant at 675 Barby Street, Brooklyn, N.Y. The firm was formerly located at Richmond Hill, N.Y. . . . **L. L. CONSTANTIN & CO.,** manufacturer of glass-to-metal vacuum seals and other electronic components, has opened a second plant at 187 Sargeant Ave. in Clifton, N.J. . . . **MICRO SWITCH** of Freeport, Illinois has purchased a multi-story factory



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RADIO-TV ELECTRONICS **TV SERVICING** **COLOR TV SERVICING**

NOW THREE HOME STUDY COURSES... prepared by instructors of RCA Institutes, engineers from RCA Laboratories, and training experts of the RCA Service Company. Clearly written . . . easy to understand . . . the same high caliber instruction as given in the resident classrooms of RCA INSTITUTES.

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● **COURSE II—TELEVISION SERVICING**—prepares you to advance from radio into the expanding field of television servicing as a well-trained service technician. If you have completed Course I or are now working in the field of radio or TV, Course II will show you the many special techniques of trouble-shooting, aligning, checking, and repairing modern black and white TV sets.

NEW TV KIT AVAILABLE WITH COURSE II—there is no better way to learn than by *doing* and RCA Institutes has developed a large-screen TV KIT available to home study students to build while taking Course II. It has the most modern up-to-date circuitry, actually enabling you to apply at home all the latest servicing techniques.

● **COURSE III—COLOR TELEVISION SERVICING**—covers all phases of color servicing techniques. It is a practical, down-to-earth course in color theory as well as how-to-do-it servicing procedure. A natural move "up" from Course II or for those now employed in TV.

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"PAY-AS-YOU-LEARN" PLAN . . . you pay for one study group at a time, as you progress through the course. Tuition costs are amazingly low. For full details, mail coupon.

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building which provides 300,000 square feet of manufacturing space. The company has been operating from this location on a lease basis for a number of years . . . **BENDIX AVIATION CORPORATION** is building a 85,000 square foot building in the Detroit area to house its research laboratories division . . . **XCELITE, INCORPORATED** of Orchard Park, N. Y., has added a new building which will increase the firm's output of hand tools by about 25 per-cent.

* * *

ARTHUR J. RICHARDS has been appointed chief radio engineer of the electronics division of *Arvin Industries, Inc.* of Columbus, Indiana.

He has been service manager of the radio division for the past six years having joined the company in 1949 after a three year tenure as radio design engineer for *Capehart-Farnsworth Corporation* of Ft. Wayne.

His new duties will include supervision of the design, engineering, and pre-production planning of the firm's radio line.

* * *

W. D. JENKINS of the *Radio Supply Co.*, Richmond, Va. has been elected president of the Electronic Parts Distributors Show for 1956. Theodore Rossman of *Pentron Corp.* was chosen vice-president; W. Walter Jablon of *Presto Recording Corp.* was named secretary while Herbert W. Clough of *Belden Mfg. Co.* was elected treasurer.

The board of directors also made preliminary plans for the 1956 Show which will be held in Chicago the third week in May. Mr. Jenkins appointed committees to deal with the budget, entertainment, housing, publicity, credentials, and the educational program of the sessions.

* * *

PAT J. MORRISEY is the new industrial sales manager for *Gramer-Halldorson Transformer Corporation* of Chicago.

He will manage sales of the firm's complete line of electrical and electronic products for industrial applications.

Mr. Morrisey has been identified with the electronics industry for over seventeen years having been associated with a leading manufacturer of electrical components prior to his present affiliation.

* * *

LLOYD E. SWEDLUND has been named manager of monochrome tube product engineering at the *General Electric* Cathode-Ray Tube Sub-Department in Syracuse . . . **JEFF D. MONTGOMERY**, former sales engineer for *Andrew Corporation*, has been named West Coast engineering manager of *Andrew California Corporation* of Claremont, Cali-

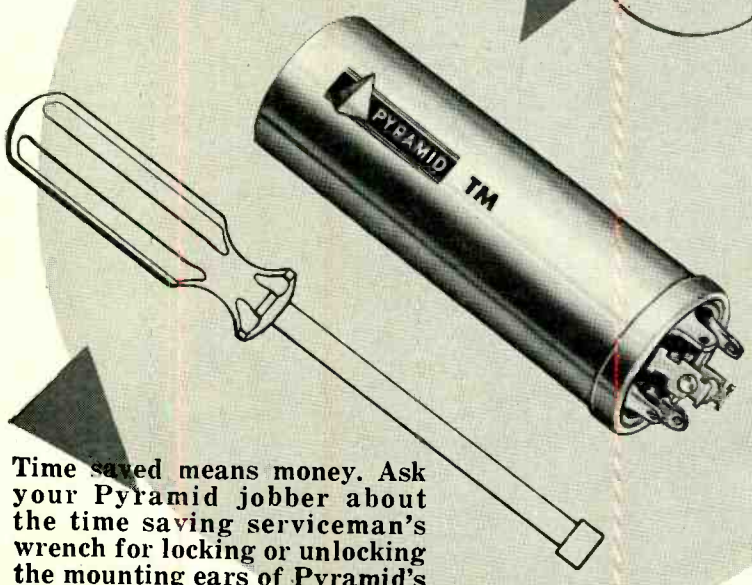
(*Continued on page* 136)

you can't argue with acceptance

proven quality
100% inspected
accurate replacement
prompt delivery

the most complete line of twist mount dry electrolytic capacitors

Burton Browne / New York



Time saved means money. Ask your Pyramid jobber about the time saving serviceman's wrench for locking or unlocking the mounting ears of Pyramid's twist mounts.

Better than any claims we could make is the unqualified and enthusiastic acceptance by engineers and servicemen alike. These are some of the features on which this acceptance is based:

- Aluminum containers provide maximum protection against moisture.
- Low leakage, long shelf life.
- Designed for 85° C. operation.
- Complete with metal and bakelite mounting plates.
- Easy to mount.
- Extremely compact—yet highly dependable.

Pyramid capacitors are listed in Sams' Photofacts

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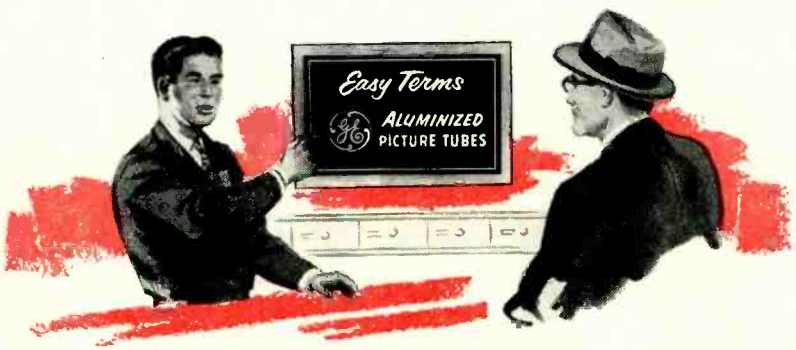
NEW G-E PICTURE-TUBE TV SERVICE DEALERS

1. How to get television service business where your customers cannot pay at once, in full.

2. How to move repaired TV sets now in your store, left there by owners unable to pay immediately.



3. How to keep down your book receivables, in order to free working capital for business growth.

YOUR G-E TUBE DISTRIBUTOR HAS FULL INFORMATION. ACT TODAY!

FINANCE PLAN HELPS SOLVE 3 MAJOR PROBLEMS

Widespread TV ownership has meant a steady uptrend in servicing volume. At the same time, demands on you have increased—demands on your time, facilities, and capital.

General Electric's consumer finance plan for complete picture tube installations, opens up to you, as a service dealer, credit resources which help you tap markets thus far untouched. Markets where customers can't pay large television service bills immediately and in full—but can, and will, pay their bills out of income.

Up to now, your local credit facilities may have been inadequate to handle instalment buying. So . . . G.E. makes available special financing aid in order to help you get all the TV service business you can profitably undertake.

The plan is simplicity itself—your customer pays a small sum down, signs one contract form, and later on you are reimbursed for the full amount of the tubes and labor you've invested, plus your profit from the job. Your capital is untouched. Your receivables remain low.

Ask your G-E tube distributor for complete information on this new way to get more service business—at no sacrifice of your working capital! Instructions . . . contract forms . . . advertising-promotion helps are ready for you. *Tube Department, General Electric Company, Schenectady 5, N.Y.*

CHECK THESE PLUS BENEFITS FROM G.E.'s FINANCE PLAN:

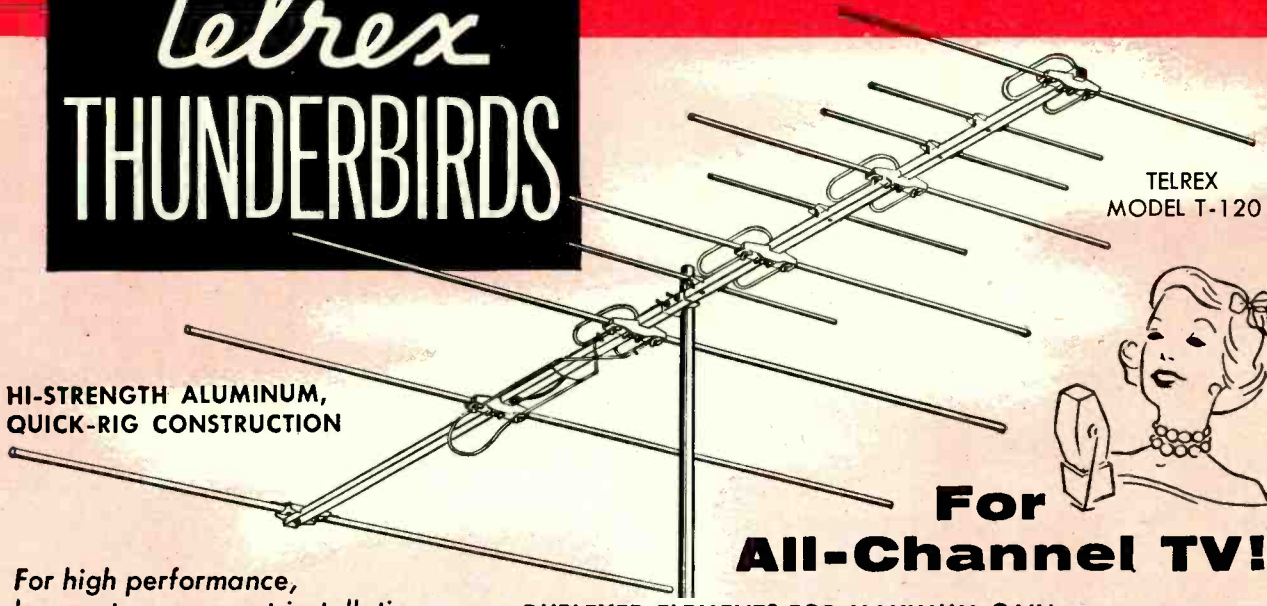
- **Your TV service customers now can afford to replace worn-out picture tubes immediately. They no longer feel obliged to wait.**
- **You can do a Grade-A servicing job, complete with new receiving tubes and any needed parts . . . because your customers need pay as little as $5 down, the rest in monthly instalments.**
- **TV owners now can afford to buy the best from you. That means G-E Aluminized Tubes—G-E Service-Designed Tubes—other high-quality components.**
- **You can successfully compete for the local consumer's retail dollar. You are offering the same up-to-the-minute credit-purchase terms as other progressive merchants in your neighborhood.**

GENERAL ELECTRIC

161-1A5

CONQUERORS OF DISTANCE!

Telrex THUNDERBIRDS



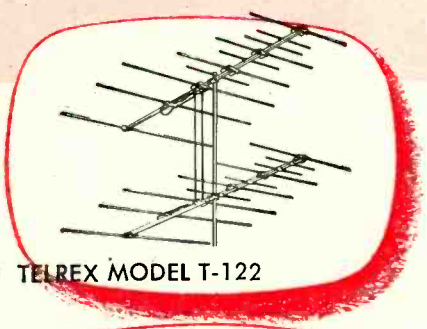
TELREX MODEL T-120

HI-STRENGTH ALUMINUM, QUICK-RIG CONSTRUCTION

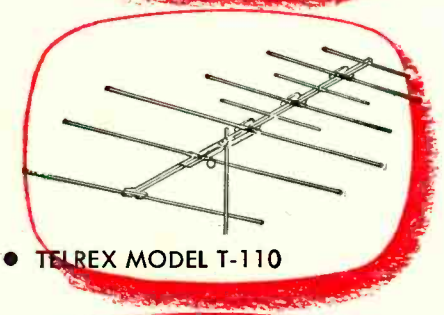
For All-Channel TV!

For high performance, low cost, permanent installation, choose a Telrex "Thunderbird"—

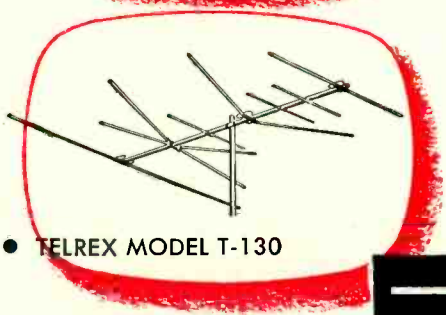
- **DUPLEXED ELEMENTS FOR MAXIMUM GAIN**
- **COMPENSATED "TROMBONE" MATCHING SECTIONS FOR MAXIMUM EFFICIENCY**
- **FULL VIDEO, AUDIO BANDWIDTH FOR MAXIMUM BLACK AND WHITE AND COLOR FIDELITY**



● TELREX MODEL T-122



● TELREX MODEL T-110



● TELREX MODEL T-130

The new Telrex "THUNDERBIRD" multi-element wide-band Beamed Power arrays are engineered for fringe and "sub-fringe" area reception, and for all receiving conditions requiring exceptionally good directivity and high sensitivity.

Super Thunderbird Model T-120 is the finest wide-band, multi-element array ever developed. A system of variable impedance phasing loops permit precision tuning and the duplexing of element functions to provide the equivalent of 6 operating elements on the LO channels; 13 elements on the HI channels. Element for element, they develop greater gain and directivity than many single channel arrays. **Model T-120** is accurately matched to 200-300 ohm transmission line for both HI and LO channels with compensated "trombone" sections to yield exceptionally high gain and optimum signal transfer efficiency. LO band gain averages better than 5.5 db; HI band gains exceed 12 db, while front-to-back ratios range to 25 db.

For brilliant, interference-free signals under toughest reception conditions, choose the Telrex **Super Thunderbird T-120!** Available also in 2 bay units—**Model T-122,** ¼-wave stacked for gain increases averaging 3 db on all channels; and **Model T-122S,** ½-wave stacked to provide gain increases up to 4.5 db on LO channels, over single-bay units.

Thunderbird Model T-110 incorporates all the high-performance features of the **Super Thunderbird T-120,** including variable impedance loop phasing, compensated "trombone" matching sections and in-line, low wind resistance configuration plus high strength, all aluminum, quick-rig construction for dependable, high performance, low cost, long lasting installations. Duplexed elements are equivalent to 5 effective elements on LO channels for average gains exceeding 5 db; and 11 operating elements on the HI channels for gains exceeding 10 db. Front-to-back and front-to-side ratios of better than 22 db minimize interference.

Available stacked ¼-wave, **Model T-112,** for all channel gain increases of 3 db; and ½-wave stacked, **Model T-112S,** for increased gains to 4.5 db on LO channels.

Thunderbird T-130 employs Conical Dipole and "V" Beam quadrature phased driven elements to achieve virtually flat, stepless gain characteristics on all VHF channels with minimum number of elements. **Model T-130** also employs variable impedance phasing loops, duplexed elements and Telrex compensated "trombone" matching sections. Four effective LO channel elements; 9 operating elements on HI channels, produce gains to 5 db on 2-6, and up to 11 db on channels 7-13. Special trap circuitry used in all Thunderbirds, attenuates interference arising outside the assigned TV bands to assure crisp, smear-free picture quality and full sound response.

Model T-132, stacked ¼-wave gives average gain increase of 3 db on all channels; ½-wave stacked **Model T-132S** provides up to 4.5 db gain on LO channels over single bay.

Producers of famous "BEAMED POWER" Communication Rotaries. Call or write for new catalogs on TV Antennas, Commercial Arrays or Amateur Rotaries.

telrex INC.

AMERICA'S STANDARD OF COMPARISON

"CONICAL-V-BEAMS"

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NEW JERSEY, U.S.A.
Tel. PRospect 5-7252

Canadian Distributor:
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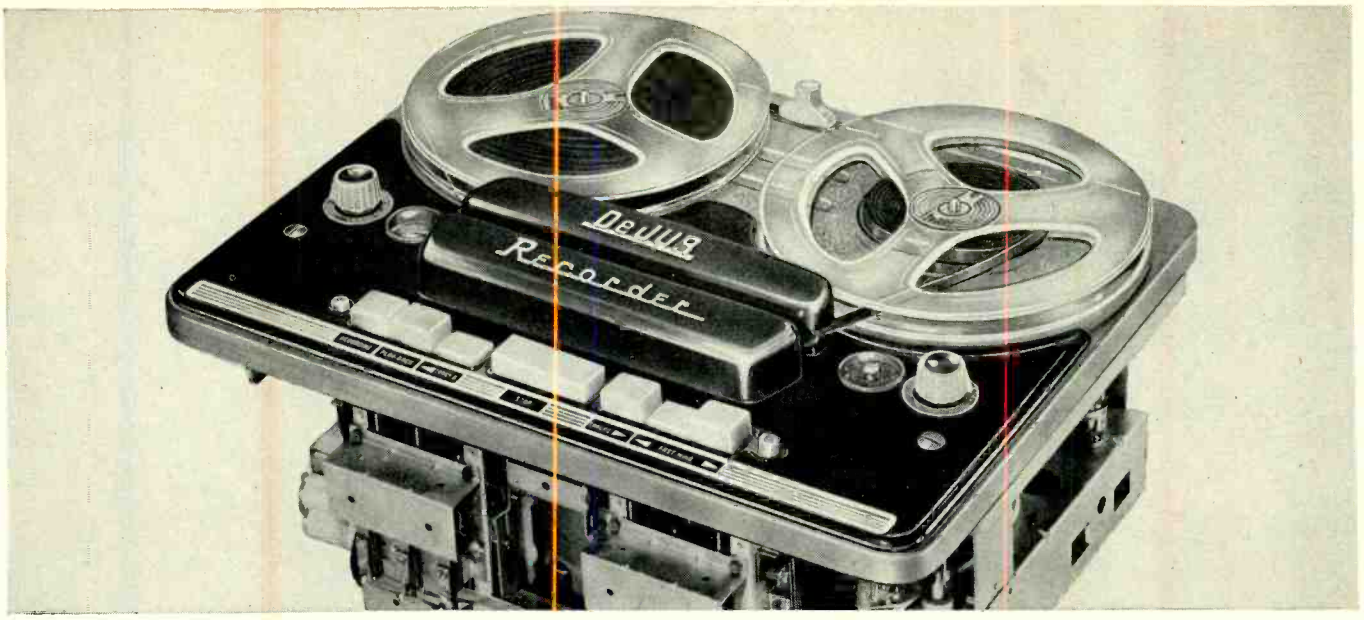
"Conical-V-Beams" are produced under U. S. Patent No. 23,346, Canadian Patent No. 500,436 and British Patent No. 691,485 — other patents pending. Sold only through authorized distributors.



HERE IS THE TAPE RECORDER THAT "COULDN'T BE MADE"...

What a serious high-fidelity enthusiast wants in a tape recorder has never been a mystery. He wants a recorder which, at 7½ ips will equal or exceed professional performance at 15 ips — and at a price comparable to the price of the usual garden variety of "home recorder" In other words, he wants flat response over the entire audio range, undetectable noise, hum, wow and flutter and professional NARTB equalization — at 7½ ips (to give up to 90 minutes of playing time on a 7" reel at a cost lower than one good LP record) — and all for less than $300.

Now, DeJUR, a great name in high-quality precision cameras, answers the demands of the HiFi enthusiast in every particular. For the first time in America, he can have a tape recorder meeting his most exacting performance requirements for a fraction of the price he would normally expect to pay.

Compare it in an A-B test with the most expensive professional recorder your high-fidelity outlet carries. We're that sure you won't be able to tell the difference!

Now, let's get down to specifications. They have been checked by an independent engineering firm and confirmed by the testing laboratories of America's largest high-fidelity distributors.

FREQUENCY RESPONSE

At 7½ ips, the frequency response is 40 cps to 16,000 cps ± 2 db (the closest comparable machine is 1,000 cps *less* and $100 more!) Even at 3¾ ips, the DeJUR Dual Professional is flat from 50 cps to 10,000 cps ± 2 db.

SIGNAL-TO-NOISE RATIO

Noise is down 55 db (that equals or exceeds the figure for recorders priced at $600 and up!)

FLUTTER AND WOW

The DeJUR Dual Professional uses a heavy-duty genuine hysteresis dual-speed, synchronous motor, the same type of motor used in $1,000 studio recorders (even the better "home recorders" use only 4-pole motors!) A hysteresis motor is independent of line voltage fluctuations, thus eliminating a major source of wow and flutter. Both are less than 0.1% at 7½ ips, 0.2% at 3¾ ips (the competitive recorder closest in performance has 0.25% at 7½ ips and costs $100 more!)

EQUALIZATION

Professional NARTB equalization is used throughout the DeJUR Dual Professional. This means that, not only can you make and play back tapes of perfect fidelity, but you can also play commercial pre-recorded tapes the way they were *meant* to be played.

INSTANT TRACK SWITCHING

Four separate heads are employed in the Dual Professional — an erase head and a record-playback head for each track. When you reach the end of a reel on the first track, you simply press a button and the tape reverses its motion recording or playing back the second track! Anyone who has fussed and fumed as he tried to change reels in the middle of a symphony will greet this feature with cheers!

ELECTROMAGNETIC DYNAMIC BRAKING

In the DeJUR Dual Professional, there are no mechanical clutches, belts and pulleys to get out of order. The dual speed hysteresis motor is reversible and electromagnetic dynamic braking is employed for instantaneous stops and starts without tape strain or stress.

ILLUMINATED TAPE COUNTER

An illuminated, clock-like dial indicates elapsed footage so accurately that the tape can be indexed to a single note!

AUTOMATIC STOP

Inexpensive DeJUR aluminum foil leaders are available which automatically stop tape motion in either direction! There's no need to re-thread — no flopping tape ends.

PUSH-BUTTON KEYBOARD

A piano key switchboard controls all recording and playback functions through relays. Even your wife can operate the DeJUR Dual Professional without an instruction manual!

OTHER EXCEPTIONAL FEATURES

Instantaneous stopping in record or playback, less than ¼" in fast wind; 2 high impedance and 1 low impedance inputs controlled by selector switch, rewind time of 90 seconds for 1200-foot reel in either direction, foam rubber pressure rollers, relay operated and triple-fused for protection against improper operation, 105-220 volt, 60 cycle AC operation.

And the price? That's the biggest surprise of all! The DeJUR Dual Professional Tapedeck is only $299.50 audiophile net!

Also available in a handsome, scuff-proof carrying case complete with built-in 6-watt power amplifier, 2 electrostatic speakers, 3 PM speakers and wide-range cardioid dynamic microphone for only $379.50 audiophile net.

AVAILABLE ACCESSORIES

Remote control foot switch $19.50.
Wide-range cardioid microphone $29.50.

WRITE FOR COMPLETE SPECIFICATIONS

DeJUR-AMSCO CORPORATION
Dept. RTN-1, Long Island City 11, N. Y.

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DeJUR DeJUR USA

Dual Professional

TAPE RECORDER

HARRY R. ASHLEY
President

DO YOU OVERPAY FOR QUALITY INSTRUMENTS LIKE THESE?

EICO's mass purchasing and world-wide distribution, together with advanced electronic design, produce values never before possible . . . to give you *LABORATORY PRECISION AT LOWEST COST!*

You build *EICO KITS* in one evening — but . . . *THEY LAST A LIFETIME!*

GET THE MOST FOR YOUR MONEY! Don't buy ANY test instrument until you put the EICO INSTRUMENT (kit or wired) equivalent before you— and . . .

★ Compare ADVANCED ELECTRONIC DESIGN

★ Examine the QUALITY PARTS

★ Notice ease of construction

★ Check EICO's 5-WAY GUARANTEE on components, instructions, performance, lifetime service and calibration

★ Compare FEATURE for FEATURE, DOLLAR for DOLLAR

Then YOU decide who's giving you the MOST for YOUR MONEY.

46 KITS and Instruments to choose from!—an instrument for every purpose.

You'll SAVE 50% and more . . . when you BUY EICO!

In stock at local parts distributors coast to coast.

Write for *FREE CATALOG R-11*

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KIT $26.95
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Range: 150 Kc. to 435 Mc.

NEW RF SIGNAL GENERATOR #324

NEW
DC WIDE BAND
5" OSCILLOSCOPE
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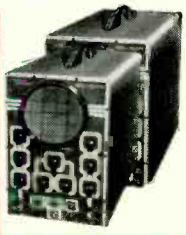
KIT $79.95
Wired $129.50



5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
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7" PUSH-PULL OSCILLOSCOPE #470
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VACUUM TUBE VOLTMETER #221
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DELUXE VTVM #214 (7½" METER)
KIT $34.95
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KIT $29.95
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5MC-4.5MC CRYSTAL ..... $3.95 ea.

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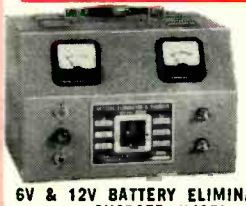

KIT $29.95
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6V & 12V BATTERY ELIMINATOR & CHARGER #1050

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

 Over ½-Million EICO KITS & Instruments sold to date—*OUR TENTH YEAR!*

By N. H. CROWHURST

Buying a Hi-Fi Amplifier?

Before you buy—make sure you know what features in a power amplifier are most important.

EVERY industry has its phases, one of which is the condition where individual manufacturers feel compelled to include some features that do not contribute anything useful to the operation of their products. Because his competitors are advertising these features and the public is insufficiently enlightened as to their value, the individual manufacturer decides to include them in his line to maintain his competitive position. Eventually the public is educated to the true value or worthlessness of such features. This may be started, either by a truly courageous manufacturer who is prepared to stake his livelihood on introducing the simplified version to the public and at the same time persuading them that they do not require all the extra features, or by some individual, with somewhat less at stake.

The audio amplifier industry seems to be in somewhat this position at present. For some time manufacturers have been producing amplifiers to better and better specifications. Individual manufacturers, when discussing their policies for the design of next year's products, are faced with the problem of not only making their amplifiers perform well, but also of being able to quote truthful figures that compare favorably with those quoted by competitors.

The newcomer to audio thus encounters real confusion when he decides to choose an audio amplifier. Naturally enough, as in selecting any other commodity, he starts by consulting catalogues, with the idea of sorting out a short list of the best from which to make a final choice at demonstrations. Right here he encounters his first problem. What do these specifications mean? How much power do I really need? How good does the frequency response really have to be? How little distortion must I have, if I'm really going to have clean-sounding reproduction?

These are the "how good?" problems. In addition to these, he has to make sure that the amplifier will fit in with the loudspeaker system he proposes to use, and also work satisfactorily from his pickup, tuner, or whatever he wishes to play through the amplifier. So let's take some of these questions in order.

How Much Power?

The kind of answer to this question that one will get by asking different people varies widely. This is largely due to the wide interpretation of what is loud or what is quiet.

If you look at a table of loudness figures you will find that the range covers 130 decibels from the threshold of audibility to the threshold of pain. This represents a power ratio of 10,000,000,000,000! A comfortable listening level, corresponding to average conversation or a program heard in an average auditorium, is about 50 decibels above the threshold of hearing. In the average living room, with a loudspeaker system of average efficiency, this can be achieved with an average power of about 300 milliwatts.

The average intensity of a sound is considerably below the maximum peaks, which occur occasionally in the same program material, whether we are considering speech or music reproduction. An amplifier must have sufficient margin to cover the peaks without going into distortion. Allowing a good margin for peak overshoot, 10 watts should be ample to cover an average power of 300 milliwatts, with the highest possible transient peaks likely to be encountered.

However, the interesting point is that the loudness scale covers such a tremendous power range. The difference between what

Use this guide in making your selection

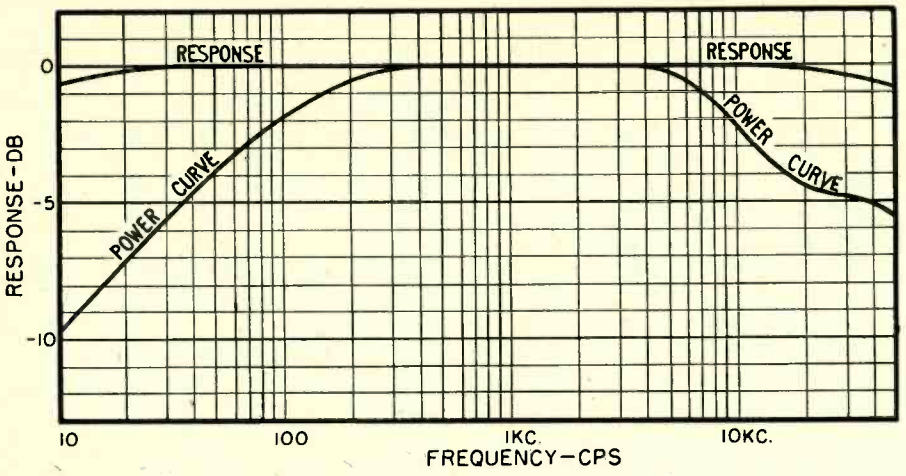


Fig. 1. Comparison between frequency and power response curves for a typical amplifier. The frequency response is plotted at a comparatively low level, where there is no risk of running into distortion. The power curve shows the maximum output at each frequency with a specified standard of distortion. Refer to discussion in text.

some people would call average conversation and the way others normally converse—which might more accurately be called shouting—can be at least 10 db. An increase in power level of 10 db represents 10 times as much power. This means that, to produce a consistent level, with head-room for peaks, equivalent to some people's "loud conversation," we should need a 100-watt amplifier instead of a 10-watt unit.

The difference between the two is that the 10-watt amplifier, turned up to a point where it would never overload on the highest peak, will provide us with a comfortable listening level in our own living room, while the 100-watt amplifier will provide the neighbors two doors away with a comfortable listening level, as well as ourselves, that is if the loudspeakers will handle that much. So, assuming that our definition of "being neighborly" means we allow our neighbor to select his own program on his own equipment, and not rely on listening to ours, we should not need more than about 10 watts to get the kind of level we need.

Popular amplifiers have outputs extending up to about 50 watts, but the reader is cautioned against a common mistake of thinking that a 50-watt amplifier turned up to give full output will sound 5 times as loud as a 10-watt amplifier turned up to full output. When we consider that 50 watts is only 7 db louder than 10 watts, and that 3 db is generally recognized as the smallest detectable change in loudness, we realize that a change from 10 watts to 50 watts represents a little over twice the smallest change in loudness that can be definitely noticed. The important thing to realize is that, although this change may not be very noticeable in our own house, it can represent the difference between inaudibility and quite an annoying audibility in our neighbor's house. Keep this in mind when planning a system.

If you are one of those fortunate people who live where you can use 50 watts without annoying the neighbors, and if you also like to have your orchestral music so the crescendos really sound like crescendos, then by all means get a 50-watt amplifier. But if you live in an apartment, or some place where it is good to consider the neighbors, then you are advised to buy a smaller amplifier, and automatically safeguard yourself against giving unwitting annoyance. You will be surprised to find that 10 watts doesn't really sound very much quieter than 50 watts in your own room.

Frequency Response

The next question is, how good does the frequency response have to be? We already have a hint at the answer to this question from the fact that 3 db is the smallest change in loudness that can readily be heard. This statement applies to general program material. On the loudness of a single tone 1 db is just noticeable. This being the case, it is fairly obvious that anything less than 1 db deviation from flat in overall frequency response is going to be impossible to detect audibly. So from the listening standpoint it is pointless to have an amplifier with a response of better than ± 3 db over the audio band.

This is one of those cases where the fact that other manufacturers are giving specifications to fractions of a db, such as .1, .2 or .5, has encouraged competitors to design amplifiers whose specifications do not look unfavorable compared with the best.

Frequency responses are usually given within tolerances of db from flat, and also between frequency limits at which it is assumed the amplifier ceases to be flat. A popular range is from 20 cycles to 20,000 cycles. This is certainly as wide a frequency response as you will ever need. From a practical viewpoint, musical tones of any kind seldom, if ever, get below 40 cycles, so a response down to 40 cycles is all that is necessary to reproduce any kind of program material you are likely to encounter. At the high end, few people can hear above 17 kc., and they have to listen hard to hear that. Quite commonly hearing ceases above 12 or 13 kc., so again it is obvious that 20 kc. is an absolute limit to satisfy even the most critical ears.

Some amplifiers, however, specify a frequency response from less than 20 cycles to over 20 kc. Various reasons are given for doing this, associated with the performance of the amplifier, but it is obvious from the foregoing that this cannot contribute to listening enjoyment.

It has been pointed out that one *can* detect the difference in sound reproduced through amplifiers whose response goes beyond 20 cps to 20 kc. limits and those whose response rolls off at these limits. This is perfectly possible, but the *difference* is not necessarily an *improvement* in quality of reproduction. A more critical examination of the facts shows that the extended frequency range tends to increase the background noise level, which is audible in the form of hiss, so there is a somewhat higher hiss level in the wider range amplifier. Some people seem to have picked up the erroneous impression that the presence of a nice lot of hiss indicates good high-frequency response.

Surely it is obvious that realism in high-frequency response requires the absence of artificial hiss, while maintaining a faithful reproduction of the high frequencies in the program material. This is better achieved by having an amplifier with a response flat between the audible limits and then rolling off gradually at both ends.

Power Response

Another aspect of power output and frequency response relationships is given by some manufacturers under the term "power response." An amplifier may give its rated output, of say 50 watts, over a band of frequencies in the middle range, but may not be capable of giving its full 50 watts over the entire frequency range specified. Its frequency response may comply with the specification at a level of, say, 10 watts, but it will not give 50 watts at the ends of the specified frequency range. Some take the view that such an amplifier does not conform to its specification, or that the specification is misleading.

If the output is given as 50 watts and the frequency range is specified as 20 cycles to 20,000 cycles, then some argue this should mean the amplifier will give 50 watts all the way from 20 cycles to 20,000 cycles. However, few amplifiers listed as having a frequency response of 20 cps to 20 kc. and a power output of 50 watts will give the full 50 watts at 20 cycles or 20 kc.

This is the reason why some manufacturers specify power response, which is a curve giving the maximum output, or the output with a given amount of distortion, plotted against frequency. Fig. 1 illustrates power response plotted against the frequency response of the same amplifier.

To design an amplifier that gives the full rated output at the extreme ends of the specified frequency response range requires the use of a much more expensive output transformer. So

the question will arise, is this extra cost worth it, in terms of improved performance?

This is a subject about which there has been some controversy. But the fact remains that any audio program material possesses nowhere near the full energy level at either the low end or the high end. Consequently the full power is not necessary at the two ends of the frequency response to reproduce any acceptable program material. It may be desirable in a special-purpose laboratory amplifier, the purpose of which is to make measurements over the whole range of frequencies, but this is an application not considered in this article.

An additional aspect would seem to argue in favor of not having the full output available at the end of the frequency response. Full rated output at the high end accounts for burn-out of a number of tweeter units, which can occur if there is any instability giving rise to either high-frequency oscillation or excessive over-emphasis of the high frequencies. If these oscillations or over-emphasis occur, say, at 20 kc. where they are not audible, but the high-frequency unit has to take the power, then the voice coil of the high-frequency unit, which is usually not very large, has to absorb the entire power output of the amplifier, and will burn out if this continues for any period of time.

At the low end of the frequency response, 50 watts at 20 cycles represents a very large movement of a lot of air, because a considerable volume movement has to take place to transmit the necessary energy at the low frequencies. This means one of two alternatives must be chosen. Either the low frequencies must be provided by a number of large low-frequency loudspeaker units, so the 50 watts can be pushed into the room with a reasonable diaphragm excursion, or else the power must be limited, down in this range, so the unit used does not have its diaphragm pushed clean out of the gap, if a stray 50 watts at 20 cycles somehow manages to get through the amplifier.

Distortion

Next we are asked, what do the distortion figures mean? Picking up current catalogues, one finds distortion figures quoted from .05% and even lower, up to 2 or 3%, yet all the units are billed as high-quality amplifiers. So the question naturally arises, what figure can be considered acceptable?

Of the two methods of specifying distortion, harmonic and intermodulation, the former, giving the total harmonic present in a reproduced waveform from a pure sine wave, remains slightly the more popular. Some years ago, the fact was noticed that less than 5% of a second harmonic was difficult to detect audibly, while other forms of distortion produced by the same amplifier (getting only 5% second harmonic distortion) were quite noticeable. This led to a search for alternative methods of specifying distortion, based principally upon intermodulation checks. The various intermodulation products are more readily noticeable on the reproduction of program material, because they introduce completely spurious tones rather than simple harmonic products which modify the timbre of a tone. But this does not necessarily mean that the method of measuring and specifying distortion is any more indicative of the auditory performance than was the simple harmonic method of measuring distortion.

Last year Mr. C. J. LeBel presented the results of some experiments in a paper before the Audio Engineering Society, in which he also discussed various theoretical relationships between the harmonic method of measuring distortion and the various methods of measuring intermodulation distortion. The specification of intermodulation distortion is further complicated by the fact that there are various standards for making the measurements. An interesting result of Mr. LeBel's experiments was that, while the theoretical relationship seems to hold fairly well with comparatively simple, non-feedback type amplifiers, the modern high-feedback, low-distortion amplifiers did not seem to give such consistent results.

This leads us to ask the question, "Supposing I take two amplifiers, in which identical methods of measuring distortion are used, and identical results are obtained from each measurement; will both amplifiers give me the same apparent distortion *on a listening test?*" The answer is that they may give widely differing results!

To understand how this can be, we need to know a little bit more about the character of distortion. Taking first the older method of measuring distortion, by checking total harmonics, the reason for a difference can be seen fairly readily. Experiments have shown that the second harmonic is the most easily tolerated, and is practically unnoticeable up to about 5% on a single pure sine wave. The third harmonic, however, becomes noticeable at a considerably lower level—somewhere around 1½ to 2%; and higher order harmonics become progressively more noticeable.

Suppose we take an amplifier, well designed but without feedback, which gives 3% harmonic distortion, all of which is of the second variety. Now suppose we put in some extra gain and add 40 db of feedback around this amplifier. According to feedback theory we could knock the second harmonic from 3% down to .03%. But we have overlooked something.

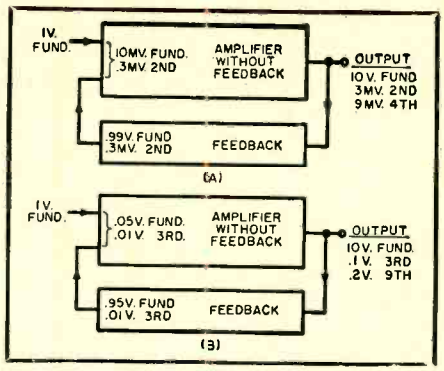


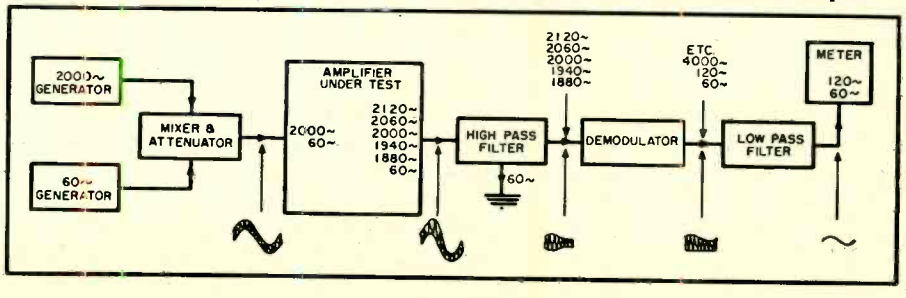
Fig. 2. (A) How an amplifier can increase the order of harmonic while reducing its magnitude, by adding feedback. (B) Another example of raising harmonic order by use of feedback. See text for details.

The input to our new amplifier, inside the feedback loop, (which has 40 db more gain than the original amplifier) is now 99% feedback balanced against 100% of the original signal. The resultant signal put in—the remaining 1%—will contain 3% second harmonic—or very nearly that much—to offset the 3% which the amplifier is going to generate, resulting in only .03% residual second at the output. Now this 3% of second harmonic, at the input to the amplifier, will generate 3% second harmonic of itself on the way through the amplifier, as well as offsetting the original second, resulting in a component at the output, 3% of 3% fourth harmonic, or .09% fourth harmonic. This is illustrated, with voltage figures, in Fig. 2A.

So our 40 db feedback has knocked our original second harmonic down to .03% and has won us .09% fourth harmonic which we didn't have at all at the beginning. Multiloop amplifiers can do a good job of multiplying the order of residual harmonic that gets left!

Suppose now that the original design is not too good, so that, without any feedback at all, the distortion component might be 20%. It is quite easy to knock this 20% down to 1%, merely by using 26 db of feedback. Assume that the 20% is third harmonic this time. So 26 db of feedback will reduce 20% third down to 1% third. But at the same time 1/5th of the resultant input to the amplifier, inside the feedback loop, will be third

Fig. 3. One way to measure IM distortion. Frequency components are marked to show first and second order components and corresponding first-order wave envelopes.



harmonic; and this will produce 1/5th third harmonic of itself on the way through the amplifier—maybe not quite as high as this because the level is lower than the fundamental. Assume perhaps that the fed back third generates 1/10th of itself, ninth harmonic. This still means that we have 2% of 9th harmonic, although we have reduced the third harmonic to 1%. Fig. 2B illustrates this case.

By dividing the feedback loops up into sections we may keep the resultant harmonic at any one point below 20% and hence avoid producing a high-order harmonic as high as 2%. But the principle is evident. Working in this manner, unless we design the amplifier to have low distortion without feedback, we have high-order harmonics, instead of the low-order harmonics that the old fashioned type of amplifier more commonly had.

Turning now to intermodulation products: most of the *theory* concerning intermodulation products is based on components caused by the same curvatures in the amplifier that produce low order harmonic products. The commonest intermodulation test consists of applying a combination of 60 cycles and 2000 cycles, in amplitude ratio 4 to 1, and then applying a filter system to the output which eliminates the two original signals and measures the residual intermodulation product.

The intermodulation we are looking for is a modulation of the 2000-cycle signal by the high amplitude 60-cycle wave. To measure this, first the 60-cycle component is filtered off by a high-pass filter. Then the residual 2000-cycle component is passed through a demodulator, similar to that used in a receiver, which will detect whether there is any modulation of the 2000-cycle signal. This entails filtering out the residual component of 2000 cycles, and getting left with a modulation consisting of 60 cycles and upward. If only low order components are produced, 60 cycles and 120 cycles may be the only spurious modulation components present, after this process. This procedure is shown in Fig. 3. But if high-order intermodulation products are generated, frequencies as high as 900 cycles may easily be present, and a filter network intended to eliminate a carrier of 2000 cycles will also practically eliminate components as high as 900 cycles at this point.

High-order intermodulation products, like high-order harmonic products, are much more noticeable. High-order intermodulation products cause a general "muddiness" in the reproduction. In addition to having a greater "annoyance factor," the high-order products are apt to be inaccurately measured, for the reason just described.

Hum and Noise

This is one more performance figure given in amplifier specifications which can be indicative of how the amplifier will sound. Sometimes hum and noise figures are given separately and sometimes a combined figure is given. Let's take them separately to see what each method of specification can tell us.

First suppose we are given a figure of hum level. Will two amplifiers both specified as giving, say, 90 db below rated output sound the same when fed into the same loudspeaker system? (Assuming of course that the two amplifiers have the same rated output.) Again the answer is. not necessarily.

A look at the loudness contours near the threshold of audibility—which is where we hope to find the hum level—shows that the ear becomes decreasingly sensitive at the rate of about 18 db-per-octave as frequency goes down. The frequencies present in amplifier hum range from 60 cycles upwards. The fact just mentioned means that —90 db hum level, in which the only component is 120 cycles, is no better than a hum level of —72 db, composed entirely of 60 cycles.

A 60-cycle hum is usually due to "break-through" from tube heaters, fed by 60 cycles from the line transformer. A 120-cycle hum is usually caused by residual ripple on the "B+" supply, which is full-wave rectified. Sometimes 180-cycle hum may be present, due to a radiated field from the power line transformer. This will be even more perceptible to the ear. For example, a —90 db hum level, in which the principal component is 180 cycles, will not be better than a 61 db hum level at 60 cycles.

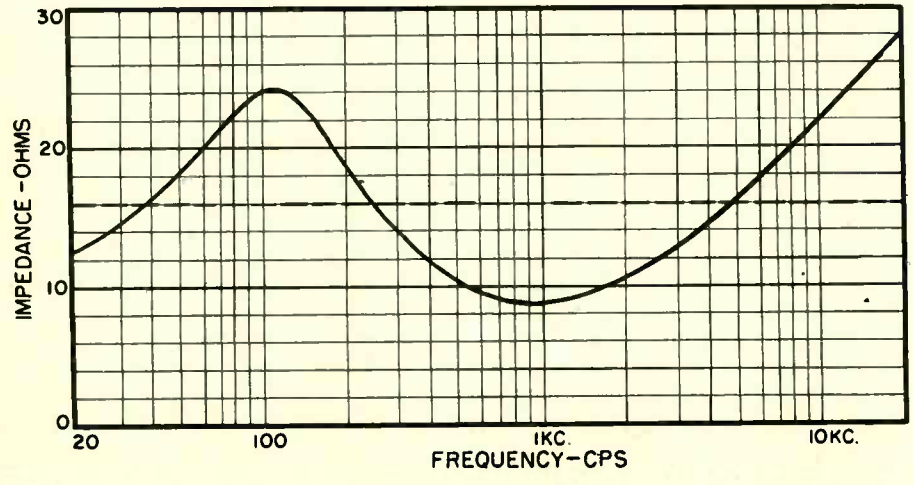
Even this is not the worst possible disparity. Another variety of hum is the ticky, static kind, that can be due either to charging pulses on the storage capacitor of the rectifier filter system or, if choke filtering is used, to current switchover between the two halves of the rectifier. Either way, the resultant is a short duration pulse, of which the hum meter will measure an r.m.s. value, integrated over a 60- or 120-cycle waveform on which it appears. Thus its instantaneous amplitude may be as much as 10 times its r.m.s. reading.

Assuming that the pulse duration is 1/20th of the 60-cycle period, and the amplitude is 10 times its r.m.s. reading, such a ticky hum level can readily fall within a specification of —90 db and yet be noticeable against most program material.

Noise level, which is generally interpreted to mean tube hiss and kindred noises, although sometimes the figure given includes hum, can also have a variety of interpretations according to the precise nature of the noise. In general, a good flat "white" noise is not too noticeable. Even if it is noticeable during quiet periods of the program, it cannot be considered objectionable. But if the amplifier has a sharp roll-off, or a tendency to peak at an ultrasonic frequency, this can give marked coloration to the noise, making it sound like a definite hiss instead of just a background. Differences of this nature can be equivalent to a deviation in measured value of between 10 and 20 db.

This, it is true, is not such a drastic deviation as can occur in specification of hum level, but when the two are given as a combined figure the value does not really convey much. A level, specified as —90 db relative to full rated output, is usually practically inaudible in the average living room, unless you put your ear fairly close to the loudspeaker. If care has been taken to keep the components of noise and hum to the less audible variety, and a figure of —90 is achieved, then you will not be able to hear the background noise, even by putting your ear right into the loudspeaker.

Fig. 4. Speaker impedance characteristic. Dotted line represents the average impedance.

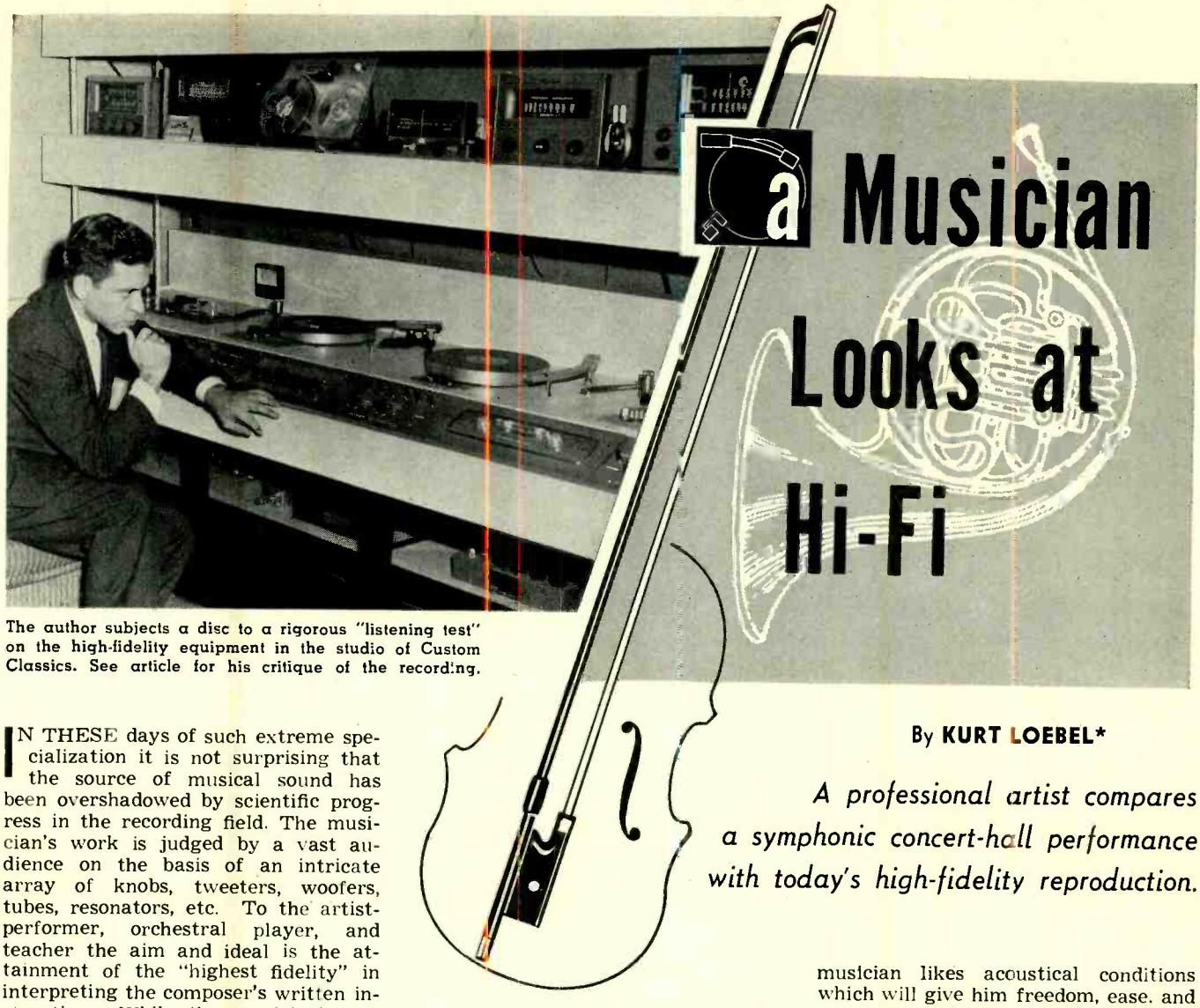


Matching

There are still some more things specified about audio amplifiers that we need to check before making our purchase.

The output impedance must provide for the particular loudspeaker system we have in mind. If the loudspeaker system operates at 16 ohms, then we need an audio amplifier with an output impedance rated at 16 ohms. The writer has one observation to make here however: a little while ago, measuring a number of loudspeaker units, he found that the impedance of the unit at a mid-range frequency was considerably below the rated impedance.

(*Continued on page* 146)



The author subjects a disc to a rigorous "listening test" on the high-fidelity equipment in the studio of Custom Classics. See article for his critique of the recording.

a Musician Looks at Hi-Fi

By **KURT LOEBEL***

A professional artist compares a symphonic concert-hall performance with today's high-fidelity reproduction.

IN THESE days of such extreme specialization it is not surprising that the source of musical sound has been overshadowed by scientific progress in the recording field. The musician's work is judged by a vast audience on the basis of an intricate array of knobs, tweeters, woofers, tubes, resonators, etc. To the artist-performer, orchestral player, and teacher the aim and ideal is the attainment of the "highest fidelity" in interpreting the composer's written instructions. While the musician's life is primarily directed toward the achievement of this goal, no realistic outlook on our present day musical scene can overlook what is commonly referred to as "hi-fi."

The estimate of retail sales of components for high-fidelity equipment for 1954 is $50,000,000. The significance of this figure can not be brushed aside by even the most "non-commercial" musician. Any movement directed towards bringing finer musical reproduction and ultimately finer music into the American home, deserves wholehearted support on the part of the musician, providing it is based on the critical appraisal of the listening audience. At the same time, however, it must be understood that a considerable difference exists between a live performance and a recording session.

Aspects of a Recording Session

The limitations of the recording session are the first of many obstacles to be overcome in the reproduction of the concert hall sound by mechanical means. There are the unavoidable physical restrictions, preventing coughs, the squeaking of chairs, sneezes, hitting buttons, and the noise of turning pages. There is the psychological tension of aiming for technical perfection in view of the permanency of one's musical creation. The musician also seeks to maintain freshness and enthusiasm despite the repetition of the same passages or movements. With the use of tape and the possibility for splicing, great improvement has been made in this direction.

As far as the technical aspects of recording are concerned, at least in the author's experience, there is often a desire from the technical personnel that the performer do a minimum of modifying dynamically and balance-wise. The recording engineer's technical and musical understanding is then trusted to achieve the proper dynamic range, without destroying musical logic or stylistic traditions.

Fortunately in the recording of classical music there is no evidence that the method of recording is like that of recording crooners, where the singer uses no dynamic range and the expression is supplied entirely by the men who turn the knobs.

For the best playing results, the musician likes acoustical conditions which will give him freedom, ease, and power in tone production. He will favor, rather, the longer reverberation time of a good concert hall (about 1.7—2 seconds) than the comparatively dead studio with shorter reverberation time, to avoid the forcing of the string sound and overblowing of the brasses. A recent experience of the Cleveland Orchestra illustrates these problems. *Columbia's* engineers have had to adjust to the accoustics of the hall by moving the orchestra out and in front of the shell as far as possible. Then they supplemented the sound by reproducing and picking up live sound from the marble-lined foyer. Eventually a much more "live" recording sound was obtained.

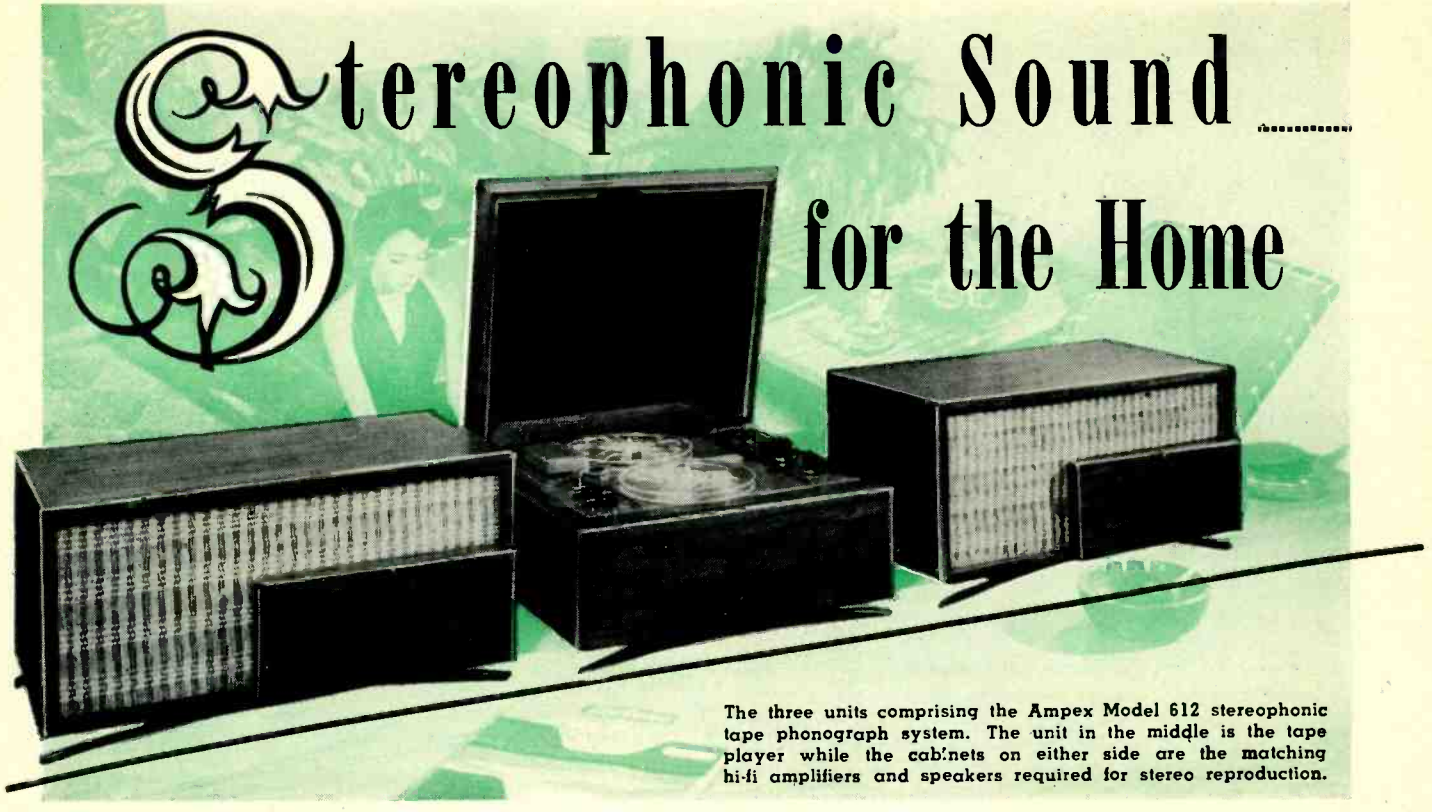
Four factors would constitute a musician's recording paradise:

1. Absorbents (appropriate types of wall coverings) adjustable in relation to the reverberation time for various musical performances, such as orchestra, chamber music, and solo recital;
2. Air-conditioning controlling the moisture content of the air, which has such a vital effect on intonation;
3. Physical conditions which would enable players to hear each other well enough to achieve perfect ensemble.
4. Conditions under which perform-

(*Continued on page* 164)

* Graduate, Juilliard School of Music and Cleveland Institute of Music. Member of Cleveland Orchestra and on the faculty of the Cleveland Institute of Music.

Stereophonic Sound for the Home



The three units comprising the Ampex Model 612 stereophonic tape phonograph system. The unit in the middle is the tape player while the cabinets on either side are the matching hi-fi amplifiers and speakers required for stereo reproduction.

The ultimate in high-fidelity reproduction—stereo sound providing concert-hall realism—can now be obtained in your living room!

LIKE the proverbial snowball, the popularity of stereophonic sound is growing steadily as more and more audiophiles are "exposed" to the advantages of this type of sound reproduction.

Basically, stereophonic sound provides the realism of "in-person" listening since the sound source is divided into two parts—the one part that would normally be heard by the auditor's left ear and the second part which the right ear would normally capture, with the sound "mixing" taking place within the listener's head.

Those persons whose musical experience has been limited to recorded works will undoubtedly find their first taste of stereophonic reproduction a unique experience while those who are lucky enough to live near urban centers where concerts are offered regularly will find this form of reproduction more closely akin to their concert hall experiences than monaural recordings, whether on disc or tape.

Those who have never heard stereophonic sound could perhaps visualize the effect more clearly if a simple example were given. Picture yourself in the country near a railroad crossing. In the distance and to your left you hear the whistle and sounds of an approaching train. Although some of the sound will reach your right ear, your instinct and experience will tell you that the train is approaching from your left. The sound increases in intensity in your left ear until the train moves directly in front of you. At this point, both ears (assuming normal hearing) will be receiving the sound with equal intensity. As the train moves past your vantage point, the sound will be received by the right ear with the left ear receiving only the attenuated sound.

If a recording were made with a single sound channel and a single loudspeaker were used to reproduce the sound, you would get an impression of the train coming closer as it nears you and then the sound would attenuate as the train moves past. Although with the monaural recording you get the feeling of the train approaching and leaving, you in no way obtain the "directional" effect. With stereo you would obtain the illusion of the train coming from, say, the left and leaving toward the right. Additional speakers on a single channel system would not change the over-all effect other than providing sound re-enforcement.

The example of the train is a good illustration of the illusion to be obtained with stereophonic equipment. Although it is unlikely that one would enjoy a steady diet of train whistles, it does demonstrate the type of reproduction that is obtainable with this type of equipment. With stereo tapes of musical selections the third dimensional effect is not as exaggerated as in the case of the train but the effect is definitely noticeable and adds depth and realism to the recording.

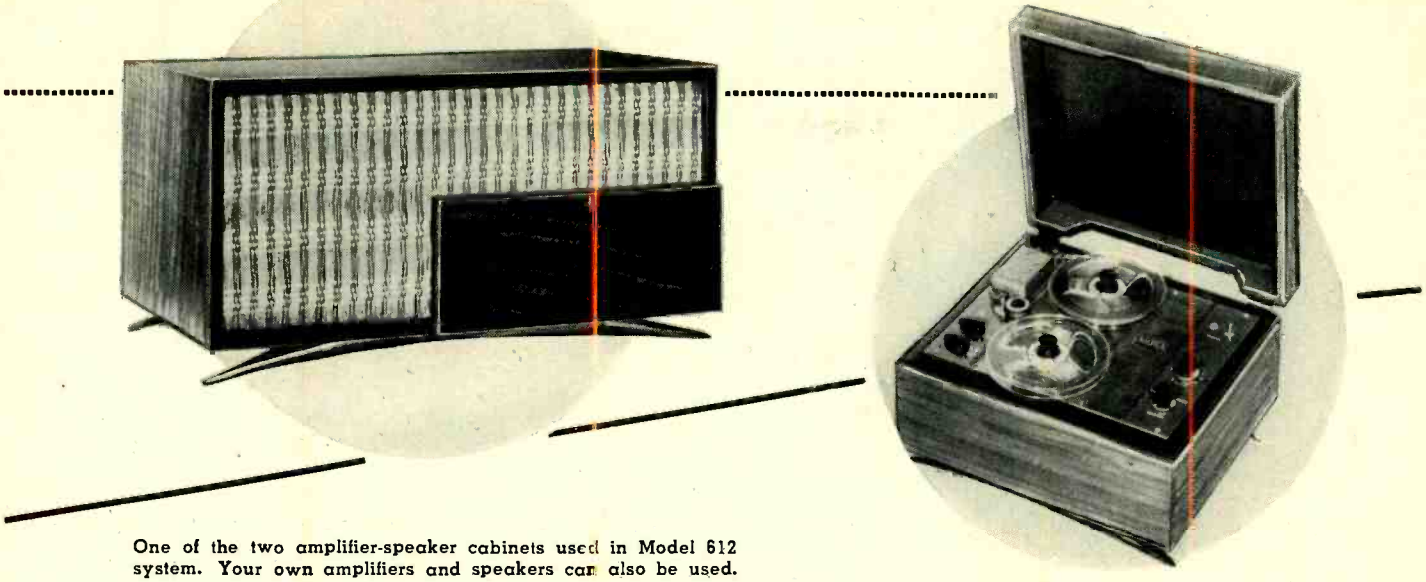
In making such stereo recordings, microphones are normally placed on each side of the orchestra. With this arrangement, sound originating on the left side of the orchestra will go through its own sound channel and emanate from the left-hand speaker in the home. Similarly, the music from the right side of the orchestra goes through a second, separate sound channel and comes out through the right-hand speaker in the reproducing system.

Thus the output of the complete orchestra is obtained in such a manner that the feeling of "10th row center" is imparted to the listener. The millions who saw and heard Walt Disney's "Fantasia" were thrilled by this early demonstration of three-dimensional sound but naturally assumed that it was a "gimmick" whose practicality was limited to elaborate installations in just a few of the larger theaters.

Today, however, the audiophile can enjoy such reproduction in his own home thanks to the variety of stereophonic equipment, tapes, and discs now being offered by manufacturers and recording firms.

Stereo equipment, to date, is not cheap but for the serious music lover who can afford quality equipment, it offers the ultimate in sound reproduction. For the technically minded hi-fi enthusiast who enjoys building his equipment, the over-all cost can be reduced considerably. The only equipment that he would need to buy is the stereo tape or record player. The balance of the equipment could all be

Close-up view of the "tape phonograph."



One of the two amplifier-speaker cabinets used in Model 612 system. Your own amplifiers and speakers can also be used.

home-constructed. Actually, the rest of the equipment required consists of a two-channel amplifier with dual speaker systems.

While the stereophonic tape and record catalogue is still relatively small and chances are that your favorite selection has not been recorded in this medium, there is a representative group of numbers on the market, both classical and popular, as well as "demonstration" tapes and records of various types. Companies offering stereo tapes and discs are listed in the directory appearing on page 194 of this issue, along with manufacturers of various stereophonic equipment items.

Another "shot-in-the-arm" for stereo reproduction was the recent FCC ruling which will permit the multiplexing of FM program material. With this system, all FM stations are permitted to put out two channels. These could be used for stereo reproduction of live material. Further details on multiplexing FM are given on page 55 of this issue.

Ampex Tape Phonograph

One moderately priced stereo system for the home is the *Ampex* 612 tape phonograph and its twin amplifier-speaker units. The tape reproducer will play either in-line stereophonic tapes, half-track tapes, or full track tapes which have been recorded at 7½ ips. Frequency response is 40 to 15,000 cps within ± 2 db when playing back the *Ampex* "Standard Tape No. 5563." Signal-to-noise is 50 db below a signal recorded at 3% distortion level. Flutter and wow is .25 per-cent. The output is 1.25 volts into a load of 10,000 ohms or more at the program level which is sufficient to operate any standard power amplifier input.

The equipment incorporates three operating modes: "play," "fast forward," and "rewind." There are five controls in all on the 612. The "power" switch turns the equipment "on" and "off" while the "play" switch sets the tape in motion at normal speed. The "rewind-fast forward" switch is used to transport the tape rapidly in the forward or reverse directions. The "selector" switch has two positions, "stereo" and "single." When stereo tapes are played, the switch is placed in the "stereo" position and each of the two tracks on the recorded tape is connected to a different amplifier and loudspeaker. The "volume" control is used to adjust the volume of both channels simultaneously. In the "single" position, the 612 acts as a conventional tape reproducer. Only one track on the tape is reproduced and it is fed to one preamplifier in the 612 system and the preamp output is fed to both output receptacles. This permits the enhancement of the recorded material although the result is not stereophonic sound.

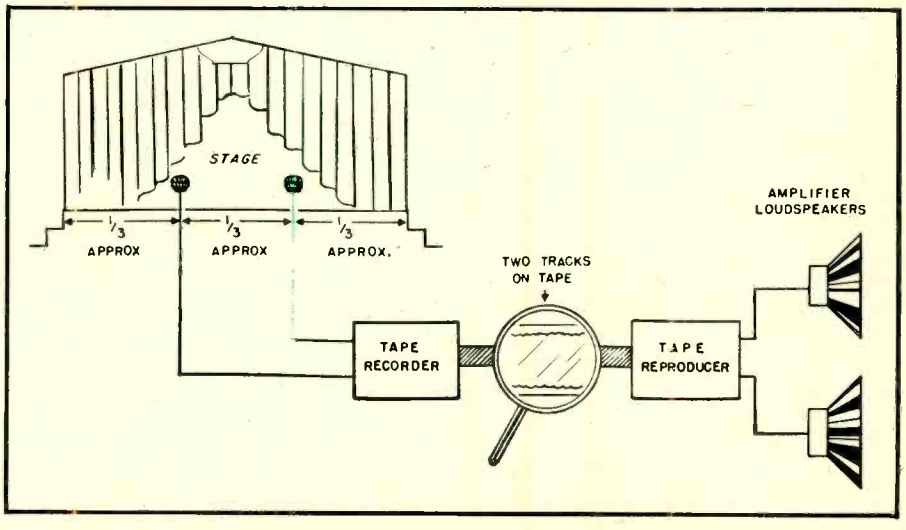
The complete 612 system consists of the stereophonic tape reproducer and two matched amplifier-speaker systems. Currently the entire system is available housed in matching mahogany furniture cabinets or as portable units encased in handsome *Samsonite* luggage-type carrying cases.

In order that audiophiles can utilize their existing equipment, the "system" can be purchased as separate component parts if desired. The tape phonograph alone is available in a brunette walnut finish at $395.00 with the blonde mahogany finish $10.00 extra. The portable unit is priced the same. The amplifier-speaker cabinets are $169.50 each for the brunette walnut type with $10.00 extra for the blonde finish while the portable unit in the *Samsonite* case is priced at $149.50.

Purchased as a complete system, the dark walnut version is $699.00, the blonde unit is $30.00 extra, and the *Samsonite*-housed system is $694.00 complete.

Now that there is commercially-built stereophonic equipment readily available on the market, audiophiles will undoubtedly want to take advantage of this newer and better method of reproducing their choice musical selections. Three-dimensional sound is here to stay! —30—

How a stereophonic tape is recorded and reproduced. See details in the text.



By **G. P. MAERKLE**
Vice-President and Chief Engineer
Fisher Radio Corporation

A New Master Audio Control

Front view of the Fisher 80-C "Master Audio Control" unit. It is a re-engineered and improved version of the company's earlier 50-C control device.

Engineering details on a hi-fi unit which provides many "professional" features for owners of home music systems.

WHEN the *Fisher* Model 50-C "Master Audio Control" was introduced, approximately three years ago, it won immediate public acceptance. Inspired by this public acceptance and the desire to anticipate future high-fidelity trends, a research program was initiated for the development of a new "Master Audio Control." As a result of this program, it was found possible to do the following: improve the signal-to-noise ratio; reduce distortion to a new low; provide more accurate phonograph equalization settings, more effective bass and treble tone control circuits, and a higher degree of ease and flexibility in switching.

In addition to improvements in circuitry, it was foreseen that complete mixing facilities should be incorporated as a result of the increased acceptance of tape recorders in the home. Also, with the major record manufacturers producing recorded tapes on a large scale, it became evident that it should be possible to treat this new medium with the same simplicity as one treats the record. That is, preamplification and equalization should be provided so that only a basic tape transport mechanism will be needed to reproduce these tapes. Such a mechanism therefore parallels the role of the record changer in function and in comparably low price.

In addition, since an audio control unit will become a decorative element in thousands of homes, it is imperative that it be well styled, so that it will be a welcome addition to living-room decor.

This article describes the new "Master Audio Control" which, with the aid of a number of new and unique circuits, meets all these requirements. The unit is intended to satisfy the most exacting and complex needs in top-quality home systems, with something to spare.

Seven inputs are included, designed to match the needs of every type of signal source which may be used in home systems, as follows: (1) magnetic tape playback head; (2) magnetic pickup; (3) crystal pickup (or any constant-amplitude pickup); (4) low-level microphone; (5) radio tuner; (6) and (7) two high-level auxiliary inputs.

Up to five sources can be switched in simultaneously and mixed in any proportion, with the ease and lack of interaction that characterizes the best professional consoles. The pickup inputs are on a "phono" channel. The tape-head input is switched onto the phono channel when the lever switches for record compensation are depressed

Fig. 1. Equalization characteristics of the 80-C "Master Audio Control." It covers all present and some past recording curves.

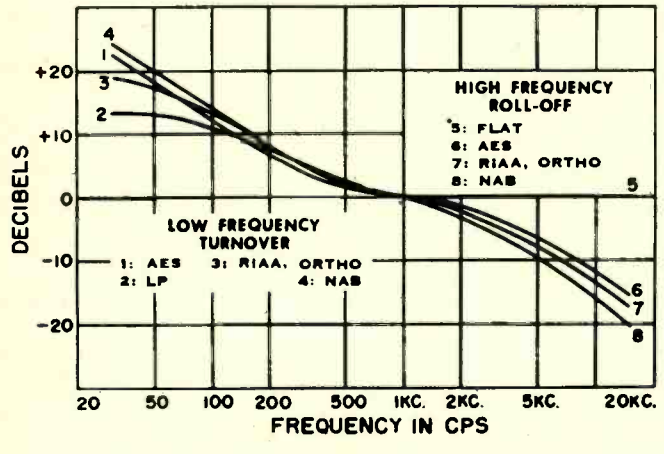
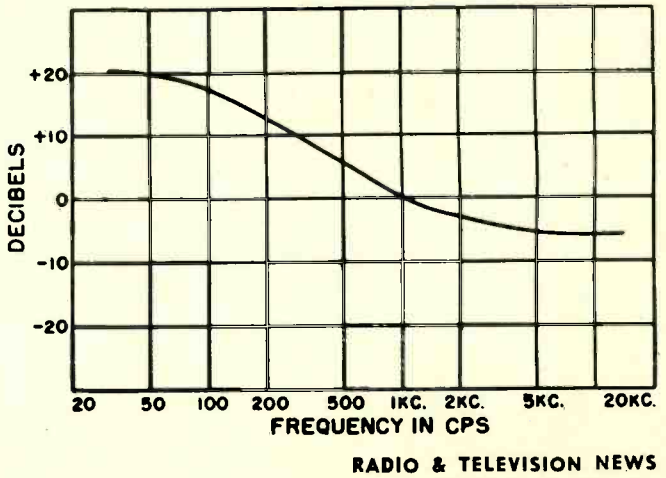


Fig. 2. Tape-head playback equalization in effect when two lever switches for the record compensators are in 5th position.



to a bottom position marked "Tape," which will be discussed later. The phono channel is one of the five mixing channels, any one of which can be mixed with any or all of the others. The other four are the radio, microphone, and two auxiliary channels.

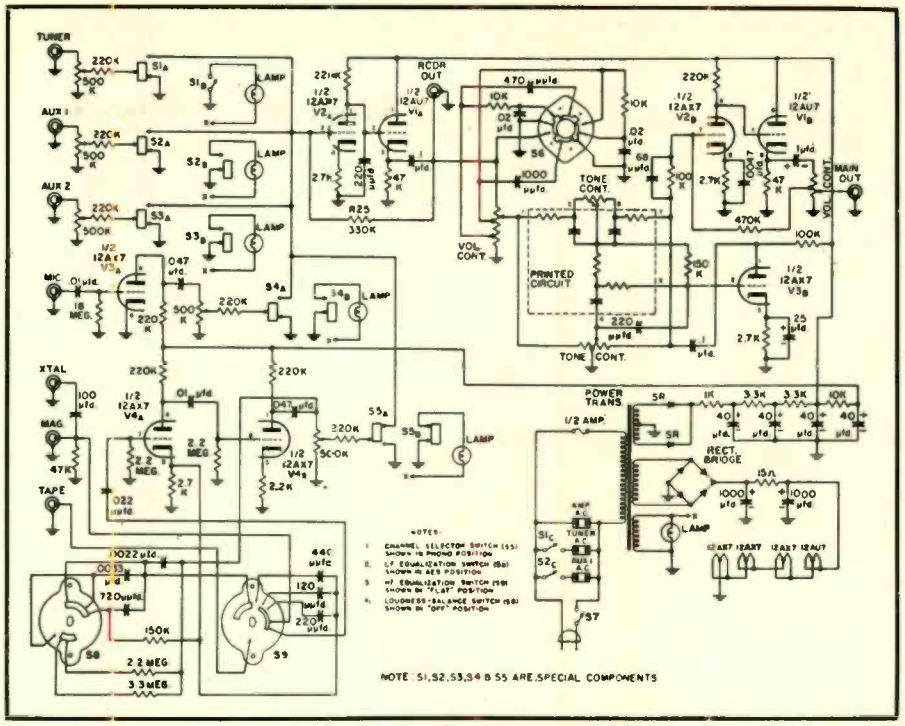
The five mixer-level controls are all controlled by knobs on the front panel. Channels are selected by push-buttons, which are in a row beneath the mixer-level controls. The operator merely pushes one button, or two or more simultaneously, to connect the channels he wants. A pilot light under each button indicates which are in use at any time.

The tuner input and the two auxiliary inputs are fed directly to the first of two pairs of direct-coupled triodes which form the main amplification line of the unit. The microphone input, with an input impedance of 18 megohms, includes a triode preamplifier which gives enough additional gain so that high-quality dynamic or crystal microphones, with their low signal levels, can be used. The gain of this stage is over 32 db.

The two pickup inputs and the tape-head input feed through a separate two-stage amplifier, which incorporates the pickup and tape equalization and the record compensation circuits. These equalization circuits are of the selective feedback type, which not only provides the equalization but also keeps the distortion and noise produced in the two stages at a low level. The gain of this stage, when used on phonograph, is 32 db at 1000 cycles. In the tape position it is 37 db at 1000 cycles.

There are four bass turnover points and four treble roll-off curves, to make 16 different record compensation curves. As shown in Fig. 1, these cover all the presently used recording curves, as well as those of recent years.

A fifth position on the two lever switches for the record compensators, as already mentioned, provides the proper gain and equalization for a signal taken directly from a tape playback head. Fig. 2 shows the equalization curve which is in effect in this position of the compensator. This equalizer position and the tape-head input,



Complete schematic diagram of the 80-C "Master Audio Control" unit.

give the music lover who wants to add tape playback facilities a convenient and economical way to do so. A tape "deck" which includes just the playback head and the transport mechanism—no electronics—will put the buyer "into tape," at a cost for the tape equipment comparable to that of disc playing equipment of similar quality. Tape decks of this description are available on the market at various price levels.

If the user, however, already has or prefers to buy a tape machine which includes equalization and preamplification, he can, of course, connect it to his system through one of the high-level auxiliary inputs.

Two of the channel selector buttons, those for the radio tuner and for Auxiliary No. 1, each automatically connects the a.c. power to a separate a.c. outlet on the back of the chassis. Thus a radio tuner or other program source which requires a supply of a.c. power will draw power only when it is actually in use, being turned on automatically when the channel button is pushed in. A third a.c. outlet on the back of the chassis is for the power amplifier and supplies power when the master switch of the unit is turned on.

A new circuit device eliminates the signal loss which usually occurs in conventional mixing circuits and, together with the resistors in series with each grid, keeps interaction between channels at a negligible level—less than ½ db. This is important in maintaining the high signal-to-noise ratio built into the individual channels. All channels come together at the grid of V_{2A}, the first triode of the first direct-coupled pair. The feedback voltage around this pair comes off a voltage divider consisting of resistor R_{25}, plus the total grid-to-ground resistance in the first triode circuit. Since additional channels, as they are switched in, add the channel resistance in parallel with that already in the circuit, the feedback

(*Continued on page* 173)

Fig. 3. Effect of the loudness balance control. At the high settings of the master volume control, accentuation is lessened.

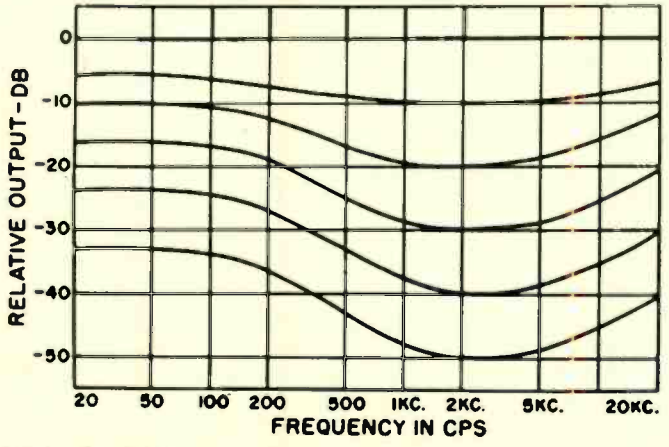
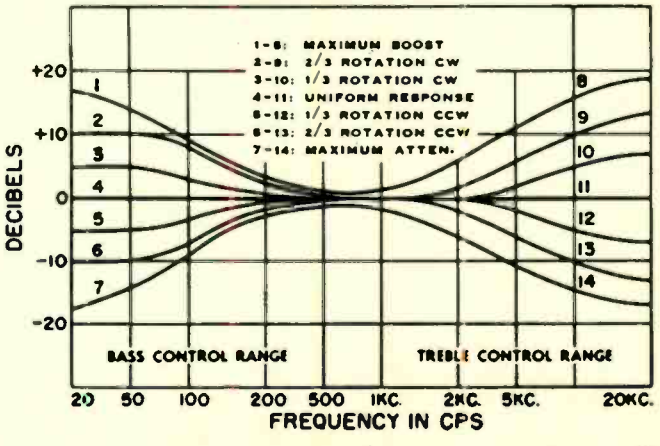


Fig. 4. Bass and treble control range of the 80-C. In the listings of positions, bass settings are Nos. 1-7, treble Nos. 8-14.



