

15 PAGES ON HIGH FIDELITY

RADIO & TELEVISION NEWS

FEBRUARY
1956
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in U. S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE

A TAPE SYSTEM YOU CAN BUILD

POWER TRANSISTORS

TURNTABLES VERSUS RECORD CHANGERS

TRANSFORMERS AND YOKES

TRANSISTOR RADIOS

FREQUENCY CONTROL THROUGH VARIABLE RESISTANCE

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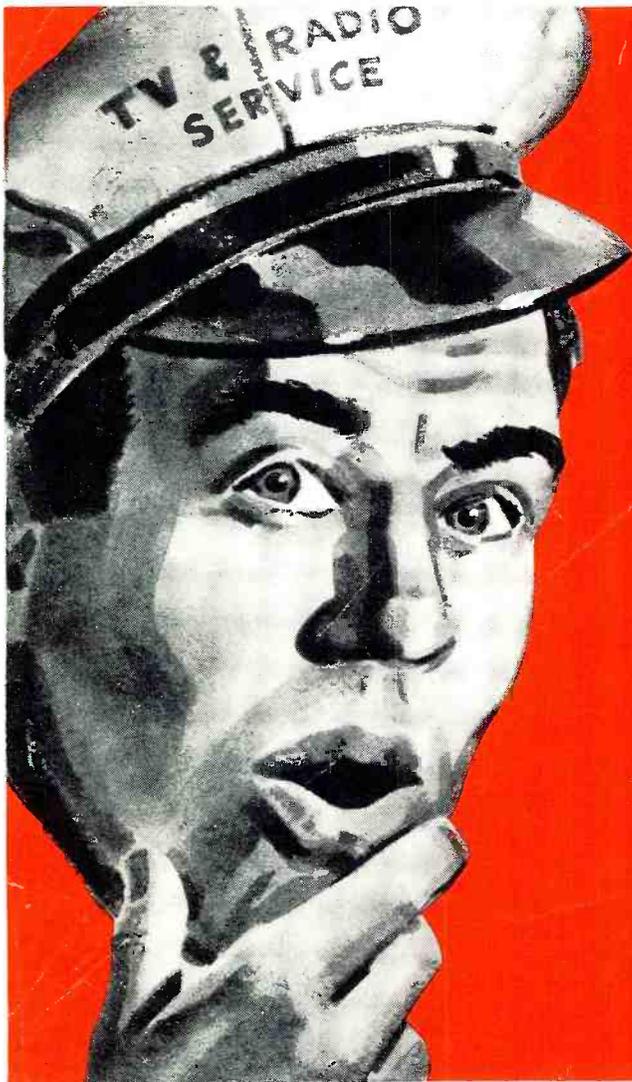
ADMIRAL TELEVISION TEST POINTS

ELECTRONIC "ROBOT" COPIES CODE
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OLIVER READ, D.Sc., WJTI

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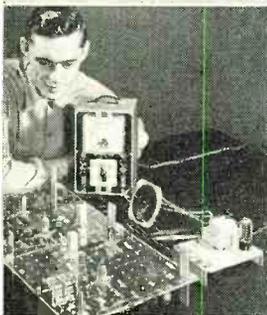
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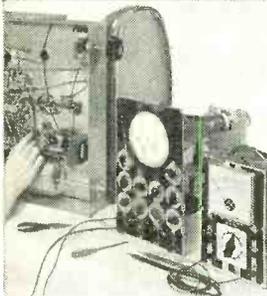
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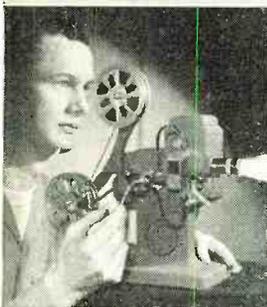
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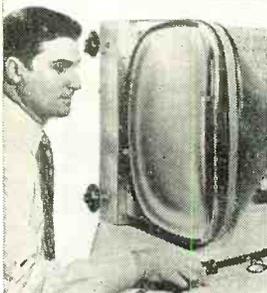
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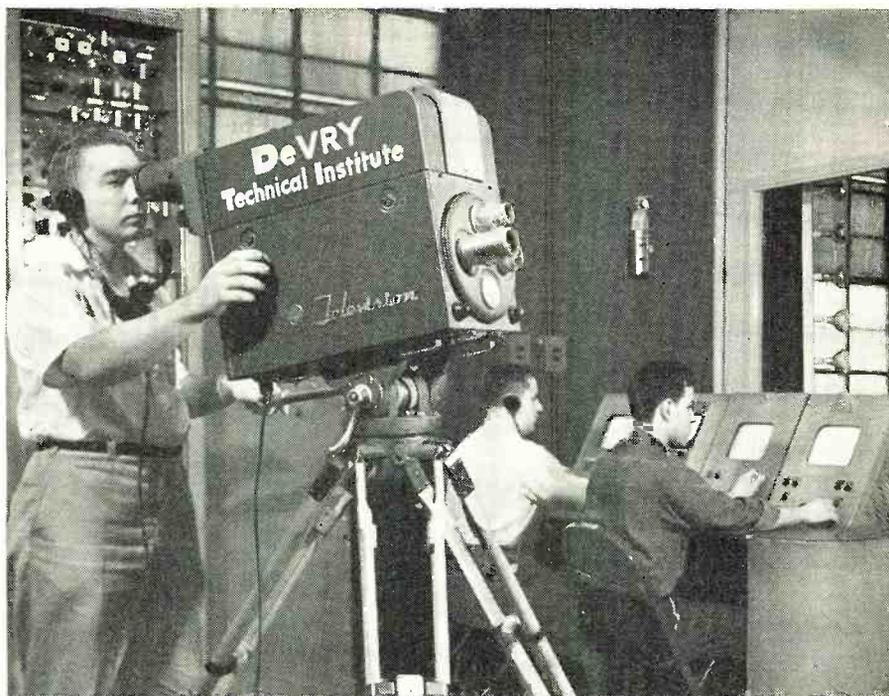
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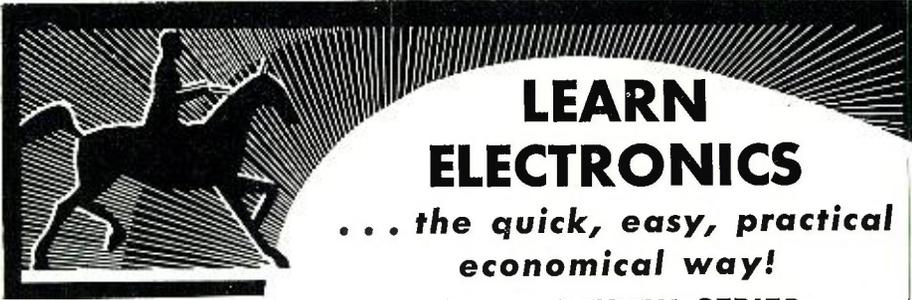


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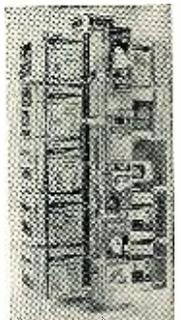
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For the **RECORD.**
 BY THE EDITOR

BLACK MARKS AGAINST HAM RADIO

SECTION 12 of the Federal Communication Commission's Rules was promulgated to provide this nation with an amateur radio service unequalled by any other country. As a part of a vast communications network regulated by the FCC, the amateur radio service affords opportunities for interested persons to engage in radio and electronic experimentation as a hobby.

The granting of a station or operator's license is, essentially speaking, a privilege not to be taken lightly. Unfortunately there are many hams wittingly or unwittingly committing infractions of Part 12 of the Rules. An increasing number of infractions are being detected by FCC monitors.

A review of the infractions cited within the past six months does not make cheerful reading. Here are a few of the instances:

1. A Florida ham moved his station without notifying the FCC. He also retransmitted local v.h.f. commercial stations and attempted to communicate with Mexican station XFIV, was detected using phone outside of the 75-meter phone band, and apparently kept no station log.

2. A Montana ham operated 20-meter phone in the 20-meter c.w. section, failed to respond to four FCC violation notices, and did not keep a station log.

3. A Novice class licensee operated in the 40-meter band from aboard a U. S. Naval vessel in the territorial waters of a foreign country. Operator did not have permission to operate from a Naval vessel, did not use crystal control, did not request permission from the foreign country to operate within its jurisdiction, and did not use an approved band for portable or mobile operation.

4. A California ham used profane language and broadcast music outside of the 40-meter band.

5. Another California ham used various call signs from transmission to transmission.

6. Two Chicago Technician class licensees were detected operating in the 144-mc. band. Neither kept a log to show that he was operating out of the prescribed bands.

7. An Iowa ham moved to Colorado without notifying the FCC of a change

of address, and continued operating until detected four months later—during which time an inaccurate log was maintained.

The situation humor involved in any of these violations is easily lost when it is realized that not only is the total number of hams increasing but the total number of detected violations is increasing *out of proportion*.

There is a tendency to suspect that the violations are becoming more serious because of the influx of Novice and Technician class licensees. Out of the instances just cited, two were Technicians, one was a Novice, and four were general class license holders. It would be unfair to all licensees to draw conclusions from these few examples, but it is worthy of note that in at least three instances the violations could have been corrected by a tighter policing of our own ham ranks.

This is not intended to be a criticism of the *American Radio Relay League* who long ago instituted a self-policing policy that has proven to be exceptionally effective. Rather, it is a plea for better operating procedures, less trying to "show off" or outwit the FCC, and more active participation by each and every ham in attempting to curb needless and senseless violations of Part 12 of the FCC Rules.

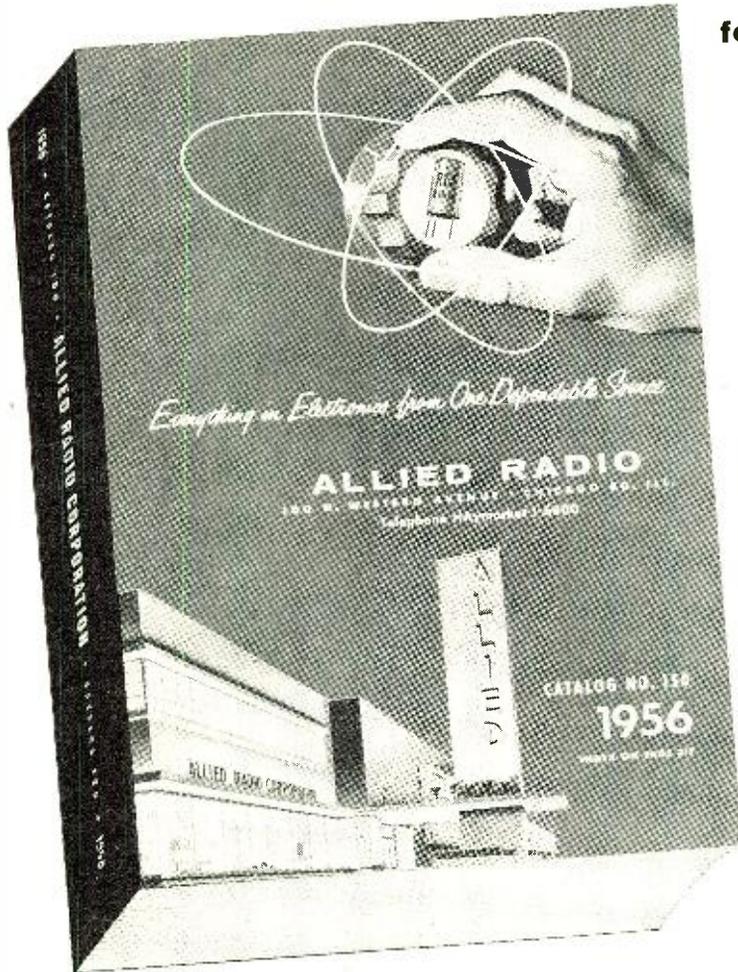
A ham license is a privilege which many legislators think is a luxury this country can ill afford. Cited violations and license suspensions become a matter of public record. All of them constitute black marks against ham radio and can be used to support a curtailment of ham radio privileges. Fortunately most Government agencies realize and appreciate the reserve manpower in the ham radio ranks and the value of our emergency communications facilities—but will such support continue if these black marks increase?

WE WOULD like to remind all of our readers, and especially the service fraternity, that next month's issue will be crammed with articles and items on all phases of receiver servicing in addition to our usual quota of material for the audiophile, radio amateur, and the experimenter. Better put in an early reservation for your copy at the newsstand. . . . O. R.

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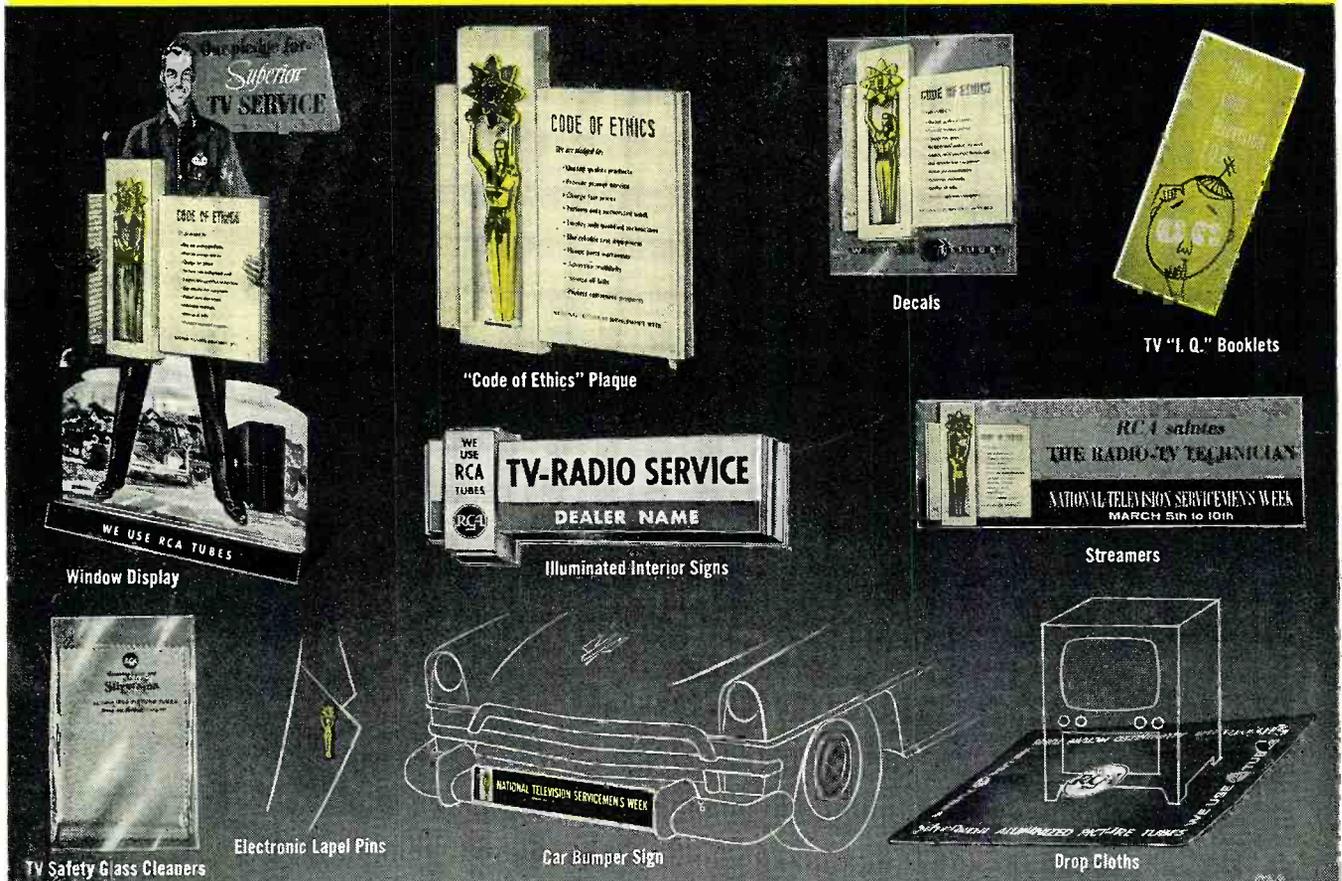
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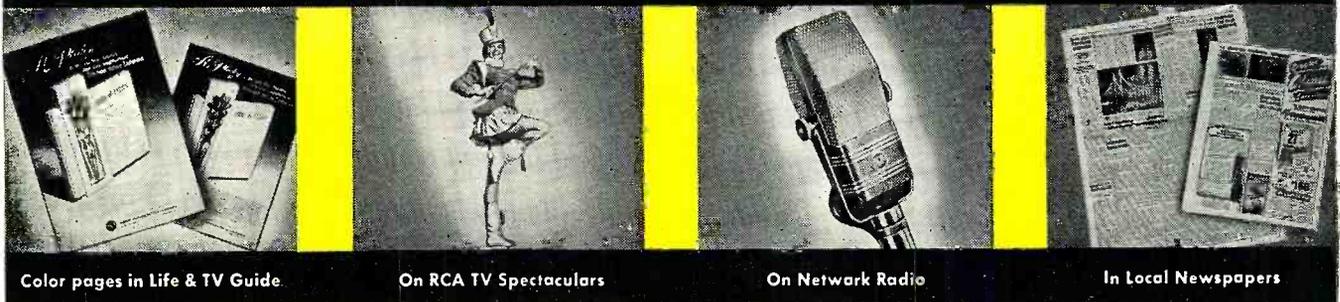
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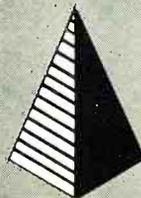
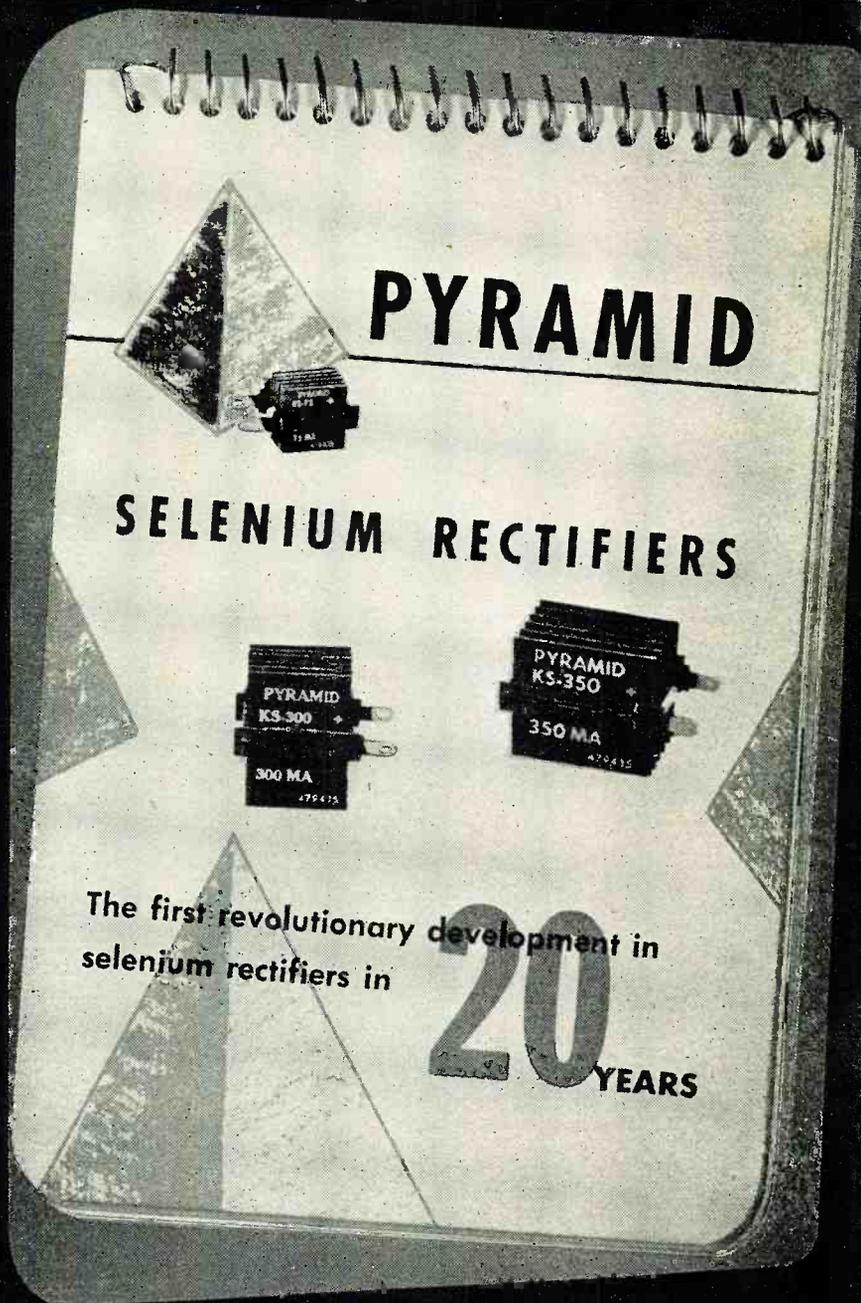
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Spot Radio News

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By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

TV's future, dimmed for over a year by the low-high band controversy in Washington and industry, has at long last been set up for an official review by the Commission.

Recognizing that it was about time to stop dallying, the guardians of the ether issued a formal notice of proposed rule making to consider possible over-all solutions to the problem on a broad, nationwide basis. All interested parties, said the FCC, including those who have informally offered proposals to the Commission, will now have an opportunity of submitting their suggestions in this proceeding.

Noting that there has been considerable debate on the routes that should be taken to untangle the forest of confusion, the FCC asked those who write in to include data and comments on such subjects as: The nature and extent of departures, if any, from the present standards, with respect to minimum separations; minimum and maximum limitations on power and antenna heights; use of directional antennas; cross polarization; effect of proposed revision on assignments occupied by existing stations; extent to which plan submitted provides for the future expansion of the TV service; impact of the plan on the problem of receiver incompatibility, and effect of the plan on educational reservations.

The Commission added that it would also be helpful if those sending in briefs, which envisage a revised table of fixed channel assignments, would include an assignment plan for zone 1, indicating the specific assignments in each city. In addition, the FCC said that it will also consider proposals which ask for revised standards for the addition of channel assignments on the basis of individual applications, rather than by incorporating new assignments in a revised fixed table of allocations.

Looking back to the objectives of the 1952 assignment plan, which called for at least one service to all areas, at least one station in the largest possible number of communities, multiple services in as many communities as possible to provide program choice and to facilitate competition, the Commission pointed out that to some extent these objectives have been realized. Over 90 per-cent of the population can receive a degree of service from at least one station, Washington noted,

and approximately 75 per-cent can receive some service from two or more stations. In addition, almost 275 communities have at least one and 112 of these have two or more local facilities in operation. But, despite this tremendous growth, it is evident from recent experience, the Commission stressed, that a nationwide competitive TV service has not been realized. Many of the smaller communities are without a first local outlet and the expansion of multiple, competing services in the larger economic and population centers of the country is lagging. The difficulties that have been encountered in achieving successful operation of stations in the u.h.f. band have been a significant factor leading to this situation, the FCC emphasized.

The Commission said that it realizes that some of the present hindrances to the further expansion of TV service in many communities are due to causes which lie beyond its control; since to an appreciable extent these problems are basically economic, rising out of the limits beyond which it is not possible, at the present stage of the art, to obtain sufficient economic support to meet the high costs of construction, programming, and operation of stations. However, it was brought out, industry can make valuable contributions to other aspects of the problem, relating to the improvement of transmitting and receiving equipment. At the same time, the Commission said that it wishes to insure that to the extent that any of the present difficulties may be alleviated by the possible revision of the present allocation system, such possibilities will be fully explored.