Remote Control for TV

Fig. 1. The Emerson model 1158 remote-control unit shown here is capable of duplicating all of the TV set's front panel adjustments for picture and sound.

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In many cases these units are furnished with the set, but, they can be installed by any service technician.

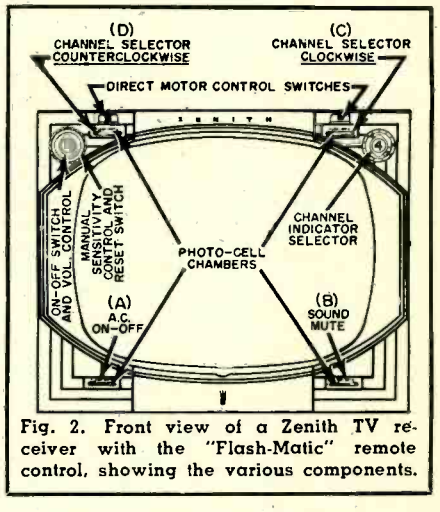


Fig. 2. Front view of a Zenith TV receiver with the "Flash-Matic" remote control, showing the various components.

NOW that TV receivers have become more standardized in circuitry and over-all design, some manufacturers are stressing special accessories for their sets as sales features. One of these is a remote-control attachment to permit the viewer to change channels and make other adjustments without leaving his seat. Quite a few receivers in the luxury class are delivered with remote control and this feature is optional on many medium-priced receivers. Adding remote control to older sets should prove an added income source for the alert service technician. Such installations are especially useful in homes where older persons or shut-ins find their major diversion in TV viewing.

Servicewise, the wired remote devices are subject to wire damage and mechanical failure of switches and relays. The photoelectric type of remote control invites defects in both the electronic and mechanical portions. This article presents a short survey of some of the most popular remote-control devices and gives troubleshooting and service data for most common defects.

Early remote-control TV systems used a separate r.f. tuner and i.f. system, feeding a video signal to the receiver itself. This system required a coaxial cable, "B+" and heater wiring, and a fairly large remote tuning cabinet. None of the more recent systems are of this type. Instead, use is made of a small motor to turn the r.f. tuner shaft while the remote unit itself usually contains only potentiometers and switches. This means that the voltages required over the cable are either 117-volt a.c., 6-volt a.c., or simple audio or bias signals. As a result, most of the control units comprise little more than can be held in the palm of one's hand.

Perhaps the most elaborate system from the technician's point of view is the *Zenith* photoelectric tuning system. For the viewer it is the simplest. He merely shines the beam of a flashlight on one of four photocells to get the control actions he desires. This wireless system is described in more detail later and is quite spectacular in its operation, although fairly expensive.

Most of the other remote control systems use a wire between the set and the viewer. In some instances this is a simple two-wire line, while in others a more complex cable is used. One type of remote control system, the *Sentinel* unit, includes a remote speaker located right in the control unit. This permits the viewer to look at his set from quite a distance and keep the volume low enough for comfortable listening.

Typical Remote Systems

The new *Zenith* "Flash-Matic" system is illustrated in Figs. 2 and 4. A total of four photocells is used. Each of these cells controls a relay through an amplifier tube. The upper two cells initiate counterclockwise or clockwise rotation of the tuner shaft by means of a small motor for channel selection. The lower-left cell turns the receiver on and off, while the lower-right photocell shorts out the sound. Since the photocell characteristics will vary with age and since ambient and incident light may further vary their operation, a manual sensitivity control is provided at the upper-left corner. There is also a reset and manual volume control and power switch.

Remote control of contrast or volume is not provided in this system. Fig. 4 shows the mechanical arrangement inside the cabinet. Note that there is a separate remote control chassis containing three tubes, relays, and additional sensitivity controls for the service technician's use. It is apparent from

this diagram that the sound is shut off at the speaker and not at the volume control. The turret tuner switching motor is geared down and stopped by means of detent and limit switches which disconnect it when a channel is tuned in.

Adjustment of the four internal sensitivity controls should be performed by the service technician after the set is installed. The room lighting should be arranged as it will be during normal receiver operation. Each control should be set individually to give good control action with the flashlight shining on the respective photocell from the farthest spot in the room. After each sensitivity control is set, the front panel sensitivity control is adjusted for best operation. The customer must be instructed not to touch the internal controls but to adjust only the front panel control if needed.

The "Automatic-Manual" switch located in the lower left-hand corner of Fig. 4 permits shutting off the remote-control chassis and converts the set to normal front-panel control operation. In the automatic position, the remote-control chassis will draw a small amount of power even if the receiver has been turned off.

A more complicated remote tuning unit is the *Emerson* model 1158 shown in Fig. 1. This unit makes use of three potentiometers and permits remote adjustment of volume, brightness, fine tuning, and channel switching. How this is done is shown in the circuit diagram of Fig. 5.

Note that there are two switches; one, S_1, the a.c. power switch, and the other, S_2, the motor actuating switch. The volume control is connected in parallel with the front panel volume control and uses shielded wire throughout. Brightness is varied by the usual d.c. voltage. The fine tuning control is accomplished by varying the "B+" voltage on the r.f. oscillator. This eliminates mechanical alignment problems at the fine tuning control on the tuner itself and accomplishes the control smoothly, electronically.

The channel tuning motor itself is stopped automatically by a conventional detent limit switch relay arrangement. Once the remote cord is unplugged from the chassis, the receiver operates in the conventional manner through the front panel controls.

When adjusting the front-end tuning circuits of a remotely-controlled set it is necessary to check the local oscillator "B+" voltage and set it to the correct median value before adjusting the individual channel tuning slugs of the local oscillator.

A completely different channel switching arrangement is used in the remote-control system of the *Walsco* model PC-9 TV receiver. The palm-sized remote control shown in Fig. 3 contains a channel selector knob similar to those usually found on the front panel of a TV receiver. In this system, the cable must carry about 17 wires to the TV receiver, but once the channel is selected, the tuner will automatically keep turning until the correct channel is reached, and then the tuner motor stops.

A circuit of the entire system is shown in Fig. 7 and indicates that the motor operates a commutator-type switch. It keeps turning the commutator and the tuner shaft until the relay receives power through the remote switch ground return. Then the 6-volt relay opens its contacts and the motor power is interrupted.

In addition to the tuner selector, there is a simple "on-off" and volume control combination switch. All audio leads are shielded. When the remote control is not used, a local volume control on the TV receiver is used in the conventional manner. It may be mentioned that the particular TV receiver used with this remote-control system employs printed circuitry throughout.

A more elaborate remote-control system is marketed by *Sentinel Radio Corporation*, both for some of their latest TV receivers and for installation in older sets. Shown in Fig. 6, this control unit is much larger than those previously described and contains a small speaker. In addition to the 12-channel selector switch there are fine-tuning, volume, and brightness controls. The latter contains the "on-off" power switch. There is another small switch to select the remote loudspeaker. One of the features of this unit is that it is designed to be installed by TV technicians in almost any receiver having a 12-position tuner.

Before describing its installation, consider the circuit as shown in Fig. 9. At the left is the remote unit itself, with all controls and the small personal loudspeaker. The fine tuning is accomplished by varying the oscillator plate voltage just as in the *Emerson* unit. A switch on the fine-tuning control potentiometer chooses either remote or on-the-set channel selection. The volume control affects the loudspeaker directly and acts either on the remote or local speaker. Brightness is controlled in the conventional manner with the remote control in parallel with the on-the-set one. A 12-position switch selects channels by letting the motor run until the desired position is reached, when the motor circuit is opened.

A relay turns the receiver off and on. The primary winding of the 24-volt transformer is always connected across the line, but draws negligible power. Both the relay and the motor operate

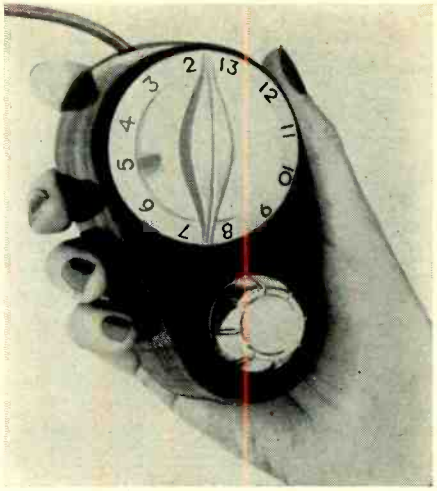


Fig. 3. Channel-selector, "on-off" switch, and volume control are included in this remote-control unit for Walsco TV sets.

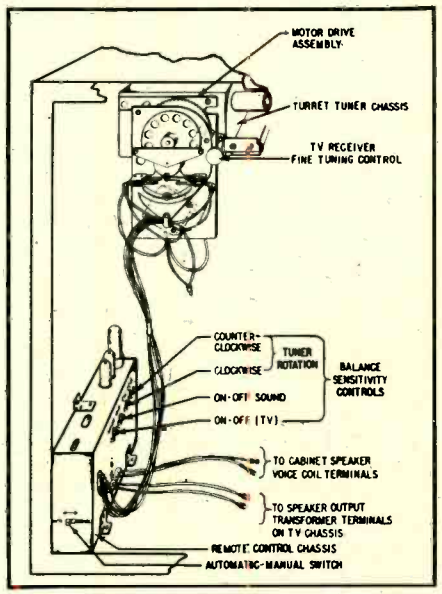


Fig. 4. The remote-control chassis and turret tuner motor drive for the Zenith "Flash-Matic" system are shown here.

Fig. 5. Schematic diagram of the Emerson model 1158 remote-control system. The unit on the right is the hand-held control; on the left, the part in the TV set.

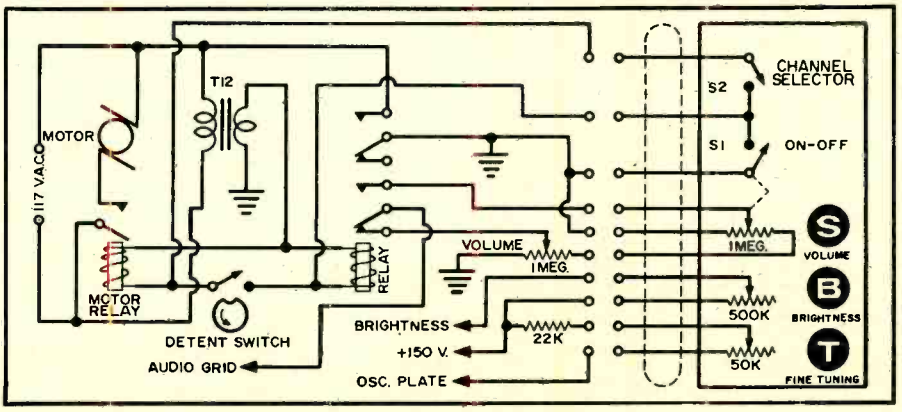


Fig. 6. The Sentinel remote-control unit. Besides including all necessary picture and sound adjustments, this unit also contains a small speaker for remote listening.

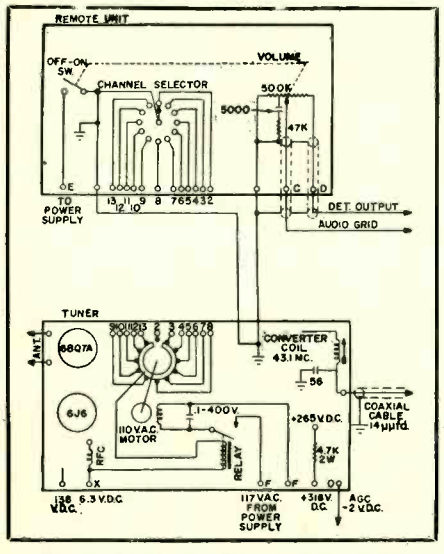
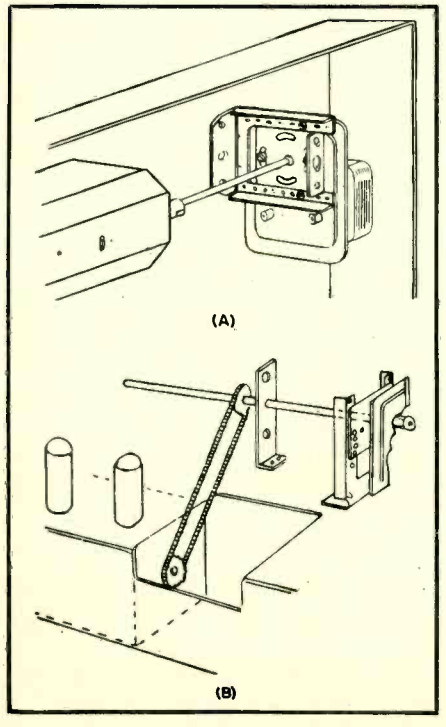


Fig. 7. Schematic diagram of both the remote unit (sometimes called the remote head) and the TV receiver portion of the Walsco remote-control feature.

Fig. 8. Mechanical coupling systems used by the Sentinel remote-control for driving a turret-type TV tuner.



on 24 volts and are simply and ruggedly constructed. A brief analysis of the circuit of the remote switch and the station-seeking switch on the motor shaft will show that with the former set to channel 2, for instance, the motor will keep turning until the latter switch reaches channel 2.

Each remote-control kit is supplied with detailed installation instructions and it is interesting to note just how the mechanical arrangements are made. In Fig. 8A, the case is shown where the motor is mounted in line with the tuner shaft. A coupler is supplied which connects the rear of the tuner shaft to the motor drive shaft or an extension thereof. Different couplers and a long shaft are supplied permitting almost any mechanical arrangement. For sets where there is insufficient room behind the tuner, a special sprocket and chain can be used as in Fig. 8B, and the motor and drive shaft can be mounted either above, below, or at the side of the tuner. It is necessary to note the channel position of the tuner shaft and to set the coupler or sprocket to get the corresponding channel indication at the remote unit.

The *Sentinel* remote-control unit is furnished complete with cable, motor, and all hardware and even includes a drill for the tuner shaft locking pin. Two different couplers, shafts, bearing brackets, and sprockets are supplied, allowing the service technician to mount and arrange the motor assembly in any convenient way.

Servicing

Defects in most remote-control systems are easily separated from the conventional troubles due to the TV receiver itself, because in every instance it is possible to operate the set without the remote features. Once the trouble has been definitely located in the remote-control system it is also relatively simple to determine in which circuit it is. If the tuner switching does not perform properly, the volume control obviously need not be checked. There is, however, one important point which is the same in practically every system. This is the common ground return lead. Be sure to check its path through with an ohmmeter, especially if the remote control does not work properly on any control.

In general, it is possible to divide all defects in remote control devices into the following categories:

Broken wire or bad insulation.

Contact troubles.

Poor lubrication (sticky shafts, detents, or relays).

Burned-out motors, relays, or solenoids.

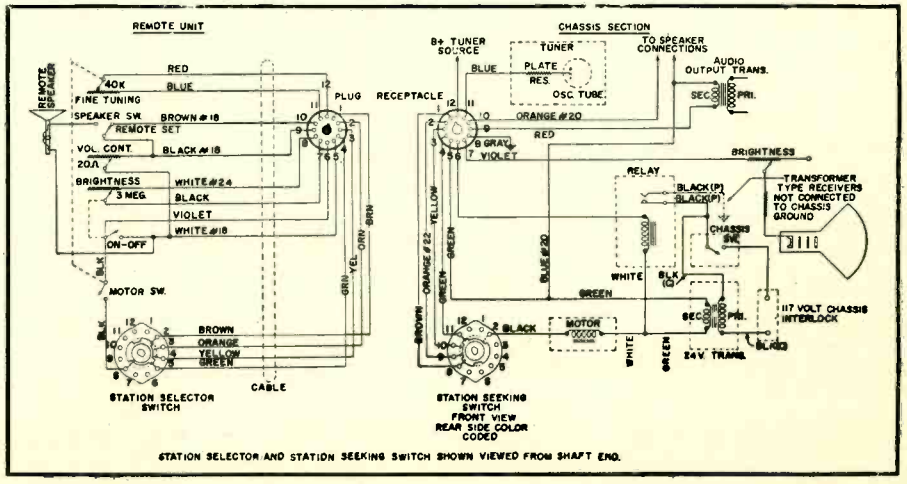
Broken mechanical parts (gears stripped, shaft worn, etc.).

In the case of the *Zenith* "Flash-Matic" system, there are no control wires from the user to the set, and this eliminates the first category, but there could be defective control amplifiers, photocells, and other parts. Troubleshooting this system is not confined to a mechanical check and continuity measurements, and the manufacturer's data must be followed carefully. Special consideration must be given to the photocells and their sensitivity adjustment.

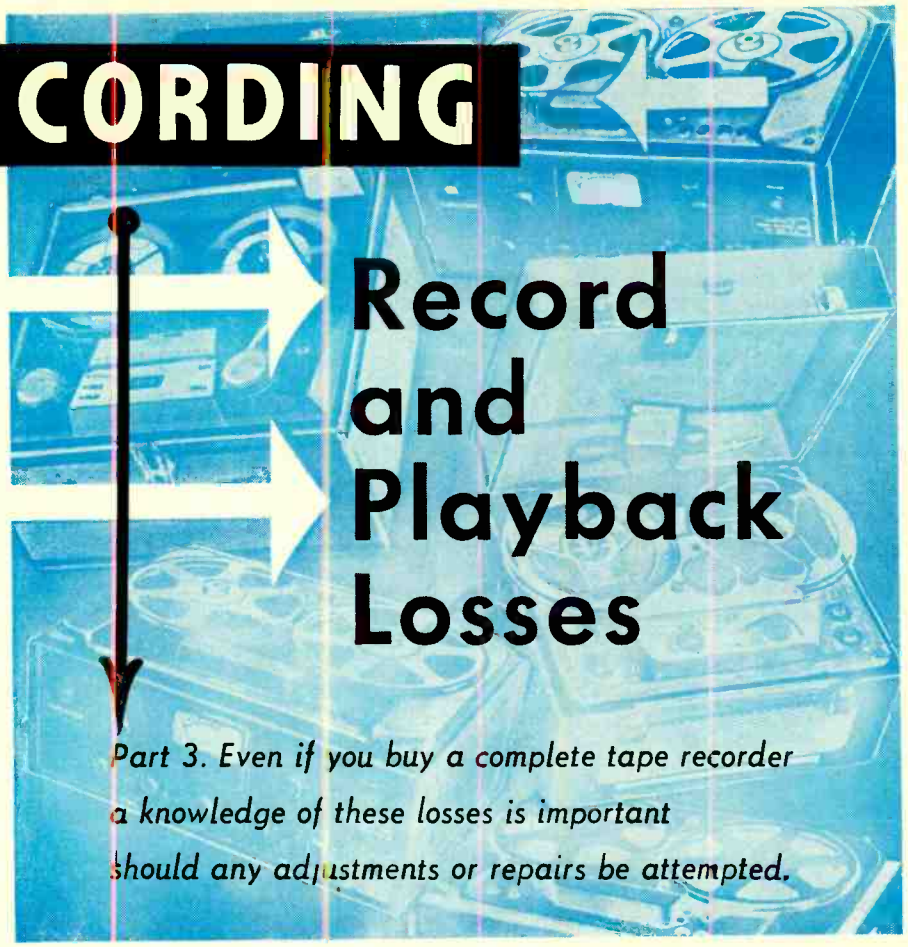
Broken wires and contact troubles are usually found by inspection and ohmmeter checks. Lubrication troubles may result in excessive wear of bearings or even broken gears, etc. Only replacement with the proper part will remedy this type of defect. At this point it might be mentioned that ordinary lubricating oil may not be satisfactory due to the accumulation of dirt and dust plus the heat generated in the set. Silicone grease is probably the best, but a high grade automobile grease is usually satisfactory for shaft bearings, cams, and other moving parts. Burn-outs in motors, relays, or solenoids are often caused by excessive voltage or current and this may, in turn, be caused by some other defect. Be sure whenever a burn-out of this type is encountered, to check the various voltages both during warm-up and after a few minutes operation.

Other defects such as wornout potentiometers, defective switches, etc., are so similar to those ordinarily found in radio and TV sets that they should not cause the experienced TV technician any trouble. —30—

Fig. 9. Schematic diagram of the Sentinel remote-control system for all TV sets.



TAPE RECORDING



Record and Playback Losses

Part 3. Even if you buy a complete tape recorder a knowledge of these losses is important should any adjustments or repairs be attempted.

By **HERMAN BURSTEIN**

THE first two articles in this series covered a broad discussion of tape recorders, and a comprehensive analysis of tape and its recording characteristics.

This month we will take up the question of recording and playback losses and their effect on recordings made at the 7.5 ips speed, which is more or less the standard for home-type tape recorders.

Fig. 1 shows the frequency response obtained *at a given tape speed* if a tape is recorded and played back with a high quality head but without equalization in the preamplifiers. Some of the losses responsible for deviation from flat response take place in recording, while others occur in playback. To a minor extent, these losses vary purely with frequency. Mostly, however, they vary with both frequency and tape speed, which is to say they vary with the wavelength of the induction recorded on the tape. Wavelength equals tape speed in ips divided by frequency in cycles-per-second. Thus a wavelength of .005" represents a frequency of 1.5 kc. at 7.5 ips and a frequency of 3 kc. at 15 ips.

The wavelength effect is illustrated by the relationship between the two curves in Fig. 1, which represent the unequalized record-playback response of an actual head at 7.5 ips and at 15 ips. Because of the 2:1 ratio between speeds, each point on the 15 ips curve corresponds to a point one octave lower (half the frequency) on the 7.5 ips curve. For example, the point of maximum response is 6 kc. on the 15 ips curve and 3 kc. on the 7.5 ips curve.

To the extent that losses vary only with wavelength, the 15 ips curve is related to the 7.5 ips curve as follows. Each point on the 7.5 ips curve is shifted one octave to the right because at higher speed a given wavelength represents twice as high a frequency. These shifted points are then raised 6 db because doubled frequency corresponds to doubled flux velocity in playback, and doubled velocity produces 6 db more playback output.

For simplicity, the following discussion is couched in terms of effects observed at a speed of 7.5 ips. *Unless specifically indicated to the contrary, it should be understood that these effects vary with recorded wavelength, although for convenience the discussion speaks in terms of variation with frequency. This holds true not only for this discussion but equally for all other effects discussed in this series in terms of variation with frequency.*

Record Losses: The treble droop in Fig. 1 is caused largely by losses that take place in recording. Record losses are principally due to "demagnetization" and "bias erase."

1. *Demagnetization.* A sine wave recorded on tape may be thought of as a number of magnetic bars, each the length of half a wave, as shown in Fig. 3. Every bar has a north pole and a south pole. With increasing frequency, the bars become shorter. A short bar has less magnetic strength because opposite poles tend to cancel, and this tendency increases as distance between poles shrinks. Thus in magnetic recording, as frequency rises and distance between poles decreases, the canceling effect of opposite poles reduces the magnetic induction on the tape. It has been pointed out[1] that in playback there is a tendency for output of the higher frequencies to be restored, but far short of the original loss caused by demagnetization. Partial restoration occurs because at short wavelengths the core of the playback head is able to neutralize opposite poles.

2. *Bias Erase.* Present day tape recording, as stated in Part 1, applies a high-frequency bias current to the record head in order to overcome distortion and raise output. As bias current is increased, recorded induction rises, but only up to a point. Thereafter, induction falls with further increase in bias. This fall occurs in part because with increased bias the tape is shifted to a region on its operating characteristic (analogous to that of a vacuum tube) where the input-output slope is less steep, producing less recorded induction. Moreover, large amounts of bias current exert an eras-

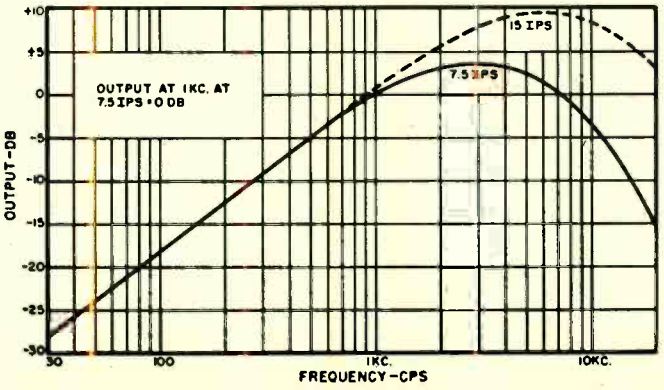


Fig. 1. The unequalized record-playback characteristic of a high quality record-playback tape head.

1. Wetzel, W. W.: "Review of the Present Status of Magnetic Recording Theory," Audio Engineering, November 1947.

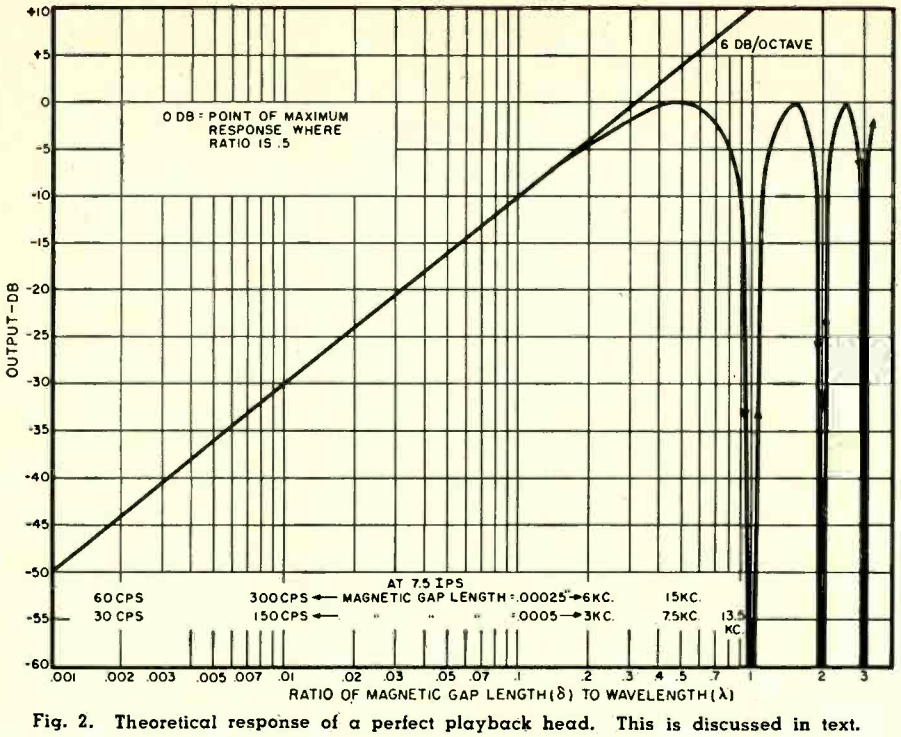


Fig. 2. Theoretical response of a perfect playback head. This is discussed in text.

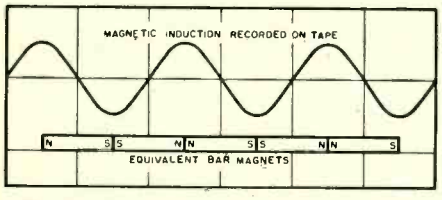


Fig. 3. Representation, by means of bar magnets, of sine wave recorded on tape.

ing effect similar to that produced by the erase head. Unfortunately, the erasure effect is greatest at high frequencies, probably because at these frequencies the magnetic flux penetrates the tape less deeply. Therefore, increased bias current results in high frequencies being recorded at less magnitude than low frequencies.

While the treble losses produced by demagnetization and bias erase vary with wavelength, other treble losses are purely a function of frequency. The latter take place in the record head as the result of eddy currents (heat losses) and hysteresis in the coil winding.

Playback Losses: The bass droop in Fig. 1 occurs because the playback head is a constant velocity device, as explained in Part 1. With decreasing frequency the flux velocity of the tape declines and so does head output.

Theoretically, output of the playback head should vary in direct proportion to frequency, that is, 6 db-per-octave. In practice the decline is not as perfectly regular as shown in Fig. 1. At low frequencies the magnetic flux extends a relatively great distance from the tape, so that the head *as a whole* as well as its gap reacts to the flux. The combined reaction produces irregularity of response. However, the geometry of a well-designed head keeps such irregularity relatively small.

A slight increase in low-frequency output is sometimes an additional result of the tendency of the entire head to react to magnetic flux.

The response curves in Fig. 1 would rise at about 6 db-per-octave over the entire audio range were it not for treble losses in record and playback. Record losses, which are most responsible, have already been discussed. The principal factor responsible for treble loss in playback is the playback head's gap length (sometimes called gap width; this dimension is parallel to tape length).

The longer the gap, other things being equal, the poorer the high-frequency response. Modern heads with extremely short gaps produce substantial output to 15 kc. and even beyond at 7.5 ips, assuming a tape recorded with constant magnetic induction at all frequencies.

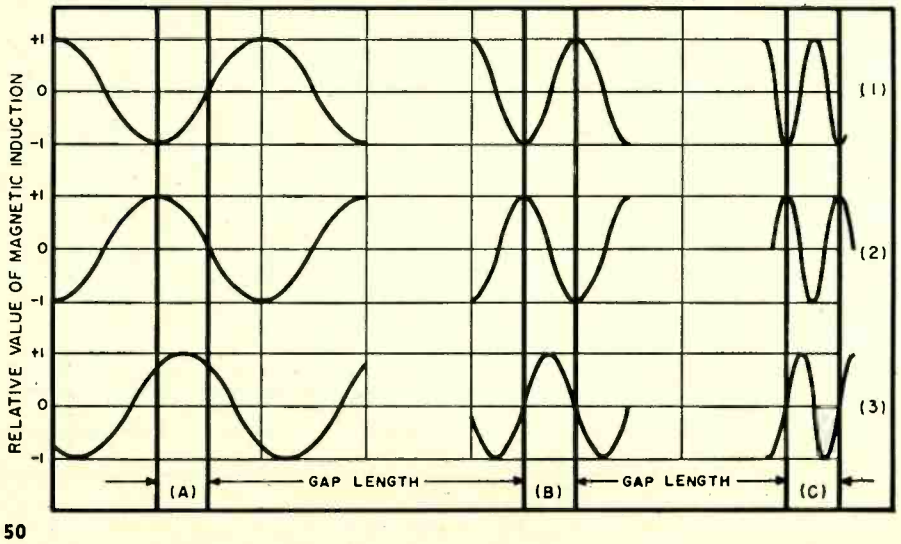
Apart from the loss due to gap length, the treble losses of a well-designed playback head are relatively slight in the audio range. Roundness of the gap edges causes the head to have a "magnetic gap length" greater than the actual physical gap length, thus limiting playback response at the treble end. Imperfect linearity of the gap's vertical dimension causes a drop in response at the high end. Losses due to these two factors vary with wavelength. Those that vary purely with frequency are, once again, the result of eddy currents and hysteresis in the playback head.

The output of an "ideal" playback head—one without any losses other than due to gap length—is related by a mathematical formula to recorded wavelength and gap length. The gap length, δ, is "magnetic gap length" rather than physical gap length and is experimentally ascertained by finding the treble frequency at which response first drops to a minimum. Wavelength is denoted by λ. Response is proportionate to 20 *log sin* $(180° \times \delta/\lambda)$, as illustrated in Fig. 2.

This formula reveals that maximum output occurs when the magnetic gap length equals one-half wavelength and that output falls to zero when gap length equals one full wavelength. These important relationships can be explained non-mathematically as follows.

In order for a voltage to be induced across the windings of the playback head, it is not sufficient that there merely be changes in magnetic flux density as the tape passes the head. It is also necessary that at various instants a magnetic potential (difference in flux density and/or polarity) exist between the edges of the gap, thus, in effect, giving the head a north and south pole at these instants. The gap scans the passing tape for changes in magnetic potential, such changes being translated by the head as voltages that correspond to audio information. The output level of the head is determined for each wavelength by the

Fig. 4. Magnetic potentials scanned by a playback head for three wavelengths (A, B, C) at different phases (1, 2, 3). A equals a magnetic gap of ¼ wavelength, B a magnetic gap of ½ wavelength, while C are curves obtained when magnetic gap is 1 wavelength.



maximum magnetic potential that is periodically presented to the gap.

When the playback head scans a long wavelength it is periodically confronted with relatively small magnetic potentials because each distance along the tape equal to one magnetic gap length represents but little difference in flux density. However, as wavelength decreases (frequency rises), greater potentials are presented to the gap. If the magnetic gap equals exactly one-half wavelength there are instants when, assuming a sine wave, the potential at the gap corresponds to the difference between the positive and negative peaks of the wave, as shown in Fig. 4B. Since this is the greatest magnetic potential that can exist, maximum head output occurs when the gap equals one-half wavelength.

Fig. 4A shows magnetic potentials when the magnetic gap equals one-quarter wavelength. It can be seen that at instants when maximum potential exists across the gap, this potential is only half as great as in Fig. 4B.

When the head scans a wavelength exactly equal to gap length, then, as shown in Fig. 4C, there is at all times a zero difference in magnetic flux at each gap edge. Consequently output of the playback head is zero. When the gap becomes longer than one wavelength, output begins to rise again, reaching another maximum when the magnetic gap is 1½ wavelengths long, another minimum when it is 2 wavelengths long, etc., as shown in Fig. 2. However, this area of operation is of no concern to tape recorders used for audio reproduction.

Given physical gap length, a rough approximation of the frequency at which maximum playback response occurs may be obtained by the formula $F = S/2G$, where F is frequency in cps, S is tape speed in ips, and G is physical gap length in fraction of an inch. As previously explained, maximum response occurs when $\delta = \lambda/2$. For purposes of the present approximation, G is substituted for δ, so that $G = \lambda/2$. But wavelength equals tape speed divided by frequency, or $\lambda = S/F$. Substituting, $G = S/2F$, Transposing, $F = S/2G$.

In actuality, the frequency of maximum playback response is less than the figure given by this formula because magnetic gap length is greater than physical gap length, since it is impossible to make a gap with absolutely sharp edges. Also, in practice, response tends to fall on the order of 30 db rather than by an infinite amount as frequency increases from that of maximum response to a frequency one octave higher. For example, a high quality playback head with a physical gap length of .00025" and operated at 7.5 ips has maximum output at 15 kc. according to the equation $F = S/2G$. Zero output would occur at 30 kc. Actually, output may reach a maximum at 13.5 kc., drop 30 db between 13.5 kc. and 27 kc., and then rise again.

The approximate practical limit to

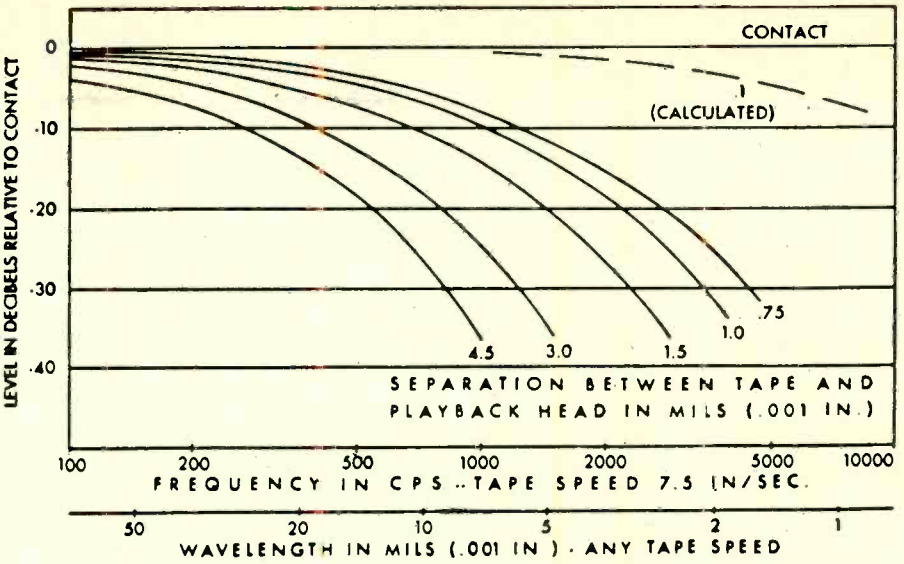


Fig. 5. Signal attenuation caused by poor contact in playback as a function of frequency (or wavelength) for various separations. Data courtesy of Minnesota Mining & Manufacturing Company, Bulletin 6 of its "Sound Talk" series of brochures.

useful response is sometimes considered to be the frequency at which the physical gap equals one-half wavelength; in short, the limit is roughly $F = S/2G$. This is so for two reasons. First, as explained, the actual frequency of maximum response is somewhat lower than F in this formula. Second, as shown in Fig. 2, within less than an octave after the frequency of maximum response, playback output drops precipitously; consequently response may be carried to a point not too far above the actual maximum. Thus at a speed of 7.5 ips, using a head with a physical gap of .00025", the practical limit is in the neighborhood of 15 kc. At the same speed but with a .0005" gap, the limit is about 7.5 kc.

Tape recorders sometimes exhibit a playback loss below 50 cps or so owing to the "wrap around" effect. This occurs when the tape contacts a large area of the playback head. Material of the head may then adversely affect

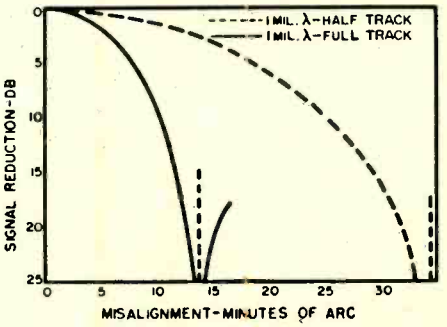


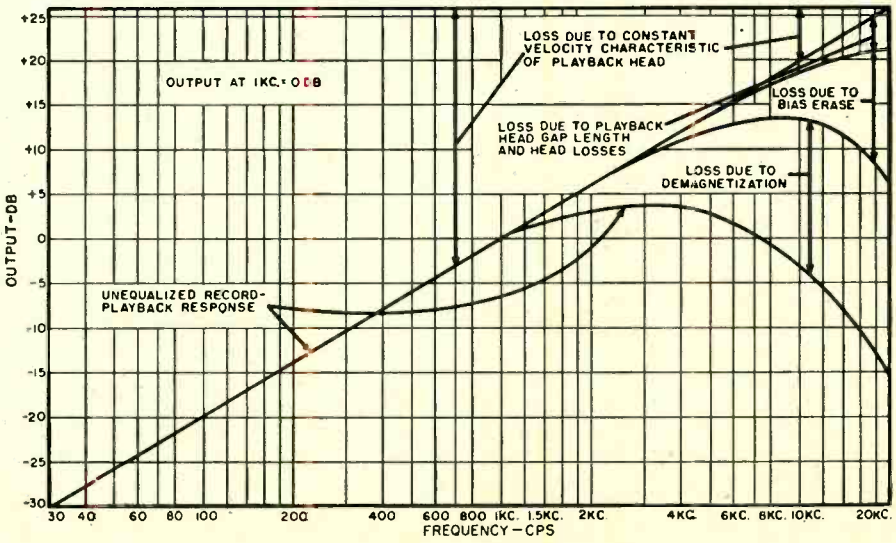
Fig. 6. Reduction of high-frequency response due to azimuth misalignment. Courtesy of Minnesota Mining & Mfg. Company.

magnetic coupling between the tape and the head gap at very low frequencies, where the magnetic flux extends an appreciable distance from the tape. The amount of loss depends in part upon geometry of the head.

A loss in playback response, especially at high frequencies, will result

(*Continued on page* 156)

Fig. 7. Principal factors responsible for losses of a record-playback head operating at 7.5 ips. Losses shown are approximate values for the record-playback head represented in Fig. 1, having a physical gap of only .00015" and operated at .6 ma. The gap length loss would be considerably greater for longer gaps. Refer to the article.



Adapting the "Ultra-Linear" Williamson to 6550 Operation

Over-all view of the "Ultra-Linear" amplifier that has been adapted for Tung-Sol 6550's.

A new high-power output tube, the 6550, will find many applications in converting present-day amplifiers and in new equipment. Up to 100 watts push-pull can be had.

By **HERBERT I. KEROES**
Acro Products Company

SINCE its introduction many years ago, the *Williamson* amplifier has undergone a few design changes to further improve its performance. As originally described by Williamson, the amplifier was a 15-watt unit designed for low distortion, uniform output, and small phase shift over the entire audio range.[1] Since the original conception of the *Williamson* amplifier, American manufacturers have jumped on the bandwagon and today one will find many variations of the original circuit. Performancewise there is wide variation among the different units made in this country. One of the circuit improvements made by American manufacturers came with the application of "Ultra-Linear" operation to the output tubes, a mode of operation which doubled output power and further reduced distortion.[2] This amplifier has been widely accepted by audiophiles with the result that there are about twenty commercial amplifiers on the market today which incorporate this design feature.

The application of "Ultra-Linear" operation to the *Williamson*-type amplifier increased the output power to 30 watts using the same type of output tubes operating at the same voltages. When this circuit was first introduced it was immediately noted that the new combination provided better sound, even at the low volume levels which the original amplifier could handle. This phenomenon has resulted in a new evaluation of the power requirements of an amplifier as a part of an audio system and, in general, it has been observed that in amplifiers of analogous design, the unit of greatest capacity will sound best.

The attainment of high power in audio amplifiers has become relatively easy and inexpensive due to two factors, the increased efficiency of the "Ultra-Linear" output circuit and the introduction of new output tubes with greater power handling capabilities. One recently introduced tube, the *Tung-Sol* 6550, is particularly adaptable to output stages of the "Ultra-Linear" type and can be used to advantage in the "Ultra-Linear" *Williamson* circuit to provide an amplifier of 60-watt capacity having an intermodulation content at maximum output of 6/10th of one per-cent. This amplifier differs only in a small degree in dimensions and number of circuit elements from its predecessors, and many *Williamson*-type amplifiers can easily be modified to take advantage of the improved performance.

Amplifier Circuit

An examination of the circuit diagram reveals the basic *Williamson* circuitry of the first three stages. The first two, the input voltage amplifier and direct-coupled cathodyne phase inverter, are familiar and unchanged even with regard to tube type, the 6SN7. The driver stage also remains a 6SN7, with but one change. Individual cathode resistors have been added to provide a slight amount of local feedback in order to improve the loop feedback phase characteristics and increase the stability margin of the amplifier.

The output stage is coupled to the driver through a resistance capacity network which provides conventional *RC* coupling at signal frequencies and an attenuated direct coupling at subsonic frequencies. This again introduces an improved low-frequency phase characteristic which adds to the stability margin of the amplifier. The use of this combined *RC* and direct coupling is made possible by the choice of fixed bias operation of the output tubes whereby the required negative bias is obtained from a separate bias supply. The fixed bias supply consists of T_3, a 6.3 volt, 1 amp. filament transformer; a 50 ma. selenium rectifier SR_1; resistor R_{29}; and electrolytic capacitors, C_{12} and C_{13}.

In order to reduce hum to a minimum in preamplifiers that are to be powered from the main amplifier, a positive bias has been applied to the heater line through resistors R_{27}, R_{28}, and capacitor, C_8. If a separately powered preamplifier is to be used, this network can be eliminated, together with the hum balancing potentiometer R_{30}, and the centertap of the 6.3 volt winding on the power transformer T_2 can be grounded. "B plus" voltage for operation of the preamplifier can be taken either from point *X* or *Y* depending on the preamp to be used.

"Ultra-Linear" Output Stage

The "Ultra-Linear" type of output stage is characterized by output tubes of the tetrode type with the screens of the tubes connected to taps equally positioned about the centertap of the output transformer. The operation of the stage can most readily be understood by the following considerations: first, if the screen of an output tube is connected to the plate, the tube functions as a triode, and the plate characteristic curves are concave upward. Secondly, if the screen is connected to "B plus," the tube operates as a tetrode, and the plate characteristic curves are concave downward. If, however, the screen is connected to a tap on the primary of the output transformer, a type of operation is obtained midway between triode and tetrode. Depending upon the type of output tube used, the tap can be chosen to result in an almost linear set of plate

characteristic curves, and this mode of operation has been termed "Ultra-Linear." It has been determined experimentally that the best operating point for the 6550 is with the tap located at 40% of the primary turns.

"Ultra-Linear" operation of an output stage has sometimes been described as the application of negative feedback to the screen grids of the output tubes. If this concept is used to explain the operation, it should be noted that the feedback is of the power type rather than the more usual voltage or current feedback, and power is supplied to the screen grids over the operating cycle. It can be demonstrated mathematically that when power feedback is applied to the screen grid of a tube, the linearity of the plate characteristic curves can be improved over and above the amount normally to be expected by a consideration of voltage feedback only.[3]

The output transformer is an *Acrosound* TO-330. This transformer is ideally suited for the 6550 tubes, providing the correct impedance match for maximum power and lowest distortion, and primary taps located at 40% of the total winding. The frequency response of the TO-330 is flat ± 1 db from 10 cps to over 100 kc., thereby providing the necessary low phase shift over the audio range for best feedback stability and faithful transient response. The halves of the primary winding are tightly coupled to make available a full 60 watts of output over the entire audio range 20 cps to 20 kc. Although the nominal rating of the transformer is 50 watts at 20 cps, no difficulty was experienced in obtaining full undistorted output at the low frequency extreme. Too much emphasis cannot be placed on the fact that an amplifier cannot be better than its output transformer irrespective of the circuit used. This component serves many functions in a feedback amplifier as well as providing an impedance match between the output stage and the speaker. However, all of the necessary conditions can be met by a propitious choice of design and this unit can, in fact, be improved in certain performance categories, for example, bandwidth over and above the circuit with which it is associated.

Feedback Stability

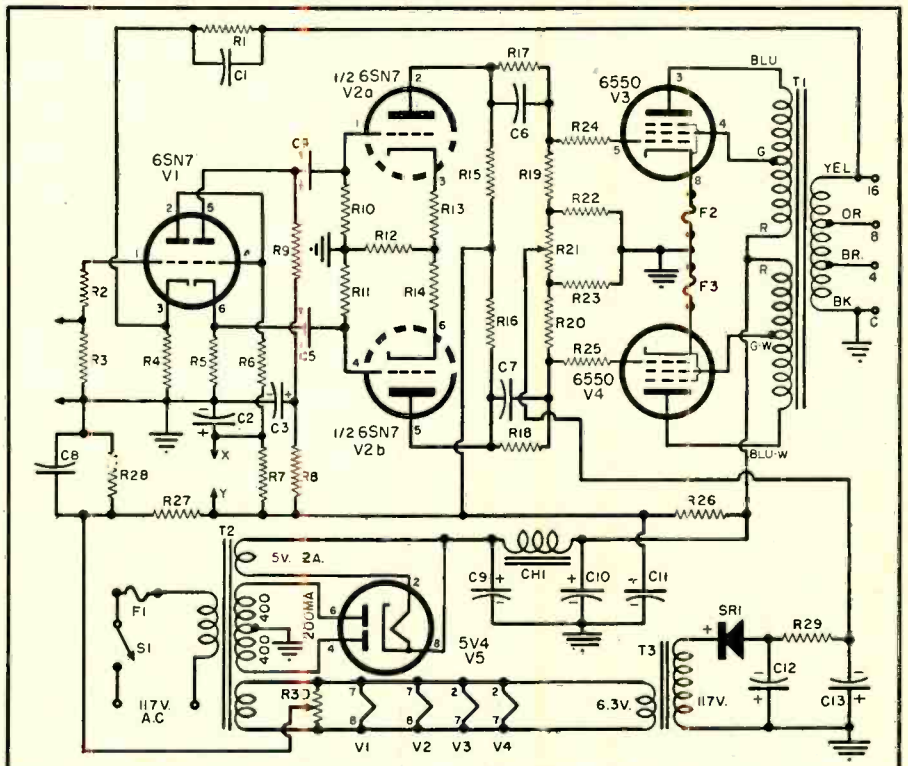
In a feedback amplifier it is always desirable to maintain a maximum amount of feedback stability in order to assure complete stability under all conditions of output power level and output load. The degree of stability of a feedback amplifier is generally rated in terms of stability margin, meaning the amount of additional feedback in db that can be added before the amplifier becomes unstable and oscillates. This design figure is usually taken under conditions of rated resistive output load. However, loudspeakers are not constant resistance devices, but present to the amplifier an impedance containing a large reactive component over a good portion of their operating range. Moreover, in the band outside of the range of the speaker, the impedance may be almost completely reactive. It is desirable, therefore, to have a stability margin of 6 db or more to assure complete stability.

The stability characteristics of a feedback amplifier are associated with the bandwidth and phase shift characteristics of the amplifier circuit and output transformer, and there are several choices available to the designer to increase the stability of a given amplifier. First, bandwidth may be traded for stability. In this procedure loss networks are added to shape the amplifier response curve so that the response of the amplifier falls off by the amount of feedback plus the stability margin before the phase of the feedback voltage becomes regenerative. Secondly, gain within the useful band may be traded for stability. In this

Power Output	60 watts @ 1000 cps; within ±.5 db of 1 kc. level @ 60 watts over range 20 cps to 30 kc.
Frequency Response	±1 db @ 1 watt, 2 cps to 220 kc.
Intermodulation Distortion (60 and 3000 cps mixed 4:1, equiv. sine-wave power)	10 watts—.07%; 20 watts—.10%; 30 watts—.15%; 40 watts—.25%; 50 watts—.40%; 60 watts—.60%
Square-Wave Response	Rise time on 20 kc.—2 microseconds; overshoot on 20 kc.—none observed; ripple on 20 kc.—approx. 1%; droop on 20 cps—5%
Hum and Noise	80 db below rated output
Nominal Feedback	20 db
Feedback Stability Margin	10 db
Damping Factor	15
Sensitivity	1.3 volts r.m.s. for full output

Table 1. Performance characteristics of the converted "Ultra-Linear" amplifier.

Complete schematic diagram of the 60-watt version of "Ultra-Linear" Williamson.



R1, R2—10,000 ohm, ½ w. res.
R3—1 megohm, ½ w. res.
R4—470 ohm, ½ w. res.
R5, R9—22,000 ohm, 1 w. res. (matched ±1%)
R6—47,000 ohm, 1 w. res.
R7—33,000 ohm, 1 w. res.
R8—22,000 ohm, 1 w. res.
R10, R11—470,000 ohm, ½ w. res.
R12—470 ohm, ½ w. res.
R13, R14—220 ohm, ½ w. res.
R15, R16—47,000 ohm, 2 w. res. (matched ±1%)
R17, R18—470,000 ohm, ½ w. res. (matched ±1%)
R19, R20—47,000 ohm, ½ w. res. (matched ±1%)
R21—10,000 ohm, linear taper pot
R22, R23, R27—100,000 ohm, ½ w. res.
R24, R25—1000 ohm, ½ w. res.
R26—2500 ohm, 5 w. res.
R28—15,000 ohm, ½ w. res.
R29—18,000 ohm, ½ w. res.
R30—100 ohm wirewound pot
C1—47 μμfd. ceramic capacitor
C2-C3-C11—20/20/20 μfd., 450 v. elec. capacitor
C4, C5, C6, C7—.25 μfd., 600 v. capacitor
C8—.1 μfd., 400 v. capacitor
C9, C10—10 μfd., 600 v. oil or elec. capacitor
C12, C13—20 μfd., 150 v. elec. capacitor
T1—Output trans. (Acrosound TO-330, see text)
T2—Power trans. 400-0-400 v. @ 200 ma.; 5 v. @ 2 amps.; 6.3 v. @ 5 amps.
T3—Fil. trans., 6.3 v. @ 1 amp.
CH1—4 hy., 200 ma. filter choke
S1—S.p.s.t. switch
F1—5 amp. line fuse
F2, F3—⅛ amp. cathode fuse
SR1—50 ma. selenium rectifier
V1, V2—6SN7 tube
V3, V4—6550 tube (Tung-Sol)
V5—5V4GA tube

procedure local feedback may be added to stages within the amplifier in order to reduce their contribution to the phase shift. Thirdly, the bandwidth of the stages may be extended by the use of certain design techniques, and the phase shift correspondingly reduced.

The first method is subject to the criticism that it restricts the amplifier band reducing the rise time with regard to square wave response and, in this manner, affects the fidelity of transient reproduction. The first and third methods may be combined; the bandwidth increased and then loss networks added.

An appreciable increase in the bandwidth of the amplifier described has been achieved by the use of the TO-330 transformer. The response of the amplifier, with feedback, is flat to over 200 kc. An adequate stability margin of 10 db has been maintained by the use of methods two and three. A small amount of degeneration has been added to the driver stage by the inclusion of individual cathode resistors. The subsonic bandwidth has been extended and shaped by the addition of the 470,000 ohm coupling resistors R_{17} and R_{18}. With these added resistors the bias developed on the grids of the output tubes is partially dependent on the voltage developed at the plates of the driver tubes, and a plate current balancing control has been added to the output stage. The procedure of balancing plate current has been facilitated by individually fusing the output tube cathodes. To check plate current the fuse is removed. The fuse clip serves as a convenient tie point for the connection of a milliammeter.

Construction of the Amplifier

The amplifier can be constructed on a chassis 8" x 12" x 3". A careful arrangement of parts permits direct point-to-point wiring of the stages and a short, direct feedback connection between the output transformer and the first stage. The axiom for wiring amplifier stages is to have leads as short and direct as possible. It is desirable to twist filament leads; also leads to the power switch and preamp power connector. A neater job will usually result if filament, switch, and power supply circuits are wired first, then "B plus" circuits, then signal circuits less the coupling capacitors. The coupling capacitors are added last, and since these are generally large, they may be looped over the space from stage-to-stage. The coupling capacitors to the output stage can terminate on pin No. 6 of the 6550 sockets, since this pin is not a tube connection and can be used as a tie point.

Care should be taken when wiring the output transformer to see that the proper color coding is observed for the primary leads. Make certain that the tracer leads are connected to the output tube that is energized from the cathode of the phase inverter. If these leads are incorrectly connected the amplifier will motorboat when it is turned on. Correct phasing can be restored by either reversing the transformer leads or by reversing the connections of the coupling capacitors at the phase inverter section of the first tube.

The total cathode current per output tube will run about 75 ma. with a plate supply voltage of 425 volts and a grid bias voltage of minus 48 volts. If the cathode current differs considerably from this figure, it may be advisable to change the value of R_{20} until normal bias and plate current is obtained.

Conversion of Existing Amplifiers

It will occur to many that their *Williamsons* may be converted to take advantage of the increased power output offered by the 6550 tube by simply adding a few extra components and changing the output transformer. One precaution should be taken, however, against overloading the power transformer. The plate current drain of the output stage has been increased from the 100 ma. drain of the usual KT-66 tubes to 150 ma., and a power transformer that is operating close to maximum rating will not be able to supply the additional drain. Many power transformers will, however, be able to take it, and one should not rush to replace the transformer if it feels hot in service. A safe operating temperature for this component is 140 degrees F. which is an uncomfortable temperature to the hand. However, if the power transformer ran at an uncomfortable temperature before conversion, it should be replaced.

Performance

The measured performance figures of the amplifier are given in Table 1. The frequency response at low output levels is flat from 2 cps to 220 kc. Maximum power of 60 watts is delivered at all frequencies between 20 cps and 30 kc. The square wave response at 20 cps shows 5% droop, and at 20 kc. the square wave is clean with no overshoot and a rise time of 2 microseconds. The intermodulation figures are particularly good, being only 0.15% at 30 watts and 0.6% at 60 watts, for a combination frequency of 60 and 3000 cps, mixed 4:1.

Much has been written about amplifier testing and on the interpretation of test results. However, the deeper one goes into the field of amplifier design, the more apparent it becomes that the best test instrument is the human ear with music supplying the signal source. Unfortunately, the ear cannot supply a numerical rating of merit, but only a comparison of "better" or "not as good." The amplifier described in this article has been subjected to comparative listening tests with both the older "Ultra-Linear" *Williamson* using KT-66's and with other good amplifiers. Listeners were generally agreed that this amplifier had many points of superiority.

The relative importance of the power amplifier in a high-fidelity system has always been a controversial subject. There are those who maintain that a low power amplifier of 5 watts or so is adequate for good reproduction and qualify this by the indisputable statement that the average sound power required for good room volume is no greater than this figure. Others state that a moderately good power amplifier is a much more perfect device than other elements of the reproducing system, in particular phono pickups and speakers. Both of these schools of thought fail to recognize some basic facts relating to requirements imposed upon the power amplifier. In the first case, although average room volume may require only a few watts, peak powers may exceed the average by 10 times or more, and it is the fidelity with which these peaks are reproduced that contribute to the feeling of presence. With regard to the second point, it is true that there is still room for improvement in pickups and speakers, however, any additional contribution to intermodulation distortion in the

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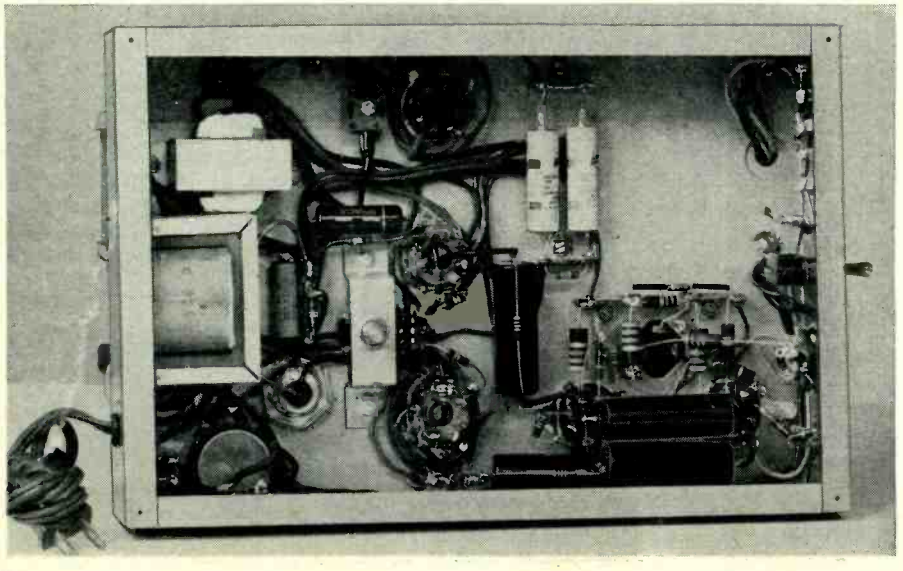
Underchassis view of amplifier. Note the point-to-point wiring of circuit.



FM Multiplexing

A New Approach to Stereophonic Sound

By BURT HINES

The FCC has finally given its approval. If financial problems can be worked out to support this new idea, it could become an added boon to all hi-fi fans.

STEREOPHONIC FM—a significant step toward greater realism in the reproduction of sound—is no longer a matter of technical development but of devising a satisfactory economic inducement for FM stations to provide this service.

Multiplex transmission, which enables an FM station to broadcast one or more "subchannels" simultaneously with the main audio channel, has been perfected to the degree necessary to win FCC sanction. This year, effective July 1, the FCC gave approval to FM stations wishing to go on a multiplex basis.

Already some of the largest FM stations in the country have installed or ordered multiplex equipment. Although there may be some experimental stereophonic broadcasts at the outset, the subchannels will initially be used essentially for commercial services to *paying subscribers*. Such services consist most commonly of music devoid of advertising which is beamed to restaurants, hotels, offices, factories, etc. Similar music programs interspersed with announcements are directed to stores, transit line passengers, and other special audiences.

Current plans, however, do not ignore the home audience. If these plans materialize, multiplex will enable the home listener to hear the two channels of a stereophonic program by tuning in just one station. Present stereophonic broadcasts, conducted a few hours a week by several stations, rely on joint use of the FM and AM transmitters of these stations. Since AM is usually the weak sister, reception is often marred by static, limited frequency response, co-channel interference, fading, and other defects of AM. Multiplex makes possible stereophonic reception coupled with the blessings of FM.

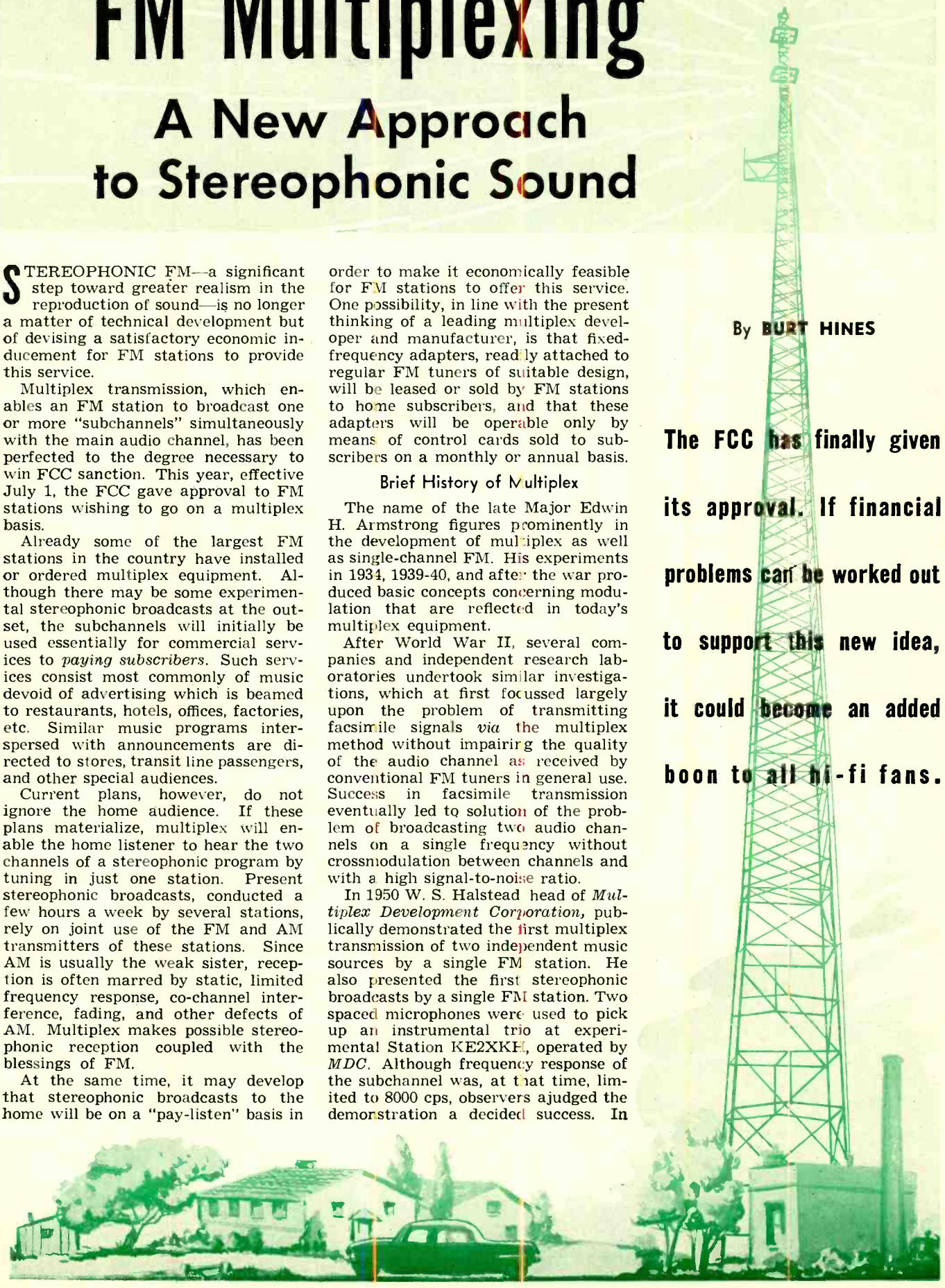
At the same time, it may develop that stereophonic broadcasts to the home will be on a "pay-listen" basis in order to make it economically feasible for FM stations to offer this service. One possibility, in line with the present thinking of a leading multiplex developer and manufacturer, is that fixed-frequency adapters, readily attached to regular FM tuners of suitable design, will be leased or sold by FM stations to home subscribers, and that these adapters will be operable only by means of control cards sold to subscribers on a monthly or annual basis.

Brief History of Multiplex

The name of the late Major Edwin H. Armstrong figures prominently in the development of multiplex as well as single-channel FM. His experiments in 1934, 1939-40, and after the war produced basic concepts concerning modulation that are reflected in today's multiplex equipment.

After World War II, several companies and independent research laboratories undertook similar investigations, which at first focussed largely upon the problem of transmitting facsimile signals *via* the multiplex method without impairing the quality of the audio channel as received by conventional FM tuners in general use. Success in facsimile transmission eventually led to solution of the problem of broadcasting two audio channels on a single frequency without crossmodulation between channels and with a high signal-to-noise ratio.

In 1950 W. S. Halstead head of *Multiplex Development Corporation,* publically demonstrated the first multiplex transmission of two independent music sources by a single FM station. He also presented the first stereophonic broadcasts by a single FM station. Two spaced microphones were used to pick up an instrumental trio at experimental Station KE2XKH, operated by *MDC*. Although frequency response of the subchannel was, at that time, limited to 8000 cps, observers ajudged the demonstration a decided success. In



1953 Major Armstrong and his research group at Columbia University demonstrated his multiplex system before the Radio Club of America. However, whereas *MDC*'s multiplex system did not interfere with main channel reception by conventional FM tuners, Major Armstrong's method required special tuners for main channel reception.

Following its two-channel demonstrations in 1950, *MDC* filed application with the FCC requesting authorization for the use of multiplex by FM stations. By the time authorization arrived in 1955, *MDC* in conjunction with *Crosby Laboratories* had developed equipment permitting high-fidelity stereophonic broadcasting. It had also succeeded in transmitting two or more subchannels on a single carrier, although frequency response is limited to 8000 cps or less when more than one subcarrier is used. The equipment developed by *MDC* is being commercially promoted and sold by *Multiplex Services Corporation*. The latter has entrusted manufacture of the equipment to two firms well known for quality of product, *Gates Radio,* which is making the transmitting equipment, and *Browning Laboratories,* which is making FM tuners, multiplex adapters, and other receiving equipment to *MSC* specifications.

Benefits to the Home Audience

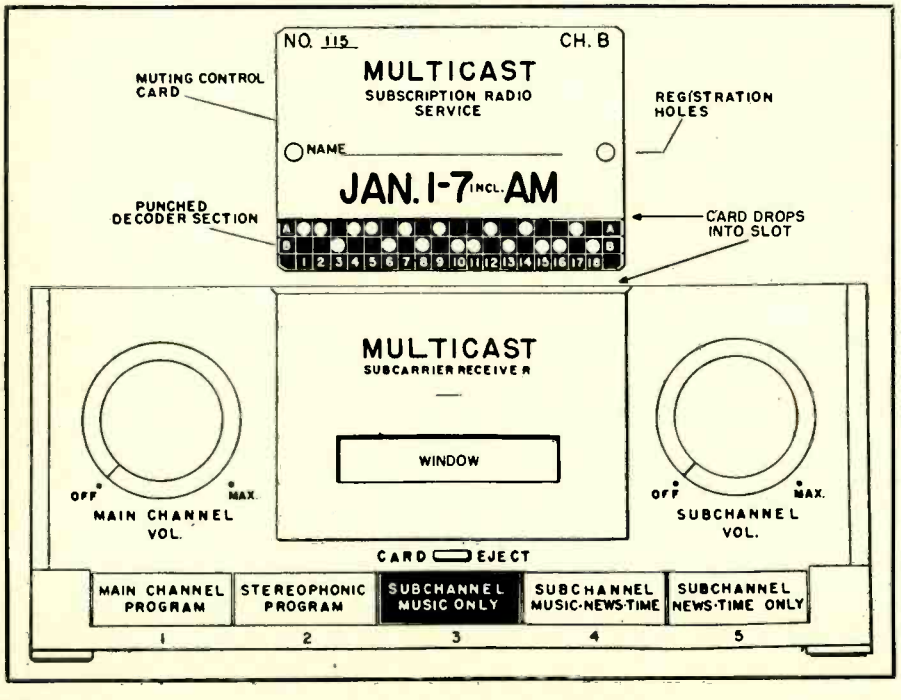
Technical specifications for *MSC*'s equipment spell performance consistent with the highest standards of audio reproduction. Two-channel transmission (main channel and one subchannel) can cover the full audio range of 50-15,000 cps on each channel, although an 8000 cps cut-off is generally used for background music and similar programs. The signal-to-noise ratio on the subchannel is about 55 db, which is substantially better than an AM tuner can produce and compares favorably with present ratios for the majority of standard FM tuners now in use. The signal-to-noise ratio on the main channel is considerably better than 60 db. At full modulation, harmonic and intermodulation distortion are kept below 1.5% on the subchannel and below .5% on the main channel.

If stereophonic reception is brought into the home on a subscription basis, the listener may expect benefits even on single-channel sound in the way of a variety of choices as to what he may hear. Fig. 1 illustrates *MSC*'s present thinking as to the choices offered a home listener *via* a "Multicast" adapter attached to his regular FM tuner. At the bottom of the adapter would be five push-buttons, marked from left to right "main channel program," "stereophonic program," "subchannel music only," "subchannel music-news-time," and "subchannel news-time only." If the listener wishes to hear the main channel, he would push button 1, which gives him the program he would normally hear on his regular FM tuner. However, if he wishes a special multiplex program devoid of announcements, he may push button 3. If a stereophonic program is on the air, he would push button 2, assuming he has an amplifier and speaker for each of the two channels. An FM station might very well provide different or more extensive musical programming on the subchannel, in which event button 4 may suit the listener's preference. In case the latest news or time checks are wanted, button 5 would bring in such fare at regular two or three minute intervals, between musical selections.

Under a subscription plan it is expected that FM stations would be in financial position to provide the latest and best in high quality programs, featuring high-fidelity stereophonic tapes. A paying system is also expected to provide FM broadcasters with the revenue which will enable them to increase the number and quality of live music broadcasts.

Even though it may not reach the home for some time, multiplex may nevertheless prove a boon to the high-fidelity audience by providing FM stations with the revenue needed to improve the extent and quality of FM programs. It is hoped that multiplex will help lift the FM industry out of its economic doldrums by enabling stations to offer subscription services for the first time or to expand their existing services of this kind. An improvement in the fortunes of FM broadcasters should be good news to the high-fidelity public, which has been apprehensively watching the number of commercial FM stations dwindle over the last few years instead of grow as anticipated. It stands to reason that the number and quality of FM programs are likely to rise if FM station owners find their lot a profitable one.

Fig. 1. A proposed multiplex adapter for use in home installations. The selector switches, Nos. 1 through 5, are actually in the form of push-buttons.



The Subscription Proposal

Of course it cannot be said for certain that stereophonic FM will be made available to the home audience only on a subscription basis. However, since this is a strong possibility, it is worth presenting some detail on *MSC*'s subscription proposal.

As previously indicated, *MSC* visualizes sale or rental of an adapter for regular FM tuners of suitable type, the adapter being operated by means of a control card sold to the listener on an annual, monthly, weekly, or similar basis. Whereas anyone could tune in the main channel on a standard tuner, the subchannel and choices of program material transmitted on the subchannel would be heard only *via* the adapter by inserting the control card, as indicated in Fig. 1. Volume controls at the left and right of the adapter would control gain on each channel.

To discourage pirating of programs by unauthorized listeners, a multicast program would send out an intrusion signal on the subchannel during intervals between musical selections. This could take the form of squeals, distortion, or other annoying sound or it could be in the nature of a repeated announcement that unauthorized reception of the subchannel is a violation of the law and subject to criminal prosecution under Section 605 of the Federal Communications Act pertaining to private communications. The control card would enable the adapter to remove the intrusion signal.

To permit removal of the intrusion signal by authorized adapters, the transmitter would send out a series of "security" code pulses at ultrasonic frequencies (frequencies above the audio range). Accompanying these pulses would be random decoy pulses intended to confuse "pirates" and cause faulty operation of illegally operated adapters. The control card shown in Fig. 1 would cause proper contacts to be

made in the adapter at a designated time so as to permit effective reception of the code pulses. The nature of the code would vary from week to week, and possibly from one time of day to another. Correspondingly, the punched holes would be changed. By the time the code could be broken, a new code and new card would be in effect. Altogether, it is felt by *MSC* that legal protection of subchannel transmission, complexity of the code system, and patents on security control equipment will prevent unauthorized subchannel reception to any significant degree.

In order to give the subscriber a choice as to what he wants to hear on the subchannel (buttons 3, 4, 5), the transmitter would use methods somewhat similar to present "beep" control. Transmission of ultrasonic control signals, filtered out or accepted by the adapter according to the button pushed, would determine what portion of the subchannel program could be heard.

How Multiplex Works

Although multiplex is a technical feat of a very high order inasmuch as it permits several program channels in the same radio spectrum space previously occupied by one channel, it is not difficult to understand, in principle, how it works, as depicted by the block diagrams of Figs. 2 and 3.

Fig. 2 represents a two-channel multiplex transmitter. The main channel is designated by squares and rectangles and the subchannel by circles. In essence, the subchannel is added through low-level frequency modulation of the FM main carrier by a subcarrier, which is a ultrasonic signal that is frequency modulated by the subchannel program source. Fig. 2 assumes a subcarrier of 35 kc.

With the exception of the multiplex modulator and the low-pass filter, the main channel stages are the same as in a conventional FM transmitter. However, equipment of special design is required for those stages prior to the power amplifiers in order to insure high quality performance. The purpose of the low-pass filter following the main channel source is to remove audio harmonics in the same range as the modulated subcarrier and thereby eliminate interference on the subchannel.

As on the main channel, the subchannel program source goes through a low-pass filter (to remove harmonics above the useful frequency range) and a pre-emphasis network, then frequency modulates a signal of several hundred kilocycles. After frequency multiplication, the subchannel signal goes through a mixer, where it is beat down to 35 kc. by a heterodyne oscillator. This 35 kc. subcarrier then frequency modulates a submultiple of the main carrier frequency (16.3 mc. in Fig. 2), which has already been modulated by the main channel audio source. The main carrier submultiple is also modulated by control signals in the range of 20-50 kc. which are introduced between musical selections; as previously discussed, these signals are intended to prevent unauthorized subchannel reception. From this point, the main channel and subchannel travel together, going through further frequency multiplication, power amplifiers, and the broadcast antenna.

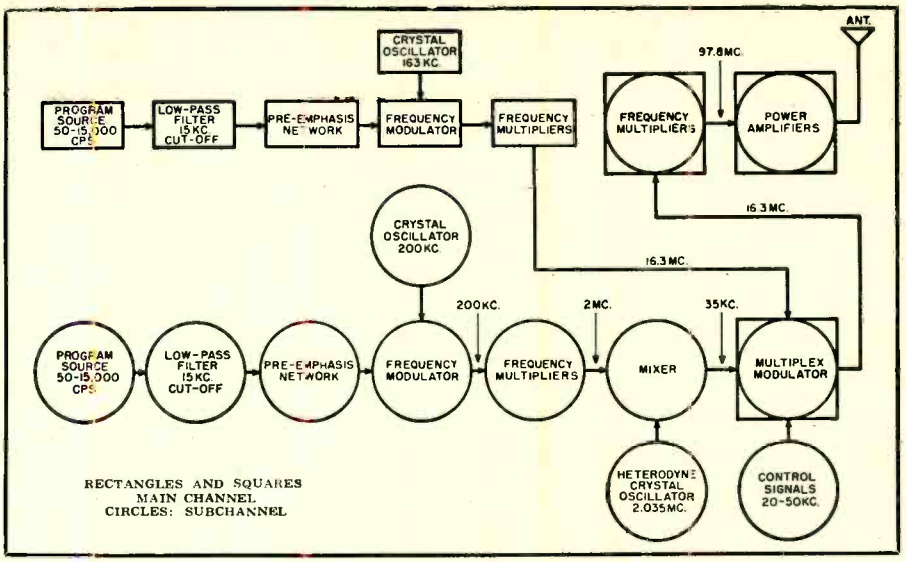


Fig. 2. Block diagram shows how a two-channel multiplex transmitter works.

The subcarrier center frequency must be at least 20 kc. above the upper limit of the audio spectrum (15 kc.) so that the modulated subcarrier does not break into the main channel. Subcarrier modulation of the main carrier is required by the FCC to be at a level at least 60 db below audio modulation of the main carrier in order to prevent audible crosstalk between the two channels on regular FM tuners. Whereas full modulation of the main carrier corresponds to a frequency deviation of 75 kc., maximum frequency modulation of the subcarrier is limited to about 6 kc. in order to avoid cross-modulation between channels. Despite these limitations on the extent to which the subcarrier modulates and is modulated, a signal-to-noise ratio of 55 db or greater is obtainable in subchannel receiving equipment.

Fig. 3 represents a multiplex adapter attached to a conventional FM tuner of "suitable design." Suitable design means wide-band i.f. stages (at least 200 kc.) and a detector with linear response to about 40 or 50 kc. The adapter utilizes the audio output of the tuner prior to de-emphasis, so that the 35 kc. subcarrier is not attenuated. This signal passes through an isolating cathode follower and then through a filter which accepts only frequencies above 20 kc. The signal is amplified, limited, detected, and de-emphasized as in a regular tuner. For purposes of "beep" control and removal of interfering signals, a decoding section draws the necessary impulses from a limiting stage of the adapter and uses them to operate an audio muting device.

The Stereophonic Future

It is difficult to resist the conclusion that stereophonic FM in the home is an inevitable outcome of multiplex, although it is a matter of speculation how long this will take. Music—classical, popular, and in-between—has a

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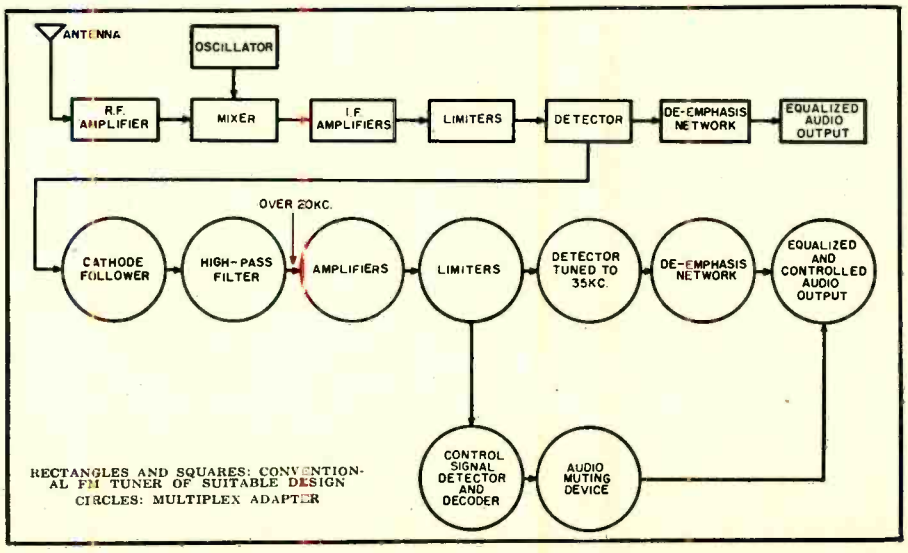
Fig. 3. Operation of a conventional FM tuner and its multiplex adapter unit.



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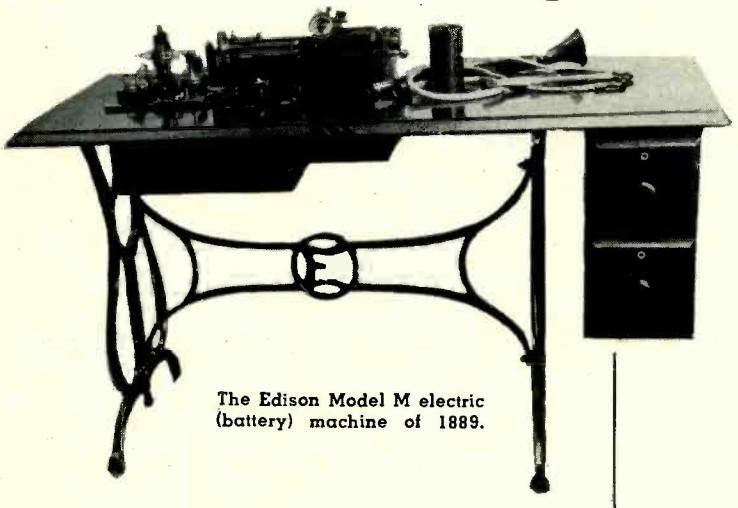
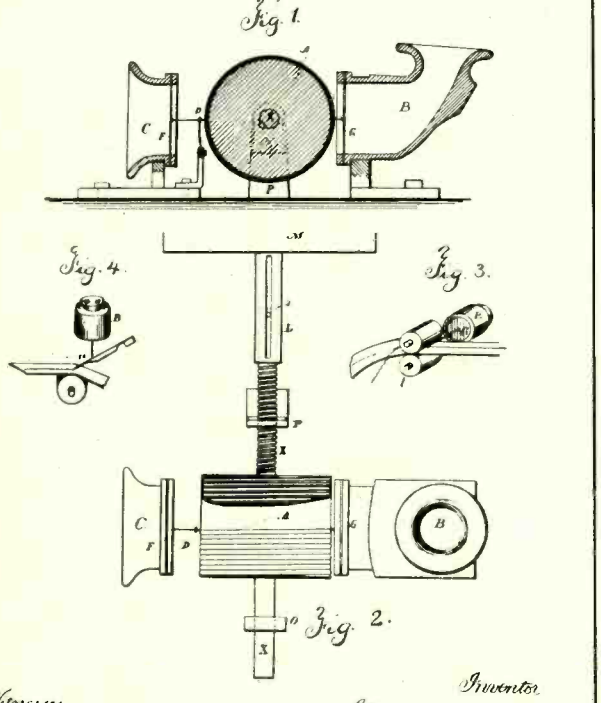


The Edison Model M electric (battery) machine of 1889.

Part 1. The invention of the "speaking machine" by Thos. A. Edison. First of a new series of articles dealing with the design and development of the phonograph.

By
OLIVER READ
Editor, RADIO & TELEVISION NEWS
and
JAMES RILEY

T. A. EDISON.
Phonograph or Speaking Machine.
No. 200,521. Patented Feb. 19, 1878



HIGH-FIDELITY phono recording and reproduction owes its inception to a discovery by Thomas A. Edison who, in 1876, hit upon the basic idea that has since resulted in the development of the modern phonograph. Edison's discovery came at a time when his interest was divided and when he was experimenting with all sorts of electrical gadgets. Edison always had a flare for "experimenting," but his first real invention took place in 1864 at Indianapolis, Indiana, where he built an automatic telegraph repeater. This was considered the forerunner of numerous inventions to follow. His invention of a stock ticker in Boston resulted in a payment to Edison of $40,000. With this he established a laboratory at Menlo Park and at West Orange, New Jersey.

Unlike the discoveries of Leon Scott and the invention of the "Phonautograph" in 1857, which provided a means whereby visual records could be made of the vibrations appearing on a diaphragm, Edison's discovery, followed by a patent application filed in December, 1877, claimed "a means for *recording* permanent characters of the human voice and other sounds—from which characters such sounds can be *reproduced* and rendered audible again at a future time."

The tremendous importance of Edison's discovery is clearly revealed by reading his application for patent filed December 24, 1877. It reads in part as follows:

"The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

"The invention further consists in the various combinations of mechanism to carry out my invention.

"I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct,

PHONOGRAPH

and therefore becomes possible to record and reproduce the sounds of the human voice.

"In the drawings, Fig. 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

"*A* is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, *X*, having at one end a thread cut with ten threads to the inch, the bearing *P* also having a thread cut in it.

"*L* is a tube, provided with a longitudinal slot, and it is rotated by the clockwork at *M*, or other source of power.

"The shaft *X* passes into the tube *L*, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube *L*, the object of the long slot being to allow the shaft *X* to pass endwise through the center or support *P* by the action of the screw on *X*. At the same time that the cylinder is rotated it passes toward the support *O*.

"*B* is the speaking-tube or mouthpiece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

"Upon the end of the tube or mouthpiece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder *A* that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

"The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

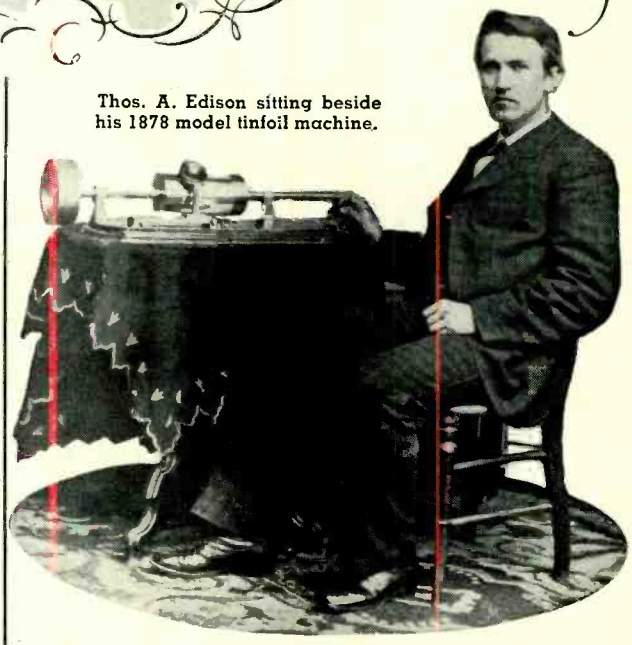
"The operation of recording is as follows: The cylinder is, by the action of the screw in *X*, placed adjacent to the pillar *P*, which brings the indenting-point of the diaphragm *G* opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube *B* is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clockwork is then set running, and words spoken in the tube *B* will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

"After the foil on the cylinder has received the required indentations, or passed to its full limit toward *O*, it is made to return to *P* by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube *B*.

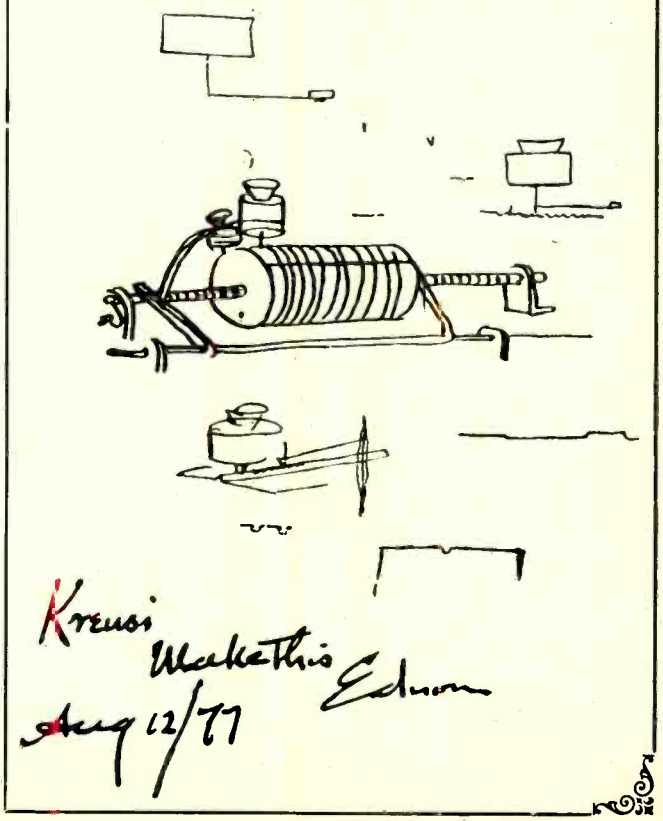
"*C* is a tube similar to *B*, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, *D*, having a small point shorter and finer than the indenting-point on the diaphragm of *B*. This spring and point are so arranged as to fall exactly into the path of all the indentations. This spring is connected to the diaphragm *F* of *C* by a thread or other substance capable of conveying the movements of *D*. Now, when the cylinder is allowed to rotate, the spring *D* is set in motion by each indentation corresponding to its depth and length. This

(*Continued on page* 149)

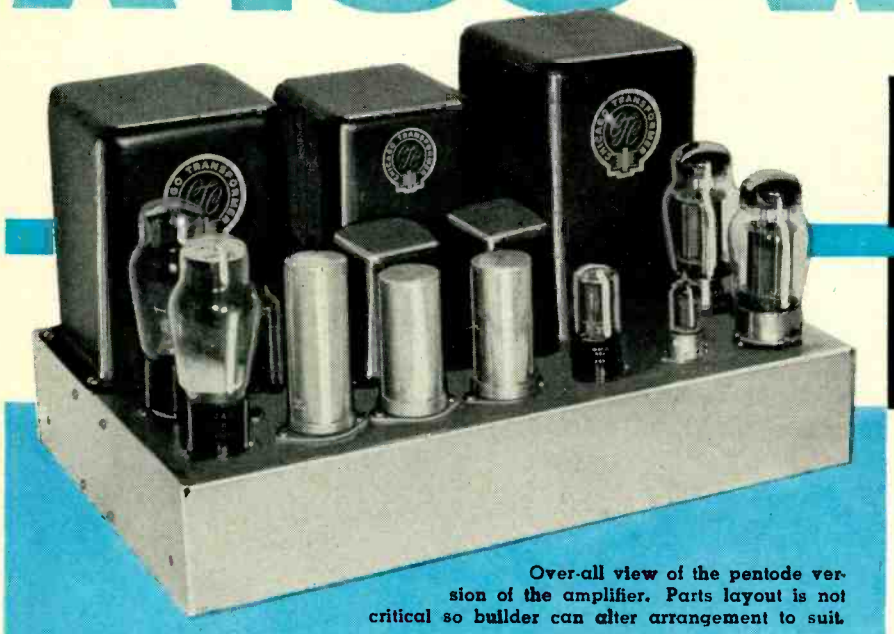
Thos. A. Edison sitting beside his 1878 model tinfoil machine.



Copy of the first sketch covering Edison phonograph of 1877.



A 100-WATT POWER AMPLIFIER



Over-all view of the pentode version of the amplifier. Parts layout is not critical so builder can alter arrangement to suit.

Details on a practical circuit which utilizes the special characteristics of the new Tung-Sol 6550.

By
A. KENNETH OLSON

HEARTS of audio designers were gladdened by *Tung-Sol's* announcement last year of the 6550 pentode, filling a long-felt need for an amplifier tube in its power class. Previously, tubes of this kind commonly used in American versions of the *Williamson* circuit did not fill the demand for a triode-connected output stage tube which could deliver the peak power requirements of a home installation at operating conditions well within the tube's maximum rating. The 6550 is rated to deliver 28 watts in the push-pull triode connection, which allows a safe reserve of power handling capacity for those who wish to design conservatively even for a large home installation. In pentode operation a pair of tubes will deliver 100 watts reliably.

Examination of the 6550 tube data given in Table 1 shows that the most unusual requirement is the large screen current swing between "no-load" and "full-load" conditions. For operation at the 100-watt output ratings, the current swing of 4 to 41 ma. is at the limit of what can be handled by VR tubes. In actual practice it would be unwise to use VR tubes because normal variations in line voltage to the amplifier power supply would very likely shift the current swing to a range that could not be handled by the VR tubes. Conservative design dictates the use of a separate 300-volt supply of good regulation. If we are to realize the 100-watt output at low distortion, a fixed bias supply is also required. By now the power supply problem alone looks formidable enough, on the grounds of complexity and cost, to discourage the 100-watt project. However, if a single power transformer could be obtained with all the necessary windings, the problem would be relatively simplified and much less expensive. Such a transformer is available as the *Chicago Standard* PCR-300, from which both screen and bias supplies can be taken through taps on the main high-voltage winding. The requirement of good regulation on the screen supply is met by a choke-input filter system, which fortunately happens to provide exactly the right voltage.

The same power transformer can be used for triode operation if the plate supply is changed from capacitor input to choke input, reducing the voltage to about 475. A unique feature is that a d.c. heater supply for a separate preamplifier can now be obtained from the bias supply taps without exceeding transformer current ratings.

Pentode Operation

To make the most of the high power output capability of the 6550, pentode operation at 600 plate volts along with fixed bias would seem sensible. A circuit along the lines of that made famous by Williamson no doubt would be highly satisfactory, but in order not to overlook other possibilities, several alternative circuits were investigated.

Some public attention has recently been focused on the use of push-pull feedback from the plates of both output tubes. If the feedback is applied to the driver cathodes, large amounts of feedback can be used without danger of oscillation. In a two-stage feedback system, oscillation cannot occur because phase shift will not reach the 180 degrees required for oscillation. Feedback in this case will reduce the phase shift as well as amplifier gain, thus making it easy to apply additional feedback around the output transformer and still maintain stability.

Bearing in mind that the distortion should be reduced by an amount equal to the feedback factor, it appears that an amplifier with lower distortion than the *Williamson* can be built because greater feedback can successfully be employed. This rosy outlook will receive a stiff jolt when an intermodulation distortion meter is used to measure the results of such designs. Different feedback circuit configurations were tried, all taken from both output tube plates, and none gave lower distortion than when feedback from the transformer output winding (á la *Williamson*) was used alone. The important factor of balance between both sides of the push-pull circuit was taken into account.

Rather than waste space with a detailed proof of these facts, let us look at the results obtained by a reputable manufacturer employing the foregoing techniques. A widely advertised amplifier on today's market uses push-pull feedback from the output tube plates plus feedback around the output transformer. The advertisement states that 36 db of feedback is employed and that the intermodulation distortion at full output is 1%. Now 36 db feedback is a 63 times reduction, and the initial amplifier distortion should be reduced this much. However, tubes of the 5881 class used here can have IM distortion as low as 4%[1] with no feedback. We can therefore expect 0.06% IM with feedback. The great discrepancy is due in large part simply to the use of the two kinds of feedback applied together as described, one of which is not wholly beneficial.

An attack on amplifier distortion may well be aimed at the output stage

alone since by far the most distortion is introduced in this unit. Application of plate-to-grid feedback will not do, because aside from the question of whether or not distortion is materially reduced, we cannot tolerate reduction of the a.c. grid circuit impedance to the low values which will result with the 50,000-ohm maximum d.c. resistance specified by the manufacturer in this service. A more attractive method is to use a tertiary winding in series with the cathodes. This circuit, facetiously dubbed "super-ultralinear" by Williamson, has not enjoyed the popularity in this country that it deserves. With it, distortion levels lower than those obtained with triodes can readily be obtained.[2] The feedback used is 100% effective in reducing distortion and furthermore is fully compatible with feedback applied around the output winding. There is, however, a price to be paid. The driving voltage required on the output stage grid will be increased by the feedback factor. Since tubes customarily used as drivers are already called upon to deliver a voltage swing which approaches the limit to be expected for low distortion, we will reach a limit on the amount of feedback that can be judiciously applied. A further limiting factor acting against developing a high driving voltage is the low value of grid resistance required in this service. Hence the 6SN7 is ruled out and, on the basis of test results, the 5687 was selected. To secure the greatest possible voltage output at the lowest distortion, it is advisable to use the full plate supply voltage of the 6550's on the 5687. A considerable portion of the success of this amplifier is attributable to the large distortion-free grid driving voltage available from the 5687 tube at impedances which suit the 6550 grids.

To offset the disadvantage of added drive requirement we have an unusual bonus in the way of distortion reduction. Ordinarily, distortion is reduced by the feedback factor. That is, if feedback is applied reducing amplifier gain by 10 db, the distortion will be reduced 10 db. In the push-pull stage, local feedback applied in the manner described results in a double reduction in distortion. Ten db of gain reduction results in 20 db of distortion reduction or, in other words, the distortion is reduced by the square of the feedback factor and not by just the amount of the feedback factor. This fact seems to have been overlooked or ignored by some previous writers but well deserves emphasis since it is not common knowledge. It is probable that earlier investigators missed the point or failed to detect it because if only a small amount of feedback is used, the double reduction effect might not be recognized, for the square of a small number is not much greater than the number itself. Matters like push-pull imbalance and driver distortion could mask small gains in distortion reductions. It is not until larger amounts of this kind of feedback are applied that appreciable gains in distortion reduction can be measured to any degree.

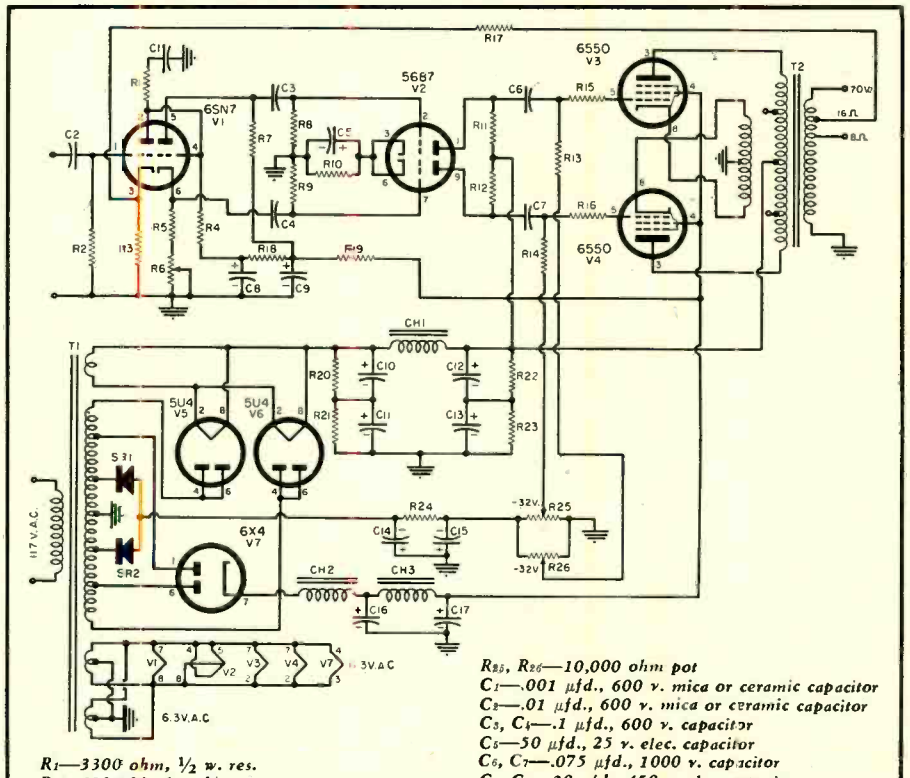
PUSH-PULL AMPLIFIER
(Values are for two tubes)

	Pentode			Triode
	Fixed bias		Self bias	
D.C. Plate Voltage	400	600	400	450 volts
D.C. Grid No. 2 Voltage	275	300	300	volts
D.C. Grid No. 1 Voltage	−23		0	−46 volts
Cathode Resistor	——	——	140	ohms
Peak A.F. Grid-to-Grid Voltage	46	62	53	92 volts
Zero Signal Plate Current	180	115	166	150 ma.
Zero Signal Grid No. 2 Current	9	4	7.5	ma.
Maximum Signal Plate Current	270	273	190	220 ma.
Maximum Signal Grid No. 2 Current	44	41	39	ma.
Load Resistance	3500	5000	4500	4000 ohms
Power Output	55	100	41	28 watts
Harmonic Distortion	3	2.5	4	2.5 per-cent
Maximum Grid Circuit Resistance	50	50	250	250 kilohms

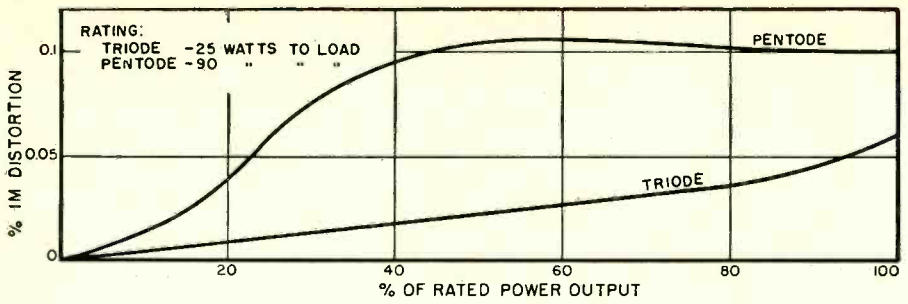
Table 1. Typical operating characteristics for the Tung-Sol 6550 tube.

The output transformer selected was the new *Chicago Standard* "Super-Range" transformer developed especially for the 6550's and employing a tertiary winding designed to give the maximum practical feedback. IM distortion using only this type of feedback is under one per-cent. A moderate amount of feedback added around the output transformer will readily bring distortion down to levels so low that it is on or below the threshold levels which a conventional IM distortion meter can measure. It was established that 14 db of outside feedback is sufficient to

The pentode version of the 100-watt amplifier using the new 6550 tubes.



R1—3300 ohm, ½ w. res.
R2—680,000 ohm, ½ w. res.
R3—270 ohm, ½ w. wirewound res. (IRC Type BW-½)
R4—47,000 ohm, 1 w. res.
R5—12,000 ohm, 1 w. res.
R6—5000 ohm pot ("Balance Adjustment")
R7—15,000 ohm, 1 w. res.
R8, R9—1 megohm, ½ w. res.
R10—470 ohm, ½ w. res.
R11, R12—25,000 ohm, 10 w. wirewound res.
R13, R14—56,000 ohm, ½ w. res.
R15, R16—2700 ohm, ½ w. res.
R17—4700 ohm, 2 w. wirewound res. (IRC Type BW-2)
R18—5600 ohm, 1 w. res.
R19—3300 ohm, 1 w. res.
R20, R21, F22, R23—68,000 ohm, 2 w. res.
R24—4700 ohm, 2 w. res.
R25, R26—10,000 ohm pot
C1—.001 µfd., 600 v. mica or ceramic capacitor
C2—.01 µfd., 600 v. mica or ceramic capacitor
C3, C4—.1 µfd., 600 v. capacitor
C5—50 µfd., 25 v. elec. capacitor
C6, C7—.075 µfd., 1000 v. capacitor
C8, C9—20 µfd., 450 v. elec. capacitor
C10, C11, C12, C13—80 µfd., 450 v. elec. capacitor
C14, C15—50 µfd., 150 v. elec. capacitor
C16, C17—20 µfd., 450 v. elec. capacitor
CH1—Reactor (Chicago-Standard RC 8300)
CH2, CH3—Reactor (Chicago-Standard RC 1585)
T1—Power trans. 1100-740-150 v. @ 300 ma.; 5 v. @ 6 amps; 6.3 v. @ 5 amps; 6.3 v. @ 1 amp. (Chicago-Standard PCR-300)
T2—Output trans. (Chicago-Standard "Super Range" BO-14)
SR1, SR2—Selenium rectifier, 130 v. @ 20 ma.
V1—6SN7 tube
V2—5687 tube
V3, V4—6550 tube
V5, V6—5U4 tube
V7—6X4 tube



Intermodulation distortion of the amplifiers, 60 and 5000 cps, mixed 4:1.

bring the amplifier distortion down to the same order of magnitude as the residual of the meter used in these tests, *i.e.*, .1% at 100 watts. Thus the total feedback of about 20 db in both sides of the push-pull stage brings the net feedback to 34 db applied to the whole amplifier.

Some attention must be paid to balance of the push-pull stages if this phenomenally low figure of distortion is to be realized. The best way is to adjust the balance control while observing either harmonic or IM distortion. A second choice is to read a.c. grid voltages on the 6550's and adjust the balance control for equal amounts on each grid. If neither of these methods is possible it will be sufficiently accurate to adjust the balance control to give equal resistances in the plate and cathode of V_{1B}.

Power output developed by the tubes and supplied to the output transformer will be 100 watts. Feedback circuit losses plus transformer losses will reduce the power supplied to the load to about 90 watts. An input level of two volts is required for full output.

Triode Operation

A triode amplifier can be built using the same major components as the pentode-connected amplifier. The power and output transformers are admirably suited to the triode requirements. By using choke input on the high-voltage supply, the proper plate voltage will be obtained for triode-connected 6550's. The screen supply is now no longer needed and its components can be dispensed with. For greatest economy the bias supply can also be omitted, and self bias used. In this case the power output delivered to a load will be 25 watts. If fixed bias is used, an additional plate voltage equal to the bias voltage then becomes available, and the output will be 30 watts. In either case the same low figures of distortion will be obtained. Required input level is 1.6 volts.

Tertiary feedback can also be profitably employed. However, since the initial stage gain is lower than in the case of the pentode version, less feedback becomes available with the same tertiary winding. Nevertheless it is profitable to use this kind of feedback since it alone will reduce amplifier distortion to 0.4%. Feedback on both sides of the push-pull stage is 7 db and with 14 db of feedback added around the output transformer, residual distortion is too low to be measured. Calculated IM distortion is 0.08% and this is borne out by examination of the residual oscilloscope trace of IM meter output. These figures were obtained by merely balancing the drive voltages to the 6550 grids. If an IM meter is available it is possible to get the IM down to about 0.06% at 25 watts equivalent sine-wave output.

These remarkably low figures of distortion are due in part to the superlative output transformer. By using the transformer at one-fourth of the output power capabilities, distortion contributed by the transformer is virtually zero.

"Ultra-Linear" Operation

The output transformer used for pentode and triode operation also has taps for "Ultra-Linear" operation placed at the position on the plate winding which gives minimum distortion. The feature of "Ultra-Linear" operation is that an output power greater than that obtained from triodes can be obtained at a distortion level intermediate between that of triodes and pentodes without the complication of a screen supply.

It has been experimentally determined that small amounts of tertiary feedback do not produce any reduction of distortion in this case, probably because of masking effects of the screen feedback. However, sufficient feedback is available in this output transformer to bring about a four times reduction in distortion through use of the tertiary winding alone. Addition of 14 db of outside feedback to this 12 db of tertiary feedback brings the net amplifier distortion to 0.25% IM. Amplifier input required is 1.7 volts for full output of 40 watts sine-wave power using self bias on the 6550's and essentially the same components and circuitry as for the triode version.

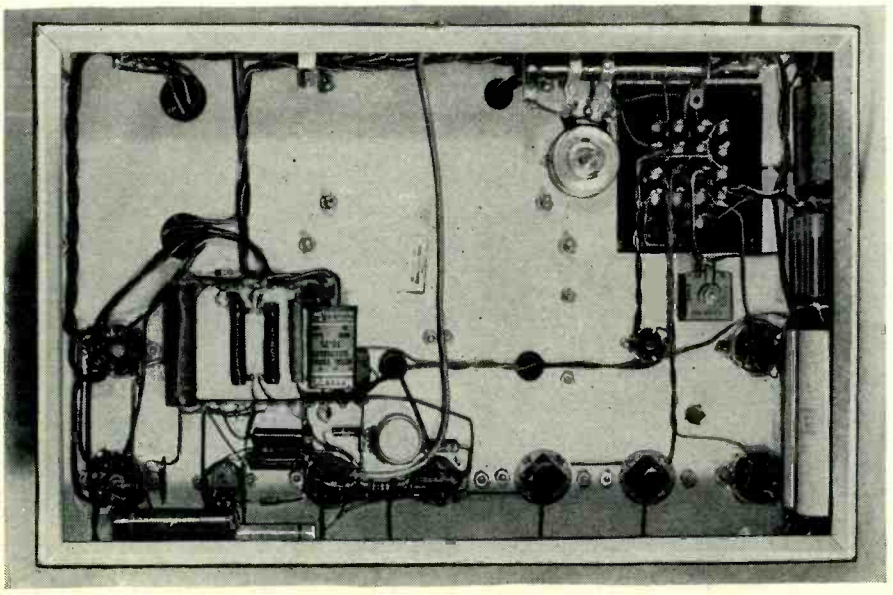
Feedback Considerations

No instability problems will be experienced in using tertiary feedback since it is applied around only one stage. For this reason it is well to use as much feedback as possible in this position in the circuit. Fortunately it turns out that with a given tertiary winding, greatest feedback will be obtained in a pentode stage where it is most needed. Fidelity obtained in the pentode circuit is very nearly comparable to that of a triode stage using the same transformer. In view of the greater power efficiency of pentodes, triodes will be the second choice in a circuit of this type.

Tertiary feedback has been tried with other tube types with similar good results. It seems that this kind of feedback should find wide application in low power amplifiers, where the smaller driving voltages required simplifies the design problem.

To equal the performance of most amplifiers on the market, it will not be necessary to use feedback around the output transformer in addition to tertiary feedback. But since there are no problems peculiar to combining these two kinds of feedback, it is a relatively simple matter to add outside feedback. It should be noted that outside feedback will not be necessary to reduce the amplifier output impedance since tertiary feedback will take care of that matter.[2]

The extreme simplicity of the pentode amplifier is revealed by this underchassis view. The power transformer has lugs rather than leads. The PCR-300 specified has leads and is suggested herein since it is less expensive.

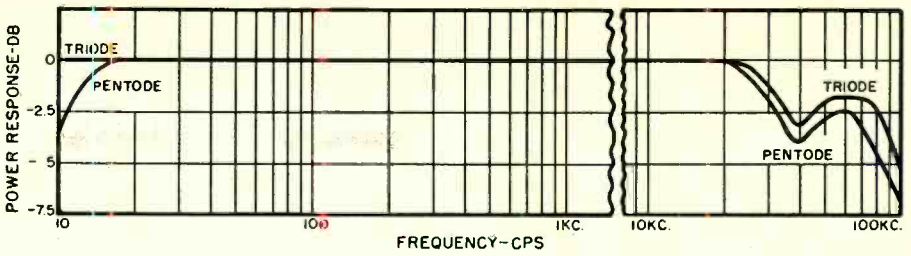


The considerations involved in applying feedback around several stages seem to be well known but not always applied. In simplest terms, the requirement is that all stages except one shall have a flat frequency response extending well past both ends of the audio-frequency spectrum, and that one stage shall be rolled off in response at both ends of the spectrum. Failure to observe these principles in several near-copies of the *Williamson* circuit has sometimes resulted in unstable performance and consequent unjustified criticism of the *Williamson* circuit. The greatest error in current practice is to ignore the requirement at the high frequency end where ripest opportunities for trouble exist. Conditions of resonance or near resonance in the output transformer at ultrasonic frequencies will usually produce the amount of phase shift required for oscillation unless steps are taken to reduce amplifier gain at those frequencies. A very simple means of doing this is by a resistance-capacitance combination introduced at the plate of V_{1A} (R_1-C_1). If this is omitted, the tube and wiring capacitances must be trusted to do the job, and they may not.

At the low-frequency end of the spectrum the primary shunt inductance of the output transformer in series with the output tube plate resistance furnishes a smooth roll-off. The trouble which sometimes arises, manifested by motorboating, is due to not carrying the amplifier frequency response flat for enough below the transformer's roll-off frequency. This situation is aggravated by today's output transformers which are designed with the large inductance necessary to get low intermodulation distortion. The roll-off frequency, then, is so low it is inconvenient to use interstage coupling networks large enough for the requisite frequency response. Requirements for low frequency roll-off can be more efficiently met by tailoring one of the interstage coupling networks. Either the last stage or driver stage input coupling capacitors can be reduced in size. The phase shift introduced will be in the opposite direction of that due to transformer inductance and will tend to offset the latter in a beneficial way. Since a low value of grid resistance is specified for the 6550's, the logical place to use small coupling capacitors is at these grids.

The finished amplifier embodying these principles is stable and trouble-free. No ringing appears on square-wave response. In the pentode-connected amplifier, frequency response is down 3 db at 100 kc. from mid-frequency response, and down zero db at 20 cps. This is excluding R_2-C_2. It is wise to include R_2-C_2 to reduce possible unwanted signals below the audible spectrum. The amplifier will deliver fully as much undistorted power at 20 cps as at mid-frequencies.

It may occur to the reader that it should be possible to use the transformer secondary as the feedback winding. On output transformers that have



Maximum power output of pentode and triode versions of the 100-watt amplifier.

4, 8, and 16-ohm taps, the center tap of the 16-ohm winding is at 4 ohms. If the 4-ohm tap is grounded, the ends of the winding coil could be returned to the cathodes of the output stage. This reasoning neglects the fact that the output winding has a low impedance load imposed on it, whereas the tertiary does not. As a result, the voltage fed back is unsuitable, especially where the load is a loudspeaker with its varying resistance and reactance. No simple substitute for the tertiary exists.

A choice of a maximum of 14 db feedback around the output transformer was made for several reasons. First, that amount is usually sufficient to bring distortion below that of most amplifiers on the market. Second, if more feedback were used, amplifier input voltage requirements would be beyond that which can be obtained at low distortion from some preamps. Third, instability problems are less likely to occur. Tertiary feedback does not aggravate the stability problem in applying outside feedback, rather it eases the problem. Stable operation with as much as 40 db outside feedback has been obtained by proper attention to control of frequency response.

Current feedback can be more readily applied than in conventional amplifiers. One way of looking at the situation is to consider that tertiary feedback reduces amplifier distortion, and current feedback around the output transformer reduces loudspeaker distortion. However, in a general purpose or distribution amplifier, current feedback may be undesirable and therefore has been omitted. Those desiring it can easily include it by placing an adjustable resistor of not more than two ohms in series with the output winding and returning the cathode of V_{1A} to the junction. The negative voltage feedback from the output should then be omitted.

Two clear-cut advantages result from use of a tertiary winding: an amplifier of lower distortion can be built, and feedback is more easily applied without oscillation troubles. This has made it possible to produce an amplifier setting a new high standard combining features of fidelity, efficiency, simplicity, and power output.

REFERENCES

1. Kiebert: "System Design Factors for Audio Amplifiers," 1954 Convention Record of the IRE.

2. Williamson & Walker: "Amplifiers and Superlatives," Journal of the AES, April 1954

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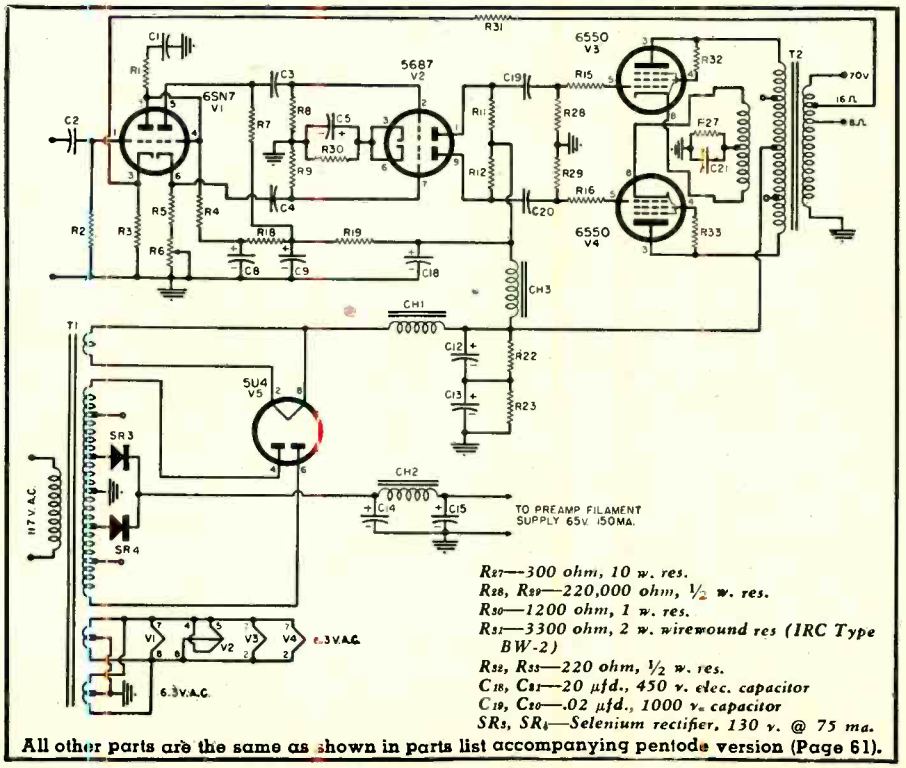
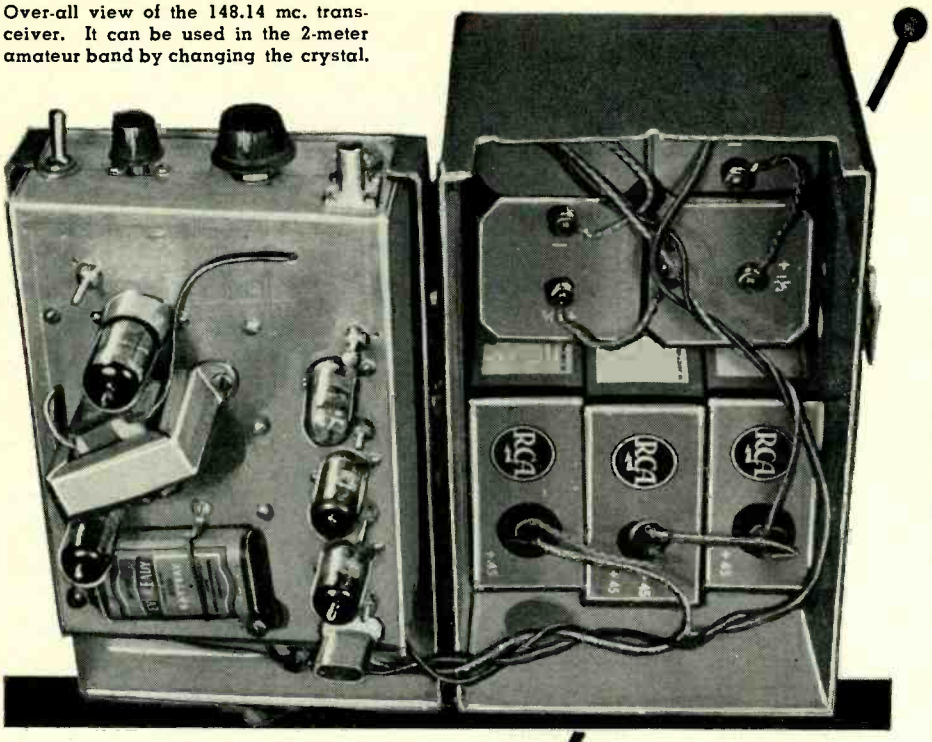
Triode version of the amplifier. Parts not listed herewith are the same as those specified for the pentode version shown on page 61 of article.



R_{27}—300 ohm, 10 w. res.
R_{28}, R_{29}—220,000 ohm, ½ w. res.
R_{30}—1200 ohm, 1 w. res.
R_{31}—3300 ohm, 2 w. wirewound res (IRC Type BW-2)
R_{32}, R_{33}—220 ohm, ½ w. res.
C_{18}, C_{21}—20 μfd., 450 v. elec. capacitor
C_{19}, C_{20}—.02 μfd., 1000 v. capacitor
SR_3, SR_4—Selenium rectifier, 130 v. @ 75 ma.

All other parts are the same as shown in parts list accompanying pentode version (Page 61).

Over-all view of the 148.14 mc. transceiver. It can be used in the 2-meter amateur band by changing the crystal.



A Portable Transmitter-Receiver for 148 mc.

By **J. F. STERNER**
Tube Div., Radio Corporation of America

A compact, battery-powered CAP unit which is suitable for 2-meter ham use too.

THE day has long passed when the modulated oscillator type of transceiver would be tolerated as a simple device for short range v.h.f. communications. Postwar communication practices have proven that only crystal-controlled transmitters provide the stability required for use on FCC-assigned channels.

This article describes such a crystal-controlled transceiver, designed primarily for use in the 148.14 mc. CAP channel, which was installed in a 65 hp. *Taylorcraft* airplane. By the substitution of a suitable crystal in the transmitter, this unit can also be used in the 144-to-148 mc. amateur band. The tuning range of the receiver is from 143.5 mc. to 149 mc. The basic transmitter/receiver chassis, without "A" and "B" batteries, weighs less than four pounds; it is thus ideally suited for portable use.

The chassis is built into a carrying case containing three 45-volt "B" batteries and four 1½-volt "A" batteries for convenient use in an airplane or car. Unless the unit is intended for field portable use, an antenna may be permanently attached to the vehicle in which the transceiver is to be used. The antenna is connected to the set by means of conventional coaxial fittings. Prior to installation in the airplane, the unit weighed slightly less than 18 pounds including antenna, case, batteries, headset, and microphone.

Receiver Sensitivity

Power output of the transmitter is approximately 0.5 watt. The receiver sensitivity is more than adequate and is limited only by the ambient electrical noise generated in the airplane or car in which it is installed. Because the receiver is of the superregenerative type, the limiting action which takes place in the detector permits reception through unusually high electrical noise levels. Provided the received signal is a well-modulated voice signal, the sensitivity of the set becomes insufficient only when the average power of the interfering noise signal is greater than that of the received carrier. Power output of the transmitter is adequate for general air-to-ground coverage; several signal reports have confirmed its performance over distances up to 50 miles.

Tube Lineup

Tubes having 6-volt indirectly-heated cathodes were chosen for use in the transceiver after a careful evaluation of their performance, heater input, plate input, and commercial availability, as compared with directly-heated battery tubes. The advantages of the tubes selected are particularly evident at frequencies above 75 mc. A further advantage is that a unit using these tubes is readily adaptable for use with either 6-volt d.c. or 110-volt a.c. power supplies. Total drain on the "B" supply is 35 milliamperes at 135 volts in the "Transmit" position and 18 milliamperes at 135 volts in the "Receive" position. Drain on the "A" supply for either position is 0.975 ampere at 6.3 volts. The unit described here has been operated from batteries for more than 20 hours. The "A" batteries were replaced after approximately 18 hours of use. The "B" batteries still deliver more than 130 volts under transmit load; it appears, therefore, that their life will be in excess of 30 hours for intermittent operation. Microphone voltage is supplied from a small 3-volt battery. Since the microphone drain is about 20 milliamperes in the "transmit" position only, this battery will outlast both the "A" and "B" batteries.

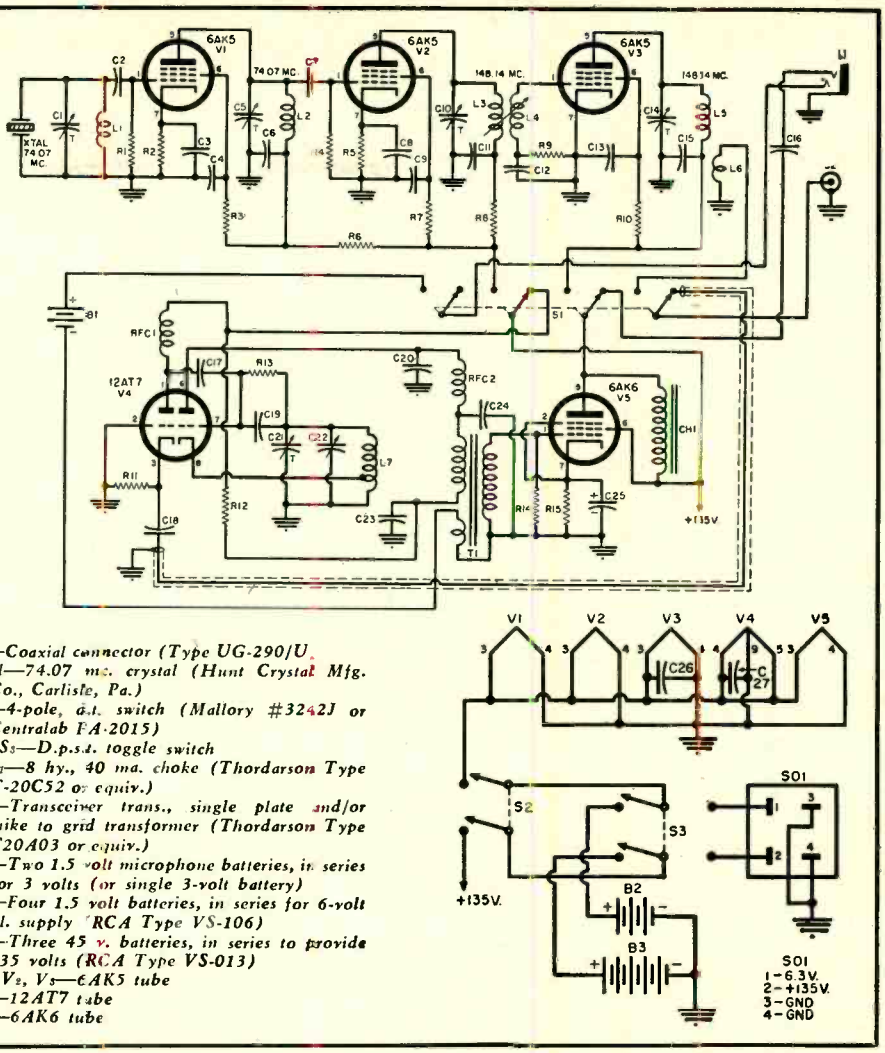
Description of Unit

The transceiver consists of the r.f. stage of the transmitter, the receiver stage, and the audio stage, which serves as both the amplifier for the receiver and modulator for the r.f. stage of the transmitter. Switching from "Transmit" to "Receive" is accomplished by means of a 4-pole, double-throw switch.

Basically, the transmitter consists of a 6AK5 crystal oscillator having a tuning range from 72 to 75 mc., a 6AK5 frequency doubler, and a 6AK5 power amplifier. Plate modulation to the power amplifier is supplied by a 6AK6 tube.

The receiver consists of a 12AT7

R_1—10,000 ohm, ½ w. res.
R_2, R_{11}—270 ohm, ½ w. res.
R_3, R_7, R_{10}—4700 ohm, ½ w. res.
R_4, R_6, R_9—47,000 ohm, ½ w. res.
R_5—180 ohm, ½ w. res.
R_8—1000 ohm, ½ w. res.
R_{12}—56,000 ohm, ½ w. res.
R_{13}—1 megohm, ½ w. res.
R_{14}—220,000 ohm, ½ w. res.
R_{15}—470 ohm, ½ w. res.
C_1, C_5, C_{10}, C_{14}, C_{21}—1-8 μμfd. trimmer (Erie Type #532-10)
C_2—47 μμfd. ceramic capacitor
C_3—5 μμfd. ceramic capacitor
C_4, C_6, C_8, C_9—470 μμfd. mica capacitor
C_7—15 μμfd. ceramic capacitor
C_{11}—220 μμfd. ceramic capacitor
C_{12}, C_{13}, C_{15}, C_{18}—100 μμfd. mica capacitor
C_{16}, C_{25}—.25 μfd., 200 v. paper capacitor
C_{17}—3 μμfd. ceramic capacitor
C_{19}—33 μμfd. mica capacitor
C_{20}, C_{23}—1500 μμfd. ceramic capacitor
C_{22}—1-3 μμfd. tuning capacitor (2-plate APC type with .250" shaft or Hammarlund Type MAC-5 with two plates removed)
C_{24}—10 μfd., 25 v. elec. capacitor
C_{26}, C_{27}—270 μμfd. mica capacitor
L_1—6 t. #18 tinned wire wound on Ohmite 2 megohm, 1-watt res. Coil length 19/32" (resistor 19/32" long, 15/64" dia.)
L_2—9 t. #18 tinned wire, ⅜" i.d., spacewound ¾" long
L_3—3 t. #18 tinned wire, ⅜" i.d. spacewound ½" long
L_4—3 t. #20 insulated wire, ⅜" i.d. Interwound with low potential end of L_3. (Actual coupling to be adjusted for maximum excitation then cemented in place with Duco cement)
L_5—3 t. #18 tinned wire, ⅜" i.d., spacewound ⅜" long
L_6—1 t. #20 insulated wire, ⅜" i.d., Coupled to low potential end of L_5. (Adjust for maximum field strength with antenna connected)
L_7—4 t. #18 tinned wire, ⅜" i.d., spacewound ½" long. Cathode tap 1¾ t. from low potential end
RFC_1, RFC_2—1 μhy. 30 t. #32 wire wound on IRC 100,000 ohm, ½-watt res. (⅜" long, 3/16" dia.)
SO_1—4-prong plug and socket
J_1—2-circuit jack (Mallory Type #702B)
J_2—Coaxial connector (Type UG-290/U
Xtal—74.07 mc. crystal (Hunt Crystal Mfg. Co., Carlisle, Pa.)
S_1—4-pole, d.t. switch (Mallory #3242J or Centralab PA-2015)
S_2, S_3—D.p.s.t. toggle switch
CH_1—8 hy., 40 ma. choke (Thordarson Type T-20C52 or equiv.)
T_1—Transceiver trans., single plate and/or mike to grid transformer (Thordarson Type T20A03 or equiv.)
B_1—Two 1.5 volt microphone batteries, in series for 3 volts (or single 3-volt battery)
B_2—Four 1.5 volt batteries, in series for 6-volt fil. supply (RCA Type VS-106)
B_3—Three 45 v. batteries, in series to provide 135 volts (RCA Type VS-013)
V_1, V_2, V_3—6AK5 tube
V_4—12AT7 tube
V_5—6AK6 tube



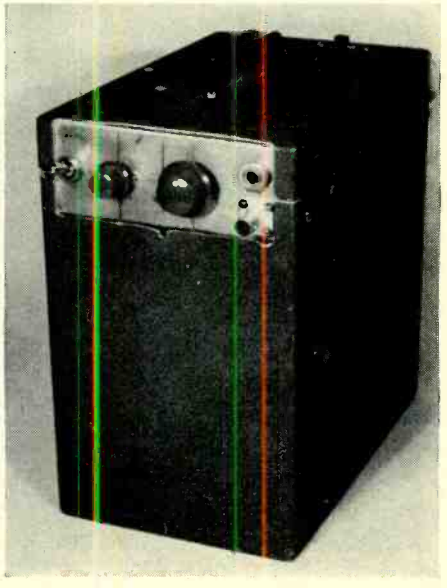
Complete schematic diagram of the crystal-controlled 148.14 CAP transceiver. With a different crystal, unit may be used for 2 meters. Heater and switching circuits are shown lower right. Note S_2 is on r.f. chassis, S_3 and SO_1 are on carrying box.

double triode, one triode section of which operates as a grounded-grid amplifier and the other as a superregenerative detector. No provision is made for controlling the volume or the amount of regeneration in the detector circuit. Because the grounded-grid amplifier isolates the antenna, antenna variations do not affect superregeneration. The grounded-grid amplifier also prevents serious radiation when the unit is in the "Receive" position. No volume control is included because the unit is intended for operation in areas where the outside noise level is high. The audio output from a pair of 2000-ohm earphones is satisfactory even for operation in aircraft.

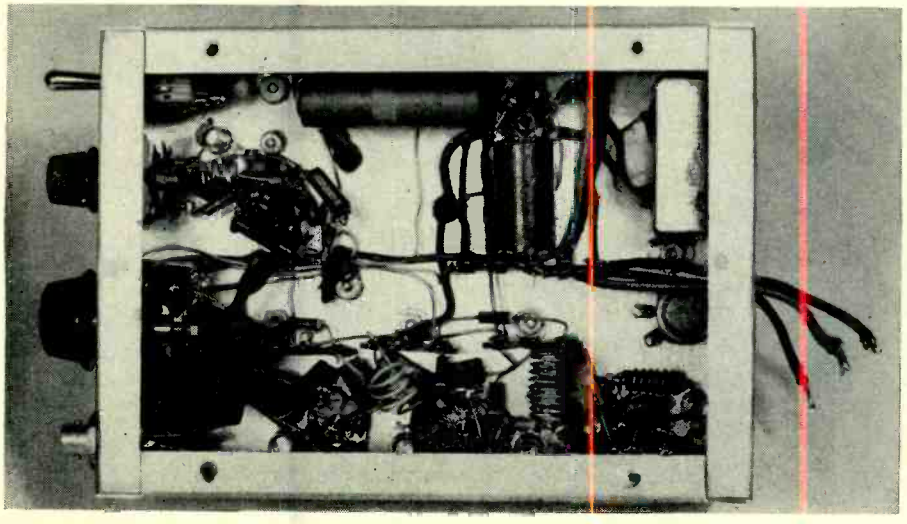
The point of superregeneration of the detector is preset by means of the tap connection to coil L_2. The location of this tap point is not critical; when the tap is adjusted as described in the parts list, the unit operates with supply voltages ranging from 100 to 150 volts.

(*Continued on page* 154)

Over-all view of transceiver. Complete, it weighs less than 18 pounds.



Under-chassis view. Although parts are uncrowded, chassis is compact.



SERVICING

Tape Recorders

By SOL HELLER

TAPE recorder servicing can be a very profitable sideline for the TV-radio service technician. Tape recorder sales are steadily increasing so that the service market is consequently expanding in proportion. The fact that many recorders are relatively high in price permits the technician to obtain adequate remuneration for his work—a state of affairs that is not often encountered in the radio field, where low-cost sets have become commonplace.

In this article, representative troubles and service procedures will be considered rather than the theory of tape recorder operation. The information presented should permit an intelligent technician to cope, with some expectancy of success, with typical tape recorder troubles.

Major Troubles

The easiest trouble to locate is encountered when the motor(s) and amplifier are inoperative with the "off-on" switch at the "on" setting. Among the possibilities are a blown fuse, open line cord or plug, or defective switch. No experienced TV-radio technician will have any trouble in tracking down defects of this nature.

When the tape recorder does not reproduce, turn the volume control to maximum and put your ear to the speaker. If some background noise is audible in the speaker—or becomes markedly audible when the grid of the first amplifier is disturbed (by scratching it with a wire, for instance), the amplifier and speaker may be ruled out as possible sources of the trouble. A defect in the reproduce head or an open in the amplifier input circuit, should now be checked.

To test the amplifier and speaker without removing the tape recorder from its cabinet, feed a signal from a microphone or phono pickup to the appropriate input jack of the amplifier. (Turn the volume control setting down far enough to avoid acoustic feedback, due to the close positioning of the microphone to the speaker.) If the signal (speech or music) can be heard in the speaker, the amplifier and speaker may be eliminated as possible sources of trouble. If the signal is not heard, a pair of earphones may be used to determine where the signal is being lost. If the phones detect the signal at the output of an inverter stage, for instance, but not at the plate of the succeeding output stage, trouble in the latter is indicated.

If the tape recorder will reproduce, but won't record, one of the following troubles may be present: the coil of the recording head may be open (it is assumed that separate heads are used for recording and reproducing. If only one head is used for both functions, an open in the head coil will, of course, cause the recorder to be inoperative on both record and reproduce settings); there may be dirt on the face of the recording head; the pressure pad (when one is present) may not be making proper contact with the head, or may be worn or damaged; or the recording bias voltage may be inadequate.

Visual inspection of the recording head assembly (see Fig. 3) will quickly reveal if the pressure pad is normal in appearance and adjustment, or whether dirt is present on the head. The recording bias voltage may next be checked with a voltmeter and compared with that listed in the manufacturer's service notes. This is the a.c. high-frequency voltage present across the head.

If no trouble is revealed during these and related tests, a new recording head should be tried. It is not advisable to make a continuity check of the coil in the recording head—passage of d.c. meter current through the coil will magnetize it. When such a test *must* be made, use the highest range of the meter and demagnetize the head after the test, as described later in this article.

When no erase is present, or erasing is incomplete, permitting the old recording to be audible in the background of the new one, one of the following troubles may be present: the coil in the erase head may be defective; pressure pads used to keep the tape in proper contact with the erase head may be worn, damaged, or improperly adjusted; dirt may be present on the face of the erase head; or the oscillator tube or circuit (particularly the oscillator coil) may not be operating properly. It is worth noting that the oscillator tube, which often functions as a power amplifier as well as an oscillator, may continue doing its duty as an amplifier while it is delinquent as an oscillator.

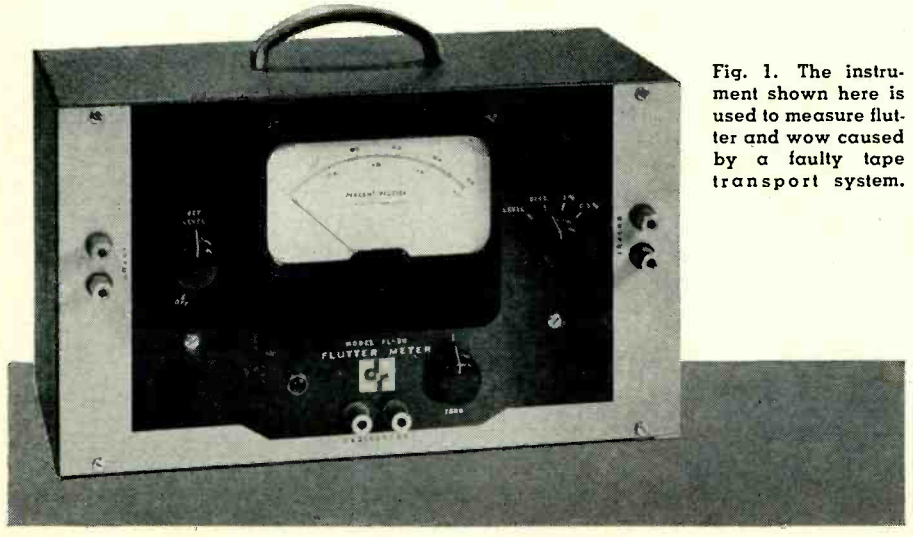


Fig. 1. The instrument shown here is used to measure flutter and wow caused by a faulty tape transport system.

Fig. 2. Those components of the tape transport mechanism that come in contact with the tape are shown here. On many home-type machines, these components are enclosed with the record and reproduce heads under a single cover.

A very practical guide to the repair and maintenance of magnetic tape recorders such as used in the home.

When a recording has been made at an extremely high level, complete erase may be difficult or impossible to obtain *via* normal methods. A permanent magnet may be used in such cases to remove the strong magnetic pattern present on the tape. Hold the magnet over the tape (*but don't bring it near the heads*), with the tape in motion. Some hiss will be heard if the tape is played back when this operation is completed. The hiss should disappear when the tape is erased once more in the tape recorder.

A pronounced hissing noise in the background of the desired signal is often due to the magnetization of one or more of the magnetic heads. When the magnetization is very strong, a sputtering noise rather than a hiss will be audible. Demagnetization of the heads, as will be described shortly, will test for the source of trouble, as well as remedy it.

To determine whether the playback or the recording head is responsible for the noise, completely erase a tape. To eliminate the recording head as a possible source of trouble, keep the tape from coming into contact with it by inserting a shim between the head and the tape. Now play back the unrecorded tape. If the noise level is excessive, the playback head is magnetized. If the noise level is no longer excessive, the recording head is magnetized. Of course, this does not apply to recorders on which one head is used for both recording and playback.

Heads may become permanently magnetized not only by coming into contact with a magnetized object, such as a magnetized tool or a permanent magnet, but also because of a component defect in an amplifier, or through improper operation of the tape recorder. Any condition that tends to send d.c. current through the reproduce or record head, or places a large, non-sinusoidal pulse on the record head, will magnetize the head. Such magnetization may cause the noise level to rise as much as 5 to 10 db, and can ruin good tapes by partial erasure of their high-frequency content. (This is particularly disastrous when expensive pre-recorded tapes are involved.)

To avoid magnetizing a head, observe the following precautions: 1. Never remove a tube from the recording amplifier stages while the machine is recording. 2. Don't connect or disconnect the leads going to the tape recorder input, or to the head, while the machine is recording. 3. Avoid saturating the recording amplifier with excessively high input signals. 4. Don't test heads for continuity with an ohmmeter.

To demagnetize a head, use a unit known as a "head demagnetizer." A number of tape recorder manufacturers make such units. The demagnetizing procedure is as follows: Turn the "on-off" switch of the tape recorder "off." Bring the tip (or tips) of the demagnetizer near the head core, and move it up or down the entire length of the core three or four times, straddling the air gap at some time during this process. Remove the magnetizer very slowly.

Only the record and playback heads usually require demagnetization; the electromagnetic erase head commonly demagnetizes itself. If the capstan or tape guides (see Fig. 2) become magnetized, a procedure similar to that just described will demagnetize them.

Distortion and Noise

In recorders using a permanent magnet as well as an electromagnetic erase head for erase purposes, an inoperative a.c. erase head will cause a hissing noise to be audible in the background of a recording. Erase may otherwise be normal. An improper oscillator supply voltage may also be the cause of the noise. To check whether the a.c. erase head is defective, hold the tape against the permanent magnet head while on "record," and bring the tape alternately towards and away from the a.c. erase head. Now play back the tape. If the tape noise is punctuated by intervals of silence, the head is not defective. If the noise remains constant and the oscillator bias voltage reading is normal, a new a.c. erase head should be substituted.

Improper contact between the erase head and the tape, due to the presence of sludge or dirt on the erase head, may cause erasure to be incomplete, and reduce the signal-to-noise ratio in consequence.

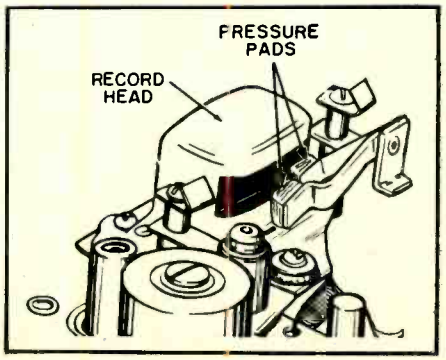
Excessive noise may be introduced in some cases when several ground points (instead of one) are used in an amplifier stage. An inexperienced technician may set up such a condition in making component replacements. Defective tubes and components may also introduce noise. Microphonic tubes are apt to cause howls.

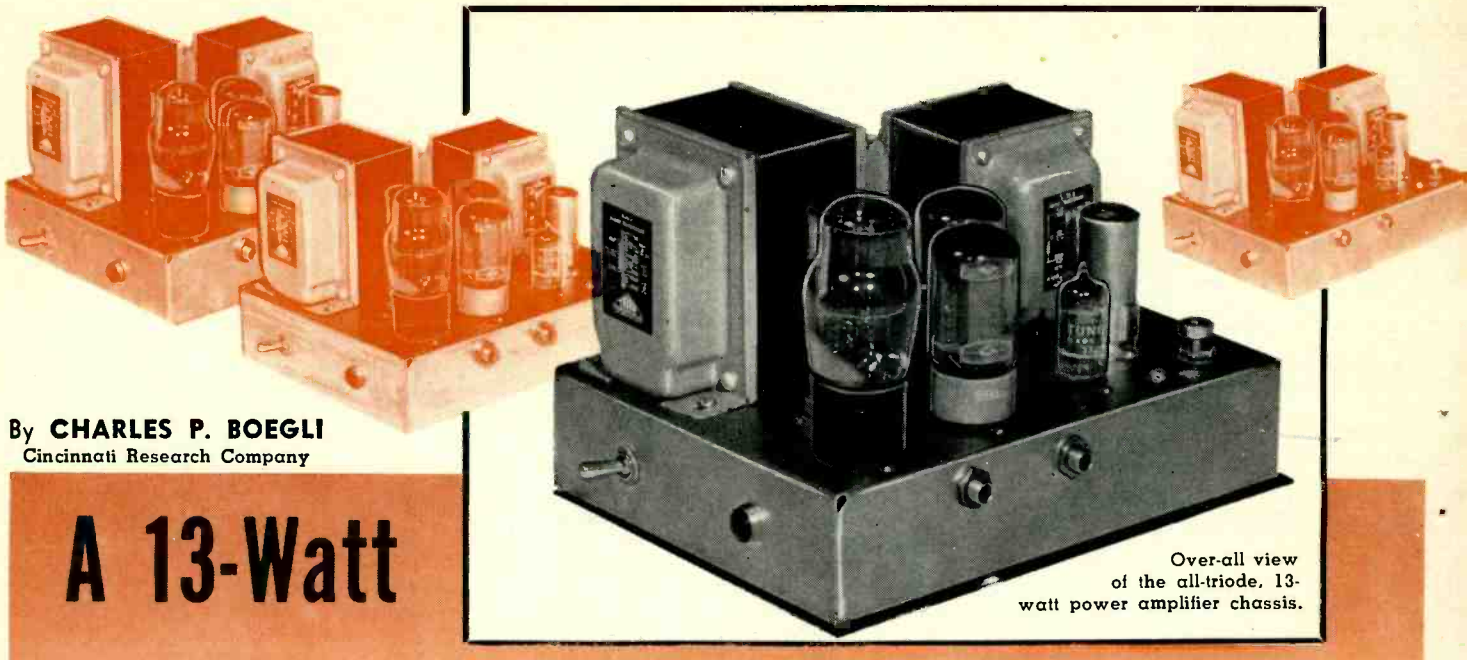
When the volume of the playback signal is weak (and the recording is known to be good) check for the following: dirty reproduce head; improper positioning of, or defects in, pressure pads; tape wound on wrong side (dull side of tape should be wound *in*); defective reproduce head; improper alignment of reproduce head; weak tubes; low plate or screen voltages in amplifier stages.

When the playback section is known to be good, and the tape recording sounds fuzzy, faint, or distorted, the trouble may be: no or insufficient high-frequency bias to record head; worn or dirty pressure pads at record head; improper positioning of pressure pads; dirty or defective record head. An over-recorded or under-recorded tape may also be the source of such trouble.

(*Continued on page* 96)

Fig. 3. Pressure pad and record head assembly of the Webster-Electric "Ekotape" recorder showing the normal position for the pads. If they do not press the tape onto the head, various types of audio distortion may result.





Over-all view of the all-triode, 13-watt power amplifier chassis.

By **CHARLES P. BOEGLI**
Cincinnati Research Company

A 13-Watt All-Triode "Infinite Feedback" Amplifier

Construction details on a well-designed, all-triode unit which is right size for the average home audio system.

IN ONE of the author's previous articles[1] he described a 35-watt amplifier with a novel combination of features, namely 100% negative feedback around the output transformer and the output and driver stages, together with sufficient positive feedback around the driver stage to cause it to oscillate in the absence of the negative feedback. That article presented the mathematical basis of the design and showed that the arrangement can lead to a very stable amplifier having extremely low distortion and approximately zero output impedance. These principles were applied to the design of an amplifier using class-A push-pull 300B tubes in the output stage and the unit was found to develop 37 watts at 2% (r.m.s. sum) IM distortion, or 35 watts at a distortion limit of 1%.

Two features of this amplifier make it somewhat unsuited for average home use. The output power of 37 watts is far in excess of that required in most homes, and the low input impedance of the amplifier necessitates a special final stage in the preamplifier with which it is to be used. Need seems to exist for a smaller amplifier which, while retaining the same circuit features, will have a maximum output on the order of ten watts, sufficient for home systems utilizing all but the most inefficient speaker systems. That the input impedance should be sufficiently high to permit the use of most available preamplifiers is a further requirement.

These objectives have been accomplished in the circuit to be described here. At the same time, because every part of the circuit has been designed with a view toward economy of construction, the new amplifier can be made at a cost somewhat less than comparable *Williamson* units. That no sacrifice in performance has been made to economy should be strongly emphasized; nevertheless, the final circuit does not contain a single unnecessary component.

Design

The circuit diagram of the complete amplifier is shown in Fig. 1. For the output stage, tubes of the class including 1614, 5881, KT-66, and 350B were selected. Not only are such tubes widely available but their characteristics are so similar that they may be used interchangeably with no modification of the remainder of the circuit. All of them have a maximum plate dissipation on the order of 26 watts when connected as triodes (with the exception of the 350B, for which the dissipation is 34 watts). The greatest power is developed by operating them near their maximum ratings. A control is incorporated into the stage for balancing the plate currents of the output tubes, but this adjustment has a very small effect on hum level.

The output transformer is a *Triad* S-35A, a reasonably-priced component of exceptional characteristics. In this circuit the full output power of 13 watts is available from less than 16 to over 30,000 cps. The entire circuit has been designed around this transformer; preliminary calculations[2] seem to indicate that a wider frequency response is of no benefit whatever in audio amplifiers. As in the earlier 35-watt amplifier, the secondary of the output transformer is connected in balanced fashion, with the 0 and 16-ohm taps attached to the 16-ohm speaker and the 4-ohm tap grounded through the driver bias resistor paralleled with a small bypass capacitor. The speaker lines are at a small positive d.c. potential and must not be grounded to the chassis in any manner.

Various output stages were tested in the experimental work, including straight pentode and "Ultra-Linear" arrangements. Both these circuits increased the available power output to about 18 watts. Both appeared to have the common property that while the distortion level was quite low if the amplifier was connected to a load of the correct impedance, it rose objectionably as the load impedance was reduced below the correct value. This tendency was not observed with the triode connection; a reduced load resistance lowered the maximum power output but the distortion at lower levels increased only slightly. The "Ultra-Linear" output stage requires an output transformer considerably more expensive than the one indicated in this article and the nominal increase of output power does not seem to warrant this extra cost.

The output stage is thus quite conventional; the bypass capacitor across the cathode resistor common to the output tubes has been eliminated in the interest of economy with no measureable adverse effect upon performance.

A neon bulb shunting the grids of the output tubes limits the input voltage and prevents destruction of the tubes in the event the speaker leads are accidentally shorted together. (Shorting the speaker leads together effectively removes the negative feedback and permits the drivers to oscillate.) Tubes like the 5881 are considerably more resistant to this type of abuse than the 300B's used in the larger amplifier but they are nonetheless ruined in less than a minute by shorting the speaker lines in the absence of the neon-bulb limiter.

The push-pull driver is a single 12AU7, around which sufficient positive feedback is fed to produce oscillation in the absence of the negative feedback. The cathodes of the 12AU7 are connected directly to the secondary of the output transformer, providing 100% negative feedback, preventing oscillation of the drivers, and indeed, resulting in an extremely stable amplifier. Output tubes of the heater-cathode type bring up several problems not encountered with the filament type used in the larger amplifier. When early models of the present unit were turned on, the driver tubes heated up much more rapidly than the output tubes and oscillation occurred for a few moments, until the output tubes "caught up." This oscillation was heard as a loud "whoop" in the speaker —frightening to many listeners. A great deal of work went into the design of the positive-feedback loop to eliminate this effect, and it never occurs in the latest circuit.

The input stage, which is also the inverter, is a dual triode with a large common cathode resistor. Signal is fed into one grid and the other grid is grounded through a capacitor. The outputs from the two plates are very closely balanced and have practically identical internal resistances. The circuit is well balanced and, except for the grid connections, completely symmetrical. 60-cps hum created by the large heater-to-cathode voltage, and 120-cps hum from the power supply appears in-phase at the two plates and is canceled at the transformer. Also, because it is quite degenerative, the input stage introduces a negligible amount of distortion.

Modification for push-pull input is easily made, and consists of reconnecting the first stage so that the two inputs are fed to the two grids. This means that for push-pull input the grid shown grounded in the circuit diagram is removed from ground and connected to the other side of the input. A dual gain control is then required.

During the experimental work on early versions of this amplifier, changing the input tube was found to have a profound effect on the distortion. The resistances inserted between the 12AX7 plates and the driver grids overcome this tendency and allow replacement of the 12AX7 with no special precautions as to selection. They also permit this tube to be lightly loaded while at the same time a comparatively low resistance is presented to the 12AU7 grids, improving the high-frequency response. A grounded tube shield will eliminate any tendency of the first stage to pick up hum, but the shield has been found unnecessary in most cases.

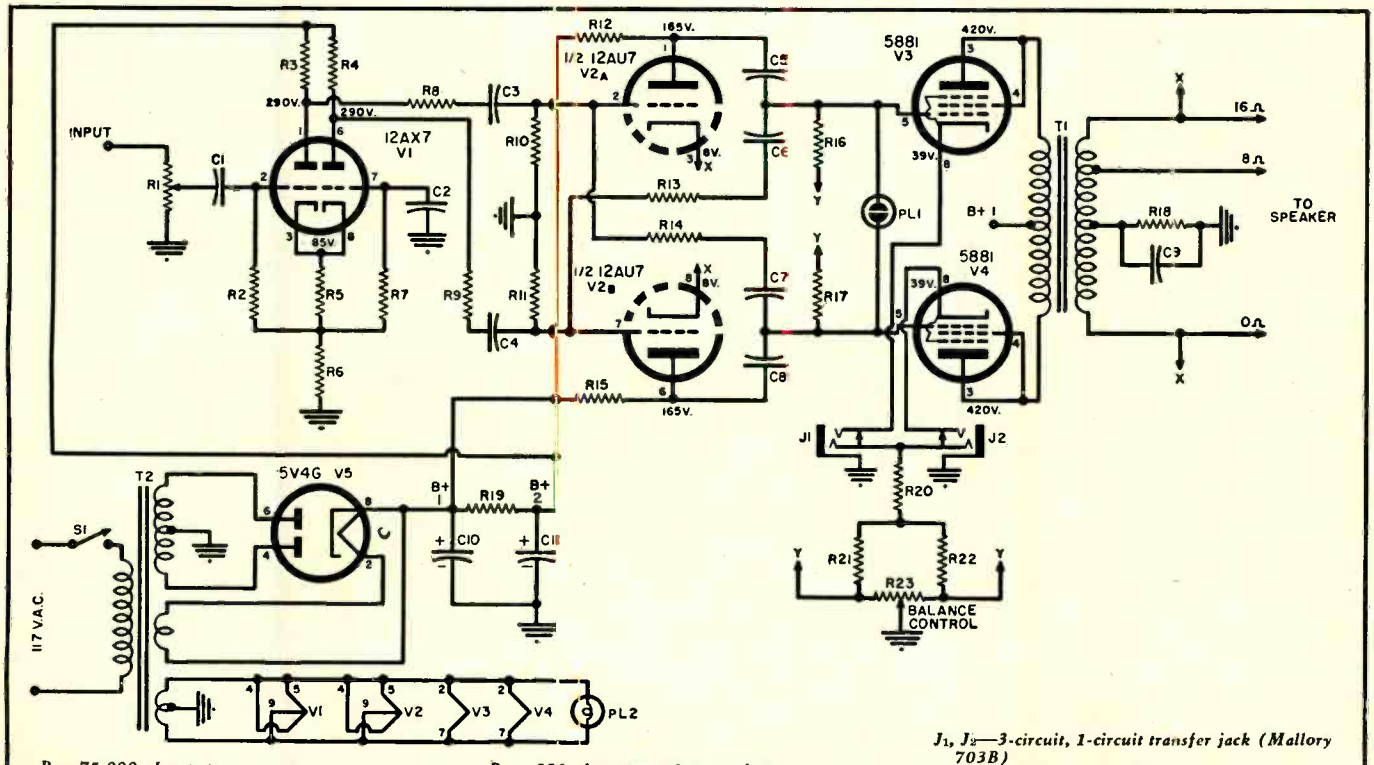
A 75,000-ohm potentiometer is employed as a gain control in the amplifier's input. This resistance is not too low for the great majority of preamplifiers if they have an output capacitor no smaller than 0.25 μfd. The use of a gain control larger than 100,000 ohms may result in an increase in hum and a loss of high frequencies at certain settings, since the input capacitance of the inverter stage is appreciable.

Because of the symmetry of the amplifier, the power supply can use a minimum of filtering without increasing the hum level. The large amount of feedback in the amplifier helps keep the hum level quite low even with unbalanced output tubes, although badly unbalanced tubes decrease the stability at low frequencies and in extreme cases can cause motorboating.

Construction

The entire amplifier and power supply can be mounted on a 7 by 9 by 2-

Fig. 1. Schematic of 13-watt amplifier. Parts should not be substituted in construction.



R_1—75,000 ohm pot
R_2, R_7—1 megohm, ½ w. res.
R_3, R_4, R_{12}, R_{15}—100,000 ohm, ½ w. res.
R_5—680 ohm, ½ w. res.
R_6—40,000 ohm, ½ w. low-noise-type res.
R_8, R_9, R_{10}, R_{11}—120,000 ohm, ½ w. res. ±5%
R_{13}, R_{14}—1 megohm, ½ w. res. ±5%
R_{16}, R_{17}—330,000 ohm, ½ w. res.
R_{18}—1500 ohm, ½ w. res.
R_{19}—15,000 ohm, 5 w. wirewound res.
R_{20}—250 ohm, 5 w. wirewound res.
R_{21}, R_{22}—100 ohm, 1 w. res.
R_{23}—50 ohm wirewound pot
C_1, C_6, C_7, C_9—.01 μfd., 400 v. capacitor
C_2—.05 μfd., 400 v. capacitor
C_3, C_4, C_5, C_8—.1 μfd., 400 v. capacitor
C_{10}-C_{11}—40/40 μfd., 475 v. elec. capacitor
S_1—S.p.s.t. switch
PL_1—NE-2 neon lamp
PL_2—6.3 v. pilot lamp
J_1, J_2—3-circuit, 1-circuit transfer jack (Mallory 703B)
T_1—Output trans., 5000 ohms c.t. to 4-8-16 ohm v.c. (Triad S-35A)
T_2—Power trans. 350-0-350 v. @ 160 ma.; 5 v. @ 3 amps.; 6.3 v. c.t. @ 5 amps. (Triad R-16A)
V_1—12AX7 tube (with shield)
V_2—12AU7 tube
V_3, V_4—5881 tube (1614, KT-66, or 350B could be substituted)
V_5—5V4G tube

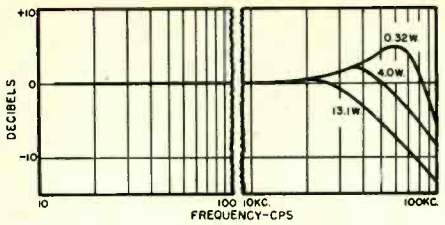


Fig. 2. Frequency response of the 13-watt "infinite feedback" amplifier. See text.

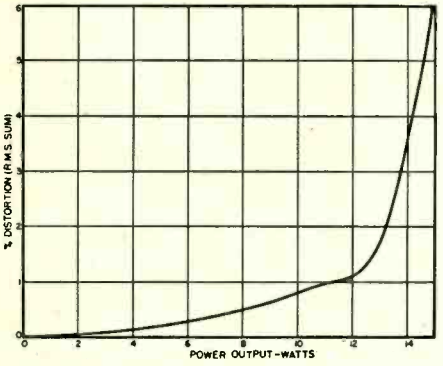


Fig. 3. Intermodulation distortion of the amplifier. 60 and 7000 cps, 4 to 1 ratio.

inch chassis if the layout is done carefully. The necessary compactness is achieved by mounting components directly on the output-tube sockets while using a terminal strip for the first two stages. The photographs show the completed amplifier and an underchassis view which clearly illustrates how the terminal strip is mounted. The terminal strip should be assembled by attaching the resistors first, followed by the capacitors.

Coupling capacitors of the highest quality should be used in constructing the amplifier. The writer has made over a dozen units, and in every case where excessive hum or distortion was encountered the trouble could be traced to a leaky capacitor which was throwing the two halves of the amplifier out of balance. Except for the few 5% resistors indicated on the diagram, no precision or specially selected or matched components are required to assure satisfactory performance.

The constructor must be cautioned not to change the values of any components in the circuit or to use tubes other than those specified. Changes very often have an unexpected result; for instance, decreasing the size of the coupling capacitors between the input and driver stages actually causes a rise in the bass response and may lead to motorboating.

Figs. 2 and 3 show the frequency response into a 16-ohm resistive load and the r.m.s. sum intermodulation distortion at various output levels. An input of 0.5 volt is sufficient to drive the amplifier to full output. The unit shows an output resistance of approximately zero ohms over the range of audible frequencies, which forces the most refractory speaker to behave docilely. Although the response is quite flat listeners are often impressed with what seems to be greater bass response than that attainable with other flat amplifiers, and this can be attributed to the high damping factor (by the usual definition, the damping factor is infinite). The improvement is especially noticeable with woofers of low efficiency.

The amplifier is very stable and shows no tendency to motorboat or, unless overdriven, to oscillate at any frequency or output level. A capacitance of 0.1 μfd. shunted across the speaker terminals does not cause any oscillation or other evidence of instability; this is far in excess of the capacitance presented by any speaker system. The entire amplifier can be wired in a few hours' time and no special precautions as far as lead dress, shielding, or bus bar ground are necessary if the layout of the experimental model is followed. The noise level of several chassis with the inputs shorted varied somewhat with the tubes used but a value greater than 2 mv. = 77 db below 13 watts was never encountered. In all the experimental amplifiers built by the author ground connections were made to any convenient chassis point.