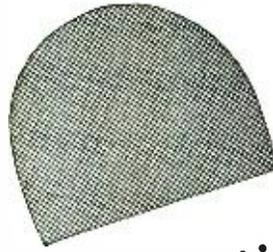
A DRAMATIC REPORT describing the unique patrol work of the field engineering bureaus of the FCC appeared recently in a special year-end release.

Citing incidents from the official log book, the Commission disclosed that some months ago a Great Lakes coastal station had asked the FCC to help locate the source of severe interference to marine radio communication. A mobile unit from Buffalo was sent to the scene, and after a two-hour search covering twenty-eight miles, it was discovered that sparks were jumping from an electric fence to an adjacent chicken-wire coop in which dogs were kept.

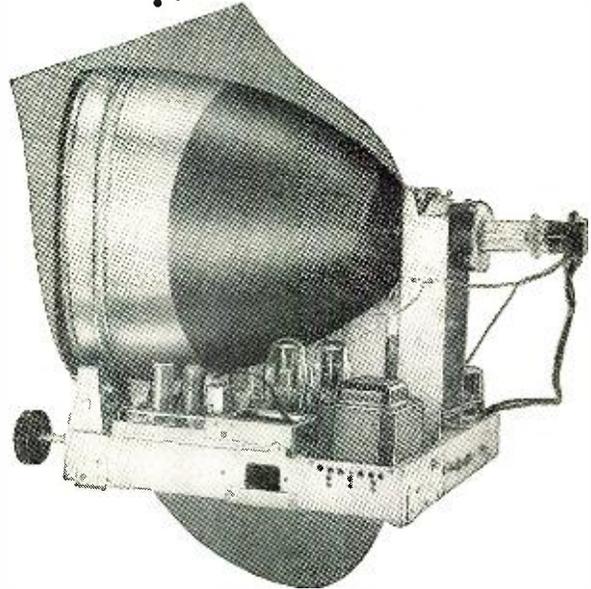
RADIO & TELEVISION NEWS



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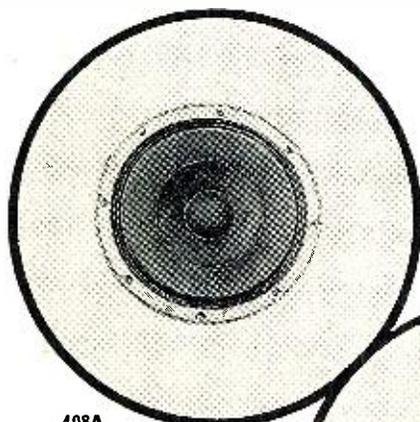
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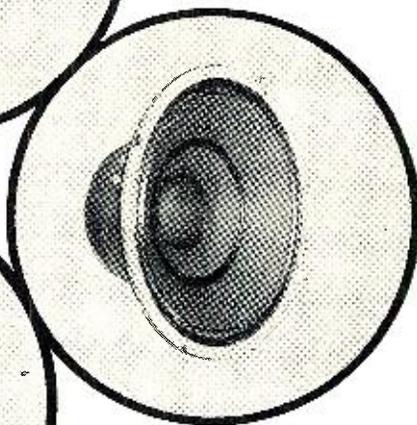
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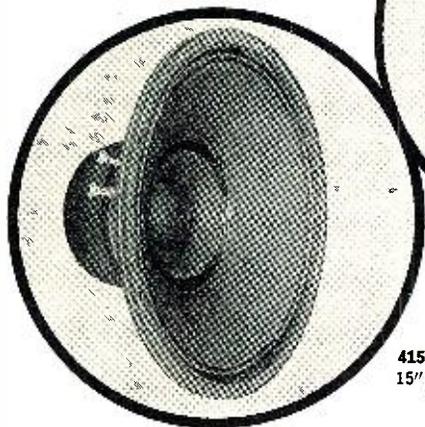
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Continuing, the FCC said that during the recent floods, the Connecticut state police had asked the district office of the Commission in Boston to inquire into interference to the state forestry radio system. From the information furnished, the Boston office felt that the trouble was in the forest service's own equipment, and suggested a check of that department's transmitters throughout the state. It was found that one transmitter was at fault; it was in continuous operation, due to a relay which had remained closed after the flood waters had receded.

Also, according to the Commission's notebook, a radio prank backfired several weeks ago, when the Los Angeles district office investigated reports of improper language and other illegal matter on a particular short wave. At first, it was assumed that the transmissions were from an unlicensed station, but a mobile unit led the way to a licensed nonbroadcast station. Here they found two youthful culprits, operators of the station, who explained that they were trying to generate trouble for another private station, whose call they were using.

Later, checking a complaint of interference to reception of radio telegraph code, a Portland (Oregon) FCC engineer found the complainant in the room of a small hotel, where an annoying *roar* disrupted his hobby of listening in on radio-telegraph messages. "If you are a code man, read this," said the complainant as he tapped out with his knuckles on the table a brief message in Morse land-line code. This was followed up by rapping out a message in International Code. After proving his qualifications by translating the message, the FCC engineer then went to work and found an intermittent arc contact in one of the leads plugged into a badly worn socket in an antiquated chandelier.

Another reported case of interference, cause by a heater, was noted as having affected a marine distress frequency. The signal, in the form of 100 pulses a minute, indicating industrial heating of very small objects, was traced to a factory in the state of Washington; the plant was using 10-kilowatt applications on roller bearings at the rate of 100 per minute.

The most recent long-distance interference case reported developed when an aeronautical service at Honolulu complained that strong signals were blotting out its radio messages between air and ground. The FCC direction finder was alerted and fixed the source, not locally, but some 5000 miles away, at a port on the east coast of the United States. The trouble proved to be a defective ground transmitter of another airline. Unusual propagation conditions caused the signal to span the continent and part of the Pacific Ocean to Hawaii.

A NEW SILVER-OXIDE-ZINC BATTERY, which employs a pile-type construction.
(Continued on page 150)

RADIO & TELEVISION NEWS

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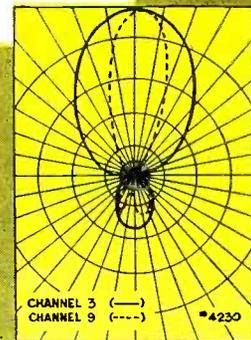
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WALSCO WIZARD Imperial equals reception of 10 element yagis on low channels, and equals a three stack 10 element (30 elements) yagi on channels 7 to 13.

Actual comparison of fringe antenna performance

Channels	Gain (db) Single Bay						
	2	4	6	7	9	11	13
WalSCO Wizard Imperial	6.1	6.9	8.2	11.9	11.6	10.8	12.6
Antenna "A" - With 3 Phase Reversing Dipoles	6.3	6.6	8.1	10.5	10.2	10.6	12.4
Antenna "B" - Yagi Type with Phasing Loops	5.1	5.5	6.8	7.5	9.6	8.8	11.2
Antenna "C" - Yagi Type with Loading Coils	5.9	6.9	8.6	9.1	8.6	9.6	7.8



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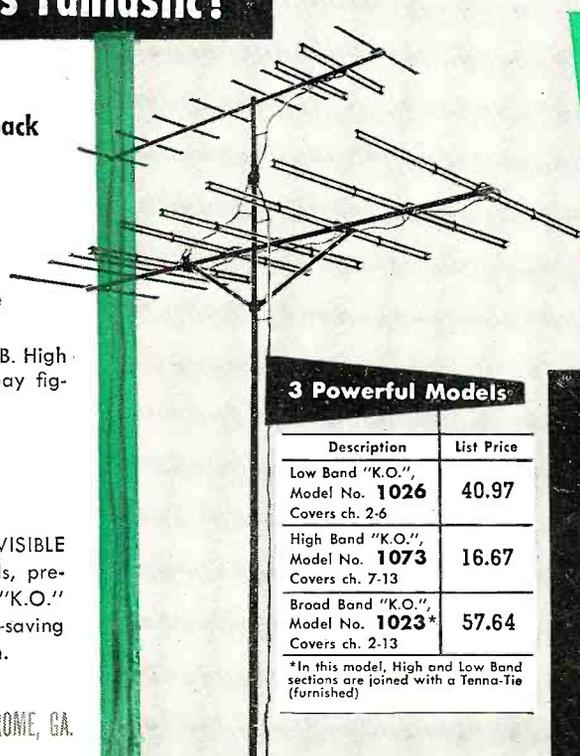
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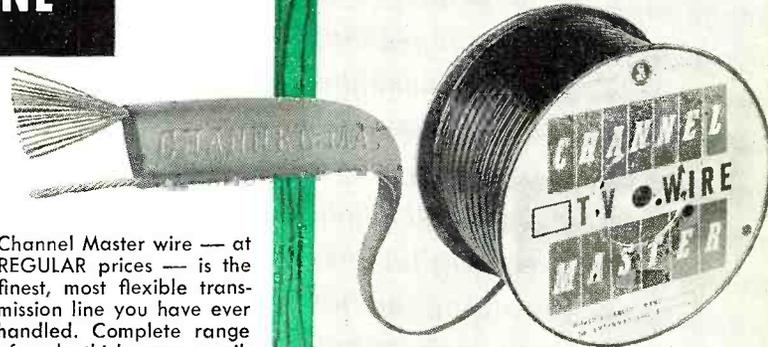
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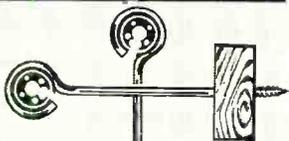
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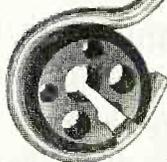
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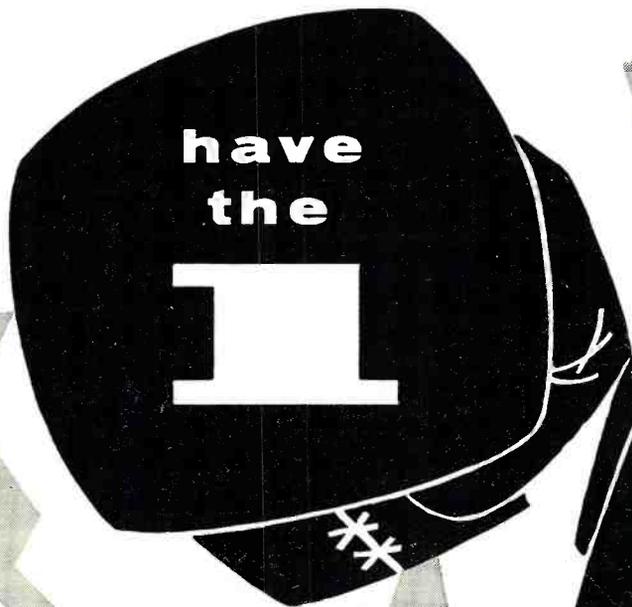


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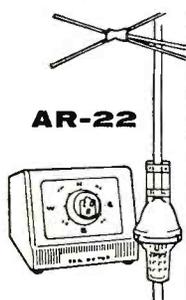


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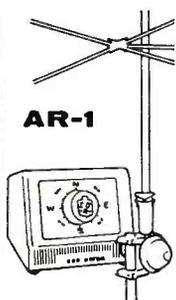
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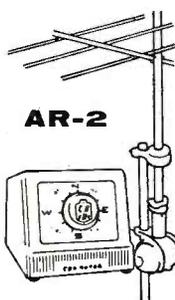
AR-22

Completely AUTOMATIC version of the TR-2 with all the powerful features that made it famous.



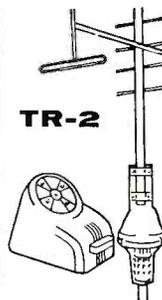
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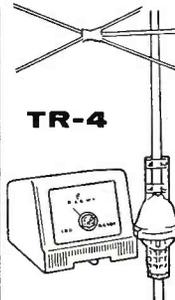
AR-2

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



TR-2

Heavy-duty rotor with plastic cabinet, "compass control" illuminated perfect pattern dial, 8 wire cable.



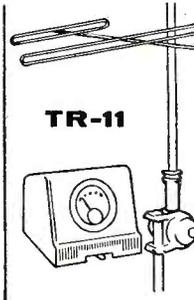
TR-4

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TR-11

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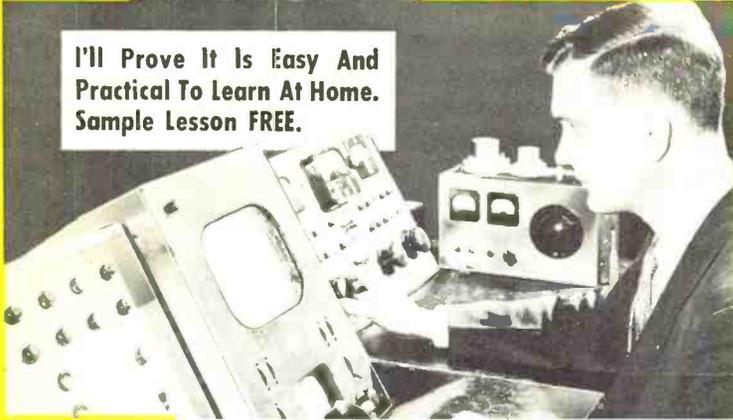
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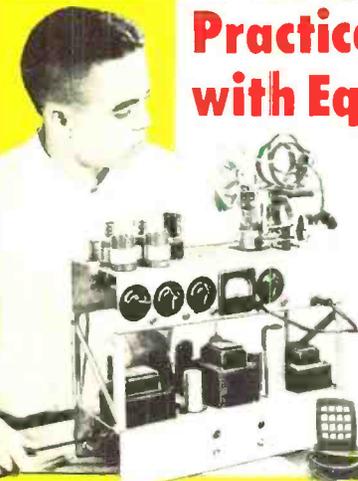


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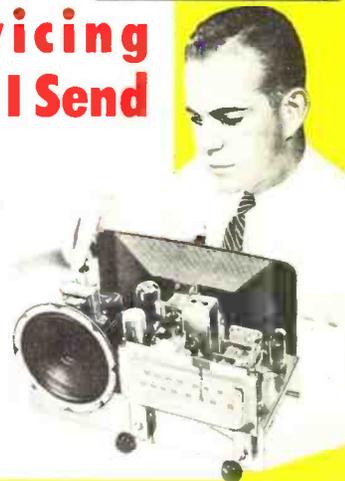
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It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing 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.



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.....

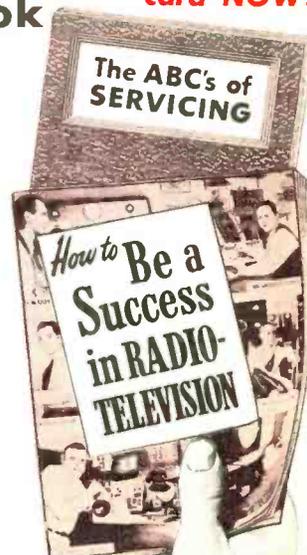
ADDRESS.....

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

VETS write in date of discharge.....

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.



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.

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 Radio-telephone 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.

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 multimeter you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

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.

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.

K L M

SAMPLE LESSON
and 64-Page BOOK
BOTH FREE
CUT OUT AND MAIL
POSTAGE-FREE CARD

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."





Silver Vision

THE ALUMINIZED TUBE THAT IS PRE-SOLD

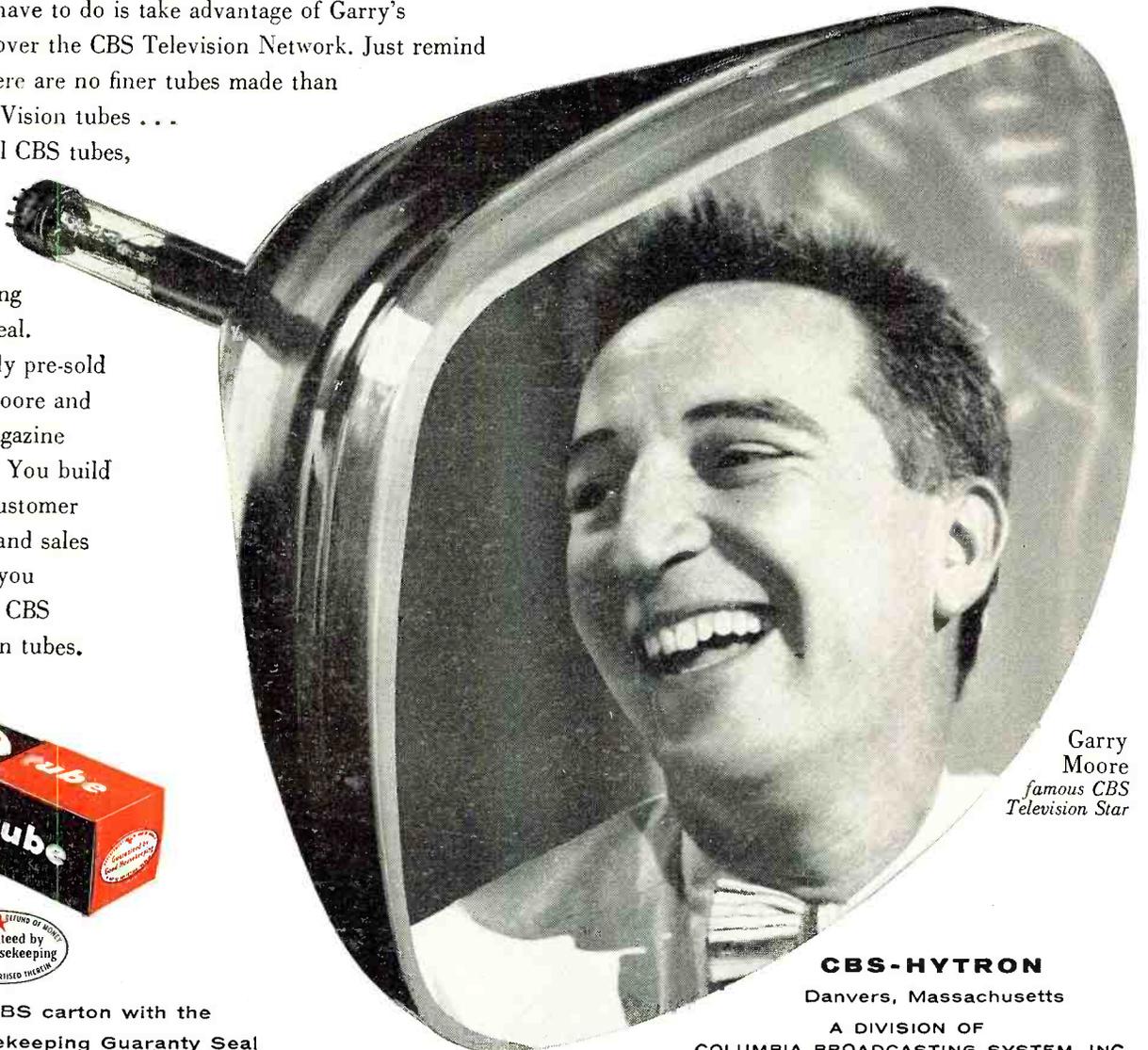
Sure, *you* are already sold on the advantages of aluminized tubes. You know that the CBS Silver Vision aluminized screen with its silver-activated phosphors and the CBS small-spot gun mean clearer, sharper, brighter pictures.

But your woman customer (76.9% of TV service customers are women) doesn't understand electronics or CBS advanced-engineering as you do.

She does know and respect the name CBS . . . she has confidence in Garry Moore and in the Good Housekeeping Guaranty Seal.

So all you have to do is take advantage of Garry's pre-selling over the CBS Television Network. Just remind her that there are no finer tubes made than CBS Silver Vision tubes . . .

And, like all CBS tubes, they have the Good Housekeeping Guaranty Seal. She's already pre-sold by Garry Moore and national magazine advertising. You build profitable customer confidence and sales every time you recommend CBS Silver Vision tubes.



Garry Moore
famous CBS Television Star



Show the CBS carton with the Good Housekeeping Guaranty Seal
February, 1956

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

NOW... MODEL SX-100 SELECTABLE SIDE BAND RECEIVER

**BUILT TO THE SPECIFICATIONS
OF 1,000,000 FIELD EXPERTS**

See it at Your Jobber—only \$295⁰⁰

Hallicrafters 22 years of production know-how, the engineering experience of developing over 100 different major receiver designs, plus the advice of over 1,000,000 field experts operating Hallicrafters receivers all are combined to bring you this outstanding new receiver—the SX-100! Hallicrafters alone, long recognized as the leading designer and manufacturer of quality communications equipment, can offer you the dependability and performance of this great new SX-100 at the amazingly low price of just \$295.00.

Look at these features you enjoy with the SX-100... before, they were available only on receivers costing a great deal more!

1. SELECTABLE SIDE BAND OPERATION.
2. "TEE-NOTCH" FILTER—This new development provides a stable non-regenerative system for the rejection of unwanted heterodyne. The "Tee-Notch" also produces an effective steepening of the already excellent 50 KC i.f. pass band (made famous in the SX-96) and further increases the effectiveness of the advanced exalted carrier type reception.
3. NOTCH DEPTH CONTROL for maximum null adjustment.
4. ANTENNA TRIMMER.
5. PLUG IN LABORATORY TYPE EVACUATED 100 KC QUARTZ CRYSTAL CALIBRATOR—included in price.
6. LOGGING DIALS FOR BOTH TUNING CONTROLS.
7. FULL PRECISION GEAR DRIVE DIAL SYSTEM.
8. SECOND CONVERSION OSCILLATOR CRYSTAL CONTROLLED—greater stability through crystal control and additional temperature compensation of high frequency oscillator circuits.

Controls

Pitch Control
Reception
Standby
Phone Jack
Response control (upper and lower side band selector)
Antenna Trimmer
Notch Frequency
Notch depth
Calibrator on/off
Sensitivity
Band Selector
Volume
Tuning
AVC on/off
Noise limiter on/off
Bandspread
Selectivity

hallicrafters

CHICAGO 24, ILLINOIS

Model SX-100. Amateur Net \$295.00
Matching R-46B Speaker \$17.95
Frequency Range 538kc-1580 kc
1720 kc-34 mc



THEY SAID HE COULDN'T LEARN TV AT HOME



... but now he repairs their sets

Read this letter from one of my students — It can help YOU!



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

I CAN DO FOR YOU WHAT I DID FOR THIS MAN!

YOU can get top pay in the fast-growing Television-Radio-Electronics field just as this man did. My easily understood lessons — especially prepared for home study — can bring you the same success they brought hundreds of men, many of them with no more than grammar school training.

LEARN BY DOING



You work with actual parts and equipment I send you as part of your course. You get enough equipment to set up your own home laboratory and prepare for a top-pay TV job. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to

"Dear Mr. Lane:
"How to begin this letter, I don't really know, I can never begin to tell you how happy I am with the outcome of your Radio and Television course. I'll never regret clipping your ad out and sending it to you. Believe me, it has changed my whole outlook on life. I believe this is the beginning of a bright new future for me, thanks to RTTA.
"Already I have established a small reputation in our city and I am looking to the very near future when I go into the radio and TV repair business full time. The last few months I've come very close to doubling my weekly income with very little time spent at it.
"Now it is my turn to laugh at the people who said I was wasting my time, that I couldn't learn anything through the mail. I've repaired television sets for some of these people and they admit that they were wrong.
"I look back now just a short year and remember how I stayed up many a night until after midnight studying and experimenting. At the same time I was wondering whether something would really come of it. Now I can proudly say it did. Because I reached out and grasped the opportunity RTTA gave me. For that I'll be forever grateful."
A. F. Duschl, Lancaster, Pa. 1 24 55

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.