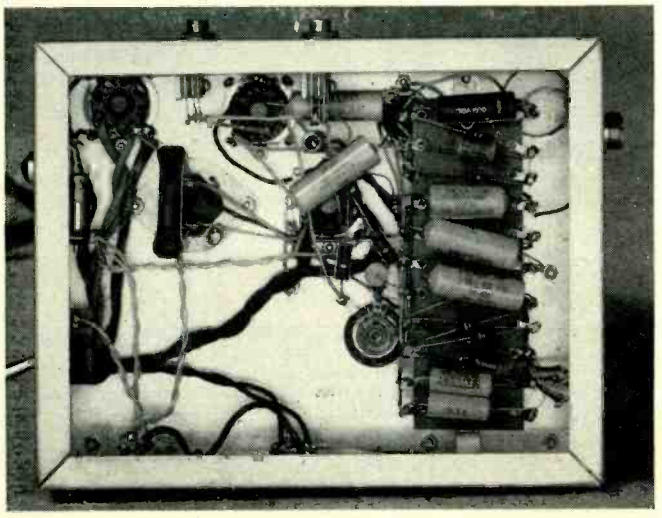
Summary

Since the appearance of the article describing the 35-watt unit several commercial amplifiers have been developed featuring "variable damping factor." The articles describing these amplifiers [3, 4] draw various conclusions as to the damping factor desirable for results of the highest quality.

If, instead of the 1-megohm fixed positive-feedback resistors in the amplifier described here, a dual potentiometer was employed, the output resistance of the amplifier can be controlled within small limits. When the amount of positive feedback is reduced the output resistance increases up to a maximum corresponding to a damping factor of 4; if the amount of positive feedback is increased the output resistance becomes negative. As the latter occurs, however, the stability of the amplifier becomes much worse, and a damping factor of —1.0 can certainly not be obtained.

When the positive feedback is varied in either direction from the optimum (sufficient to make the driver oscillate in the absence of negative feedback) the distortion of the amplifier at a given ouptut level increases. The increase is gradual while the positive feedback is being lowered. On the other hand it rises rapidly as the positive feedback is increased beyond the optimum value. For this reason, the use of such a control to obtain negative damping factors is not to be encouraged. *No circuit has yet been devised* which will, at the same time, produce a large negative damping factor and low amplifier distortion[5]. This objection does not apply, of course, to amplifiers in which a control is provided to vary the output resistance between positive limits.

An amplifier of the type described here, unfortunately, will not make a five-dollar speaker in a cardboard box perform like a two-hundred dollar assembly in a folded horn. It will try, of course, and sometimes the effort becomes so strenuous that oscillation occurs. Such oscillations have been touched off by overloading the amplifier during efforts to obtain resounding bass from tiny speaker enclosures. Given the amplifier, the remedy in such cases lies in either of two directions: a better speaker system should be installed or a filter should be inserted before the amplifier to remove the low frequencies which the system cannot reproduce anyway. Used in conjunction with a speaker of comparable quality, the amplifier is capable of results which have, to date, been thoroughly pleasing to well over a hundred persons and displeasing to only two or three.



Under chassis view of the 13-watt amplifier. Layout and lead dress is non-critical but use of terminal strip simplifies construction.

REFERENCES

1. *Boegli, Charles P.: "A 35-Watt 'Infinite Feedback' Audio Amplifier,"* RADIO & TELEVISION NEWS, *July, 1954.*
2. *Boegli, Charles P.: "Transient and Frequency Response in Audio Equipment," Audio Engineering, February, 1954.*
3. *Wilkens, Charles A.: "Variable Damping Factor Control," Audio, September, 1954.*
4. *Tomcik, D. J.: "The Missing Link in Speaker Operation," Radio-Electronics, December, 1954 and January, 1955.*
5. *Langford-Smith, F.: "The Radiotron Designer's Handbook," 1952 Edition, page 514.*

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the "Minipack" #2

By
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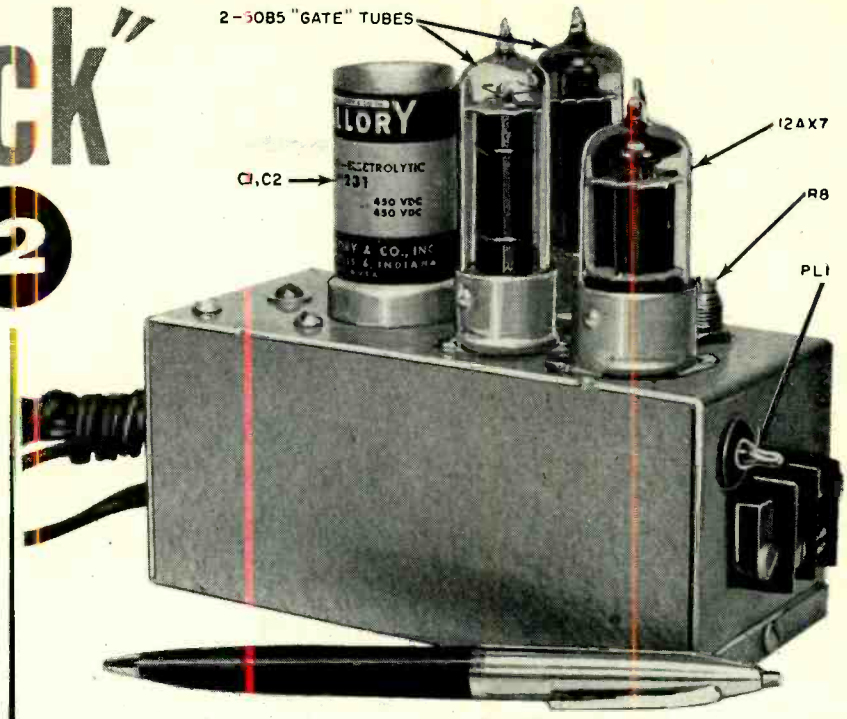


Fig. 1 Top chassis view of the "Minipack #2." It can be built in a 2¼" x 2¼" x 5" utility box.

A miniature "permanent B battery" — delivers 145 to 190 volts at 35 milliamperes with ±1% regulation yet uses no transformers.

LAST MONTH we described "Minipack #1," a small power supply capable of one per-cent regulation over a 75 to 175 volt range. Recently a second power supply became necessary. Rather than borrow voltage from another source, "Minipack #2" was designed to meet the following specifications: 150 volts d.c. output at a maximum load current of 35 ma; regulation, better than a VR tube's three per-cent. No transformer was available, thus the circuit developed as follows.

The spare parts box contained some 75 ma. selenium rectifiers and a dual 10 μfd., 450 volt electrolytic capacitor. *Voila!* These components eliminate the transformer shortage! "Minipack #1's" electronic regulator circuit filled the bill to complete the circuit. Here's the story of "Minipack #2."

The Circuit

Fig. 2, the schematic diagram, demonstrates the "Minipack's" simplicity. Start with the 117 volt a.c. line cord, connected directly to the three tube filaments, which are in series. The filament transformer is eliminated but the tubes are illuminated! Continue to R_1, a 100-ohm, 2-watt carbon resistor which prevents inverse peak current damage to selenium rectifiers SR_1, and SR_2. C_1, one half of the dual 10 μfd., 450-volt capacitor, works in series with line voltage input. This voltage multiplier, being a full-wave rectifier-doubler, is the only circuit available wherein both capacitors have a common negative. The scheme allows use of the single-can dual capacitor, the can serving as the common negative return.

Essentially, the doubler functions by charging C_1 and C_2 in parallel and discharging them in series, and the peak output voltage equals 2.82 times the r.m.s. line voltage under "no-load" conditions. "No-load" potential at point X measures 285 volts.

Cascade multipliers have poor regulation; with a few ma. load, X drops from 285 to 206 volts. Regulated maximum d.c. must be less than the doubler's loaded output to permit well-controlled potential within the 150 to 190 volt region.

The 50B5 gate tubes act as a variable series resistance controlled by the 12AX7 regulator tube. Action is similar to automatic volume control in superhet receivers. The 12AX7 amplifier controls the gate's bias, which varies the gate tubes' resistance, which controls the output, which controls the 12AX7's plate current, and so on. That cycle has a very fast time constant, resulting in steady output voltage irrespective of load fluctuations. The "Minipack's" output holds constant at one volt in 100 for 25% variations in line voltage or load resistance.

Resistors R_2 and R_3 prevent parasitic oscillation. The 50B5's are parallel-connected to allow higher current passage through the gate.

(*Continued on page* 126)

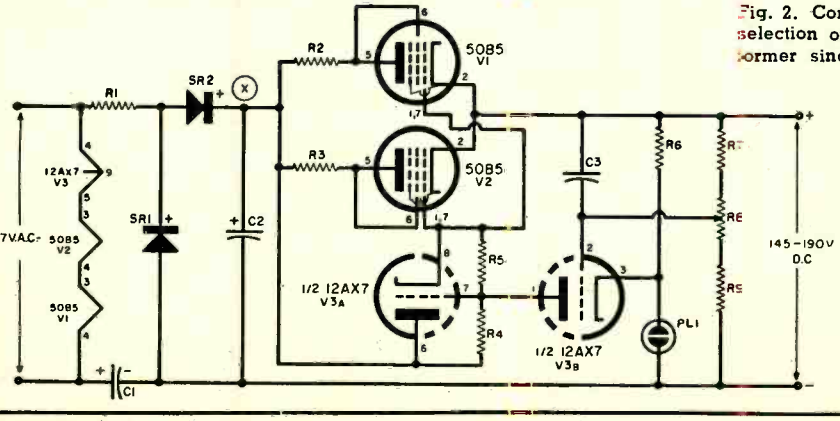


Fig. 2. Complete schematic of power supply. The judicious selection of tubes eliminates the need for a filament transformer since the tubes operate in series across the line.

R1—100 ohm, 2 w. carbon res.
R2, R3—51 ohm, ½ w. carbon res.
R4—10 megohm, ½ w. carbon res.
R5, R7—220,000 ohm, ½ w. carbon res.
R6—470,000 ohm, ½ w. carbon res.
R8—100,000 ohm carbon pot
R9—100,000 ohm, ½ w. res.
C1, C2—10/10 μfd., 450 v. elec. capacitor (Mallory FP-231)
C3—.1 μfd., 200 v. paper capacitor
SR1, SR2—75 ma. selenium rectifier (Sylvania NB-5)
PL1—Miniature neon bulb, NE-2
V1, V2—50B5 tube
V3—12AX7 tube

FM-TV Sound Portable

An inexpensive metal lunch box will house this compact, easily-built portable. The circuit uses standard parts.

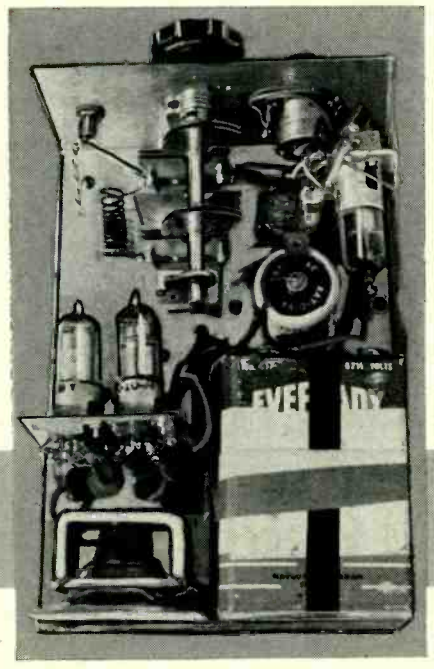


Fig. 1. Under chassis view of receiver. The batteries are easily replaceable although battery life is amazingly long since drain is low. Subassemblies make for compact construction and aid construction simplicity.

By **BRUCE MORRISSETTE**

A BATTERY-OPERATED portable receiver that will provide reception on the FM bands is a "rare bird" indeed but when such a circuit also offers reception of the sound portions of TV channels 2 through 6, the user has a veritable "jewel" of a set.

The trim, efficient portable to be described will bring in the sound portions of channels 2 through 6 as well as the entire FM broadcast band of 88-108 mc. It is calculated to fascinate and entertain both children and adults.

Construction

An attractive green-and-gray metal lunch box, measuring approximately 6" x 8" x 3", is used to house the FM-TV portable. This "cabinet" is available at any large dime store for about a dollar. Holes to clear the antenna plug, tuning capacitor shaft, and volume control shaft are cut in one end of the box while a pattern of holes for the speaker opening is drilled in the opposite end. A sheet of aluminum or steel, 5¾" x 11½", is shaped to form a chassis to fit the lunch box. Bend up a small lip (¼") at one end and a 2⅞" panel lip at the other. The chassis bottom measures exactly 8$^{7}/_{16}$" x 5¾" for the box shown, but the builder should, of course, check the dimensions of his box before cutting and bending the aluminum sheet.

Holes to permit the controls to pass through the end of the box are cut to ⅝" to allow free passage of the shafts. Shaft nuts are used only on the inner chassis panel holes. These holes measure ⅜". If the chassis is fitted properly in the case, in the inverted position shown in Fig. 3, mounting screws will jut into the free space below the box lid and the whole unit will fit snugly and have no tendency to rattle when the lid is closed.

The "B" batteries are fastened together with tape and mounted one on top of the other with a metal or cloth strap. The "A" battery was mounted vertically by means of an iron bracket which happened to fit — a similar bracket can easily be fashioned from aluminum or other scrap. The little 2" PM speaker is a readily available item. It will give surprisingly good volume and tone. Mount it on two spade bolts through the chassis in the position shown in Fig. 1. Its small output transformer is mounted below the speaker. If the builder is unable to secure an output transformer small enough to fit under the speaker, space for a larger unit may be made by moving the V_3-V_4 subassembly forward.

Tuning capacitor C_3 is a *Hammarlund* MCD-50-M, but any standard two-gang capacitor rated at about 3-35 $\mu\mu$fd.-per-section will work nicely. If the unit selected has more than the required capacity or if the tuning range is greater than needed, remove one or two plates from each stator and rotor section by prying them loose carefully with a long-nose pliers. The smaller the over-all capacity range, the greater will be the bandspread and the greater the ease of tuning.

Battery tubes capable of operating at TV and FM frequencies are not plentiful but the acorn type 957 works fine in the required range. Mount the tube by joining the two "F—" filament pins with a piece of stiff wire. Bend the wire downward to form a bracket and screw to the chassis. If microphonics develop, wedge a piece of sponge rubber under the tube.

The other tubes are mounted on aluminum subassembly brackets: V_2 on a 1⅛" x 2" high bracket close to the volume control and V_3 and V_4 on a plate 2½" x 2½" near the speaker. Tie points support resistors R_2, R_3, and R_6. It is important, particularly in wiring the first stage, to keep all leads as short as possible. When working with high-gain stages, oscillation problems arise quite frequently and therefore special care should be taken when wiring this circuit. The disc ceramic capacitors, specified in the parts list, are compact and inexpensive and of considerable assistance in eliminating crowding.

Circuit

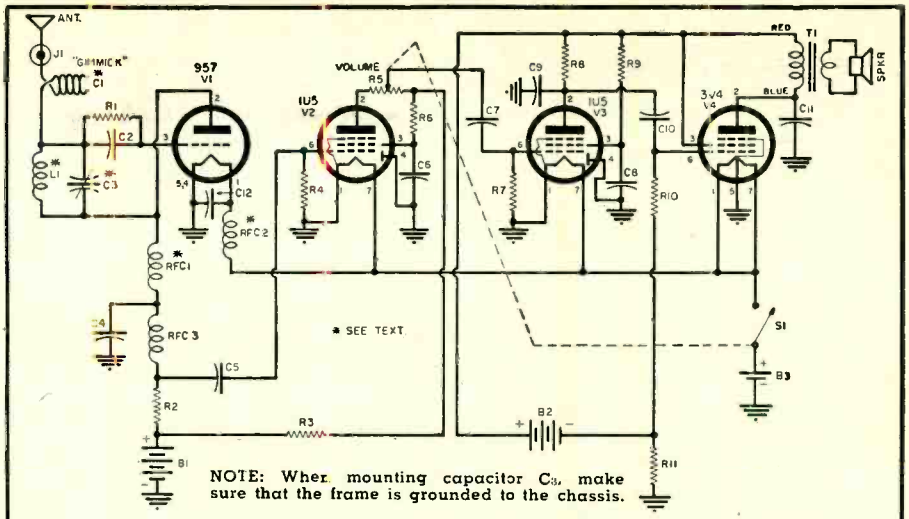
The circuit diagram of the receiver is given in Fig. 2. The antenna is coupled through an insulated banana jack and a twisted-wire "gimmick" capacitor to the grid side of the superregenerative coil-and-capacitor combination, L_1-C_3. Wrap the gimmick wires together for about 1½ inches. L_1 is formed by winding 12 turns of #18 enameled wire over any ¼" diameter shaft, clipping off the turns, soldering the ends to the capacitor stator lugs, and spacing the turns to a coil length of about 1⅜". Correct frequency coverage is obtained when L_1 and C_3 tune together from 58 mc. (channel 2 sound) to 108 mc. (high end of the FM band). Such frequency-measuring devices as signal generators, grid-dip meters, etc., are useful but not essential in working out the frequency coverage. The important thing is to be sure the receiver tunes throughout the range of available TV and FM stations in your locality in the channel 2-6 and FM range. This is best determined by an on-the-air check of the completed receiver. It is simple

to make adjustments in L_1 at any time.

The placement of parts and wiring is critical because of the frequencies involved. Note that the 957 detector tube is located on the opposite side of the tuning capacitor from L_1. Grid lead resistor R_1 and capacitor C_2 connect from the 957 grid pin to the stator of C_3 (grid side). A direct wire joins the plate pin to the plate side of the C_3 stator from which plate isolating choke RFC_1 connects to the filter C_4-RFC_3 which eliminates the superregenerative "quench." Audio is developed across plate resistor R_2 and coupled to the first audio amplifier, V_2, through C_5. RFC_2 and C_{12} keep r.f. from the other filament circuits. Both RFC_1 and RFC_2 may be small commercial high-frequency chokes or may be closewound with about 37 turns of #30 enameled wire on the bodies of any 3/16" diameter resistors of 500,000 ohms or more.

R_1 provides the grid-leak bias for V_2 and the volume control, R_5, also functions as a plate resistor for this tube. One resistor and one coupling capacitor are saved by this arrangement. The center arm of R_5 leading to the grid of V_3 (through C_7) picks up any amount of the audio developed across R_5 from zero to maximum.

The V_3 stage is identical to that of V_2 except for the fixed plate resistor, R_8. Bias for the power output tube, V_4, is obtained by returning the minus terminal of B_2 to the junction of R_{10} and R_{11}. This gives about −3 volts fixed bias while the high value grid resistor R_{10} increases this slightly by grid-leak action when an audio signal is present. C_9 and C_{11} are tone-control elements which cut down excessive high-frequency response in the small speaker. Observe that the filament of V_4 must be wired in the parallel manner, with pin 5 grounded and pins 1 and 7 connected together. The "hot" side of all filament leads goes to one side of switch S_1, which disconnects the tube filaments in the "off" position, thus automatically



NOTE: When mounting capacitor C_3, make sure that the frame is grounded to the chassis.

R_1—2.2 megohm, ½ w. res.
R_2—2",000 ohm, ½ w. res.
R_3—3?,000 ohm, ½ w. res.
R_4, R_7—10 megohm, ½ w. res.
R_5—1 megohm volume control (with switch, S_1)
R_6, R_9—4.7 megohm, ½ w. res.
R_8—1 megohm, ½ w. res.
R_{10}—3.3 megohm, ½ w. res.
R_{11}—390 ohm, ½ w. res.
C_1—"Gimmick" (approx. 2 μμfd., see text)
C_2—47 μμfd. ceramic capacitor
C_3—Two-gang, 3-35 μμfd.-per-sec. capacitor (see text)
C_4, C_5, C_7, C_{10}, C_{11}, C_{12}—.002 μfd. disc ceramic capacitor
C_6, C_8—.02 μfd. disc ceramic capacitor
C_9—.001 μfd. disc ceramic capacitor
L_1—12 t. #18 en. wire, 1/4" dia., spaced 1 3/8" (see text)
RFC_1, RFC_2—Approx. 37 t. #30 en. wire on 3/16" dia. form (see text)
RFC_3—2.5 mhy. r.f. choke
T_1—Miniature output trans., 10,000 ohms to v.c.
B_1, B_2—67½ volt battery (Eveready #467 or Burgess XX45)
B_3—1½ volt flashlight cell
S_1—S.p.s.t. switch (on R_5)
Spkr.—2" PM speaker (see text)
J_1—Banana jack with insulating washer (Amphenol)
V_1—957 acorn tube
V_2, V_3—1U5 tube
V_4—3V4 tube

Fig. 2. Complete schematic diagram of the FM-TV sound portable. Antenna length is frequency sensitive and must be carefully determined. Parts are all standard.

stopping the flow of "B+" current and cutting off all drain on both "A" and "B" batteries.

Some means was required to prevent "motorboating" feedback through the power supply in the three-stage, high-gain amplifier. The best practical solution proved to be the use of independent "B" batteries for V_1-V_2 and V_3-V_4. This arrangement is less wasteful of battery power than it seems. The drain on B_1 is only .15 ma. which means that the life of B_1 is practically shelf life. The drain on B_2 is 7 ma. Only B_2 will need to be replaced in normal use. The "A" battery should last several months and B_1 and B_2 up to a year or more with moderate use.

Hints on Adjustment

The circuit and parts values for this portable have been carefully determined by design and experiment and

(*Continued on page* 158)

Fig. 3. Rear view of receiver. Chassis is bent to fit lunch box.

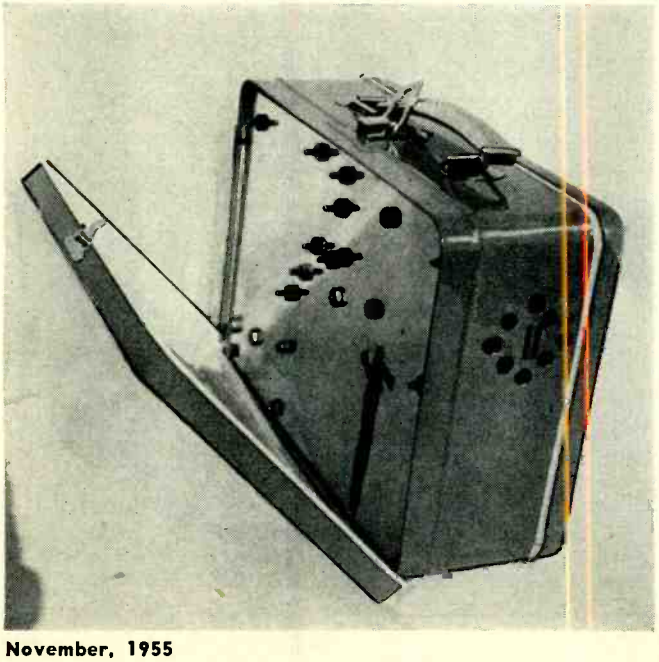
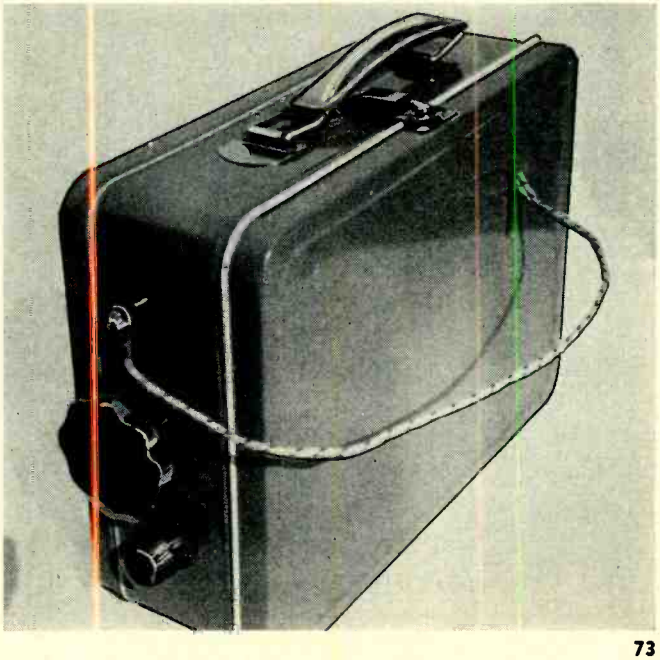


Fig. 4. Completed receiver housed in an inexpensive metal box.



By J. A. MAY
RCA Service Company

RCA Test Points

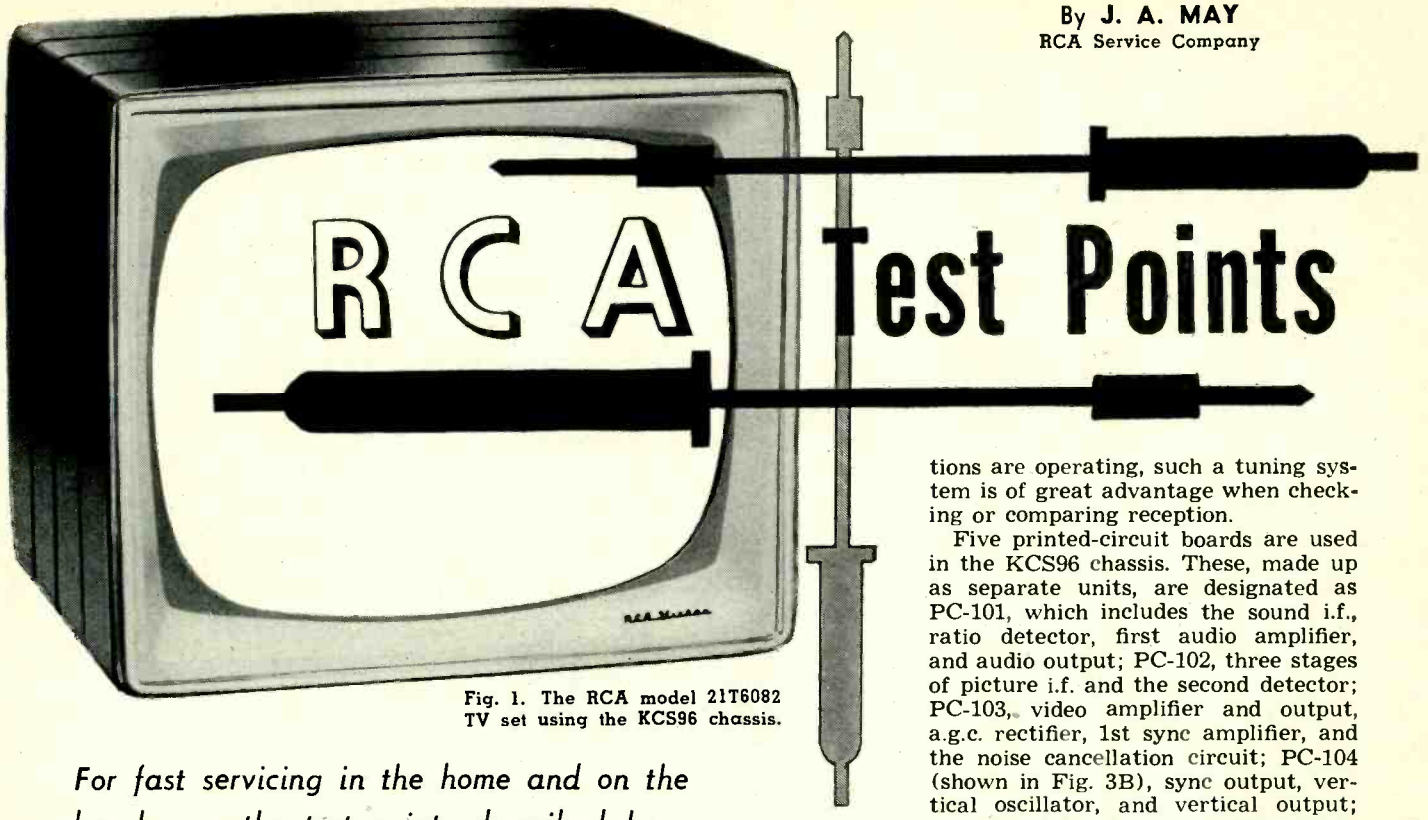


Fig. 1. The RCA model 21T6082 TV set using the KCS96 chassis.

For fast servicing in the home and on the bench, use the test points described here.

ALL of the new *RCA Victor* black-and-white television receivers have totally new chassis which differ from previous years' models. Representative of this new, completely restyled and refined group in the "Super" series is the 21-inch model 21T6082, the "Headliner," shown in Fig. 1. The model 21T6082 uses a vertically mounted KCS96 chassis shown in Fig. 4. Some of the features of this chassis include five printed-circuit boards, a new synchronization stabilizer circuit, and the use of solderless, wrapped-wire connections.

This receiver includes many test points for rapid servicing checks. TP1, reached through an opening on the side of the tuner (see Fig. 2), is the oscillator injection and r.f. alignment test point. Oscillator injection voltage, measured with a vacuum-tube voltmeter should be from 2 volts (minimum) to 5.5 volts (maximum). The mixer grid test point, TP2, is used for i.f. alignment purposes.

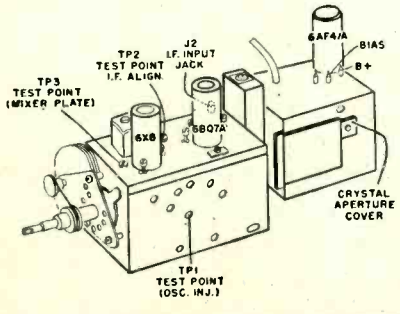
The KRK30F u.h.f.-v.h.f. tuner, optional with this receiver, consists of a type KRK29H v.h.f. section and a separate "piggy-back" u.h.f. section. Continuously variable tuning is utilized when tuning u.h.f. A simplified "slow-fast" mechanism permits coverage of the entire u.h.f. television band in as little as 2½ seconds, yet provides vernier operation for fine tuning.

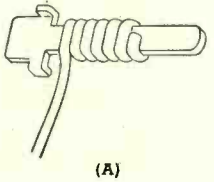
The u.h.f. tuning control also includes the *RCA Victor* "return without retune" feature. This means that, due to the operation of the clutch in the tuning mechanism, if a u.h.f. channel has been tuned in, the channel selector switch can be set to any v.h.f. channel and then, when desired, be returned to the previous u.h.f. channel without the need for retuning the u.h.f. channel. To service technicians in an area where both u.h.f. and v.h.f. stations are operating, such a tuning system is of great advantage when checking or comparing reception.

Five printed-circuit boards are used in the KCS96 chassis. These, made up as separate units, are designated as PC-101, which includes the sound i.f., ratio detector, first audio amplifier, and audio output; PC-102, three stages of picture i.f. and the second detector; PC-103, video amplifier and output, a.g.c. rectifier, 1st sync amplifier, and the noise cancellation circuit; PC-104 (shown in Fig. 3B), sync output, vertical oscillator, and vertical output; and PC-105, the horizontal sweep oscillator and control circuits. Note the novel method of showing the layout of each printed circuit board used in Fig. 3B. The printed boards are shown in such a manner that it is possible to "see through" the printed board. This greatly simplifies circuit tracing and locating components.

The individual components that make up each printed board should be replaced independently, when necessary. Only extensive damage to the printed connecting strips, or breakage of the board, would necessitate replacement of the complete board. When removing and replacing components, every possible precaution should be taken to prevent damage to the connecting strips. Soldering should be done with extreme care to prevent excess solder from causing shorts. If one of the connecting strips on the printed circuit board is cracked or broken, it may be repaired easily. A short length of tinned copper wire

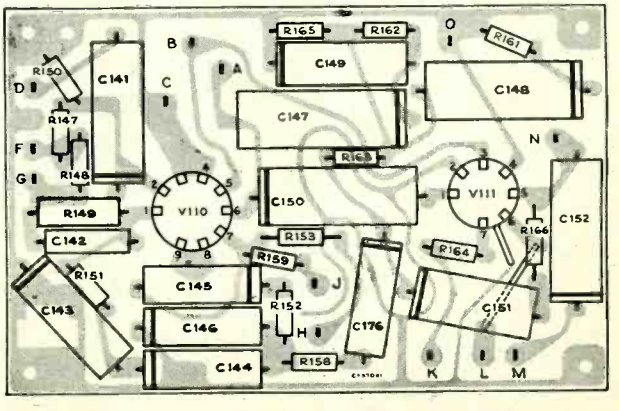
Fig. 2. V.h.f. and optional u.h.f. piggy-back tuner used with the KCS 96 chassis Note the test points.





(A)

Fig. 3. (A), enlarged view of wrapped connection. (B), Printed-wiring schematic.



(B)

should be placed across the break. The joint is then soldered by flowing solder over the break and the length of wire. A small soldering iron should be used since too much heat may cause a break or a short in the copper circuitry.

Another new feature used in these receivers is the wrapped-wire connection. These connections consist of six or seven turns of wire, tightly machine-wrapped around special square studs. They are both electrically and mechanically equal or superior to conventional soldered connections and should not be considered to require soldering. However, when rewiring is necessary, or the original tightly wrapped connection has once been unwound, conventional soldering methods must be used to replace the connection. An enlarged view of a "wire-wrap" solderless connection is shown in Fig. 3A.

All check points on this chassis can be conveniently reached from the top (rear) of the chassis, without removing the chassis from the cabinet. By inserting a test probe through the openings at the printed circuit board mounting supports, and through the openings where the tubes extend through the chassis it is possible to measure tube pin voltages. Of course, caution must be exercised not to short the probe to the chassis while making "B+" measurements. The high voltage fuse is readily accessible and has a snap-in type mounting which, together with the other features described before, enables rapid, efficient, and convenient servicing.

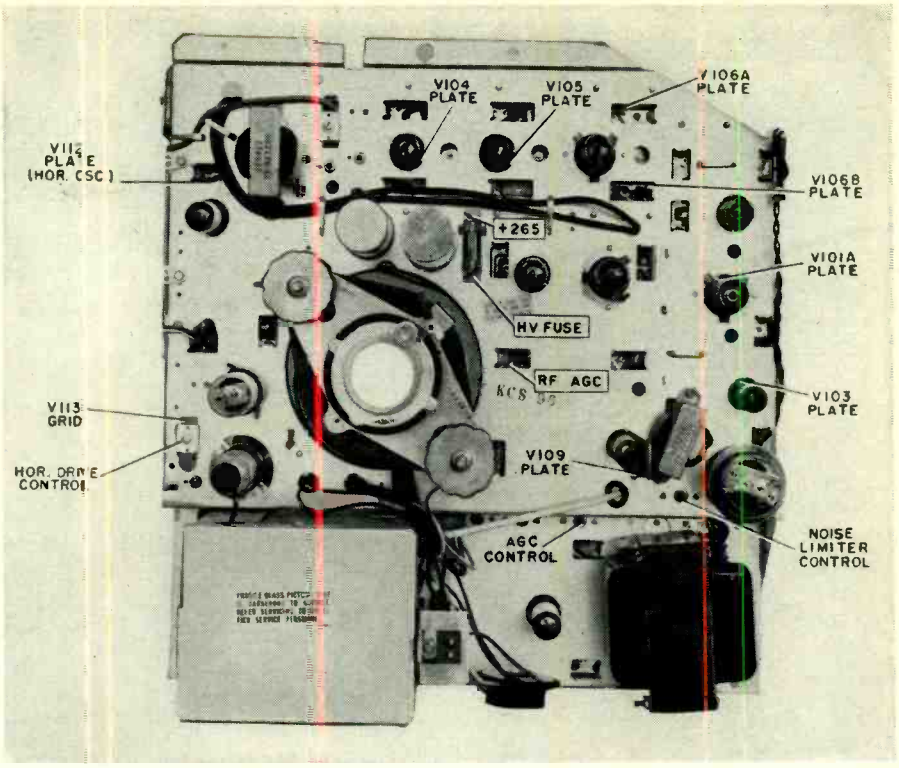


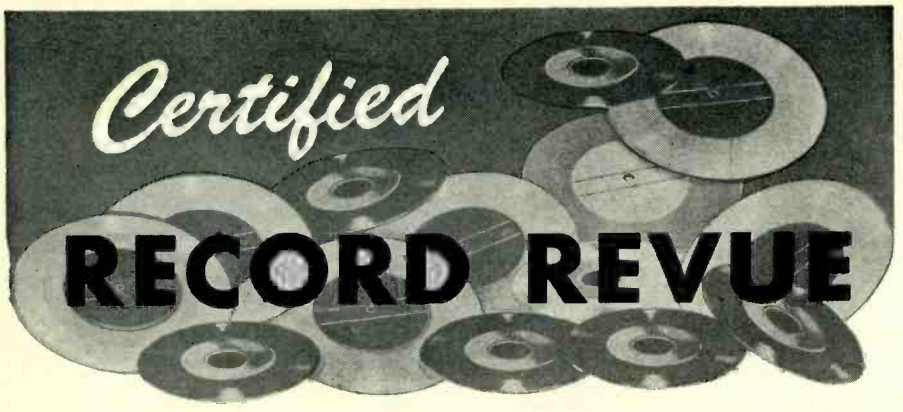
Fig. 4. View of the KCS96 chassis showing the location of tubes and test points.

The voltage chart, Table 1, provides a reference for locating the most common causes of receiver troubles. —30—

Table 1. Identification of most useful test points on the RCA chassis with the normal voltage readings for each point.

TUBE	CIRCUIT FUNCTION	TEST POINT	VOLTAGE (NO SIGNAL)	SERVICE PROCEDURE
V_{101A} 6U8 (pentode section)	Sound i.f. ampl.	Pin 6	102*	If voltage is incorrect, check C_{101} (grid coupling) or C_{180} (screen bypass)
V_{103} 6AQ5	Audio output	Pin 5	187**	If voltage is incorrect, check C_{111B} (screen bypass) or R_{112} (cathode bias).
V_{104} 6DE6	1st pix i.f. ampl.	Pin 5 Pin 6	103* 113	If no voltage, check pin 6; if voltage is normal at pin 6, check transformer winding.
V_{105} 6DE6	2nd pix i.f. ampl.	Pin 5 Pin 2 Pin 6	231* 127 252	If no voltage, check pin 2; if voltage is normal at pin 2, check screen, pin 6; if screen voltage is normal, check transformer winding.
V_{106A} 6AS8 (pentode section)	3rd pix i.f. ampl.	Pin 2	0*	If voltage is present, check 3rd i.f. transformer, T_{106}, for shorted winding.
		Pin 9	127*	If no voltage is present, check 4th i.f. transformer, T_{107}, for open winding. If voltage is too high, check for shorted winding.
V_{106B} 6AS8 (diode section)	Pix 2nd detector	Pin 8	0.47*	If voltage is too high, check T_{107}.
V_{109} 6AQ5	Video output	Pin 5	171	If voltage is too high, check wiring for short to pin 6. If too low, check R_{225} or R_{227} (plate "B+").
V_{112} 6CG7	Horizontal osc.	Pin 6	199	If voltage is incorrect, check R_{174}-C_{158} (at pin 7).
V_{113} 6BQ6-GTB	Horiz. sweep output	Pin 5 Pin 8	-22.0 11.9	If voltage is incorrect, adjust C_{162}, horiz. drive control, and check R_{180} (cathode bias).
		high volt. fuse	265	

*Measure with 1 megohm, ½-watt resistor in series with probe.
**At minimum setting of volume control.



By **BERT WHYTE**

THE recent action of *Columbia Records* in establishing a "Record Club", brings sharply into focus a situation which for some time now has been a matter of growing concern to the record companies. This has been the phenomenal mushrooming of many "record clubs", some of which were the offspring of some of the smaller record companies and some of which were subsidiaries of well-known book clubs. Starting in a modest way and attracting little attention at first, these clubs have flourished to the extent that some of them can afford full page ads in magazines like *Life* and the *Saturday Evening Post*. What really jolted the big record companies were the fantastic statistics compiled at the close of 1954, which showed that these record clubs now took a 15 per-cent bite out of the over-all record market, and even more incredible, they accounted for 35 per-cent of total classical record sales!

Figures like these cannot be ignored and *Columbia* took a deep breath, plunged into the club business and thereby set the record industry on its ear! Boy, you should hear some of the howls! *Victor* promptly announced they would *not* sponsor any record club, stating that this was unfair to the retail dealer, who after all is "the bulwark of the industry, etc., etc." Some of the larger New York dealers (who have very little to lose since their business is largely mail-order anyway) filled *The New York Times* with ads supporting the new club. The smaller dealers, smoke pouring out of their ears, held mass meetings protesting the *Columbia* club and demanding that a company representative meet with them to discuss(?) the matter. I understand some hapless individual was made the sacrificial goat, to what ends, I wouldn't know.

Some of the more hot-headed dealers gave the entire *Columbia* catalogue the heave-ho and flatly stated that as long as there was a *Columbia* record club, they would not stock *Columbia* records.

In format the *Columbia* club is much like the other clubs. You join by signing up at your local record shop (a sop to the dealer from *Columbia*) which entitles you to a free record from a prescribed group of recordings. For every two selections you buy, you get a special bonus record free. You do not need to buy more than four records per year. The records are mailed directly to your home (one of the dealers' pet gripes).

Sounds like the old familiar pitch, doesn't it? What I personally think of this development is of little moment. I neither condemn nor condone the *Columbia* action. It is easy enough to see the issues from both sides. *Columbia* contends that their club will stimulate greater interest in records and that as a result more people will visit the record retailer. Certainly there is some validity in this concept. The retailer claims that the club will keep customers *out* of his store, and he will thereby lose sales, especially of the "impulse" type. His argument would also appear to have some merit. On the other hand, the dealers have displayed a strange apathy to the fact that once a person has signed up for the record club at a particular store, the dealer receives 20 per-cent of the selling price of any records the customer buys at the time of joining and any records purchased in the future. Irrespective of who is morally right or wrong in this hassle, several facts are clearly evident for those who want to see them.

First of all, except for the bigger urban centers of population, the average record customer has not been able to buy his records at a discount. In essence, the *Columbia* club gives these buyers a discount, even if it is in the form of records rather than cash. The second thing that comes to mind is—*who are these people who have joined these record clubs?* I feel I am on fairly safe ground when I say that these people are *outside* of what is normally considered the record-buying public. These are the people to whom the old record price of $5.95 was just too much for their indulgence, and who probably feel that even the present price is pegged too high. There are lots of people who are not musically trained but "know what they like" and who will buy if the tariff is not too steep. Who can say what particular stimulus prompted their interest in classical music? After all, the average person is exposed to a great deal of publicity about good music these days. Articles in digest type magazines, the women's magazines, stories on hi-fi in the Sunday supplements, the awareness of new sound quality in the stereophonic realism of Cinerama and CinemaScope movies, this is only part of the barrage that has been elevating our cultural level.

Now let's face a few facts squarely in the eye—many people are not musically erudite. With both good and bad records on the market today, they still can't appreciate the difference between a Toscanini performance and one by Joe Doakes if it bit them (I do not deprecate these people for this, I am merely stating fact). It is for our great good that so many people have found that, whatever motivations are involved, they like to hear the Beethoven 5th or the Tchaikovsky 6th, etc. Now these people, like any other group, can be reached by advertising and be told what is good for them and what they should buy. That is the function of competitive interests and I leave that to them.

The golden opportunity for *Columbia* and any other *equipment* manufacturer, if they will just take the trouble to *see it*, is this: not everyone can be a musicologist, or musically educated. But God gave everyone a set of ears and rich or poor, saint or sinner, most people hear alike. The only way the musically uneducated can judge whether they like recording "A" better than recording "B" or vice versa *is how it sounds to them!* Now couple an intelligent educational program with good quality records, good quality playback equipment sold at sensible prices and you have a huge new market.

In simple language, with liberal use of visual aids, people should be educated to the whys and wherefores of a diamond stylus, the philosophies of separate enclosed speaker systems, what an amplier does and why one unit must be higher priced than another, acoustical considerations in the average home or apartment, etc. There is a contention that the public is too dumb, not capable of absorbing this sort of info, or that they don't give a toot. I flatly state that I could go into any town you want to name, even the legendary "East Podunk"—the synonym for hicks with hayseed in their hair—give a lecture demonstration before the PTA and the garden club and the Lions, Kiwanis, Rotary, etc., and guarantee a fair percentage of converts to hi-fi music reproduction. As long as people can hear, most can perceive the difference between what is good and what is bad sound. I insist that equipment of reasonable hi-fi quality can be manufactured and merchandised to sell at prices at the same or slightly higher levels than presently prevails. The manufacturer who has the money and the courage to follow through on a deal like this has a gold mine waiting for him!

Getting back to the bigtime major label record clubs, I say this: like it or not, I think they are here to stay and I predict that denials or no, other companies will soon be in the field. What the ultimate effect on the retail dealer will be is hard to say. Let's have the pot simmer a while and I'll report on this again in a month or two.

Equipment Used This Month: New *Pickering* 350Ds cartridge, *Pickering* arm, *Marantz* preamp, 30-watt *McIntosh* amplifier, *Jensen* "Imperial" speaker system.

SCHUMAN, WILLIAM
SYMPHONY #6
PISTON, WALTER
SYMPHONY #4

Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML4992. NARTB curve. Price $4.98.

Every year *Columbia* issues a spate of recordings by contemporary American composers, which I personally find of great interest. I find much that is musically worthwhile in this series and much that, admittedly, is not the most inspired writing and even some which is downright pretentious. In music as in any other field, there is a great deal of chaff with the wheat, but good, bad, or indifferent the American composer deserves to be heard and *Columbia* is to be commended for this effort.

I heartily deplore the attitude displayed by certain pseudo-intellectual critics who think it is "smart and fashionable" to deprecate the works of our composers, in much the same way as these critics sneer at the "poor musical illiterate" who happens to like Tchaikovsky's "Romeo and Juliet" or the "1812 Overture". No one should pay any attention to these flatulent pundits—they all have a congenital dislike of any red-blooded, pulse-pounding music as it makes their ulcers kick up and might even blow a gasket in their tin ears! Well, now that I have gotten that off my chest, I can tell you that this recording is one of the most musically interesting and sonically exciting of the current crop. Schuman is a vital force in our contemporary musical society and his writing is unique for its rhythmic, propulsive drive and its intense emotionalism. (*Continued on page* 160)

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.

by h.h. Scott

Revolutionary New Turntable Has Everything

710-A Stroboscopic Turntable, $125.00*

New acoustic filtering keeps out ALL interference

■ New turntable design principle, acoustic filtering, prevents speaker, building and motor vibrations from ever reaching the turntable. This frees record playing from distortion found in conventional systems.

■ Center-gear drive, with torsional filtering, eliminates "garbling" of high frequencies which results from the flutter inherent in rim drive.

■ Separate vernier control of each speed allows super-exact pitch adjustment. Convenient pushbutton selection of 33⅓, 45 and 78 rpm speeds.

■ Optical stroboscope for extremely precise speed settings, even while record is playing.

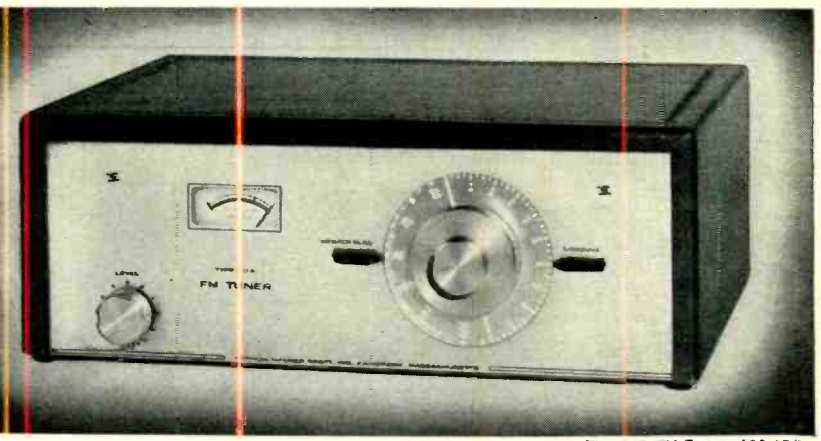
■ Built-in vibration isolation and pickup arm mounting system simplify installation.

TECHNICAL SPECIFICATIONS

Rumble more than 60 db below recording level — wow and flutter less than 0.1% — built-in slip-clutch permits cueing — heavy non-magnetic cast aluminum turntable — heavy-duty special induction motor with dynamically balanced rotor and extremely low hum field — pickup arm mounting board furnished with turntable — dimensions: 16⅞" x 14½" x 7⅛" — accessory mahogany base $14.95* *Slightly higher west of Rockies.

by h.h. Scott

Sensational FM Performance at a Best-buy Price



The 311 FM Tuner, $99.95*

There are NO weak stations with this new tuner

■ Terrific 3-microvolt sensitivity makes distant stations sound as clear and strong as those nearby.

■ New wide-band FM design gives super-selectivity, to separate stations so close together you would ordinarily pass right over them.

■ Wide-band circuitry insures rock-steady, drift-free reception, so you never need readjust tuning.

■ Automatic gain control always keeps tuner perfectly adjusted, no matter how the signal varies.

TECHNICAL SPECIFICATIONS

2-megacycle wideband detector — 2 stages of full limiting — 80 db rejection of spurious response from cross-modulation by strong local signals — low-impedance output — equipped for multiplex — beautiful accessory case $9.95* *Slightly higher west of Rockies.

310 FM BROADCAST MONITOR TUNER

For perfectionists and connoisseurs, H. H. Scott offers the 310 FM tuner. High Fidelity Magazine says: The 310 "... is a tuner that seems as close to perfection as is practical at this time." The Audio League Report says: "The 310 is the most sensitive tuner we have yet tested." Price, including case $149.95 East Coast; $157.45 West Coast.

PIONEERS IN SOUND

Recognition of leadership includes: First-choice rating of amplifiers in the SATURDAY REVIEW HOME BOOK; amplifier ratings as "finest on the market" by Harold Weiler, author of HIGH FIDELITY SIMPLIFIED; Medal of Merit at International Sight and Sound Exposition.

h.h. Scott

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Hi-Fi Questions and Answers

By **ED BUKSTEIN**

What is high-fidelity?

To give it a formal definition, high-fidelity is that characteristic of a sound reproducing system which enables it to reproduce sound that is, as nearly as possible, like the original sound. The real test of a high-fidelity system is whether or not a listener can tell, without looking, that he is listening to a recording rather than to a "live" orchestra. If the listener can easily tell the difference, the system is low in fidelity. A high-fidelity system would reproduce the sound so authentically that only a trained listener could perceive the difference.

What is a "flat" sound system, and why is it desirable?

A sound reproducing system is said to be flat if it responds equally well to all of the frequencies applied to it. This is a prerequisite of high-fidelity sound reproduction. If the sound system is not flat (if it favors some frequencies over others), the tuba, violin, or piccolo of an orchestra may sound disproportionately loud. Within limits, it is practical to compensate for lack of flatness in one component with another component of opposite characteristic. For example, an amplifier with exaggerated low-frequency response may be used to partially compensate for a loudspeaker which is deficient in low-frequency response.

What is a mono-range loudspeaker?

Many high-fidelity systems use two loudspeakers, one for the high frequencies (the tweeter) and the other for the lows (the woofer). When only one speaker is used for the full spectrum of audio frequencies, it is known as a mono-range loudspeaker.

Hi-fi enthusiasts often talk about spatial distribution of a loudspeaker. What do they mean?

Spatial distribution refers to the directional properties of a loudspeaker. The run-of-the-mill loudspeaker concentrates the high frequencies in a narrow beam along its axis, while the low frequencies are dispersed over a wider angle. A listener directly in front of the loudspeaker will therefore hear the high notes as well as the lows, while a listener off to one side will hear the low notes only. A woofer-tweeter combination generally has a more uniform spatial distribution than a single speaker, although some mono-range loudspeakers are specifically designed for improved spatial distribution.

The input stage of a high-gain amplifier is sometimes shock mounted on rubber supports. What is the purpose of this arrangement?

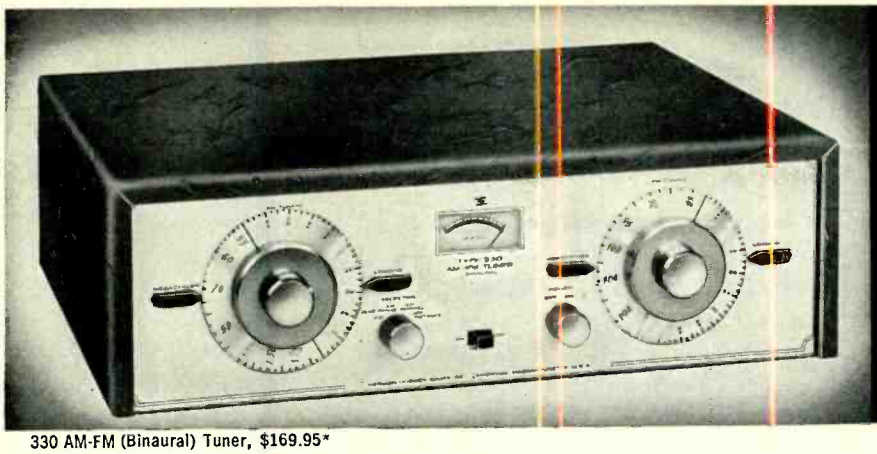
If the elements of the tube are loose, sound from the loudspeaker may cause the elements to vibrate. This variation of the spacing of the tube elements causes the plate current to be modulated and results in a howl in the loudspeaker. Shock mounting of the tube base, and the use of sponge rubber or other sound absorbing material around the tube envelope, isolates the tube from sound waves and other vibrations. In addition, the tube should be a selected, low-microphonic type.

What is the purpose of a record compensator?

A record compensator is a circuit which boosts the low frequencies and de-emphasizes the highs. This is necessary because the low frequencies are attenuated and the high frequencies are boosted during recording. Low-frequency attenuation is required to prevent the cutting stylus from swinging too far and cutting into adjacent grooves on the record, and high frequency pre-emphasis is used to improve the signal-to-noise ratio. Because of lack of standardization and agreement among recording companies, different degrees of compensation are required for records manufactured by different companies. For this reason, record compensators are provided with a switching arrangement to substitute part values and permit compensation for records issued under various domestic and foreign labels.

What is meant by the term "transient distortion" when applied to loudspeakers?

When a signal is suddenly applied to the voice coil of a loudspeaker, the cone does not instantly vibrate at the frequency of the applied signal. Further, when the signal is suddenly removed, the cone may continue to vibrate (like a tuning fork) for a length of time. As a result of these characteristics, the reproduced sound differs from the original, and this difference is referred to as transient distortion. The inability of the cone to stop vibrating as soon as the applied signal is removed is known as acoustic hangover, and causes each note to persist and merge with the next. This blurring of the sounds robs the reproduction of its clear and crisp qualities. —30—



Sensational New Advance in AM-FM Tuners

by h.h. Scott

330 AM-FM (Binaural) Tuner, $169.95*

ONLY really wide-range AM, plus super-selective FM

■ Now you can receive the full 10 kc frequency range broadcast by the better AM stations. Entirely new IF and detector circuits make this possible for the first time.

■ New AM detector insures distortionless reception even if stations modulate to 100%. Conventional detectors give distorted AM above moderate modulation percentages.

■ Three-position IF-bandwidth switch for perfect AM reception under any signal conditions.

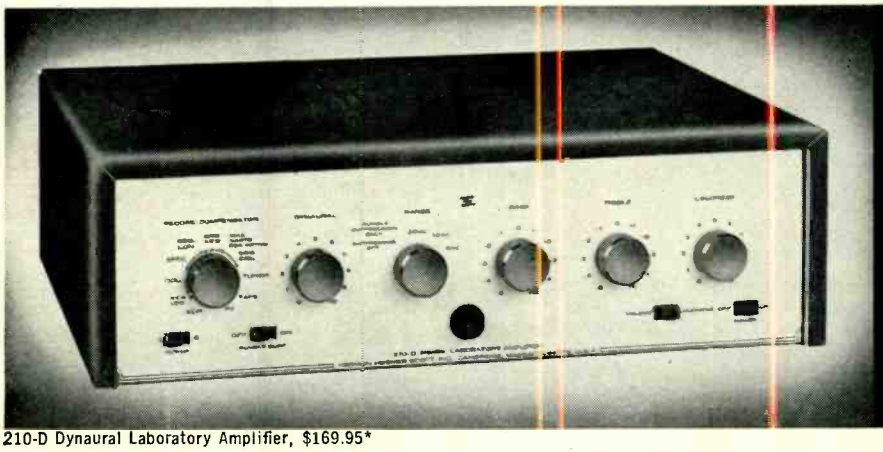
■ New wide-band FM design gives super-selectivity to let you separate stations so close together you would ordinarily pass right over them.

■ Wide-band design insures drift-free reception.

TECHNICAL SPECIFICATIONS

FM Section: 3 mv. sensitivity for 20 db quieting — 2-megacycle wideband detector — 80 db rejection of spurious cross-modulation response by strong local signals — automatic gain control — equipped for multiplex. AM Section: 1 mv. sensitivity — 10 kc whistle filter — extended frequency response to 10 kc — ferriloopstick antenna — output jacks for binaural — beautiful accessory case $9.95*

*Slightly higher west of Rockies.



by h.h. Scott

Most Complete Amplifier Made

Full 30 Watts

210-D Dynaural Laboratory Amplifier, $169.95*

Includes famous DNS – makes worn records sound new again

■ Complete professional equalizer-preamplifier with magnificent new 30-watt power amplifier.

■ Amazing, patented DNS (dynamic noise suppressor) eliminates record noise and rumble, but *without* losing audible music as fixed filters do.

■ Seven-position record compensator exactly equalizes practically any record made.

■ Unique features for tape-recording, with three special inputs for recording and monitoring.

■ Special provision for playback of pre-recorded tape through your 210-D.

■ Continuously variable speaker damping control.

TECHNICAL SPECIFICATIONS

Input selector for 3 high-level inputs, 2 low-level phono (magnetic), and one high-level phono (constant amplitude) — NARTB tape playback curve — frequency response flat from 19 cps to 35,000 cps — adjustable record-distortion filter — harmonic distortion less than 0.5% — first-order difference-tone intermodulation less than 0.25% — beautiful accessory case $9.95*

*Slightly higher west of Rockies.

Write for FREE BOOKLET giving complete details on entire H. H. Scott line.

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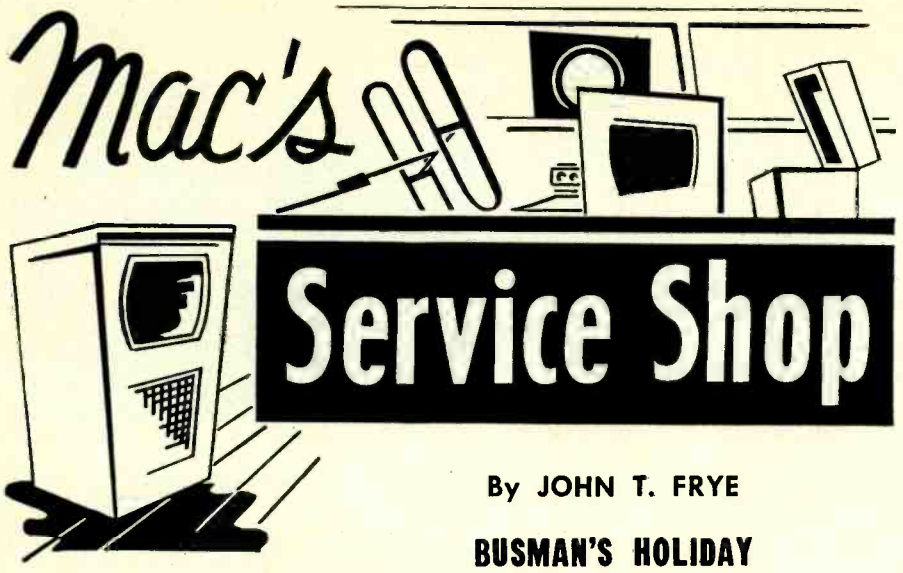


By JOHN T. FRYE

BUSMAN'S HOLIDAY

BARNEY stepped out of the picture show into a cloudy, chilly, November Sunday afternoon; but he felt good—*real* good, he told himself. Margie, his One and Only, had callously forsaken him this weekend to visit a girl friend at the state college; and he had just evened the score by seeing a picture starring Marilyn Monroe, whom Margie disparagingly called "that woman" and whose name she would scarcely let Barney mention, yet whose pictures she somehow never missed. And, he recalled with deep satisfaction, when the blonde star first slithered across the screen, *his* wolf whistle had topped the whole chorus. That would teach Margie to leave him all alone!

As he was passing Mac's Service Shop he noticed a light back in the repair department, and then he saw Mac, his employer, standing at the service bench and beckoning him to come in.

"Hey, Boss, don't you get enough of this sweat-shop during the week?" Barney wanted to know as he let himself inside with his key.

"Guess not," Mac admitted with a slow grin. "The wife is visiting her sister up in Chicago today, and I felt rather at loose ends. Finally I decided to come down here and do a little playing with the equipment with which we have to work all week long; and you know something? I'm getting a big kick out of it. Takes me back to when I was getting started in radio when I hardly had time to sleep or eat because I was so interested in experimenting. I had almost forgotten how much fun it is to work calmly, leisurely, and without interruption with good test equipment purely for the joy of seeing what you can do with it."

"Just exactly what have you been doing?" Barney pressed.

"For one thing I've been checking out the new wide-band scope we got a couple of weeks ago and which I have not had time to test."

"What do you mean 'checking it out'? All you have to do is read the spec sheet and you know what it will do."

"Maybe I'm a mean suspicious nature, but I'm not that trusting. I have to put an instrument through a whole series of stiff tests and be thoroughly familiar with what it can and cannot do before I am willing to let it take its place with our other trusted test instruments and be content to rely on what it tells me."

"What kind of tests did you make on the scope?"

"First I checked the sensitivity and the accuracy of the stepped attenuator. With a 1000 cycle signal from the audio generator and with the a.c. v.t.v.m. right across the vertical input terminals, I adjusted the output of the generator until I had exactly one inch of vertical deflection on the screen and then I saw that .024 volt r.m.s. was present across the input terminals. This meant the sensitivity was one millivolt better than the 25 millivolts-per-inch claimed. Next I set the stepped attenuator to the X10 position and increased the input voltage to .24 volt. The trace was still one inch high. Setting the attenuator to the X100 position and increasing the generator output to 2.4 volts produced the same one inch of deflection; so the stepped attenuator was proved very accurate. A similar sensitivity test of the horizontal amplifier established that this, too, was slightly better than its rating."

"What else did you test?"

"Well, next I decided to check the vertical amplifier for linearity. To do this I set the step attenuator to the X10 position and adjusted the fine attenuator so that exactly one volt from the signal generator produced one inch of deflection on the screen. Then I increased the generator output to one and one-half volts and noted the trace increased to one and one-half inches. Two volts produced a two-inch trace; two and a half volts came very close to producing a two-and-a-half-inch trace; *but* three volts produced a trace only 2.6 inches long; and four volts extended the trace just barely beyond three inches."

"How come?"

"The positive peaks are being shortened by the clipping action of one or more of the amplifier tubes. If you merely observe a sine wave and keep increasing the trace until flattening of the positive peaks is evident, you might think the amplifier was linear up to about four inches of deflection, for it is pretty hard to see the slight flattening of the peak curve; but with this other test you can clearly see that the linearity of the amplifier falls off rapidly as it is required to produce a deflection trace more than two and a half inches in height."

"That's pretty bad, isn't it?"

"Not as long as you remember the limitation is there. A two-and-a-half-inch-high trace is plenty large enough for easy viewing, and really serious waveform distortion will not be present if the trace goes up to three or three and a half inches. However, when you are using the step attenuator and the calibrated peak-to-peak voltages furnished by the scope to measure peak-to-peak voltages of waveforms, you should arrange so the trace being measured does not exceed two inches in height for maximum accuracy."

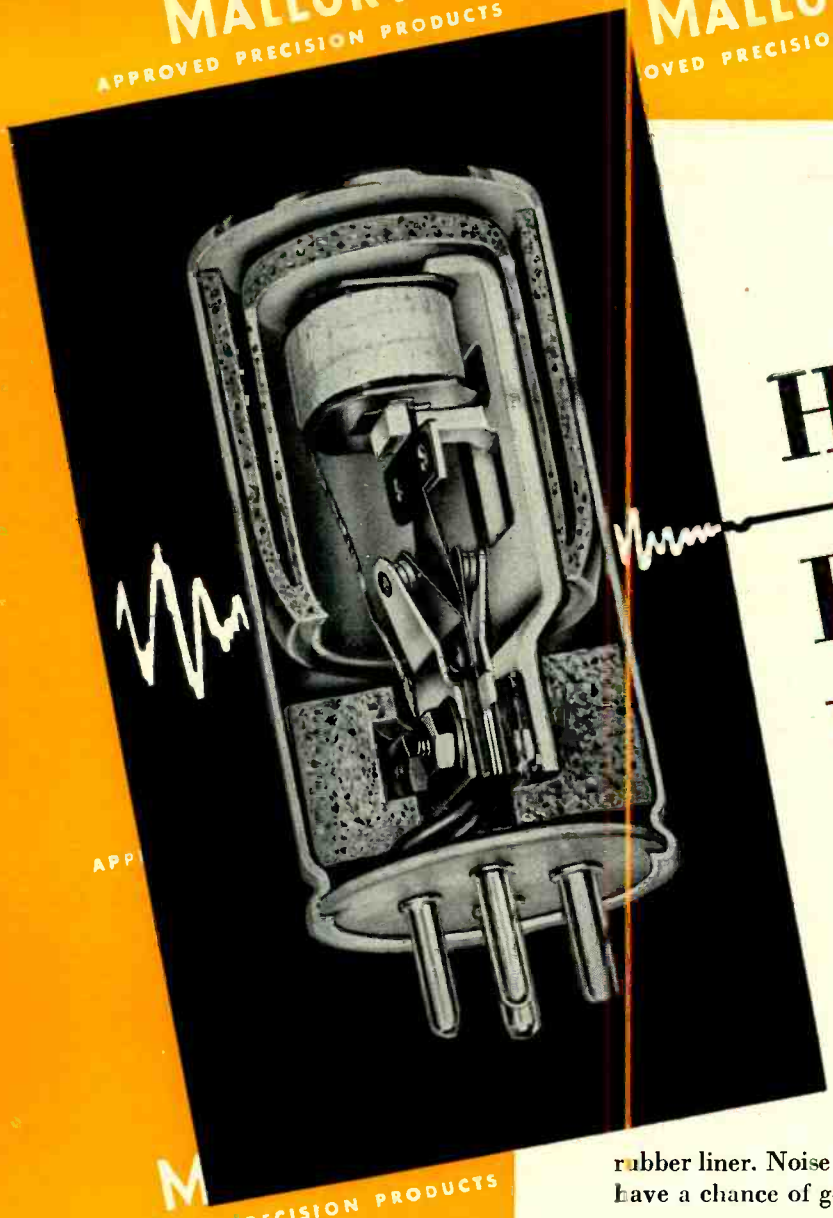
"Maybe something's wrong with the scope."

"I thought of that, too, but when I read in the instruction book that positive peak flattening was to be expected at around four inches of deflection, I gave up the idea. You see the design of a highly-sensitive, broadband, linear amplifier is no easy job, for improving any one of these features is almost certain to degrade one or both of the other two. As a consequence, scope amplifiers are always a compromise. In order to extend this one to five megacycles and beyond in bandwidth while retaining the high 25 millivolts-per-inch sensitivity, it was necessary to restrict the maximum linear deflection. This is very commonly the case. Some broadband scopes have a mask to insure that a waveform being observed is kept within prescribed vertical limits. Other scope manufacturers simply mention that linear vertical deflection cannot be expected beyond stated limits."

"How did you check the bandwidth?"

"Two ways: first I passed square waves of various frequencies through the vertical amplifier and observed the waveforms for tilt, overshoot, rounded corners, etc., in accordance with standard square-wave testing procedures. The amplifier looked mighty good with these tests, but our square-wave generator does not go high enough in frequency to provide a really severe test of the extended high frequency limit of the scope amplifier in this fashion; so I next ran the r.f. signal generator into the vertical input with the peak-to-peak probe of the v.t.v.m. being used to measure the voltage delivered to the input terminals. While this input was held at a constant value with the attenuator of the signal generator, I varied the fre-

(*Continued on page* 128)



HUM HUSHING DESIGN

makes Mallory's "25th Anniversary" model the quietest vibrator ever

TAKE a look inside the Mallory 25th Anniversary Vibrator*—and you'll see why it's so free of mechanical hum. The vibrator mechanism "floats" in a bell-shaped rubber liner. Noise produced by the vibrating element just doesn't have a chance of getting to the case or mounting plug.

That's not all. The rubber cup at the plug end also "floats" in place . . . never touches the can at more than one point. Even the leads are designed to minimize transmitted noise.

The net result is the quietest-running vibrator you've ever seen . . . or heard. Its mechanical hum is actually less than the electrical noise emitted by the speakers of most auto radio sets. And it costs no more than previous Mallory models.

On every vibrator replacement job, treat your customers to the quietest performance on the market. Check your stock today . . . and call your local Mallory distributor for quick delivery.

*Pat. Pending

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MALLORY
CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES
APPROVED PRECISION PRODUCTS
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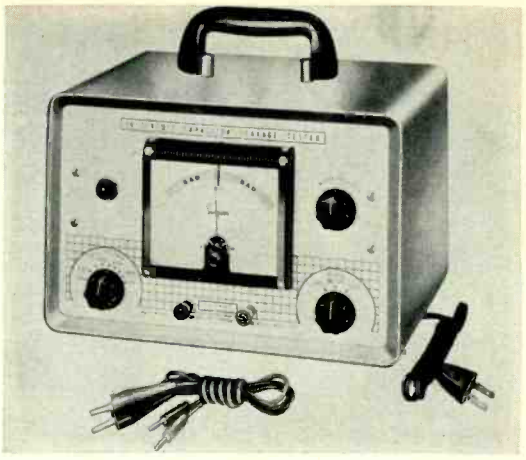
A NEW IN-CIRCUIT CAPACITOR LEAKAGE TESTER



A recent discovery about capacitor leakage resistance is the basis for the Simpson model 383 capacitor tester.

CAPACITOR leakage resistance is different from other types of resistance. The former is unstable, *i.e.*, it can be made to change its value by subjecting it to a pulse of voltage. This principle is used in the new *Simpson Electric Company* model 383 capacitor leakage tester to detect deteriorating capacitors without disconnecting them from the circuit. The tester will detect a leaky capacitor even when it is shunted by a low value of circuit resistance.

Fig. 1 is the schematic diagram of the in-circuit capacitor leakage tester. The type 2050 tube is a thyratron in which the control-grid bias determines the point at which the tube will fire, and the actual firing is effected by the plate voltage. When the function switch (comprised of three sections ganged together) is in the "test" position, high voltage is fed to the plate of the thyratron. This voltage builds up to the firing potential at which time the thyratron fires, sending a large pulse of voltage across the 600 ohm resistor in its plate circuit and into the test circuit.

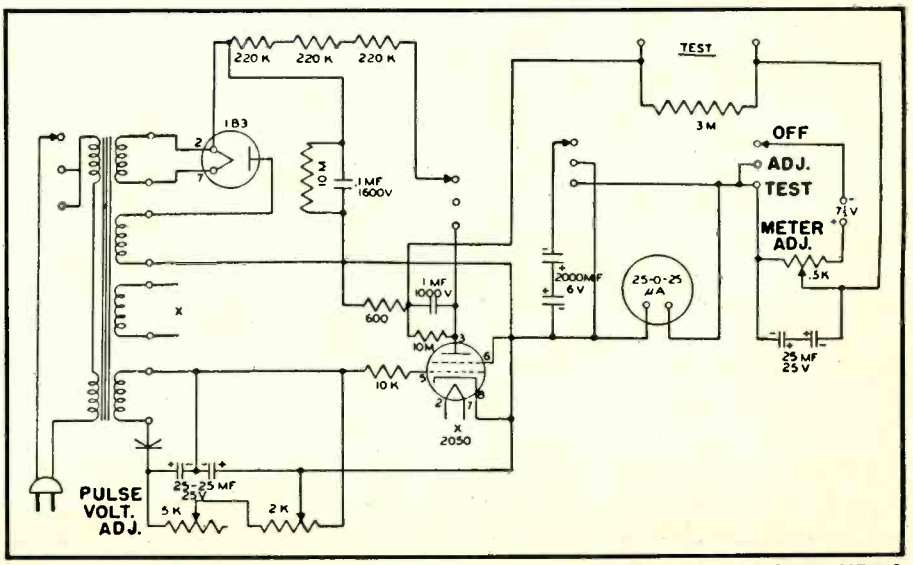
The meter is protected by the two bypass capacitors which also integrate the pulse to obtain a faster rise time. This pulse is then applied across the capacitor under test. Since the leakage resistance of a defective capacitor varies with the voltage across the capacitor, the meter will indicate a varying resistance in the external circuit.

In the "meter adjust" position, the meter is adjusted to the static characteristics of the circuit *via* an internal battery voltage.

Although this instrument is designed to check paper, mica, and ceramic capacitors ranging from 1 $\mu\mu$fd. to .25 μfd., it can also detect intermittent resistors, transformer leakage from winding to core, and similar effects. This instrument will not check electrolytic capacitors, nor will it give a positive leakage indication when the unit under test is shunted by a coil.

When testing parallel or series networks of capacitors mixed with resistors, the amount of meter deflection across each capacitor will tell whether it is good or bad. —30—

Fig. 1. Schematic diagram of the Simpson model 383 in-circuit capacitance tester.



Heathkits

FOR THE ENTIRE ELECTRONICS INDUSTRY

AMATEUR RADIO

RADIO & TV SERVICEMEN

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

INDUSTRIAL LABORATORIES

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more than 65 top-quality models to choose from, including such outstanding kit designs as . . . . .

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

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

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

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

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

Greatest Dollar Value Through Factory-To-You Selling!

ONLY Heathkits CAN GIVE YOU ALL OF THESE DISTINCTIVE ADVANTAGES!

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

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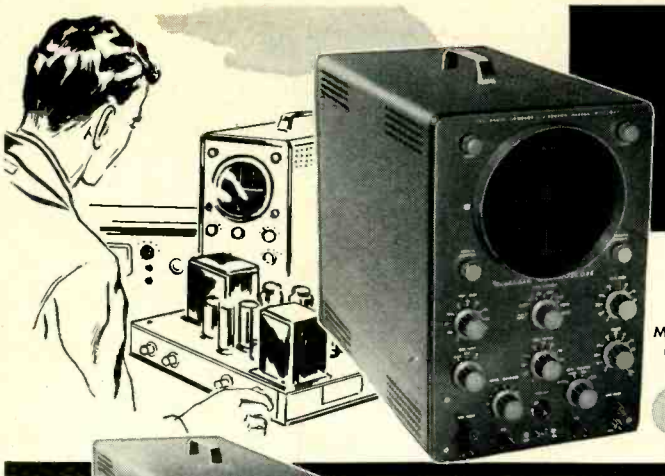
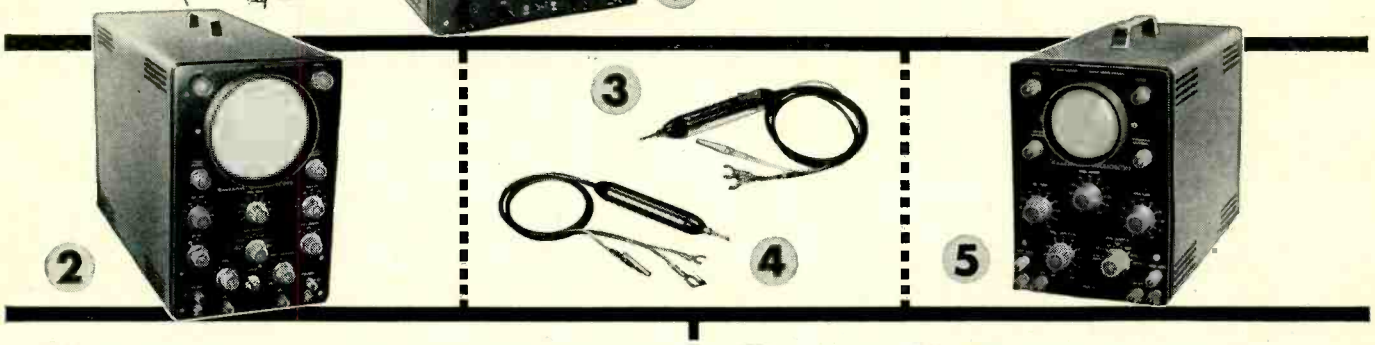


there is no substitute for

HEATHKIT QUALITY

MODEL O-10

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



1 Heathkit ETCHED CIRCUIT COLOR-TV 5" OSCILLOSCOPE KIT

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

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

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

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

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

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

2 Heathkit ETCHED CIRCUIT 5" OSCILLOSCOPE KIT

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

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

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

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

3 Heathkit LOW CAPACITY PROBE KIT

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

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

4 Heathkit ETCHED CIRCUIT SCOPE DEMODULATOR PROBE KIT

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

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

5 Heathkit ETCHED CIRCUIT 3" OSCILLOSCOPE KIT

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

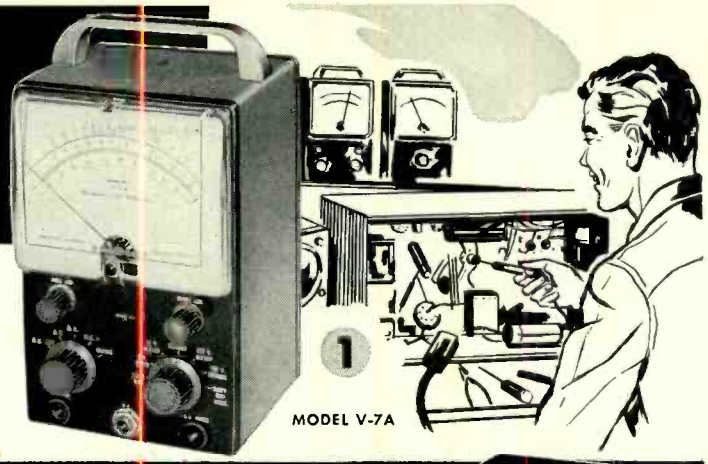
Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring,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

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

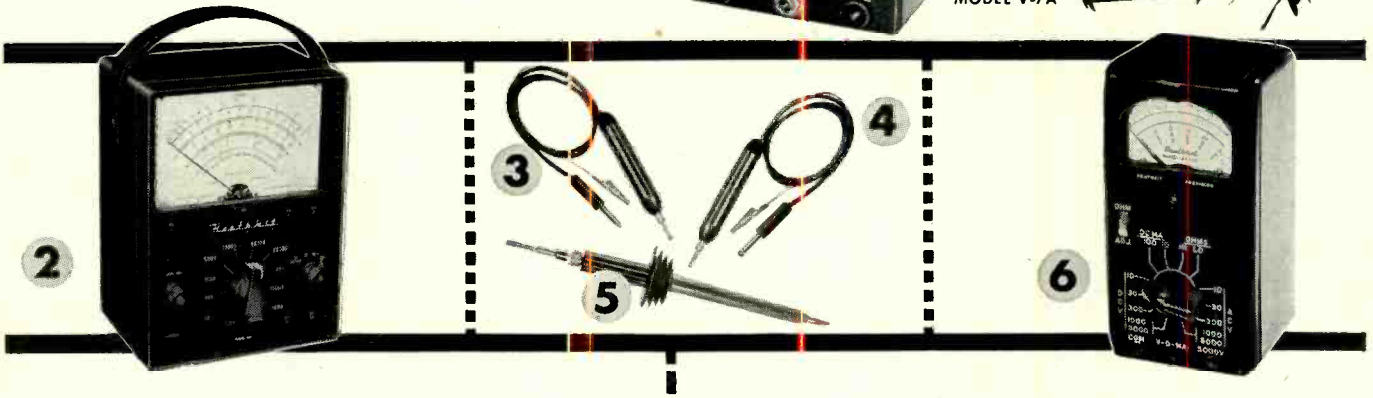
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

fill your test requirements

WITH HEATHKITS



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



1 *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

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

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

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

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

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

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

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

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

3 *Heathkit* ETCHED CIRCUIT RF PROBE KIT

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

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

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

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

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

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

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

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

6 *Heathkit* HANDITESTER KIT

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

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

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

Heathkit
TV ALIGNMENT
GENERATOR KIT

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

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

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

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

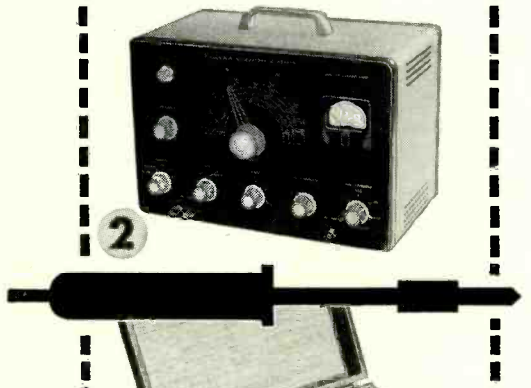
1

Heathkit LINEARITY PATTERN
GENERATOR KIT

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

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

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



2

Heathkit LABORATORY
GENERATOR KIT

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

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

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

3

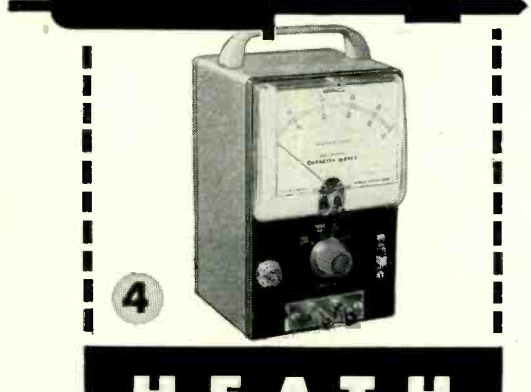
Heathkit CATHODE RAY
TUBE CHECKER KIT

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

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

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

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



4

Heathkit DIRECT READING
CAPACITY METER KIT

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

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

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

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

Heathkit SIGNAL GENERATOR KIT

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

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

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

1 Heathkit . . . IMPEDANCE BRIDGE KIT

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

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

MODEL IB-2 **$59.50**
Shpg. Wt. 12 Lbs.

2 Heathkit "Q" METER KIT

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

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

3 Heathkit 6–12 VOLT BATTERY ELIMINATOR KIT

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

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

4 Heathkit DECADE RESISTANCE KIT

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

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

5 Heathkit VIBRATOR TESTER KIT

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

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

6 Heathkit DECADE CONDENSER KIT

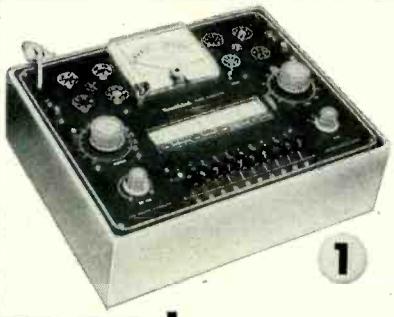
Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

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

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

Heathkit TUBE CHECKER KIT



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

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

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

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

2 Heathkit **PORTABLE TUBE CHECKER KIT**

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

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

3 Heathkit **TV PICTURE TUBE TEST ADAPTER**

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

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

4 Heathkit . . .

CONDENSER CHECKER KIT

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

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

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

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

5 Heathkit **VISUAL-AURAL**

SIGNAL TRACER KIT

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

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

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

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC

BENTON HARBOR 15, MICHIGAN

MODEL HD-1

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

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

Heathkit HARMONIC DISTORTION METER KIT

1 Heathkit AUDIO ANALYZER KIT

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

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

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

2 Heathkit AUDIO GENERATOR KIT

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

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

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

3 Heathkit AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

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

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

4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

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

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

5 Heathkit AC VACUUM TUBE VOLTMETER KIT...

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

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

6 Heathkit CONDENSER SUBSTITUTION BOX KIT...

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

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

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost

MODEL DX-100

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

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

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

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

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

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

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

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

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

2 *Heathkit* VFO KIT

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

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

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

3 *Heathkit* CW AMATEUR TRANSMITTER KIT

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

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

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

4 *Heathkit* . . . ANTENNA COUPLER KIT

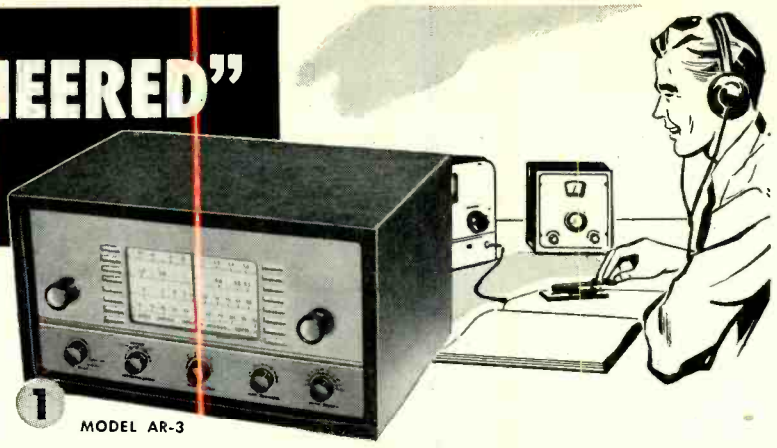
The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality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

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

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

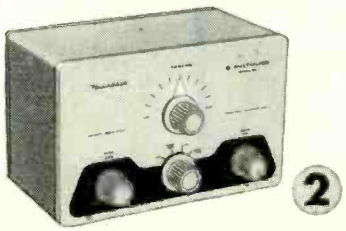
"AMATEUR-ENGINEERED"

Equipment For The Ham



MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*

1 MODEL AR-3



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1 Heathkit COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

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

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

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

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

2 Heathkit "Q" MULTIPLIER KIT

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

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

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

3 Heathkit VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

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

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

4 Heathkit ANTENNA IMPEDANCE METER KIT

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

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

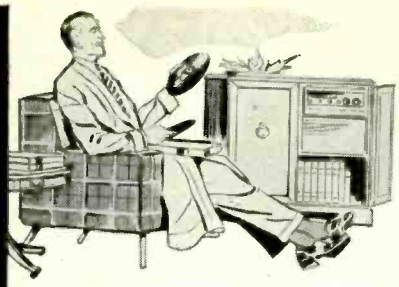
5 Heathkit GRID DIP METER KIT

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

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

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

Heathkits
PROVIDE THE "CONSTRUCTIVE" APPROACH TO HIGH-FIDELITY



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

1 Heathkit ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

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

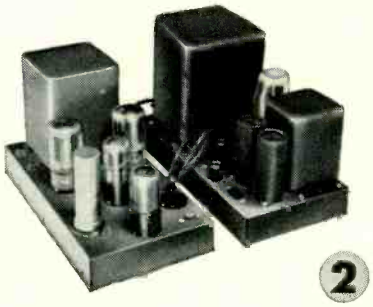
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics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

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

KIT COMBINATIONS:

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

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



2 Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

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

KIT COMBINATIONS:

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

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

3 Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

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

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

KIT COMBINATIONS:

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

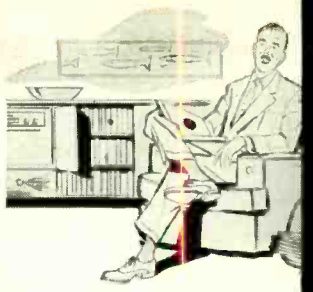
W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

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



enjoy....

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

HEATHKITS

1 *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

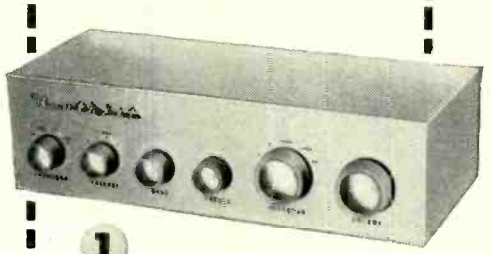
This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

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

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

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

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



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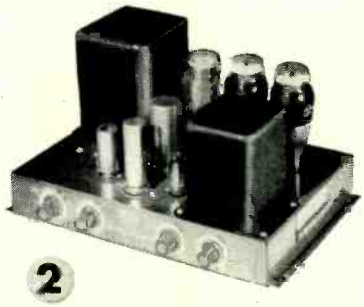
2 *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

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

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

MODEL A-9B
$35.50
Shpg. Wt. 25 Lbs.



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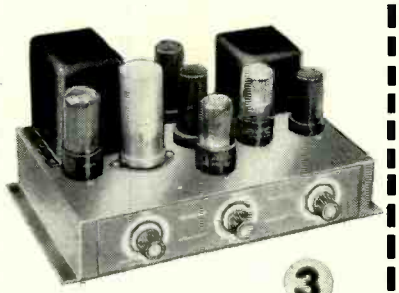
3 *Heathkit* 7-WATT AMPLIFIER KIT

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

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

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

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



3

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

MODEL FM-3

Shpg. Wt. 7 lbs.

$24.50 (with cabinet)

Brand New HEATHKIT HIGH-FIDELITY FM TUNER KIT

Features

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

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

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

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

HEATHKIT BROADCAST-BAND RECEIVER KIT

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

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

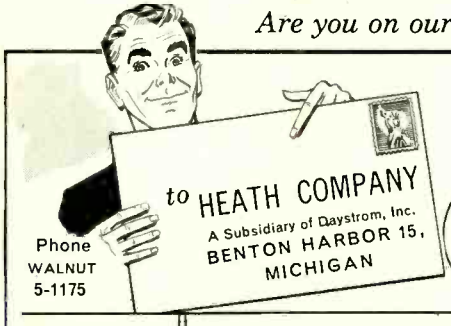
CABINET: Fabric covered plywood cabinet with aluminum panel as shown. Part 91-9, Shpg. Wt. 5 lbs., $4.50.

MODEL BR-2

$17.50 *Less Cabinet*

Shpg. Wt. 10 lbs.

Are you on our mailing list? If not—how about sending us your name?



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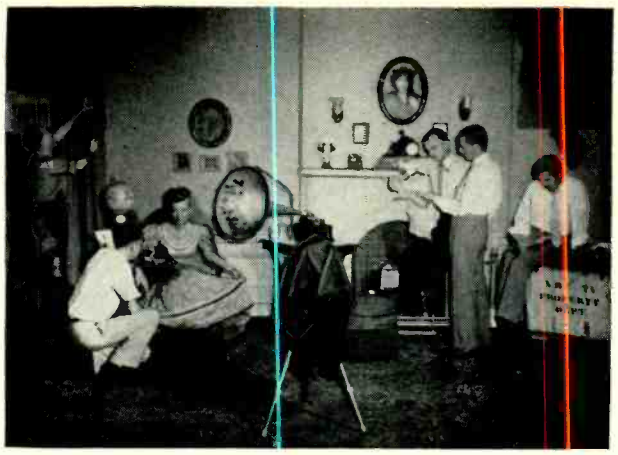


OUR COVER

Each "prop" is carefully checked for authenticity prior to shooting the photograph.

All of the care lavished on a TV stage set is taken in setting up this month's cover photo.

THE cover of this issue of RADIO & TELEVISION NEWS will be of small help to any reader who has wondered whether magazine covers are made—or born. But its effect of simple charm certainly belies the immensity of the production effort that went into it.

To Editor Oliver Read, who directed that production, it was marked by the skill and coordination of able men at work.

He wanted a setting that would picture, at a glance, the long road hi-fi has traveled since the voice was first reproduced. What better than a parlor of the 1890's adorned by an *Edison* phonograph as its central feature. But where was such a setting to be had?

First step: A phone call to Mr. Eiges, *NBC* vice-president for press relations. Mr. Eiges said he would look into the possibilities. Promptly, a call came back from Sid Desfor, manager of the photo unit, *NBC* press department.

"What do you need?" he asked.

He was told of the need.

"Well," he said, "*NBC* breaks up its sets after every show, but they might build one."

He'd call back. He did, and got answers to his questions on the period, the exact year, and the requisite furnishings. It could be simply managed, he implied. He told us to come to *NBC's* warehouse in downtown Manhattan on July 19 and everything would be in shape, ready for photographing. A model, Miss Exine Jones, was engaged on the basis of her fitness to typify the period.

The R & TVN task-force was at the warehouse on the designated day and time along with the model and Read's *Edison* talking-machine from his personal collection, one of the country's foremost arrays of old phonographs restored to use.

On that cruelly hot July day, the scene at the warehouse astounded the visitors. They had expected to see a mere stage-setting. But first to greet them was designer George Bockman, who showed them a scale drawing he had made on his drafting board. It noted the smallest details, down to authentic daguerrotypes. The R & TVN delegation was now to meet, in turn, seventeen people concerned with the set, from vice-presidents to stagehands! They embraced a full crew of artists, designers, scenic painters, constructors, prop men, carpenters, electricians, and again, Mr. Desfor and his staff photographer, Jack Zwillinger, quietly and efficiently looking after a thousand details. It was a model of magnificent organization.

The picture making then proceeded. Each time the model's pose was changed at the photographer's direction, the entire crew moved into action, as if carefully rehearsed for weeks, moving lights, cameras, and props. Without hearing an order given, every man acted as part of a well-oiled machine.

When a designer called for six feet more of floor area, a man moved in with a bucket of colored calcimine and a huge brush and with a few giant swipes it was done. What's more, it was dry in two minutes. Another painter, looking askance at a wall mirror, gave the frame a fast coat of gold flake for authenticity. As the dramatic "production" proceeded, design plans and element charts were rechecked again and again.

Then the photographer wheeled his camera back for a shot of the crew at work—the picture of the picture, as it were. A dungareed stagehand stopped him.

"Can't you hold this up a half-hour or so," he asked, "till I shave and change to my tuxedo?"

When it was all over, Editor Read and his R & TVN assistants had the sensation that they had witnessed the tense drama of achieving the perfection demanded by one of *NBC's* top-rated network shows.

A postscript about the *Edison* phonograph on the cover. It, along with other items in Read's fabulous collection, was displayed at the RADIO & TELEVISION NEWS exhibit at the Audio Fair in New York.

For additional information on the evolution of the phonograph, see the article on page 58 of this issue. —30—

Servicing Tape Recorders

(*Continued from page 67*)

When the recordings contain considerable distortion, and the recorded sound level is low, an improper recording bias is often responsible. If a voltage check verifies that this is the case, a defect in the oscillator coil, tube, or associated circuit may be the cause. In tape recorders where a bias adjustment is provided, the adjustment should be checked whenever the output tube is changed.

Insufficient erase can result in distortion. Playing back an erased but unrecorded tape will help determine if this is the source of trouble.

When the sound coming from the tape machine varies regularly in pitch, the symptom is referred to as either "wow" or "flutter," depending on the rate of variation. A pitch variation that occurs approximately once every second is generally described as wow. A variation that occurs ten times or so per second is called flutter.

Wow and flutter are most obvious when piano or organ music, or slow passages of music, are being reproduced. Any trouble that causes the tape to pass the record or reproduce head at a varying speed may produce flutter or wow.

Some common causes of flutter and wow are as follows (remedies are suggested in parentheses): slipping of idler wheel, due to dirt or oil on the rubber drive (clean wheel); idler not turning freely on shaft (lubrication needed); flat spot on idler wheel (replace wheel); tight feed or take-up spindle, pressure roller, or flywheel shaft (lubricate); insufficient tension on a flywheel belt (increase tension); sludge deposits on heads, capstan shaft, or capstan pressure roller (clean). Many other troubles similar to those described can produce flutter and wow.

Sometimes, wow and flutter may be due to excessive tape curl, resulting from uneven tightness of wind. Such edge curl may prevent the tape from following an even path as it passes the heads. Portions of the tape are apt to flap in passing, causing wow or flutter.

Flutter meters are commercially available which reveal the presence (or absence) of excessive percentages of flutter and wow. See Fig. 1.

A loud buzz or hum may be caused by a partial short to chassis in a motor bypass capacitor. Improper setting of a hum balance control may be responsible for excessive hum, as may cathode-to-heater leakage in a tube—particularly the one used in the first stage, or a defective ground connection. Loss of capacitance in a filter capacitor will, of course, produce marked hum. Reversing the line plug will reduce the hum level in many instances where a slight but objectionable hum is audible.

Mechanical Trouble

Clutches are used in many tape recorders to keep the tape tension constant (see Fig. 4). When a clutch becomes too tight, or is damaged, the tape may move too slowly or quickly. When an idler spring becomes unhooked or breaks, there will be no drive on, say, "record," if the idler in question affects this function.

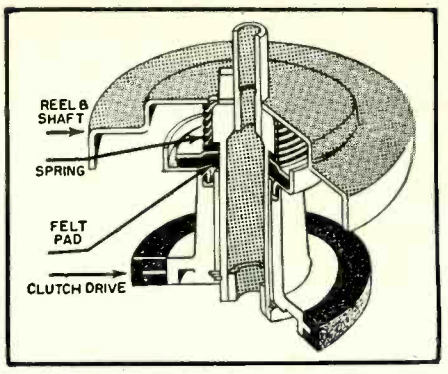


Fig. 4. Slip clutch system used in many tape recorders to keep the tape under proper tension and prevent slack or stretch.

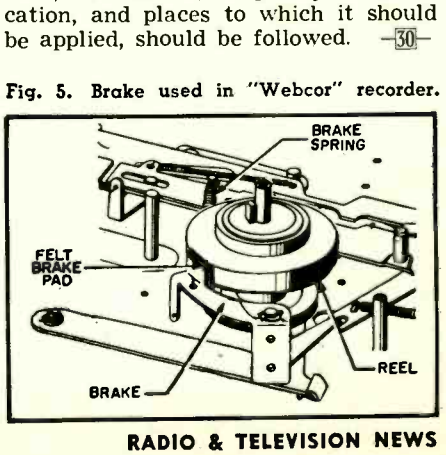
Tape spilling may, in some machines, be due to defective or disengaged brake springs, or worn felt pads on brakes (see Fig. 5). An almost infinite variety of similar mechanical troubles is possible. Any mechanically-minded technician who has a fair smattering of the theory of tape transport operation should have no trouble in tracking down such troubles, particularly when a service manual covering the machine being serviced is available.

The coating material on the tape tends to form oxide deposits on the heads which must be removed periodically. Failure to remove deposits, or dirt, may cause poor frequency response, incomplete erase, lowered signal-to-noise ratio and other troubles. A pipe cleaner dipped sparingly in carbon tetrachloride is often used to clean the heads. Care should be taken to let the heads dry before tape is passed over them, since the tape base is soluble in carbon tetrachloride.

Metal parts of the machine may be cleaned with a soft dry rag. The rag may be moistened with a few drops of carbon tetrachloride, if it can't do an efficient job otherwise. Rubber surfaces should be cleaned with soap and water only, then thoroughly dried.

The manufacturer's recommendations regarding the lubricant to be used, its amount, frequency of application, and places to which it should be applied, should be followed. —30—

Fig. 5. Brake used in "Webcor" recorder.



THE *fluxvalve* PICKUP

the first really new pickup in a decade

The FLUXVALVE is made by perfectionists — for perfectionists. Literally the cartridge of the future, its unique design meets the demands of all presently envisioned recording developments, *including those utilizing less than 1 mil styli.*

There is absolutely nothing like it!

The FLUXVALVE *Turnover Pickup provides the first flat frequency response beyond 20kc!* Flat response assures undistorted high frequency reproduction—and new records retain their top "sheen" indefinitely, exhibiting no increase in noise. . . . *Even a perfect sylus can't prevent a pickup with poor frequency characteristics from permanently damaging your "wide range" recordings.*

With this revolutionary new pickup, tracking distortion, record and stylus wear are reduced to new low levels. The FLUXVALVE will last a lifetime! It is hermetically sealed, virtually impervious to humidity, shock and wear . . with no internal moving parts.

The FLUXVALVE *has easily replaceable styli. The styli for standard and microgroove record-playing, can be inserted or removed without use of tools.*

For a new listening experience, ask your dealer to demonstrate the new FLUXVALVE ...words cannot describe the difference...but you will hear it!

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New Hi-Fi-Audio Equipment

As a special service to our readers this month, we are including a "Reader Service Coupon." If additional information on any of the products described in this department is desired, simply check off the corresponding number in the coupon below and mail it direct to: RADIO & TELEVISION NEWS, Room 1010, 366 Madison Ave., New York 17, N. Y.

NEW 12-WATT AMPLIFIER

Allied Radio Corporation has released a newly restyled version of its "Knight Bantam" 12-watt amplifier.

Housed in a metal cabinet with cork-grain finish, the new amplifier is a perfectly matched companion for the company's "Bantam" FM-AM tuner or other basic tuner.

Ready for use on table top, mantel, or bookshelf, the "Bantam" can also be installed behind panels without removal from its metal cabinet. It measures only 3½" x 13" x 10½". There is a 3.3 megohm input for ceramic phono cartridges, a level control on the tuner input, and a variable damping control plus the other features incorporated in the predecessor model. 100

"MUSIC LOVERS" CARTRIDGE

A new cartridge which is said to eliminate the problem of induced hum, cartridge drag caused by magnetic attraction to steel turntables, etc. has been announced by *Shure Brothers* as its "Music Lovers" cartridge.

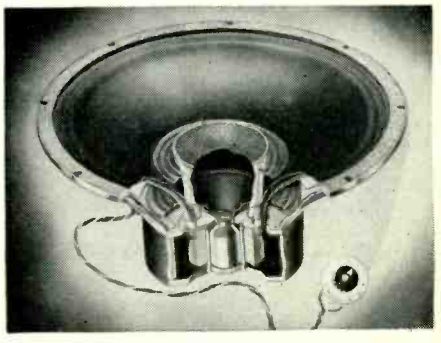
The definition is such that it will reproduce all instruments sharply and clearly yet there is a subtle softness that reproduces the original voice and music with a naturalness that is sought by hi-fi fans.

The cartridge features a "twin-lever" needle shift transport which eliminates cumbersome turnover mechanisms. It provides a lower mass and individual needle compliance for 78, 33⅓, and 45 rpm response. Needle replacement is accomplished in seconds without need for tools. 101

15" COAXIAL SPEAKER

Stromberg-Carlson, a division of *General Dynamics Corporation,* has come out with a new 15" coaxial loudspeaker which will reproduce the full audio range from 30 to 20,000 cps without distortion.

The performance of the speaker and its low cost are attributed to a new concept of speaker construction wherein a ¾" aluminum "voice ring" replaces the conventional voice coil and voice coil leads in the tweeter. The voice ring is attached to the apex of the high-frequency diaphragm and has



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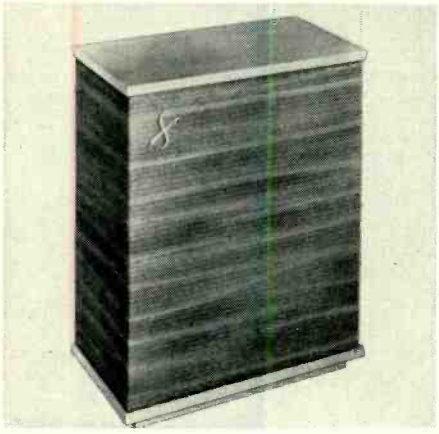
no mechanical connection to the speaker circuits.

The RF-465 speaker will handle 35 watts throughout the entire frequency range and the angle of coverage exceeds 90 degrees. 102

3-WAY SPEAKER SYSTEM

Sherwood Electronic Laboratories, Inc. has announced the availability of



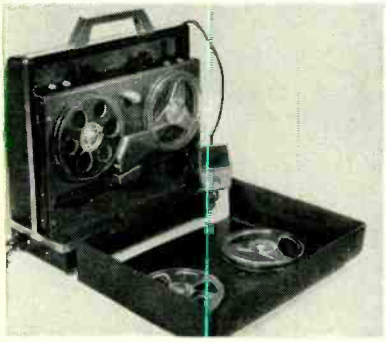
a new low-distortion, 3-way speaker system with a 5½ cubic foot, curled-horn cabinet.

Designated as the "Forester," the new unit is based on the principle of complete acoustical and electrical isolation of each of three specially-designed speakers (12", 8", and 5") for covering the audio range with only .6% IM distortion at 10 watts.

The individual speakers and the 300-5000 cps, 12 db/octave electrical crossover are available in kit or assembled form. The cabinets are offered in blonde contemporary, mahogany traditional with gold-tooled leatherette top, and in French Provincial styles. 103

PORTABLE TAPE RECORDER

Especially designed for vacationers, doctors, lawyers, clergymen, teachers, students, etc. is the new "Melatone" portable tape recorder recently introduced by *Raytronic Laboratories, Inc.* Housed in a lightweight (14 lb., 12 oz.) case which resembles a piece of luggage, the new recorder features a single knob control for rewind, fast forward, or playback with full stop and three positions. A side jack is available for connecting an external speak-



er the unit may be used as a p.a. system, if desired. The recorder can be operated in either open or closed positions and comes equipped with a microphone with long cord, and a spare

5" pickup reel. It will record at either 3¾ or 7½ ips as desired. 104

"MAGNETIC NOISERASER"

A device which operates through a carefully-engineering magnetic circuit and eliminates all signals and background noise on tapes has been introduced by *Minnesota Electronics Corporation* as its "Magnetic Noiseraser."

Said to restore tape to a completely erased condition, the new unit permits indefinite useful tape life with a minimum of background noise. It also conditions new tape and increases dynamic range. Operation of the device is simple as it merely involves placing the entire reel on a spindle. A switch is turned on and the reel is slowly rotated manually through slightly more than one complete revolution. The spindle is then removed, the reel slowly drawn off the top surface of the instrument and then the switch is turned off. The entire operation takes approximately 15 seconds. 105

BOGEN SOUND EQUIPMENT

A new catalogue of public address amplifiers, sound systems, and sound accessories is now being offered by *The David Bogen Co. Inc.* as its Catalogue PA555.

The publication lists complete characteristics for the new "J" series of p.a. amplifiers and lists complete sound systems for permanent installations, both indoors and out, as well as portable systems.

Listed accessories include microphones, stands, cone speakers, trumpet speakers, wall baffles, line-to-speaker matching transformers, recessed baffles, rack mountings, and vibration isolating bases. Also included are portable phonograph units, transcription players, industrial high-power paging systems, and a music-instrument amplifier. 106

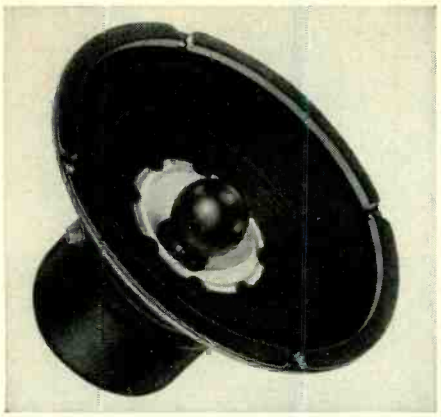
"PANASONIC" SPEAKER

R. I. Mendels, Inc. is handling the distribution of the new "Panasonic" Model 8P-W1, 8" speaker which has recently been introduced to the trade.

The new speaker provides a frequency response of 40 to 16,000 cps and features a patented phase equalizing globe for better high-frequency response, a patented elliptical corrugation of the cone to eliminate standing waves, and a cone with a super-compliant edge for exceptional low-frequency response.

The Model 8P-W1 has separate tweeter and woofer cones, coaxially mounted with a mechanical crossover.

The paper used in the cones is made by an exclusive method of pulp beating



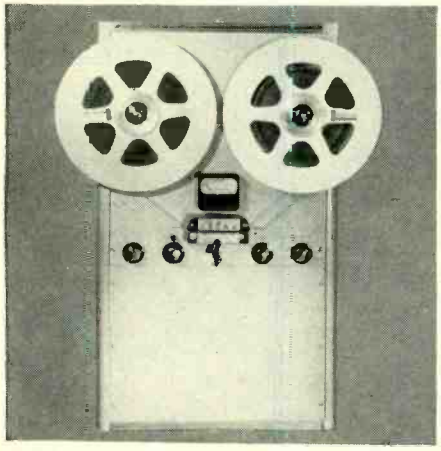
and screening which develops optimum characteristics for use in speaker diaphragms. The woofer is made by applying different degrees of molding pressure so that different parts of the diaphragm have different mechanical resistances. 107

"CROWN LP" RECORDER

A new professional-type tape recorder has been introduced by *International Radio & Electronics Corporation* as the "Crown LP."

The company claims that this unit is the only 3-speed recorder and playback unit now on the market which uses 14" reels. The recorder incorporates a built-in amplifier and has 30 watts peak output. The 15 watt peak has less than 1% distortion. Outputs of 4, 8, and 16 ohms are available.

The "Crown LP" is designed for rack mounting and has a 19" x 21" panel. It meets all NARTB standards and has electromagnetic brakes for positive action and smooth stops. It will han-



dle, 15, 7½, and 3¾ ips tapes (NARTB equalized) and 1⅞ ips tapes by means of a special speed reducer. 108

THE "ERICORDER"

The Ericsson Corporation is now marketing a push-button controlled tape recorder under the tradename "Ericorder".

Frequency response of the unit is from 40 to 15,000 cps. The wow is less than .1 per-cent. Tape speed is 7½ and 3¾ ips and the unit records as a dual-channel instrument. At high speeds the recorder will handle 45 min-

utes of program material per channel while at low speed up to 1½ hours of material can be handled on each channel.

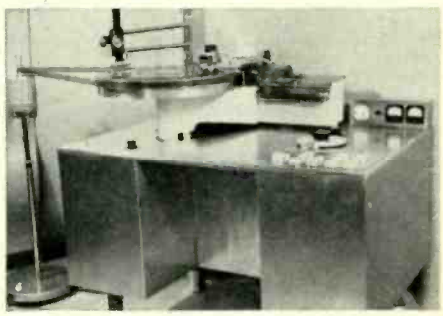
The "Ericorder" is currently available in a cabinet (the KTB 202) or as a chassis (the KTB 201) model. In chassis form, no speaker or amplifier is included. 109

MASTER RECORDING LATHE

Components Corporation has recently delivered the first of its new "Hydrofeed" precision master recording lathes to *Olmsted Sound Recording Studios.*

The new lathe incorporates a hydraulic feed system on the carriage instead of the usual lead screw, thus reducing residual rumble to less than 70 db down from a standard level of 7 cm/sec. at 1000 cps. Unlike conventional lead screw carriage drive systems, there is no appreciable wear with use and consequent increase in residual rumble.

With the "Hydrofeed" system pitch can be altered with ease. Automatic



anticipatory memory-controlled valves have been developed and actual masters have been cut and processed with a pitch of 420 lines per inch. 110

REPLACEMENT CARTRIDGE

Shure Brothers new "Twin-Lever" ceramic crystal cartridge has been designed specifically for replacement applications and can be used in place of 132 models of 3-speed, plastic-cased, ceramic and crystal, turnover and single-needle cartridges in home phonographs.

The new unit has individual needle compliance for 78 rpm and microgroove response, a unique needle shift design, and an amazingly simple needle replacement procedure. 111

DONNER WAVE ANALYZER

Donner Scientific Company has just released a frequency selective vacuum-tube voltmeter which accurately measures the amplitude and frequency of electrical signal components within the range of 30 to 50,000 cps.

Known as the Model 21 wave analyzer, the instrument can be used for harmonic and intermodulation distortion measurements, hum and noise analysis, and carrier telephone line and equipment testing.

A precise, double half-lattice crystal filter and switch for choosing either narrow or broad selectivity are important features. Narrow selectivity

is needed for separating signal components which are close together while broad selectivity is advantageous when

scanning the spectrum or when input signals contain small amounts of frequency modulation. 112

AUDIO LEVEL INDICATOR

A versatile vacuum-tube audio level indicator, the Model 5514, has just been introduced by *Kilpatrick Electronic Laboratory*.

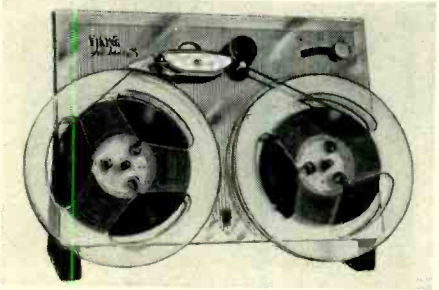
Unlike conventional vu meters, the new indicator may be used anywhere in any audio system from preamplifier to speaker or recording head. The input impedance is 1 megohm and reference level (¾ scale) is adjustable from .7 to 350 volts peak. Feedback stabilization makes the indication independent of line and tube fluctuations.

Adapter-cable assemblies are available for rapid connection at the power amplifier stage or connection may be made to the monitor or spare output jack. The Model 5514 is currently

available in three styles a 3½" panel mounting unit, a 4½" panel, and a 4½" portable unit. 113

VIKING TAPE DECK

Viking of Minneapolis is marketing a compact, inexpensive tape deck which



provides a frequency response of 40 to 14,000 cps at 7½ ips. Used with a NARTB compensated equalizer amplifier, response will fully meet broadcast requirement for minimum distortion, flutter, and wow.

The Viking FF75 tape deck uses a 1½ pound capstan flywheel, which is belt-driven from a floated motor plat-

form. The deck uses the "Dynamu" head which is designed specifically for playing the extended recorded music tapes. Both monaural and binaural adaptations are available. Fitted with erase and record heads and using suitable circuitry, the FF75 may be adapted to professional quality recording and duplicating. 114

NEW FISHER AMPLIFIER

Fisher Radio Corporation has come out with a new 30-watt amplifier, the 80-AZ, which features the firm's "PowerScope" peak power indicator cali-

brated in watts in order to provide maximum speaker voice coil protection.

Distortion is less than .5% at 30 watts and less than .05% at 10 watts. The amplifier is capable of handling 60-watt peaks.

Response is uniform from 10 to 50,000 cps and ±.1 db from 20 to 20,000 cps. IM distortion is less than .5% at 25 watts and .2% at 10 watts.

There are three controls on the unit, "PowerScope", "Z-Matic", and "Input Level." 115

STEPHENS "SUPER TWEETER"

By popular request, *Stephens Manufacturing Corporation* is now making available its tweeter, normally used in its "Tru-Sonic" 152AX and 122AX coaxial speakers, as a separate No. 212 "Super Tweeter."

The new unit features the company's double exponential horn to assure wide, even dispersement of highs. It has a handspun aluminum diaphragm activated by a fully-enclosed magnetic structure. Smooth frequency response

from 5000 to 18,000 cps is obtained with this tweeter. 116

"KNIGHT" AM-FM TUNER

Allied Radio Corporation is now offering its low-cost "Knight" AM-FM tuner which has been designed as a companion unit to the 12-watt "Bantam" amplifier.

Since it is a "basic" unit it has only

two front panel controls, "tuning" and "function selector," making it ideal for use with amplifiers or preamps having

full sets of controls. A third control, "output level," located on the rear panel, prevents overdriving the amplifier.

The highly sensitive, 7-tube plus rectifier, circuit provides good reception, even in weak signal areas. An automatic frequency control circuit locks in stations as their dial setting is approached. This feature also eliminates drift during tuner warm up. 117

AM-FM RECEIVER

David Bogen Co. Inc. has added an AM-FM receiver to its line of audio equipment. Known as the RR550, the new unit includes FM sensitivity of 2½ μv. for 30 db quieting (70 ohm input measured using IRE standards). The AM sensitivity is 5 μv. for 20 db signal-to-noise ratio.

A tuning meter, which works on both AM and FM, is included along with an a.f.c. defeat switch on the panel. There is a built-in ferrite loop for AM and a built-in line antenna for FM.

Provisions are also made for the use of external antennas including 70 ohm unbalanced and 300 ohm balanced. 118

"DOUBLE-PLAY" TAPE

A new magnetic recording tape that will double the playing time over standard recording tape has been announced by *ORRadio Industries,* manufacturer of the "Irish" brand of recording tape. The new tape will be known as the "Irish" Double-Play Recording Tape, No. 7-2400.

Up to four hours can be recorded without a reel change at 1⅞ ips and eight hours dual track. The 7" reel, standard with most home-type recorders, accommodates 2400 feet of the tape. The secret of the increased tape age is the use of the new .5 mil. "Mylar" film. It is virtually tear resistant, is unaffected by temperature extremes, and cannot dry out and embrittle with age. 119

"STATICMASTER" SYSTEM

Nuclear Products Company has developed a new "Staticmaster" system to meet the specific needs of broad-

casting stations where it is not always possible to take the time to neutralize

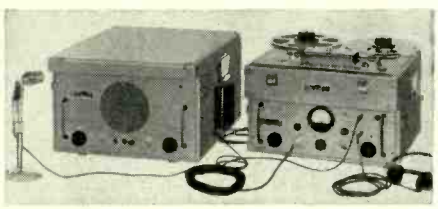
the static charge on the record to zero after the brush has eliminated surface dust.

The system consists of the company's standard record brush plus a special ionizing unit mounted on a polished chrome flexible arm and base. The brush is used to clean the records and neutralize all surface static electricity. The flexible arm permits accurately locating the ionizing unit so that the radiation is effective in maintaining the neutralization of the entire surface. 120

PROFESSIONAL TAPE UNIT

Telectro Industries Corporation is now offering a new magnetic tape recorder-reproducer which has been especially designed for broadcast and high-fidelity applications.

The Model 1000 is a portable dual track recorder and reproducer which will operate at either 7½ or 15 ips. Frequency response is 30 to 10,000 cps ± 2 db at 7½ ips and 30 to 15,000 cps



± 2 db at 15 ips. Rewind time is one minute for 2400 feet of tape. The unit operates on 115 volts, 60 cycles. 121

3-SPEED TAPE DECK

Fenton Co. is again announcing a new tape deck, this model providing three speeds in a more elaborate layout.

Known as the "Brenell Hi-Fi" deck, the new unit has three independent motors driving the capstan, feed, and take-up reels and is provided with instantaneous mechanical braking. All

braking, switching, and pinch-roller operations are positively interlocked in two simple control knobs.

The speed selection mechanism consists of a precision-ground capstan and a 2:1 ratio screw-on sleeve, permitting either 3¾ and 7½ ips or 7½ and 15 ips operation. The heads are completely shielded with Mumetal to eliminate 60 cycle hum and meet NARTB requirements. 122

AUDIO ATTENUATOR

Cinema Engineering Company, a division of *Aerovox Corporation,* is in production on a new type of audio attenuator which features self-wiping

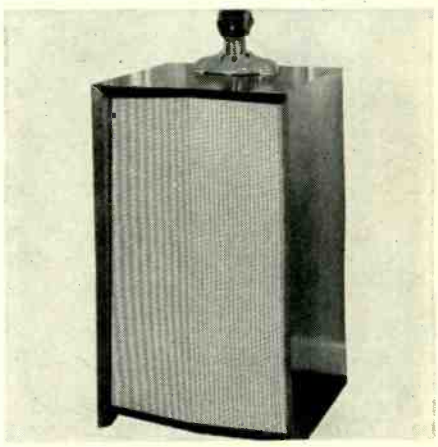
contacts of nickel silver, carbon composition, and wirewound resistors.

The unit is available in 150, 250, and 600 ohms. The resistance element values are standard 5% accuracy. The audio ladder controls have a 6 db inherent insertion loss. All other network types of mixer controls have zero loss. Other tap units are available in potentiometer, "T," ladder attenuator networks. Controls are capable of handling levels of + 30 dbm. 123

HARTLEY ENCLOSURE

Hartley Products Co. is currently marketing a newly-designed non-resonant enclosure which will house either one or two of the firm's non-resonant 215 speakers.

Available in either blonde or mahogany finishes, the unit includes a two-



stage acoustic filter which eliminates air and cabinet vibration. The enclosure is 30" x 18" x 16" deep. 124

A.F. WAVE ANALYZER

Federal Telephone and Radio Company is handling the distribution of a new a.f. wave analyzer, the Type FT-FNA. The instrument is self-contained and includes an analyzer, two-axis recorder, filter, and other apparatus for complete manual or automatic frequency range.

The unit provides both narrow and wide band operation, offers logarith-

(*Continued on page* 132)

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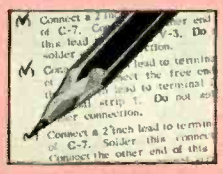

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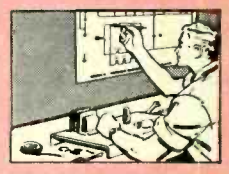

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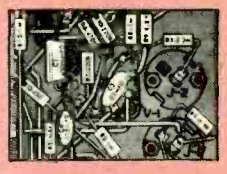

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Model F-143. Counter type Knight Tube Tester Kit. Net only..... **$29.75**
Model F-142. As above, but with carrying case. Net only..... **$34.75**
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Model F-119

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KNIGHT CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and trouble. Just press a button and the "magic eye" instantly shows opens and shorts. Checks by-pass, blocking, coupling and filter condensers from 20 mmf to 2000 mfd, even when the capacitor under test is wired with a resistance as low as 60 ohms. Capacitors between .1 mfd and 2000 mfd may be tested even when in parallel with resistance as low as 2 ohms. Housed in the professionally styled Knight Kit case, sturdy steel in blue wrinkle finish with gray control panel. Complete kit, ready for easy assembly. Shpg. wt., 5 lbs.

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Model F-140 Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; ± 2% full scale deflection; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust". Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, −30 to + 63 in 6 ranges. Uses precision 1% multipliers. Complete kit with bakelite case, batteries and test leads. Shpg. wt., 5 lbs.

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Model F-128 Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and Output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, −20 to + 69 in 6 ranges. Uses 1% precision resistors. 3-position function switch and 12-position range switch. Complete kit with bakelite case, battery and test leads. Shpg. wt., 2½ lbs.

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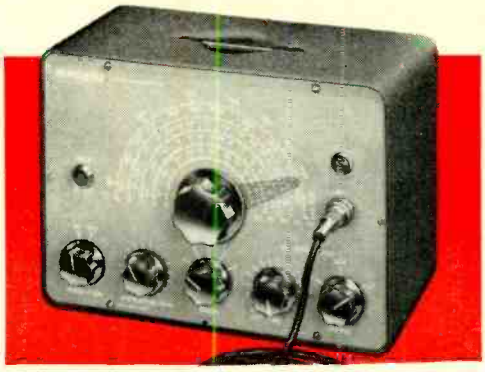

Model F-145 **$19.75**

An extremely popular kit, noted for its wide range and exceptional stability—saves you two-thirds the cost of a comparable wired instrument. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonic output to 220 mc. Ideal for aligning RF and IF stages and for audio equipment troubleshooting. Also serves as TV marker generator when used with any sweep generator. Features the famous Colpitts circuit for high accuracy with negligible drift. RF output rated over 100,000 microvolts. Output can be modulated at 400 cycles. Has built-in sine-wave audio oscillator with output jack for 400 cycle output. Maximum audio output, 10 volts. Jack for external modulation; step and continuous-type output attenuators. Complete kit with professional portable case. Shpg. wt., 10 lbs.

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Model F-137. Knight Audio Generator Kit. Net.. **$31.50**

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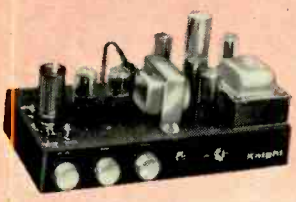

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Model S-234 **$20.95**

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ± 1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chassis punched to accommodate preamp kit. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

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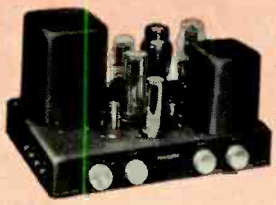

20-WATT HI-FI AMPLIFIER KIT

Model S-750 **$34.75**

True hi-fi for less! Frequency response, ± 1 db, 20 to 20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono, 72 db below 20 watts. Sensitivity: tuner input, 0.6 volt for 20 watts output; magnetic phono, .007 volts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records, controlled from front panel. Shpg. wt., 23 lbs.

Model S-750. 20-Watt Hi-Fi Amplifier. Net..... **$34.75**

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Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristic for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate scales for 40, 20, 15 and 10 meters (11 and 80 meters have combined scale); vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. Complete kit for easy assembly. Shpg. wt., 8 lbs.

Model S-725. Knight Self-Powered VFO Kit. Net.. **$27.50**

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Design Details on a New Audio Analyzer

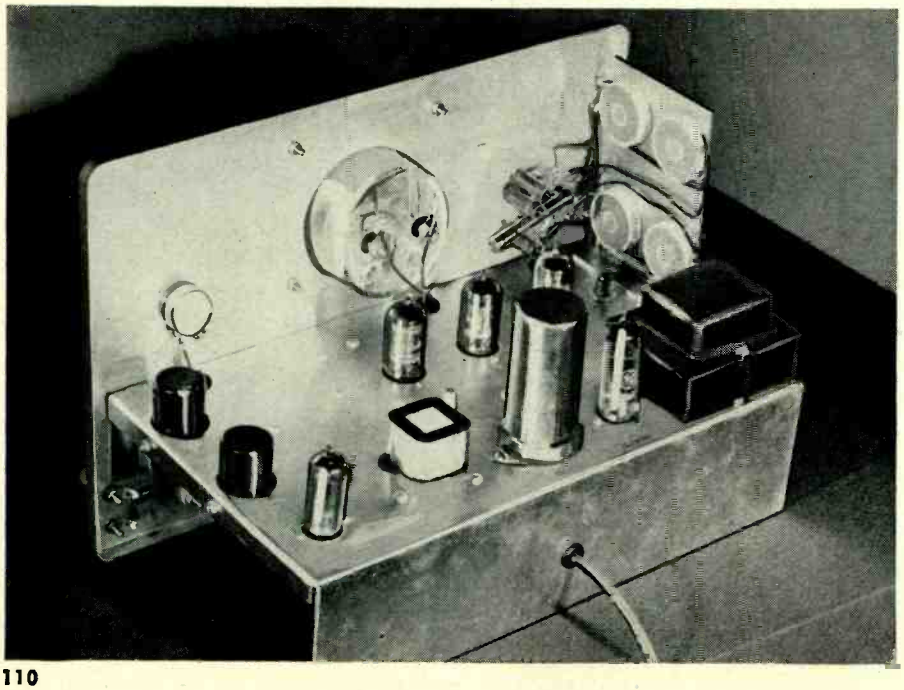
Front panel view of the Model AA-1 audio analyzer. The unit measures 13" wide, 8½" high, and 7" deep over-all.

The new Heathkit Model AA-1 offers test facilities normally found only in three separate instruments.

SERVICE technicians specializing in audio work and serious audiophiles require certain items of test equipment not normally found on the service bench in order to properly analyze the operation of audio equipment.

Among the test units most often used for audio servicing are the audio wattmeter, the a.c. vacuum-tube voltmeter, and the intermodulation analyzer. The recently-released *Heathkit* Model AA-1 audio analyzer offers all three of these important facilities in a single instrument. A separate audio oscillator is not required in view of the fact that this new instrument generates, within itself, two audio signals—a low 60 cycles and a high 6 kc. Both of these signals are brought out to individual binding posts and can be used separately for testing or mixed for IM measurements.

Rear view of instrument. Assembly requires careful attention to details.



This new unit tests power output, noise, gain, overload characteristics, and IM characteristics and offers non-inductive load impedances of 4, 8, 16, and 600 ohms, which may be selected by means of the "Load Selector" switch. A high-impedance position is provided for stage-to-stage or other high impedance circuit analysis.

The a.c. vacuum-tube voltmeter incorporates three stages which provide 10 millivolt full-scale sensitivity. Two diodes in a half-wave bridge supply the d.c. for the 200 μa. meter. The non-linearity of crystal diodes at low voltage levels is compensated by making the meter movement non-linear in the opposite direction. Another diode and variable resistor are shunted across the meter allowing adjustment of meter linearity, thus insuring decading accuracy.

Power measurements are made in conjunction with the a.c. vacuum-tube voltmeter and precision compensation networks to correct voltage in relation to power dissipated in the high-wattage load resistors. Since the power dissipated is related to the voltage out of the input network, the meter scale can be calibrated directly in watts. Power output can be read in dbm or watts on the red meter scales.

The intermodulation analyzer operates much the same as a broadcast radio receiver. Mixed high and low frequencies are fed to the analyzer which amplifies the high frequencies but rejects all low frequencies except those actually modulating the higher

frequency. The modulated high-frequency signal is set to a predetermined level and is then detected or demodulated. The remaining signal appears as a low-frequency component and is passed through a low-pass filter to remove residual high-frequency components. The remaining signal is intermodulation and is indicated on the meter in percentage.

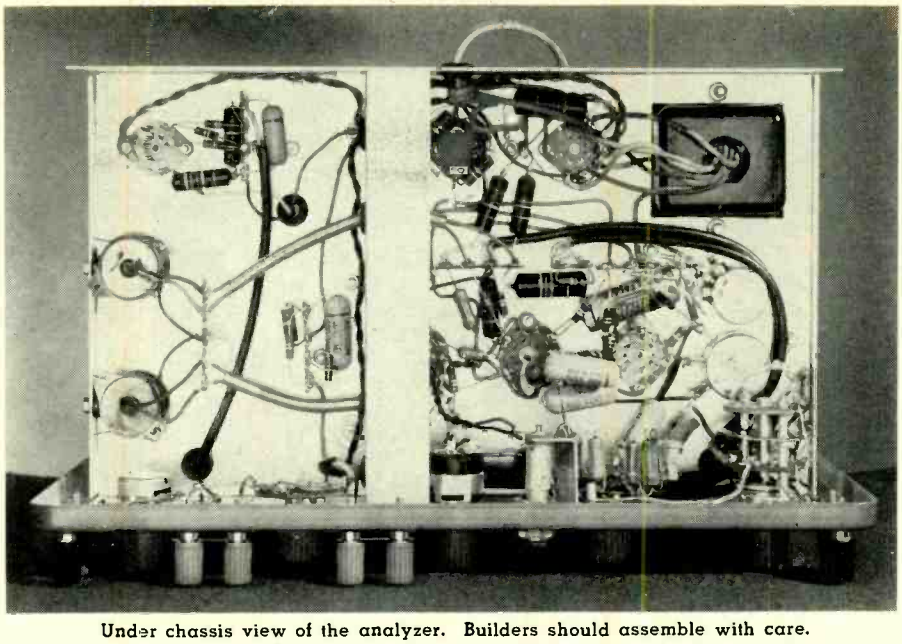
The power supply for the instrument consists of a full-wave 6X4 rectifier with filtered d.c. output. Plate voltages are supplied to the rectifier and filaments from the power transformer as well as voltages for the low-frequency signal source. Separate filtering systems are provided for the high-frequency oscillator and analyzer to insure complete isolation. The AA-1 is designed for 105-125 volts, 50-60 cycles. It draws 20 watts.

In addition to the "Load Selector" switch mentioned previously, the instrument has a "Function Selector" switch which controls all operations of the unit. In the first position, the input terminals are connected directly to the v.t.v.m. decade and the instrument operates as a 1-megohm input a.c. vacuum-tube voltmeter, unless the load selector is on one of the internal load positions. The next function is "Power" and the output of the wattmeter voltage-correcting divider is connected to the v.t.v.m. decade.

Measurement of the low- and high-frequency test level is done in the "LF-HF" test position of the switch. Initial adjustment for IM measurement is made with the switch in the "Set Level" position. In the full clockwise position, the v.t.v.m. decade is connected to the output of the IM analyzer and the low-frequency intermodulation component is read directly on the meter.

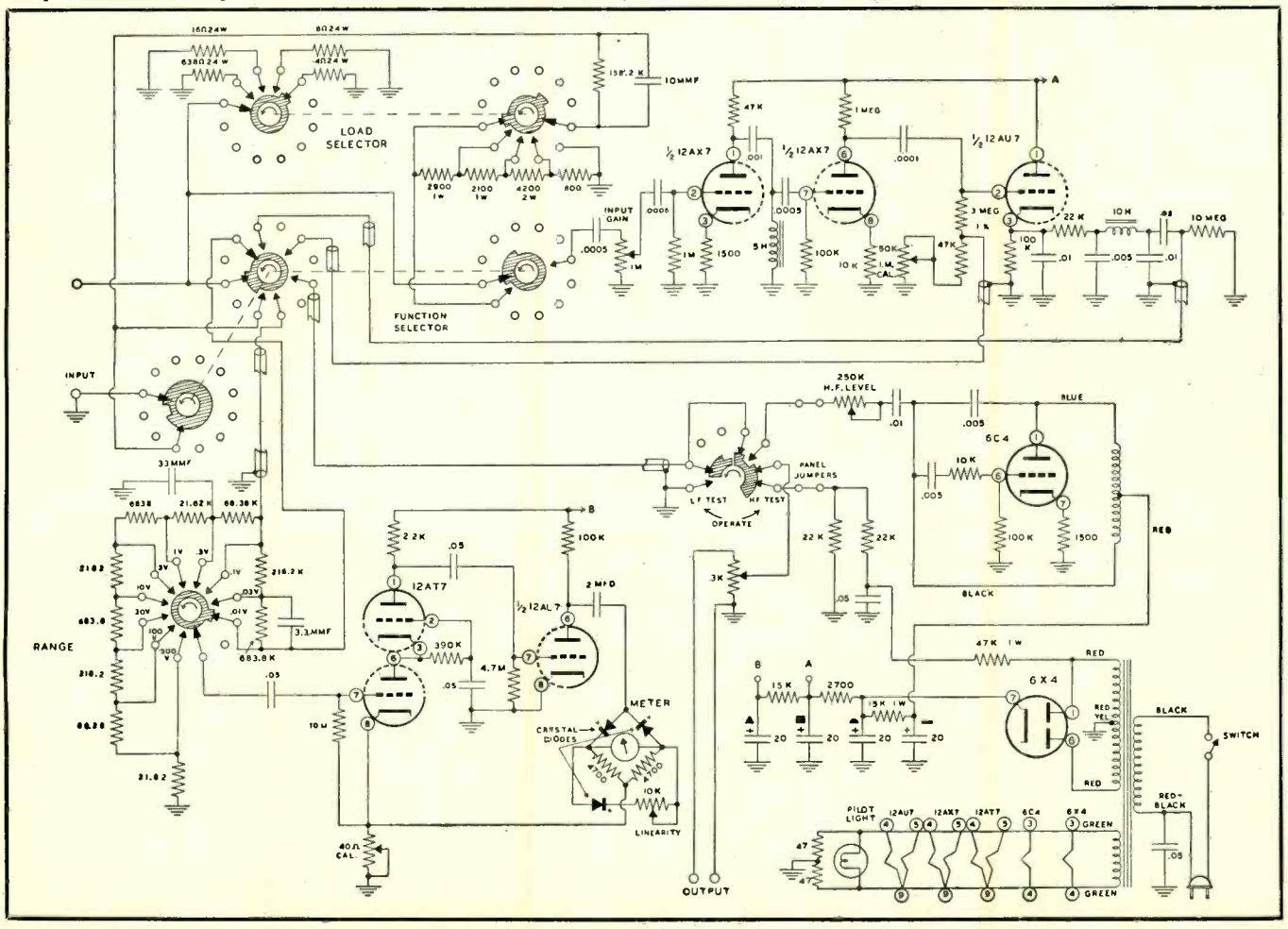
The v.t.v.m. decading is handled by the "Range" switch. It controls all functions of the audio analyzer and the proper meter scales are marked on the front panel in terms of full-scale readings. Operating levels of the low and high frequencies can be checked individually by placing the test switch in the appropriate position.

The Model AA-1 uses five tubes. In kit form, it lists at $59.50. —30—



Under chassis view of the analyzer. Builders should assemble with care.

Complete schematic diagram of the Heathkit Model AA-1 audio analyzer. The unit is powered by a full-wave rectifier with filtered d.c. output.



"THE FABULOUS PHONOGRAPH" by Roland Gelatt. Published by *J. B. Lippincott Company,* Philadelphia. 310 pages. Price $4.95.

The subtitle "From Tin Foil to High Fidelity" is indicative of the scope of this volume. Covering the entire phonographic era from 1877 to the present, this book is somewhat of a *tour de force.* The author, who is New York Editor of *High Fidelity* magazine, spent years collecting his material and verifying his findings with many of the principals involved in the early experiments with recorded sound.

While most people are aware that all was not smooth sailing for Edison and his successors, few realize the downright "skullduggery" involved as well as the legal and commercial battles that shaped up before the industry was "tamed." In addition to the claims and counterclaims that were wafted around, the recording artists themselves added many colorful chapters to phono history.

Mr. Gelatt has told his story interestingly and well, drawing upon numerous anecdotes to point up his text. We believe that modern audiophiles will find this fascinating, as well as giving them a true appreciation of the fact that "they never had it so good." The text material is illustrated with a number of historic photographs and some reproductions of the original sketches of equipment as submitted by the inventors in connection with their patent applications.

* * *

"SECOND THOUGHTS ON RADIO THEORY" by "Cathode Ray" of *Wireless World.* Published by *Iliffe and Sons Ltd.,* London. Available in the U. S. from *The British Book Centre,* 122 E. 55th Street, New York 22, New York. 403 pages. Price $5.00.

Those who have access to the monthly British publication, *Wireless World,* will need no introduction to "Cathode Ray." For over twenty years he has conducted a monthly column devoted to the task of de-mystifying radio theory. That he has succeeded admirably in his self-appointed chore is attested to by the thousands of "fans" who consider the column "must reading."

In order to satisfy these devotees and introduce "Cathode Ray" to an even larger audience, some forty of his articles have been correlated and compiled into this book which will serve admirably as a textbook for the beginner, a "refresher" course for the "old timer," and a reference volume for all who are interested in radio and electronics.

The author's style is completely informal with the text material written in the first person. Before the reader has gone five pages, the impression of a friendly discussion has been established with the result that it is possible to acquire a lot of valuable information painlessly.

The text covers an amazing amount of territory for so slender a volume, but we are willing to wager that readers of this book will add a surprising amount of "know-how" by the time they are through. Self-testing problems and answers have been included as an extra boon.

* * *

"COLOR TV SERVICING" by Walter H. Buchsbaum. Published by *Prentice-Hall, Inc.,* New York. 252 pages. Price $6.35.

This volume, written by RADIO & TELEVISION NEWS' Television Consultant, is for the practicing and experienced TV technician. Those without a thorough understanding of monochrome television principles will find this text rough sledding since the author has assumed that only those who really know their radio and black-and-white television circuitry will be able to "graduate" to servicing color receivers.

Because of this limitation in the scope of the volume, the reader is directed to the similarities and differences between monochrome and color receivers which precludes all discussion of basic television theory. This is a valid position inasmuch as the complex and relatively expensive color receivers will not be entrusted to the offices of the novice technician or apprentice.

Those whose background qualifies them for color service work will find this volume extremely helpful in preparing for the deluge that is sure to come or in the actual day-to-day servicing of existing receivers if the technician is operating in an active color market. The author covers the principles of colorimetry; color TV signals; the color TV system; picture tubes and their circuits; typical color receivers; antennas, tuners, and i.f. sections; the special circuitry unique to color; installation and troubleshooting procedures involving the actual receiver; and, finally, miscellaneous troubleshooting techniques.

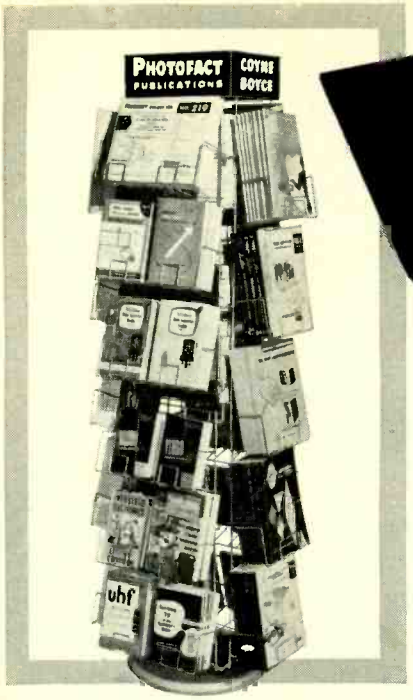
The technician seeking an advantage over his less alert competitors will find this volume a real help in putting him ahead of the game for the new boom in color TV.

* * *

"SELLING YOUR TV-RADIO SERVICE" by the General Electric Tube Department. Published by *John F. Rider Publisher, Inc.,* New York. 59 pages. Price $1.00. Paper bound.

That many well-qualified and thoroughly-trained service technicians go into bankruptcy every year cannot be attributed to a lack of knowledge of their subject but rather to their lack of "know-how" when it comes to the various business aspects of their operations.

So important are these "plus" techniques that the *General Electric Company,* in conjunction with *Rider,* has



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Radio Receiver Servicing. A book on practical radio receiver servicing covering such basic troubles as dead set, weak set, intermittent and noisy sets, etc. 192 pages, 5½ x 8½".
Order **RS-1** $2.50

AM-FM Servicing Short-Cuts. Describes actual AM and FM service case histories; shows practical ways to solve similar troubles in *any* AM or FM receiver. 152 pages, 5½ x 8½". Order **RK-1** $1.50

Radio Receiver Tube Replacement Guide. Shows where to replace each tube in 5500 receivers made from 1938 to 1948. 196 pages, 5½ x 8½". Order **TP-1** $1.25

Dial Cord Stringing Guide. Vol. 4. Shows correct way to string dial cords in radio receivers made from mid-1951 through 1953. With index. 96 pages, 5½ x 8½". Order **DC-4** $1.00

Vol. 3. Covers receivers produced from 1950 through mid-1951, and TV-radio receivers from 1946 through mid-1951. 96 pages, 5½ x 8½". Order **DC-3** $1.00

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Atomic Radiation, Detection and Measurement

This book covers the information necessary for a basic understanding of nuclear science and its applications. The service technician will be particularly interested in those chapters dealing with the circuitry and operation of the many types of detection devices, in case he is called upon to service these units. 200 pages, 5½ x 8½". Order **ADR-1** $3.00

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Technicians whose businesses show signs of seasonal slumps or have contracted alarming cases of "no-customer-itis" should study the excellent suggestions offered in this handy manual and then, having put them into practice, watch their businesses grow.

* * *

"TV REPAIR QUESTIONS & ANSWERS" by Sidney Platt. Published by *John F. Rider Publisher, Inc.*, New York. 117 pages. Price $2.10. Paper bound. Vol. 2.

This second book in the current "Q & A series" covers the servicing aspects of video circuits.

Since this text has been written for the benefit of practicing TV technicians as well as for would-be technicians, the presentation is practical rather than theoretical. The book is divided into five sections dealing with video i.f. amplifiers, video detectors, video amplifiers, d.c. restorers and a.g.c. circuits, and video i.f. alignment.

Each question (and they are all practical questions involving actual service cases) is followed by a concise answer which, in turn, is followed by a discussion in which the subject is enlarged upon and presented in greater detail for the benefit of the technician who desires more background data on the answer.

The text is illustrated by means of CR tube pictures, scope patterns, schematics, etc. for maximum utilization of the information contained in the body of the book.

* * *

"ADDITIONAL 1955 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Chicago. 190 pages. Price $3.00. Paper bound. Vol. TV-10.

This is a supplementary and companion volume to the same publisher's "Most-Often-Needed 1955 Television Servicing Information" which was released earlier in the year.

This latest handbook includes material recently released by the manufacturers, service data, changes in production models, as well as complete circuit and servicing information on a number of receivers which came out during the summer months. Sets from *Admiral, Bendix, Capehart-Farnsworth, CBS-Columbia, Crosley, Emerson, General Electric, Hallicrafters, Hoffman, Motorola, Muntz, Olympic, Packard-Bell, Philco, RCA, Raytheon, Stromberg-Carlson, Sylvania, Westinghouse,* and *Zenith* have been included in this new volume.

Service technicians will find this volume as complete and helpful as were the earlier volumes in this series. —30—

Hams to Participate in "Operation Deepfreeze"

MORE than 130,000 radio amateurs will vie for a chance to penetrate the Aurora Australis and swap QSL cards with men of the Navy's "Operation Deepfreeze" in the Antarctic between March 1956 and February 1959.

Task Force Forty-Three will put out from East Coast ports late this fall in the first leg of setting up bases for American participation in the International Geophysical Year, 1956-1957. The first goal is the establishment early next year of two bases, Little America Station on Kaiman Bay and an Air Operating Facility at McMurdo Sound.

The Seabees and aviation personnel put ashore in this first phase of the operation will be accompanied by communicators who will have been licensed to set up stations KC4USA at Little America and KC4USV at McMurdo Sound about March 1, 1956.

These bases will serve as springboards from which some 150 construction men will move overland to set up Byrd Station in Marie Byrd Land and from which aviators will air-drop men and materials to establish South Pole Station at the South Pole itself, when KC4USB and KC4USN will be out about March 1st.

Selected volunteers will "winter-over" at Little America Station and at the Air Operating Facility between February and December 1956 in order to get a head start on construction of the other bases before the task force ships can penetrate the pack ice in Phase Two. Scientists and supporting personnel will winter over at all bases between later phases of the operation.

This will be the first time American amateurs will have a chance to communicate with Americans in the Antarctic since the Byrd expedition in 1939 and the Finn Ronne expedition at Marguerite Bay in 1948. (No ham facilities were available in "Operation Highjump" during 1946-47.)

The FCC has allocated a block of call letters, KC4USA through KC4USZ, for use in the Antarctic in the event other ham stations become feasible. The Navy radio crew has acquired gear to operate c.w., voice, and single-sideband. They will operate on the 80, 40, 20, 15, 11, and 10 meter bands.

Chief Radioman A. B. Garrett, USN, has emphasized that the Navy is anxious to contact amateurs in the States who have sufficient power and phone patch facilities. Hams are asked to contact Commander Task Force 43, Attn: Staff Communications Officer, Room 831 Old Post Office Building, 12th & Pennsylvania Ave., N.W., Washington, D. C.

The Navy's objective in providing the ham gear is morale. There will be 1500 men in the task force of which 150 will winter-over. It is in order to provide communications facilities for these men that the Navy is setting up this communications network.

The Navy amateur operators will fit their ham communications into their work routine on a recreational basis so they cannot predict at this time what hours they might be on the air. Nor can they predict when the Aurora Australis will work for or against good transmission or reception. Chief Garrett says that the Navy men will be on the air as often as possible and that by the time the task force puts to sea every radioman in his crew will have at least a general license.

Ham radio will be so important in "Operation Deepfreeze" that the Navy will give the amateur equipment preferential treatment in allocating valuable cargo space. The reaction of one veteran explorer and an ardent ham is that "No equipment could be considered more vital than ham equipment! What better morale instrument is there in the world than a chance to talk to the folks back home?"

The cooperation of all U. S. amateurs is sought for this project and it is to be hoped that, with their legendary spirit of helpfulness, amateurs will contact the group at the Washington address to offer their facilities for keeping the wintered-in Navy men in touch with home. Write today and give your name, address, call letters as well as details of your amateur equipment.

-30-

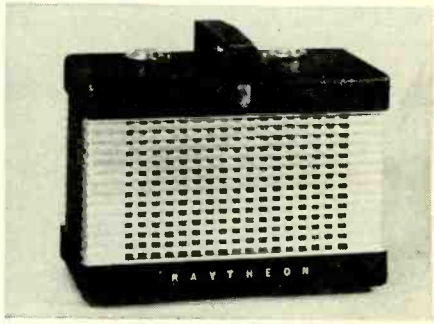
What's New in Radio

TRANSISTOR PORTABLE

Raytheon Manufacturing Company's Television and Radio Division, Chicago, Illinois is in production on a new transistorized, twin-speaker portable radio receiver, the "Super-T."

The company estimates that the receiver will operate for 2500 hours, or two years' normal playing time, on a single "A" battery pack. It will also play for 500 hours on the power from four standard flashlight batteries in case an "A" pack is not available.

Completely portable, it can be used anywhere. Batteries slip easily into place. The set weighs 8 pounds, has a

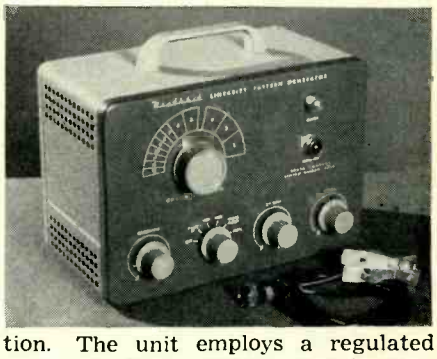


leatherette finish over a solid hardwood cabinet, a carrying handle, and a gold-finished speaker grille.

LINEARITY PATTERN GENERATOR

Heath Company of Benton Harbor, Michigan is currently in production on a new test instrument that has been designed specifically for the accurate adjustment of monochrome or color TV receivers.

The Model LP-1 linearity pattern generator provides an extended operating range which covers all television channels from 2 to 13 with the unused TV channel being used for linearity adjustments, even in metropolitan areas with several stations in opera-



tion. The unit employs a regulated power supply for stability and is characterized by high quality components throughout.

The instrument produces vertical or horizontal bar patterns, a cross hatch pattern, or a white dot pattern on the

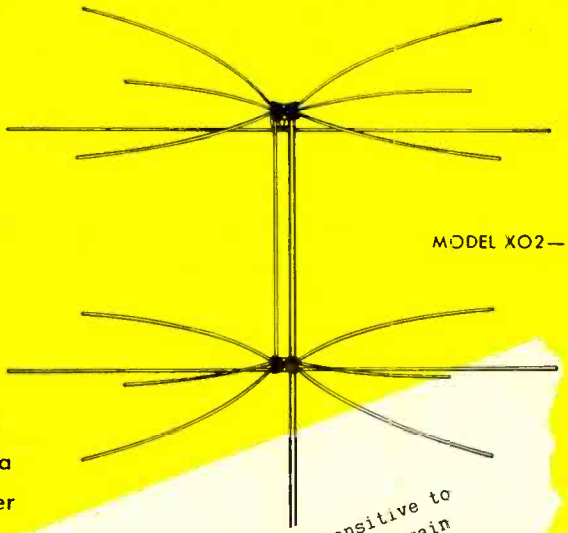
EXPO

Have you ever seen or heard of the Exponential Antenna? You have not, for until now it was unknown to the engineering world.

WHAT IS EXPO ?

EXPO, the exponential antenna, represents an historical technical advance that eliminates the crippling frequency limitations of all known antennas by the use of exponentially curved elements.

The ultimate in antenna design! One antenna for all 82 channels with gains progressively increasing with increase of frequency. This principle recently discovered* is the basic answer to the limited bandwidth problem. There is no need for multiple antenna installations or other expedients to gain slightly wider bandwidth operation.



MODEL XO2—2 BAYS

Here is an antenna that is insensitive to frequency variations — except that gain increases as you go higher in the spectrum, reaching astounding gains in the upper VHF and throughout the UHF regions. Where wide bandwidth operation is necessary as in T.V., EXPO ushers in a new era in antenna design, wiping out the frequency restrictions of straight element antennas.

EXPO comes in 1, 2 and 4 bays in the standard and deluxe models. The standard models use a single parasitic reflector while the deluxe models employ a screen-type reflector for areas in which the ultimate in back attenuation and increased forward gain is desired.

Higher gains
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– one installation.
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Servicemen will appreciate the ease and speed of installing EXPO:
occupies less space — pleasing appearance — supreme performance. Its performance sells it for you.

Will you be among the first to see it perform? Consult your distributor, or for further information, write:

HOLLOWAY ELECTRONICS CORP.
Fort Laudurdale, Florida

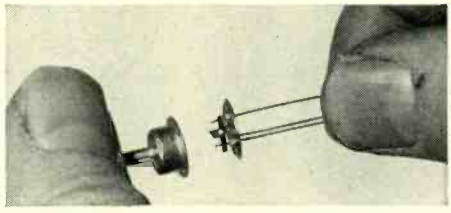
*Patent applied for.

TV receiver under test. No internal connections to the receiver are required. A special clip on the shielded output cable is merely attached to the antenna terminals of the TV set. A function switch provides instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, over-all aspect ratio, and focus. The unit will produce 6 to 12 vertical bars or 4 to 7 horizontal bars. The Model LP-1 is available in kit form and can be assembled in one evening.

TRANSISTOR FOR HAMS

A new transistor, designed to meet the demands of radio amateurs, hobbyists, and experimenters for a stable and inexpensive unit, has been introduced recently by *General Electric Company* as the 2N107.

The new transistor is the first in a series that the company plans to mar-



ket for the exclusive use of amateurs and hobbyists. It is a *p-n-p* audio transistor produced by the fused junction process. Others in the line will include i.f. and r.f. *p-n-p* units made by the fused junction process and r.f. *n-p-n* transistors made by the new rate-grown process.

A free booklet containing suggested circuits for using the 2N107 is available from the distributors stocking the transistor.

PROGRAM TIMER

Gorell & Gorell of Haworth, New Jersey in now offering a patented timer and programming instrument which provides ten instantly-selected speeds: 1, 5, and 15 minutes, 1, 4, and 12 hours, 1 and 2⅓ days, and 1 and 4 weeks.

In operation it is only necessary to slide the pickup gear along its shaft to select the desired speed. The cam or program discs up to 6" diameter can be obtained for use with any reasonable number of switches. The 6" program disc will handle 10 switches.

Other models are available with 13 speeds. Over-all speed range is more than 40,000 to 1.

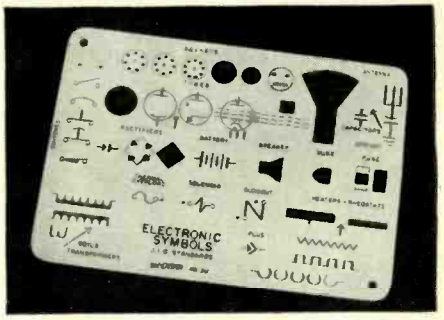
Write for a data sheet giving complete information on this "M. G. Timer."

ELECTRONIC SYMBOLS TEMPLATE

A. Lawrence Karp, 16 Putnam Park, Greenwich, Conn. is now offering a new "Electronic Symbols Template" to the industry.

The new unit carries the engraved symbols that are most commonly used in the industry and are the most difficult and time-consuming to draw. The template includes switches, rectifiers, coils, transformers, heaters, rheostats, antennas, capacitors, fuses, batteries, solenoids, sockets, tubes, plugs, and thermal overload marks.

The template is engraved on .030 vinyl plastic and measures 7" x 5".



Write the company for full details on this and other electronic and communications templates in the line.

PASTE SOLDER

Mico Instrument Company, 85 North Trowbridge Street, Cambridge, Massachusetts has developed a new non-corrosive paste solder especially for the electrical and electronic equipment industries.

The new product consists of powdered solder suspended in a non-corrosive flux that can be used for all delicate soft-soldering operations as well as routine tasks. It cleans, tins, and solders in one operation. The flux residue is non-corrosive. The paste solder comes in ¼ and ½ pound sizes.

PORTABLE P.A. UNIT

Associated Designers, 135 East Las Tunas Drive, San Gabriel, California is now offering a compact, 10-watt public address amplifier that operates from either a 6 or 12 volt battery.

Known as the "Portavox," the unit is built for use in automobiles, boats, etc. It is rugged, small, and is built in two packages which fasten together forming a single unit, if desired. Frequency response is 60 to 12,000 cps. All controls are on the amplifier section panel which measures 2⅞" x 5¾".

Power may be supplied from the cigarette lighter receptacle on the car dash.

The manufacturer will supply complete specifications on request.

COLOR BAR-DOT GENERATOR

Hycon Mfg. Company, 365 South Arroyo Parkway, Pasadena, California is now marketing a new color bar-dot generator which simplifies the adjustment, testing, and troubleshooting of color television receivers.

Every color sequence and linearity adjustment necessary for optimum re-

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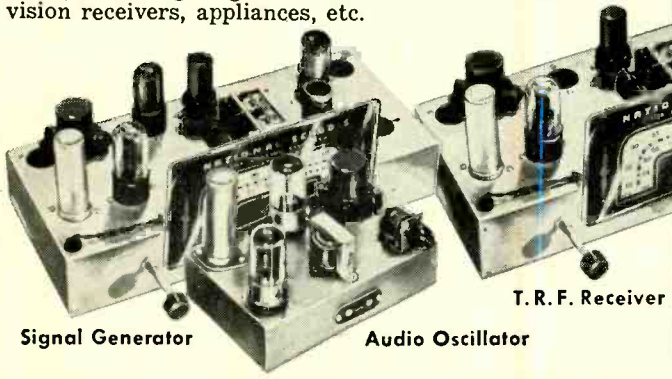
Superheterodyne Receiver



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- Television Manufacturing, Sales, Service
- Laboratories: Installation, Maintenance of Electronic Equipment
- Electrolysis, Call Systems
- Garages: Auto Radio Sales, Service
- Sound Systems and Telephone Companies, Engineering Firms
- Theatre Sound Systems, Police Radio
- And scores of other good jobs in many related fields.

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ceiver performance is available in this one compact instrument which is suitable for both production-line testing and in-the-home servicing.

Three color sequences are offered, each graphically portrayed on the instrument's front panel for ease in identification. Color band "A" is the complete NTSC sequence, band "B" has four bars (G-Y at 90 degrees, R-Y, B-Y, and black) while band "C" consists of black, I, Q, black. Quadrature signals are held within 1 degree. All three color sequences are selected by means of a single, front-panel control.

Linearity adjustments, convergence adjustments, and standard synchronizing signals are all provided. The completely portable, self-contained tester weighs 22 pounds and measures 8½" x 11" x 13⅜".

CONTROL LUBRICATOR

R-Columbia Products Co., Inc., 305 Waukegan Ave., Highwood, Illinois is now offering a new tool that cleans and lubricates TV or radio controls in sixty seconds or less.

Known as the "TrolMaster," the unit is designed to save technicians' time since it is not necessary to remove the chassis from the set or to take the back off the cabinet. The procedure is simple, involving the removal of the control knob and the application of the solvent by means of the tool. The unit works on either single or dual controls. By the addition of a simple adapter which screws into the "TrolMaster," it can also be used to clean and lubricate auto radio controls.

For complete details on this tool and the recommended solvents to be used with the device, write the company for a copy of its Bulletin No. 21.

SHORT-WAVE RECEIVER

David Bogen Co., Inc., 29 Ninth Avenue, New York 14, N. Y. is now offering a new high-fidelity AM receiver for use on short-wave and standard broadcast bands.

The RR29 is an 11-tube, 6-band superheterodyne receiver which is available in chassis form or housed in a mahogany cabinet complete with two loudspeakers as the Model RR29W. It is designed to operate on 110 volts d.c. and 110, 150, and 220 volts, 50-60 cycles a.c. The short-wave frequencies from 4.7 to 18.1 megacycles are covered in

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Central Electronics 20A 199.50
Central Electronics "A" 49.50
Central Electronics AP1 ..... 5.95
Collins 32V1 Transmitter 299.50
Collins 32V2 Transmitter 349.50
Collins 32V3 Transmitter 499.50
Collins 75A1 with speaker 299.50
Collins 75A2 with speaker 349.50
Collins 75A3 with speaker 419.50
Collins 310B1 Exciter 150.00
Collins 310B3 Exciter 174.50
Elenco SS75 SSB Exciter 99.50
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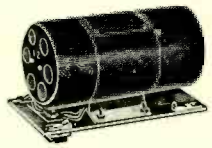
TEST EQUIPMENT

Detectron DG7 Geiger Counter 92.50
Superior TV11 Tube Tester 32.50
Radion FSM5000 Field Strength Meter 34.50

DYNAMOTOR BARGAIN

Brand new government surplus. 12 VDC input. 440 VDC, 400 MA output. Can be filtered with 2 mfd paper condenser. Starting relay not included, but has a snap-on mounting plate with Jones S-412AB socket for input and output leads. Size: 5¾Hx4½Dx9"W. Weighs 13½ lbs. Only....$ 14.95



CROSS HATCH GENERATORS

Hickok 620 ..... 49.50
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SIGNAL GENERATORS

Approved Electronics A100 ..... 14.50
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General Electronics 200 ..... 17.50
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Precision E400 ..... 79.50
RCA WR53A 29.50
Simpson 479 ..... 124.50
Superior TV30 ..... 17.50
Supreme 571 ..... 19.50
Triplett 3433 ..... 39.50
Vision Research TSW50 ..... 19.50

VACUUM TUBE VOLTMETER

Jackson 109 ..... 27.50
Jackson 645 ..... 27.50
RCA 165 ..... 27.50
RCA 195 ..... 39.50

SIGNAL TRACERS

Feiler TS3 ..... 17.50
Heath T2 – Wired 17.50
McMurdo Silver 905 ..... 17.50
Precision Electronics 201 ..... 17.50

CONDENSER CHECKERS

Write for complete list.