FCC COACHING COURSE

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

CHOOSE FROM THREE COMPLETE COURSES covering all phases of Radio, FM and TV

RADIO-FM-TELEVISION TECHNICIAN COURSE — no previous experience necessary.

FM-TV TECHNICIAN COURSE — previous training or experience in radio required.

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 complete either the Radio-FM-TV Technician or the FM-TV Technician course you get two weeks of Lab work on modern electronic equipment at our associate resident school in New York City, Pierce School of Radio & Television. Available if you want it—AT NO EXTRA COST WHATSOEVER!

Radio Television Training Association

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

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

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.

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.

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. T-2C, 52 East 19th Street, New York 3, N.Y.

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

(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 OBLIGATION!

GREATEST TIME-SAVER FOR



SERVICE-DESIGNED TUBES



SAVES WORK-BENCH TIME

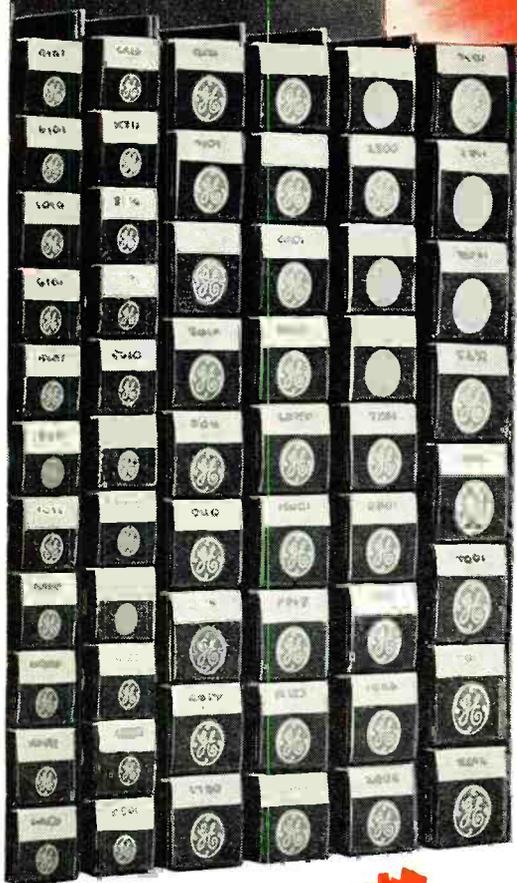
TV-RADIO SERVICE EVER OFFERED!

NEW!



SEE-LECT-A-TUBE

Best for any set!



- Speeds up your counter tube sales.
- Increases work-bench efficiency.
- Makes tube selection easy, quick, sure.
- Protects tubes against breakage losses.
- Visual inventory control helps you rotate your tube stock properly.
- Saves valuable space . . . 250 tubes of all carton sizes occupy a dimension only 38" by 20½" by 6¼".

General Electric TV-radio technicians pooled their experience to help design this new SEE-LECT-A-TUBE for your TV-radio service business.

Complete flexibility in meeting your tube requirements! Rugged blue steel dispensing units, mounted side-by-side, each hold a vertical row of tubes. The types can vary with your individual needs. Six carton sizes are provided for—from miniatures to large glass types. The number of dispensers allotted to each size is scientifically based on average tube usage, but dispensers can be arranged so that they will match your special requirements.

Friction flanges hold tubes in place! When a tube is removed from a dispenser, those above it can't slide down. The tube alignment remains intact. Open spaces, therefore, indicate tubes that need to be re-ordered . . . or, as a further check, you can put back the

empty cartons in reverse position, with bottom ends forward. Thus—besides gripping the cartons for safety—the friction flange in each SEE-LECT-A-TUBE dispenser helps you determine how many tubes of any given type you have in stock.

Wall-bracket included! A bracket comes with each SEE-LECT-A-TUBE which will fasten easily to any wall, giving solid support to dispensers and tubes. The SEE-LECT-A-TUBE is shipped pre-assembled . . . just unbox the complete unit and hang it on the wall bracket.

See your G-E tube distributor for details! Right now your General Electric distributor is waiting to tell you all about the new SEE-LECT-A-TUBE, and how you can obtain one promptly. Contact him today! Don't miss this chance to modernize your tube inventory for bigger sales, improved shop efficiency! *Tube Department, General Electric Company, Schenectady 5, New York.*



SPEEDS UP TUBE SALES

Progress Is Our Most Important Product

GENERAL  ELECTRIC

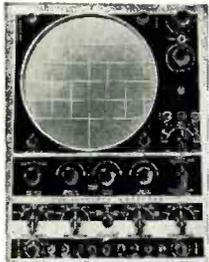
161-1A1

precise

EXTRA!

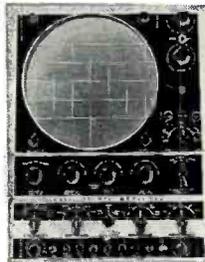
EXCLUSIVE..

Who murdered the serviceman?



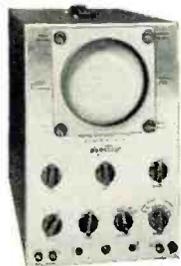
THE FIRST LOW PRICED 7" COLOR SCOPE

300K \$94.95
300W \$199.50



THE FIRST AND ONLY 8 1/2" COLOR SCOPE

308K \$129.50
308W \$229.50



LOW PRICED 5" SCOPE

315K \$49.95
315W \$84.95



THE FAMOUS MODEL #111

111K \$69.95
111W \$139.95



LOWEST PRICED WIRED 4 1/2" VTVM

909K \$25.98
909W \$37.50



RF-AF-BAR GENERATOR with pre-assembled* head

630K \$33.95
630KA* \$38.95
630W \$53.95



THE FINEST VOLT, REG, 7" VTVM KIT

9071K \$35.95
9071W \$49.95



LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD

610K \$23.95
610KA pre-assembled head..... \$28.95
610W \$39.95



UNIV. AF, SINE, SQ, & PULSE GEN.

635K \$33.50
635W \$52.50

OR at least the serviceman's confidence in tube testers. LOOK at the FACTS —A serviceman trusts his VTVM (like the Precise 9071 or 909); his signal generator (like the Precise 610 or 630 or 635); his oscilloscopes (like the famous 300 or 308 or 315).

BUT . . . HE DOES NOT TRUST HIS TUBE TESTER (UNLESS IT'S A PRECISE 111).

For the serviceman's sake, WHY?

Precise engineers recognize him as a logical, intelligent fellow. They knew he had good reasons and they looked into the matter with him in mind. Our electronic sleuths found that some manufacturers used an Em (emission) test, some a Gm (mutual transconductance), some a so-called combination, and some a sort of OUIJA board. Some manufactured tube testers that were fast—some slow—some tied almost all the elements together. In some you could cut off pins and the tube merrily read "good." Some didn't even connect all the pins. NO wonder our serviceman's confidence was being murdered!

What then has Precise done to prevent this mayhem. We went directly to the tube manufacturers before offering the serviceman a tube tester. We found out how the tube manufacturer gets the kind of check a serviceman wants . . . a 100% test! We wanted to offer a tube tester that simulates operating conditions in a set. WE HAVE DONE THIS. We added a lot of other requirements . . . A SHORT CHECK, GAS CHECK, Gm, Em, LIFE, FILAMENT CURRENT for 600 mil tubes, BIAS, NOISE and other checks.

RESULT, a tube tester with built in confidence . . . you can even see the tube characteristic curve on an oscilloscope. What's more you can operate this tube tester as simply as the ordinary testers. The Precise 111 has about the same number of controls . . . Remember! it uses rotary switches instead of lever type, because the rotary gives over twice the protection against becoming obsolete. Furthermore, several tests are listed for each tube (an Em and a Gm) with the 100% test starred.

NOW YOU CAN TEST YOUR TUBES COMPLETELY. FOR PROOF OF WHAT WE OFFER SEE THE RESULTS OF AN INDEPENDENT SURVEY.

Prices slightly higher in the West. Prices and specifications subject to change without notice.

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR JOBBER TODAY!

precise THE FINEST KIT AND WIRED TEST EQUIPMENT

WRITE FOR CATALOG RN 2-6

DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

... INDEPENDENT SCIENTIFIC SURVEY

PRECISE MODEL #111 PROVED

"BEST COMMERCIAL TUBE TESTER

AT ANY PRICE" IN INDEPENDENT SURVEY



precise
Model #111

MUTUAL CONDUCTANCE AND EMISSION **TUBE TESTER**

An independent scientific survey conducted by an impartial testing laboratory confirms what purchasers already know: "The most advanced, the most complete tube tester and the best priced is made by PRECISE DEVELOPMENT CORP., Oceanside, N. Y."

NOW YOU CAN CHECK TUBES THE MANUFACTURER'S WAY

- Checks both emission and mutual conductance
- Checks all tubes including hearing aid, miniatures
- Six different plate voltages
- Different grid signals
- Simplified Short check
- Gas check
- New type switches
- Deeply etched aluminum panel
- Three different screen voltages
- Latest roll chart
- Measures filament current
- Measures grid bias

111K (kit form)
NOW ONLY

\$69⁹⁵

111W (factory wired) \$139.95

Prices slightly higher in the West. Prices and specifications subject to change without notice.

CHECK THESE ADDITIONAL 'specs' ... TALK TO YOUR JOBBER AND TO ANYONE WHO HAS THIS OUTSTANDING TUBE TESTER ...

The Model 111 is the only single commercial tube tester that checks all tubes for both EMISSION and MUTUAL CONDUCTANCE separately. Filament current is measured directly on large meter when checking a VOLTAGE SAPPER tube. NEW, MODERN DESIGNED ROTARY SWITCHES allow you to check each tube element individually NEW TYPE Single Rotary switch for complete short checks. The 111 makes all BIAS,

FILAMENT VOLTAGE, GAS, LIFE checks visually on large meter ... 5 individually calibrated ranges and scales for mutual conductance tests. NEWLY DESIGNED "NO BACKLASH" ROLL CHART lists all tubes including the new type 600 mil series tubes. Provisions are made for testing many color tubes. All CRT's can be checked with accessory adaptor, Model PTA.

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR JOBBER TODAY!

precise

THE FINEST KIT AND WIRED TEST EQUIPMENT

WRITE FOR CATALOG RN 2-6

DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.



MOST ACCEPTABLE

FROM DELCO RADIO . . .

come the **coils**

with highest performance.

You trust them . . . so do your customers!

The core of quality service and really fine radio performance is always in Delco Radio coils. Delco Radio coils are made with powdered-iron cores, specially treated and compressed to exact shape on tolerance-true machines in Delco Radio's own plant. Skilled craftsmen wind and test the entire assembly so that you can depend on Delco Radio coils for *uniform* performance characteristics.

Your UMS-Delco Electronics Parts Distributor carries a complete line of Delco Radio parts, including precision-built Delco Radio coils. See him today! And, keep your eye on the Delco Wonder Bar Radio as advertised in leading consumer publications. It'll be helping you tune in to a greater service market.

DELCO



RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA



A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE
Distributed by Electronics Distributors Everywhere

A complete line of original equipment service parts from the

WORLD LEADER IN AUTO RADIO

RADIO & TELEVISION NEWS



Get more money!
More security! More out of life!



Learn

TELEVISION • RADIO • ELECTRONICS

Get the best!

Get National Schools' SHOP-METHOD HOME TRAINING!

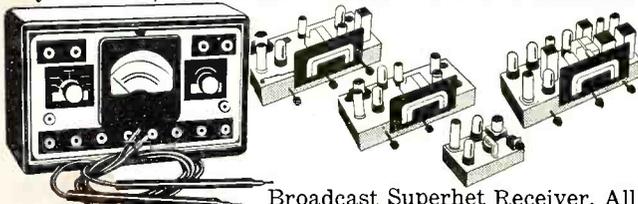
Start now! Why wait around for that raise or promotion that may never come? Get started *now* in high-paying TV-Radio-Electronics! National Schools' SHOP METHOD Home Training prepares you for success in a top-salary job or in your own business. You learn *all three*... Television, Radio, Electronics... in one complete course. Our Shop-Tested lessons and manuals help you master all phases in shortest possible time! Send coupon, find out today!

WHY NATIONAL SCHOOLS LEADS THE FIELD

Located in the "Television Center" of the world, our staff is in close touch with latest developments and opportunities. We give you personalized job placement assistance. We also give you confidential help with both technical and personal problems relating to your training. We show you how to make Part Time Earnings as you progress. Whether you live 30 miles away, or 3,000, you will always be pleased with our prompt, friendly service!

DRAFT AGE? Our home training helps you achieve specialized ratings and higher pay grades if you go in service.

We send you this precision-tested Multitester! Plus parts to build Oscillators, Receivers, Signal Generator, Continuity Checker, Combination Short Wave and Standard



Broadcast Superhet Receiver. All this equipment is part of your National Schools course. **NO EXTRA CHARGES!** Send coupon for free books!

NATIONAL SCHOOLS, world-famous technical trade school. Now in our 50th year!



NATIONAL SCHOOLS

TECHNICAL TRADE TRAINING SINCE 1905
LOS ANGELES 37, California • CHICAGO: 323 West Polk St.
IN CANADA: 811 West Hastings Street, Vancouver, B. C.

- APPROVED FOR G. I. TRAINING
- BOTH HOME STUDY AND RESIDENT COURSES OFFERED

30 MILLION TV SETS

need regular repair! Color TV means more sets than ever before. NOW is the golden opportunity to cash in on this multi-billion-dollar industry. Or "write your own ticket" in broadcasting, manufacturing, and other specialized phases!

**YOUR AGE
IS NO
OBSTACLE!**



**Send for
FREE LESSON!**
FREE BOOK & SAMPLE LESSON
will convince you!
SEND COUPON TODAY!

MAIL NOW TO OFFICE NEAREST YOU!

(mail in envelope or paste on postal card)

NATIONAL SCHOOLS, Dept. RH-26

4000 SOUTH FIGUEROA STREET
LOS ANGELES 37, CALIFORNIA

OR 323 WEST POLK STREET
CHICAGO 7, ILLINOIS

Please rush **FREE BOOK**, "My Future in Radio-Television-Electronics," and **FREE LESSON** at once. I understand there is no obligation, and no salesman will call.

NAME _____ BIRTHDAY _____ 19 _____

ADDRESS _____

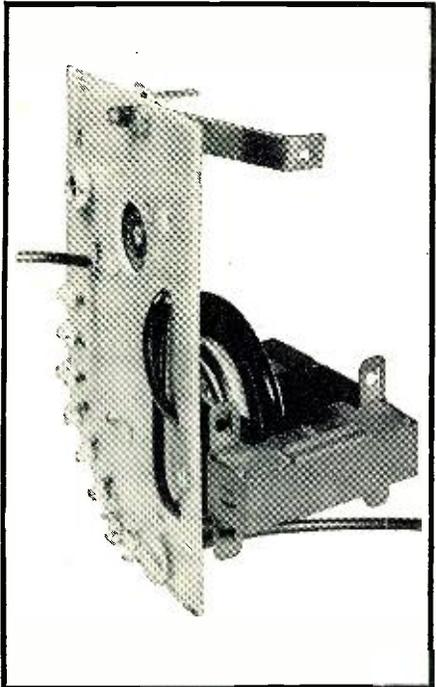
CITY _____ ZONE _____ STATE _____

Check if interested **ONLY** in Resident Training at Los Angeles.

VETERANS: Give date of discharge _____

Merit

FIRST IN EXACT REPLACEMENT.



HVO-50 FOR EXACT REPLACEMENT in over 75 TRAVLER models and chassis. Another in the complete Merit line of exact and universal transformers, yokes and coils. Merit is the only manufacturer of transformers, yokes and coils who has complete production facilities for all parts sold under their brand name.

Merit

MERIT COIL & TRANSFORMER COMPANY
4427 N. CLARK ST., CHICAGO 40, ILL.

Within the Industry

IRVING GOLIN, president and co-founder of *University Loudspeakers, Inc.*, passed away recently at the age of 46, after a year's illness.



Despite his comparative youth, Mr. Golin was considered an "old timer" in the electronics industry and enjoyed a wide acquaintance in the field.

Sidney Levy and Arthur Blumenfeld, who originally founded the company with Mr. Golin, will continue the management of the firm.

* * *

JFD MANUFACTURING CO., INC. of Brooklyn has opened a Canadian manufacturing and sales division, **JFD CANADA, LTD.** at 51 McCormack Street, Toronto, Ontario . . . **PREMIER METAL PRODUCTS CO.** has moved to new and larger quarters at 337 Manida Street, New York 59 . . . A \$2,700,000 addition is being constructed at **RCA's** plant in Cambridge, Ohio to provide 210,000 square feet of floor space for the manufacture of tape recorders and high-fidelity equipment . . . **SANDS ASSOCIATES, INC.**, public relations and marketing consulting firm, has moved its main offices from Santa Barbara to 26 O'Farrell Street in San Francisco. A branch will be maintained in Santa Barbara . . . National headquarters of **"THE REPRESENTATIVES"** of Electronic Products Manufacturers, Inc. has moved to Room 1219 at 600 S. Michigan Avenue, Chicago. The move provides expanded facilities for handling the administrative affairs of the organization . . . **P. R. MALLORY (HUNTSVILLE), INC.** has opened a two-million-dollar manufacturing plant for the production of electrolytic capacitors in Huntsville, Alabama . . . **CALIFORNIA CHASSIS CO.** has added a 10,000 square foot building to its facilities at 5445 E. Century Blvd., Lynwood, California . . . **VITRO LABORATORIES** has broken ground for a new million-dollar laboratory near Silver Spring, Maryland. When completed in 1957, the new laboratory will replace the presently leased facilities in Silver Spring . . . A new 12,600 square foot research and advanced engineering building is under construction for **ARVIN INDUSTRIES, INC.** at Columbus, Ind. . . **SPENCER-KENNEDY LABORATORIES, INC.** has moved into its new plant on Soldiers Field Road in Boston. The new facility doubles the firm's existing manufacturing and engineering space . . . The West Coast Division of **HETHERINGTON, INCORPORATED** has moved to new and larger quarters at 139 Illinois

Avenue, El Segundo, California. . .

ALLIED RADIO CORPORATION has opened a new high fidelity studio at 2025 W. 95th Street in Chicago to serve the city's South Shore, including the Evergreen Park and Beverly Hills areas. This is the company's third location in the Chicago area . . . **SYLVANIA ELECTRIC PRODUCTS INC.** is building a new 110,000 square foot building in Altoona, Pa. for the production of receiving tubes. It will ultimately replace an existing smaller plant and leased warehouse space in that city . . . **VARIAN ASSOCIATES** has built a new manufacturing and research plant in Georgetown, Ontario. It will be operated by the firm's Canadian subsidiary . . . **RODNEY METALS, INC.** has opened a new West Coast office and warehouse at 4312 Pacific Way, Los Angeles 23, California . . . **JAMES VIBRAPOWR COMPANY** has moved into a new plant at 4036 N. Rockwell in Chicago. The new building more than triples the company's present facilities . . . **TEXAS INSTRUMENTS INCORPORATED** has established an eastern region marketing office at 500 Fifth Avenue, New York 36, N. Y. The firm now has marketing offices in Los Angeles and Chicago as well . . . The West Coast headquarters of **ALLEN B. DU MONT LABORATORIES, INC.** is now in operation at 11800 W. Olympic Blvd., Los Angeles, California . . . **ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA** has added 6300 square feet of space at 183 South Alvarado, Los Angeles, directly across the street from its main plant . . . **RDM, INC.** has opened a West Coast plant in the Los Angeles area . . . **RAYTHEON MANUFACTURING COMPANY** has leased 65,000 square feet of floor space in Maynard, Mass. which will be devoted to the development and engineering activities of its radar systems group.

* * *

WILLIAM VASSAR has joined *CBS-Columbia* as director of engineering in Long Island City, New York.

He was most recently associated with *Emerson Radio and Phonograph Corporation* as executive chief engineer. His experience also includes being chief engineer for engineering services at the *Crosley Corporation*, and industrial engineer for the Chemical Warfare Service War Plans Division.

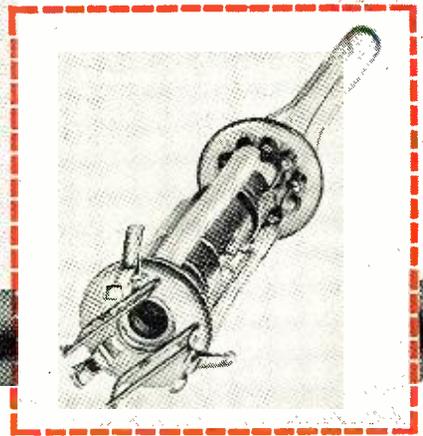


Active in industry affairs, Mr. Vassar was for many years chairman of the safety committee of RETMA as well as a member of the RETMA ex-



"Silver Screen 85's" new barium "picture-guard" process deposits a lining of barium over the tube's inside walls. Increased "getter" action keeps the vacuum pure, protecting the screen and electron gun from contamination. The result: Silver Screen 85 gives a brighter picture for a longer time.

"Silver Screen 85's" new high-energy electron gun delivers 10% more light-producing electron energy to the screen. Brightness is increased an equal amount. Precision-focus keeps the picture in perfect sharpness.



"Silver Screen 85" steals the show again

**...with new "picture guard" and
new high-energy electron gun**

Sylvania's "Silver Screen 85" is now improved four ways to give brighter pictures for a longer time. New "Picture Guard" and high-energy electron gun headline these improvements. In addition, refinements have been made in the silver activated screen and super-aluminized reflector to make television's brightest picture tube even brighter. And to make this *your* biggest year with "Silver Screen 85" Sylvania will be telling more consumers than ever about the improved "Silver Screen 85."

In addition to "Beat the Clock" Sylvania will use Sunday Supplements to promote the "Silver Screen 85" in your own locality. Full schedules will be run in *This Week* and *American Weekly*, plus a score of independent Sunday Supplements.

A better tube, better promotion, with more tie-in material made available for your use. That means this can be your biggest picture tube year if you make it a "Silver Screen 85" year.

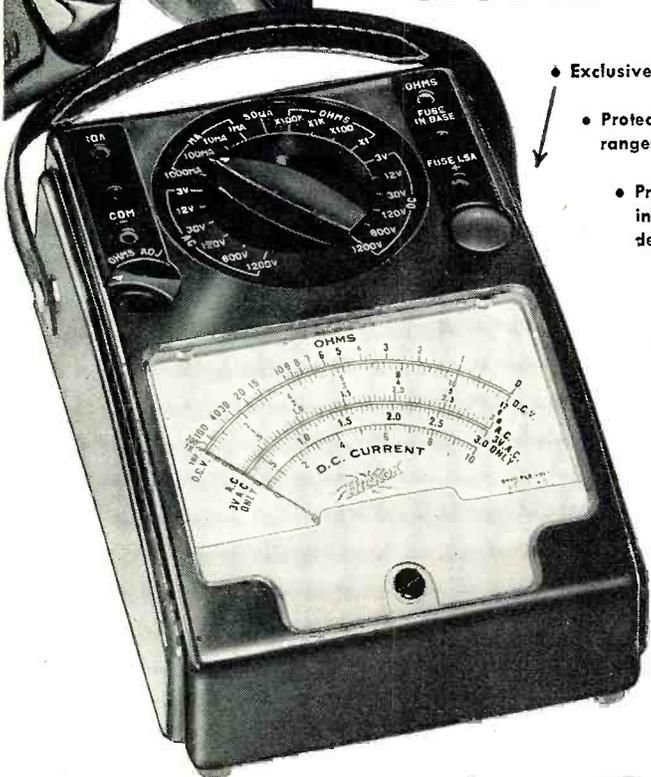


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1740 Broadway, New York 19, N. Y.
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University Tower Bldg., Montreal



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MODEL 455**



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- Protection of all practical ranges.
- Protects meter and entire internal circuit against accidental burn-outs.