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Dumont 164E 3 inch 29.50
Dumont 208 5 inch 79.50
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Heath 06 – Wired – 5 inch 44.95
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Rush my order for used equipment as follows:
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five bands with the sixth band covering standard broadcasts.

The r.f. frequency response is 40 to 4000 cps within 3 db and power output

is 2 watts at 2 per-cent distortion. Bandwidth is 8 kc. for 3 db and 20 kc. for 56 db attenuation. Sensitivity is rated at 1 microvolt and 30 microvolts for 6 db and 40 db signal-to-noise ratios respectively. Separate inputs are provided for phono and auxiliary sources.

TV SERVICE KIT

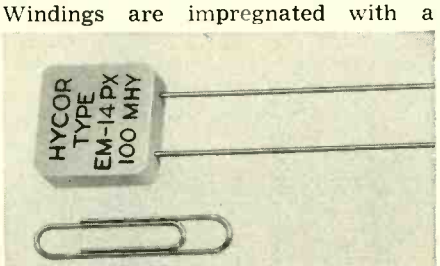
The Electronics Distributor Division of *Erie Resistor Corporation*, Erie, Pa., has added a "Ceramicon" TV service kit to its line of kits for technicians.

The new kit consists of an assortment of 62 general-purpose high-voltage and bypass disc "Ceramicons"; temperature-compensating tubulars, printed circuits, and high-voltage filter units packed in a convenient 18-section plastic case. The capacitors selected are those the service technician requires most frequently.

"POSTAGE STAMP" TOROIDS

Hycor Company, Inc., 11423 Vanowen Street, North Hollywood, California has added a new unit, which has been designed specifically for use in printed circuitry, to its "Postage Stamp" toroid coil series.

The tinned No. 20 AWG wire leads of the new coils are spaced in accordance with the standards recently proposed by the RETMA Automation Committee. The unit consists of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16" diameter. Windings are impregnated with a



special compound and the finished coil is encased in epoxy plastic. Over-all dimensions are: 13/16" x 13/16" x ⅜".

Bulletin STP, providing complete technical data, is available from K. T. Eckardt, sales manager of the firm.

SYLVANIA TUBES FOR TV

The Radio Tube Division of *Sylvania Electric Products Inc.*, Emporium, Pa. has announced the development of two new tubes, the 6CS7 and 25DN6, for vertical and horizontal TV circuit applications.

The Type 6CS7 is a miniature 9-pin, medium-mu, dual triode with dissimilar sections and is suitable for vertical deflection and oscillator applications using conventional transformer supply voltages. The output section has a very high plate dissipation rating of 6.5 watts, high perveance, and an absolute peak positive pulse plate voltage of 2200 volts. The other triode section is intended for service as an oscillator, detector, or amplifier. The tube is designed for series string or conventional parallel operation.

The 25DN6 is a beam-power pentode rated for television service as a horizontal deflection amplifier and is designed especially for use in "off-the-line" series string sets using low "B+" voltages. The tube has a desirable low plate knee characteristic at zero bias.

REMOTE CONTROL UNIT

Of interest to technicians is the new remote control unit for television receivers which is being offered by *Sentinel Radio Corporation* of Evanston, Ill. for the replacement or reconditioning market.

The unit is a small, lightweight plastic box which can be placed on the viewer's lap or can rest on the chair

arm or floor. It has all of the controls of the TV set including "on-off-volume," fine tuning, brightness, and channel changer, allowing complete operation from as far away as 20 feet.

The individual speaker of the unit permits some members of the family to study or read while others watch TV with the sound at a low level. This remote unit is designed so that it can be installed in virtually all TV receivers.

SILICON POWER RECTIFIERS

Automatic Manufacturing Corporation, 65 Gouverneur St., Newark 4, N. J. is now in production on a new line of silicon power rectifiers which the company claims to be the smallest and lightest on the market.

The new silicon rectifiers are of the diffused-junction type and are available in six voltage ranges capable of handling voltages as high as 1000 volts with d.c. output currents on the order of 300 to 400 milliamperes. The units take up only 3/100 of a cubic inch of space and weigh 7/100 of an ounce. They have been tested to operate at temperatures as high as 200 degrees C, are shockproof and vibrationproof and have a "virtually infinite life."

A data sheet on the new line is available on request. —30—

Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-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

About Testing Picture-Tubes...

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture-tube tester. Sounds fine—but—it simply doesn't work out that way!
We do not make nor do we recommend use of C.R.T. adapters 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. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.
Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C.R.T. TUBE TESTER

Tests *all* magnetically deflected tubes...in the set...out of the set...in the carton!!

SPECIFICATIONS:

- 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.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only

$15.85 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try any of the above instruments for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-178, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ Model 670-A.....Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TV-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

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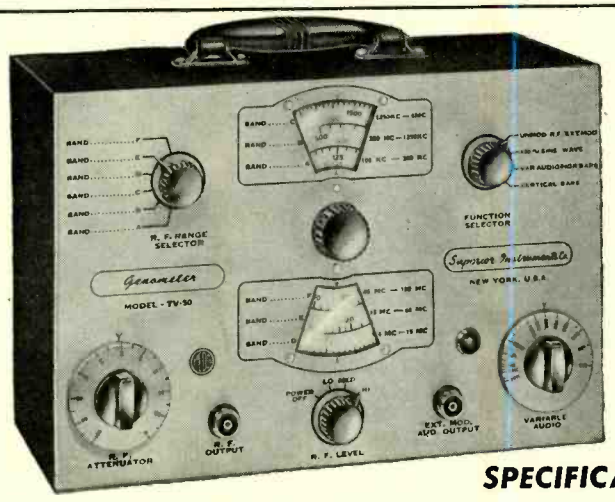
The Model TV-50 GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio F. M. Radio Amplifiers Black and White TV Color TV



7 Signal Generators in One!

- ✓ *R. F. Signal Generator for A.M.*
- ✓ *R. F. Signal Generator for F.M.*
- ✓ *Audio Frequency Generator*
- ✓ *Bar Generator*
- ✓ *Cross Hatch Generator*
- ✓ *Color Dot Pattern Generator*
- ✓ *Marker Generator*

SPECIFICATIONS:

R. F. SIGNAL GENERATOR:

The Model TV-50 Genometer provides *complete* coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available *separately,* modulated by the fixed *400 cycle sine-wave* audio or modulated by the *variable* 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR *(For Color TV)*

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence.* When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

MARKER GENERATOR:

The Model TV-50 includes *all* the most frequently needed marker points. Because of the ever-changing and ever-increasing number of such points required, we decided against using crystal holders. We instead adjust each marker point against precise laboratory standards. 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.)

The Model TV-50 comes absolutely complete with shielded leads and operating instructions. Only _____

$47.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try it for 10 days before you buy. If completely satisfied *then* send $11.50 and pay balance at rate of $6.00 per month for 6 months. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

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Please rush one Model TV-50. I agree to pay $11.50 within 10 days and to pay $6.00 per month thereafter. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

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

The "Minipack #2"

(Continued from page 71)

The 12AX7's second section, a cathode follower, extends the gate's maximum "open" condition by allowing the control grids to operate at a higher positive bias at the top of the control range.

Voltage divider R_7, R_8, and R_9 is proportioned so that the 12AX7's grid #2 permits operation within the class A amplifier range. Output variations in the round-robin manner just described apply as bias to grid #2, starting the regulatory cycle.

C_3 offers a return path to grid #2 for minute output fluctuations caused by a.c. ripple. Filtering results from the round-robin cycle in the same way that voltage regulation is effected, and no filter chokes are required.

The neon bulb, PL_1, has a constant voltage drop of about 55 volts when ignited. Current flowing from "B+" through R_6 causes the bulb to "fire," and its voltage drop is applied to the 12AX7's cathode #3 as a stabilized reference voltage. Potential difference between grid #2 and cathode #3 represents control grid bias, thus variation of potentiometer R_9 allows output voltage control within the pack's specified limits. Grid-to-cathode voltage measures from —0.7 to —3.2 volts over the usable output range.

Construction

The "Minipack" is built in a small utility box measuring 2¼ x 2¼ x 5 inches. All components mount on the "U"-shaped open half of the box, as shown in Fig. 3, allowing easy access for wiring.

SR_1 and SR_2 are mounted on a #6-32 machine screw which passes through both rectifiers and bolts to the chassis. Dual capacitor C_1-C_2 must be insulated from the chassis. As the voltage doubler has no direct connection with either side of the 117 volt a.c. line, the "B—" output is isolated from chassis ground, minimizing the possibility of shock or power line short circuit.

The 50B5 gate tubes mount side by side, which facilitates their parallel wiring. The 12AX7 control tube is located beside the output control potentiometer, R_8. The neon bulb, PL_1, secured within a rubber grommet, protrudes just above the 12AX7 socket's base.

Parasitic suppression resistors R_2 and R_3 are soldered directly between C_2's positive lug and pins 5-6 of the gate sockets. A small stand-off insulator is the "B plus" tie point for C_3, R_6, and R_7, each of which connect directly to other components. Fig. 3 shows how this point-to-point wiring results in neatness and efficient parts location.

Power output connections are made with a cut-down *Jones* barrier strip mounted beneath the neon bulb regulator. PL_1 does double duty as a VR tube and "Power On" pilot lamp.

Applications

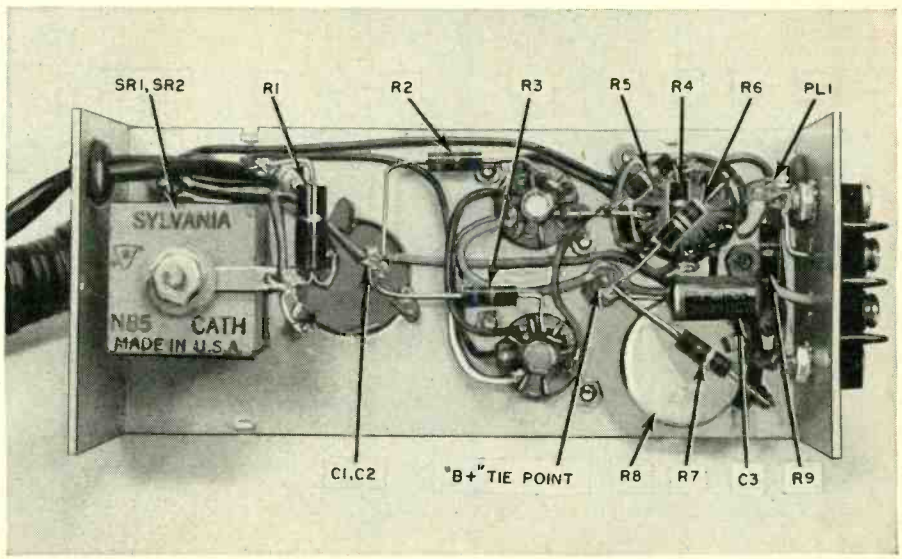
The "Minipack" supplies "B+" to variable frequency oscillators, converters, or any small device requiring well-regulated low current plate voltage. When a bias supply is needed, connect a 500,000 ohm potentiometer across the power output terminals and return "B+" to the biased equipment's ground. Negative bias taken from the pot's center arm is variable from zero to 190 volts.

Don't try to run a kilowatt amplifier with the "Minipack"! A maximum of 35 milliamperes is the limit; excessive current drain results in loss of regulation and consequent a.c. ripple.

Supposing you don't like the idea of a "floating B minus"? Connect a 0.1 μfd., 200 volt paper capacitor from "B—" to chassis, à la table model radios.

Finally, don't put tube shields or fingers on the heated 50B5's. They're designed to operate *hot* . . . almost hot enough to permit the "Minipack" to supply voltage and function as a cigarette lighter too! —30—

Fig. 3. Under chassis view of the power supply with the major component locations identified. The unit may be built on a larger chassis if the constructor desires.



If you're willing to lose your job tomorrow to a technically-trained man,

turn the page, mister

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics. You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. However, you must have some prior electronic experience, either in military service, professional employment, experimenting, or ham operating. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies *you* for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and *grade* your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly specialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge. Ask an electronics engineer, if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer. Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Development; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations *that pay CREI* to train their own personnel: All American Cables & Radio, Inc.; Canadian Aviation Electronics, Ltd.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Hoffman Radio Corp.; Machlett Labs.; Glenn L. Martin Co.; Magnavox Co.; Pan American Airways, Atlantic Division; Radio Corporation of America; United Air Lines. Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon below, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics." It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details. It's free.

Note: CREI also offers Residence School instruction, day or evening, in Washington, D.C. New classes start frequently. If you are a veteran discharged after June 27, 1950, let the new GI Bill help you obtain resident instruction. Check the coupon for more data.

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To help us answer your request intelligently, please give the following information:

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TYPE OF PRESENT WORK .....

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ELECTRONICS EXPERIENCE .....

Name.....

Street.....

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

CHECK: ☐ Home Study ☐ Residence School ☐ Veteran

Mac's Service Shop

(*Continued from page* 80)

quency of that instrument all the way from 100 kc. through 7 mc. while I watched the variation in the height of the trace on the scope. The results convinced me the manufacturer is very conservative in claiming the amplifier is down not more than 5 db at five megacycles. As near as I could determine, it was not down more than 3 db at this point. What delighted me still more was the complete absence of any pronounced hills or valleys in the amplifier response over this whole range."

As Mac finished talking Barney pointed at a cardboard box of tubes sitting on the bench. "Where did these come from?" he wanted to know.

"I gathered them up around the house and brought them down to test them before throwing the bad ones away. And that brings up a gripe of mine. I couldn't test at least a third of those tubes because the type numbers on the glass could not be made out. Why tube manufacturers cannot put the type numbers on the tubes so they can be read for the life of the tube is beyond me. I know it could be done, for you never see a tube so old or beat up but what you can easily make out the name of the manufacturer; and if he can print his name so you can always read it, he can also print the much-more-important tube type number in the same fashion."

"I'm with *you!*" Barney said warmly. "If he can't do that, it would be much better if he arranged to have his name fade out with the type number, because what I think of him when I'm trying to make out that dim etching he wouldn't want to know. When I think of all the cross-eyed looking and peering and puzzling I've wasted on this problem, of all the breathing-on-the-glass, put-'em-in-the-refrigerator, and other dodges to make the faded type numbers appear that seldom work —when I think of all this wasted looking that could so much better have been spent on something worth while like bathing beauty parades, I get mad all over again."

"Not to change the subject, but you forgot to put No. 47 dial lamps on the short list, and I couldn't find one in the shop," Mac gently chided.

"We just can't seem to keep those little cusses in stock," Barney complained. "Dial lamps are a nuisance, anyway, and I'm glad to see several sets are coming out with no dial lights at all."

"Now don't go off half-cocked on that idea," Mac warned. "As far as a.c.-d.c. sets are concerned, a dial lamp can be a technician's best friend. They are as useful to his troubleshooting as the patient's tongue is supposed to be to a doctor's diagnosis."

"Yeah?" Barney doubted.

"Yeah!" Mac said firmly. "Think how a winking 'on' and 'off' dial lamp sig-

nals that a tube filament is developing a thermally-triggered open circuit, and how it settles down and burns continuously when you replace the guilty tube. Remember how often a blooming dial lamp has warned you in time to switch off a set with a short in the high voltage supply and so save the rectifier. A dial lamp that burns brighter than normal is often a clue to a leaky filter capacitor or an output tube with low or reversed bias due to a leaky coupling capacitor or a defective tube. On the other hand, a lamp that is dimmer than normal often points a finger at a weak rectifier or weak output tube. And don't forget that in an intermittent set a dial lamp that flickers up and down in step with the change in volume indicates the intermittent condition is affecting 'B'-current drain and so can save you a lot of looking for the trouble in the wrong places. And . . ."

"OK, OK!" Barney interrupted as he slid off the bench and vigorously brushed the seat of his best trousers. "I'm convinced that a technician can tell more from eying a pilot lamp than a swami can see in a crystal ball. Now I've got to go home and rest up from my Sunday so I can be back here bright and early tomorrow morning."

"Don't make it hard on yourself," Mac said teasingly as he reached for the light switch. "I'll settle for your just being here early." —30—

"HAM OF THE YEAR"

NOMINATIONS for the fourth annual "Ham of the Year" award have been opened by the Edison Radio Amateur Award Committee, according to an announcement from its chairman, J. M. Lang of General Electric Company, sponsor of this top amateur honor.

Judges for this year's award include Under Secretary of State, Herbert Hoover, Jr.; President E. Roland Harriman, American National Red Cross; Commissioner E. W. Webster of the FCC; and G. L. Dosland, president of the American Radio Relay League. Mr. Hoover, an amateur himself, is a new addition to the judging panel this year.

This year's winner will receive a $500 cash award in addition to the trophy and national recognition which has stemmed from the Washington, D. C. presentation ceremonies of the past three years.

Any individual or organization can nominate as a candidate for the Edison Award a radio amateur who has performed some public service. The Award rules specify the public service must have been performed by a licensed American radio amateur while pursuing his hobby in the continental United States. Judging is based on sacrifice, ingenuity, and amount of public service on behalf of an individual or group.

Nominations for the 1955 Award will close at the end of the year and letters of nomination must be postmarked not later than January 3, 1956. Official rules are available from the Edison Award Committee Secretary, Tube Department, General Electric Company, Schenectady 5, N. Y. Nominating letters will be turned over to the judges for appraisal in January and the Award presentation made at a dinner ceremony in Washington, D. C. in February. —30—

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- Sylvania patented linearity circuit.
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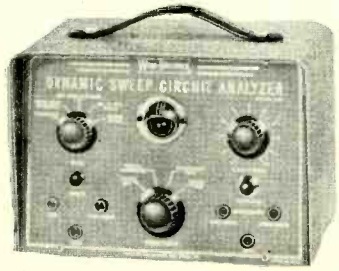

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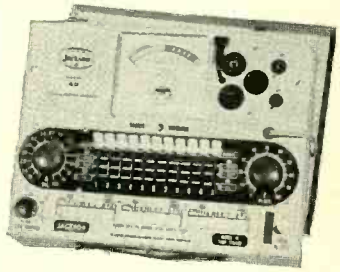

- Quickly checks all modern tubes
- Lever action shows which pins are connected or disconnected
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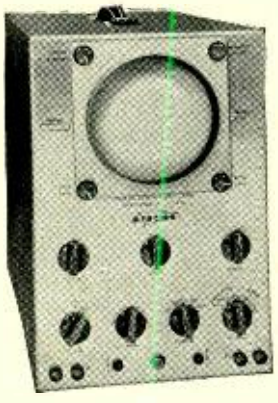

No. 315K 5' OSCILLOSCOPE

- Has frequency compensated vertical and horizontal attenuators along with identical vertical & horizontal amplifiers (within 6db through 500KC).
- Uses 5CP1 type tube with pos accelerator. Both horizontal and vertical sections are cathode-follower input type and are AC coupled. Outputs are push-pull.
- Basic sensitivity is approximately 250 millivolts per inch.
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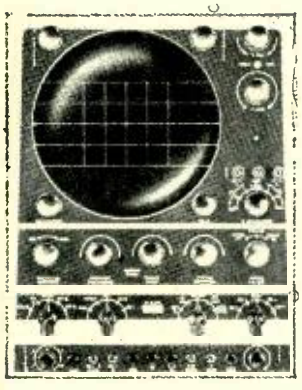

No. 308K 8½' OSCILLOSCOPE

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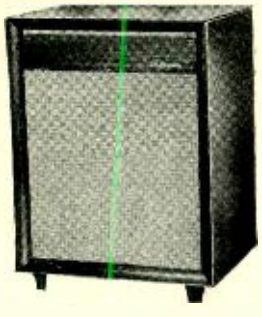

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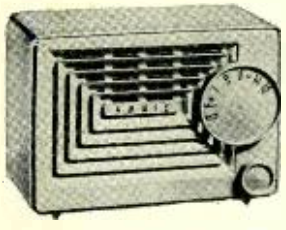

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Hi-Fi-Audio Equipment

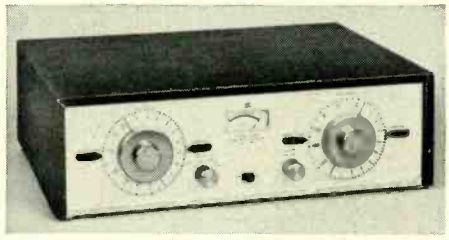
(*Continued from page* 106)

mic or linear response, and is capable of making highly sensitive measurements. The instrument may be used for the analysis of harmonic distortion of all audio components and systems, IM distortion, vibration and noise sources and their reduction and control, Fourier series of complex signals, etc. 125

BINAURAL AM-FM TUNER

Of interest to audiophiles is the recently-announced Type 330-A, AM-FM tuner just released by *Hermon Hosmer Scott, Inc.*

Both binaural operation and multi-



plex provisions are included in the new design to take advantage of the recent FCC ruling permitting multiplexing by FM stations.

The tuner features wide-range distortion-free AM and highly selective, sensitive drift-free FM performance. The AM design permits the full 10 kc. frequency range broadcast by better AM stations to be received. A three position i.f. bandwidth switch allows wide range, normal, or distant reception.

A second model, the Type 331-A, AM-FM binaural tuner, which includes a complete equalizer-preamp, is also available from the company. 126

NEW PRESTO TAPE RECORDER

Presto Recording Corporation is now offering a new tape recorder, the SR-27, a two-speed unit designed for home music systems.

The recorder includes a tape transport mechanism and a 10-watt ampli-

fier, each housed in its own case. The R-27 transport mechanism embodies several of the design features of the company's professional models. It has three individual magnetic heads to record, erase, and play back tape on standard 7" or on the new 8" reels with the NARTB hub. Three separate motors are employed.

The companion amplifier includes a microphone and playback preamplifier, a power supply, and two small speakers for low-level playback. Mike inputs of 50 or 250 ohms and a bridging input are provided. The maximum power output is 10 watts at 15 ohms. 127

CORNER SPEAKER SYSTEM

Brociner Electronics Corp. is handling the U.S. distribution of a new British-designed dual-horn corner loudspeaker system, the "Lowther TP1."

The new system incorporates new design principles in its horn structure as well as in its unique drive unit, the "Lowther PM3." This drive unit is a twin-cone speaker having the exceptionally high field strength of 22,000 gauss, stabilized high-frequency characteristics, and an accurately-controlled, built-in, back air chamber designed to permit true pressure loading.

The back air chamber constitutes an acoustical low-pass filter having a cut-off of 200 cycles. The conventional crossover network is not required in this design.

The system is housed in a 47" x 32"

x 23" cabinet which is available in golden or medium dark mahogany or natural walnut finishes. 128

BELL FM TUNER

Bell Sound Systems, Inc. has added a new FM tuner to its line as a companion unit to its recently-introduced "Golden Twins."

The Model 2254 covers the entire FM band from 88 to 108 mc. and comes complete with a log scale for precision

tuning. The circuit features a grounded grid input stage, a two-stage limiter, true *Armstrong* FM and low dis-

tortion characteristics in the output stage.

The tuner is cabineted in a golden-hued case to match the other units in the line although it is designed to be used with any amplifier. 129

SONOTONE AMPLIFIER

Sonotone Corporation is in production on a compact, 12-watt amplifier which has been designed especially to be used with the firm's ceramic car-

tridges and other cartridges not requiring equalization and preamplification.

The HFA-100 has a frequency response from 15 to 20,000 cps ± 1% with the tone controls in the flat position. The unit incorporates five controls and has four inputs.

Currently the HFA-100 is available in either solid mahogany or solid walnut, with a brass panel. 130

NEW TAPE CATALOGUES

"TAPE-OF-MONTH" RELEASES

Recorded Tape of the Month Club, Inc. has announced that its entire tape library will be made available on a retail basis independent of its Club operation. The catalogue is released on 7" reels recorded at 7½ ips. The recordings range from classical music, pops, jazz, dramatic readings, satire, folk songs, and others. 131

RECORDED TAPE DIRECTORY

Electronic Specialties, manufacturer of the "Fidelivox" tape player, is offering our readers free copies of its new tape directory which lists currently available recorded tapes from a number of manufacturers.

The tapes are classified as to "mood." No attempt has been made to rate the tapes for quality but all are of at least commercial quality or better. The listing includes the recording firm's name and address, label name and number, playing speed, nominal playing time, reel size, playback curve, etc. 132

RECORDED TAPE LIBRARY

Berkshire Recording Company has announced a new library of recorded tapes which includes, in part, recordings of the *Haydn Society.*

Music lovers have a choice of three differently priced series, each designed to meet a specific need. The "Hi-Fi Supreme" series provides up to one hour of recorded material at 7½ ips, dual-track, on a 7" reel. The "Royal Deluxe" series offers a two hour program. This 7" reel is recorded at 3¾ ips, dual-track. The "Extended Deluxe" series provides three hours of recorded material on a 7" reel and is recorded at 3¾ ips, dual-track. 133

—30—

JOIN TWO PHONO CORDS

By ARTHUR TRAUFFER

THIS shielded connector is easy to make and allows two phono cords, or any other kind of cords with phono plugs on them, to be quickly joined together. This connector is simply a metal can containing two standard phono jacks wired in parallel.

Any small can, at least 15/16" in diameter, having a friction lid is OK. The writer uses metal "Herb-Ox" bouillon cube cans. As shown in Fig. 1, cut off a 1¼"-long bottom section using a thin-blade, fine-tooth hacksaw, and then file the sawed edge smooth. Drill the three necessary holes in the bottom of the can and install a standard phono jack in the usual manner. Then install another phono jack in the lid of the can, as shown.

Wire the two jacks in parallel using insulated flexible wire or, if desired, just run a wire from the center electrode lug of one jack to the center electrode lug of the other jack, and let the metal can act as the connector for the two outside electrodes of the jacks. In the latter case, be sure that the jacks make good contact with the can lid and can bottom, and be sure that the lid makes good contact with the bottom. When completely wired, solder the lid to the can's bottom section.

As shown in Fig. 2, the writer simply wrapped a 1¼" wide strip of "Mystik Tape" around the can to improve its appearance. Otherwise, the can could have been given a coat of enamel to cover the lettering. —30—

Fig. 1. A small bouillon cube can is used to make this phono cord connector unit.

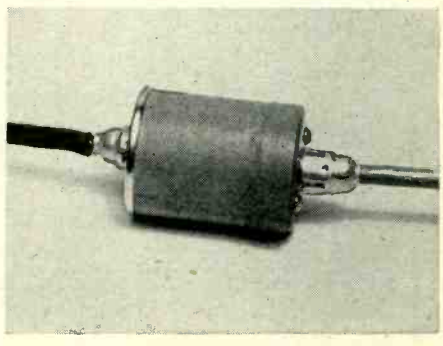


Fig. 2. The completed construction. Mystik tape is wrapped around to improve looks.

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9. Exclusive photo coverage of all chassis views is provided for each receiver.
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12. Complete, detailed alignment data is standard and uniformly presented in all Folders.
13. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

TUBE PLACEMENT CHARTS

14. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.
15. Blank pin or locating key on each tube is shown on placement chart.
16. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

17. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.
18. Series filament strings are schematically presented for quick reference.

COMPLETE PARTS LISTS

19. A complete and detailed parts list is given for each receiver.
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21. All parts are keyed to the photos and schematics for quick reference.

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(*Continued from page* 30)

fornia . . . Appointment of **CHARLES ROBBINS** as vice-president of *Sonora Radio & Television Corp.* has been announced by the company. He formerly held a similar post with *Emerson* . . . **LUTHER M. SANDWICK** is the new sales manager of *Pilot Radio Corporation.* He was formerly with *Bell & Howell Company* . . . **RALSTON H. COFFIN** has been elected vice-president, advertising and sales promotion, for *Radio Corporation of America.* He has been with the firm since 1949 . . . **G. LEONARD WERNER** has been named director of sales and **JOHN P. YOHE** director of purchases for *Astatic Corporation,* Conneaut, Ohio . . . **WILLIAM B. KESSLER** is the new general sales manager of *Milo Radio & Electronic Corporation* . . . **REAR ADMIRAL ARTHUR S. BORN, USN** (Ret.) has joined *Collins Radio Company* as assistant to the vice-president, research and development. His most recent assignment prior to his retirement was in the Office of the Assistant Secretary of Defense (Applications Engineering) . . . **GWILYM A. PRICE,** president of *Westinghouse Electric Corporation* since January 1946 was elected chairman of the board and president of the firm. The board chairmanship has not been occupied since 1951 . . . *Precision Radiation Instruments, Inc.* has named **ROBERT F. KAUFMAN** to the post of vice-president in charge of advertising and public relations . . . **LOUIS MARTIN** is the new general sales manager of the *Westinghouse* Electronic Tube Division in Elmira, N.Y. He was formerly general sales manager of *Standard Coil Products Co., Inc.* —30—

"Ultra-Linear" Williamson

(*Continued from page* 54)

power amplifier makes itself felt by the generation of new combination tones which further change the identity of a musical instrument, and produce the effect of blurring the sound. This latter effect can be easily demonstrated in a comparison test by playing a poor recording with lots of surface noise. The noise will be there in each instance, but will be much less objectionable with an amplifier of lower distortion. Finally, one must recognize that a condition of interaction exists between the speaker and the power amplifier. A high power amplifier of low and constant internal impedance exerts better control over the speaker characteristics at high peak powers.

REFERENCES

1. *Keroes, Herbert I.:* "*Building the 'Williamson' Amplifier,*" RADIO & TELEVISION NEWS, *December 1950.*
2. *Hafter, David & Keroes, Herbert I.:* "*Improving the Williamson Amplifier,*" RADIO & TELEVISION NEWS, *February 1953.*
3. . . . . *Wireless Engineer (Editorial), August, 1955.*

—30—

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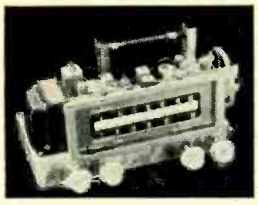

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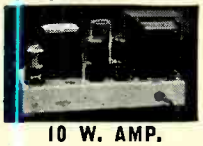

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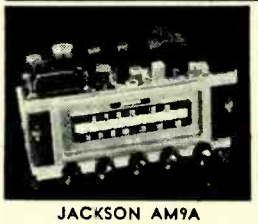
BOTH FOR **$44.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 3 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased, we will include the necessary pre-amp, no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 2—6BA6, 6AT6, 6AL5 and 6X4 rectifier. Amp has 2—6V6's, 6SN7 and rectifier. Full superhet circuit with AVC. 3 position tone control, 9" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone control, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. FA9-2CR tuner and amplifier complete. Ship. wt. 22 lbs. Sale price, $44.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.



JACKSON AM9A

9-TUBE HI-FIDELITY

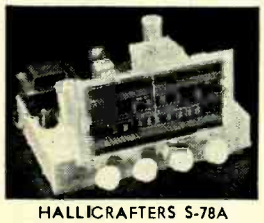
12 Watts Audio
Dual Tone Controls

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9½" x 6" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 19 lbs. Sale price, $39.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

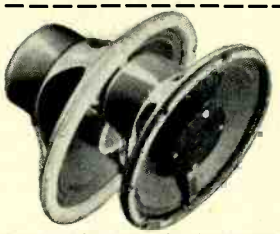
11-TUBE FM-AM HALLICRAFTERS



HALLICRAFTERS S-78A

Regular $89.50
McGEE'S SALE PRICE **$69.95** LESS SPEAKER
★ HIGH FIDELITY
★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom chassis. Size 73/8" x 12½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 3.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. This chassis found in $400 to $600 radio combinations. Has input for crystal phono pickup. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.
S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price..... $69.95
CU-14Y, 12" COAX SPEAKER $10.00 EXTRA. 15" COAX SPEAKER $20.00 EXTRA.



McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

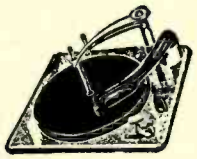
$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.

WEBCOR 3 SPEED CHANGER

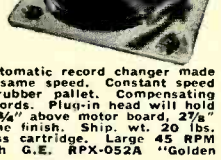
WITH RPX-050 G. E. CARTRIDGE **$29.95**



114-43, Webcor 3 speed automatic record changer with G.E. RPX-050 variable reluctance cartridge. Plays all 3 speeds and all 3 sizes. Shuts off after last record. Has neutral position to prevent damaging drive wheels. Size, 13½" x 12". Ship. wt. 12 lbs. Sale price..... **$29.95**

REGULAR $65.00 LIST COLLARO 3 SPEED HI-FI CHANGER

Imported from England — Sale Price **$38.95** Less Cartridge



Regular $65.00 list Collaro Model 3/532, 3 speed automatic record changer made in England. Intermixes 10" and 12" records of the same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and Std. records. Plug-in head will hold any popular cartridge. 14¾" long, 12¾" wide and 4¾" above motor board, 2⅞" below. Available in grey, cream and gold hammertone finish. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95, less cartridge. Large 45 RPM spindle $3.30 extra. 3/352 Collaro changer with G.E. RPX-052A "Golden Treasure" cartridge, $58.95.

ENGLISH GARRARD CHANGERS

RC-80 WITH GE RPX052A $68.51

RC-80 Garrard, 3 speed automatic record changer. Shuts off after last record. Heavy 4 pole AC motor and weighted turntable gives constant speed. Muting switch silences pickup during change cycle. Separate plug-in head to fit all cartridges. 13¼" wide, 15½" deep and 8" high. 2½" below motor board. Net price, less cartridge, $48.51, with flip-over crystal cartridge, $52.46, with G.E. RPX-052A "Golden Treasure" cartridge, $68.51. 45 RPM spindle $3.43 extra.

RC-90 w. GE RPX052A $88.11

RC-90 Garrard "Crown" 3 speed automatic record changer. All of the features of the RC-80 plus adjustable speed control to regulate speed faster or slower on all 3 speed settings. Has manual position for playing single records. Separate plug-in heads to fit all cartridges. 15½" long, 13½" wide, 5¾" above motor board, 3⅞" below. Finished in cream and brown. Ship. wt. 19 lbs. Net price, $68.11, less cartridge, with flip-over crystal cartridge, $72.06, with G.E. RPX-052A "Golden Treasure" cartridge, $88.11. 45 RPM spindle $3.43

TELEVISION CONSOLE CABINETS AT LESS THAN FACTORY COST!

FOR YOUR TV CHASSIS—MODELS FOR 27 INCH TO 16 INCH CHASSIS

RT-21MA $49.95 — KL-27X $39.95 — $59.95 — $59.95

$29.95 — $19.95 — NRT-21M $59.95 — BT-210 $22.95

21" MAHOGANY ½ DOOR TV-PHONO CABINET $49.95

RT-21MA. Mahogany Television-Phono combination cabinet with half doors, for 20" and 21" TV chassis and record changer. 36½" high, 39¼" wide and 22" deep. Baffle cut for 12" speaker. TV compartment 21½" high, 21¼" wide and 19" deep will hold most 20" and 21" chassis. Changer shelf 15" x 16" with 9" height clearance. Ship. wt. 75 lbs. Sale price, only $49.95. 21" gold trim plastic safety shield and mask to fit cabinet, $6.95 extra.

24"-27" MAHOGANY TV CABINET $39.95

Large mahogany open face cabinet for 27" or 24" television chassis. 44" high, 30¼" wide and 24¼" deep. Will hold a TV chassis 29" high, 29" wide and 23½" deep. Offered at a fraction of the manufacturer's cost. Limited quantity available. Has room for 8" or 10" speaker. This cabinet and other TV cabinets listed might also be converted to a high fidelity speaker baffle. Stock No. KL-27X. Ship. wt. 90 lbs. Sale price $39.95. Blank front panel available at $5.00 extra.

27" Mahogany Full Door Cab. $59.95

(a) No. 27-MA. Mahogany with full doors for 21", 24" and 27" TV. 43" h. 30¼" w. 23" deep. Chassis area 27¾" w. 25" h. 18¼" deep. Baffle for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

27" ¾ Door Mahogany Cab. $59.95

(b) No. 27-34MA. Mahogany with ¾ doors for 21", 24" and 27" sets. 43" h. 31¼" w. 22¾" deep. Chassis area 27½" w. 26¾" h. 21" deep. Baffle cut for 2 10" speakers. Made for one of America's largest TV builders. Cost over $100. Ship. wt. 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

17" FULL DOOR $29.95

Fig. (e) No. AH-430, Mahogany with full doors. 36" h., 24" w., 21¾" deep. Chassis area 22" w., 17¾" h., 18¾" deep. Blank panel. Holds 17" TV easily. Baffle cut for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price, $29.95.

17" with PHONO DRAWER $19.95

Fig. (g) SE-21, 17" mahogany TV cabinet with phono drawer 40" h., 24" w., 18½" deep. Blank panel. TV chassis area 19" h., 20½" w. Changer drawer 19¾" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price, $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M, Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22¾" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 85 lbs. Sale price, $22.95. No. WT-210, walnut 21" TV cabinet, same as above, Sale price, $19.95. No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

6-TUBE, 2-BAND RADIO KIT $14.95

6-18 MC 550-1650 KC

6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model ME6-2, Net $14.95.

8", 10", 12" SPEAKER-BAFFLE COMBINATIONS

8" - $3.95 — 10" - $4.95 — 12" - $6.95

Our most popular speaker-baffle combinations. Brown leatherette covered wood baffle and 8", 2.5 oz. Alnico V magnet speaker. Most economical wall speaker. Stock No. 818-X. Sale price, $3.95 each. Lots of 3 or more, $3.79 each.
Brown leatherette covered wood baffle and 10", 3.16 oz. Alnico V magnet speaker, at little more than the 8" size. Stock No. CA-10Z. Sale price, $4.95. Lots of 3 or more, $4.79 each.
Brown leatherette covered wood baffle and 12" RCA PM speaker. A terrific McGee value. Only 500 to sell. You get the baffle and speaker for the value of the speaker only. Stock No. RCA-B12. Sale price, $6.95. Lots of 3 or more, $6.79 each.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

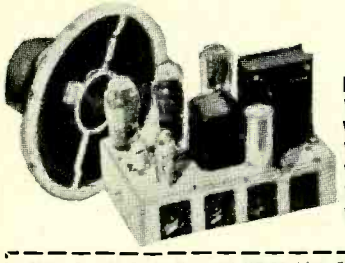
AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

NEW 7 TUBE—30 WATT AMPLIFIER MODEL HF-30—SALE PRICE $29.95

New, 7 tube 30 watt Model HF-30 high fidelity amplifier. Response 30 to 17,500 cps. Separate bass and treble boost tone controls. Inputs for crystal or dynamic microphone, crystal or variable reluctance phono pickup and TV or radio tuner. Ideal for home music systems or for background music in stores, factory or office. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes: 2-6L6, 2-6C4, 6AT6, 6AU6 and 5U4G rectifier. Model HF-30, 7 tube, 30 watt High Fidelity amplifier, Sale price, $29.95.

6 TUBE - 20 WATT HI-FI MODEL HF-20—SALE PRICE $22.95

RESPONSE 30-17,500 CPS—PUSH PULL 6L6 OUTPUT—TWIN TONE CONTROLS
INPUTS FOR MIKE AND CRYSTAL OR V.R. PHONO PICKUP



MODEL HF-20:

With CU-14Y, 12" Coax Speaker.....$32.95
With CX-156, New 15" Jr. Coax.....$37.95
With P15-CR, 15" Coax Speaker.....$42.95
With Imperial IV Speaker System.....$39.95
With SP-12125 CR Speaker System.....$44.95
With HF-33GE Speaker System.....$69.95
(Add $7.00 for HF-30 Instead of HF-20)

A tremendous High Fidelity amplifier value. Response 30 to 17,500 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes; 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, $22.95.

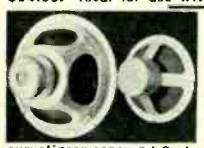
This amplifier is recommended for use with the speaker systems described below, as well as the 12" and 15" coaxial PM speakers shown on the opposite page. HF-20 amplifier with CU-14Y, 12" coaxial PM speaker, $32.95; with P15-CR, 15" coaxial PM speaker, $42.95; with Imperial IV speaker system, $39.95; with SP-12125CR speaker system, $44.95; with HF-33GE speaker system, $69.95. If the HF-30 amplifier is desired, add $7.00 to the above combination prices.

25 WATT HI-FI SPEAKER SYSTEM

2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE $24.95

25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply for only $24.95. Frequency response 20 to 18,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 2000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.
No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.95. Ideal for use with HF-20 and HF-30 amplifiers described above.

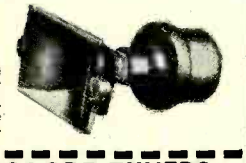


HIGH FIDELITY SPEAKERS

5" BLUE STREAK TWEETER.....$ 2.95
8" BLUE STREAK.....$ 6.95
15" BLUE STREAK WOOFER.....$16.95

Model HF-8J, 8" "Blue Streak." High Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,500 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt. 6 lbs. Model HF-8J. Sale price, $6.95.
Model HF-15WF, new 15" "Blue Streak" HiFi woofer. Has 21½ oz. Alnico V magnet with curvelinear one piece cone and 1¼", 8 ohm voice coil. Will give excellent response from 50 to 9500 cps. Takes 18 to 25 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.

2000 CYCLE L-C NETWORK $4.95
EXTRA—MODEL 4401 UNIVERSITY TWEETER $14.70



Model CR-2000, 2000 cycle L-C type crossover network. Regular $9.95 net, only $4.95 extra when purchased with either of the "Blue Streak" speakers and the Model 4401 University tweeter.
University Model 4401 single tweeter. Frequency response 2000 to 15,000 cps. Ideal for use with "Blue Streak" woofer and CR-2000 crossover network. Net price $14.70.

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.

Have Juke Box tone quality in your own home. Strictly High fidelity. These speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE, Sale price, $49.95.
Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)
Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

DELUXE CONSOLE SPEAKER SYSTEM $89.50

15" UTAH WOOFER—8" GE—2 - 5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity console speaker system. Has 15" Utah woofer with 21 oz. Alnjco V magnet, 8" model 850 G.E. mid-range speaker and two Utah 5" tweeters. This is the finest console speaker system that we offer. Available in blond oak or natural mahogany finish. Cabinet size, 43" high, 31" wide and 23" deep. Has 3¼" length doors with attractive hardware and ornament on grill below doors. All 4 speakers are connected to a 600 cycle frequency dividing network, so that there are only 2 wires to connect to any 4 or 8 ohm output of your radio or amplifier. Has variable tone compensating control built-in. Model HF-15CR4, deluxe quality Hi-Fi console speaker system. Ship. wt. 100 lbs. (Specify cabinet finish desired.) Sale price, $89.50.

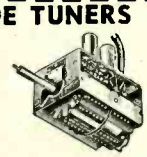
NEW IMPERIAL IV with General Electric

8 in. HIGH FIDELITY SPEAKER $19.95

New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric 10 Tended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95. Ideal for use with HF-20 and HF-30 amplifiers described above.

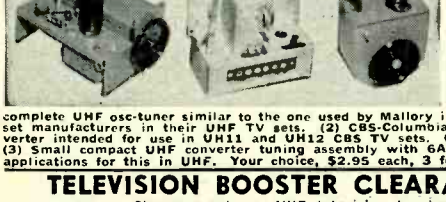
FAMOUS STANDARD COIL CASCODE TUNERS

SALE PRICE $12.95



2 FOR $25.00

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.
No. TV-40D1-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.
Matching knobs for Standard Coil tuners. Set No. 5CK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.



UHF CONVERTER TUNERS $2.95
3 FOR $7.50

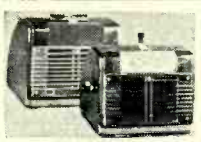
Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory inducto-tuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH12 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice, $2.95 each, 3 for $7.50.

TELEVISION BOOSTER CLEARANCE SALE

Clearance sale on VHF television boosters for channels 2 through 13.
RMS Model SP-5, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascode front end. Sale price.....$4.95
RMS Model SP-6, brown plastic case. Same as SP-5 except has variable gain control. (Pictured.) Sale price.....$4.95
McMurdo-Silver GB-6B continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price.....$5.95
Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price.....$6.95

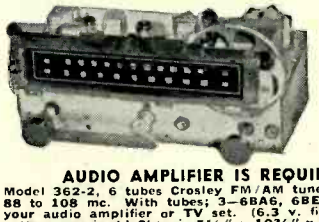
PHILCO SPEAKER SALE!

GENUINE PHILCO FIELD COIL DYNAMIC SPEAKERS. 3.2 OHM VOICE COIL. INDIVIDUALLY CARTONED. BUY AT LESS THAN FACTORY COST.
8" 1700 or 2500 Ohm Speaker...$1.29
10" 1700 or 2500 Ohm Speaker...1.49
12" 1700 or 2500 Ohm Speaker...1.99
BUY 12 ASSORTED AND WE WILL SHIP A BAKER'S DOZEN (13 SPEAKERS FOR THE PRICE OF 12).



3-STATION MASTER SUB-STATIONS $3.95 EACH $16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MPM-A3. Ship. wt. 10 lbs., $16.95. Matching sub-station PM-A5, with 5" PM and call-back switch, $3.95 ea.; 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft.; 500 ft. for $8.95.



CROSLEY FM-AM TUNER

SALE PRICE $19.99

AUDIO AMPLIFIER IS REQUIRED TO OPERATE A SPEAKER

Model 362-2, 6 tubes Crosley FM/AM tuner. Receives broadcast 550 to 1600 kc, FM 88 to 108 mc. With tubes; 3—6BA6, 6BE6, 12AT7 and 6T8. Power this tuner from your audio amplifier or TV set. (6.3 v. filament and 125 to 180 v. at 20 mils "B" voltage required.) Chassis 5½" x 10¾" x 5⅜" high. Illuminated slide rule dial 8½" long. 4 position switch selects FM, AM, TV or Phono. One-half of 6T8 used as pre-amp for variable reluctance pickup. Has no volume control. Audio is fed to your TV or hi-fi amp. These are new Crosley FM-AM tuners that cost over $20.00 to build.
Model 362-2, complete with escutcheon, knobs, diagram, instructions and parts list. Ship. wt. 9 lbs. Sale price, $19.99.
Crosley 362-2VC, same as above but has volume control and power supply added to make a self-powered AM-FM tuner. Ship. wt. 10 lbs. Sale price, $24.99.
Note: An Audio amplifier is required to operate these tuners thru a speaker.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

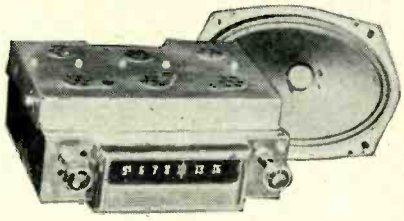
6 TUBE UNIVERSAL MOUNTING AUTO RADIO $19.99

LESS THAN FACTORY COST!

★ A SENSATIONAL AUTO RADIO VALUE AT A TERRIFIC LOW PRICE.
★ MADE BY A BIG NAME MANUFACTURER.
★ FULL SUPERHET—WITH TUNED R.F. STAGE—6 TUBES—TONE CONTROL.

McGee makes another tremendous purchase and passes the saving on to you. This universal mounting, 6 tube, 6 volt auto radio is a full superhet with fully tuned R.F. stage. Made to sell at a much higher price, by one of America's best known manufacturers. Its very thin and compact construction lends it to a neat underdash installation in most any car or truck. Or, you can arrange a place in the dash for custom installation. (Dial requires a cutout 5⅛" long x 2½" high; two control holes on 7" centers. A minimum of 6¾" depth behind dash.) When mounted underdash it extends only 2⅛" below. Overall size; 9" wide, 4¼" high and 7¼" deep. Requires no more room under your dash than an ordinary auto radio remote control head. Not intended for an exact custom panel fit, but it lends itself very well for your custom installation ideas. Can be custom fit in most late model cars and trucks. Has no built-in speaker, but is furnished with a heavy duty 6x9" speaker. This is the most popular size auto radio speaker. Tubes: 6BE6, 2—6BD6, 6AV6, 6AQ5 and 6X4. Ship. wt. 12 lbs. Stock No. AH-759. McGee's sale price, $19.99 for the radio complete with 6x9" speaker. 3 section top cowl antenna, $2.29 extra.

New Snyder Rear Deck Dual antenna kit $6.95 extra. Has two 3 section antennas and 15 ft. connecting cable with "High-Q" auto antenna booster. Model RD-8B, Ship. wt. 4 lbs.



6-TUBE, 6-VOLT UNIVERSAL MOUNTING AUTO RADIO

$19.99 WITH 6" x 9" SPEAKER

CAN BE CUSTOM FIT INTO THE DASH OF MOST LATE MODEL CARS AND TRUCKS

ESPEY

1st Offering—by a Famous Maker

14-Tube FM-AM Chassis
Williamson Type Circuit
Ultra-Linear Response—
20 to 22,000 CPS

SALE PRICE **$84.95**

LESS SPEAKER

With 15" Coax. $99.95

10 WATTS HI-FI AUDIO

New 1956 model, 14 tube FM-AM chassis. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt radio. You could spend $200 to $250 for a separate tuner and amplifier and not have the quality of this receiver. 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 at 2 watts. 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, $84.95. With heavy duty Utah 15" coaxial PM speaker, both for only $99.95.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

A sensational value. A 50 watt booster amplifier with push-pull, parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X pre-amplifier to allow the use of 2 microphones and one low level input. The amplifier has one input jack with 1 volt input giving 50 watts of audio. Amplifier has a 6 lb. potted case high fidelity output transformer with taps at 4-8-16-60 and 250 ohms. 225 mil power transformer and 5U4G rectifier. Includes tubes: 4—6L6, 7N7 and 5U4G. Two variable tone controls for master volume and bass boost tone control. Chassis size, 8" x 6½" x 14½". Model No. PA-55N. Ship. wt. 26 lbs. Sales price, $39.95. PR-2X, 2 mike input pre-amplifier plugs is directly to the PA55N 50 watt booster amplifier. Allows use of 2 microphones, either crystal or dynamic and one low level input. Furnished with 4 ft. connecting cable and plug for remote control of the 50 watt booster. Chassis size, 5¾" x 3½" x 2½". Model PR-2X, Sale price, $12.95.

MINIATURE BROADCASTING STATION FOR THE HOME

NEW 1955 MODEL WITH CRYSTAL MIKE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

ATTENTION! TV SERVICEMEN

PICTURE TUBE RESTORER-TESTER

NEW—POWERFUL TRANSFORMER OPERATED $49.95

Designed to rejuvenate television picture tubes that have become weak due to cathode deterioration. Also repairs shorts and welds open elements in most cases. We have tested several makes and offer this unit as the best value in its field. This unit weighs a full 20 lbs. It incorporates a heavy power transformer. It is more equipment and more for your money. Will perform as well as units selling above $100.00. Relay controlled flashing cycle reduces operating technique to a simple operation. Effective on 90% of all picture tubes. A built-in test feature gives quality test on new or old tube to determine condition before and after rejuvenation. We think every active TV Service Dealer should have a rejuvenator of this type. Operating instructions included. Fully guaranteed. Stock No. AJ-59, ship. wt. 20 lbs. (not mailable). Sale price, $49.95.

NEW—SMALL VOLT-OHM METER

2000 OHMS PER VOLT AC-DC WITH TEST LEADS

McGEE SCOOP SALE PRICE $9.95

2 FOR $19.50—4 FOR $37.00

New, small Volt-Ohm meter 5¼" tall, 3⅝" wide and 1½" thick. 3¼" meter. Sensitivity 2000 ohms per volt. DC volts 0 to 1000 in 5 ranges; AC volts 0 to 1000 in 5 ranges; DC current 0 to 500 ma. in 3 ranges; Resistance 2 ohms to 1.5 megohms in 3 ranges; Decibels minus 20 to plus 16 (0db .774 volts). A thin, compact instrument small enough to fit in your service kit. A fine imported meter specially priced at $9.95 for this Radio & TV News ad. Never before have we offered an instrument value like this. Model TP-5, complete with test leads. Sale price, only $9.95. Ship. wt. 2 lbs. Special quantity price, 2 for $19.50, or buy 4 for only $37.00.

New, larger size Volt-ohm meter Model MT-1A, 6¼" tall, 4¼" wide and 2⅝" thick. 2000 ohms per volt. Similar in appearance to Model TP-5, except that it is larger, has 3½" meter and 4 resistance ranges instead of 3. Model MT-1A. Ship. wt. 2 lbs. Sale price, $12.95 each, 2 for $25.00.

$100.00 LIST—12 VOLT BUICK AUTO RADIO $39.95

Fits All '53 Models Except Special

No. 981323. 8 tube 12 volt Buick radio. Custom made for all '53 Buicks except the Special. Cost over $100 retail. Magic Selectronic single push-button tunes set electronically. Built-in 8" speaker, tone control, PP 12V6 audio. Ship. wt. 20 lbs. Sale price, $39.95.

6" SESSIONS CLOCK-TIMER

With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9⅝" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¾" x 4" high and 2⅜" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63, Sessions Clock Timer with case of your color choice. Sale price only $3.95.

$59.95 TIMEX MAGNETIC RECORDER

SPECIAL SALE PRICE $29.95

CRYSTAL PICKUP TO PLAY PHONO RECORDS $2.95 EXTRA

SALE PRICE $29.95

MODEL 40 TIMEX

RECORDS AND PLAYS BACK PLAYS 16⅔ AND 45 RPM RECORDS

A product of United States Time Corp. (Timex). A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adaptor and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 9½x11½x4⅞". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-R1 recorder, ship. wt. 13 lbs. Sale price, $29.95.

Recording discs, package of 6 for 99c. One blank shipped with recorder.

You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER.
BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

Spot Radio News

(*Continued from page* 24)

minimum of six contacts to the chassis, required to operate any one of the three proposed decoding systems.

To break the toll system using a code card, the brief said, it would only be necessary to install a series of rotary switches that would duplicate the switching operations performed by the card. The same technique could be used for the other scrambling plan, it was also noted. In other words, the Commission was told, it is possible to devise an *electronic skeleton key* that would automatically open all of the locks in the code chain.

Commenting on the coin-operated device, the brief reported that even here the code could be broken, even though the coin-operated switch was an intricate device linked to a decoder which consists of 19 tubes, five relays, six solenoid-operated ratchet devices, an electric motor and an assortment of gears, cams, sprockets, and electronic components. The only function of this elaborate equipment, it was noted, is to switch on the decoder, in much the same fashion as the second dime in a telephone coin box brings on the dial tone. This entire mechanism could be replaced with an "off-on" toggle switch, the FCC was told.

All of these weaknesses, said the brief, could be overcome with a wired system, which utilizes no coding; programs would be available only to subscribers tapped on to the system. To prove the validity of the wireless code-breaking point, the Commission was told that a supervised demonstration could be held. One station in Philadelphia was described as willing to participate in such a test. And to prove the practicality of the wired idea, the brief added, the company was planning to make its own public-acceptance tests in Casper, Wyoming; Tyler, Texas; and Muscle Shoals (Florence, Sheffield and Tuscumbia), Alabama.

In support of the toll plan, the Chicago set-maker proponent said that his method is the . . . "only one yet suggested, short of government financing and control, that would dilute network domination of the broadcast industry and permit TV to become a truly national and competitive service, such as contemplated by Congress in the Communications Act and by the FCC in its allocation of TV channels."

AN ELECTRONIC DEVICE, a lightweight detector (about twenty ounces), designed to add electronic eyes to ground observer personnel during periods of darkness or poor visibility, that will tighten our air defense, has been developed by engineers of the Air Research and Development Command's Rome (N. Y.) Air Development Center at Griffis Air Force Base.

Mounted on a hat, the receiver operates on the basis that any enemy aircraft penetrating our defenses would

OLSON RADIO FOR GREATEST BUYS IN RADIO AND TV SUPPLIES

NEW "DELUXE" 13-WATT HI-FI AMPLIFIER

LIST $79.50
Stock No. AM-9
OLSON'S PRICE..... $34.95

New **PRINTED** Circuit in a completely modern style metal case to match any music system made. Freq. response ± 1 db, 20-20,000 cps. Damping factor 6, 6-8 or 16 ohms output impedance. Hum 70 db below rated output. Continuously variable bass compensator, 11 db boost at 50 cycles. Sensitivity: Tuner—7 volts, magnetic phono—8 millivolts equalized for RIAA recording curve, and crystal phono—.25 volts. Front panel controls are: Volume, Bass, Treble and Tuner-Magnetic-Crystal Function Switch. Panel and case finished brown hammertone with yellow markings. AC outlet at rear for tuner or recordplayer. Operates on 115 V, AC 60 cycles. Supplied complete with full instructions for operation and use, and 5 tubes (2—6V6GT, 2—12AX7, 1—5Y3). Two of the tubes are dual purpose hence results are equivalent to a 7 tube outfit. Shpg. wt. 15 lbs. Size: 11" x 5" x 4".

"SUPER DELUXE" 13-WATT HI-FI AMPLIFIER

LIST $99.50
Stock No. AM-10
OLSON'S PRICE ONLY.... $44.95

Has all of the above features plus practically every other significant feature available in Hi-Fi Amplifiers today. Loudness control—provides proper response to conform to the characteristics of the human ear. Three position high frequency roll-off switch for 8, 12 and 16 db. Three position low frequency turnover, for LP, AES and RIA recording characteristics. Two position contour switch. Two position rumble filter to suppress scratch, hiss, rumble; makes your old records sound like new. Front panel controls are: Loudness, Treble, Bass, High-Frequency Roll-Off, Low-Frequency Turnover, Selector for Tuner, Magnetic Phono or Crystal Phono, Contour Switch, and Rumble Switch. Housed in attractive ventilated satin black finished steel cage, panel finished in gold with black markings. Front panel illuminated. Operates on 115 V, AC 60 cycles. Shpg. wt. 15 lbs.

FAMOUS UTAH 12" COAXIAL SPEAKER

Stock No S-226 $12.95

Latest Design
Parabolic Woofer
with 3½" Parabolic Tweeter

This Utah 12" dual range reproducer compares in every respect with highly advertised $50.00 units—yet COSTS LESS than most speakers. Exclusive built-in cross-over network ensures a frequency response from 35 to 15,000 cycles. The handling capacity is a full 12 watts. Ideal for any custom installation. Voice Coil impedance—8 ohms. Shipped in factory sealed cartons. Shpg. wt. 9 lbs.

12" WOOFER SECTION, through its modern parabolic seamless cone, faithfully delivers all the true natural bass and middle register tones. The cadmium-plated heavy gauge frame offers top protection and durability plus secure distortion-free cone mounting. The heavy duty 6.8 oz. Alnico Magnet guarantees long, powerful life. Special corrugated impregnated dust proof spider assures dependable voice coil alignment and the braided phosphor bronze voice coil pigtails provide trouble-free performance.

3½" TWEETER SECTION truthfully reproduces all the clean and brilliant highs of truer High Fidelity recording. Combined with the 12" woofer—even the most critical music lover will be thrilled by its magnificent dual range performance. The 3½" tweeter features the latest parabolic cone, a .68 oz. Alnico 5 Magnet and a strong heavy gauge cadmium plated frame. This special parabolic tweeter cone and rigid dust cover contribute toward improved high frequency response and sound distribution.

BRAND NEW TV PICTURE TUBES

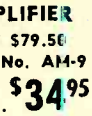
Guaranteed A Full Year • Dark Face • Individually Boxed • No Trade-In Required • Keep Your Old Tubes • Guarantee Registration Card Included

Factory Sealed Cartons. Every one guaranteed a FULL year and every one is shipped with manufacturers registration warranty card. Tubes carry the famous Olson Akrad label. No need to send in old tubes on trade-in. You can keep them and sell locally.

All tubes are standard in every respect and have magnetic focus and deflection. All have dark face for best picture contrast. Cash in now on this unheard of bargain. Guaranteed perfect arrival by Railway Express.

STOCK NO.	TYPE	OLSON SPECIAL
TU-3	12LP4A	$12.95
TU-4	16KP4	16.95
TU-5	16RP4	16.95
TU-6	16TP4	16.95
TU-7	17BP4A	17.95

"GOLDEN GATE 8" SPEAKER"



with "Whizzer" Sound Disperser
Stock No. S-229
List Price $12.50
Olson's Price, Ea. $4.44
2 for $8.50

Finely finished in all gold lacquer. Dealers, order these speakers for installation where space is a factor. Will outperform many 12" units. Employs two concentrically mounted cones for extremely smooth reproduction at high or low volume. Small cone in center of large cone is called a "Whizzer" and provides extended treble response, good overall balance and wide dispersion angle. Equipped with heavy Alnico 5 magnet and cover. Power handling capacity 8-10 watts. Response 40-12,500 cps. Speaker cone 8" diameter, voice coil 8 ohms. Shpg. wt. 5 lbs.

The Royal Monarch AUTOMATIC RECORD CHANGER

3-SPEED
MADE IN ENGLAND
TWO MODELS
VARIABLE RELUCTANCE MODEL

CRYSTAL MODEL
REG. LIST $69.95
REG. WHOLESALE PRICE $41.97
SPECIAL
$28.95
Stock No. RP-5
Equipped with dual crystal turnover cartridge with 2 sapphire needles.

REG. LIST $79.95
REG. WHOLESALE PRICE $47.97
SPECIAL
$32.95
Stock No. RP-6
Equipped with GOLDRING 500 turnabout Magnet (Variable Reluctance) Cartridge with 2 sapphire needles.

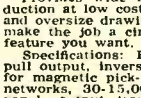
The Only Record Changer to Carry Exclusive Gold Cross Guarantee: Fully Guaranteed for ONE YEAR, against all failure. This includes the motor, cartridge and every moving part. If the "Monarch" Changer should fail for any reason, Olson Radio Warehouse will repair or replace the entire unit FREE.

"The Changer that obsoletes all other changers" • Plays Intermixed 7-10-12" records • "MAGIDISK" selector enabling 7", 10", and 12" records to be automatically selected and played at 33⅓, 45 or 78 rpm • TEN record capacity—INTERMIXED in any order • Pick-up automatically returns to rest and motor switches itself off after last record • Reversible dual sapphire stylus cartridge delivers full tonal range to over 10,000 cps. • "Roto-com" equipped. Control for ON-OFF, REJECT • Turntable heavily weighted, covered with rubber mat and runs in friction-free Ball Bearing Race • Oversize 4-pole induction motor • Base is mounted on suspension springs. Shpg. wt. 15 lbs.

MONARCH MOUNTING BASE. Top is cut to fit the "Monarch" Changer. Mahogany finish. Size approx. 14 x 12 x 3½". List price $8.50. Stock No. CA-3 $4.95 ea.
Shpg. wt. 5 lbs.

ARKAY 12-WATT HI-FI AMPLIFIER KIT

STOCK NO. AM-11
Includes ALL Tubes $22.95



Provides wide response and fine reproduction at low cost. Comprehensive manual and oversize drawings and wiring diagrams make the job a cinch. Contains every fine feature you want.

Specifications: Employs 5 tubes, push-pull output, inverse feedback, pre-amplifier for magnetic pick-up, built-in compensator networks, 30-15,000 cps, removable front panel, output transformer matches 4, 8, 16 ohms. AC receptacle provided on rear panel for connecting tuner or record changer. Has inputs for crystal pickup or mike, magnetic pickup, tuner, plus two auxiliary inputs. Completely with all parts, chassis and tubes. Less wire and solder.

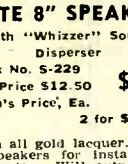
Tubes employed: 1—6SC7, 1—6SL7, 2—6V6, 1—5Y3. Size of chassis, 11¼" L. x 6¼" W. x 5⅝" D. Operates on 115 volts 60 cy. Shpg. wt. 12 lbs.

NO GHOST ELECTRONIC TV ANTENNA

Regular List $7.95 • New—Different • Really Good—FOR VHF—UHF COLOR TV AND AM-FM RADIO
STOCK NO. X-526 $1.99 3 for $5.

ELIMINATES GHOSTS—SNOW—DRIFT—FUZZ—FLUTTER AND INTERFERENCES. Contains variable tuning circuits with calibrated visual indicator. Its ten position circuit is intended, by a process of matching, mismatching or damping to serve to resonate the impact circuit to bring in the strongest, clearest signal and to trap out unwanted electrical interferences. Eliminates rabbit ear antennas. Operates independently as an indoor antenna; in conjunction with roof antennas or any existing antennas. Concealed anywhere. Wt. 1 lb.

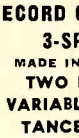
GIANT TV ANTENNA KIT



Stock No. AU-24.... $12.99

Complete Kit—Nothing More To Buy! For all around good reception on ALL VHF CHANNELS. Best of all is Olson's price—we knocked the regular list price of $31.95 down so low it defies competition. Elements are made of GENUINE AIRCRAFT ALUMINUM tubing. Contains everything you need: 2 Six Element Conical Bays, 1 pair "Q" Bars, 2 Five Ft. 1¼" Mast Sections, 60 Ft. 300 Ohm Twin Line, 3 Standoff Insulators, 2 Screw-eye Standoffs, 1 Mounting Base, 1 Guy Ring, 1 Clamp Ass'y, 1 Pipe Strap, 4 Lag Bolts and Complete Instructions. Shpg. wt. 15 lbs.

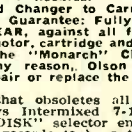
PHILMORE TRANSISTOR BATTERY RADIO KIT



Stock No. KB-12 ..... $5.85 Kit
List $9.75
3 for $16.50

Germanium diode crystal detector combined with transistor audio amplifier stage to provide loud clear reception of your local radio stations. One single standard 1½ volt penlite cell supplies all of the power and will last almost indefinitely. Perfect for picnics, camping trips or gifts. Special high efficiency coil and variable condenser assures sharp tuning. Designed for use with double 2000 ohm headphones (see below). Housed in an attractive plastic case, size: 3¾" x 2½" x 1⅛". Weighs only 4 ounces with battery. Supplied with detailed, illustrated assembly instructions, from which anyone can build and complete this set within a few hours. Solder, hookup wire, headphones and battery not included. Shpg. wt. 2 lbs.
2000 OHM DOUBLE HEADSET—
Stock No. X-542 .....Pr. $1.95

Make Your Own Printed Circuits



Professional Etched Circuit Kit
List $9.95
STOCK NO. KB-14 $5.40 3 for $16.

PERMITS ANY SERVICEMAN OR LAB TO MAKE NEW "PRINTED" CIRCUIT BOARDS OR REPAIR OR MODIFY EXISTING BOARDS. Produces boards of commercial quality. Can be used for both mechanical or photographic process negatives, both methods can be used to produce as many boards from one negative. Excellent for an electronic or electric assembly operation, amateur or commercial communications equipment where emergency or civil defense equipment is required in quantity, and many others. Includes: 36 square inches of 1/16" copper clad phenolic, two negative masks, one printing frame glass, two frame clamps, developer, etching solution, 1—developing tray, 1—etching tray, 1—cleaning pad and complete instructions. 3¢'s

INTERPHONE AMPLIFIER
Signal Corps No. BC-709

Stock No. AM-15
$1.99 Special 3 for $5.00
Attention: Schools, Clubs, large Dealers—write for quantity prices.

Brand new in factory sealed cartons. Original cost $32.00. Contains a wealth of valuable parts including 5 x 2½ x 8" aluminum case, 3B4 tube, socket, condensers, resistors, 4 jacks, input and output transformers, battery holders, etc. For operation on 2 flashlight cells and one 67½ volt battery.

Ready to operate or can be rewired for many other uses, such as: baby-sitter amplifier, SW or BC receiver, transceiver, crystal set audio amplifier, etc. The polished aluminum case alone is worth more than the $1.99. Get yours now—while they last. Circuit diagram and instruction book included. Shpg. wt. 7 lbs.

TRIPLETT MODEL 321-T DC MILLIAMMETER

0-1 M.A. DC—3½" DIA.—FLUSH MOUNT
Regular List $8.50
STOCK NO. ME-2 $4.95 Each 3 for $13.95

Quality panel meter uses D'Arsonval movement. Accurate to within 2% of full scale. Precision balanced pointer. Steel parts are rust-proofed. Molded zero adjust. Cushioned ceramic bumpers protect against overthrow. Balance "U" frame construction, bar type bridges and rigid bearing sunports protect from vibration in any direction. Special alloy steel pivots, jeweled bearings, reduce friction to a minimum. Permanent Alnico magnets. Metal dial finished in white enamel with easy to read black scale and characters. Molded high impact bakelite case, size: flange, 3½" dia.; body, 2¾" dia.; overall depth, 1⅝". Almost 2¼" of dial scale. In original factory boxes. Shpg. wt. 2 lbs.

OLSON'S GREATEST TAPE RECORDER VALUE

Reg. $129.50 • Brand New • Limited Supply
Stock No. AM-8
List Price $129.50
$79.95

FREE! Five 1200' Reels Recording Tape with every Recorder ordered. Dealers—Stock Up Now.

Two Speed • Two Track • Featuring New "Plug-In" Recording Head

Here is one of the very few tape recorders with precision die-cast construction. Other features include the exclusive "Tape Guide" for perfect alignment and the pre-equalized heavy duty amplifier. Latest Model Electro-Voice crystal mike included. Entire outfit is guaranteed to be distortion-free and deliver super-sensitive performance at either speed. Lowest wow and flutter, highest sound-to-noise ratio of any model 3 times its price.

Records and plays back at 3.75 or 7.5 inches per second. Handles both 5" and 7" reels. Records up to 3 hours on one reel. Multiple input-output recording from mike, radio, TV or phono. Provisions for external speakers or monitoring headphone. Freq. response 50 to 7500 cps. Employs a full 5 tube amplifier. Carrying Case is finished in two-tone pin striped forest green. Operates on 115 V. AC 60 cy. Case size 14¾ x 11¾ x 8½". Weighs 24 lbs. Shpg. wt. 30 lbs.

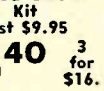
FIRST QUALITY PLASTIC BASE RECORDING TAPE
1200' on 7" Dia. Reel

STOCK NO. X-249
Single, ea. $2.19
Lots of 6, ea. $1.79
Lots of 12, Ea. $1.59

This famous brand tape regularly sells for $5.50—but Olson gives you a 71% discount. Perfect in every respect, this quality tape is famous for its low noise level and uniform output. Freq. response 50-15,000 cps—red oxide base—¼" wide. Reg. $1.25 seven inch plastic reel included—fits all recorders. Stock up now during this Giant Sale and get the Tape Buy of Your Life. Shpg. wt. (one doz.) 10 lbs.

ROYAL DYNAMIC MICROPHONE

Reg. $12.00
Stock No. M-89 $2.98 Ea.

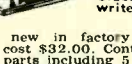


Built-In Western Electric Unit

Olson is the first to bring you this new pencil type microphone. Genuine Western Electric Dynamic unit is internally coupled to a UTC ouncer High Impedance Transformer. Matches any amplifier which is designed for crystal, dynamic or ribbon mike. Shpg. wt. 2 lbs.

Only 1¼" diameter, Base swivels and is removable so mike can be hand held. Satin gray finish with 5' shielded cable.

Masco "E-Z TALK" INTERCOMS



STOCK NO. AM-4
Complete Outfit $14.87

BIGGEST INTERCOM BARGAIN, while they last! Easy to install. For homes, nurseries, offices, farms, etc. Quick easy communications between any two points up to 300 feet apart. Master station has volume control with on-off switch, separate "press-to-talk" switch, built-in amplifier utilizing a 12AT7 and selenium rectifier. Remote station is always "on" or ready, no buttons to push. Hence, Master always hears the remote station. Ideal for baby sitting. Speakers are 4" Alnico 5 PM. Cabinets 6⅛ x 3¾ x 4⅛", all metal finished ivory enamel. Complete with 50 ft. of 2 conductor cable. Operates on 115 volts AC or DC. Shpg. wt. 4 lbs.

EXTRA 2 CONDUCTOR CABLE FOR ABOVE
Stock No. W-103, 100 ft. coil.....$1.19
Stock No. W-104, 250 ft. spool.....$3.50

HOW TO ORDER

Mail your order to 278 E. Market St., Akron 8, Ohio. Send remittance with order (add for postage 5¢ for each dollar's worth ordered—10¢ for each dollar's worth if you are more than 1000 miles away). OLSON REFUNDS EVERY CENT NOT USED. Or—send no money—we'll ship C.O.D. and you pay mail or expressman for merchandise and postage. ALL MERCHANDISE 100% GUARANTEED. PLEASE—MINIMUM ORDER $3.00.

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be forced to use non-optical methods of navigation and bombing under low-visibility conditions. The radar from this aircraft would radiate large bursts of high-frequency energy, which could be easily detected by the new unit. When an aircraft, operating under these conditions, approaches the site of an observation post, the receiver is able to pick up the signal automatically. The observer can then immediately telephone the enemy's position to the appropriate filter center.

The unique device incorporates transistors with printed circuits as a pulse amplifier; also included is a four-ounce battery pack as a power source, and a horn antenna which receives high-frequency signals. A crystal, mounted in the stem of the apparatus, serves as a detector. And the connecting link is a coaxial choke assembly, which features a filtering action so as to deliver a sharp pulse to the amplifier. Positive pulses from the output of the detector and coaxial choke are fed directly to the pulse amplifier. And from the amplifier they are fed into lightweight headphones. In field tests it was found that the low-power drain of the transistors makes operation possible for a week under normal conditions.

IN ANOTHER REMARKABLE contribution to aero-electronics, ARDC revealed that the Communication and Navigation Lab, at the Wright Air Development Center, had developed a six-subminiature-tube, 15-ounce emergency radioset, which permits a stranded airman to direct his own rescue.

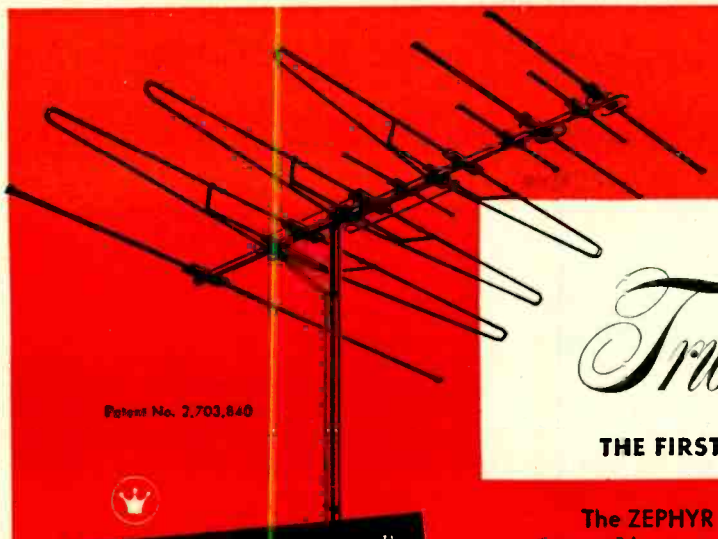
Approximately half as large and heavy as rescue radios now in use, the new unit, a combination transmitter and receiver, is expected to be used primarily by pilots of fighter aircraft, whose cramped cockpits offer little space, and who must carry all of their survival equipment in a small seat-style kit.

In operation, a pilot would merely push a button on the transmitter and then proceed to broadcast information regarding his forced landing. Or, the radio could be set to broadcast a continuous tone, which rescue aircraft could use to fix the position of the lost pilot. Two-way conversation can also be carried on between the stranded airman and rescue aircraft.

An ultra-high emergency frequency is used for voice and tone signals. The equipment is powered by mercury-cell batteries.

AN ELECTRONIC COMPUTER, technically known as a differential analyzer, said to be capable of solving mathematical problems in almost every field of science and engineering, and providing means for analog study of Air Force weapon systems, including a complete aerial weapon and its components, is now being developed for the Air Force by ARDC's Wright Air Development Center and a New York manufacturer.

Some of the new features in this electronic brain will make it possible



Patent No. 2,703,840

ANNOUNCING THE

Trio Zephyr Royal

THE FIRST STAGGER-TUNED TELEVISION ANTENNA

What Hi-Fi brings to Audio
Stagger-tuning
brings to TV Antennas!

The ZEPHYR ROYAL employs three "wing" dipoles, stagger-tuned, to provide even higher and more uniform gain, absolute flat response on all channels 2–13—a necessity for color TV. It is tuned on six predetermined frequencies in the same way that stagger-tuned circuits are used in I.F. stages in TV receivers.

The ZEPHYR ROYAL is not just an addition to the famous TRIO ZEPHYR, but is a completely new electrical design. Parasitic elements are used ONLY where they contribute to the efficiency of the antenna's electrical design—not just for promotional purposes.

A new phasing method provides increased directivity—and functions equally well on the highs as well as the lows.

The elimination of minor lobes, to an extent never before realized in an all-channel antenna, finally banishes all co-channel interference. All of the gain is packed into one efficient forward lobe.

Try a new TRIO ZEPHYR ROYAL. You'll find that in gain and directivity it's the best all-channel TV antenna ever produced for color or black and white.

Pre-Assembled—Uses TRIO's famous Insta-Lok Clamps. Sturdy—Rugged—Compact and it's patented too!

MODEL ZR-1
$34.95 LIST

America's New Favorite

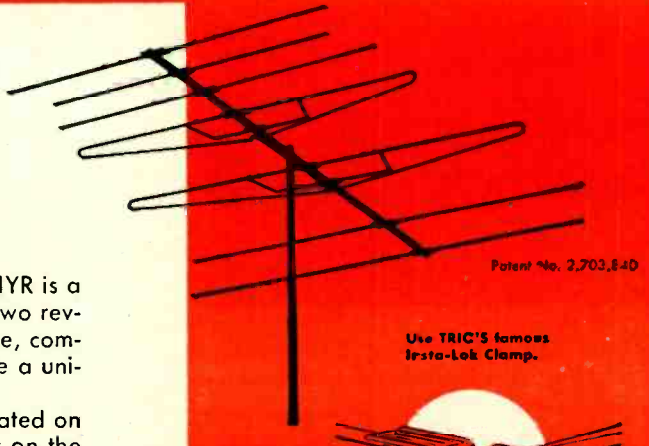
the Trio Zephyr

The antenna everyone's talking about! The ZEPHYR is a high performance, single lobe antenna, employing two revolutionary "wing" dipoles. Three half waves in phase, combined with an integrated director makes each dipole a unidirectional antenna on the high channels.

The ZEPHYR uses two "wing" dipoles, one resonated on the low ends of channels 2–6, and 7–13, the other on the high end of these channels. These composite dipoles, both driven, together with fully functional parasitics elements, produce the high performance to size ratio never before achieved in antenna design.

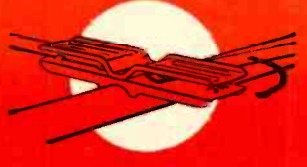
There's sharp directivity too, on all channels—comparable to a yagi.

TRIO believes that with the introduction of the ZEPHYR and the ZEPHYR ROYAL, the need for stacked arrays is eliminated.



Patent No. 2,703,840

Use TRIO'S famous Insta-Lok Clamp.



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for the machine to detect its own malfunctioning components and pinpoint their location, enabling the operator to make needed corrections; thus increasing the reliability of the machine.

The computer, which will contain over four-hundred operational amplifiers, making it the largest single integrated unit of its type, will be able to simulate all of the movements of a guided missile in flight. Thus the cost of building and testing flying missiles, to determine their suitability, will be greatly reduced.

The device, expected to cost about a million dollars, will be housed in a six-thousand square-foot room in the aeronautical research lab at WAD's facilities in Dayton, Ohio.

ALL THE TV BANDS, the very-highs and the ultra-highs, should be used and every effort made to insure such use promptly.

Thus declared FCC Commissioner Rosel Hyde, during a recent address before the Lions Club in Washington.

He viewed an immediate re-examination of the TV allocation program as an absolute "must," in order to provide conditions which would be favorable to the growth of the high bands.

Warning that without solid attention now, u.h.f. will . . . "wither and die . . . and buried with it may be our hopes for a nationwide competitive system" . . . Hyde said that we must face . . . "present realities and examine the existing situation, not with a view to allocating blame, but to see what can be done to correct trends which have developed, and to press for the proper development of a . . . system . . . in the American tradition."

Elimination from active use of seventy of the eighty-two channels, the Commissioner added, would drastically curtail the present and future scope of the industry. It would result, he pointed out, in TV . . . "becoming a limited, protected, and necessarily regulated service, rather than the dynamic service contemplated by Congressional policy."

Reviewing the variety of plans now being suggested to the Commission to extend the very-high band assignments, Hyde said that the proposed " . . . squeeze-in or shoe-horn techniques (involving lower power, lower antennas, directional antennas, etc.), if experience in other fields is to be relied upon, can be expected to cause interference in outlying areas . . ." and therefore the cumulative effect would be to . . . "provide additional services in population centers, at the expense of outlying areas where it is most needed."

The Commissioner felt that any such move would inevitably . . . "undermine present incentive to the development of the ultra-high channels . . ."

In his opinion, any general course of action, which looks forward toward the licensing of stations . . . "under a system with a built-in low ceiling on future expansion, should not be adopted until we have at least made

a thoroughgoing study of possible alternatives."

HURRICANES, floods, and the torrid heat waves did a perfect job of stalling operations in the TV authorization department of the Commission during closing days of summer. Station grants just disappeared.

TV continues to demonstrate its ever-broadening dramatic range of uses every day.

Recently, in Detroit, TV displayed its versatility by acting as a traffic guide. On one of the key expressways, a three-camera chain was set up in an experimental program to handle accidents and congestion on the roads. The cameras, tied to a control room three miles away, were placed on pedestrian bridges overlooking the highway, which connects downtown Detroit with suburban areas. Through an ingenious control system, the cameras could be raised, lowered, panned, and tilted to provide complete visual coverage of this extremely busy thoroughfare. Traffic experts believe that TV can provide that split-second control which will avoid costly tieups due to accidents and other road problems.

The cost of such a system was described as ridiculously low, when compared with the huge costs involved in building the throughways and the road efficiency the tele-coverage network can offer on a reliable basis . . L.W.

Buying an Amplifier?

(*Continued from page 40*)

Some loudspeaker manufacturers have been following the practice of rating the impedance on the average value over the audio range. Fig. 4 illustrates this on a typical impedance curve of a loudspeaker. Now, an amplifier is tested to give its full rated output when it is loaded with a dummy resistance of the value specified for the output tap used. If the amplifier is tested on the 16-ohm output tap, a 16-ohm dummy resistance load will be used for measurements. Many loudspeakers will be found to dip below their nominal impedance value over a range of mid-frequencies and, for this reason, they will absorb more power from the amplifier than is indicated by measuring the voltage on the voice coil terminals. This means that when the amplifier is connected to a loudspeaker it will not appear to give its rated power output.

This method of rating also tends to make the efficiency of the loudspeaker look better because the calculation of power input may show only, say, 9 watts where the loudspeaker may actually be absorbing 15 watts. The writer suspects that this method of rating loudspeaker impedance may have arisen due to an endeavor on the part of the speaker manufacturer to make the sensitivity of his unit appear favorable in comparison with other units, and average impedance is quite a legitimate interpretation.

As the reader will not usually have facilities for checking the impedance of a loudspeaker system at different frequencies, he had best take the loudspeaker manufacturer's word for it and match it to the amplifier according to its rating.

Next comes the specification of input impedance and loading level. By loading level, the manufacturer means the voltage input required to give full output. The input impedance should match whatever the user intends to connect to the input. If the audio amplifier does not include a preamplifier and the user has in mind a separate preamplifier, then the output impedance of the preamplifier and input impedance of the power amplifier should match, both in impedance and level.

Many preamplifier outputs are cathode followers rated at 600 ohms. However, in this case the output impedance rating is not indicative of the load with which the preamplifier should be terminated. It will invariably work better into a high impedance grid, than into a 600-ohm load. This will be discussed more fully in a subsequent article on the choice of a preamplifier.

Power amplifiers have an input, either high impedance to grid or a line impedance of 600 ohms through a transformer. The former is the more practical arrangement for most purposes. If the output from the pream-

plifier, or whatever source of program material is going to be used, is matched down correctly for 600-ohm loading, then an audio amplifier with 600-ohm input and the right gain for the levels to match can be used.

A high-impedance input to grid has the advantage that it can be connected to a 600-ohm output of the same voltage level rating, without any problems at all, but a high-impedance output from the preamplifier, or other unit which precedes the power amplifier, cannot be fed into a 600-ohm input in the same manner. The 600 ohms will shunt away the high-impedance output, probably causing considerable distortion and certainly reducing the level.

This whole problem is avoided by using one of the combined audio amplifiers, which includes a "front end" in the same unit. This is the present trend. It brings us to the last question we have space to answer here: "Should I buy a separate preamp and power amp, or a combination job?"

This choice depends upon two factors: *(a)* how much you want to spend; and *(b)* what kind of system you have in mind.

There is the obvious advantage, from the cost viewpoint, that combining the two units saves a considerable number of components, an extra chassis, and extra power supply. So the combined job is bound to be cheaper than the two separate units.

On the other side of the picture, however, the two separate units offer the advantage, if your system is going to be a fairly large one, that the power amplifier and the preamplifier need not be all together in the same place. The preamplifier can be located on a small table beside your favorite arm chair, while the power amplifier can be located in a cabinet that also houses the rest of your audio equipment. The combined unit may be rather large to locate next to your favorite arm chair, although there are some nice compact units, with outputs in the region of 10 watts, that are very convenient for this purpose.

What about difference in performance between the two types of equipment?

It is difficult to make an over-all statement but the trend is for the combined unit to have a higher hum level.

In separate units, the power transformer for the preamplifier has to handle very small power and it is a simple matter to use a low flux density design of power line transformer, which makes it easier to minimize hum transfer. In a power amplifier, the amount of power to be handled by the power transformer necessitates use of a unit with much higher flux density, and consequent possibility of hum transfer to low level stages such as are used in a preamplifier.

As was pointed out earlier, a 180-cycle component of hum, registering the same on the meter is almost 30 db more audible than a 60-cycle hum. In the combined units the kind of field

radiated by the power transformer is principally 180 cycles, so this is more likely to be the frequency of hum that will appear in a combined unit.

Although careful design can improve these conditions, the problem is much more acute in a combined unit than where two separate units are used. So in making a comparison between systems of the two types, the writer suggests that you should look especially for difference in apparent hum level *when listening to it.* It may be that the specifications will give hum level pretty much the same, but the thing to watch for is whether the *audible* hum level is the same.

We hope that the reader has not formed the impression that we could have said: "listen to it; don't trust specifications" in much fewer words. In discussing what specifications mean, we hope to have given him something to listen *for;* and also to have convinced him that failure of specifications to tell the whole story does *not* mean that the specifications, or those who write them, lie. Intelligent reading of good specifications *can* be a good guide for that "short list."

EDITOR'S NOTE: *The factors that enter into the selection of an appropriate preamplifier for use with your power amplifier will be covered by the author in an article next month.*

—30—

UNDERWATER TV USE

AN underwater application of closed-circuit television which is enabling the U.S. Fish and Wildlife Service, Department of the Interior, to observe and test the performance of experimental fishery methods and equipment under actual oceanic conditions has been reported by the Engineering Products Division of RCA.

In underwater operations, the RCA ITV closed-circuit system camera is housed in a watertight steel cylinder which is mounted in a submersible free-flooded, ball-type diving bell. Atop this "bell" and connected to it by a gear train and yoke assembly, is a watertight electrically-driven power unit, which permits remote control of the TV camera's scan—360° in azimuth and 90° in elevation.

—30—

An RCA TV camera "goes below" to record marine life for Fish & Wildlife Service.

Phonograph Evolution

(*Continued from page 59*)

motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm *F*, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance

"The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

"The record, if it be upon tinfoil, may be stereotyped be means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tinfoil or other material upon it. This is valuable when musical compositions are required for numerous machines.

"It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved or *vice versa.*"

From the above, we find a very crude method for the recording and reproduction of sound. Edison's application made four important claims as follows:

1. "The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth for the reproduction of the sound vibrations.

2. "The combination, with a diaphragm exposed to sound-vibrations of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound substantially as set forth.

3. "The combination, with a surface having marks thereon corresponding to sound vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. "In an instrument for making a

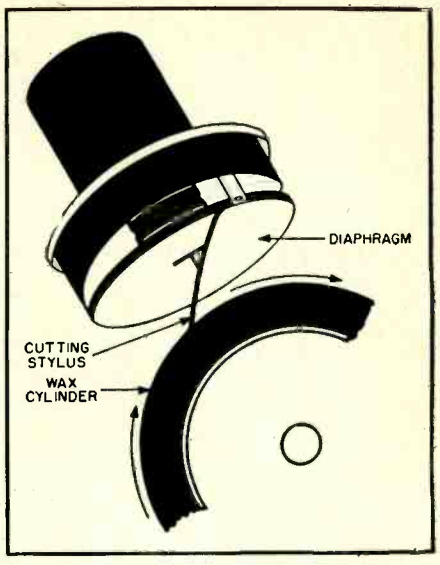


Fig. 5. Enlarged view of the recorder.

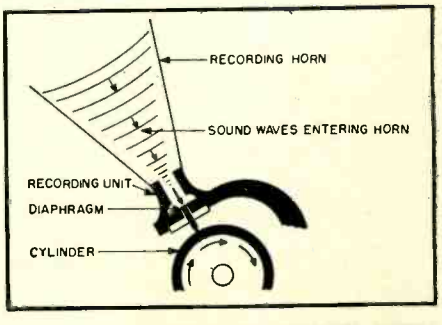
record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth."

Edison, in 1888, took steps to improve his foil machine. His later experiments resulted in a cylinder made of a soap-like substance which resembled wax in texture. These cylinders were recorded by the method known as "hill-and-dale." Sound was indented on these cylinders using his original technique developed for the metal foil.

This acoustical process was indeed very crude, and was based on the principle that no two sounds could produce the same vibrations. With the invention of the cylinder, the stylus, and the diaphragm, sound could be recorded as shown in Figs. 5 and 6. Reproduction was had by simply reversing the process.

Edison had visualized his invention as a business aid. He had not considered the "phonograph" as a means for providing pleasurable listening of music. As soon as the public accepted this new medium, it became immediately apparent that here at last was an instrument from which could be heard the music of world-famous bands, ragtime songs, the silver-voiced orators, operatic stars, the wit of minstrels, and excerpts from the grand

Fig. 6. Sound waves entering a recording horn. Directed at the horn, they vibrate the diaphragm. See discussion in article.



operas. This was all made possible by the rotating cylinder which was turned by various methods beginning first with the so-called hand-powered machines which relied on constant physical rotation of a handle and stabilized to some extent by heavy flywheels to maintain some degree of stability.

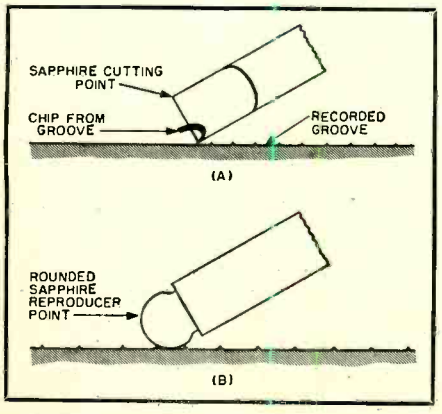
While Edison, on his original application spoke of his invention as a "phonograph" or "speaking machine," other makers later referred to their products as "Graphophones," "Gramophones," "Graphaphones," "Zon-o-phones," and "Talking machines," etc.

The first records were made in the following fashion: above the rotating cylinder and mounted to a diaphragm was a recording stylus suspended in a ring-like container. Coupled to the assembly by means of a flexible hose was a long metal horn having a slight taper. The thickness of the glass-like diaphragm used on the "recorder" varied from .003 to .008 of an inch. A feedscrew engaged a carriage containing the diaphragm assembly to thread its way across a rotating cylinder. The recording stylus performed two functions. First it cut a shallow groove about .001 inch deep in the material and, when modulated by sound, indented the vibrations resulting from sound further into the groove. The process was akin to embossing. This method of recording employed a vertical vibration rather than the lateral methods later devised by Berliner and others. The first Edison cylinders were recorded at about 100 grooves per inch, and the speed of rotation was 160 rpm. Playing time was 2 minutes.

During recording, sound waves (vibrations) were funneled to the diaphragm through the long horn and impinged upon the cylinder. Thus, each sound wave, having its own peculiar vibration, would be indented on the wax cylinder.

The reproduction or playing back of these vibrations was a reversal of the recording process. In place of the cutting stylus, Fig. 7A, a special sapphire point, ground carefully to the shape of a doorknob, Fig. 7B, was used. Vibrations appearing on the rotating cylinder were those transmitted to the diaphragm and, in turn, would produce the same sound waves as were originally recorded.

Fig. 7. (A) Enlarged view of the cutting sapphire and (B) reproducing sapphire.



Horns of many shapes and varieties were tried, and those which produced the greatest directivity, volume, and clarity were used in the early studios during the recording process. This was the technique employed commercially by Edison on the first cylinder records.

The Duplication of Cylinders

One of the most severe problems in the early days of recording was a satisfactory means for producing duplicates of recorded cylinders. It was customary then to place a group of recording machines on shelves in the recording studio. The horns attached to the recorders were pointed at the artist or group of performers to gather up the sounds in very crude fashion and to funnel these sounds to the diaphragms. This was a tedious method of making cylinder records. The technique was referred to as the "round" method of recording. After the selection had been recorded on one bank of machines, another round of records was set in place and the process was repeated. As a result, the recorded cylinders would each have its own peculiar share of loudness (volume), clarity (fidelity), and cleanliness.

A duplicating machine was then devised which overcame some of the obstacles encountered by this technique. After a round was completed, the best cylinder was selected to be used on a duplicator. This particular cylinder record was chosen for its loudness, clarity, and general quality. This was known as the "master"—so-called because from it could be made many copies. The duplicating machine used a sapphire stylus to "play back" the sounds from the master cylinder. A cutting stylus was coupled to the reproducing stylus by mechanical means. The reproducing stylus transferred the sound to a recording stylus.

Duplicate copies could be made by this process. This was the mechanical method of making duplicates from a master cylinder and was an improvement over the previous method of making the records.

Economies were effected because the time required of the artists was reduced to that required only for the making of a master. Accordingly, artists who could demand higher fees were employed and the prestige was accordingly raised as far as the phonograph was concerned. For the first time, the public was able to enjoy recordings of world-famous stars of the stage, opera, and the theater in their parlors.

The public quickly accepted the marvelous machine of Edison. They took it to their homes and into their hearts. A new industry had been born!

Edison Phonographs

The first machines of Edison were driven directly by hand. They were known as hand-powered phonographs. Following these early machines, Edison produced a "spectacle-type" model which relied on a primary battery for its driving power. This was produced in 1888.

Few people realize that these first commercial machines relied on a source of direct current for their operation. Such a machine was produced in 1889, see photo on page 58, which contained a direct-current motor that operated from a 2-volt battery supply. This was known as Type M and two models were produced—one known as the "Victor Diaphragm" model—and the other as the "Balmoral." These machines were bulky and weighed over 50 pounds. They were equipped with a speaking tube for recording, a shaver to remove sounds from a cylinder for re-use, and a hearing tube for use during reproduction.

A dual pulley, mounted on the armature shaft, coupled to the drive shaft and feedscrew of the machine by means of a flat hand-sewn leather belt, provided driving power to rotate the cylinder and its feedscrew. Another belt, shown in the photo on page 58, was coupled to a vertically mounted governor to stabilize the rotation of the cylinder. An ingenious electrical limit switch was included so that when the speed of the machine became excessive, a shunt across the motor supply would cut the field current and reduce the driving power and slow the machine.

In operation, this make-and-break action resulted in considerable wow due to the rapidly fluctuating voltage. This was not too noticeable on these early machines because they were designed as dictating devices.

Some of these models (and they are now quite rare) were sold by the *North American Talking Machine Company* of New York and were identified as Class M. There was a restriction on a nameplate stating that the machine could not be used in the State of New Jersey.

Several varieties of the Model M were produced during the year 1889, the main differences being in the cabinet and in the accessories. The Model M used a standard-size wax cylinder and was a single-speed job providing two minutes recording at a speed of approximately 160 rpm.

Following chapters of this series will tell of the Edison developments to follow, the inventions of Emile Berliner (specifically the disc phonograph), Eldridge Johnson, Tainter and Bell will be revealed. *(To be continued)*

148 mc. Transceiver

(*Continued from page 65*)

Assembly and Testing

It should be emphasized that because of the frequencies involved, variations in layout, parts, and/or wiring may cause difficulty in obtaining satisfactory performance. Close attention should be paid to the layout as indicated in the photographs.

After the unit is assembled and wired, it should be checked and inspected before power is applied. Visual inspection of the mechanically assembled parts may disclose screws which weren't tightened. Checking the wiring with the schematic may disclose an omission or a shorted or unsoldered connection. After the assembly is checked, the receiver is aligned and tested as follows:

1. Turn "Transmit-Receive" switch, S_1 to "Receive" position.
2. Plug headset into J_1.
3. Connect all batteries.
4. Connect antenna to J_2.
5. Adjust tuning capacitor C_{22} so that the plates are meshed about 15 degrees.
6. Turn on power switch S_2.
7. Connect the signal source, which may be either another 148.14 mc. transmitter or a calibrated signal generator, to the antenna. Adjust capacitor C_{21} until a 148.14 mc. signal is heard in the earphones.

For alignment and testing of the transmitter, the following pieces of test equipment should be available if maximum performance is to be obtained.

a. High-impedance voltmeter such as an *RCA* WV-77A "VoltOhmyst" or equivalent.

b. A v.h.f. receiver tunable to 148.14 mc.

c. Field-strength meter tunable to 148.14 mc. or a v.h.f. receiver with meter to indicate the relative field strength.

The transmitter is adjusted as follows:

1. Adjust the external v.h.f. receiver to 148.14 mc.
2. Turn switch S_1 to "Transmit" position.
3. Adjust capacitor C_5 until the signal of the crystal oscillator "locks in" at the correct frequency. Then, adjust capacitor C_1 and readjust C_5 until the most stable condition of "lock in" is obtained, or until C_5 can be varied over the widest range with the crystal still "locking in" at the proper frequency.
4. Connect the voltmeter to the junction of resistor R_9 and capacitor C_{12}. Adjust capacitor C_{10} and the coupling between coils L_3 and L_4 until maximum voltage is noted (between −25 and −30 volts with a "B" supply voltage of 135 volts.) Final adjustment of the power amplifier is made with the antenna connected. The radiated field strength is measured with either the field-strength meter or the meter of the external v.h.f. receiver.
5. Adjust capacitor C_{14} for maximum field strength and then adjust the coupling between coils L_5 and L_6 for maximum field strength. (It may be necessary to adjust C_{14} and L_5 and L_6 alternately to maximum strength.) After maximum field strength is obtained, reduce the coupling between L_6 and L_5 until the indicated output drops about 10 per-cent. Recheck tuning of C_{14}.
6. Check modulation by talking into the microphone and listening on the external receiver.

As mentioned previously, this equipment was installed in a light airplane. The antenna system consists of a police-type, car-top whip 18 inches long fed by a length of 50-ohm coaxial cable connected to the antenna jack J_2. The antenna is mounted at the top center of the windshield. The shield of the coaxial cable is connected to a metal crossbrace located directly under the antenna. The metal crossbrace and metal structure under the antenna provide a ground plane. If metal sheathing is available on top or bottom of the airplane, the antenna can be mounted on the sheathing and the coaxial shield grounded directly adjacent to the insulator. The manufacturers of this type of antenna usually furnish car-installation instructions which can be followed for either cars or airplanes.

If desired, the transceiver can be housed in a portable carrying case for field use. A suitable antenna can be made by fitting a piece of stiff 0.050 inch hard brass rod into a female coaxial fitting and plugging it directly into the receptacle J_2. The chassis, batteries, and carrying case form a ground plane for the antenna. A double-pole, single-throw switch (S_3) and a receptacle (SO_1) in the top of the carrying case permit plugging in an external power supply when battery operation is not required. —30—

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By H. LEEPER

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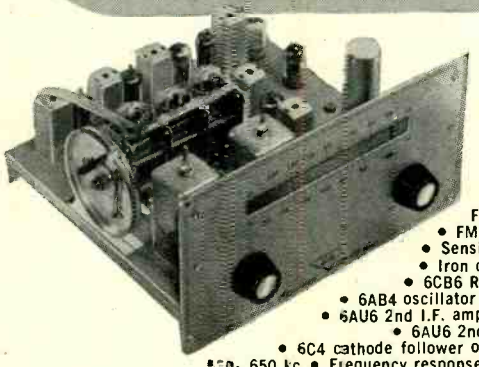

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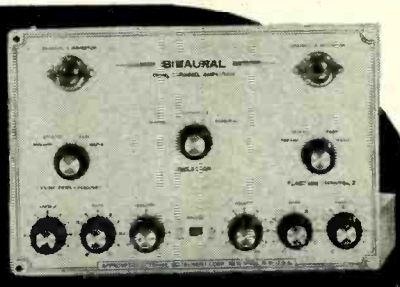

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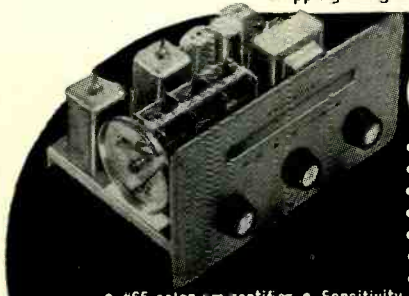

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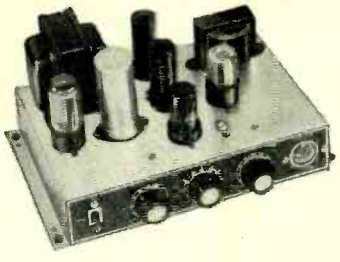

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Tape Recording

(*Continued from page* 51)

from poor contact between tape and playback gap. This loss is especially severe at high frequencies, where the magnetic flux extends but a small distance from the tape. A film of minute thickness, such as produced by wear of tape oxide, can virtually obliterate high frequencies. Poor contact may also result from improper adjustment of pressure pads, tape tension devices, etc. Fig. 5 shows how serious the losses can be. At 7.5 ips, separation of as little as .0001" reduces response about 5 db at 5 kc. Separation of .001" reduces response at 5 kc. by more than 40 db. (Although not necessarily of the same order, losses due to poor contact also occur in recording.)

Imperfect azimuth alignment is often a source of high frequency loss in playback. Correct azimuth alignment means that gap height is *exactly* perpendicular to tape length. Fig. 6 shows the severity of losses for a wavelength of .001" at 7.5 ips. This represents a frequency of 7.5 kc. In the case of a half-track playback head, misalignment of only 30 minutes of arc reduces output about 17 db. Losses are even more drastic for a full-track head. Thus misalignment of only 12 minutes of arc causes 20 db attenuation at 7.5 kc.

It is assumed in Fig. 6 that the recording is made with a perfectly aligned record head, and that it is the playback head which is misaligned. However, a perfectly aligned playback head and an imperfectly aligned record head also produce the results indicated in Fig. 6. In the case of recorders using a combination record-playback head, the problem of azimuth alignment, except in the case of severe departure from perpendicular, is insignificant as long as use of the machine is confined to recording only for itself and playing only its own recordings.

The losses associated with poor azimuth alignment can also be caused by skewing of the tape as it passes the head. That is to say, the angle of the tape relative to the gap may be constantly changing due to faults in tape guides and tension devices.

High frequency losses due to poor azimuth alignment may be explained as follows. Assume the tape has been recorded by a perfectly aligned head. If the playback head is also perfectly aligned, all points of the left edge of the gap, at a given instant, are in contact with the same magnetic potential. A similar condition is true for the right edge. But if the playback gap is inclined from perpendicular, the left edge will contact different magnetic potentials at various points along the edge. At high frequencies, where magnetic poles are close together, the inclined gap edge will contact a number of north and south poles, which cancel out. Thus the net magnetic potential confronting the left edge of the gap is less than if the edge were

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1G6GT	.41	5Y4G	.36	6C5	.35	7A7	.45	14B6	.38
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1LA4	.57	6AF4	.79	6F6	.38	7C4	.39	25BQ6GT	.78
1LA6	.47	6AG5	.50	6G6	.40	7C5	.42	25L6GT	.47
1LB4	.57	6AG7	.69	6H6	.38	7C6	.43	25W4GT	.43
1LC5	.49	6AH6	.69	6J4	1.79	7C7	.45	25Z5	.37
1LC6	.47	6AJ5	.70	6J5	.39	7E5	.45	25Z6	.37
1LD5	.57	6AK5	.54	6J6	.47	7E6	.55	27	.25
1LE3	.57	6AL5	.39	6J7	.43	7E7	.70	35A5	.46
1LG5	.57	6AQ5	.46	6J8G	.85	7F7	.59	35B5	.50
1LH4	.64	6AR5	.46	6K6GT	.37	7F8	.70	35C5	.50
1LN5	.47	6AS5	.48	6K7	.39	7G7	.75	35L6GT	.47
1N5GT	.50	6AS6	1.70	6K8	.65	7H7	.50	35W4	.34
1R5	.50	6AS7G	2.19	6L6	.68	7J7	.75	35Y4	.34
1S5	.42	6AT6	.39	6L7	.42	7K7	.75	35Z3	.39
1T4	.50	6AU4GT	.65	6N7	.60	7L7	.75	35Z5GT	.34
1U4	.47	6AU5GT	.59	6Q7	.40	7N7	.50	37	.29
1U5	.42	6AU6	.42	6S4	.40	12AT6	.37	50A5	.48
1V2	.65	6AV5GT	.65	6S8A7	.45	12AT7	.66	50B5	.50
1X2	.61	6AV6	.39	6SC7	.48	12AZ7	.63	50C5	.50
2A3	.55	6AX4GT	.60	6SG7	.41	12AU6	.41	50L6GT	.43
2A5	.57	6AX5GT	.57	6SH7	.43	12AU7	.53	75	.42
2A7	.55	6B4G	.52	6SJ7	.43	12AV6	.35	76	.42
3A4	.51	6B8	.69	6SK7	.45	12AV7	.67	77	.38
3A5	.50	6BA6	.47	6SL7GT	.55	12AX4GT	.65	78	.38
3AL5	.45	6BA7	.58	6SN7GT	.55	12AX7	.58	80	.34
3AU6	.46	6BC5	.47	6SQ7	.39	12B4	.68	84/6Z4	.44
3BC5	.54	6BC7	.80	6SR7	.42	12BA6	.46	117L7GT	1.09
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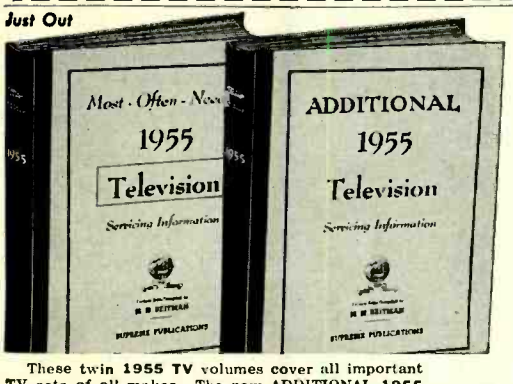

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perfectly perpendicular to the length of the tape. Similarly, the right edge of the inclined gap contacts various magnetic potentials, which cancel out. As the result of the reduced potentials at each edge of the gap, the potential *across* the gap is also lowered and output falls off.

Summary

The response curve of a pair of record and playback heads or of a single record-playback head, as shown in Fig. 1, is not flat principally as the result of (1) treble losses in record due to demagnetization and bias erase, (2) bass loss in playback owing to the playback head being a constant velocity device, and (3) treble losses in playback due to gap length and other losses in the playback head. Fig. 7 shows approximations of these major losses for a head having a .00015" physical gap, with bias current close to optimum, and with tape speed at 7.5 ips.

In addition to the losses shown in Fig. 7, there may be losses at the low end of the bass spectrum due to excessive wrap of the tape around the playback head, treble losses resulting from poor contact between head and tape, and treble losses caused by imperfect azimuth alignment of either the record or playback head. Finally, some bass boost may occur as the result of the head as a whole reacting to the tape's magnetic flux.

Next month we will go into the question of the important role played by bias current and the problems it raises with respect to equalization of frequency response.

(Continued Next Month)

FM-TV Sound Portable

(Continued from page 73)

should be followed as closely as possible. The completed receiver should work well from the start. Since some builders may run into trouble in one way or another or may not be able to duplicate some of the components used by the author, here are a few hints for getting the most out of the receiver.

First, the antenna length is somewhat frequency sensitive. Try a 12-inch or longer wire. Gimmick C_1 should give just enough coupling so that squeezing the hand around the insulated antenna wire increases the volume up to the point where the detector goes out of regeneration, as evidenced by the cutting off of all sound. Particular TV or FM stations may be favored by cutting an antenna to the best length for that station, or an over-all compromise may be used. A "ringing" sound similar to feedback indicates improper antenna coupling and may be eliminated by shortening the antenna or decreasing the number of turns in the "gimmick." Once the antenna coupling is set for clear, loud reception, it should need no further attention.

Tune the receiver carefully. In the absence of a signal, the superregenerative "hiss" will be quite loud. This is a

sign that the receiver is working. A station tuned in will cause the hiss to drop below the audible level, unless signal strength is too weak. For all FM signals, and this includes the sound signals of TV channels, the receiver must be tuned *slightly to one side of center.* This is necessary because "slope" detection permits the superregenerative detector to demodulate the FM signals which, in normal FM and TV sets, require many stages of amplification followed by a discriminator or ratio detector circuit. Always tune for best quality of sound rather than maximum volume, then adjust the volume with control R_5.

If any distortion appears in the audio output after the receiver is carefully tuned, try a slightly higher or lower value of plate resistor R_2. Select the value that gives the best quality at both the high-frequency FM end of the dial and the low-frequency maximum capacity end. Since the superregenerative detector likes a particular *LC* ratio for best performance, a different tuning capacity may work better with a different number and spacing of coil turns. Be sure the "A" battery is fresh. You should be able to see the filament burning in the 957 tube or it will oscillate sluggishly or not at all. A voltmeter across either "A" or "B" batteries should not change its reading appreciably as the set is turned off and on. If the voltage drops noticeably when the set is turned on, the battery should be replaced.

In normal use, this portable receiver will not interfere with TV sets or other receivers. Since it is tuned to TV sound channels its slight re-radiation is not of the type that causes interference with picture or sound. When it is tuned through a picture carrier TV frequency (the picture may be "heard" in the speaker as an unpleasant 60-cycle buzz due to sync pulses) it will cause a momentary herringbone pattern to cross the screen of a TV receiver in the immediate vicinity that is tuned to that channel. The interference is brief and of negligible intensity—no worse, in fact, than the re-radiation of many TV tuners with "leaky" oscillators. Since the portable is not left tuned on picture carriers, and is usually played away from houses, no interference problem will arise.

The portable may be played in any position or while it is being carried by the handle. You will notice that high-frequency TV and FM signals vary considerably in strength as you move about so pick a spot where reception is good before putting the set down for a listening session. Except in valleys or among tall metal-frame buildings the set will work well up to 25 miles from the average TV or FM station. Actually, the volume of the portable may be used as a rough-and-ready indication of field strength and could be employed for such purposes as locating a TV antenna on top of a roof, but the set is not a test instrument. It was built for relaxation and entertainment—so have fun!

—30—

Certified Record Revue

(*Continued from page 76*)

This 6th symphony is described as a one movement work, but the discerning listener will quickly discover there are six fairly discrete sections or motivations ranging from *larghetto* to *presto* in expression. From the opening bars the work is unmistakably identified with Schuman. The same remarkable brass textures, the clever use of percussion as dramatic counterpoint, the ascending and descending runs on the woodwinds, characterize this work as in his earlier symphonies. I am reminded most of all of his third symphony, especially by the rousing, almost frenetic finale. (Incidentally, the 3rd was issued some years back by *Columbia* and is a most exciting work, well worth your attention.) Yes, there is atonality and dissonance in this work, but Schuman's unique chordal structures and his fresh ideas on the expression of these sonorities make for an easily assimilable score. As a hi-fi piece, this will be a delight to the *afficionados*. The liberal use of all types of percussion, which is very clean and articulate, the bite of the trombones and trumpets, the soaring woodwinds, and the clean delineation of the strings mark this recording as one of the best of recent *Columbia* efforts. Ormandy is a good man for this sort of repertoire and this is apparent in the metronomic precision of his tempi and the intelligent balance which he maintains throughout the score. My one quibble with this recording you may find odd! I think the Philadelphia men played the score with their usual precision and brilliance. But I think this score calls for a less "fat" and sumptuous string tone, and generally less orchestral weight. Perhaps my feeling this way is heightened by the acoustic perspective which is just a shade over-reverberent and tends to increase the illusion of mass.

The Piston work is equally interesting, if a somewhat less athletic endeavor than the Schuman. Cast in four movements, this score is not as rough-hewn as the Schuman and is better suited to the Philadelphia talents. The smooth sweetness of the strings, especially the violas, can be heard to advantage in the third movement. The second movement, *ballando*, and the finale, *energico*, will appeal most to devotees of exciting sound, what with the rollicking woodwinds, the dance-like figures for the strings and brass, and the free use of percussion, especially the tympani and cymbals in the last movement. Throughout both symphonies, frequency and dynamic range is quite wide, transients are cleanly reproduced, and pre- and post-echo groove distortion is minimal. This disc is supposed to be reproduced with the RIAA curve, but I found the old NARTB more suitable to my ear. If you have been feeling adventuresome in your musical appetites, try this "modern". Whatever other reaction you might have, I am sure you won't be bored!

ORGAN MUSIC FROM SWEELINCK TO HINDEMITH

Fritz Heitmann, organist. Telefunken LGX66037/8. RIAA curve. Price $9.96. Two discs.

Although the masters of these recordings are several years old, this is the best organ recording to come my way in some time. This is not so much a question of super hi-fi sound, although it is very good, as the overall picture of good sound, splendid performances, superb instrument. I was fortunate enough to have heard Heitmann in this country several years ago, even though he obviously was hampered by the modern voicing of the *Moller* he played. I was impressed at that time by his economical tech-

niques; some have even accused him of being too pedantic and dry, a result, probably, of hearing some organists long on the razzle-dazzle and short on authentic interpretations. The program in this album is varied and interesting, but the highlights for me were the Bach "Toccata and Fugue in D Minor," which was given a beautifully integrated and loving performance with extremely luminous registration, done in the best classic manner (compare with any recording of the work done on a modern instrument for a real surprise) and the fascinating Hindemith "Organ Sonata #1." Of all modern works for organ, I think this is the most interesting both from a structural and listening standpoint. Old Heitmann, who has been dead about two years now, showed his versatility by turning in a fine performance notable for its careful phrasing and dynamic shadings.

You lovers of the organ bass will not find any ultra-lows on this disc, but what bass pedal is heard is superbly clean as is the rest of the baroque voicing. No instrument is mentioned but it sounds like Heitmann's favorite in the DOM in Berlin. Sound is quite wide range, distortion, transient or otherwise, negligible. Most appreciated were the fabulous acoustics and the over-all balance achieved by the engineers which make for one of the most pervasively "live" organ sounds I have heard. If you really like organ, and not just the hi-fi potential of the pedals, I can recommend this most highly.

BRITTEN
YOUNG PERSON'S GUIDE TO THE ORCHESTRA
TCHAIKOVSKY
THE NUTCRACKER SUITE
Minneapolis Symphony Orchestra conducted by Antal Dorati with Deems Taylor, narrator. Mercury MG50055. RIAA curve. Price $4.98.

BRITTEN
YOUNG PERSON'S GUIDE TO THE ORCHESTRA
GINASTERA
VARIACIONES CONCERTANTES
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG-50047. RIAA curve. Price $4.98.

Confusin', ain't it? Well, not really—it's just *Mercury* records clever and sensible way of presenting its version of "The Young Person's Guide to the Orchestra." On one disc we have the delightfully urbane voice of Deems Taylor narrating along with the music, and for those who like their "Guide" straight, another disc *sans* narration. Mr. Taylor also holds forth on the "Nutcracker Suite," which I understand is the first time this has been done, and on the other disc, the "purists" get a considerable bonus in the form of the record premiere of Argentinian composer Ginastera's "Concert Variations." As to the results? Well, the "Guide" has been pretty thoroughly documented on a number of recordings, but as far as I'm concerned this is the last word on the subject.

I find Mr. Taylor's easy, unstrained delivery completely in good taste as well as perfectly articulate. His beautifully modulated voice seems equally fitting whether the recording is being addressed to adults or to children. The narration on the "Nutcracker" is not "corned" up as it could have been so easily, and I find it quite diverting.

In the "Guide," Mr. Dorati has accomplished another of his orchestral *tours-de-force*. There is some quite astonishing material here and people will be attracted as much by the virtuoso playing of the orchestra and the brisk, unflagging performance as they will by the incredible super-fi sound. That this disc will find wide use as a demonstration piece, encompassing as it does, the

entire orchestral resources, is a foregone conclusion.

From the machine-gun rap of the snares and the sound of the taut skins on the tympani, the crystal clarity of the high percussives, the brazen brilliance of trumpet and trombones, the true intonation and vibrato of the flutes and piccolo, the mellow smoothness of clarinet, and bassoon, the shimmering clean-toned violins, the dark resonance of the contrabassi to the stunning impact of the full orchestra in the fugal finale on Purcell's great theme, this is super-sound which will bring a gleam to the eyes of even the most jaded audiophile.

The music for the "Nutcracker" is excerpted from the complete ballet *Mercury* issued last year. The Ginastera piece is of more than passing interest, with the brilliant orchestration, although most of it is smaller scaled from chamber orchestra. Instrumental definition is, if anything, even more startling than the "Guide" and the remarks made on the "Guide" are equally applicable here. Either of the two discs is hi-fi realism at its best. Ultra wide in frequency and dynamic range, there is no distortion of any type apparent, and acoustic perspective is that magic amalgam of "big" liveness with perfectly preserved inner detail. This should be a "must" on everyone's list.

GERSHWIN
RHAPSODY IN BLUE
CONCERTO IN F
Julius Katchen, pianist with Mantovani and his Orchestra. London LL1262. RIAA curve. Price $3.98.

This incongruous and totally unexpected pairing, that of Mantovani and Julius Katchen, bears unexpected fruit. No matter what your opinion may be of Mantovani and your estimate of him as a conductor for this type of repertoire, I think you will find that with the splendid performance of young Katchen, this is the recording of choice for these scores. On second thought and to give the devil his due, why shouldn't Mantovani be successful on this disc. The jazz antecedents and jazz elements in the works are well known and need no discussion here. Since this is Mantovani's native idiom, no reason why it should be cause for alarm. Rest assured, there is none of the Mantovani mannerisms in evidence here, as he plays it straight.

Katchen is a natural for these works and the vigor and spontaniety of his reading could only stem from a person who was obviously enjoying himself. His rhythmic sense is most acute and he combines this valuable trait with deft clean phrasing and strong melodic line, which doesn't bog down in sentimentality.

With regard to the sound, this disc has no close competition. The piano is big toned and exhibits no ringing or harshness. Transient detail is exceptionally clean. No wow or flutter was noted. The Mantovani orchestra gives a good account of itself and the whole is heard in one of *London's* most spectacular jobs of imparting "liveness" to a disc. Dynamics, which are so important in these scores, are very wide and the balance between piano and orchestra is good although slightly favoring the piano. Don't let Mantovani scare you away—this is definitely the top version on these every popular Gershwin scores.

DVORAK
SYMPHONIC VARIATIONS
BALAKIREFF
TAMAR (SYMPHONIC POEM)
Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Columbia ML4974. RIAA curve. Price $4.98.

Sir Thomas is always a formidable protagonist of Dvorak and in this recording, unless a version by Rafael Kubelik is forthcoming, this would appear to be the closest we shall get to that elusive word, "definitive". Sir Thomas' reading is notable in the main for his forthright delineation of the "Variations," all the while managing to keep the score well integrated. As always, he has his magnificent orchestra under firm control and this helps no end in matters of balance and dynamics. I could wish for a little more brilliance in the sound, but generally the recording is quite good with nice clean strings and good acoustics.

The Balakireff tone poem, "Tamar", is somewhat less successful, not so much from the performance as from the sound. The recent Ansermet effort on *London* was a smoother, more "romanticized" reading, in better keeping with this sometimes dullish score. The *London* sound was one of their best jobs, which is very good indeed, whereas this disc again suffers from a lack of brilliance and a bass line not as clean as I would like. Everything considered, the disc is worth the price of admission for the wonderful job Sir Tommy does on the Dvorak "Variations."

BENNY GOODMAN AND HIS ORCHESTRA
Columbia CL534. RIAA curve. Price $3.98.

This disc is for enthusiasts with long memories, because some of the material goes "way back". This is the Benny Goodman and the Goodman orchestra as I remember it—the red hot hard drivin', hard swingin' outfit, with the bespectacled young man who made such wonderful sounds on his licorice stick. There are some all-time Goodman favorites on this disc such as "Six Flats Unfurnished", "Idaho", "The Man I Love", and a terrific "Jumpin' at the Woodside" among others. The sound is obviously dated and obviously has been enhanced, with some reverb and equalization trickery. On good wide range equipment the sound is quite listenable and is, I would say, a pretty fair representation of what the great Goodman band sounded like in the old days. If you're a Goodman fan, this is a "must". —30—

NEW SYLVANIA LAB

SYLVANIA Electric Products Inc. recently dedicated its new Waltham (Mass.) Laboratories which will be devoted exclusively to highly advanced projects relating to guided missiles and aviation electronics.

Among the test facilities available to the engineers at the labs is the environmental test chamber shown below. It will permit the testing of equipment at temperatures as low as 100 degrees below zero and as high as 350 degrees above. Conditions at altitudes as great as 100,000 feet can be duplicated.

The new labs are housed in a modern, air-conditioned, 120,000 square foot building overlooking Route 128. —30—

Musician Looks at Hi-Fi
(Continued from page 41)

ing or rehearsing could take place in the same hall.

Playback

Listening to the results of a recording session frequently proves a bit disappointing. The sound is often harsher and more edgy than the quality of sound perceived while playing. On occasion, an individual instrument or a certain passage clearly heard on stage seems to assume a different place within the over-all recorded balance. Certainly the type of playback equipment used and the lack of the final editing and recording refinements at that moment, play an important part. Since all musical and some technical improvements during a session are based on the playback, the more realism the playback can offer, the higher the degree of self-criticism which can be supplied by the player.

Home Reproduction

After the recording has been optimized and edited, what can we finally expect to hear at home, on a fine hi-fi system? We must first of all take into consideration the following facts; the most sensitive aural response lies within the range of 500-8000 cps (frequencies above 15,000 cps being inaudible to most people.) There is considerable variation in what people hear under the same conditions, particularly regarding music, as well as some deterioration in hearing with advancing age.

There are also distortions in the ear at low frequencies, and we must also allow for masking effects. Masking effects occur when one of two tones of different frequency is increased in volume and thereby renders the other tone inaudible. Generally masking comes about when frequencies are fairly close together. (2-3 octaves). Furthermore generalizations are difficult to arrive at, because of the differences in individual record pressings and listening-room acoustics.

In all the following listening tests these high fidelity components were used by the courtesy of *Custom Classics,* Cleveland, Ohio: *Weathers* pickup arm; *Rek-O-Kut* T 12 turntable; *McIntosh* C8 preamplifier; *McIntosh* Mc 30 amplifier; and two *Bozak* B305 speakers and enclosures.

The listening room, 14 feet wide, 16 feet long, and 12 feet high, is fairly well damped, with carpeted floor. 64 square feet of the wall area is treated with acoustical tile. The remainder of the walls and ceiling is hard.

In comparing several of the leading labels it was observed that they could be distinguished by certain individual traits. None of them was entirely free from crackles and slight hissing noises. Even the factory-sealed records showed occasional scratches. In listening for accurate reproduction of the various

sections of the orchestra and comparing them with live sound, the string sections, especially violins, were the least natural. We discovered the speakers to be the most essential factor for improving or ruining the potential of a given recording.

Strong hi-fi responses seem to be stimulating to some people, while others prefer the more mellow tone quality and volume which one might hear in the first row or amidst the orchestra itself. The author's preference would be an objective position such as the center of a hall or the dress circle. Hi-fi addicts sometimes delight in such slogans as "sharp brasses, edgy strings, enormous percussion triumphs." These impressions would often prove musically incorrect when checked against the score, however effective these distortions.

Loudness

In order to test the effect of loudness on reproduction we used the clarinet solo at the opening of the 3rd movement of Rachmaninoff's "Symphony No. 2" (*Capitol*). The test was made without loudness compensation. The set was adjusted to correspond to a level which might be heard in the center of a concert hall. A reduction of 10 db showed no considerable change in the orchestral balance. A reduction of 20 db, however, distorted the musical balance beyond reason. The increase of 10 db above the original level caused considerable surface noise and the relation of the solo clarinet to its accompaniment became unbalanced.

Frequency Response

In trying to test the effects of a flat frequency response *versus* bass and treble boost, we had to favor the flat response, which offered greater musical clarity. Although more apparent "presence" was achieved with the treble boost, the resulting surface noise seemed to cancel any advantage gained. While bass boost was not as objectionable, the texture of the music was nevertheless obscured.

The author wishes to emphasize that these statements represent a personal reaction which, due to room acoustics and equipment variations, may call for individual modifications.

Discs Versus Tape

Discussing such controversial matters as the difference between tape and discs or the importance of overtones, the musician is caught in a web of contradictory statements by the experts. The absence of stylus noises, rumbles, changing of sides, and storage problems and the possibility of transferring discs to tape, all seem to be attractive features serving the cause of music well. The musician contends that it is the overtone structure which characterizes the instruments and supplies timbre and tone color. Tape suffers from some limitations in this regard. In comparing the frequency range of the fundamentals with that of the entire spectrum, it is clear that

the overtones extend the range by two or more octaves.

Even though the complete overtone series remains inaudible, we prefer that reproduction of music which will offer us the same richness and timbre which we hear in a hall.

General Musical Remarks

From a musician's point of view, the technical limitations are superseded by the restrictions hi-fi recording places on the performer by replacing human impulses with electrical ones. The audience is an essential participant in any performance which is generated by inspiration and life. The performer, if he is to give his best or perhaps even surpass himself, needs the attention and approval of his audience. He senses keenly to what extent the audience is participating after playing for only several minutes. The recording session entirely eliminates these very vital aspects of making music. Furthermore we are deprived of the visual enjoyment of a live performance and of what is generally called the "concert atmosphere." If these facts would be realized and understood by the many listeners whose entire musical knowledge is based exclusively on listening to records, we would create standards and conditions most certainly of advantage to the recording industry. We would be wiser not to try to duplicate the concert hall despite the progress made, but to create our individual standard of phonograph music, which will supplement and enrich our general musical experience.

On a subject as diversified as hi-fi one could not expect absolute agreement, either amongst musicians or laymen. Furthermore the very existence of the musical artform depends on individual and sometimes contradictory reactions toward the same subject matter. It is a well known fact that musicians rarely agree in judging the merits of a musical interpretation. An interpretation of the same work even by the same musician will differ from performance to performance depending on the artist's mood and physical well-being, acoustic conditions, audience response, and the change and maturing of thought and emotion. The listening requirements for the non-musician basically do not vary from those of the musician. The latter might be inclined to concentrate more on the content and details of interpretation, whereas the non-musician is often satisfied with the mere stimulation of emotions.

Conclusion

It would be difficult to deny the progress and accomplishments of the record industry. Although the musician realizes the need for further mechanical improvements, there are some other aspects connected with hi-fi recording which are most valuable to him. To name only a few, there is the advantage of repeated hearings of complex works, hi-fi productions of new

music, American or otherwise, under the guidance or directly by the composer, educational series such as the various "appreciation" records, authentic recordings of world-famous organs and ancient instruments, and recent electronic research into the field of musical creation.

With the appearance of hi-fi LP, complete operas have been brought to Americans living thousands of miles removed from the Metropolitan Opera House in New York. It has enabled us to hear, for the first time, some of the artists from behind the Iron Curtain and introduced some of Europe's finest musicians and orchestra prior to their personal appearances over here.

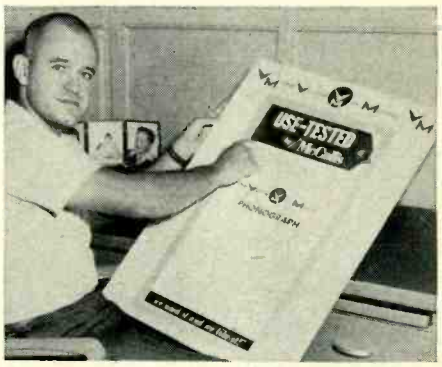
In the field of pop music hi-fi has actually created new styles. Here the engineer has taken over from the musician by adding fancy sound flourishes such as bird calls, the barking of a dog, and above all the echo chamber. Well known is the trick of a singer singing a duet with himself, which has as its counterpart in the classical recording literature in the Bach "Double Concerto for Two Violins," with Heifetz playing both parts. Although many of these effects are being overdone, we hear some interesting and sophisticated orchestrations on popular recordings nowadays. By the use of the oboe, the French horn, and even the harpsichord there has been somewhat of a reconciliation between the long-haired and the short-haired musician.

All this, however, has shifted the responsibility for maintaining our cultural level as far as music is concerned from a few individuals to the record buying and listening public. There is a danger in accepting a musical performance by repeated listening to the same recording of it, or by mechanical manipulations of one's hi-fi set. If we are to have participating and discriminating listeners, their judgment must be based on as much listening experience with actual live music as possible. If the highs and lows are exaggerated or overemphasized the sound is robbed of its natural musical quality. The hunt for the elimination of rumbles, scratches, and rattles often strips the music of its freshness and spirit. These technical alterations diminish the high fidelity of music. If hi-fi is not to become an end in itself, its interdependence with live music, the composer, the critic, performer, and educator must be realized. Frequently the performance of a new composition will be followed up with a recording of it. Just as often the reverse is the case, when a musician will perform a piece of music, which was initially heard on records. The reactions of a reputable critic to a live performance or a recording obviously have an important influence on the entire musical scene. Particularly from an economic point of view this interrelation is of utmost consequence. Without this realization, neither the industry's interests, economic or otherwise, nor further development and cultural progress can be served. —30—

MAGAZINE TIE-IN

V-M Corporation of Benton Harbor, Michigan has opened a new dealer merchandising campaign which includes a mailing to 4500 dealers announcing the company's "Pleasurama" selling theme.

The entire program, led by *McCall's* magazine marketing concept with its



family "togetherness" theme, will be keyed to increasing activity in dealers' stores. At the point of sale each of the company's models will carry the *McCall's* "Use-Tested" product tag to perform a "sales-making" job. Consumer magazines will be used to full advantage to increase dealer support.

Companion units include new, sales-tested permanent display fixtures, and complete in-store promotions with 4-color paper, silk, and die-cut 3-dimensional hardboard pieces to carry the "Pleasurama" theme to the shopper. TV and movie trailers, radio announcements, and newspaper advertisements will supplement the other items in the campaign.

Complete information on the sales program is available from the company or local *V-M* distributors.

* * *

TIE-IN FOR TEENAGERS

A merchandising tie-up between *Emerson Radio and Phonograph Corporation* of 14th & Coles Streets, Jer-

sey City 2, New Jersey and the Arthur Murray Dance Studios has resulted in *Emerson* featuring in its new line the "Arthur Murray Music Box," a three-speed portable designed for teenagers.

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1110	2040	2245	2410	2615	2985	3160	3655	4280	4785	5305	5780	6073.3	6406.6	6840	7306.6	7508.3	7610	7710	7810	7910	8016.7	8116.7	8210	8316.7	8425	8533.3	8641.7
1129	2045	2250	2415	2655	2990	3165	3680	4295	4790	5327.5	5782.5	6075	6425	6850	7308.3	7510	7616.7	7716.7	7816.7	7916.7	8020	8120	8216.7	8320	8430	8540	8650
1150	2050	2258	2425	2660	3010	3170	3700	4300	4815	5335	5800	6100	6440	6873.3	7316.7	7516.7	7620	7720	7820	7920	8025	8125	8220	8325	8433.3	8541.7	8658.3
1180	2055	2260	2430	2685	3015	3175	3760	4310	4830	5385	5806.7	6106.6	6450	6875	7325	7520	7625	7725	7825	7925	8030	8130	8225	8330	8440	8550	8660
1195	2065	2265	2435	2700	3025	3180	3800	4330	4840	5397.5	5820	6125	6473.3	6900	7333.3	7525	7630	7730	7830	7930	8033.3	8133.3	8233.3	8333.3	8441.7	8558.3	8666.7
1900	2070	2270	2442.5	2710	3030	3185	3825	4340	4845	5435	5825	6140	6475	6906.6	7340	7530	7633.3	7733.3	7833.3	7933.3	8040	8140	8240	8340	8450	8560	8670
1910	2075	2275	2450	2740	3035	3190	3840	4360	4852.5	5437.5	5840	6142.5	6500	6925	7341.7	7533.3	7640	7740	7840	7940	8041.7	8141.7	8241.7	8341.7	8458.3	8566.7	8675
1920	2080	2280	2460	2750	3040	3195	3885	4395	4870	5485	5850	6150	6506.6	6940	7350	7540	7641.7	7741.7	7841.7	7941.7	8050	8150	8250	8350	8460	8570	8680
1925	2085	2282.5	2465	2765	3045	3202.5	3940	4397.5	4880	5500	5852.5	6173.3	6525	6950	7358.3	7541.7	7650	7750	7850	7950	8058.3	8158.3	8258.3	8358.3	8466.7	8575	8683.3
1930	2095	2285	2470	2770	3050	3205	3945	4430	4885	5545	5860	6175	6540	6973.3	7366.7	7550	7658.3	7758.3	7858.3	7958.3	8060	8160	8260	8360	8470	8580	8690
1935	2100	2290	2475	2775	3055	3210	3950	4445	4900	5582.5	5873.5	6185	6550	6975	7373.3	7558.3	7660	7760	7860	7960	8066.7	8163.4	8266.7	8366.7	8475	8583.3	8691.7
1940	2105	2295	2480	2780	3060	3215	3955	4450	4920	5587.5	5875	6200	6573.3	7000	7375	7560	7666.7	7766.7	7866.7	7966.7	8070	8166.7	8270	8370	8480	8590	8700
1942.5	2110	2300	2485	2785	3065	3220	3980	4460	4930	5633.3	5880	6206.6	6575	7006.6	7383.3	7566.7	7670	7770	7870	7970	8073.3	8170	8273.3	8375	8483.3	8591.7	8708.3
1960	2115	2305	2520	2790	3070	3225	3995	4485	4950	5635	5892.5	6225	6600	7025	7391.7	7570	7673.3	7773.3	7873.3	7973.3	8075	8173.3	8275	8380	8490	8600	8710
1965	2120	2310	2525	2875	3075	3230	4030	4490	4980	5645	5900	6235	6606.6	7040	7400	7573.3	7675	7775	7875	7975	8080	8175	8280	8383.3	8491.7	8608.3	8716.7
1970	2125	2315	2532.5	2880	3080	3235	4035	4495	4995	5655.5	5906.7	6240	6625	7050	7406.6	7575	7680	7780	7880	7980	8083.3	8180	8283.3	8390	8500	8610	8720
1972.5	2135	2320	2535	2910	3085	3237.5	4045	4520	5030	5660	5907.5	6250	6640	7073.3	7408.3	7580	7683.3	7783.3	7883.3	7983.3	8090	8183.3	8290	8391.7	8508.3	8616.7	8725
1975	2140	2325	2540	2915	3090	3240	4080	4535	5035	5675	5920	6273.3	6650	7075	7416.7	7583.3	7690	7790	7890	7990	8091.7	8190	8291.7	8400	8510	8620	8730
1977.5	2145	2330	2545	2920	3095	3245	4090	4540	5065	5677.7	5925	6275	6673.3	7100	7425	7590	7691.7	7791.7	7891.7	7991.7	8100	8191.7	8300	8408.3	8516.7	8625	8733.3
1980	2150	2335	2555	2925	3100	3250	4095	4565	5090	5687.5	5940	6300	6675	7106.6	7433.3	7591.7	7700	7800	7900	8000	8106.6	8200	8306.6	8410	8520	8630	8740
1990	2155	2340	2557.5	2930	3105	3320	4110	4580	5115	5700	5950	6306.6	6700	7125	7440	7600	7706.6	7806.6	7906.6	8006.6	8108.3	8206.6	8308.3	8416.7	8525	8633.3	8741.7
1995	2170	2345	2560	2935	3110	3322.5	4130	4610	5127.5	5706.7	5955	6315	6706.6	7140	7441.7	7606.6	7708.3	7808.3	7908.3	8010	8110	8208.3	8310	8420	8530	8640	8750
1997.5	2185	2350	2565	2940	3115	3440	4135	4620	5135	5722.2	5973.3	6325	6725	7150	7450	7608.3											
2005	2200	2355	2570	2945	3120	3455	4165	4635	5165	5725	5975	6335	6740	7200	7458.3												
2010	2205	2360	2575	2950	3125	3465	4175	4640	5180	5730	5995	6340	6750	7206.6	7466.7												
2015	2210	2380	2580	2955	3130	3505	4190	4680	5205	5740	6000	6350	6773.3	7225	7473.3												
2017.5	2215	2385	2585	2960	3135	3510	4210	4695	5235	5744.4	6006.6	6362.5	6775	7240	7475												
2020	2220	2390	2590	2965	3140	3525	4215	4710	5245	5750	6025	6373.3	6800	7250	7483.3												
2025	2225	2395	2603.7	2970	3145	3540	4240	4735	5285	5760	6040	6375	6806.6	7273.3	7491.7												
2030	2230	2400	2605	2975	3150	3568	4250	4755	5295	5773.3	6042.5	6400	6815	7275	7500												
2035	2235	2405	2610	2980	3155	3640	4255	4780	5300	5775	6050	6405	6825	7300	7506.6												

TERMS: All items subject to prior sale and change of price without notice. Minimum order: $2.50. ALL crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. No C.O.D. IN ORDERING INDIVIDUAL CRYSTALS, INCLUDE APPROX. 5c PER CRYSTAL FOR POSTAGE. Also indicate second choice frequencies wherever substitution may be made. Calif. buyers add sales tax.

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1456 pages
OFFICIAL BUYING GUIDE OF THE INDUSTRY

At no additional cost, purchasers of the new phonograph, the Model 839, will receive an Arthur Murray "Let's Dance" book worth $1.25 and a $15.00 certificate good for two dance lessons at any Murray studio.

As a part of the campaign, the company has prepared and is furnishing to distributors promotion packages containing a three-color lithographed counter display consisting of a combination product wrapper and turntable dancers; three-color streamers for dealers' stores; consumer postcards designed as direct mailers, store giveaways, or statement stuffers; advertising mats; and other promotional devices.

* * *

FURNESS SELLS SERVICE

Betty Furness is spearheading a program which will reach 93.8 per-cent of television set owners in 99 cities across the nation, urging them to rely on their service technicians for set repairs rather than tinkering with their sets themselves.

The message will be carried on the *Westinghouse*-sponsored "Studio One" series which is viewed by an estimated 20,288,000 people weekly. Stressing the slogan "Don't do it yourself," Miss Furness will tell viewers to patronize the dealer who uses the company's "Reliatron" tubes.

At the dealer level, the campaign will be implemented by life-size store displays of Miss Furness holding a

Westinghouse tube carton. Dealers will also be provided with booklets pointing out the hazards of amateur tinkering which they can hand out to their customers.

* * *

RECOTON MERCHANDISER

Recoton Corporation, 52-35 Barnett Ave., Long Island City, New York has two display cards available to merchandise its 45 rpm record inserts and its #3D "Combo" card which carries an assortment of 3-speed phonograph needles.

The insert display card carries 5 inserts to a package with 24 packages to the card. The second display carries 12 packs of the 50-cent osmium needles, 12 of the $1.00 super-osmium units, and 8 of the $1.50 nylon needles.

Write the company for full details on these assortments.

* * *

"SERVICESPOOL"

Alpha Wire Corp., 430 Broadway, New York 13, New York has packaged

some of its most popular plastic tubing items in an attractive 2-color, self-service counter display.

The new "ServiceSpool" assortment standardizes and streamlines the merchandising and inventory of plastic

tubing. Convenient, handy, neat, it is made up of uniformly-priced spools covering 6 colors each of the 7 most popular sizes.

The assortment has been carefully planned to meet the most general market needs yet is highly flexible to accommodate individual requirements. The "Alphlex" tubing is *UL* approved and meets or exceeds the specifications of MIL-I-631B, ASTM-D876, and ASTM D922.

* * *

INTERCOM DISPLAY

Fanon Electric Company, 150-09 South Road, Jamaica, New York has started distribution of a compact intercom display for dealers.

The unique point-of-purchase merchandiser is actually part of the inner protective material used in the firm's regular corrugated shipping carton. Each of the "Fanfare" two-station in-

tercom systems will be shipped in this special packing with the self-contained display.

* * *

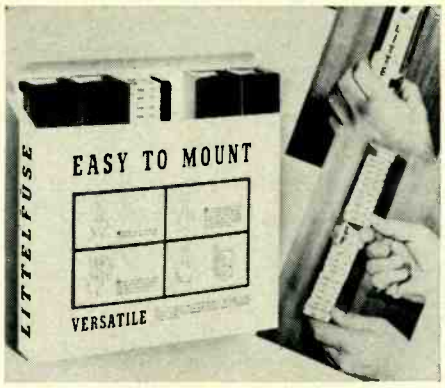
FUSE DISPENSER

Littelfuse, Inc., 1865 Miner Street, Des Plaines, Illinois has designed a new single-channel fuse dispenser which saves time and money for service technicians. The dispenser can be handily mounted by screws in single, double, or multiple channels right over their work benches.

In addition to answering the storage problem, the new dispensers facilitate

stock control and technicians can tell at a glance when any particular fuse size needs replenishing.

For full details on the dispensers and



accompanying fuse stocks, consult your jobber or write the company direct.

* * *

HI-FI INSTITUTE EMBLEM

The Institute of High Fidelity Manufacturers, an organization whose membership list includes some of the fore-

most manufacturers of high-fidelity components, has recently adopted an identifying emblem which was designed for the organization by Avery Fisher of *Fisher Radio Corp.*

The emblem, which pictures a lyre, will be used on all official literature. It will also be made available to members of the Institute for use in advertising and promotion.

For further information regarding the Institute and its activities, write Institute of High Fidelity Manufacturers, 25 Broad Street, New York 4, N. Y.

* * *

RESISTOR ASSORTMENTS

Sprague Products Company, 51 Marshall Street, North Adams, Massachusetts has four kits available which carry popular values of its new axial-lead "Blue Jacket" resistor line.

The set consists of four separate card-mounted kits, one a sampler, and three assortments, each available individually. Sampler RK-1 includes ten popular radio-TV values from the 3, 5, and 10 watt lines. RK2 has fifteen of the most popular 3-watt values while assortment RK-3 has fifteen 15-watt units and RK-4 has fifteen of the 10-watt values. -30-

A New Audio Control

(*Continued from page 45*)

voltage is reduced for each channel added. This increases the gain of the two tubes to offset the mixing loss. No degradation of quality occurs as channels are mixed in. When a channel is out of the circuit, it is grounded to prevent crosstalk.

The signal is taken from the cathode of the second tube in the first common pair to give a low-impedance drive for the following loudness control and tone control circuits. This is another important factor in the remarkable signal-to-noise characteristic of the unit: the low impedance keeps down stray hum pickup and noise in the equalization and switching circuits that follow these controls.

The loudness control can be switched in or out from the front panel and is connected to the first section of a dual master volume control. At low settings of the master volume control, with the loudness circuit switched in, there is maximum accentuation of the bass and treble ends of the spectrum, to match the low-volume Fletcher-Munson curve. At high settings of the master volume control, the accentuation is lessened, as shown on the curves of Fig. 3. Thus the amount of loudness compensation at any given loudness can be adjusted to personal taste and to the acoustic character of the room by the relative settings of the mixer level controls and the master volume control. To *increase* the compensation at any given loudness, it is only necessary to set the master control *down* and the mixer control *up* or *vice versa*.

The tone control circuit is essentially the Baxendall circuit, with modifications to reduce the noise level. This is also a selective-feedback equalization circuit, with the feedback taken from the plate to grid of tube V_{3B}, which functions purely as a tone control tube —there is basically no gain in the stage.

The tone control curves are shown on the chart of Fig. 4: they are of the variable-crossover, constant-slope variety, with a maximum boost or cut of 15 decibels at both the bass and treble ends of the spectrum. The tone control knobs have marker dots which show instantly where the "flat" setting is.

The use of pairs of triodes with appreciable negative feedback around each pair gives the unit as a whole extremely high stability, with freedom from variation in performance because of normal aging of tubes or other components, or normal shifts in supply voltage.

The four feedback loops in the unit also aid in producing the truly vanishing level of the distortion and noise. Harmonic distortion is 0.05% (five-hundredths of one per-cent) at an output of five volts, more than enough to drive most power amplifiers to full output. Intermodulation distortion is

Rear view of the 80-C "Master Audio Control." Shielding is used extensively.

unmeasurable at the same 5 volts output. At 10 volts, IM distortion is 0.2%, and at 15 volts it is 0.65%.

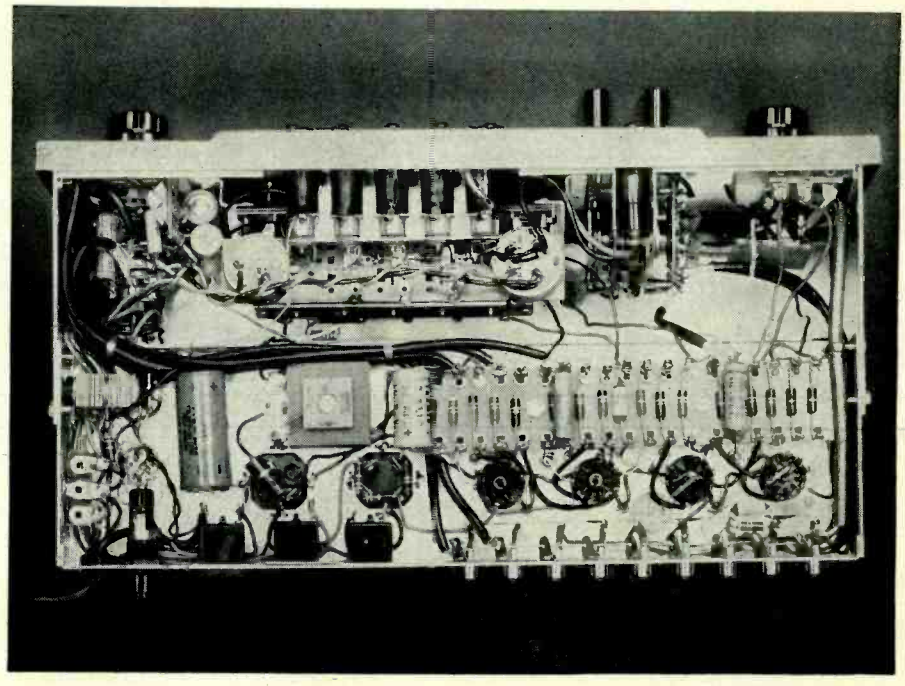
The noise level, including hum and all other sources of noise such as tube hiss, is better than 85 decibels below the signal at 2 volts output, on the high level channels. On the phono channels, the noise is 72 db below a 10-millivolt input signal. Distortion and noise have, in effect, been "designed out" of this unit.

The two output circuits, one for feeding a tape recorder and the other for the main power amplifier connection, are both from cathode followers, allowing the use of long cables without loss of signal quality. The tape recorder output follows the first pair of direct-coupled triodes, so any of the input channels can be mixed to feed it, with a total gain from high-level signal input to tape recorder output jack of 3 decibels.

The main cathode-follower output has an exclusive circuit which contributes to the low noise level of the unit. The second half of the master volume control is connected in parallel with the cathode-follower load resistor, that is, the volume control is right across the output cable.

This placement of the volume control has been avoided in the past, because (1) a low-resistance control in this position upsets the performance of the cathode-follower tube, producing high distortion; (2) a high resistance con-

Underchassis view. Terminal strip construction makes servicing very simple.



trol does not bother the tube, but produces a high impedance for the output cable to "look back" at, whenever the control slider is in the mid-range of the resistance. This makes the cable susceptible to hum and noise pickup, and produces loss of high-frequency response in the cable capacity.

In the present unit, the control has a comparatively high resistance, but negative feedback is taken from a tap on the control back over the two final stages. This lowers the output impedance for all settings of the control, so that cable noise and loss effects are practically eliminated.

It allows the control to be put at the output of the unit, with the advantage that the signal-to-noise ratio is not impaired as the control is turned down. If the control were ahead of one or more stages, the noise produced in those stages would not be reduced as the signal is reduced by the control. With the control across the output, signal and noise are reduced in the same proportion, as the control is turned. The maximum gain from all high level inputs to this output is 21 db.

The power supply has two separate rectifier circuits, one for the plate voltage and one for the direct current which is used on the heaters of all tubes. The plate supply is a full-wave circuit using two selenium rectifiers and a four-section resistance-capacitance filter, which practically eliminates plate-supply ripple. The direct current for the tube heaters comes from a selenium bridge rectifier and two-section filter and is another essential factor in the extremely low noise level of the unit.

A separate winding on the power transformer supplies all indicator and pilot lights. The specially-designed transformer is completely potted and magnetically shielded with a very low temperature rise which means long life for the various small parts in the unit.

Terminal board construction keeps the small parts below the chassis firmly in place. All tubes and associated parts are on a separate rubber-mounted subchassis to reduce microphonic effects. The unit is completely shielded, with a metal bottom plate.

Arrangement of the controls on the front panel has been carefully designed for maximum convenience and quick identification. By putting a large knob for the master volume control in a visually-emphasized sub-panel, at the left end, and the tone controls in similar prominence at the other end, it is possible for those members of a family who have no interest in the more complex functions to adjust the unit, undisturbed by "all that stuff in the middle."

The symmetry of the arrangement, the outward slope and the brushed-brass finish of the panel, present a modern, clean-cut appearance.

It can be seen from the foregoing that the new *Fisher* 80-C represents a complete and extremely flexible audio center. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

AS THE present year swings along toward its close, a quick glance over the records of the months that have slipped by reveal some very significant trends in the established service industry.

The first is the extremely high mortality rate among one-man shops. In appraising the effect of the economic pressures that have been forcing small operators in all types of activity out of business, it is necessary to define what is normally called a one-man service shop. This is the type of shop that was most common in pre-television days in which a single individual handled everything in connection with the business. Since more than eighty per-cent of the radio service jobs were brought to service shops, it was possible for a technically competent, promotion-minded individual to make a fairly good living out of a radio service business.

Television reversed the flow of business. Where eighty per-cent of the radio service jobs were brought to shops by the set owners, more than eighty per-cent of television service is completed in the customers' homes. This one factor alone added considerably to the expense burden of a service business. Regardless of whether he operates out of his home or a business location, the individual who attempts to run a service business entirely by himself must carry an overhead burden that is beyond the productive capacity of the average man. Hence the high mortality rate in this type of business.

Many TV service businesses are successfully operated by man and wife teams. These are classified as two-man shops since the wife is able to relieve the technician of all of the time-consuming details that are involved in the operation of any type of service business. There are many very successful businesses of this type in operation. But they are distinctly highly individualistic enterprises in which the income stops when the couple takes a vacation or the technician is laid up by sickness.

When an electronic service business reaches the point where its average volume will support the full-time efforts of three men, it acquires a basis of stability. The fact that the business is able to maintain the average annual gross volume of forty to fifty thousand dollars that is necessary to support an organization of three men, indicates that its owner has created a successful operational and sales promotion pattern. If the area is comparatively free from service sharpies and sun-downers, the business will grow steadily with a more or less stable income.

However, the incursion of service promotions based upon price, especially low charges for home service calls, will seriously disturb the activities of the established businesses from the dual standpoint of customer relations and service volume. The unfavorable publicity that independent service has gotten from time to time leaves it vulnerable to set owner suspicion whenever extensive service price advertising invades an area. Fast-buck service promoters usually reap a harvest when they invade a new area at the expense of the competent, established service businesses. They can get a lot of service businesses into trouble before the shady character of their operations is revealed.

The experience of having to compete with unethical service operators has served to jar service operators out of their complacency and made them realize that the operation of an electronic service business is no longer healthy for the rugged individualist. It has served to make the owners of legitimate service businesses realize that their only protection is to cooperate with their fellow service businessmen to fight the activities of the gyps and the incompetents.

From coast to coast and border to border, new associations of service business operators are being formed. There is a growing realization that the stabilization of electronic service as a business rests squarely on the shoulders of the men who now operate legitimate, ethical shops. It is becoming widely recognized that industry cooperation and assistance will be given only if the service industry itself shows a willingness to pay the costs of the programs that are necessary to establish the identity and qualifications of the legitimate, established service shops.

Association Promotion

The fact that so many new associations are being formed indicates the

widely growing interest in doing something about the problems that beset the electronic service activity. However, far too many associations are formed with the idea that the fact of the existence of the organization will, in some way or another, take care of the problems. No tangible, definitive programs are inaugurated by the officers to insure continued interest of the members.

When a man joins an association he expects to see something happen. Unfortunately, most men usually expect to benefit from some immediate, tangible returns from their association membership. Since the benefits of association membership are largely intangible, interest lags if the officers fail to provide a dynamic program of regular meetings.

The basic weakness of service associations is that the officers assume responsibilities that they usually are not trained to handle. The dues structures are seldom adequate to pay for experienced help to carry out the details of the organization's programs, with the result they are handled as part-time activities of officers who are hard-pressed for time in managing their own businesses.

Every service association should purchase enough copies of a new book recently published to furnish a copy to each of its officers. The name of the book is "How to Organize and Operate a Small Association," and it was prepared by C. D. "Jack" Hughes, managing director of the Kansas Appliance Dealers Association. This book is a gold mine of information for association officials. The address of KADA is 815 Central Building, Wichita, Kansas.

The second significant trend that has been moving forward with quickened speed this year, is the broadening interest in national unity—a joining of the forces of the several national, state, and unaffiliated local associations to work together on service problems that could best be handled on a national level.

Early in August a meeting was held in Pittsburgh, Pennsylvania, to explore the possibility of achieving national unity for the service industry. It was attended by representatives of most of the national groups and many unaffiliated associations. The delegates boldly met all of the issues that have stood in the way of national cooperation.

The first question that was explored had to do with whether a national association should represent shop owners, technicians, or both. The discussion revealed the universally-held opinion that to be effective, a national service organization should represent all of the elements of service which would include both shop owners and technicians. When brought to a vote, it was unanimously decided that the desirable national organization should represent both shop owners and technicians.

The second question discussed at the exploratory meeting was that of selecting a name for the group which would

hold future meetings in the hope of achieving national unity. The delegates voted to adopt the name of "Electronic Service Council for National Unity."

No attempt was made to recommend the mechanics of organization for a unified national association. Most delegates felt that it would be presumptious of the delegates to the Pittsburgh meeting to attempt to decide on the organizational mechanics without full representation from all interested associations. The delegates selected Indianapolis, Indiana, as the place at which the next unity meeting would be held on October 9. A report on this meeting will be given in a future issue. Gordon Vrooman, secretary of the Empire State Federation of Electronic Technician Associations, was elected secretary *pro tem* of the unity planning committee. He was given the responsibility of contacting every association on record to invite them to send representatives to the first meeting of the Electronic Service Council for National Unity at Indianapolis.

NATESA Convention

Delegates from the various affiliates of the National Alliance of Television and Electronic Service Associations met in their annual convention at the Morrison Hotel in Chicago recently. During the three-day conclave, the delegates and visitors attended a five-session technical seminar and a series of meetings dealing with the business phases of the operation of an electronic service business.

The technical meetings included: "Printed Circuitry and Service," by W. W. Cook of the *RCA Service Company;* "Automation and How it Affects the Service Industry," by Frank Hadrick of the *Admiral Corporation;* "Transistors and Service," by Ken Kleidon of the *Raytheon Manufacturing Company;* "The *RCA* Music Synthesizer," by W. W. Cook; and "Color TV Service," by Al Saunders, NATESA Educational Director and Director of the *Saunders Radio & Electronic School* of Boston, Mass.

The business sessions were conducted by the Television Technicians Lecture Bureau. The Bureau's managing director explained the TTLB "Spee D. Servus" plan, a national public relations and business building program for ethical service shops. Hal Chase, president of the *Chase Television Service Co.,* of Detroit, described the new TTLB service control system for electronic service businesses. The heart of this system is a newly designed work order form that will soon be available from the Bureau. Samples of this form may be obtained by sending a three cent stamp to TTLB Special Services Dept., P. O. Box 1321, Indianapolis, Indiana, and requesting a sample of the TTLB Work Order Form.

Delegates from 38 NATESA affiliates, meeting in official session, adopted a plan to change the organizational pattern by creating new districts. With the addition of governors for the new districts, state chairmen, and a new

advisory council, it was hoped the organizational structure would reach right down to town level.

The delegates also adopted a plan to standardize the name used by all affiliates which are to be known as the Television Electronic Service Associations of the cities in which they are located. Reports were heard on u.h.f., "pay-as-you-see" television, training, and technician accreditation. NATESA voted to adopt the requirements of the RETMA accreditation program as part of its occupational standards and moved to create accreditation bodies in each of its affiliated cities.

Elected to office for the coming year were Frank J. Moch, president; Robert Hester, secretary general; Bertram Lewis, treasurer; Harold Eskin, eastern vice-president; Russ Harmon, east central vice-president; Vincent Lutz, west central vice-president; Jim Failing, western vice-president; P. P. Pratt, eastern secretary; L. C. Stallcup, east central secretary; Joe Driscoll, west central secretary; and Albert C. W. Saunders, educational director.

T.E.A. Annual Clinic

For the third year in a row, the Texas Electronic Association presented a highly successful Radio and Television Service Clinic and Electronics Fair. This professionally-handled event is rotated annually between the four major Texas cities: Fort Worth, Dallas, San Antonio, and Houston. This year's event was hosted by the San Antonio Radio and Television Association whose president, A. R. "Al" Niehaus, managed the affair in the capacity of Clinic Chairman.

T.E.A. is a state-wide organization of local service associations which was started originally by the associations in the State's four major cities. Three additional affiliates were added during the San Antonio meeting and service operators from several other Texas cities requested State organization assistance in establishing associations in their areas.

The pattern of the T.E.A. annual clinic starts with a banquet on Friday night, a series of talks on business and technical phases of the service industry starting with a breakfast meeting on Saturday morning, and closes with a highly popular panel discussion session on Sunday morning.

After welcoming addresses by the Mayor of San Antonio, the Attorney General of the State of Texas, and by Forrest Baker, president of the Texas Electronics Association, those who attended the Friday evening banquet heard a stirring keynote address on the "Power of the Serviceman," delivered by Charles Golenpaul, vice-president of the *Aerovox Corporation* of New Bedford, Mass.

The Saturday sessions featured talks on "Business Management" by Paul H. Wendel, editor and publisher of "Service Management Magazine"; "Selling Service Through Accessories" by Ray Nugent, general sales manager of the

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Philco Accessory Department; "Simplified Service Business Control" by Harold Chase, president of the *Chase Television Service* of Detroit, Michigan; "Automation" by Frank Hedrick, field engineer for the *Admiral Corporation;* "Transistors in 1955" by Dr. Willis A. Adcock, director of materials and research for *Texas Instruments* of Dallas, Texas; the "RETMA Vocational Training Program" by Al Coumont, service coordinator for the manufacturers' association; the "New Texas Tax Law and How it Affects Service Businesses" given by Albert Brown, director of the Store Tax Division of the Texas State Comptroller's Office; "Today's Color" presented by Clint Walters, Administrator of Field Television for the *RCA Service Company;* and "A Look Into the Future of Electronics" by Dan D. Halpin, general sales manager of the *Westinghouse* Television-Radio Division.

The complete management and promotion of each year's clinic are handled by the host organization in the city where the annual affair is held. However, the coordination of experience from year to year is maintained through the association's executive secretary, Will A. Shaw, of Fort Worth, Texas.