Greatest engineering achievement in VOM history

Latest Design
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The Model 455 is a new portable multimeter that incorporates the latest engineering advancements including the new technique that protects both meter and the entire internal circuit against accidental burn-outs. In fact, any high voltage or current may be applied directly across any function, including ohms, without danger to the meter movement or associated components.

This instrument is available in two models: Industrial Model 455 . . . has a sensitivity of 20,000 ohms per volt AC or DC; Audio Model 456 . . . has a sensitivity of 20,000 ohms per volt DC and 1,000 ohms per volt AC. The 456 also includes DB ranges and provision for output measurements.

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Ask for a demonstration of this most practical VOM from your Radio-Electronic Parts Jobber today! . . . Or write direct for technical details.

ecutive committee of the receiver division.

* * *

WILLIAM W. CARGILL has been appointed production manager of *Berlant Instruments*, Los Angeles manufacturer of *Berlant* and *Concertone* tape recorders and a line of audio components.



He was formerly production control priorities supervisor with *Allis-Chalmers* of Madison, Wisconsin until 1943 when he entered the Marine Corps. He served as an officer in the South Pacific theater until his honorable discharge in 1946.

He joined *Berlant* from the *McCullough Motor Corporation*, where he was production control supervisor with the *Rhodes-Lewis Division*.

* * *

ARTHUR V. LOUGHREN, color television expert and vice-president in charge of research of the *Hazeltine Corporation*, has been elected president of the Institute of Radio Engineers for 1956. He succeeds John D. Ryder, dean of the School of Engineering at Michigan State.

Herre Rinia, director of research of the *Philips Research Laboratories* in Eindhoven, Holland is the new vice-president. The association also named E. W. Herold, director of the Electronic Research Lab., *RCA Laboratories*, and J. R. Whinnery, professor of electrical engineering, University of California, to serve as directors for the 1956-58 term.

* * *

BRUCE VINKEMULDER is the new distributor sales manager of *Centralab*, replacing Robert A. Mueller who resigned late last year.



Mr. Vinkemulder has been active in the electronics industry for the past nine years, with *Sangamo Electric Company* and more recently as sales manager of *Carter Parts Co.* He is an engineering graduate of Marquette University and took graduate work at Columbia and MIT.

In addition to his distributor duties, he will supervise the advertising and export departments of the company.

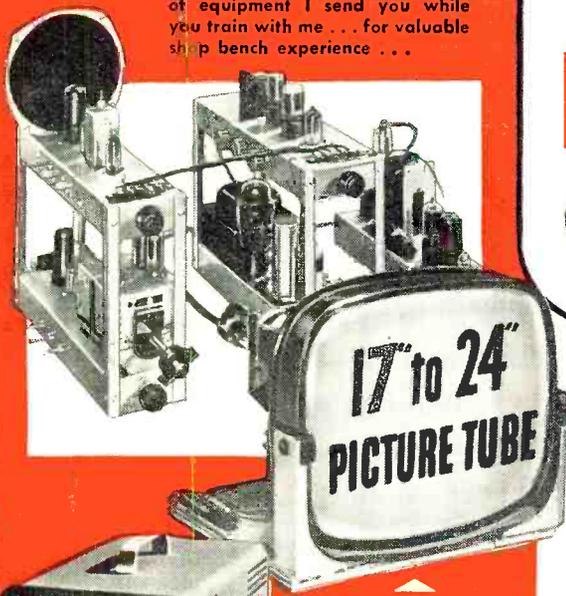
* * *

JERROLD ELECTRONICS CORPORATION has acquired controlling interest in **CABLEVISION, INC.**, a company which recently started construction of a community antenna system in Key West, Florida . . . Control of **OLYMPIC RADIO AND TELEVISION INC.** has been acquired by a group of industrialists and financiers . . . **P. R. MALLORY & CO., INC.** and **SCHWARZKOPF DEVELOPMENT CORPORATION** have announced the formation of **MALLORY-SCHWARZKOPF METALS, INC.** The new firm will produce and fabricate refractory metals
(Continued on page 164)

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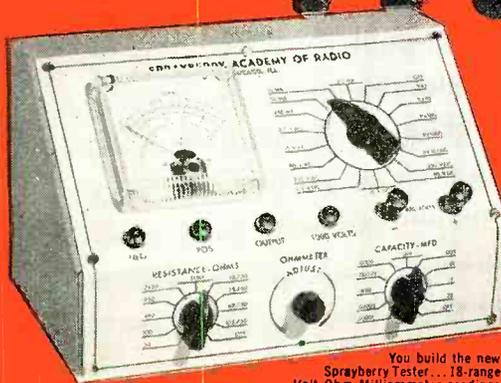
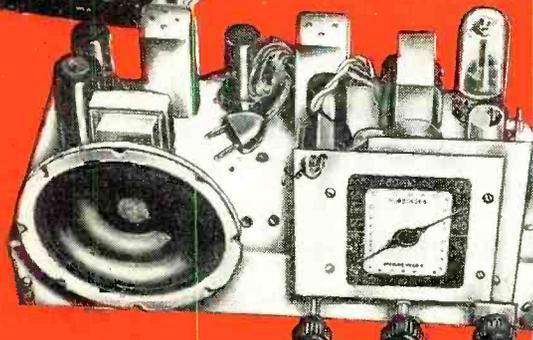
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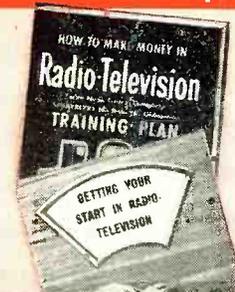
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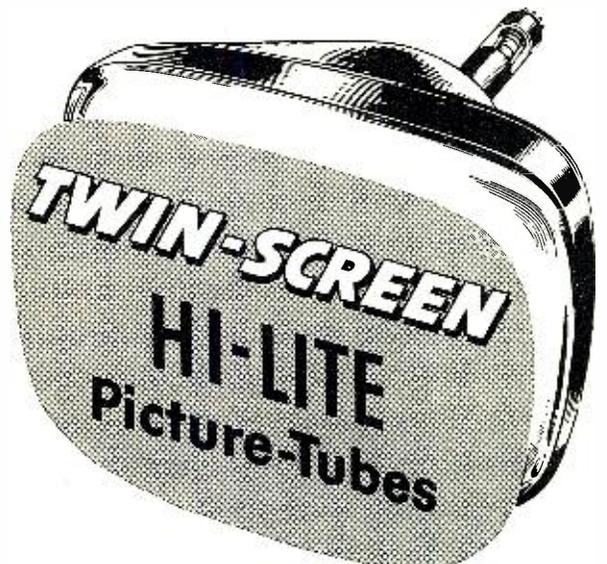
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by North American Aviation in electronic assembly (final checkout)." Glen A. Furlong, Fresno, Calif.

MOBILE SERVICING
"I am now employed by the Permian Basin Communications, Inc. and now manage the service shop in Odessa, Texas for Motorola 2-way communication equipment. I got the job through your Job Finding Services. My sincere thanks."
Robert W. Cook, Odessa, Texas

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Milton L. Geisler, ET3 FPO, San Francisco, Calif.	1st	26 weeks
Marvin F. Kimball, Lafayette, Ind.	2nd	21 weeks
L. M. Bonino, Harlington AFB, Tex.	2nd	16 weeks
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KIT \$26.95
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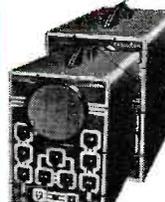
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150 kc-435 mc; 6 fund. bands.



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TUBE TESTER #625

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- tests 600 mil series string type tubes
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#944 FLYBACK TRANSFORMER & YOKE TESTER

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- fast check all flybacks & yokes in or out of set.
- spots even 1 shorted turn!

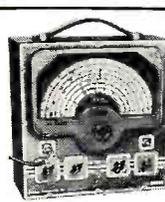


Range 500 kc-228 mc on fund. Cont. sweep width control, 0-30 mc.

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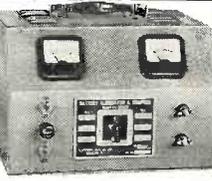
5MC-4.5MC CRYSTAL\$3.95 ea.



1% accuracy on all 7 ranges. Range 75 kc-150 mc. Volt reg.

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Sep. volt-meter & ammeter

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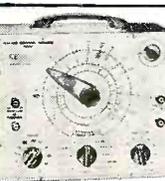
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Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.

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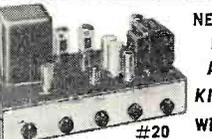
DELUXE MULTI-SIGNAL TRACER #147



Reads 0.5 ohms -500 megs, 10 mmfd-5000 mfd power factor.

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NEW! High Fidelity Amplifier

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20-20,000 cps ±0.5db IM distortion 1.3%. Harmonic distortion 0.3%. All at 20 watts. Ultra Linear Williamson, 5 pos. equal., tone & loudness controls.



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High Voltage Probe-1		\$6.95
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Demodulator	\$3.75	\$5.75
Direct	\$2.75	\$3.95
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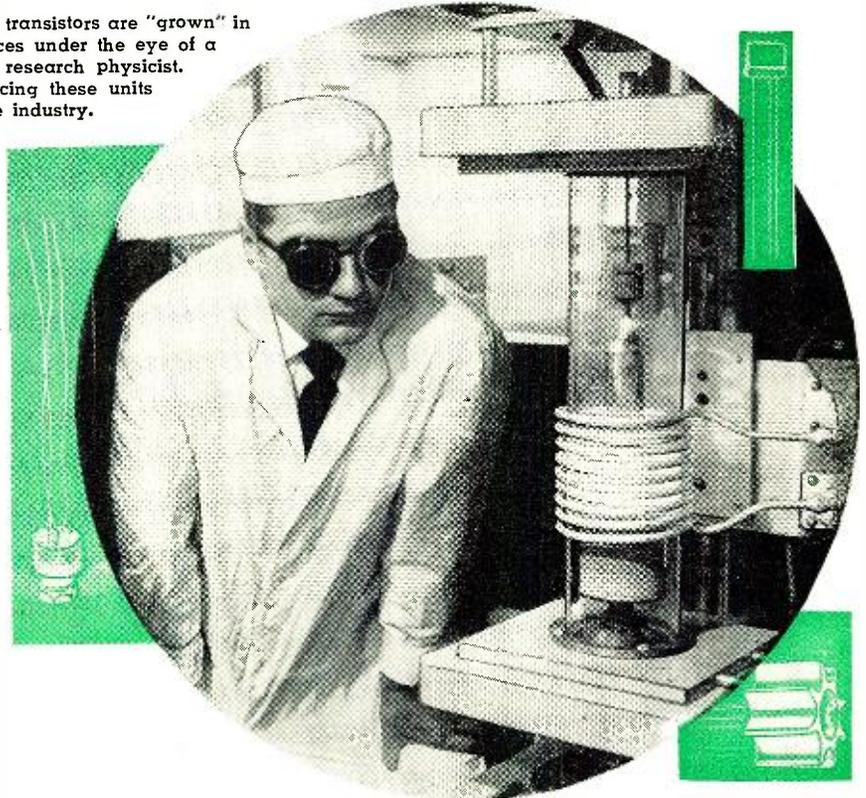
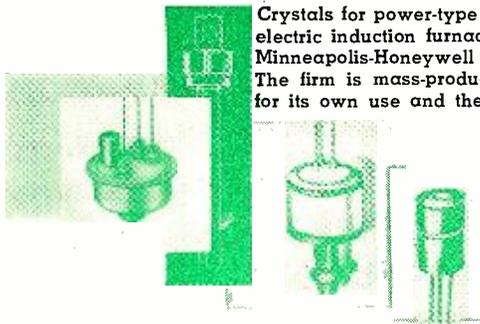
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POWER TRANSISTORS

Crystals for power-type transistors are "grown" in electric induction furnaces under the eye of a Minneapolis-Honeywell research physicist. The firm is mass-producing these units for its own use and the industry.



By PAUL PENFIELD, JR.

WHEN first introduced, the transistor was a low-power device. Current was limited to a few milliamperes, voltage to a few volts, and power dissipation to a few milliwatts. One of the primary points of research was to increase the power-handling capabilities of transistors. Today's power transistors and tomorrow's research developments are the result of this activity. Typical of present germanium power transistors are the 2N68, 2N57, and P-11. The P-11, not yet in production, will safely dissipate 60 watts at room temperature!

The crux of the problem of high-power transistors is the effect of high temperature on transistor operation.

As everyone knows, transistor action is based on the presence of small amounts of impurities in an otherwise perfect crystal of germanium. The impurity atoms, either donor or acceptor, introduce excess electrons or holes, which flow in controlled amounts to produce transistor action. Without these excess electrons or holes, the current that would flow depends on the temperature. At high temperatures, the germanium begins to look like a conductor, and so in a transistor the flow of current is no longer controlled by the impurity atoms, and transistor action stops.

If the temperature gets high enough, the atoms in the germanium crystal may be "bouncing around" so much that the impurity atoms get kicked from one side of the junction to the other. This process, known as impurity diffusion, does not occur at room temperature. Once this diffusion has occurred, the transistor is ruined.

In addition, some transistors are made in such a way that indium metal is used in the emitter and collector terminals. The temperature of the transistor must be kept below the melting point of indium.

Whichever of these temperature limits is lowest determines the *maximum allowable temperature* of the transistor. This is specified by the manufacturer and may lie anywhere from 160° F to 200° F. This temperature

The advantages and limitations of power transistors, class A, AB, and B operation, available outputs, circuitry, etc. are all discussed in this survey of these new components.

must not be exceeded when the transistor is in use, when being soldered, or when in storage.

The power that is dissipated in a transistor goes toward heating up the transistor. Unless some method is devised to get rid of the heat, the transistor will be ruined by the temperature effects as noted.

The collector junction dissipates the most amount of power and therefore is the most liable to damage. Commercial power transistors are designed so that heat can be removed from this junction as quickly as possible, and put into a "heat sink"—some piece of metal to which the transistor is bolted. Use of a heat sink makes a transistor run cooler and so for any given temperature rating more power can be safely dissipated—usually more than twice as much.

The amount of power that can be safely dissipated by transistors also decreases if the ambient temperature is high. This is because the heat flow out of the transistor will be less if the heat sink is at a higher temperature. This "temperature derating" is fundamental to high-temperature operation. At the specified maximum allowable tempera-

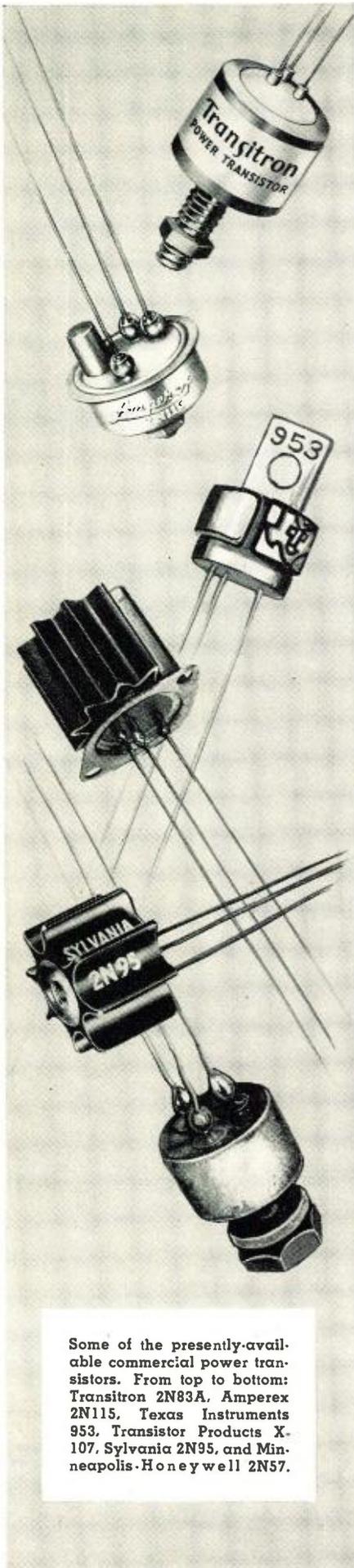
ture, the power dissipation is de-rated to zero.

An entirely different approach to the design of power transistors is to use silicon which, like germanium, can exhibit transistor action. Silicon is useful to temperatures much higher than germanium (up to about 250° F), so at any given ambient temperature, more power can be dissipated than with an identical germanium unit. Silicon transistors offer the disadvantage that the transistor properties change at high temperatures, so these transistors are not as widely used as might be expected.

It is possible to mix silicon and germanium in any proportion as an alloy and currently work is being done to develop an alloy power transistor which will combine the best features of each material.

Meaning of Power Ratings

Power ratings assigned by manufacturers may be a bit misleading. In normal vacuum tube practice, the ratings are given in terms of *average* power dissipation. Nothing drastic happens if a plate is temporarily overheated, as long as it has a chance to cool down



Some of the presently-available commercial power transistors. From top to bottom: Transistron 2N83A, AmpereX 2N115, Texas Instruments 953, Transistor Products X-107, Sylvania 2N95, and Minneapolis-Honeywell 2N57.

Model	Manufacturer	Type	MAXIMUM RATINGS			
			Maximum Collector Voltage (volts)	Maximum Collector Current (amp.)	Maximum Collector Dissipation (watts)	Maximum Junction Temp. (degrees C)
2N57	Minneapolis-Honeywell	p-n-p	60	1.0	20	93
2N68	Sylvania	p-n-p	25	1.5	4**	70
2N83A	Transistron	p-n-p	60	1.5	10	85
2N84A	Transistron	p-n-p	45	1.5	10	85
2N95	Sylvania	n-p-n	25	1.5	4**	70
2N101	Sylvania	p-n-p	25	1.5	4**	70
2N102	Sylvania	n-p-n	25	1.5	4**	70
2N115	AmpereX	p-n-p	24	2.0	2	70
951	Texas Instruments	n-p-n Silicon	50	0.06	1	150
952	Texas Instruments	n-p-n Silicon	80	0.05	1	150
953	Texas Instruments	n-p-n Silicon	120	0.04	1	150
970	Texas Instruments	n-p-n Silicon	120	.14	*3.5	150
H-1	Minneapolis-Honeywell	p-n-p	60	0.8	20	93
H-2	Minneapolis-Honeywell	p-n-p	60	1.4	20	93
H-3	Minneapolis-Honeywell	p-n-p	60	0.35	5	93
H-4	Minneapolis-Honeywell	p-n-p	60	0.5	5	93
P-11	Minneapolis-Honeywell	p-n-p	60	5.0	60	120
X-107	Transistor Products	p-n-p	60	1.0	2	85
X-120	Transistor Products	p-n-p	60	4.0	15	85
X-122	Transistor Products	p-n-p	60	4.0	7.5	85
X-125	Transistor Products	p-n-p	60	1.0	3.0	85

** With external heat sink

Specifications for a number of power transistors are given in this table. Only transistors with a collector dissipation of one watt or more are listed—this arbitrary limit was placed to eliminate from consideration several "medium-power" or "output" transistors, leaving only true high-power models. The maximum ratings given should not be construed as simultaneous ratings. For example, simultaneously applying maximum collector current and maximum collector voltage would exceed the maximum power dissipation rating. In addition, the maximum power dissipation rating is given for room temperature—it must be lowered when work-

ing at higher temperatures. For further information on any particular transistor type, consult the manufacturer's literature. Any operation which falls within these maximum ratings is permissible—the circuit designer should not feel limited to the typical operating conditions as tabulated, but should feel free to design his circuit within the maximum ratings. The class A and class B typical operating conditions listed are as given on the manufacturers' specification sheets, with only minor arithmetical operations to bring them all into the same form. Thus, whereas manufacturer "A" might list the average collector current, or the collector-to-collector load

on the next quarter-cycle. However, a transistor will burn out instantly under comparatively short overloads. Therefore, the *peak* power dissipation—that dissipation which is the greatest, wherever it may occur on the normal voltage swing—must be below the manufacturer's recommendations or else the user is risking a burnout.

As noted before, the maximum temperature must not be exceeded at any time during the life of the transistor. One of the effects of high junction temperature is to increase the cut-off current, which is the collector current when the emitter is left open-circuited. Unfortunately, the total collector current is increased by far more than the cut-off current, due to regular transistor action, unless precautions are taken to stabilize the transistor.

This increase in collector current further heats up the collector junction and, if the effect is severe enough, the heat generated by the cut-off current will produce a high enough temperature rise so that more cut-off current is produced, and the transistor may enter a condition known as "runaway," in which case the transistor current and temperature will continue to rise until the unit burns out.

Stabilizing a transistor is done by means of the circuitry involved. While stabilized operation is recommended for all transistor amplifiers, it is practically a necessity for power transistors. In general, one way to achieve stability of operation is for the base-emitter junction to "see" externally a low resistance, say under 500 ohms d.c.

Stability is especially important when operating close to the maximum temperature or power and not as important in amplifiers operated well under the maximum ratings.

Rough data on most of the presently-available power transistors is given in Table 1.

Power Transistor Circuitry

Now that we know what "makes" a power transistor, we can begin designing circuits for them. Since audio amplifiers are the most common, and since the high-frequency response of available power transistors is low, we'll discuss audio output circuits.

Two immediate questions come to mind: What class of operation (class A, class AB, or class B), and what configuration (grounded-emitter, grounded collector, or grounded-base) should be used. Because of the high power gain, we'll talk only about grounded-emitter operation, although the other configurations have some advantages.

Class A operation for transistors has been unjustly criticized by engineers because of the relatively low efficiency and the high no-signal current. Nevertheless, class A transistor amplifiers are a vast improvement over vacuum-tube circuits and are quite useful when small power output is required.

Class A Operation

Class A operation is characterized by a maximum efficiency of 50%, high zero-signal (or quiescent) current, low distortion, moderate power gain, and single-ended input and output.

TYPICAL OPERATION—CLASS A GROUNDED-EMITTER					TYPICAL OPERATION—CLASS B GROUNDED-EMITTER					Remarks
Collector Supply Voltage (volts)	Peak Collector Current (amp.)	Load Resistance (ohms)	Power Output (watts)	Power Gain (db)	Collector Supply Voltage (volts)	Peak Collector Current (each transistor) (amp.)	Load Resistance (per collector) (ohms)	Power Output (2 units) (watts)	Power Gain (db)	
28	1.0	56	6.25	16	28	1.0	28	12.5	13	The Maximum Collector Current is a suggested value only and may be exceeded providing no other ratings are exceeded in the process. Complement of type 2N95. Complement of type 2N68. Complement of type 2N102. Complement of type 2N101. *Ratings at 100°C. Formerly type X-78 and or X-108.
12	0.3	100	0.6	23	12	0.87	12	5.0	15	
28	0.6	100	4.0	18	28	1.0	28	12	15	
22	0.8	50	4.0	18	22	1.0	22	10	15	
12	0.3	100	0.6	23	12	0.87	12	5.0	15	
12	0.3	100	0.6	23	12	0.87	12	5.0	15	
12	0.3	100	0.6	23	12	0.87	12	5.0	15	
67.5	.095	1250	*1.0	*32	28	0.05	375	0.45	20	
28	0.8	70	5.0	15	45	0.035	1000	0.65	21	
28	1.2	47	7.5	20	67.5	0.027	2000	1.0	23	
28	0.3	187	1.9	16	67.5	.1	500	*2.5	*22	
28	0.3	187	1.9	21	28	0.8	35	10	12	
28	4.0	14	24.0	20	28	1.4	20	17.5	16	
28	0.16	375	1.0	23	28	0.35	80	4.4	12	
30	1.0	70	5.3	18	28	0.5	56	6.25	14	
30	0.5	150	2.8	22	28	5.0	5.6	60	15	
28	0.16	375	1.0	23						

resistance, and manufacturer "B" may list the same variables as peak collector current, and load impedance per collector, here all operating data was put in the same form, to permit easy comparison. Certain of the parameters had to be calculated on the basis of the manufacturers' graphs, so there may be some disagreement between the figures listed and those which may be published in the future. The fact that certain operating data is missing should not be construed as implying that these transistors are not suited for this type of work—it merely means that at the time of writing this data was not available. Since the field of power

transistors is so young, there will likely be considerable change in the amount of data available, so the blanks may be filled in later. Most of the typical operating conditions given are for average transistors, operating very close to the maximum ratings. This is common practice in giving data on vacuum tubes, as well as transistors, since it is near the maximum ratings that the most power output can be had, and it is here that the capabilities of the particular model show up. Therefore, the reader should not expect necessarily to attain these operating conditions without considerable trouble, and may have to settle for something less. The parameters selected to represent the class

A operating conditions are collector supply voltage, peak (not average) collector current, load resistance, power output (for a sine wave), and power gain. The average collector current will be slightly over one-half the listed peak value. The parameters selected to represent the class B operating conditions are collector supply voltage, peak collector current per transistor, load resistance per transistor, and power output and power gain for both transistors together. The collector-to-collector load resistance is four times the load resistance per transistor. The average full-signal collector current for both transistors is approximately 0.64 times the peak collector current, for a sine-wave signal.

Table 1. Operating characteristics of most of the currently-available power-type transistors. Data supplied by manufacturers. See notes.

Efficiency: All class A amplifiers, vacuum tube or transistor, have a maximum possible efficiency of 50%, that is to say, power output will always be less (for a sine wave signal) than the power dissipated within the transistor. Power for tube filaments is additional.

In vacuum-tube practice, where average power dissipation is the significant rating, the maximum average power dissipation occurs when there is no signal. This fact is commonly used to help in seeing if power stages operate safely: if they do so with no signal, then they will, also, with a signal present.

In transistor practice, however, the peak power is the significant rating, and with reactive loads (like a loudspeaker) the peak power will be greater with a signal present than without, although average power will be less.

Transistor operation close to the theoretical maximum of 50% is possible, although not with vacuum tubes. With only a little distortion, efficiencies of more than 50% have been noted.

Distortion: Present power transistors are not at all distortion-free, but class A operation usually is better than class B. Practical amplifiers may have less than 2% total harmonic distortion, most of which is second-order.

Power Gain: The power gain possible from power transistors is lower in class A than in class B, but because the input is single-ended, driving problems are simpler.

Single-Ended Input and Output: This is very important. Typical output impedances from power transistors are very small and suitable output transformers, such as are required with class B operation, are not yet available. Often, in class A work, the output resistance is around 10 ohms, and since the output is single-ended a good loudspeaker can be connected directly into the circuit without a transformer.

This brief analysis should make it clear that class A operation should not be overlooked. A simple output stage is shown in Fig. 1. Properly driven with 1 volt at 4 ma. r.m.s., the stage will put out a quarter of a watt into the loudspeaker load. Efficiency is about 45%. The quiescent current is about 100 ma. Although the transistor used is capable of higher power outputs, this circuit is conservatively designed.

Class B and AB Operation

Class AB operation is merely a compromise between class B and class A, so it will be discussed with class B at this time. Note that what is normally referred to as class B operation is, in reality, class AB, very close to class B.

Conventional class B operation is characterized by good efficiency, high distortion, high power gain, and need for input and output transformers.

Efficiency: 78% is the efficiency limit of a class B amplifier, whether vacuum tube or transistor, for a sine wave signal. This mark is seldom approached

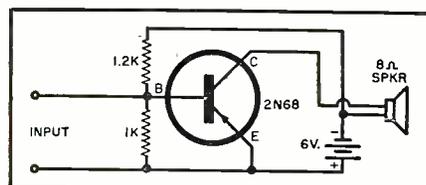
in either type of operation, due to heavy distortion. Class AB efficiency ranges from a maximum of 50% to a maximum of 78%, depending on how close it is to either class A or class B.

Zero-signal, or quiescent current, for true class B operation is zero, but for practical amplifiers, operating just inside class AB, is not zero. However, it is not as high as that necessary for class A operation.

Distortion: In vacuum-tube practice, class B and AB operation is noted for lack of distortion, in particular the complete cancellation of even-order harmonics. However, because of the uneven phase-shift in transistor amplifiers, and the inevitable unbalance between the sides, even-order distortion is apt to be quite bad. Use of matched pairs of transistors is a virtual necessity.

In addition, transistor class B amplifiers suffer from "crossover distortion." This is due to the nonlinear operation of the base-emitter junction near the cut-off region which distorts the sine-wave input of Fig. 2A as shown in Fig. 2B. This distortion can

Fig. 1. Simple transistor class A amplifier.



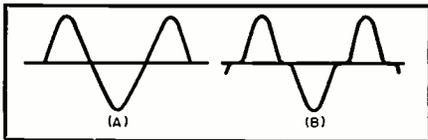


Fig. 2. (A) Sine wave. (B) Sine wave distorted by crossover distortion. See text.

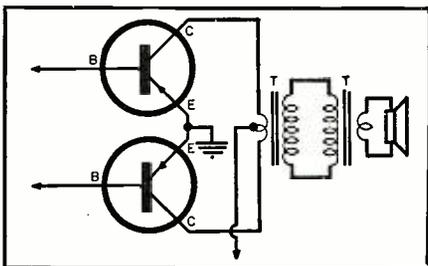


Fig. 3. Using two line-to-voice-coil transformers back-to-back to give a flexible impedance match. Refer to the article.

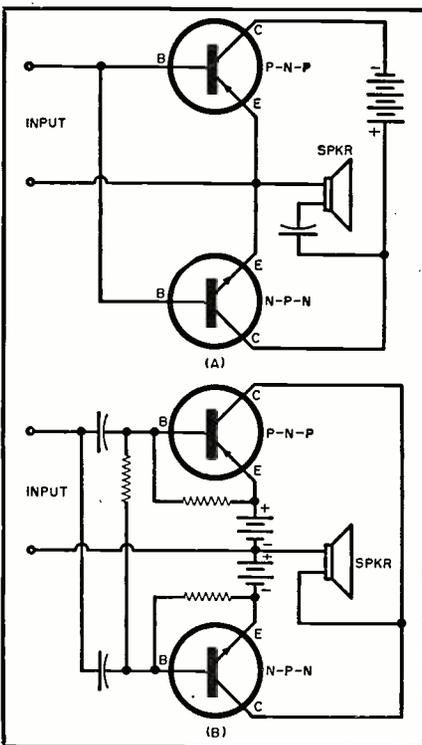


Fig. 4. (A) Complementary class B amplifier using only one battery. (B) Complementary grounded-emitter class AB circuit using the same battery to power the preceding stages of the audio amplifier.

be almost eliminated by operating class AB with a quiescent current greater than zero. This, of course, reduces the efficiency but is absolutely necessary in audio amplifiers, since crossover distortion cannot be tolerated.

At this stage of the game, class B operation will have more distortion than class A, although future improvements may be made which will reduce the distortion.

High Power Gain: Power gain at any given output power is greater for class B by some 3 db and the power gain for class AB is intermediate between the two. However, driving a class B or AB amplifier can be quite a problem, because the input is double-ended.

Double-Ended Input and Output: This feature is, of course, characteristic of vacuum tube amplifiers, too. Either transformer coupling, or else phase inversion by standard techniques may be used, although transformer coupling is usually preferred.

In vacuum-tube practice, the making of output transformers is a fine art. However, at this writing there are no transformers on the market designed for high-power transistor output stages. It is, of course, possible to use two transformers, connected back-to-back, as shown in Fig. 3. The *Stancor* Model A-3837 is suitable for this application and can handle the power required. The number of taps available makes possible the selection of a large number of impedances to present to the output stage.

Another alternative to the problem of combining the two half-outputs is to use a speaker with a center-tapped voice coil. Since the output impedance of typical transistor output stages is low, a center-tapped speaker could be used directly without the necessity of employing an output transformer. As far as the author knows, no such speakers are currently available, but undoubtedly will be soon.

Another type of operation exists with transistors, but not with vacuum tubes. This is complementary class B or AB operation and, because of its inherent advantages, will ultimately be used almost exclusively in output circuits.

A basic complementary amplifier is

shown in Fig. 5A. Because one side uses a *p-n-p* transistor and the other side an *n-p-n* unit of equivalent characteristics, one side "pushes" while the other side "pulls," with a single-ended input and output. Phase-splitting is done automatically by the two base-emitter junctions. Because collector current is opposed in the two units, the output is single-ended. As far as the a.c. signal is concerned, the two collectors are tied together, as are the two bases, and the two emitters. The stage can then be imagined as a composite device whose "collector" current can flow either way, depending on the polarity of the "base" current. With no signal input, the collector current will be zero.

This circuit combines the efficiency and low standby power consumption of the class B and AB circuits and the single-ended advantages of class A operation. A loudspeaker can be connected directly as the load in typical circuits, using modern power transistors.

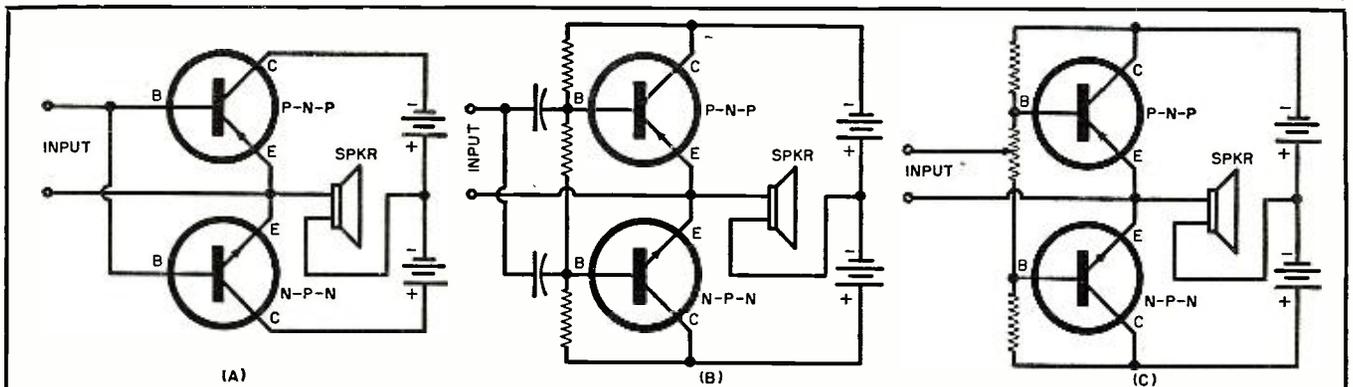
Unfortunately, complementary circuits suffer from the same distortion as conventional class B circuits—and some zero-signal bias must be provided to reduce crossover distortion. Two circuits for providing this bias are shown: Fig. 5B is for use with matched pairs, and Fig. 5C has the input signal going to the wiper of the potentiometer to act as a "balance" control.

Several disadvantages should be mentioned in this connection. Although it is possible to use just one battery (as in Fig. 4A) the distortion is worse, and two-battery operation (as in Fig. 5A) is to be preferred. Although circuits exist for allowing the same battery to power the driver and preceding stages as power the final stage (see Fig. 4B), it is usually preferable to use separate batteries.

Selecting the amount of zero-signal bias to be used depends on the use to which the amplifier is to be put. The higher the bias, the less the crossover distortion, up to the point where this distortion becomes negligible. However, operation at this point means a large standby current, and the resultant inefficiency. Line-powered amplifiers will probably operate with a rather high

(Continued on page 110)

Fig. 5. (A) Basic grounded-emitter complementary class B amplifier. (B) Complementary class AB amplifier. (C) Circuit for biasing and balancing non-matched output transistors. This circuit is class AB. See text for a full discussion.



A New Type Circuit Assembly

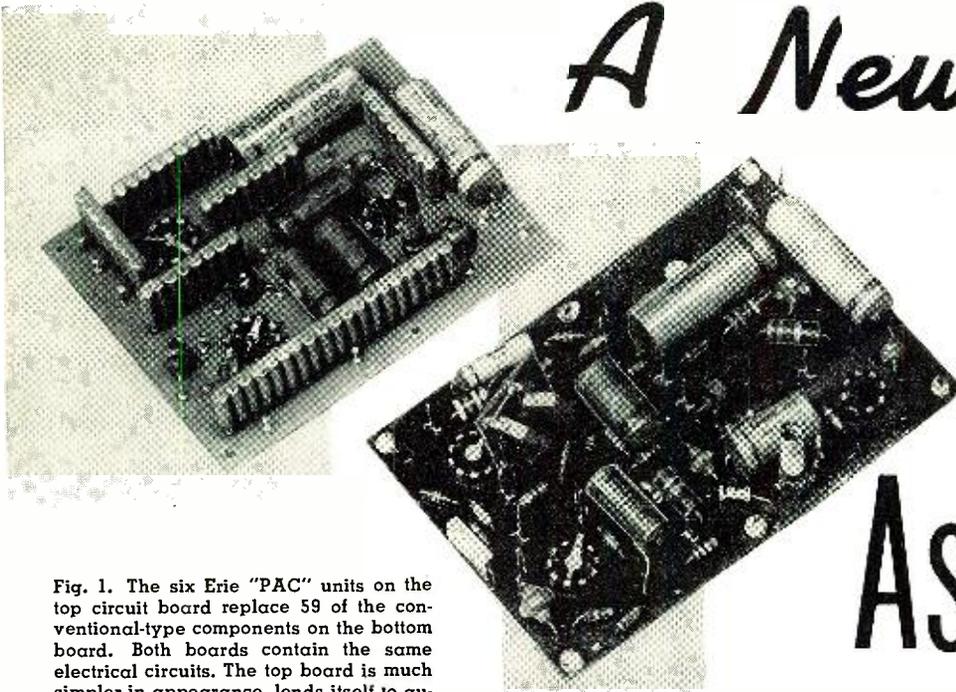


Fig. 1. The six Erie "PAC" units on the top circuit board replace 59 of the conventional-type components on the bottom board. Both boards contain the same electrical circuits. The top board is much simpler in appearance, lends itself to automatic assembly methods, is cheaper.

TODAY, leading radio and television producers are working towards making their assembly lines automatic at every stage. Component parts are mounted individually on printed-wiring boards through automatic equipment that usually cuts and forms the wires and inserts them through the proper holes punched in the board.

A new method of combining up to 92 individual components into one package and effecting a considerable reduction in cost of assembly, labor, and equipment has been developed by the Erie Resistor Corp. of Erie, Pa. Called "PAC" (for Pin Assembly Circuit), the new system simplifies automation for the electronics industry in that groups of parts, such as resistors and capacitors, are assembled together into a unitized package. Because these parts are handled at a stage where they have no wires attached and are uniform in size, the assembly is greatly simplified and can be speeded up.

The objective of Erie Resistor has been to design a system for mass-producing reliable, easily adaptable circuit subassemblies at an over-all cost approximating that of the individual components.

After the wiring pattern for a given circuit is determined, the required printed-wiring grid is formed on a laminated plastic base. Component terminal clips, much like miniaturized fuse clips, are next riveted to appropriate tie points and individual tubular components, $\frac{1}{8}$ " in diameter and $\frac{5}{8}$ " long, are automatically assembled into position. The over-all assembly is enclosed in a plastic compound for electrical insulation and moisture-seal, and to provide a package of uniform size which can be handled easily by machinery. See Fig. 2.

The resistors and capacitors used as

The use of modules and packaged subassemblies in TV sets and elsewhere is hastened by this new advance.

building blocks in this system can be made to close electrical tolerances and pre-sorted before assembly. Different combinations of circuits may be quickly produced without costly setup charges. By using uncoated units, development engineers can readily make their own experimental modules.

The resistors currently in use in the "PAC" system are the cold-molded composition type. Other types of resistors such as pyrolytic or glass can be adapted to this form as required. The composition type are conservatively rated at $\frac{1}{2}$ watt and 500 volts. Typical tolerances are ± 5 per-cent, and nominal resistance values from 5 ohms to 50 megohms are available. Multiple pins in the assembly are connected in series or parallel for higher wattage ratings.

The capacitors used are of the ce-

ramic dielectric tubular type and are available in values from 1 $\mu\text{fd.}$ to 5100 $\mu\text{fd.}$ All capacitors carry a minimum rating of 500 volts d.c.

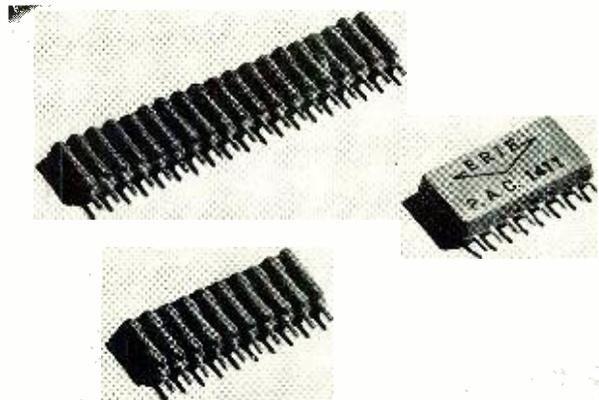
Although capacitors and resistors are the only circuit elements which have been included in pin assemblies designed to date, any other components which can be made in the basic $\frac{1}{8}$ " by $\frac{5}{8}$ " cylindrical form could be included in the system.

Fig. 1 gives some idea of the simplification in physical circuit configurations that is possible through the use of "PAC" units. Accompanying this simplification is a great saving in assembly time and cost.

Although this method of automatic component assembly has been designed with the TV industry in mind, it should find wide application in other electronic equipment manufacturing. —50—



Fig. 2. Two methods of coating "PAC" units are shown here. The top and left units are dip coated, while the unit to the right has a molded case.



New Tube Tester Data

SYLVANIA MODEL 620

TUBE TYPE	A	B	C	D	E	F	GK
2AF4	5.0A	3	467	14	4	2U	1 5
	5.0A	3	124	14	4	6U	7 5
3BY6	6.3A	3	4	61	4	067X	5 2
	6.3A	3	4	31	4	1RX	6 2
3CF6	6.3A	3	4R	65	4	16Y	5 2
3CS6	6.3A	3	4	49	4	067RT	5 2
	6.3A	3	4	15	4	1RT	6 2
5AQ5	7.5A	3	14	34	4	067Y	5 2
	7.5A	3	47	34	4	16Y	5 2
5AT8	7.5A	4	5R	46	5	079X	6 3
	7.5A	4	5R	60	5	1W	2 3
5B8	7.5A	4	5R	38	5	68X	9 7
	7.5A	4	57	21	5	2U	3 1
5U8	7.5A	4	58R	76	5	23Y	6 7
	7.5A	4	57R	19	5	9X	1 8
6AX7	6.3	4	59R	—	5	Shorts Only	3-8
	6.3A	9	R	23	5	2T	1
	6.3A	9	R	23	5	7T	6
6BZ6	6.3	3	4R	45	4	16X	5 2
6CG7	12.6A	4	35	23	5	7X	6 8
	12.6A	4	58	23	5	2X	1 3
6SN7GTB	12.6A	7	68	39	8	1U	2 3
	12.6A	7	38	39	8	4U	5 6
12B4A	12.6	4	357	13	5	Shorts Only	1
	7.5A	3	7	13	5	2Y	9
	7.5A	3	2	13	5	7Y	9
12BH7A	12.6	4	59	15	5	Shorts Only	3-8
	7.5A	9	8	15	5	2X	1
	7.5A	9	3	15	5	7X	6
12BK5	19.0B	4	57	19	5	38Y	1 6
	19.0B	4	35	19	5	78Y	1 6
6350	12.6	4	259	38	5	8W	6 7
	12.6	4	579	38	5	3W	1 2

SYLVANIA MODEL 219/220

TUBE TYPE	A	B	C	D	E	F	GK
2AF4	2.5	3	467	13	4	2V	1 5
	2.5	3	124	13	4	6V	7 5
3BY6	3.3	3	4	61	4	067Y	5 2
	3.3	3	4	20	4	1SY	6 2
3CS6	3.3	3	4	49	4	067SU	5 2
	3.3	3	4	16	4	1SU	6 2
5AQ5	5.0	3	14	33	4	067Z	5 2
	5.0	3	47	33	4	16Z	5 2
5AT8	5.0	4	5S	38	5	079Y	6 3
	5.0	4	5S	57	5	1X	2 3
5B8	5.0	4	5S	38	5	68Y	9 7
	5.0	4	57	25	5	2V	3 1
6AX7	6.3	4	589S	22	5	2U	1 3
	6.3	4	359S	22	5	7U	6 8
6CG7	6.3	4	35	24	5	7Y	6 8
	6.3	4	58	24	5	2Y	1 3
6SN7GTB	6.3	7	68	39	8	1V	2 3
	6.3	7	38	39	8	4V	5 6
12B4A	12.6	4	357	12	5	2Z	9 1
	12.6	4	235	12	5	7Z	9 1
12BK5	12.6	4	57	19	5	38Z	1 6
	12.6	4	35	19	5	78Z	1 6

SYLVANIA MODEL 139/140

TUBE TYPE	A	B	C	D	E	F	G	TEST
2AF4	2.5	0	46	0	2	2	21	X
	2.5	0	32	0	3	6	21	X
3BY6	3.3	0	—	0	4	46	69	W
	3.3	0	—	0	5	3	37	U
3CS6	3.3	0	—	0	4	46	19	V
	3.3	0	—	0	5	3	38	U
5AQ5	5.0	0	4	0	4	36	40	Y
5AT8	5.0	0	—	0	3	579	35	W
	5.0	0	—	0	2	2	41	U
5B8	5.0	0	2	0	4	49	93	W
	5.0	0	7	0	5	3	39	U
6AX7	6.3	0	5	0	1	3	16	V
	6.3	0	5	0	3	7	16	V
6CG7	6.3	0	9	0	1	3	32	W
	6.3	0	6	0	3	7	32	W
6SN7GTB	6.3	0	678	1	7	5	36	W
	6.3	0	278	1	3	3	36	W
12B4A	12.6	0	67	0	4	3	20	Y
	12.6	0	36	0	4	7	20	Y
12BK5	12.6	0	7	0	1	69	28	Y
	12.6	0	6	0	1	79	28	Y

IF YOU have any of the tube testers listed on this page, use the information given here to bring it up to date. The tube types listed are new ones which will make or have already made their appearance in radio or TV sets. The settings given here will allow you to test these new tubes on any of the models listed.