State-Wide Associations

There is a growing feeling among service business executives that the logical pattern for an effective national service association would be for local associations to form into state associations. The state associations would then send representatives to function in meetings at the national level. This springs from the line of reasoning that the inevitable bills that will be introduced from time to time to regulate electronic sales and service will be done in State Legislatures. Where an effective state-wide organization of service associations is functioning it will be able to influence the content of the bills and work for passage of only those that are in the best interests of the industry as well as the public.

The state-wide pattern of organization started in the east with the formation of the Federation of Radio-Television Service Associations of Pennsylvania. This was followed by the formation of the Empire State Federation of Electronic Technicians Associations. However, since the nucleus of both of these early state-wide associations was technicians' associations their interests were devoted almost exclusively to the technical aspects of electronics servicing. Because of the preponderance of interest in technical matters, these groups have had difficulty in gaining the support and interest of the larger service businesses.

In the opinion of many seasoned service association officers, the ideal association would provide a triple combination of services that would appeal to the independent service business operator, the dealer who maintains a top-flight service department, and the technician. —30—

MICAMOLD BROCHURE

Plant facilities, typical capacitor products, key company personnel, and a brief summary of the company's 31-year history are contained in a new illustrated brochure recently issued by *Micamold Electronics Manufacturing Corp.*, 1087 Flushing Ave., Brooklyn, N. Y.

A number of capacitors, used for a variety of applications, is presented by means of photographs and text, as are the company's production facilities, shielded laboratories, and test equipment.

Requests for copies of this brochure should be addressed to A. S. Gartner, vice-president, sales, in care of the company.

TOROIDAL COIL MACHINES

A new 4-page folder which describes a portable torodial coil winding machine for laboratory and production applications is now available from *Arnold Magnetics Co.*, 5962 Smiley Drive, Culver City, California.

The literature explains how the machine can be set up quickly, its ease of operation, and that it will accommodate a range of wire sizes from AWG 26 to 44. The machine winds at speeds up to 1500 turns per minute.

WIREWOUND RESISTORS

Precision, Inc., 730 Lyndale Avenue North, Minneapolis, Minn. is offering an 8-page brochure describing the various wirewound resistors in its line.

The publication also contains valuable information in the form of an alloy characteristics chart listing symbols, alloys, tradenames, nominal temperature coefficients, thermal e.m.f. on copper, and a guide to proper selection.

The bulletin covers fixed, adjustable, tapped multisection, pigtail terminal, and ferrule terminal vitreous enamel, as well as wirewound precision resistors. Photographs of each available type are included.

ALLIED'S 1956 CATALOGUE

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Illinois is currently releasing copies of its 1956 general catalogue to the trade.

The new 324-page catalogue lists over 26,000 items and is said to be the largest catalogue published by an electronics distributor. The publication carries a 128-page rotogravure section featuring the latest high-fidelity components, including 34 complete hi-fi systems; television chassis, boosters, rotators and u.h.f. converters, table model and portable phonographs, professional and home recording equipment, p.a. ampli-

fiers and complete systems. The catalogue also lists amateur receivers, transmitters, and other gear, industrial v.h.f. radio and radiotelephone equipment. Other listings cover a wide selection of kits and supplies, books, manuals, diagrams, tools and hardware, plus thousands of other radio, television, and industrial electronic items.

The catalogue will be sent without charge upon request to the company.

ELECTRIC TOOL CATALOGUE

A new 25-page 1956 catalogue describing 52 portable electric tools and kits with over 400 accessories, has been issued by *Porter-Cable,* 58 Exchange Street, Syracuse 8, New York.

This free book includes 150 pictures of tools and their uses with complete specifications and prices on electric saws, sanders, drills, planes, routers, shapers, combination tools, grinders, etc. When requesting a copy of this catalogue, please specify No. 102.

RCA'S COLOR SERVICE MANUAL

RCA Service Company, Inc. of Camden, N. J. has recently published an up-to-date manual designed to aid television service dealers and technicians in installing and maintaining color television receivers.

The 36-page manual was prepared as a supplement to the publication, "Practical Color Television for the Service Industry" published by the firm in 1952. While the supplement carries schematic diagrams and other data in detail dealing primarily with *RCA Victor's* two new 21-inch color receivers (Models 21CT661 and 21CT662), the publication also provides additional information on color TV receivers in general.

Extensive text, color and black-and-white diagrams and charts, and photographs occupy most of the space in the new booklet. National distribution of this book is being handled by *RCA* tube distributors or a copy may be obtained from the company. The price is 75 cents per copy.

PERMOFLUX DATA SHEETS

Permoflux Corporation, 2835 N. Kedzie Ave., Chicago 18, Illinois has announced publication of three data sheets which are available on request.

These catalogue sheets cover the firm's HD-1 hi-fi headset (JH-401), the new "Largo" dual 8 speaker system (JS-S-402), and the "Diminuette" speaker system (JS-S-401). Any or all of these sheets are available on request. Please order by publication number.

TELECTRO FACILITIES

Telectro Industries Corporation, 35-16 37th Street, Long Island City 1, New York has issued an informative 24-page booklet describing its facilities and typical products.

Sections of the booklet describe in text and illustration the company's facilities for designing and engineering, production personnel, and testing. A list of available machine tools and

Catalogue data, complete, with applications, features, descriptions, specifications, photos, and ordering information is contained in Bulletin 428. Bulletins 428-1 428-2, and 428-3 include radiation pattern for the four, six, and ten foot sizes respectively.

TV REPLACEMENT PARTS

Todd-Tran Corp. of 156 Gramatan Avenue, Mount Vernon, New York has issued two new catalogue sheets on *RCA* and *Motorola* TV replacements. These catalogues feature a full and exact replacement line of deflection yokes, flybacks, vertical, and power transformers for the two makes of sets.

All of the parts described on the two sheets are made to the original specifications including the lead colors, terminal connections, mounting, networks, etc. Copies of these catalogue sheets will be supplied free of charge on request.

MAGNETIC CORES

General Ceramics Corporation, Keasbey, New Jersey has issued a four-page data sheet on its "Ferramic" magnetic cores.

The bulletin includes graphs of magnetic properties of the firm's "Ferramic H" as well as magnetic properties of other "Ferramic" bodies in tabular form.

Copies of this bulletin will be supplied without charge upon request to the manufacturer.

TV REPLACEMENT GUIDE

The 1956 edition of its comprehensive "TV Repl. Guide" has been issued by *Merit Coil & Transformer Corp.* of 4427 N. Clark St., Chicago 40, Ill.

This new 80-page booklet lists approximately 12,000 models and chassis with over 155 brand names or manufacturers carried in the cross-reference guide.

The catalogue section shows both list price and unit weight and is more descriptive than ever before. For ready reference, various types of unit mountings have been consolidated.

Quantities of the new guide, Form No. 408, have been sent to the company's jobbers but individual requests will be filled by the company direct.

ENCAPSULATED RESISTORS

Cinema Engineering Company Division of *Aerovox Corporation,* Burbank, California is now offering copies of its new 20-page catalogue which covers a line of encapsulated resistors. Illustrated are both the CE 100 and CE 200 series for axial wire terminals, radial wire terminals, and radial lug terminals. The PW 100 and PW 200 series are for printed circuitry.

Dimensional details, wattage ratings, maximum resistance, and military equivalents are also included.

Bulletin LC-1030-A is available either from the factory direct or from any of the sales representative offices of the firm throughout the United States. —30—

STARTING A SERVICE BUSINESS

By **JACK WILSON**
Pierce School of Radio and Television

Here are a few tips of the trade on how to obtain customers whether you work from a store or home.

SO NOW you have that technical school diploma hanging on the wall and are carrying a wallet-size photostat as well. You are prepared to go into business on your own, servicing sets. Perhaps you are one of the fortunate few who either have or could borrow enough capital to open a modern store and even have a franchise for retailing a well-known set. Or, maybe you are the fellow who has purchased some equipment over a long period of time, enough to commence servicing, and have a neat but small workshop in your basement or garage with shelves moderately stocked with tubes, resistors, capacitors, and all other necessary parts just to get started. The sign on your front lawn does not read "Keep Off The Grass" but "John Doe, Radio & Television Repairs."

If you are in the latter category, then this article is for you.

It is safe to say that radio and television servicing has progressed from just a trade to a profession. Today's service technicians are not doing the same routine thing day after day. With so many advancements being made in the electronics field, they are constantly learning something new. They read the technical magazines and manuals and try to keep abreast of the times. They are eagerly awaiting color television.

But right now, you are interested in obtaining more business so that you can look forward to the future. To start with, you have to make new contacts. One way of going about this is to take a look at the rooftops in your neighborhood. Where the antennas are, there are your prospective customers. One thing to keep in mind at this point is that now you are a salesman and not a technician, so before knocking on doors be sure you look the part. Leave the khaki trousers and the "T" shirt in the workshop. You have to be as presentable as the people you are calling on, if not more so. Supply yourself with enough printed business cards stating the name you have chosen for your company, your address, and telephone number. Also, arm yourself with an appointment book—any small notebook will do.

When the lady of the house comes to the door, introduce yourself and offer her one of your business cards. Inform her that you are a radio and television service technician and would like to know if her set is in good working condition. If the reply is yes, tell her that when she does have trouble with either a radio or television set, you would appreciate the opportunity of serving her, and if she is ever dissatisfied with her present service company, to please give you a ring. Thank her and leave. Do not go into detail about crooked servicing companies, or how much smarter you are at repairing sets than the next fellow, and certainly do not give any hard luck stories. In other words, do not linger; thank your prospect and leave. Remember, you are not selling sewing machines or vacuum cleaners, you are selling a service and everyone at some time will need this service. If you leave a favorable impression, you will be answering your phone more often than you think.

On the other hand, if your prospect replies that she is having trouble with her set and would like to have you look at it, make an appointment with her for that evening and return with your kit. Don't be an eager beaver and try to pick up the first few dollars you flush. Your mission today is contacting as many homes as possible to establish yourself in the neighborhood and you might have five appointments at the end of the day instead of wasting all morning or afternoon on the set. Be sure to space your appointments, allowing enough time for each customer.

Not everyone you contact will be courteous, but don't let this bother you. It is surprising how many people will eventually be customers and good friends of yours, because of the word-of-mouth advertising that moves through a neighborhood after you have satisfied a few people. The first day of this type of selling is the hardest. From then on, you can conduct each interview with the graciousness of a good businessman.

Another tried-and-true method of gaining new customers is to approach professional men such as doctors or lawyers. You are sure to find a few sets needing repair if you contact enough of them. A doctor or lawyer meets a lot of people each week and he, like everyone, is glad to tell a friend or client about the expert service he received on his set. One technician repaired his dentist's TV set and from the dentist telling a patient and one patient telling another, he had sixteen service calls which he did not have to solicit. These he terms as his "bonus" calls. Incidentally, he has just purchased a new panel truck for his

business, and he graduated only eight months ago from a television servicing school.

One system that is keeping a service technician so busy he works morning, noon, and night is the following. He approaches the superintendents of large apartment buildings and offers them a small commission for every set he services in their buildings. These "supers" are happy to recommend the technician to their tenants, the tenants are happy because they receive good service at a reasonable cost, and the service technician has a lot of steady customers.

Another recent graduate, operating out of a basement workshop, has hit upon a profitable idea by servicing hard-to-fix sets on a flat-rate basis. He works with the larger service and appliance companies only. They welcome the chance to send him these sets because it cuts down on their overhead and they can devote more time to the repairing of the many other electrical items they carry.

As a final touch to this sales picture, you should know something about television personalities themselves. Watch television, read some fan magazines and the television column in your local newspaper. This way you can pass along and exchange information with your customers.

Here are a few ideas for you to start with, now add some of your own and you will soon be a successful businessman working exclusively for the fellow whose name appears on that sign on your front lawn. —30—

CIRCUIT IMPROVEMENT

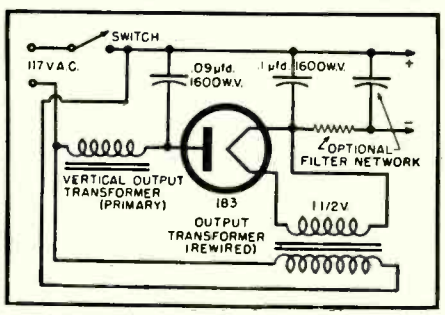
By DAVE FREEDMAN

IT WAS pointed out in Jesse Jacobson's article ("1250 Volt D.C. Power Supply," March 1955 issue of RADIO & TELEVISION NEWS) that an inductance with a higher "Q" at 60 cps would give a higher voltage.

Keeping this in mind, the author used the primary winding of a vertical output transformer which has an extremely high "Q" since it is designed to work only at 60 cps. This transformer delivered 900 volts r.m.s. which, when rectified by a half-wave rectifier, produced 1300 volts d.c.

The scheme permits a simple circuit to be used in order to obtain the same results—and all at a reduced cost. It should be mentioned, however, that the size of the tuning capacitor (.09 μfd. in this case) is determined experimentally as it will vary with the vertical output transformer selected. —30—

A simple improvement on the circuit described on page 84 of the March 1955 issue.



FM Multiplexing

(*Continued from page 57*)

role of increasing importance in daily living. High-fidelity reproduction is part and parcel of this trend, and there are enthusiasts everywhere eager to profit by advanced technical developments which afford a decided increase in listening pleasure. Stereophonic reproduction is such a development and is catching on. People are hearing it in movie houses, in audio showrooms, at audio fairs, and elsewhere. Inasmuch as stereophonic FM is now technically feasible, its failure to make headway would be an exception to the rule that what the public wants the public gets.

The likelihood of stereophonic FM is further increased by the fact that by mid-1956 there will be a substantial number of FM stations on a multiplex basis. The FCC in early 1955 not only sanctioned multiplex but required that FM stations wishing to render "subsidiary communications" services must use multiplex after July 1, 1956. The present simplex ("beep") method of providing subscription services, which mutes segments of a single channel broadcast by means of brief ultrasonic signals, will no longer be permitted. Inasmuch as an FM station is required to provide at least 36 hours per week of public broadcast service on its main channel, it seems that only a moderate sacrifice, if any, would be involved if a station already possessing multiplex facilities were to render several hours a week of live, taped, or disc stereophonic material.

To the audiophile who has already strained his budget or is planning to strain it for just one high-fidelity system, the thought of duplicating this effort to bring stereophonic sound into the home doubtless presents searching questions. How much more will it cost? How much extra room will it take? Is it worth the effort?

As to cost, there is every reason to believe that a two-channel system will cost decidedly less than twice the cost of a one-channel system. For example, a second power amplifier, or two amplifiers on one chassis, can effect a cost saving through use of smaller output transformers inasmuch as the power requirement, for equivalent single-channel sound, is halved on each channel. Moreover, it appears that the total power requirement is less with a stereophonic system. It has been remarked that much of the call for high wattage amplifiers has resulted from the audiophile's desire to suffuse the room with sound from a single source. Given two sources, the effect of spatial distribution can be obtained without blasting.[1] Thus a total of ten watts may be more than adequate for the home in all but exceptional circumstances.

Perhaps the biggest cost saving can be effected in terms of speakers. Whereas a super-duper speaker is necessary to achieve super-duper sound on

a one-channel system, considerably smaller and less expensive speakers are very satisfactory in stereophonic applications. In other words, the difference between an inexpensive speaker and a costly one is much less pronounced on stereophonic reproduction than on one-channel sound. In this connection note the relatively modest speakers used by theaters in connection with stereophonic sound.

With respect to the amount of room that a two-channel system takes, two-channel amplifiers, preamplifiers, tape machines, etc. are being produced today in packages hardly, if at all, bigger than their one-channel counterparts. The principal increase in space requirements concerns speakers. But, again, the fact that substantially smaller speakers are adequate in stereophonic reproduction lessens the problem. Moreover, ingenious applications of acoustic principles have brought forth small speaker systems with astonishingly good sound.

Finally, is stereophonic sound worth the effort? Without question one can find sharp division of opinion as to whether stereophonic sound *via* speakers does something extra for the listener. Majority opinion seems to be that it does, although the three-dimensional sensation is not as profound as provided by binaural reproduction *via* earphones. Even at its present relatively crude stage of development, two-channel sound *via* speakers does afford many listeners a substantial margin of pleasure over one-channel methods of reproduction, including (1) reproduction by one speaker, (2) reproduction by two speakers, (3) "pseudo-stereophonic" reproduction by two speakers, one speaker emphasizing bass and the other emphasizing treble.

It must be further considered that any new art requires time to achieve a substantial measure of its ultimate potential. There is no reason to believe that this principle fails to apply to stereophonic reproduction, which is a mere fledgling. Improved techniques in lateral and vertical placement of microphones, selection or development of microphones with optimum response patterns for their designated purpose, and other technical improvements yet unforeseen will very likely enable stereophonic sound to substantially increase its present superiority over single-channel sound. Under these circumstances, FM stereophonic reproduction should be a "natural" for which the public is willing to pay in one form or another.

Listeners in certain urban areas have had just enough of a taste of "stereo" reception, *via* the binaural (AM-FM transmissions) broadcasts to whet their appetites for the improved reception that can be theirs with both channels transmitted *via* FM.

Undoubtedly these persons will give FM multiplex a hearty welcome.

REFERENCE

1. Marsh, R. C.: "Yorkshireman in Festival Hall," High Fidelity, August 1955.

—30—

MAKING USE OF LOAD LINES

By **N. H. CROWHURST**

The gap between "theory" and "practice" can be bridged by using graphic tube characteristics and load lines.

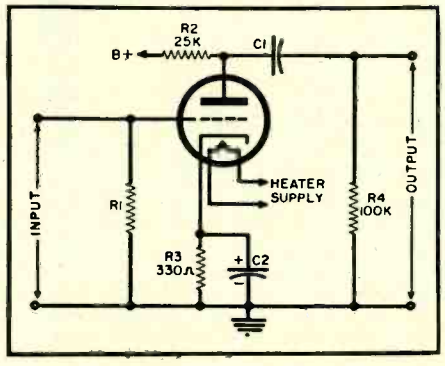
EVER since the days when electronics went under the name of radio there has been a controversy between the "theory" and "practice" boys. The proponents of "theory" like to start by calculating a circuit in all its detail. After building it, they hand it over to a practical man to make it work. The practical man naturally argues that practice is of greater value than theory because the theorists never manage to arrive at the right answer the first time.

Often the designer who relies on theory does not take all the factors into account. In "theory" a tube has simple characteristics which are listed in a neat little table and by using a convenient formula with algebraic symbols the gain of that tube in a certain circuit can be calculated. An amplifier designed on this basis often misses its objective in one of two ways: either it has less gain than was anticipated; or, if a margin of gain was allowed to take care of this contingency, it turns out to have considerably more gain than was required. It may also be deficient in that although it has the correct gain it will not handle the full output for which it was intended.

This sort of thing happens because the neat little table of tube characteristics does not tell the whole story. The best link between theory and practice, which enables the prospective designer of an amplifier to come fairly close to the right answers the first time, is the use of graphic tube characteristics and the drawing of load lines. To illustrate this we will take a simple voltage amplification stage, the purpose of which is to receive a specified input voltage on the grid of a tube and amplify it as much as possible at the plate, in order to drive the next stage.

Assume that the circuit is the simple

Fig. 1. A simple resistance-capitance coupled stage for voltage amplification.



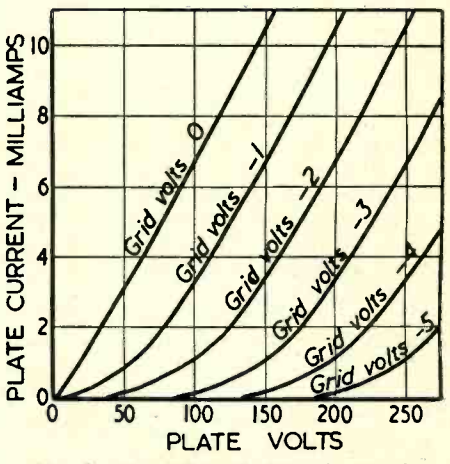


Fig. 2. Tube characteristics for use in the circuit of Fig. 1. Refer to article.

one shown in Fig. 1 and that the tube we have chosen has the characteristics shown in Fig. 2. The first thing to do is to draw a load line (Fig. 3) from the "B+" voltage to be used across the tube characteristics at an angle representing the plate resistor R_2.

This is done by taking the "B+" supply voltage of 250, in this case, and dividing it by the value of R_2 (25,000 ohms). Thus, 250 volts divided by 25,000 ohms will give a plate current of 10 ma. The load line is then drawn between 250 volts and 10 ma.

Next we want to find what value cathode resistor (R_3) is required to provide the right operating bias. This really is quite simple: we have to find a point along the load line that will be a suitable operating point to give the required degree of grid voltage swing without running into distortion and then find out what resistance in the cathode will give us the bias value corresponding to this operating point.

Suppose we know that the maximum voltage swing applied at the grid of this tube will be 1 volt, then from the tube characteristics we will find that the best operating position is about 1 volt negative so that the swing of 1 volt alternately positive and negative from this position goes from zero to –2 volts. That this will give the minimum distortion can be seen by examining the spacing between the various curves representing different grid voltages. The spacing between the curves for zero, –1, and –2 grid volts, is nearer equal along the load line than any other pair of adjacent grid voltage curves. The spacing should be equal so that all of the waveform is amplified

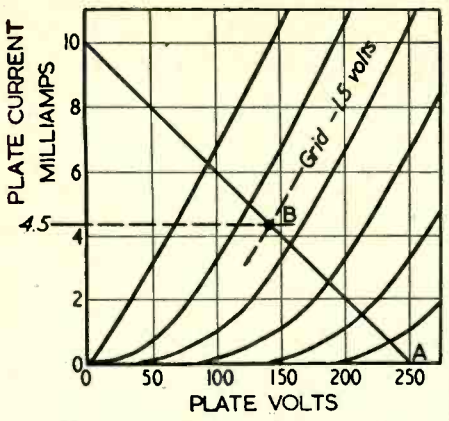


Fig. 3. First step in calculating values. The load line represents an R_2 of 25,000 ohms. The cathode bias resistor is calculated from plate current and the bias voltage operating at point B. Refer to text.

uniformly. To allow a slight margin, in case the voltage swings a little more than 1 volt to avoid the positive grid region, which causes grid current flow, we will choose a bias voltage of −1.5 volts. This gives us the point *B* on the load line, shown in Fig. 3.

Referring to the current scale at the left-hand side of the tube characteristics we find that point *B* represents a plate current of 4.5 milliamps. We now have the information necessary to calculate the value of the bias resistor, R_3; it must drop 1.5 volts with a plate current of 4.5 milliamps; this means its resistance value must be 1.5/.0045 = 330 ohms.

Now, to work out the rest of the circuit, in order to provide a voltage for driving the next stage grid, we need a coupling capacitor C_1 and a grid resistor R_4. To calculate the effect of these components on the amplification of the tube we have to recognize two things that may not be obvious at first sight: first, that the coupling capacitor C_1 blocks any d.c. potential from the grid of the next stage and, second, that at audio frequencies the reactance of capacitor C_1 is negligible.

This means that, as far as audio frequencies are concerned, R_2 and R_4 are effectively connected in parallel because at one end the reactance of C_1 has negligible effect, and at the other end "B+" is connected to ground through a low reactance decoupling or smoothing capacitor. So we have to draw another load line, to represent R_2 and R_4 in parallel.

We can easily calculate the value of this load line from the formula $R = (R_2 \times R_4)/(R_2 \times R_4)$. Assume, for example, that we choose 100,000 ohms as the value for R_4. R_2 has already been set at 25,000 ohms, so the value of R works out to be 20,000 ohms.

If R_2 is actually 20,000 ohms instead of 25,000 ohms, the load line would be as shown dotted at *AD* in Fig. 4. But because the d.c. feed to the plate of the tube is only through the 25,000-ohm resistor, the "direct current" load line is truly represented by the line *AB*, and the operating point has been set, by choice of resistor R_3, at point *B*. So the "dynamic load line" as it is called,

or the load line for amplifying purposes, is represented by drawing a line having the same slope as *AD*, but passing through the point *B*. This is very simple to construct, by drawing a line parallel to *AD* through the point *B*, shown as *EF*.

It is shown connected between the grid voltage curves for zero and −3 volts, because the actual swing which will be employed for amplification purposes will not be greater than this—actually a little less.

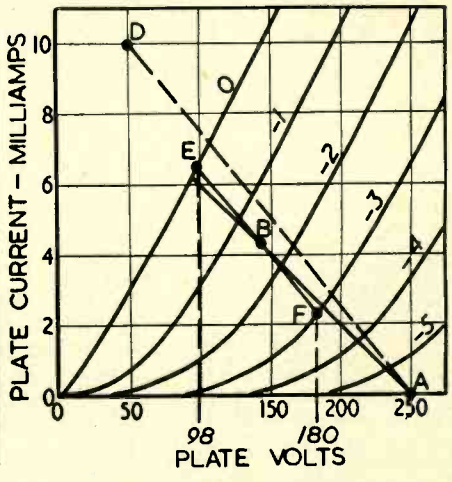
Now we can see how much amplification the stage will give. Point *E* on the zero grid voltage curve represents a plate voltage of about 98 volts. Point *F*, on the −3 grid voltage curve, represents a plate voltage of about 180 volts. So the grid voltage variation of 3 volts, between zero and −3, will give a plate voltage variation of 82 volts, from 98 to 180. These are convenient values to read on the graph, but other voltages will run proportionally, so, dividing one by the other, this means that a grid voltage swing of 1 volt will give a plate voltage swing of 82 divided by 3 = 27.3 volts. Otherwise expressed, the stage will show a gain of about 27.

This method of working out the performance of a tube comes a lot nearer to the practical results than calculation using the algebra given in textbooks and the tabulated tube constants given in a tube manual. It will also show without any doubt whether the tube is capable of handling the volume level intended at the particular point in the amplifier without overloading, which use of the tabulated data in a tube manual may overlook.

All that is left in completing the stage is to determine the value of the cathode bypass capacitor C_2. By good engineering standards the reactance of C_2 at the lowest frequency to be amplified by the stage should be 10% or less of the cathode resistor, R_3. In this case the reactance of C_2 at, say, 50 cycles, should be 33 ohms at most. This would work out as 100 μfd.

Pursuing the case we have just considered a little farther, we know that

Fig. 4. Remaining steps in calculating performance of stage. AB is the direct-current load line, obtained as shown in Fig. 3. EF is the dynamic load line, taking into account the effect of R_L through C_2.



full volume will represent 1 volt on the grid of this tube, and that this 1 volt on the grid will produce about 27 volts on the plate. From there we can consider the next stage with the characteristics of a suitable tube, knowing that we will now get up to 27 volts swing on its grid.

In this discussion we have been working forward, *i.e.*, we started with 1 volt input, and worked our levels forward toward the output. In practice it is often better to work backward from output to input. We know first what voltage we need at the grid of the output tubes. From there we work backwards to find what tube and what resistance values we can use to get this voltage to drive the output tubes. We then find what voltage this tube needs to swing its grid to give the required plate swing. Then we move back to an earlier stage to find how we can get enough gain from the available input voltage.

Irrespective of whether we work backwards or forwards, this discussion has shown how valuable a load line can be in determining a circuit for a simple tube. We have kept the discussion to a consideration of voltages, because the kind of stage we have talked about has been the one known as a voltage amplifier. -30-

VARIABLE FEEDBACK

By G. TUTT, VE7JS

MANY amateurs, including myself, use their communications receivers for broadcast reception. To improve the audio qualities and, at the same time, retain the original design, the following feedback circuit was incorporated in my Bendix RAIB.

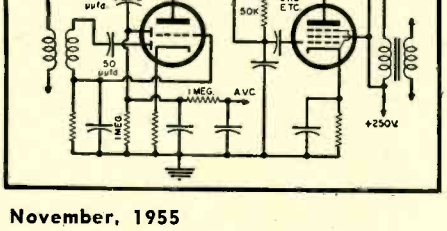
The feedback was taken from the output plate and tied to one side of a 100,000 ohm pot. The other side of the pot is connected to the positive high voltage. The variable arm goes to the first audio plate resistor.

As the control is advanced towards the output plate connection, a decided improvement in fidelity results. At the same time audio gain decreases. When the control is retarded toward the positive high voltage, less feedback occurs and the over-all gain returns to approximately normal.

In practice, one setting will be found suitable for broadcast listening and the variable feature is handy for fone and c.w. reception.

In the diagram below, the detector diodes are shown split—one for a.v.c. and one for audio. The first audio plate bypass can be used as a tone control if desired. -30-

Simple circuit change for improving the audio quality of communications receiver.



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of High-Fidelity Audio Equipment

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A Amplifier, preamps., etc.
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D Record Player
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G Tuners
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B Record blanks
C Recorders
D Styli (recording)

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LIVINGSTON ELECTRONIC CORP., Livingston, N. J. **(D)**
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MP ENGINEERING CO., Fairfield 3, Conn. **(B, D)**
NATIONAL COMPANY, INC., 61 Sherman St., Malden 48, Mass. **(E)**
PERMO, INC., 6415 N. Ravenswood Ave., Chicago 26, Ill. **(C)**
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PICKERING AND CO., INC., 309 Woods Ave., Oceanside, L. I., N. Y. **(A, C, D)**
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RECOTON CORP., 52-35 Barnett Ave., Long Island City 4, N. Y. **(A, C)**
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ROBINS INDUSTRIES CORP., 41-08 Bell Blvd., Bayside 61, N. Y. **(F)**
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ELECTRO-VOICE, INC., Buchanan, Mich. **(A, B)**
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HEATH CO., 305 Territorial Rd., Benton Harbor, Mich. **(A, B)**
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NATIONAL COMPANY, INC., 61 Sherman St., Malden 48, Mass. **(A, B)**
NEWCOMB AUDIO PRODUCTS CO., 6824 Lexington Ave., Hollywood 38, Calif. **(A)**
PALMER, INC., M. V., 4002 Fruit Valley Rd., Vancouver, Wash. **(A, B)**
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SHRADER SOUND, INC., 2803 M St., N. W., Washington 7, D. C. **(A, B)**
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SONOTONE CORP., Elmsford, N. Y. **(B)**
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SUMMIT ELECTRONICS, INC., 7 Industrial Pl., Summit, N. J. **(B)**
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UNITED TRANSFORMER CO., 150 Varick St., New York 13, N. Y. **(B)**
U. S. RECORDING CO., 1121 Vermont Ave., N. W., Washington 5, D. C. **(A, B)**
WEBSTER ELECTRIC CO., 1900 Clark St., Racine, Wis. **(B)**
WELLS-GARDNER & CO., 2701 N. Kildare Ave., Chicago 39, Ill. **(A, B)**

PREAMPLIFIERS AND EQUIPMENT

A Audio Mixers
B Dynamic Noise Suppressors
C Filters (rumble and scratch)
D Phono Equalizers
E Preamplifiers

ALTEC LANSING CORP., 9356 Santa Monica Blvd., Beverly Hills, Calif. **(E)**
APPROVED ELECTRONIC INSTRUMENT CORP., 928 Broadway, New York 10, N. Y. **(E)**
BEAM INSTRUMENTS CORP., 350 Fifth Ave., New York 1, N. Y. **(E)**
BIGG OF CALIFORNIA (BIGG RADIO CO.), 2506 W. Washington Blvd., Los Angeles, Calif. **(A, B, D, E)**
BOGEN CO., INC., DAVID, 29 Ninth Ave., New York 14, N. Y. **(A, D, E)**
BRAINARD ELECTRONICS, 8586 Santa Monica Blvd., Los Angeles 64, Calif. **(D, E)**
BROCINER ELECTRONICS CORP., 344 E. 32nd St., New York 16, N. Y. **(E)**
CLEGG LABORATORIES, INC., Hanover Rd. & Ridgedale Ave., Morris Township, N. J. **(A, C, D, E)**
DICTOGRAPH PRODUCTS INC., 95-25 149th St., Jamaica 35, N. Y. **(D, E)**
DUBROW DEVELOPMENT CO., 235 Penn St., Burlington, N. J. **(C)**
DYNAMU MAGNETRONICS CORP., DIV. OF THE MAICO CO., INC., 21 N. 3rd St., Minneapolis 1, Minn. **(E)**
ELECTRONIC INSTRUMENT CO., INC. (EICO), 84 Withers St., Brooklyn 11, N. Y. **(E)**
ELECTROSONIC SPECIALTIES, 7230 Clinton Rd., Upper Darby, Pa. **(E)**
ELECTRO-VOICE, INC., Buchanan, Mich. **(E)**
EMC RECORDINGS CORP., 806 E. Seventh St., St. Paul 6, Minn. **(E)**
EPCO ELECTRONICS, INC., 140 Liberty St., New York 6, N. Y. **(D, E)**
FAIRCHILD RECORDING EQUIPMENT CO., Whitestone 57, N. Y. **(E)**
FANON ELECTRIC CO., INC., 150-09 South Rd., Jamaica 33, N. Y. **(E)**
FEMCO, INC., Box 32, Irwin, Penna. **(E)**
FENTON CO., 15 Moore St., New York, N. Y. **(E)**
FISHER RADIO CORP., 21-21 44th Dr., Long Island City 1, N. Y. **(A, C, D, E)**
GENERAL ELECTRIC CO., Electronics Park, Syracuse, N. Y. **(C, E)**
GOTHAM TELEVISION CORP., 123 W. 64th St., New York, N. Y. **(D, E)**
GROMMES DIV. OF PRECISION ELECTRONICS, INC., 9101 King Ave., Franklin Park, Ill. **(D, E)**
GROSSMAN RADIO & ELECTRIC CO., 81 Spring St., New York, N. Y. **(E)**
HAMILTON ELECTRONICS, 2726 Pratt Ave., Chicago 45, Ill. **(A)**
HARMAN KARDON INC., 520 Main St., Westbury L. I., N. Y. **(E)**
HARTLEY PRODUCTS CO., 521 E. 162nd St., New York 51, N. Y. **(D, E)**
HEATH CO., 305 Territorial Rd., Benton Harbor, Mich. **(E)**
LANGEVIN MFG. CORP., 47-37 Austell Pl., Long Island City 1, N. Y. **(A, C, D, E)**
LOGE SOUND ENGINEERS, J. M., 2171 W. Washington Blvd., Los Angeles 18, Calif. **(A, E)**
MARANTZ CO., 44-15 Vernon Blvd., Long Island City 1, N. Y. **(E)**
MARTIN AND CO., H. S., 1916 Greenleaf St., Evanston, Ill. **(E)**
McINTOSH LAB., INC., 320 Water St., Binghamton, N. Y. **(A, D, E)**
MILLER CO., J. W., 5917 S. Main St., Los Angeles 3, Calif. **(C)**
MP ENGINEERING CO., Fairfield 3, Conn. **(A, D, E)**
NATIONAL COMPANY, INC., 61 Sherman St., Malden 48, Mass. **(E)**
NEWCOMB AUDIO PRODUCTS CO., 6824 Lexington Ave., Hollywood 38, Calif. **(E)**
ORTHO FILTER CORP., 196 Albion Ave., Paterson, N. J. **(C)**
PALMER, INC., M. V., 4002 Fruit Valley Rd., Vancouver, Wash. **(A, C)**
PENTRON CORP., THE, 777 S. Tripp, Chicago 24, Ill. **(E)**
PFANSTIEHL CHEMICAL CORP., 104 Lake View Ave., Waukegan, Ill. **(D, E)**
PICKERING AND CO., INC., 309 Woods Ave., Oceanside, L. I., N. Y. **(D, E)**
PILOT RADIO CORP., 37-06 36th St., Long Island City 1, N. Y. **(D, E)**
PRECISE DEVELOPMENT CORP., 2 Neil Court, Oceanside, N. Y. **(E)**
PRESTO RECORDING CORP., P. O. Box 500, Paramus, N. J. **(D, E)**
RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.), Front and Cooper Sts., Camden, N. J. **(E)**
RADIO CRAFTSMEN, INC., THE, 4401 N. Ravenswood Ave., Chicago 40, Ill. **(C, E)**
RADIO MUSIC CORP., 84 S. Water St., Port Chester, N. Y. **(A, C, D, E)**
R. AND B. ELECTRONICS CO., Box 6998, Washington 20, D. C. **(E)**
REGENCY DIVISION, I. D. E. A., INC., 7900 Pendleton Pike, Indianapolis 26, Ind. **(E)**
SCOTT, INC., HERMON HOSMER, 385 Putnam Ave., Cambridge 39, Mass. **(B, D, E)**
SHRADER SOUND, INC., 2803 M St., N. W., Washington 7, D. C. **(A)**
SONEX, INC., 245 Sansom St., Upper Darby, Penna. **(D, E)**
SONOTONE CORP., Elmsford, N. Y. **(E)**
SPECIAL PRODUCTS CO., P. O. Box 188, Rockville, Md. **(A)**
STROMBERG-CARLSON CO., SOUND DIV., 1225 Clifford Ave., Rochester, N. Y. **(A, E)**
SUMMIT ELECTRONICS, INC., 7 Industrial Pl., Summit, N. J. **(A, B, E)**
SWITCHCRAFT, INC., 1328 N. Halsted St., Chicago 22, Ill. **(A)**
TANNOY (AMERICA), LTD., 38 Pearl St., New York 4, N. Y. **(E)**
TECH-MASTER CORP., 75 Front St., Brooklyn, N. Y. **(E)**
TELECTROSONIC CORP., 35-18 37th St., Long Island City 1, N. Y. **(A, E)**
THORDARSON-MEISSNER MANUFACTURING DIV., 7th & Bellmont Ave., Mt. Carmel, Ill. **(C, E)**
TRI-DEX CO., P. O. Box 1207, Lindsay, Calif. **(E)**
UNITED TRANSFORMER CO., 150 Varick St., New York 13, N. Y. **(C, D)**
U. S. RECORDING CO., 1121 Vermont Ave., N. W., Washington 5, D. C. **(A, E)**
WEBSTER ELECTRIC CO., 1900 Clark St., Racine, Wis. **(E)**

SPEAKERS AND EQUIPMENT

A Crossover Networks
B Enclosures—Baffles (speaker)
C Mid-Range
D Tweeters (cone type)
E Tweeters (horn type)
F Wide-Range
G Woofers
H Tweeters-Electrostatic

ACOUSTIC RESEARCH, INC., 23 Mt. Auburn St., Cambridge 38, Mass. **(B, D, G)**
ALTEC LANSING CORP., 9356 Santa Monica Blvd., Beverly Hills, Calif. **(A, B, E, F, G)**
AMI, INC., 1500 Union Ave., S. E., Grand Rapids, Mich. **(A, B)**
ANGLE GENESSEE CORP., 107 Norris Dr., Rochester 10, N. Y. **(B)**
ARGOS PRODUCTS, 310 Main St., Genoa, Ill. **(B)**
ATLAS SOUND CORP., 1449 39th St., Brooklyn 18, N. Y. **(A, C, E)**
BEAM INSTRUMENTS CORP., 350 Fifth Ave., New York 1, N. Y. **(A, B, C, E, F, G)**
BENNETT & CO., PAUL, 230 E. Ohio St., Chicago 30, Ill. **(D, E, F)**
BIGG OF CALIFORNIA (BIGG RADIO CO.), 2506 W. Washington Blvd., Los Angeles, Calif. **(A, B)**
BOGEN CO., INC., DAVID, 29 Ninth Ave., New York 14, N. Y. **(B)**
BOZAK SALES CO., THE R. T., P. O. Box 966, Darien, Conn. **(A, B, C, D, G)**
BROCINER ELECTRONICS CORP., 344 E. 32nd St., New York 16, N. Y. **(F)**
BUD RADIO, INC., 2118 E. 55th St., Cleveland 3, Ohio **(B)**
BUTLER MFG. CO., INC., B. B., 3150 Randolph St., Bellwood, Ill. **(B)**
CALIFORNIA CABINET CO., 522 S. San Pedro St., Los Angeles, Calif. **(B)**
CARBONNEAU INDUSTRIES, 100 Lexington S. W., Grand Rapids 4, Mich. **(D, F)**
CLEVELAND ELECTRONICS, INC., 1974 E. 61st St., Cleveland 3, Ohio. **(C, D, F, G)**
COMPONENTS CORP., 106 Main St., Denville, N. J. **(H)**
CONSOLIDATED RADIO PRODUCTS CO., 350 W. Erie St., Chicago 10, Ill. **(D, E, F, G)**
D & R, LTD., 402 E. Gutierrez St., Santa Barbara, Calif. **(A)**
DICTOGRAPH PRODUCTS INC., 95-25 149th St., Jamaica 35, N. Y. **(B)**
DuKANE CORP., St. Charles, Ill. **(C)**
ELECTRON ENTERPRISES, 6917 W. Stanley Ave., Berwyn, Ill. **(B)**
ELECTRO-VOICE, INC., Buchanan, Mich. **(A, B, C, E, F, G)**
GENERAL APPARATUS CO., 344 E. 32nd St., New York 16, N. Y. **(A)**
GENERAL ELECTRIC CO., Electronics Park, Syracuse, N. Y. **(B, D, F, D)**
G & H WOOD PRODUCTS CO., INC., 99 N. 11th St., Brooklyn 11, N. Y. **(A, C)**
GROSSMAN RADIO & ELECTRIC CO., 81 Spring St., New York, N. Y. **(C, D, F, G)**
HARTLEY PRODUCTS CO., 521 E. 162nd St., New York 51, N. Y. **(B, F)**
INTERNATIONAL RADIO & ELECTRONICS CORP., Elkhart, Ind. **(B)**
JAMES INSTRUMENT LABORATORY, 9110 S. 52nd Ct., Oak Lawn, Ill. **(B)**
JENSEN MFG. CO., 6601 S. Laramie St., Chicago 3, Ill. **(A, B, C, D, E, F, G)**
KARLSON ASSOCIATES, INC., 1483 Coney Island Ave., Brooklyn 30, N. Y. **(B)**
KINGDOM PRODUCTS, LTD., 23 Park Pl., New York 7, N. Y. **(A, D, F, G, H)**
KLIPSCH & ASSOCIATES, P. O. Box 64, Hope, Ark. **(A, B, C, F, G)**
LANSING SOUND, INC., JAMES B., 2439 Fletcher Dr., Los Angeles 39, Calif. **(A, B, C, E, F, G)**
LOWELL MFG. CO., 3030 Laclede Station Rd., St. Louis, Mo. **(B)**
MANFREDI WOOD PRODUCTS CO., 226 New York Ave., Huntington, N. Y. **(B)**
MARKELL ASSOCIATES, JEFF, 764 Sixth Ave., New York, N. Y. **(B)**
MATTISON TELEVISION AND RADIO CORP., 10 W. 181 St., New York 53, N. Y. **(B)**
MENDELS, INC., R. I., 41 E. 42nd St., New York 17, N. Y. **(F)**
ORTHO FILTER CORP., 196 Albion Ave., Paterson, N. J. **(A)**
OXFORD ELECTRIC CORP., 3911 S. Michigan Ave., Chicago 15, Ill. **(D, F, G)**
PALMER, INC., M. V., 4002 Fruit Valley Rd., Vancouver, Wash. **(B)**
PERMOFLUX CORP., DISTRIBUTOR DIV., 2835 N. Kedzie Ave., Chicago 18, Ill. **(A, B, C, D, F, G)**
PILOT RADIO CORP., 37-06 36th St., Long Island City 1, N. Y. **(B)**
QUAM-NICHOLS CO., 234 E. Marquette Rd., Chicago 37, Ill. **(A, C, D, F, G)**
RACON ELECTRIC CO., INC., 1261 Broadway, New York, N. Y. **(A, B, C, D, E, F, G)**
RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.), Front and Cooper Sts., Camden, N. J. **(A, B, D, E, F)**
RIVER EDGE INDUSTRIES, 5 River Edge Rd., River Edge, N. J. **(B)**
RJ AUDIO PRODUCTS, 80 Shore Rd., Port Washington, L. I., N. Y. **(B)**
ROCKBAR CORP. (AGENTS FOR COLLARO, LTD., & GOODMANS INDUSTRIES), 215 E. 37th St., New York 16, N. Y. **(A, C, D, F, G)**
SHERWOOD ELECTRONIC LABORATORIES, INC., 2802 W. Cullom Ave., Chicago 18, Ill. **(A, B, C, D, G)**
SIGHTMASTER CORP., 111 Cedar St., New Rochelle, N. Y. **(A, B, D, F, G)**
SONOTONE CORP., Elmsford, N. Y. **(D, F, G)**
SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas **(A)**
STANDARD WOOD PRODUCTS CORP., 47 W. 63rd St., New York 23, N. Y. **(B)**
STEPHENS MANUFACTURING CORP., 8538 Warner Dr., Culver City, Calif. **(A, B, C, D, E, F, G)**
STROMBERG-CARLSON CO., SOUND DIV., 1225 Clifford Ave., Rochester, N. Y. **(B, F)**
SUMMIT ELECTRONICS, INC., 7 Industrial Pl., Summit, N. J. **(A)**
TANNOY (AMERICA), LTD., 38 Pearl St., New York 4, N. Y. **(A, B, E, F, G)**
TEXAS INSTRUMENTS, COMPONENTS DIV., 6000 Lemmon Ave., Dallas 9, Texas **(A)**
ULTRA HI-FI CO., 709 Sip St., Union City, N. J. **(B)**
UNITED AUDIO PRODUCTS DIV., UNITED OPT. MFG. CORP., 202-4 E. 19th St., New York 3, N. Y. **(C, D, F, G)**
UNIVERSITY LOUDSPEAKERS, INC., 80 S. Kensico Ave., White Plains, N. Y. **(A, B, C, E, F, G)**
UTAH RADIO PRODUCTS CO., INC., 1123 E. Franklin St., Huntington, Ind. **(B, C, D, E, F, G)**
WHITE, INC., STAN, 725 S. La Salle St., Chicago, Ill. **(B)**
WILCOX-GAY CORP., Charlotte, Mich. **(B)**
WRIGHT, INC., 2233 University Ave., St. Paul 14, Minn. **(B, F)**

WRIGHT ZIMMERMAN, INC., New Brighton, St. Paul 12, Minn. (A, B, C, D, F, G)

TAPE RECORDERS AND EQUIPMENT

A Demagnetizers
B Heads
C Players
D Recorders
E Splicers
F Tape
G Tape (recorded)
H Tape (test)
(Italics apply only to trade name of recorded tapes.)

ALONGE PRODUCTS, INC., 163 West 23rd St., New York, N. Y. (E)
AMPLIFIER CORP. OF AMERICA, 398 Broadway, New York 13, N. Y. (C, D)
AMPRO CORP., 2835 N. Western Ave., Chicago 18, Ill. (D)
AUDIO DEVICES, INC., 444 Madison Ave., New York 22, N. Y. (A, F)
AUDIO-MASTER CORP. (*MASTERTAPE*), 17 E. 45th St., New York 17, N. Y. (C, D, F, G)
A-V TAPE LIBRARIES, INC. (*A-V RECORDED TAPES, NATIONAL MUSITIME*), 730 Fifth Ave., New York 19, N. Y. (G)
BELL & HOWELL, 7100 McCormick Rd., Chicago 45, Ill. (D)
BELL SOUND SYSTEMS, INC., 555 Marion Rd., Columbus 7, Ohio (D)
BERLANT-CONCERTONE (AUDIO DIV., AMERICAN ELECTRONIC, INC.), 4917 W. Jefferson, Los Angeles 16, Calif. (D)
BROADCAST EQUIPMENT SPECIALTIES CORP., P. O. Box 149, Beacon, N. Y. (D)
BRUSH ELECTRONICS CO., 3405 Perkins Ave., Cleveland 14, Ohio. (B)
BURDETT SOUND & RECORDING CO. (*BURDETT*), 3619 Henderson Blvd., Tampa 9, Fla. (G)
CINEMA ENG. CO., DIV. AEROVOX CORP., 1100 Chestnut St., Burbank, Calif. (A)
COLUMBIA RECORDS, 799 Seventh Ave., New York, N. Y. (D)
CONCERTAPES, INC., 400 Jackson Ave., Glencoe, Ill. (G)
COUSINO, INC., 2325 Madison Ave., Toledo 2, Ohio (E)
CRESCENT INDUSTRIES, INC., 5900 W. Touhy Ave., Chicago 31, Ill. (D)
DAYSTROM ELECTRIC CORP., 837 Main St., Poughkeepsie, N. Y. (D)
DEJUR-AMSCO CORPORATION, 45-01 Northern Blvd., Long Island City, N. Y. (D)
DUBBINGS SALES CORP., THE, 41-10 45th St., Long Island City 4, N. Y. (G, H)
DUBROW DEVELOPMENT CO., 235 Penn St., Burlington, N. J. (D)
DuKANE CORP., St. Charles, Ill. (D)
DYNAMU MAGNETRONICS CORP., DIV. OF THE MAICO CO., INC., 21 N. 3rd St., Minneapolis 1, Minn. (B, C)
EICOR, INC., 1501 W. Congress St., Chicago 7, Ill. (D)
ELECTROSONIC SPECIALTIES (*FIDELIVOX*), 7230 Clinton Rd., Upper Darby, Pa. (G)
ELECTRO SOUND CORP., 115 Halleck St., Boston 20, Mass. (D, G)
EMC RECORDINGS CORP., 806 E. Seventh St., St. Paul 6, Minn. (C, G)
ERICSSON CORP., THE, 100 Park Ave., New York 17, N. Y. (D)
ESS TEE DISTRIBUTORS, INC. (*TAPE TOONS, SKATIN' TOONS*), Box 397, Smithtown, N. Y. (G)
FAIRCHILD RECORDING EQUIPMENT CO., Whitestone 57, N. Y. (D)
FEDERAL MFG. & ENG. CORP., 211 Steuben St., Brooklyn 5, N. Y. (D)
FENTON CO., 15 Moore St., New York, N. Y. (B, D)
GENERAL INDUSTRIES CO., THE, Olive and Taylor Sts., Elyria, Ohio (D)
GORDON ENTERPRISES, 5362 N. Cahuenga Blvd., N. Hollywood, Calif. (C, D)
HARTLEY PRODUCTS CO., 521 E. 162nd St., New York 51, N. Y. (D, F)
INTERNATIONAL PACIFIC RECORDING CORP. (*ALPHATAPE OMEGATAPE, JAZZTAPE*), 858 N. Vine St., Hollywood 38, Calif. (A, G, H)
INTERNATIONAL RADIO & ELECTRONICS CORP., Elkhart, Ind. (D)
INTERNATIONAL SCIENTIFIC INDUSTRIES CORP., 3101 E. 42nd St., Minneapolis 6, Minn. (C, D)
JAMES INSTRUMENT LAB., 9110 S. 52nd Ct., Oak Lawn, Ill. (D)
LIPPS ENGINEERING, EDWIN A., 5485 W. Washington Blvd., Los Angeles 16, Calif. (B)
LIVINGSTON ELECTRONIC CORP. (*CONNOISSEUR, ESOTERIC, HACK SWAIN MUSIKON, OCEANIC, RIVERSIDE, SWAIN-A-FONIC*), Livingston, N. J. (C, G)
MAGNASYNC MFG. CO., LTD., 5523 Satsuma Ave., North Hollywood, Calif. (B, D)
MAGNECORD INC., 1101 S. Kilbourn, Chicago, Ill. (B, C, D)
MAGNE-TRONICS, INC. (*MUSIC TAPES*), 122 E. 42nd St., New York 17, N. Y. (G)
MICHIGAN ELECTRONICS, INC., 854 N. Rockwell St., Chicago 22, Ill. (C, D, F)
MILLER ELECTRONICS (*MILLER*), 2840 Naomi, Burbank, Calif. (D, G)
MINNESOTA MINING AND MANUFACTURING CO., 900 Fauquier Ave., St. Paul 6, Minn. (F)
MITCHELL MFG. CO., 2525 Clybourn Ave., Chicago 14, Ill. (D)
MOHAWK BUSINESS MACHINES CORP., 944 Halsey St., Brooklyn 33, N. Y. (C, D)
MORRISON RECORDING LABS. (*MORRISONTAPE*), 120 S. Batavia Ave., Batavia, Ill. (G)
MUSIC TAPE SOCIETY, Box 661, Detroit 6, Mich. (G)
MUSITAPES, INC. (*MUSITAPE, TEMPOTAPE*), 8540 Sunset Blvd., Hollywood 46, Calif. (G)
ORRADIO INDUSTRIES, INC., Opelika, Ala. (F)
PENTRON CORP., THE, 777 S. Tripp, Chicago 24, Ill. (A, B, C, D, G)
PERMO, INC., 6415 N. Ravenswood Ave., Chicago 26, Ill. (F)
PHONOTAPES, INC. (*FOLKWAYS*), 853 Ninth Ave., New York 19, N. Y. (G)
PRESS WIRELESS LABORATORIES, INC., 25 Prospect Pl., West Newton 65, Mass. (D)
PRESTO RECORDING CORP., P. O. Box 500, Paramus, N. J. (A, B, C, D)
RADIO CORP. OF AMERICA (*RCA VICTOR*), 630 Fifth Ave., New York 20, N. Y. (G)
RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.), Front & Cooper Sts., Camden, N. J. (D, F)
RANGERTONE, INC., 73 Winthrop St., Newark, N. J. (B, D, H)

RECORDED TAPE OF THE MONTH CLUB, Box 195, Radio City P. O., N. Y. (G)
REEVES SOUNDCRAFT CORP., 10 E. 52nd St., New York 22, N. Y. (F)
REVERE CAMERA CO., 320 E. 21st St., Chicago 16, Ill. (D)
ROBINS INDUSTRIES CORP., 41-08 Bell Blvd., Bayside 61, N. Y. (E, H)
SHURE BROTHERS, INC., 225 W. Huron St., Chicago, Ill. (B)
STANCIL-HOFFMAN CORP., 921 N. Highland Ave., Hollywood 38, Calif. (D)
SUMMIT ELECTRONICS, INC., 7 Industrial Pl., Summit, N. J. (A, D)
TECHNICAL TAPE CORP., ELECTRO-MAGNETIC PRODUCTS DIV., Morris Heights 53, N. Y. (F)
TELECTRO INDUSTRIES CORP., 35-16 37th St., Long Island City 1, N. Y. (C, D)
TELECTROSONIC CORP., 35-18 37th St., Long Island City 1, N. Y. (C, D)
VIKING OF MINNEAPOLIS., 3520 E. 43rd St., Minneapolis 6, Minn. (C, D)
WARREN CORP., J. C., 21 Hanse Ave., Freeport, N. Y. (D)
WEB MUSIC PUBLISHING CO. (*WEB*). 149 W. 48th St., New York 36, N. Y. (G)
WEBSTER-CHICAGO CORP. (*WEBCOR*), 5610 W. Bloomingdale Ave., Chicago, Ill. (D, F, G)
WEBSTER ELECTRIC CO., 1900 Clark St., Racine Wis. (D)
WILCOX-GAY CORP., Charlotte Mich. (C, D)

TRANSFORMERS
A Input
B Output

ACRO PRODUCTS CO., 369 Shurs Lane, Philadelphia 28, Pa. (A, B)
AIRCRAFT TRANSFORMER CORP., Corner West & Willow Ave., Long Branch, N. J. (A, B)
BUTLER MFG. CO., INC., B. B., 3150 Randolph St., Bellwood, Ill. (B)
CHICAGO STANDARD TRANSFORMER CORP., 3850 Elston, Chicago 18, Ill. (A, B)
CONSOLIDATED RADIO PRODUCTS CO., 350 W. Erie St., Chicago 10, Ill. (A, B)
DIETZ DESIGN & MFG. CO., Grandview, Md. (A, B)
ELECTRO-SONIC LABS., 35-54 36th St., Long Island City, N. Y. (A, B)
FAIRCHILD RECORDING EQUIPMENT CO., Whitestone 57, N. Y. (A)
FEMCO, INC., Box 32, Irwin, Penna. (A, B)
FOREST ELECTRIC CO., THE, 7216 Circle Ave., Forest Park, Ill. (A, B)
FREED TRANSFORMER CO., INC., 1718 Weirfield St., Brooklyn 27, N. Y. (A, B)
GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. (B)
GROSSMAN RADIO & ELECTRIC CO., 81 Spring St., New York, N. Y. (B)
KENYON TRANSFORMER CO., 840 Barry St., New York 59, N. Y. (A, B)
LANGEVIN MFG. CORP., 47-37 Austell Pl., Long Island City 1, N. Y. (A, B)
McINTOSH LAB., INC., 320 Water St., Binghamton, N. Y. (A)
MERIT COIL & TRANSFORMER CORP., 4427 N. Clark St., Chicago 40, Ill. (B)
MICROTRAN CO., DIV. CREST LABORATORIES, INC., 84-11 Blvd., Rockaway Beach 93, N. Y. (A, B)
MORROW RADIO MFG. CO., 2794 Market St., Salem, Ore. (A, B)
NYT ELECTRONICS, INC., 2979 N. Ontario St., Burbank, Calif. (A, B)
ORTHO FILTER CORP., 196 Albion Ave., Paterson, N. J. (A, B)
PEERLESS ELECTRICAL PRODUCTS DIV., ALTEC LANSING CORP., 9356 Santa Monica Blvd., Beverly Hills, Calif. (A, B)
QUAM-NICHOLS CO., 234 E. Marquette Rd., Chicago 37, Ill. (B)
RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.), Front & Cooper Sts., Camden, N. J. (A)
RADIO MUSIC CORP., 84 S. Water St., Port Chester, N. Y. (A, B)
SKYSWEEPER, INC., McHenry, Ill. (A, B)
SNC MANUFACTURING CO., INC., P. O. Box 277, Oshkosh, Wis. (A, B)
SONEX, INC., 245 Sansom St., Upper Darby, Penna. (B)
SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas (A, B)
STANDARD ELECTRICAL PRODUCTS CO., 2240 E. Third St., Dayton, Ohio (A, B)
TELEVEX CO., THE, 46 Lakeview Ave., Yonkers, N. Y. (A)
TEXAS INSTRUMENTS, COMPONENTS DIV., 6000 Lemmon Ave., Dallas 9, Texas (A, B)
THORDARSON-MEISSNER MANUFACTURING DIV., 7th & Belmont Ave., Mt. Carmel, Ill. (A, B)
TRIAD TRANSFORMER CORP., 4055 Redwood Ave., Venice, Calif. (A, B)
UNITED TRANSFORMER CO., 150 Varick St., New York 13, N. Y. (A, B)
WHEELER INSULATED WIRE CO., INC., 150 E. Aurora St., Waterbury 20, Conn. (A, B)
WRIGHT, INC., 2233 University Ave., St. Paul 14, Minn. (B)

TUNERS
A AM-FM B FM

ALTEC LANSING CORP., 9356 Santa Monica Blvd., Beverly Hills, Calif. (A)
APPROVED ELECTRONIC INSTRUMENT CORP., 928 Broadway, New York 10, N. Y. (A, B)
BELL SOUND SYSTEMS, INC., 555 Marion Rd., Columbus 7, Ohio (A, B)
BIGG OF CALIFORNIA (BIGG RADIO CO.), 2506 W. Washington Blvd., Los Angeles, Calif. (A, B)
BOGEN CO., INC., DAVID, 29 Ninth Ave., New York 14, N. Y. (A, B)
BRAINARD ELECTRONICS, 8586 Santa Monica Blvd., Los Angeles 64, Calif. (A, B)
BROWNING LABORATORIES, INC., 750 Main St., Winchester, Mass. (A, B)
COLLINS AUDIO PRODUCTS CO., INC., Route 29, Mountainside, N. J. (A, B) (Mailing Address: P. O. Box 368, Westfield, N. J.)
COLUMBIA RECORDS, 799 Seventh Ave., New York, N. Y. (A)
DeWALD RADIO MANUFACTURING CORP., 35-15 37th Ave., Long Island City 1, N. Y. (A)
DICTOGRAPH PRODUCTS INC., 95-25 149th St., Jamaica 35, N. Y. (A, B)
ELECTRON ENTERPRISES, 6917 W. Stanley Ave., Berwyn, Ill. (A)

ELECTRO-VOICE, INC., Buchanan, Mich. **(A, B)**
FISHER RADIO CORP., 21-21 44th Dr., Long Island City 1, N. Y. **(A, B)**
GOTHAM TELEVISION CORP., 123 W. 64th St., New York, N. Y. **(A)**
GRANCO PRODUCTS, INC., 36-07 20th Ave., Long Island City 5, N. Y. **(B)**
GROMMES DIV. OF PRECISION ELECTRONICS, INC., 9101 King Ave., Franklin Park, Ill. **(A)**
HARMAN KARDON INC., 520 Main St., Westbury, L. I., N. Y. **(A, B)**
HEATH CO., 305 Territorial Rd., Benton Harbor, Mich. **(B)**
INTERNATIONAL RESEARCH ASSOCIATES, 2221 Warwick Ave., Santa Monica, Calif. **(A)**
NATIONAL COMPANY, INC., 61 Sherman St., Malden 48, Mass **(A)**
NEWCOMB AUDIO PRODUCTS CO., 6824 Lexington Ave., Hollywood 38, Calif. **(A)**
PILOT RADIO CORP., 37-06 36th St., Long Island City 1, N. Y. **(A, B)**
RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.), Front & Cooper Sts., Camden, N. J. **(A)**
RADIO CRAFTSMEN, INC., THE, 4401 N. Ravenswood Ave., Chicago 40, Ill. **(A, B)**
RADIO ENGINEERING LABS., INC., 36-40 37th St., Long Island City, N. Y. **(B)**
RAULAND-BORG CORP., 3515 W. Addison St., Chicago 18, Ill. **(A)**
REGENCY DIVISION, I. D. E. A., INC., 7900 Pendleton Pike, Indianapolis 26, Ind. **(A, B)**
SARGENT-RAYMENT CO., THE, 1401 Middle Harbor Rd., Oakland 20, Calif. **(A)**
SCOTT, INC., HERMON HOSMER, 385 Putnam Ave., Cambridge 39, Mass. **(A, B)**
SHERWOOD ELECTRONIC LABS., INC., 2802 W. Cullom Ave., Chicago 18, Ill. **(A)**
SIGHTMASTER CORP., 111 Cedar St., New Rochelle, N. Y. **(A)**
STROMBERG-CARLSON CO., SOUND DIV., 1225 Clifford Ave., Rochester, N. Y. **(A)**
TECH-MASTER CORP., 75 Front St., Brooklyn, N. Y. **(B)**
THORDARSON-MEISSNER MANUFACTURING DIV., 7th & Bellmont Ave., Mt. Carmel, Ill. **(A, B)**
WELLS-GARDNER & CO., 2701 N. Kildare Ave., Chicago 39, Ill. **(A)**
WILCOX-GAY CORP., Charlotte, Mich. **(A, B)**

WIRE RECORDERS AND EQUIPMENT
A Heads
B Recorders
C Wire

CRESCENT INDUSTRIES, INC., 5900 W. Touhy Ave., Chicago 31, Ill. **(A, B)**
ELECTRON ENTERPRISES, 6917 W. Stanley Ave., Berwyn, Ill. **(B)**
GENERAL CEMENT MFG. CO., 919 Taylor Ave., Rockford, Ill. **(C)**
GORDON ENTERPRISES, 5362 N. Cahuenga Blvd., N. Hollywood, Calif. **(A, B, C)**
INTERSTATE PHOTO SUPPLY CORP., 17 W. 17th St., New York 11, N. Y. **(B)**
MAGNASYNC MFG. CO., LTD., 5523 Satsuma Ave., North Hollywood, Calif. **(A)**
PERMO, INC., 6415 N. Ravenswood Ave., Chicago 26, Ill. **(C)**
SHURE BROTHERS, INC., 225 W. Huron St., Chicago, Ill. **(A)**
TELECTROSONIC CORP., 35-18 37th St., Long Island City 1, N. Y. **(B)**
WEBSTER-CHICAGO CORP. (WEBCOR), 5610 W. Bloomingdale Ave., Chicago, Ill. **(B, C)**

EDITOR'S NOTE: *The above listing has been confined solely to manufacturers, both in this country and abroad, who replied to our questionnaire. Foreign suppliers are listed under their U. S. distributors.*

We want to call the reader's attention to the fact that one major group is not included, i.e., the electronic parts distributor. Many of these companies market various audio components both in assembled and kit form under their own brand names. We would like to suggest that for further information on these components, you check your local parts distributor or consult the ads in this magazine. —30—

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ERRATUM

On page 115 in the August, 1955 issue, in the article "Fixed Capacitors," the new Corning Glass Works capacitors are referred to as "mica glass-seal capacitors." Actually, these units are glass throughout.

INDEX OF Advertisers

NOVEMBER 1955

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

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When you order by mail . . . please print your name and address clearly, be specific in your order, enclose proper amount, allow ample time for delivery.

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COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

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TRADE-IN Television Sets $14. Jones Radio, 1115 Rambler, Pottstown, Pa.

HEARING Aids, as is $7.50. In operating condition $12.50. Shelby Instrument, 1701 Magnolia, Long Beach, Calif.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 512 Broadway, New York 12, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

RADIO equipment, Navy surplus just released, good condition, used, complete with tubes. Transmitters—BC 696A, 3 to 4 MC $8.00 ea. BC 457, 4 to 5.3 MC $4.50 ea. BC 458, 5.3 to 7 MC $4.50 ea. Receivers—BC 453, 190 to 550 KC $8.00 ea. BC 454, 3 to 6 MC $4.95 ea. BC 942A 100 to 156 MC $8.00 ea. Transmitter New BC 458 $7.00 ea. Order C.O.D., F.O.B. Birmingham. Inquire if interested in large quantities. Rogers Trading Company, 2325 Second Ave. North, Birmingham 3, Ala.

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DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TV Trade-In sets. Philco, R.C.A., Emerson, others. List available. 10"—$17. 12" to 17"—$20. up. Washtek Service Co., Dept. R, 956 Southern Blvd., Bronx, N. Y.

PRECISION resistors, 1000 ohms, .1%, laboratory quality. $1 each, 5 or more 90c each. Laboratory Devices Co., 619 Summit Ave. N., Seattle 2, Wash.

80-40-20-10 METER Antenna. Patented. "Hams" write Lattin Radio Laboratories, Owensboro, Ky.

BUY Surplus radios, electronic equipment, Direct from Government. Bulletin $1.00. Box 1842R, Hartford 1, Conn.

SPECIAL: New English Collaro RC-54 Changer, Mounting Board, Plug-In Head, $38.75 Prepaid. Guaranteed: Diamond-Sapphire Stylus RPX-050, $10.75. Simulated Base-Cover for All Changers, $9.75. 3¾—7½—15 Ips Dual Tracks. 30—15,000 cps English High Fidelity Tape Deck. Three 4 Pole Motors. Best Buy $79.50 Prepaid. Write Today. Dept. RN, Fidelity Unlimited, 63-03 39th Ave., Woodside 77, N. Y.

SCINTILLATION Crystals. NE-101 Plastic Phosphors at new low cost, with instructions for use. Scintillation counter circuit $1. Uranium Yearbook $2. Geiger tubes only $5. Geiger counters $37.50 to $545. Scintillation counters $289 to $3500. Ultraviolet lamps. Metal detectors. Western Radiation Laboratory, 1107 West 24th Street, Los Angeles 7, California.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

TUBES, Radio & TV, New, Net up to 70% off. Details 10c. Sonoret Box D, 36 Woodbury St., Wilkes-Barre, Penna.

TRADE-IN Televisions; Test Equipment. W4APl, 1420 South Randolph, Arlington 4, Virginia.

TAPE Recorders, Accessories. Best values. Trade-ins accepted. Will quote on hi-fi components. Boynton Studio, 10R Pennsylvania, Tuckahoe, N. Y.

WANTED

BATTERY operated (or capable) Portable Tape or Wire Recorder. E. Lucas, 13802 Military Road, Seattle 88, Washington.

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

WANTED—Electronic Tubes, all types. Also all types airborne electronic equipment: ART-13; BC-788; I-152; ARC-1; ARN/7, etc. Top dollar paid! Bob Sanett, W6REX, 1524 S. Edris Dr., Los Angeles 35, California.

CYLINDER and old disc phonographs. Edison Concert, Balmoral, Conqueror, Opera, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia disc and cylinder Graphophones, Bettini micro-reproducer. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % RADIO & TELEVISION NEWS.

EARLY Radiolas Atwater Kents, and other major makes of early receivers. Will pay cash. Paul Thompson, 1300 So. Main, Las Vegas, Nevada.

WILL Buy All. ART-13 T47A Transmitters $200.00. ART-13 T47 Transmitters $150.00. BC-788C Altimeters $160.00. ARC-3 Complete $185.00. R5/ARN-7 Radio Compass $175.00. BC-348 Rec'r Modified $25.00. BC-348 Rec'r Unmodified $50.00. ARC-1 Radio Complete $250.00. BC-312 Receiver $40.00. BC-342 Receiver $50.00. Ship via Express C.O.D. Subject to Inspection to: H. Finnegan, 49 Washington Ave., Little Ferry, N. J.

AUDIO frequency wave analyzer wanted for cash. Warren TV Corporation, Warren, Pennsylvania.

REPAIRS AND SERVICING

TEST Equipment Repaired and Calibrated by Factory staff. All makes. Superior, Simpson, Triplett, etc. Free estimate. Our twentieth year. Douglas Instrument Laboratory, 176 Norfolk Avenue, Boston 19, Mass.

SPEAKER Reconing 48-Hour Service. Mc's, 506 North Ward Street, Benton, Illinois.

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y. Ba. 7-2580.

TELEVISION Tuner Repairs. Dan's Television Laboratory, 2 West 183rd St., N. Y. 53, N. Y.

HELP WANTED

TELEVISION Jobs—Names and addresses of companies to contact. $1.00. Fitzgerald, (Chicago Division), Dept. A-14, 815 Countryside Drive, Wheaton, Illinois.

MILITARY or Civilian trained Radio-Radar or Television mechanics wanting good jobs, Write: Box 201, Culver City, Calif.

BUSINESS OPPORTUNITIES

$200 weekly cleaning Venetian Blinds. Free Book. Burtt, 2434CE, Wichita 13, Kansas.

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USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

USED Correspondence Courses and Educational books bought, sold, rented. Catalog free. Educational Exchange, Menlo, Georgia.

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STUDY at home for Commercial Radio Licenses. Free sample lesson very reasonable fee. Write Radio License Aids, Box 455, Limestone, Maine.

MISCELLANEOUS

BUSINESS Gifts and Advertising Specialty Catalog Free, Ideal Specialties, TV, 1133 Broadway, New York City.

CRYSTAL Photocells, extremely sensitive type CL-1. $2.50 postpaid. Horton, Dept. A, 267 W. Eleventh Street, New York City, 14.

RECORDING Tape. Brand new—plastic base—standard brand—7 inch reel. $2.50 postpaid. Horton, Dept. A, 267 W. Eleventh Street, New York City 14.

GRADUATE Electronic Engineers with laboratory and shop facilities. Small consulting and development problems sought. Box 127, Baldwin, New York.

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He'mmann Magn Bkrs—Amps: 3, 5, 7, 9, 12, 30, 35, 40, 80, @ $1.98 ea; ..... 12/$20;
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Best balanced Dual 120 & 250 Watts heat at your fingertips. For fine or heavy duty soldering. Non-corroding alloy long & short tips, prefocused twin lights, rugged construction. 120 VAC/60 cycles Input.
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THI	AMGL05804X	100	10.98
28ST	GE FT210	200	9.98
THVA	SYLV. 4330	200	9.98
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TDX	DXC/250-350	150	10.00
353GTQ	FT503	2000	49.98
	Trigger coil for LO V.Flash..		1.47

Write for "TAB" Flash Tube Data....50¢

866A KIT & XFMR

(2) 866A Tubes, Sockets & Transformer. Rated PR1 115V/60 cy. SEC 2.5VCT/10A—HI Volt Insulation.
"TAB"
Special Only..... $4.98

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500 MMF
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$2 KIT OF 5

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Inbuilt network, 2 wires needed for HF & LF Response. Famous Hi-Fi Speaker mfgs.
15" Coaxial PM & 5" Tweeter 25 Watt/20-17500 cycles.
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GE Original Boxed, $ $ $ Back Gtd.

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Replacement Needles "TETRAD" Diamond †

RPJ010A	Dual(S) .001&.003 GE....$ 1.98
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Complete Stock of Replc'mnt Needles
Send Cartridge Name & Number
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MG and 78 Dual Dia. "TETRAD"†..$20.89

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Finest Tape S, S, $ Back Gtd.

Precision Coated & slit, Gtd Splice Free. Quality Controlled. Plastic Base. Gtd Constant Output. Freq 7½ IPS 40 to 15KC (Oxide Wod Im). 7" Reel, 1200 ft. P/Reel
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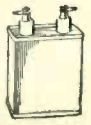

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Lots 24—Any Assortment

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All 115V 60 Cyc. Input TV & CR pwr. xfmr. up to 20" tubes. Hi Volts up to 20 Kv. (w/quadrupler ckt.) All tubes, Pl. & Fil. wndgs. 5000 VDC/5MA. 300 VDC/275 MA Full-Wave; 6.4V/10.3A, 5.4V/8A. 2.5V/3A Hypersil Core. Oil Fill....$4.98
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• 1st Quality • No Electrical or Mechanical Rejects

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35¢ EA — 6C4, 6W4, 12AV6

40¢ EA — 1L4, 1S5, 6AB4, 6AL5, 6AT6, 6J5, 6SH7, 6X4, 12AT6, 12AU6

45¢ EA — 0Z4, 1H4, 1U4, 1U5, 3Q4, 3S4, 5U4, 6AG5, 6AQ5, 6AU6, 6AV6, 6BA6, 6BE6, 6J6, 6K6, 6K7, 6S4, 6X5, 12A6, 12H6, 12J5, 12K8, 12SK7, 12SR7, 35Z5

50¢ EA — 1R5, 1T4, 5AZ4, 6AQ6, 6BH6, 6CB6, 6SA7, 6SK7, 7E6, 12AL5, 12AU7, 12BA6, 12SJ7, 12SQ7, 50A5

55¢ EA — 6BC5, 6SL7, 6SN7, 6SQ7, 6SR7, 6V6, 12AX7, 12SN7, 25Z6, 50L6

60¢ EA — 0B2, 1A5, 1V2, 1X2A, 5Y4, 6AK5, 6C6, 6H6, 6SG7, 6U7, 12BD6, 12BE6, 12C8, 12SA7, 12SH7

65¢ EA — 1B3, 1E5, 1H6, 3Q5, 6AC7, 6BJ6, 6C5, 6SJ7, 7A8, 12AT7, 12AY7, 12BH7, 76 & 77, 5Y3, 117Z3

70¢ EA — 0A2, 1G6, 1H5, 6AK6, 6BD6, 6J7, 6SC7, 6SF7, 7A5, 7B6, 7E7, 7H7, 35A5, 35C5, 71A

1AX2	1.25
1G4	.69
1G5	.69
1Q5	1.19
2X2A	1.15
3A4	.48
5T4	1.48
5V4	1.28
6AC5	1.19
6AF6	1.18
6AG7	1.14
6AL7	1.22
6AS6	1.60

75¢ EA — 0D3, 1J6, 1LN5, 2A5, 3V4, 5X4G, 6AB7, 6F6, 6L7, 6N7, 6T8, 7A7, 7F7, 12A8

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19T8	1.49
19V8	1.96
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Variable 0-28 VDC. Completely Built. Full Wave Selenium Rectifier, Transformer, Variac, Volt & Amp Meters, Switch, Terminals & Fuse. In Hvy Duty Steel Cabinet. Std 115V/60cy In. 110 or 220V† and 3 Phase to order. Specify.

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Primary 115V 60 Cyc

5 Amp†	$8.65; 2/$15.75
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18 Volt 2 Amps.....$1.98; 2 for $3.50
†Wndgs in Series at ratings shown; Parallel 2X Amps, Voltage One-half Max. *Dual Pri 115 & 220V 60 cy; Tapped 36 VCT

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CR6003/5AMP/.07HY/.6R	.$7.90; 2/$15
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For 220-240V/50-60 cy. In. To 110-120V or Step-up. W/ Cord, Plug & Receptacle†.

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TPA250/250W†	$6.75
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New Variable 0 to 6 & 12 Volt/12A

DC Power Supply
Battery Eliminator, Charger, Model RR, Plater, Aircraft, Marine or any DC Req. Extra Hvy Duty Selenium Rectifier, 2 Meters V & A. Designed for cont. service & up to 20 Amps intermittent overload.
Model T612V12AC....$29.95

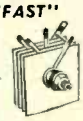
NEW "TABTRON" SELENIUM BRIDGE RECTIFIERS DATED & YR GTD

We mfg. Power Rectifiers to your specs. From 1 Amp up to and above 1000 Amps. Following List. Full Wave Bridge.

Curr. Cont.	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1AMP	$1.30	$2.30	$3.70	$7.40
2AMP	1.95	2.70	5.30	9.10
3AMP	2.90	4.10	5.75	12.70
4AMP	3.45	6.40	11.10	21.70
6AMP	3.95	7.70	12.35	29.65
10AMP	5.85	11.15	19.20	41.10
12AMP	7.20	14.25	21.75	43.75
20AMP	12.95	24.85	36.85	77.00
24AMP	14.05	28.55	43.25	78.25
30AMP	17.75	33.50	55.50	106.50
36AMP	22.10	41.50	64.75	131.00
50AMP	29.40	54.00	97.35	171.00

RECTIFIER & XFMR COMBO, Up to 28VDC at 24 Amps Cont. Duty.....$60

HEAVY DUTY BATTERY "FAST" CHARGER RECTIFIER



13-0-13V (CT) 100 Amp Fan Cooled or 34 Amp Air Cooled. Repl'mt 6V Fast Charger. Model CR16 $10; 3/$27. 16-0-16V (CT) Fan Cooled. For 12V/60A and 8V/100A Fast Charger. Model CR30.....$11; 3/$30

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SUPERIOR—GR—STACO—UTC

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Cased 0-135V 7.5A	21.95
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Six or More 10% Disc.

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Only $16.98

LINE VOLTAGE STABILIZER
Stabilizes line voltage within plus or minus 3% regardless of VOLTAGE & FREQ. shift. Insures full size, strength, & sync of TV picture regardless of line voltage. Automatically operated . . . regulator turns on & off with set or equipment. Trouble free, quiet, needs no adjustment. Universal use from 100 to 300 Watts. Input 100-125V/Output 115V ± 3% 50-60 cy.
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69c ea.
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Balanced double-spring tension grip assures permanent contact.

"this wide-range model

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No protruding knobs on switch or ohms control—both are flush with the panel.

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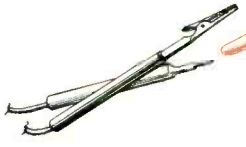

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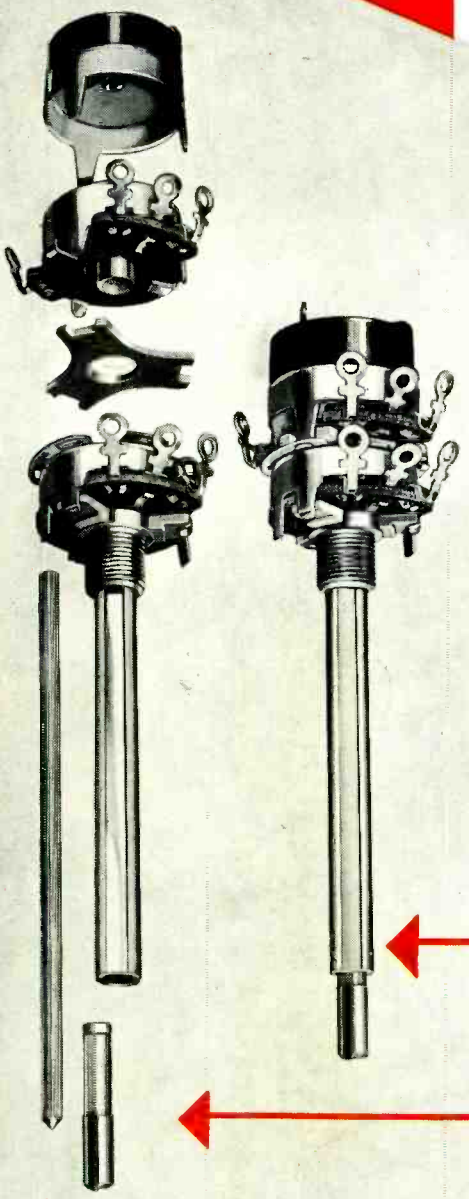

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