Other tube testers will be covered next month. Sylvania, Electronic Instrument Co., Inc. (Eico), and Electronic Measurements Corp. (EMC) make new roll charts available regularly. These may be obtained from them for a nominal fee and are very simple to install in place of the old one in the tester. —50—

EICO MODEL 625

3A3	55	3.3	1	10	2	5AW4	23	5.0	1	6	2
	(May show short on 1, 3, 5, 7, 8)						20	5.0	1	4	2
	Good = 200					6AW8	24	6.3	2	7,8,9	4,6
5AS8	24	5.0	2	1,2,9	3,5,7		24	6.3	2	2,3	1,4
	26	5.0	2	6	5,8	6BZ6	25	6.3	2	1,5,6	2,3,7

ELECTRONIC MEASUREMENTS CORP. MODEL 206

TUBE TYPE	F	S	G	P	BIAS	SENSI-TIVITY	AVER. Gm.	NOTA-TIONS
s)2AF4	2	3	—	1-2-6-7	—	14		rect. glows at 1, 2, 4, 6, 7
s)3BA6	3.3	3	1	5-6	13	12	4200	
s)3BZ6	3.3	3	1	6	19	20	2500	
s)5AV8	5	4	2	3	20	15	3000	
s)5AV8	5	4	6	8-9	11	11	5000	
s)5V6GT	5	2-4	5	3	20	17	3000	
s)5X8	5	4	2	3	11	14	3500	
s)5X8	5	4	7	8-9	11	14	3500	
s)6AS8	6.3	4	—	6	—	50		diode
s)6AS8	6.3	4	2	1-9	10	13	4000	
s)6AU8	6.3	4	2	3	10	14	3500	
s)6AU8	6.3	4	7	8-9	10	10	5000	
s)6AV5-GA	6.3	2-8	1	6	55	29	1500	
s)6BA8	6.3	4	2	3	18	15	3100	
s)6BA8	6.3	4	7	8	11	10	5500	
s)6BC7	6.3	4	—	8	—	50		diode
s)6BC7	6.3	4	—	6	—	50		diode
s)6BC7	6.3	4	—	2	—	50		diode
s)6BC8	6.3	4	2	1	15	15	3300	
s)6BC8	6.3	4	7	6	15	15	3300	
s)6BZ6	6.3	3	1	6	19	20	2500	
s)6CG7	6.3	4	2	1	15	20	2500	
s)6CG7	6.3	4	7	6	15	20	2500	
s)6CN7	3.3	9	7	8	5	22	2000	glows at 4, 5
s)6CN7	3.3	9	—	1	—	50		diode
s)6CN7	3.3	9	—	2	—	50		diode
s)6DE6	6.3	3	1	5-6	12	11	5000	
7E5	6.3	2	1-5	3-7	11	20	2500	glows at 1, 3, 5, 6, 8
12AV5-GA	12.6	2-8	1	5	55	29	1500	
s)12BR7	6.3	9	2	1	8	17	3000	glows at 4, 5
s)12BR7	6.3	9	—	6	—	50		diode
s)12BR7	6.3	9	—	7	—	50		diode
s)25CA5	25	3	2-5	6-7	25	9	6000	glows at 2, 4
25CD6	25	2	5	8-10	65	9	6000	
25AX4	25	7	—	5	—	15		rect.
1201	6.3	2	1-5	3-7	11	20	2500	glows at 1, 3, 5, 6, 8

ELECTRONIC MEASUREMENTS CORP. MODELS 204-205-207-209

TUBE TYPE	HI-LO	FIL.	F	P	SHUNT	NOTATIONS
OD3	HI	1	—	5	0	cold K. glows at 3, 7 if tube is good it will glow. bat. type, glows at 1, 5
1AF4	HI	1	7	2-3-6	45	glows at 1, 2, 4, 6, 7
2AF4	LO	3	3	1-2-6-7	30	glows at 2, 7
2E24	LO	4	1-4-6	3-5-10	42	glows at 3, 4
2E30	LO	4	7	1-5-6	45	
5AN8	HI	3	4	1-2	16	
5AN7	HI	3	4	6-7-8	14	
6BA8	HI	4	4	2-3	16	
6BA8	HI	4	4	7-8	14	
6CN7	LO	4	9	7-8	52	glows at 4, 5
6CN7	LO	4	9	1	50	diode
6CN7	LO	4	9	2	50	diode
6DE6	HI	4	3	1-5-6	14	
12BR7	HI	4	9	1-2	14	glows at 4, 5
12BR7	HI	4	9	6	17	
12BR7	HI	4	9	7	17	
5654	HI	4	3	1-5-6	15	glows at 2, 4, 7
5670	HI	4	1	3-4	15	
5670	HI	4	1	6-7	15	
6265	HI	4	3	1-5-6	15	

Turntables

Versus

Record Changers

ALL a turntable has to do is to turn the disc at constant speed so the pickup will give reproduction free from any speed fluctuation. While we're about it, it is a nice idea to add some mechanism to the drive to make the disc changing automatic, so we don't have to keep getting out of our armchair to put another disc on. At first sight, the selecting of a turntable or record changer appears to be just as simple as that.

However, it is that little requirement of "constant speed" we mentioned that causes all the trouble. It sounds simple enough, but it is not so easy to achieve in practice. In fact, turntable and record changer manufacturers have spent fortunes on developing systems as good as they are today for this purpose.

In this effort for better performance, three principal types of turntable drive have been used, and, naturally, each manufacturer claims the one he is using gives the best results. To be able to assess these claims, the prospective buyer needs to know how these methods attack the problem and what weaknesses to look for, which we shall describe in the following presentation. In particular one needs to know the variety of causes of the speed fluctuations designated wow and flutter, and how to identify them.

Then, of course, comes the important question, "turntable or record changer?", but we have postponed the answer to this until later in the article for reasons that will appear as we proceed.

Wow and Flutter

Electrical engineering theory tells us that certain types of electric motors are inherently constant speed. This statement means they will give a constant indication on a tachometer, which merely means that if the speed for which the motor is designed is 1200 rpm, every revolution will be performed in 1/1200 of a minute, or 1/20

of a second. This assures us that the time taken for each rotation of the motor will be consistent. But this is not enough for our requirement, it does not provide us with any guarantee that the speed of rotation throughout each individual revolution is really constant.

The rotational torque developed by the motor at any instant is dependent upon the electromagnetic structure of the motor. To make an efficient motor it is necessary to design the armature, or rotating part, with slots or holes in the laminations, into which are inserted windings or copper bars. The fixed part consists of a succession of pole pieces, designated according to their number as either a two-pole or four-pole motor. As these slots or holes in the rotating armature pass under the pole pieces, there will be a slight variation in the magnetic pull provided by the motor, according to whether the part of the armature going into the influence of a stationary pole is solid core or a slot containing a winding or copper bar.

This means that the driving force cannot be constant as the motor rotates. It will probably fluctuate fifteen or twenty times during the rotation of the armature. This effect can be minimized by very careful design of the motor, such as making the slots containing the windings or copper shorting bars on the skew, so they don't run under the area of the fixed pole simultaneously but progressively. But, however carefully the motor is made, it is impossible to make its torque absolutely uniform throughout rotation and there will be some degree of fluctuation.

This relatively high speed fluctuation, occurring several times per revolution of the motor and usually an even greater number of times per revolution of the turntable, is called "flutter", from the effect on the reproduced sound. Flutter has a speed fluctuation as high and often higher than normal

It depends on what sort of performance you are seeking—author presents the "pros" and "cons" of both units—final decision is all yours.

By N. H. CROWHURST

vibrato or tremolo fluctuations in music.

Unfortunately, our ears are extremely sensitive to pitch fluctuation in reproduced music. This is particularly noticeable on tones that are supposed to be of constant pitch. With organ music, which has a built-in vibrato, and much orchestral music, which also has some degree of vibrato, the effect of very slight speed fluctuation may not be noticed. But on a piano, in which the sustained tone following the initial strike is originally of extremely constant pitch, any fluctuation at all is quite noticeable on the reproduction. This is why it is difficult to reproduce piano music effectively from records.

Not only should the drive motor use an extremely good design from the viewpoint of maintaining constant speed, and providing freedom from speed fluctuation during each revolu-

tion, but the method of drive from the motor to the turntable should be designed with a view to further reducing the residual fluctuation present in the motor.

Besides the fluctuations already mentioned, due to variation in driving force throughout the revolution, there is also the possibility that frictional drag will vary throughout the revolution. This gives rise to a slower fluctuation, called "wow." The rate of this fluctuation is always much slower than any vibrato or tremolo effect. This will often occur if there is any out-of-roundness on the drive shaft or in any of the bearings. For this reason extreme precision in machining is required for both shaft and bearings of all parts connected with the drive mechanism of a turntable or record changer.

Some might wonder why ball-bearings are not more widely used for this purpose. It is true that ball-bearings provide very low friction, especially under stress or thrust. But it is extremely difficult to produce ball-bearings of guaranteed constant friction throughout their rotation. If they possess constant friction when brand new, they may lose it with even the slightest degree of wear. For this reason, the common type journal bearing, manufactured with extreme precision, is to be preferred for this kind of drive.

Not only must all shafts and bearings be perfectly round, so there is no non-uniformity of friction due to this cause, but the shafts must be machined extremely true so there is no fluctuation due to the shafts exerting any twist action during rotation because it is ever so slightly bent. These points are mentioned here because they will illustrate the need for rugged and precision construction in all components in the drive mechanism of a turntable or record changer.

In addition to this the drive must provide filtering of a mechanical nature between the motor torque and the turntable so as to reduce the residual fluctuations to an absolute minimum

at the turntable itself. Three principal forms of drive are used.

The first one developed, which was popular for many years, is the helical gear drive. Attached to the motor shaft is a small metal worm gear, which engages a gear wheel whose teeth are usually fiber, or in more recent design, nylon or some better plastic material, attached to the turntable shaft. This arrangement is shown in Fig. 1. Any small fluctuation in speed during the rotation of the motor shaft can be taken up either in the resilience of the end-thrust bearings of the motor shaft or, to a greater extent, in the resilience of the fiber or plastic material of the gear on the turntable shaft. In the earlier designs of this type a mechanical governor was provided on the motor shaft and the motor was not designed for constant speed, but was of the type that would run quite a bit faster than the desired drive speed if it were not for the governor attached to it. The governor then provided a frictional drag that held the speed down to the desired value, controlled by the point at which the rotating centrifugal weights brought the friction disc into contact with the friction pad.

This device is an alternative way of absorbing torque fluctuations, but it is also another feature that could possibly bring in speed fluctuation, because the frictional drag must be extremely constant during a rotation, which calls for accurate machining of the governor parts as well as careful balancing. An improved design of this type is still used by some manufacturers. Some of the more modern drives employ a similar helical gear but with a constant speed motor and some form of variable gear ratio to accommodate three-speed arrangements instead of the old governor arrangement.

The other two types of drive both couple to the rim of the turntable instead of driving the shaft. It should be noticed that the rotating turntable driven from the shaft constitutes a mechanical resonant system, rather like the rotating pendulum used in 400-day clocks. This means that, unless some precautions are taken, this form of drive is susceptible to a low-frequency speed fluctuation, not more than once per second, probably much slower, at the resonant frequency of the turntable with the resilience of its drive.

In the earlier days, before the advent of pickups which require such small stylus forces as modern pickups do, the friction of the needle on the disc was sufficient to provide considerable damping for this kind of resonance. This fact could be confirmed by noting the pattern on a stroboscope disc placed over the record to check speed. With most of the earlier type turntables, when the record was rotating without the pickup on it, the pattern would be moving forward slightly if the speed was correctly set so the pattern would be stationary with the pickup on the record.

But with modern low stylus force

pickups the friction between the stylus and the disc is so low that it does not contribute appreciable damping to any such resonance. So the design of the drive must be arranged to eliminate this effect. If you are considering a turntable using this kind of drive, try playing some music with constant tones such as piano and listen carefully for a low speed wow.

The rim drives stand a better *inherent* chance for avoiding this trouble because they drive directly on the mass "end" of the turntable, which is at the periphery rather than at the center. One type uses an idler pulley to transmit the torque from the motor shaft to the turntable while the other uses a belt. In the first case the idler pulley, which is made of rubber or similar resilient material, provides the mechanical filter to absorb slight speed fluctuations during the rotation of a motor shaft. In the case of the belt drive, the motor is resiliently mounted so as to maintain constant tension on the belt and the resiliency of the motor mounting, together with the slight resiliency in the belt material, serves as a mechanical filter in the transmission of drive from the motor shaft to the turntable rim. These forms of drive are illustrated in Figs. 2 and 3.

Multiple Speed Arrangements

In the days of the turntable drive that used a mechanical governor mentioned a little earlier, the problem was somewhat simpler because only one turntable speed was in popular use at the time, 78 rpm. But nowadays, with the advent of LP records and the new 45 rpm size, we have the problem of providing three different turntable speeds, and this hardly falls within the practical working range of a single governor. This is a further reason for the general changeover to a constant-speed type of motor for this purpose.

For transmitting drive from a constant-speed motor so as to rotate the turntable at one of the three required turntable speeds, two methods are adopted. In one, different shaft diameters are used on the motor to provide the different linear speeds at the peripheral drive. In the case of the idler pulley, the idler pulley engages whichever shaft diameter is correct for the speed the turntable is required to rotate. In the case of the belt drive, different pulley sizes engage the belt to give the required speed corresponding to each rpm.

The other method uses an arrangement that basically provides continuously variable speed by using a conical driving member instead of the stepped pulley. This is illustrated in Fig. 4. To provide the speed desired, pulleys are engaged at the diameters on the conical arrangement that correspond to the speed required. An advantage of this method is that slight adjustment can be made for each individual turntable speed to get the precise value required.

Another variation of this uses a single idler pulley and moves it to three

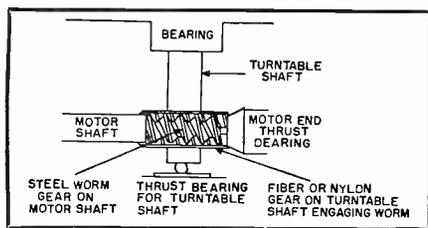
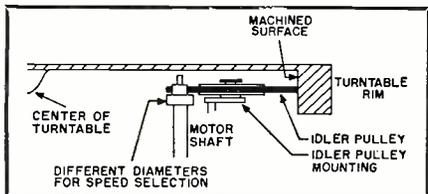


Fig. 1. Arrangement of worm and gear drive used on earlier turntable drives. Improved versions of this pattern are used now.

Fig. 2. Cross-section through the idler pulley drive on the inside of the turntable rim.



specific positions along the driving cone. The positions are located by indents on the continuously variable speed control.

There are, it is true, some applications where a continuously variable speed control is desirable. A particular example of this is where it is desired to play pre-tuned instruments, such as a piano or organ, in combination with a recorded program. In this case the pitch of the recorded program must be adjusted so as to come in tune with the piano or organ. The only way to do this is to adjust the speed of the turntable slightly until the pitch is correct.

Probably most of our readers will not be interested in this particular application and for them a constant speed that gives the correct speed (to within a small fraction) by three position settings will be quite adequate.

In all these kinds of drives, one item at least may be regarded as expendable and requiring replacement after a period of time. In the case of the drive using the idler pulley between the motor shaft and the rim, the idler pulley will wear down and require replacement in the course of time. In the case of the belt drive, the belt undergoing a certain friction will wear down and require replacement if the quality of the drive is to be maintained.

It is feared that, in the case of the conical drive, the fact that the idler pulley engages it at only three particular points of its continuous range, will cause it to tend to wear in slight grooves at these points, and hence the conical drive piece will also require replacement at intervals as well as the idler pulley part of the mechanism. The stepped drive using flat sections of shaft instead of conical sections is less likely to wear appreciably and will therefore last longer, whereas the other parts of the mechanism are likely to need replacement. So it is seen that choice between a continuously variable speed drive with some method for selecting the desired running speeds, or three fixed speeds, depends upon the applications you have in mind.

If you only require to play back records at fixed speeds and are not likely to want fine adjustment to an exact speed the fixed speed drive is probably the best solution. Whereas, if you are likely to need careful adjustment to an exact speed, so as to get two different sources of program exactly in pitch together, the variable speed will be necessary.

Rumble

Another important thing about turntable drives is the possibility of producing rumble. This is due to vibration from the motor being picked up along with program material from the disc. It is different from the effects previously discussed in that motor noise, or a very low-frequency rumble is heard as a separate entity from the program with which it is heard. Wow and flutter are only audible as an effect on the program material, and they usually

show up only on particular types of program. Rumble is heard best in the absence of program, when the pickup is riding a silent groove.

The only successful way to eliminate or minimize it is to prevent motor vibration from being transmitted either to the turntable or the tone arm. The motor should be of vibration-free construction. But even a motor that is nominally vibration-free will have a slight residual vibration. For this reason it should be mounted so that this residue is filtered out, and not transmitted to the motorboard, by means of shock mounting.

So much for the question of what kind of drive. Now for the big question.

Turntable or Record Changer?

For many people this is the first decision to make, but in this article we started with a discussion of different kinds of drive, because this is the important feature as far as performance is concerned. Having appreciated the problems involved in getting a good drive, we are better able to assess the relative merits of a turntable and record changer. Viewed practically, a record changer is for quite a different purpose than a turntable.

A turntable comes in the professional class and is designed to give the best possible reproduction from the disc and also to provide maximum flexibility. With a turntable it is possible to pick a passage from the middle of a disc and lift the tone arm off when the desired passage has been played. With most record changers this is not easily accomplished.

On the other hand, the record changer is designed to present a continuous program without the necessity of leaving one's armchair to put the next disc on. For this purpose, quality of performance is, almost of necessity, a consideration second to pleasure and comfort. A record changer can interfere with the performance of the equipment in two ways: (a) as a turntable, and (b) as a tone arm.

Because the motor has to drive a whole lot of other things at certain periods in the performance in order to get the next disc in position, there is the possibility that this extraneous drive may cause problems in creating constant speed during the playing, although this mechanism is not then in use. There must be some kind of clutch arrangement to couple the motor to the changing mechanism when the time comes to change from one disc to the next. If this clutch is in any way riding on the motor shaft while it is idling, it adds a further possibility of irregular friction, which can cause undesired speed fluctuations during the playing of the record.

For this reason, find out whether the clutch mechanism to operate the changer comes completely free of the drive or whether it is riding in a position which could possibly exert some friction.

Any record changer has to "know"

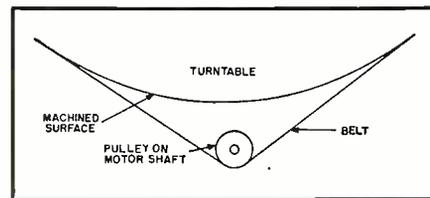


Fig. 3. Arrangement of belt drive on the outside of the turntable rim. See Fig. 2.

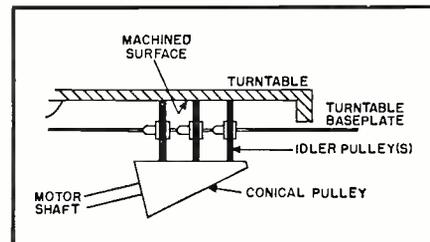


Fig. 4. Use of conical member to provide basic continuously-variable speed drive. In some models based on this principle, three idler pulleys are used, only one being engaged in its present position at a time. In other models there is only one pulley, which can be moved to the alternative positions shown. In another variant, the drive is not direct to the underside of turntable but to intermediate member.

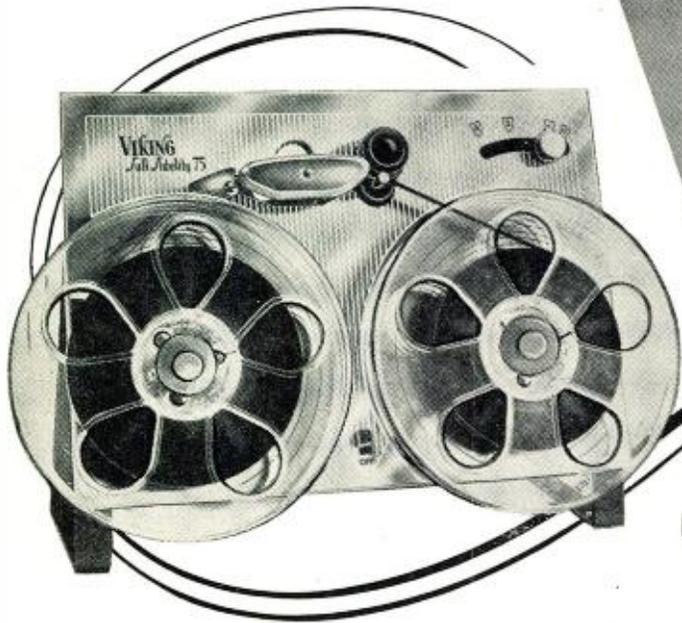
when the record being played comes to an end, so as to initiate the mechanism to change for the next one. This is achieved by detecting the rapid movement occasioned by the pickup when it reaches the run-in groove at the end of the disc. This rapid movement uses some trigger arrangement to initiate the change mechanism. The gradual move-in of the continuous program groove is slow enough not to initiate this mechanism, but one point to watch is whether the mechanism attached to the arm for detecting this movement creates any appreciable drag or other action on the arm, which interferes with the performance of the tone arm as an instrument for carrying the pickup.

The device for detecting when the end of the disc is reached inevitably applies a slight drag to the tone arm, which means that, to keep the stylus in the groove and maintain correct tracking, a larger stylus force is necessary than can be achieved with a simple turntable mechanism. Also a more rugged type of pickup should be used than one for high quality reproduction with a straight turntable, so as to avoid the distortion that can occur when a delicate pickup has a slight side thrust applied to the arm.

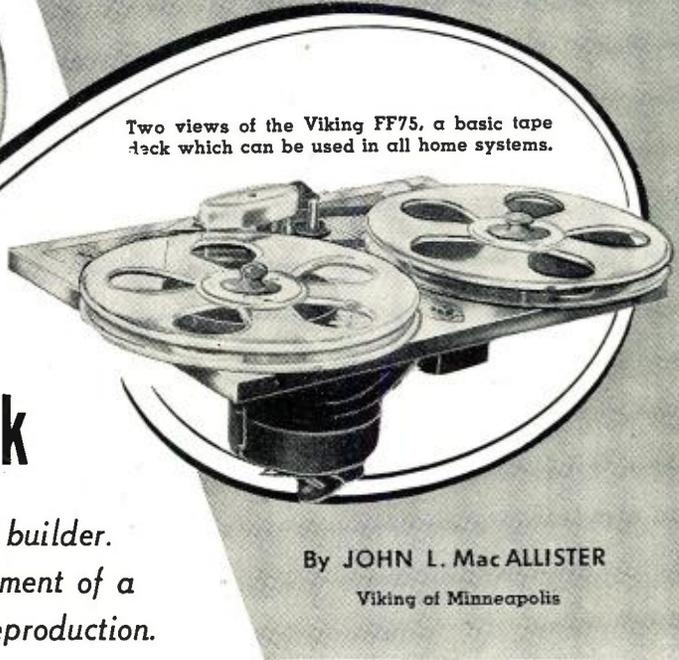
Some record changer models provide a manual position in which the operation of the record changer is put out of action and the pickup can be lifted by hand and put on the record in any desired position. For such equipment to have the advantages of a plain turntable make sure that the mechanical switch, changing over to manual operation, completely disengages all the changer mechanism both from the motor drive and also from the pickup arm, otherwise it is impossible for the rec-

(Continued on page 158)

A Tape System You Can Build



Two views of the Viking FF75, a basic tape deck which can be used in all home systems.



By JOHN L. Mac ALLISTER
Viking of Minneapolis

A Compatible Tape Deck

Part 1. A new tape deck for the custom hi-fi builder. It is a basic building block in the development of a record-playback assembly, including stereo reproduction.

IN A MATTER of years tape equipment and, specifically, "tape recorders" have graduated from the realm of mystery into the category of "assemble-it-yourself" components with which the audiophile feels completely at home.

Tape decks and their associated electronic components are now available from many manufacturers. The audiophile can purchase one of these basic decks and add the necessary preamplifiers and recording amplifiers *ad lib* or hook the deck up to the preamps and amplifiers he already has in operation.

One of the newest of these component tape decks is the Viking FF75, which retails at \$59.95. It is basically a tape transport for playback (both full- and half-track) only and can be used with most present-day high-fidelity preamps and power amplifiers without any additional accessory equipment being required.

Many of the high-fidelity preamps now being marketed provide a preamplifier input equalized expressly for tape. Any of these units may be used with this tape deck. Similarly, some amplifiers provide a means of adjusting roll-off and attenuation to provide almost any desired characteristic. These may be adjusted to provide the equalization characteristic indicated in Fig. 1. Preamplifiers with fixed equalization to compensate for the various disc recording characteristics require modification for use with NARTB recorded tapes.

For the user who does not have a preamplifier, the company's PB60 unit is available. It is specifically designed to be used for this purpose and provides exact equalization for NARTB recorded tapes. Its output can be introduced at the input of a power amplifier.

Considering the cost of this new tape deck, it is obvious that it was not intended to compete with the more expensive units available today. It does, however, provide many of the features of better quality units. It has negligible flutter and wow; provides a frequency response of 40 to 14,000 cps (± 3 db) at a tape speed of 7.5 ips; and is easily adaptable to many varied modes of operation.

It can be used for monaural playback, monaural record and playback, stereophonic playback, and stereophonic record and playback by simply adding the necessary heads and the required erase and recording bias. In this respect

the deck may be considered to be "compatible."

As was pointed out previously, this series of articles will cover in detail the design and construction of the various electronic units required to

convert this tape deck to its many possible modes of operation. In addition, the mechanical problems of installing the additional heads, for these various operations, will be discussed in future articles.

"Dynamu" heads, manufactured by the Maico Company, a Minneapolis concern, are used exclusively on all of the FF75 series decks. This head, one of the best in the industry, is characterized by a very short flux gap. This short gap, .00015" (.15 mil), provides for full playback response at frequencies to 14,000 cps (± 3 db) at a tape speed of 7.5 ips. The electrical specifications for the record-playback and erase heads are given in Table 1.

The Tape Transport

In the interest of economy and for the purpose of providing maximum over-all rigidity of the assembly, the motor-

EDITOR'S NOTE: In view of the many requests we have had from our readers for details on a home-assembled tape recorder, we are presenting herewith details on a tape transport (playback only) which has recently been put on the market. We will present, in subsequent issues, complete details on various accessories such as a playback and record preamp, a bias oscillator, and methods of using this basic mechanism for stereophonic recording and playback. We do not believe it advisable that the basic tape transport be home built. It is an intricate mechanical device whose critical tolerances can only be achieved in a commercial unit. As pointed out in the article, this unit can be used as is for playing full- or half-track recorded tapes. The additional units to convert to recording and stereophonic can all be home-built. Additional heads will, of course, be required to convert this unit for such operation. It is not the intention of your editors to restrict the home builder solely to this transport. Actually, any tape deck can be used. If recording and playback heads other than the "Dynamu" units are used, the equalization networks of the equipment must be changed accordingly.

board on which the deck is mounted consists of a single stamping of 16 gauge steel. The thickness of the steel prevents local distortion which would affect performance. The deck itself measures only 12½" x 8½" and requires little mounting or shelf space. The 7" tape reels extend approximately an inch beyond the sides and bottom of the deck.

The motor is ordinarily a very critical component of a tape drive system. On this item alone a manufacturer can spend almost as much as he chooses. The ultimate in linearity is the hysteresis synchronous motor found in transports designed for professional use. Such a motor is desirable in that the output is completely linear, *i.e.*, it suffers no interpole variations in rotor speed as does an ordinary induction motor. Also its speed is absolutely constant when operating within its load limits. However, the cost of such a motor alone would make the compatible deck much too rich for our average man's high-fidelity budget. So, like other manufacturers of popularly priced decks, we must compromise on the universally used four-pole induction motor—proven in turntables and tape transports for many years—but characterized, unfortunately, by certain inherent problems of flutter and speed regulation.

At this point, however, *Viking* departs from heretofore accepted practice. The motor is mounted on a separate motor platform and this entire assembly is floated on resilient, vibration-absorbing, rubber shock-mounts. This is the first important point of departure. The second is in the capstan drive itself. Instead of a roller or conventional belt drive, the capstan is driven through a slender, resilient synthetic belt, leaving the motor free to move within the restricted orbit of the shock-mounts. Actually, any other type of drive would be difficult under this circumstance; however, the advantage is two-fold. The resilience of the belt in this case is matched to the inertia constant of a very heavy capstan flywheel (approximately one and a half pounds). The effect is to provide a filter for smoothing out the interpole variations in motor speed, the most common source of flutter. It is equally effective in the elimination of irregularities due to motor or fan unbalance.

The capstan, as in any tape equipment, is a very critical component. The capstan on the *Viking* FF75 is ground to a tolerance of 1/10,000th of an inch. An eccentricity of as little as 5/10,000th of an inch here would result in noticeable flutter. The same critical limitations apply to the capstan bearings and to the capstan roller.

Long Term Accuracy

One disadvantage of the induction motor that is not easily eliminated is that of long-term accuracy of tape speed. Through rather careful check and selection of motors, where necessary, the accuracy in this respect is held within 2 per-cent or about 1.2 seconds per minute. While not accurate enough for cueing or synchronizing effectively, this is not sufficient to appreciably affect pitch. It should be pointed out that the error, whatever it may be, is a positive or negative error consistent for a given deck.

Shift Mechanism

The shift mechanism involves only a few moving parts—all flat steel stampings, reinforced when necessary. In the

Table 1. Specifications on the "Dynamu" heads used with deck.

RECORD-PLAYBACK HEAD	
Track width090"
Gap length00015"
(effective gap can be considered as .0002")	
Impedance	2000 ohms @ 1000 cps
Frequency response	30 to 15,000 cps @ 7.5 ips
Head output (average recorded music tape)	2.5 mv.
Recommended preamplifier gain	55 db
Driving current (recording)	0.06 ma. @ 6000 cps
Recommended bias current (recording)	0.6 ma.
ERASE HEAD	
Track width125"
Gap length008"
Inductance	30 mhy.
Recommended erase bias frequency	60 to 70 kc.
Recommended erase current	12 to 14 ma.

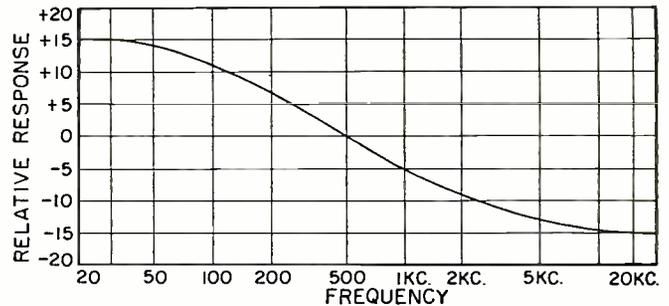


Fig. 1. Playback equalization required for the FF75 tape deck.

center position, both the feed reel and takeup reel brakes are engaged and the capstan pressure roller is released. The capstan continues to turn but the tape does not feed.

In the "forward" position, the supply reel brake is permitted to drag slightly, the takeup reel brake is released, and the pressure roller engages the capstan, causing the tape to feed. The takeup reel is belt-driven from the capstan flywheel but provides sufficient slippage so that only a moderate and uniform tension is exerted on the tape. In the "rewind" position, the supply reel is shifted a few thousandths of an inch engaging a drive ring on the motor pulley, providing a brisk rewind. Actual rewind time is 1¼ minutes for a standard 7" reel.

The "fast forward" mode on the FF75 deck is a comparatively recent development. Actually this mode, which has been characterized as "gentle fast forward," is not really a "fast forward" in the general sense of the word. It provides for tape transport at four to five times normal speed yet offers maximum protection for the new thin-base recording tapes currently enjoying widespread popularity.

In order to adapt the basic tape deck to the other modes of operation mentioned earlier, the deck is modified merely by the addition of the appropriate head or heads and bracket components. The heads are supplied complete with output connector jacks and can be installed with simple hand tools. Only minor disassembly of the deck is involved and adjustments entail nothing more, in most instances, than careful azimuth alignment.

Each of the various modes of operation will be covered completely in future articles. Next month the use of the compatible deck for playback of recorded tapes will be described along with full details for building a suitable companion amplifier and information on the computation of equalizing networks for typical preamplifier input stages.

A subsequent issue will cover adaptation of the compatible deck to recording as well as playback applications, with construction details for an integrated erase-bias oscillator and NARTB-equalized recording amplifier and playback preamp. This will give particular consideration to the design requirements for extended range (40 to 12,000 cps) operation.

A later issue will cover stereo playback and recording configurations and in-line vs staggered head assemblies.

The over-all performance of the deck is given in Table 2. (To be continued)

Table 2. Over-all performance of the Viking FF75 tape deck.

Frequency response	40 to 14,000 cps ± 3 db. 7½ ips 40 to 7000 cps at 3¾ ips
Signal-to-noise ratio	45 db or better (This characteristic can be adversely affected by location of transformers or other sources of strong magnetic fields within 12 inches of the head or heads)
Flutter (average)	0.2 per-cent or less
Total harmonic distortion	Less than 1.0 per-cent with NARTB recorded tape and NARTB compensated preamplifier
Tape speed	7½ ips (3¾ ips available by changing belt to smaller groove on motor pulley)
Maximum reel size	7"



TAPE RECORDING

Equalization

By HERMAN BURSTEIN

Part 6. In this, the concluding article of the series, the author continues his discussion of equalization covering (1) maximum permissible record boost, (2) optimum magnetic induction, and (3) need for standardizing equalization.

SO FAR in this series, we have covered the various components comprising a tape recording system, the tape, record and playback losses, the effects of bias current, and finally last month and this, a discussion of various equalization problems.

5. *Maximum Permissible Record Boost:* As discussed last month, Curves 3 and 4 in Fig. 3 show the amount of treble and bass boost employed in an actual tape recorder operating at 15 ips. Given the record losses of Curve 1, the magnetic induction required by the NARTB standard determines the amount of boost needed.

However, it would be more correct to state that the NARTB recorded induction is determined by the permissible amount of record boost. In other words, the standard was formulated with a careful eye to the recording level that can be used at various frequencies without exceeding distortion specifications, at the same time maintaining a high signal-to-noise ratio.

The factors involved in determining maximum permissible record boost are represented in *approximate* fashion in Fig. 2. It should be clearly understood that Fig. 2 is not definitive. While based essentially upon published studies, it is also founded in part on projections and estimates. Although the principles underlying Fig. 2 are

clear, the absolute values are less clear and await further research.

Curve 1 shows, in relative terms, the maximum permissible record current that may be applied to the record head at 7.5 ips so as to produce the same amount of distortion (harmonic or intermodulation) at all frequencies. This curve is based on harmonic distortion data for frequencies to 7.5 kc. The dotted portion is a projection for higher frequencies. Although harmonic distortion above 7.5 kc. appears non-existent in a recorder going only to 15 kc., it would seem that above 7.5 kc. there would still be intermodulation distortion among such frequencies and between them and lower frequencies. Permissible record current varies with wavelength, so that at 15 ips each point on this curve would be moved to the right one octave. For example, whereas Fig. 2 shows a permissible increase of 5 db in record current at 10 kc., an increase of 5 db would take place at 20 kc. for a 15 ips recorder.

Curve 2 is an approximation of the peak energy at each frequency relative to average energy for the entire audio spectrum. It is based on sound energy at a distance of 15 feet from a 75-piece orchestra playing a "typical" selection. The curve is a free-hand fitting to tabular figures in Harry F. Olson's "Musical Engineering," 1952 edition,

page 206. As Olson states, "It is the peak pressure that must be considered in the design of sound-reproducing equipment. The equipment must be capable of handling the peak power without overloading or distorting."

Curve 2 shows that peak energies occur in the general neighborhood of 400 cps. Olson's data reveals that this is also true for most of the other sources of audio energy usually reproduced on sound systems, such as the human voice, a small orchestra, the piano, and various solo instruments. Although the distributions of energy over the audio spectrum for these other sources differ appreciably from Curve 2, nevertheless the data for the 75-piece orchestra pretty well encompasses the extent of the problem at hand. That is, the 75-piece orchestra data gives a good indication of the relative height which peak energies may attain at various frequencies, taking into account various sources of audio energy.

Curve 3 represents the maximum amount of boost that could be applied to program material so as to attain the same amount of distortion at all frequencies. It is derived by adding the absolute values of Curve 2 to Curve 1. In other words, if a boost having the shape of Curve 3 could be introduced in a record preamplifier, the permissible record current of Curve 1 would not be exceeded inasmuch as frequencies below and above 400 cps have substantially reduced peak energies.

It is obviously impractical to incorporate in a preamplifier a record boost characteristic shaped as oddly as Curve 3; moreover, Curve 3 is only an approximation. Curve 4 represents a smoothed practical version of Curve 3, at the same time allowing a 2 db margin of safety at the extremes of the audio spectrum. This margin

makes some allowance, very possibly not enough, for the uncertainties as to the actual nature of Curve 2.

6. *Optimum Magnetic Induction:* Fig. 4 illustrates the principles of determining optimum magnetic induction, that is, the record characteristic which achieves the best balance of high signal-to-noise ratio and low distortion for a stated frequency range. The illustration assumes a speed of 7.5 ips.

The magnetic induction recorded on the tape should meet the following requirements.

A. As much induction should be recorded on the tape as possible, consistent with distortion requirements. The more induction recorded, the higher is the ratio of signal-to-tape-noise and to noise in the playback pre-amplifier.

B. Recorded magnetic induction should not require an amount of record boost that raises distortion above the allowable maximum. In Fig. 4 it is assumed that maximum permissible record boost is that of Curve 4 in Fig. 2.

C. Recorded induction should essentially conform to a curve that eventuates in a treble droop of 6 db-per-octave. It was previously pointed out that part of the treble equalization in a tape recorder occurs in playback as the result of the playback head's 6 db-per-octave increase in output as frequency rises. Thus the slope of the recorded induction characteristic must match that of the playback head.

Curve 1 in Fig. 4 shows the record losses that occur when bias current is set to obtain maximum output at 500 cps.

Curve 2 is an arbitrary curve with a 6 db-per-octave slope. For convenience, the NARTB magnetic induction characteristic, which has this desired slope, is used. Curve 3 defines the treble boost required in the record pre-amplifier to raise Curve 1 to the level of

Curve 2, that is, to achieve the induction represented by Curve 2.

However, part of Curve 3 lies above Curve 4, which is the maximum permissible treble boost in record. Distance Y between the extremities of Curves 3 and 4 represents the maximum amount of excess treble boost. As shown in the illustration Fig. 1, after the 2 per-cent harmonic distortion level has been reached, harmonic distortion increases very rapidly with relatively small increases in record current; it may be assumed intermodulation distortion behaves similarly. Therefore it is important to avoid excess treble boost and the consequent increase in record current.

In order to eliminate excess treble boost, it is necessary to shift Curve 2 in Fig. 4 to the left until distance Y is reduced to zero. This may be done as follows. Point A is marked at a distance Y db below the 15 kc. point of Curve 2. This is where the optimum recorded induction should be at 15 kc. Point B is marked on Curve 2 to the right of point A. Distance X between points A and B shows how much Curve 2 must be shifted to the left. Curve 5 is traced out by measuring distance X to the left at various points on Curve 2. Thus Curve 5 defines optimum recorded induction. It may be noted that in the area of about 400 to 2000 cps response will be slightly above flat (at most 1 db) because Curve 1 (record losses) is higher than Curve 5 in this area.

Curve 6 shows the treble boost required in the record pre-amplifier to produce the optimum recorded induction. It equals Curve 5 minus Curve 1. Note that at 15 kc. the required treble boost coincides with the maximum permissible amount.

If it were necessary at 7.5 ips to produce the recorded induction represented by Curve 2, excess treble boost and consequent distortion could be avoided by lowering the entire recording level 8.5 db, which corresponds to distance

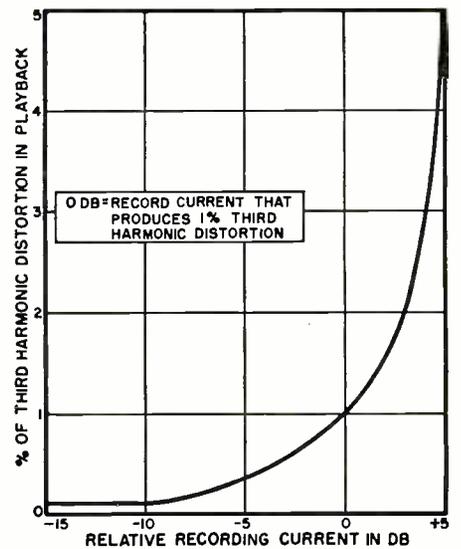


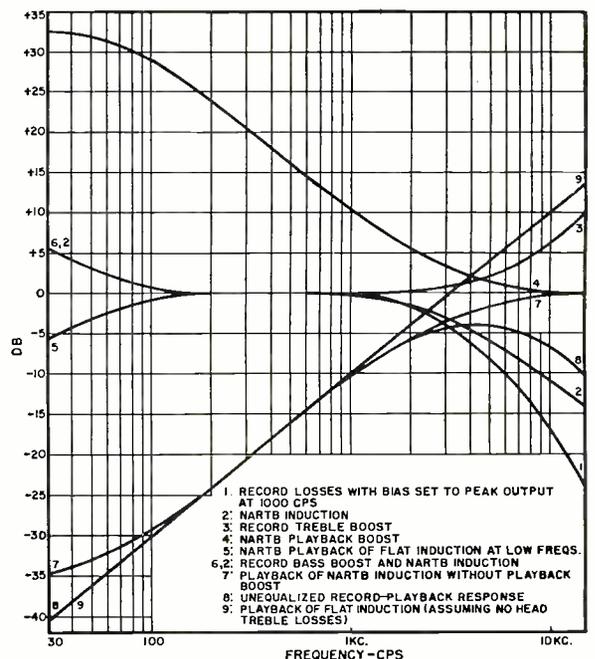
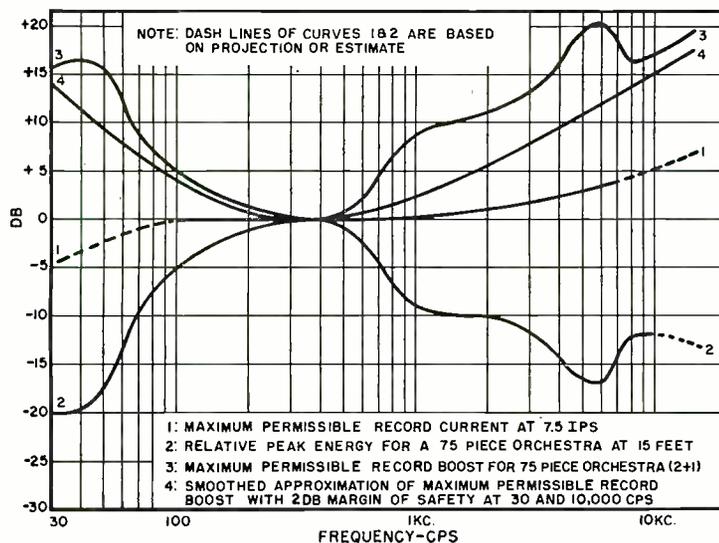
Fig. 1. Relationship of tape distortion to amount of record current at 400 cps. Data courtesy of Minnesota Mining & Mfg. Company. Figures based on the company's #111 tape, using a Brush head and optimum bias current. See article for details.

Y. But for most tape recorders an 8.5 reduction of signal-to-noise ratio over the entire audio range would be quite serious and noticeable. On the other hand, if it is necessary to produce only the magnetic induction represented by Curve 5, the reduction in signal-to-noise ratio is much less than 8.5 db over much of the audio range, although at 15 kc. it is still that amount.

The discussion up to this point has dealt with determination of optimum magnetic induction for the treble range. The procedure is much the same for the bass range and need be examined only briefly. Curve 4' in Fig. 4 represents maximum permissible bass record boost; it is the same as Curve 4 in Fig. 2. It so happens that this curve has virtually the same shape as Curve 2', which is a 6 db per-

Fig. 3. Characteristics of a 15 ips recorder with NARTB equalization, flat from 30 to 15,000 cps.

Fig. 2. Approximation of maximum permissible bass and treble record boost in 7.5 ips tape recorder.



octave characteristic. Thus in transferring 2' to the right, in order to take advantage of permissible record boost, the new curve, 5', representing optimum recorded induction at the bass end, coincides with 4'. Inasmuch as no record losses are assumed at the low end, as shown by Curve 1', Curve 6', which is required bass record boost, also coincides with 4' and 5'.

In conclusion, it should be pointed out that the optimum induction characteristic, Curve 5-5', is based on a set of premises represented by Curve 4-4' which indicates maximum permissible record boost. To the extent that permissible boost differs from Curve 4-4', the optimum induction curve will also differ. Furthermore, to the extent that signal-to-noise ratio can be reduced without this being noticeable, which may be true in some of the better recorders, the recorded induction curve can have a higher turnover point; that is, Curve 5-5' in Fig. 4 can be shifted to the right and at the same time dropped down to the extent necessary to avoid overloading at the treble end.

7. The Need for Standard Equalization: Assuming that Curve 2 in Fig. 4 or some other curve with a higher turnover point represents the optimum recorded induction at 15 ips, it may be realized that an induction characteristic which is optimum for the 15 ips speed cannot be optimum for 7.5 ips. (This principle is recognized in a tape produced by the *Dubbings Sales Corp.*, 41-10 45th St., Long Island City 4, N. Y., which contains the recommended induction for 7.5 ips recorders. This induction characteristic has a turnover point one octave lower than the NARTB induction curve.) True, it is possible to record the same magnetic induction at these two speeds, but only at a sacrifice in performance at one speed or the other or both.

Optimum induction at a given speed is not necessarily the same for two brands of tape recorder. Depending upon the record heads and amounts of bias current used, the record losses will differ somewhat and therefore so will the optimum induction. However, it

seems safe to state that in most cases the differences in record losses between two machines operating at the same speed will be considerably less than the differences that exist when one machine operates at two speeds differing by a ratio as great as 2 to 1.

Allowing for the fact that recorders operating at the same speed differ somewhat from one another with respect to record losses, it is nevertheless reasonable to assume that equalization standards can be developed which assure close to optimum performance on most machines. Such appears to be the case for recorders operating at 15 ips, to which the present NARTB standard applies. At the same time, the induction characteristic which is generally best for 15 ips recorders is not also best for other speeds.

In the absence of standard equalization at speeds other than 15 ips, unsatisfactory performance often results when, at these speeds, a tape made on one machine is played back on another machine or when a recorded tape utilizing the NARTB characteristic is played. To illustrate, Fig. 5 shows what happens if a 7.5 ips machine using NARTB playback boost (Curve 4 in Fig. 3) is used to play a reel of tape on which the magnetic induction of Curve 5-5' in Fig. 4 has been recorded. Curve 1 in Fig. 5 is the playback response before application of NARTB boost. Curve 2 is the NARTB characteristic, and Curve 3 is the resultant over-all response. Curve 3 obviously exhibits an undesirable declining characteristic throughout the audio range. While this decline could be compensated to an extent by the tone controls of a music system, there is no assurance that the tone control characteristics would match Curve 3 with enough accuracy to provide reasonably flat response. Quite possibly, despite use of tone controls, there would be noticeable bumps and valleys in response. Moreover, to the extent that treble has to be boosted, noise is accentuated.

Conversely, if a tape recorded at 7.5 ips according to the NARTB in-

duction characteristic were played back on a machine with playback equalization meeting the requirements of Curve 5-5' in Fig. 4, then instead of the decline shown by Curve 3 in Fig. 5 there would be a rise in response.

The foregoing discussion indicates that equalization standards are needed not only to assure close to optimum performance but also to permit satisfactory interchange of tapes among machines operating at the same speed.

The recently formed Magnetic Recording Industry Association (M.R.I.A.) is at work on the problem of drawing up standards for each speed. Its task is formidable, and as of early-1956 it was too soon to obtain an indication of M.R.I.A.'s progress. It was expected that from one to three years might pass before standards could be developed and put into effect.

The task of formulating a standard magnetic induction characteristic for a given speed is complicated not only by differences among commercial heads. It is further necessary to investigate tape characteristics insofar as they affect record losses and permissible record current over the audio frequency range; preamplifier performance with respect to distortion and noise; optimum bias setting so as to achieve the best balance of high output, low distortion, and moderate treble losses; and, far from last in importance, the distribution of peak energies over the audio range. Based on such investigation, it seems that equalization standards would specify at least the following for each speed.

1. The frequency range within which over-all response should be ± 1 db (or perhaps ± 1.5 db); the frequency limits at which response may be down 3 db.
2. Maximum harmonic distortion at one or more specified frequencies and/or maximum intermodulation distortion using specified frequencies.
3. Minimum signal-to-noise ratio at one or more specified frequencies.
4. Variation of magnetic induction with frequency. Conversely, this might be stated, as in the NARTB standard

(Continued on page 103)

Fig. 4. Optimum magnetic induction for a 7.5 ips tape recorder, assuming maximum permissible record boost of Fig. 2.

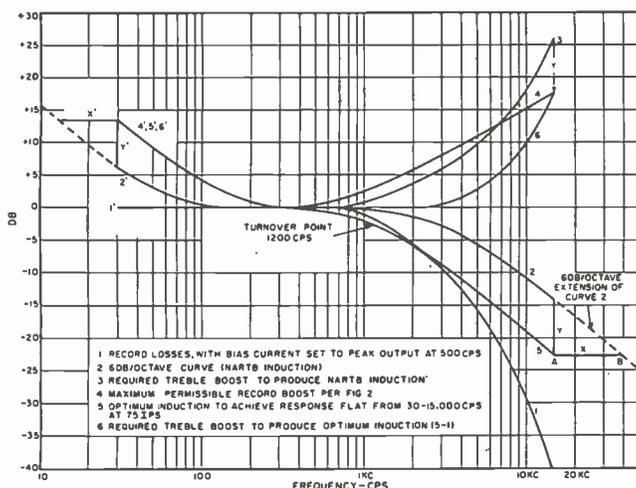
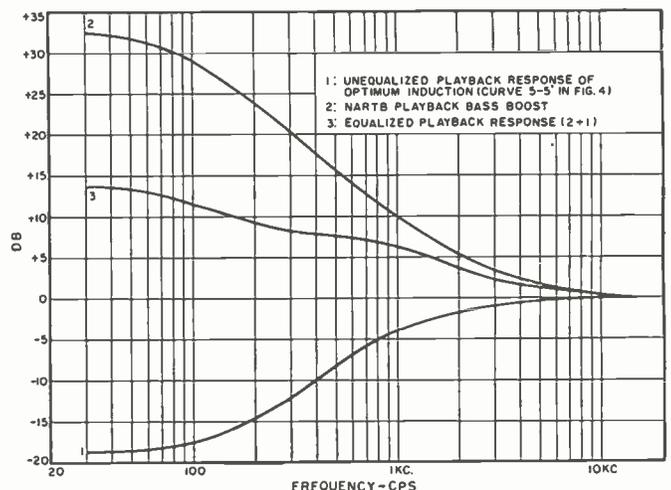


Fig. 5. Response of a 7.5 ips tape recorder with NARTB boost to a tape recorded with a turnover point at 1200 cycles sec.



TV Transformers and Yokes

By
WALTER H. BUCHSBAUM
 Television Consultant
 RADIO & TELEVISION NEWS

THE three most costly components of the average TV receiver, aside from the picture tube, are the power and flyback transformers and the deflection yoke. In making repairs or selecting a suitable replacement for any of these parts, it is helpful to know more about the component and to get some idea as to how it works.

To the service technician, the designer, and the manufacturer, a comprehensive set of specifications is required to describe a transformer accurately. Some of the more important specifications of each of the three major items and their relation to service work are discussed in this article.

Many of the basic criteria discussed for the power and flyback transformers are also applicable to the vertical sweep output transformer.

Power Transformers

The various types of transformers in this category include autotransformers which have a primary connected to the a.c. power line. Basically, the specifications for any power transformer are dictated by the power requirements of the TV receiver. Since the receiver circuitry requires certain d.c. voltages and currents, with a minimum of a.c. ripple, the rectifier and filter portions of the power supply must be designed to meet this need. The power transformer, in turn, must be designed for use with a certain rectifier and filter circuit to get satisfactory performance. For example, the transformer needed if the filter input contains a 10 μ fd. capacitor is different from the one that would be used with an input capacitor of 80 μ fd. Whether the circuit uses a selenium or 5U4 tube rectifier also influences the choice of transformer.

The following technical specifications are generally used to describe a power transformer:

Primary—for TV use 117 volt, 60 cps, is standard. Primary current is not usually stated.

Heater windings—one or more 6.3 volts, with current ranging from 6 to

Review of the use of power and flyback transformers and deflection yokes, together with service hints.

10 amperes per winding. Many transformers have additional 6.3-volt windings for the picture tube, damper tube, or other uses. These special windings are usually rated at 1.2 amperes.

Rectifier filaments—most transformers have a 5-volt winding with 2 or 3 amperes of filament current for each rectifier tube used. In general, 5U4 dual diodes are used, but in many recent receivers 6.3-volt types have made their appearance.

"B+" power—this is usually stated in two ways. The a.c. secondary voltage from the rectifier plate to the transformer center-tap is given in r.m.s. volts, and the d.c. current passing through the rectifiers is shown in milliamperes. Many transformer manufacturers also give the rectifier nomenclature and the d.c. voltage and current values available with a stated capacitor value at the rectifier cathode. The reason for this information lies in the fact that large capacitors result in considerable surge currents, while the plate resistance of the rectifier is a limiting factor of available d.c. voltage.

It should always be kept in mind that the current and voltage stated in the transformer specifications depend

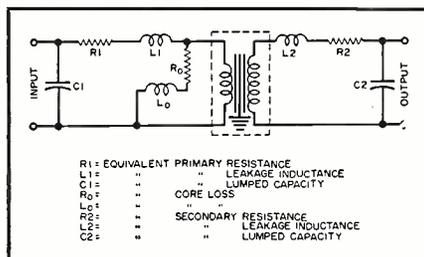
on fulfilling all other specifications. For example, if one of the heater windings is short circuited, all of the other voltages will drop. Similarly, if the primary voltage is low, all of the others will also be lower than specified. Low filament voltage at the rectifier results in less "B+" current and lower "B+" voltages throughout the receiver.

To illustrate the actual operation of a transformer, Fig. 1 shows the equivalent electrical circuit of the primary and a single "B+" type secondary. Note that there is a grounded shield between the two windings. This electrostatic shield consists of some aluminum or copper foil wound over the primary winding. Its purpose is to reduce electrostatic coupling of high frequency noise which would interfere with the TV picture and sound.

The electrostatic shield should not be confused with the broad copper band seen on the transformer of Fig. 2. This serves as a magnetic shield. There is some confusion about the ability of copper to act as a magnetic shield, but the actual operation of this feature is quite simple. The wide copper band forms a shorted turn in the transformer field, with considerable current circulating in the copper. This current sets up a magnetic field in opposition to the main transformer external field. If the copper loop were removed or unsoldered, the external field might be sufficient to cause interference in the picture tube operation.

Repairing power transformers is usually limited to fixing the leads projecting from the shell or located directly on the exterior of the outer winding. When an open circuit is indicated, check the leads as close to the transformer body as possible. It is gen-

Fig. 1. Equivalent circuit for the typical power transformer. The primary winding and a "B+" secondary are symbolized.



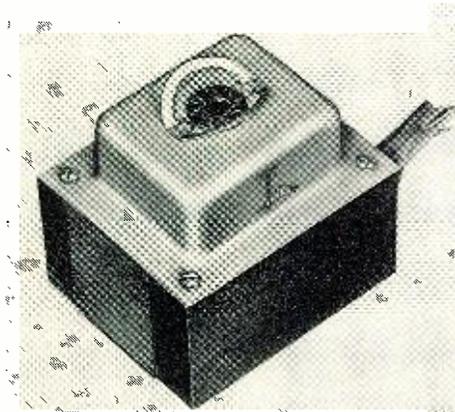


Fig. 2. Typical TV power transformer. Notice the socket for the rectifier tube.

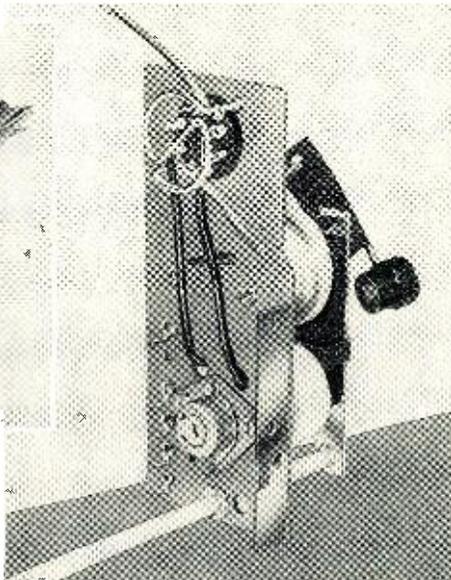


Fig. 3. Flyback transformer which also contains a socket for the high-voltage rectifier as well as the horizontal centering potentiometer on its base.



Fig. 4. Flyback transformer with an air core, as used in earlier TV sets.

erally not recommended that the entire unit be taken apart and the wiring unwound to find a broken lead. If the damage occurs near the edge of a winding, visible from the outside, the wire can sometimes be repaired with a very small soldering iron. In most instances, a defective power transformer will call for a replacement—and an exact replacement at that. Mounting methods, size, and the electrical specifications must all be considered in selecting a replacement. Fortunately, most transformer manufacturers publish lists of replacement components for exact receiver types and models.

Flyback Transformers

Those who have been in the TV servicing field since the days of the early 630 models will recall the evolution of flyback transformers from the powdered iron types to the present-day ceramic core, high-efficiency, high-voltage units. Hand in hand with this evolution, the number of types of flyback transformers has also increased. Today there are almost as many different flyback transformer types as there are TV set models and whenever possible, the correct replacement type has to be obtained.

Flyback transformers vary considerably in appearance as well as electrically. Some types include mounting space for high-voltage rectifier tubes and capacitors (Fig. 3), others have windings for several rectifier filaments, some have the core grounded, and on others the core is well insulated from ground.

Electronically, the flyback transformer is far more complex than the power transformer even though its equivalent circuit is the same. Because of the higher frequencies it must handle, the distributed capacity, leakage, and core losses become very important. The "Q" of the transformer is usually quite critical since it deter-

mines the efficiency of the horizontal sweep and the high-voltage section. Cores of flyback transformers are carefully matched for optimum "Q" and such details as the air gap, wire insulation, and high-voltage breakdown of the mounting board are all critical factors in flyback production. Even the lead length from the high-voltage terminal to the rectifier tube plate cap often controls the "Q" and therefore the anode voltage. In some circuits it was found that by shortening this wire by two inches the anode voltage could be raised by 1000 volts.

Most recent flyback transformers are generally of four basic types, irrespective of physical appearance. The first type, easily recognized, is the autotransformer having an air core. It is used together with a high impedance deflection yoke in some earlier receivers and is illustrated in Fig. 4. A second, very popular type, is the autotransformer having a ferrite core. The remaining two types have ferrite cores and differ in that the core may be at ground potential or the core may be floating in order to reduce the over-all capacity to ground. See Figs. 5 and 6.

Some of the most frequent troubles due to either a defective flyback transformer or an incorrect replacement are described below.

Arcing or corona. Due to temperature variations inside a TV set, the insulation of the high-voltage coil of the transformer may crack. Or, the internal insulation of the coil may have been damaged allowing moisture to condense between windings. These defects lead to arcing.

Internal transformer arcing can sometimes be cured by heating the transformer under a heat lamp and then impregnating it with high-temperature wax. Most frequently, replacement will be indicated since old age affects transformer "Q" as well as insulation. When arcing or corona ap-

pears to originate in the high-voltage section, lead dress should be carefully inspected. Pay particular attention to the high-voltage rectifier lead, making certain that it is well in the clear and as short as practicable.

Insufficient width. This may not be due to the flyback transformer but to the horizontal drive circuit or any of the tubes prior to the transformer. Often, a new transformer provides a higher anode voltage, making poor width more apparent. The usual remedy is to connect a .001 to .01 μ fd. capacitor across a portion of the transformer secondary to reduce the anode voltage and thereby give more width. Checking the cathode current control-grid bias, and screen-grid voltage of the horizontal output tube may locate a source of insufficient width.

Insufficient high voltage. This may occur when the transformer is dried out and has high leakage currents and a poor "Q" or a replacement does not match perfectly. In any instance where it is desired to step up the anode voltage by approximately 1000 volts this can be done by returning the ground side of the high-voltage filter capacitor to the "hot" side of the deflection yoke. Reducing the value of the screen-grid resistor of the output amplifier also helps, but the cathode current of that tube must be kept within the recommended limit (75 to 100 milliamperes).

Foldover and nonlinearity. This sometimes appears even when a new transformer is installed, and is due to mismatch with the horizontal output amplifier circuit or the deflection yoke. To correct this condition, first adjust the horizontal drive control, linearity coil, and width coil. A new output tube and/or damper tube may also be needed. If nothing else avails, a new deflection yoke may be required.

Such a mismatch can occur because of uneven aging among these components.

Singing. This type of defect is quite annoying, and is usually apparent only after a replacement unit has been in-

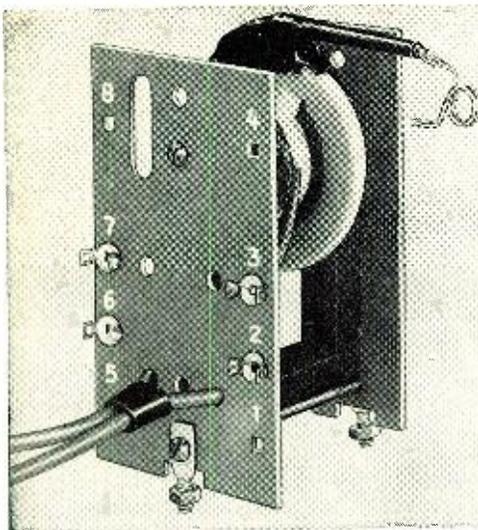


Fig. 5. This flyback transformer has a floating core, i.e., it is ungrounded.

stalled. Usually, this is due to a mechanical vibration at the horizontal sweep frequency, and the obvious remedy would be to dampen it. Placing a strip of felt, sponge rubber, or "Vinylite" between the transformer mounting and the chassis should cure the vibration. If the transformer itself seems to "sing," a spraying with acrylic or similar insulating material between the coils, core, and brackets of the transformer is suggested.

Deflection Yokes

Fortunately the service technician does not have to replace deflection yokes too often, nor is there much to be repaired in this component. The deflection yoke, however, can be the cause for quite a bit of serious trouble ranging from burn-out of the flyback transformer to a slight nonlinearity, edge scalloping, or pin-cushioning.

Basically the deflection yoke consists of four separate coils, arranged in two pairs as shown in the diagram of Fig. 7. The horizontal deflection coils are inside, closest to the neck of the picture tube and are located above and below the electron beam. The vertical coils are located to the right and left of the CRT neck. The resistor and capacitor values shown in Fig. 7 are typical ones.

Three major criteria govern the design and operation of deflection yokes. These are impedance of the windings, deflection angle, and the type of winding and core material.

Deflection angles for older picture tubes range from 52° to 66° while most of the large screen picture tubes have either a 70° or 90° deflection angle. Impedances for the horizontal coils range from 8.3 to 30 millihenrys while the vertical coils vary from 3.3 to 50 millihenrys, with the latter figure and 43 millihenrys in widest use. The d.c. resistance ranges from about 4 to 60 ohms for either set of coils.

The core material of earlier yokes was powdered iron. Then, iron wire was used, and now most models have ferrite cores and are constructed like

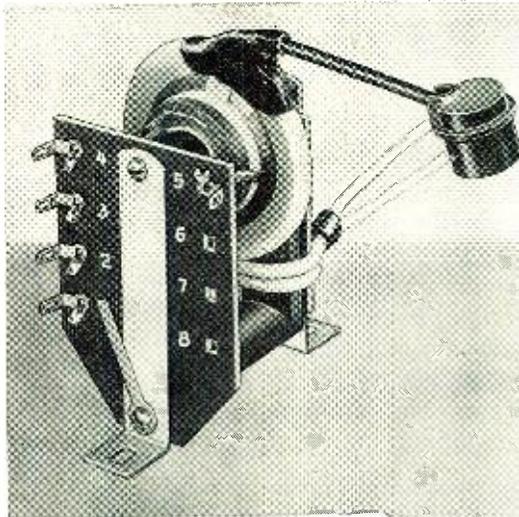


Fig. 6. The flyback transformer shown here has a grounded ferrite core and was used in many Admiral receivers.

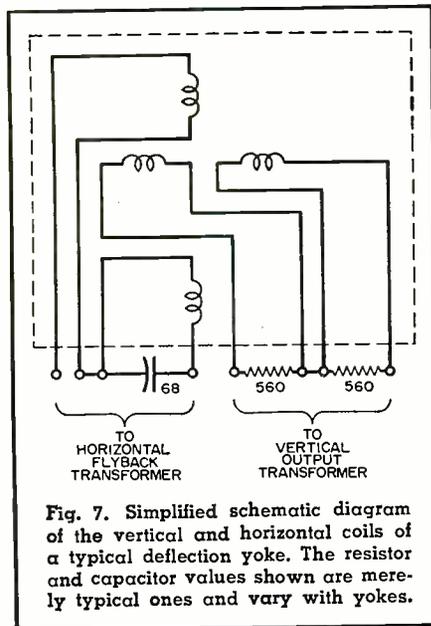


Fig. 7. Simplified schematic diagram of the vertical and horizontal coils of a typical deflection yoke. The resistor and capacitor values shown are merely typical ones and vary with yokes.

the one shown in Fig. 8. Note that insulation is provided between the coils and the grounded core segment. During aging, heating, etc., this insulation might become brittle and break down. This can cause arcing and internal shorts.

In the assembled deflection yoke of Fig. 9, the flare of the horizontal coils, the orientation of all four coils, and the windings are quite critical. This illustration of a 90° yoke shows the precision and care required to avoid crosstalk, pin-cushioning, distortion, and poor over-all focus. The latter was encountered when some of the earlier yokes were used with large-screen, wide-angle picture tubes. To overcome this poor focus, the horizontal coils are wound according to a modified cosine function so that as the electron beam is deflected farther from the center the focal point also changes. This uniform focus feature was sometimes obtained at the expense of pin-cushioning at the sides of the picture, but most present-day deflection yokes provide good linearity as well as over-all focus.

When the damping capacitor or re-

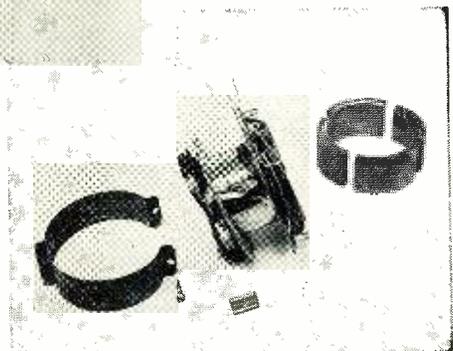


Fig. 8. Disassembled deflection yoke of the wide-angle variety for large CRT's.

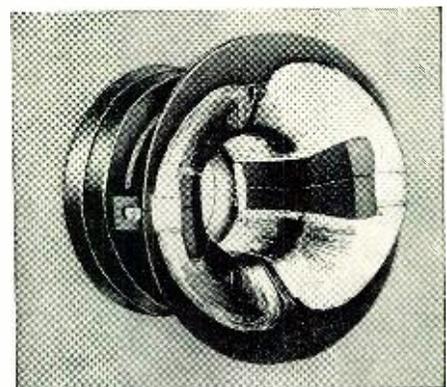


Fig. 9. The assembled deflection yoke.

sistors mounted inside the deflection yoke housing go bad, ringing (vertical bars at the left of screen), excessive and distorted height of half the picture, or Barkhausen oscillations usually result. The latter may also be due to sloppy wiring or a defective output tube.

Defects due to the deflection yoke itself can best be repaired by replacing the yoke with a new unit. These troubles include pin-cushioning, nonlinearity, lack of vertical or horizontal sweep, arcing inside the deflection yoke, insufficient width, poor high voltage, burned-out flyback transformer, and excessively dim, expanded picture. The defects causing these troubles can be either an open or short or partial short circuit in any of the windings, lowered "Q," or insulation breakdown. Replacing the yoke with a good one is usually simpler and cheaper than attempts at repair.



Fig. 1. Eldridge R. Johnson, founder, The Victor Talking Machine Company.

EVOLUTION of the PHONOGRAPH

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

Fig. 4. The "Toy" Talking Machine, circa 1900.

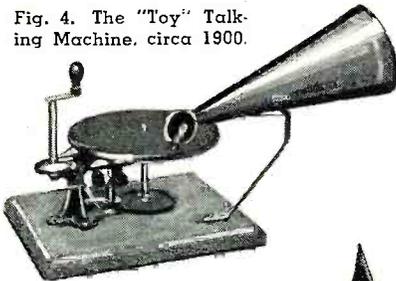


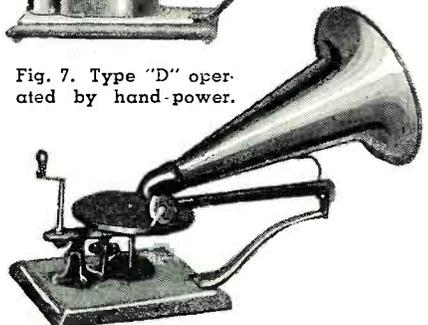
Fig. 5. Type B Victor or "Trade Mark" model.



Fig. 6. This Victor "A" sold for \$12.00 in 1900.



Fig. 7. Type "D" operated by hand-power.



Part 4. The developments of Eldridge Johnson and the early models produced by him and, later, Victor Talking Machine Co.

GREAT turbulence existed in the early days of the talking machine over which was the best—graphophone, phonograph, or gramophone. Eldridge Johnson (Fig. 1) and Berliner had been working together in an attempt to perfect a machine which not only would improve upon the reproduction of the flat disc records but, also, would provide more competition to Edison and other makers of the cylinder machines.

Johnson later purchased an interest in *Scull & Johnson*, a firm of manufacturing machinists. The name was then changed to *Eldridge R. Johnson*. This was the beginning of the business that later became the *Victor Talking Machine Company*. The company, in reality, was simply a small shop for repairing any and all kinds of machines. The business had been started by Captain Andrew Scull in 1886 as a career for his son, John, a mechanical

engineer and graduate of Lehigh University. Scull was very clever and possessed great ability as an engineer. Young Scull died very suddenly and, in 1888, Johnson took charge of the *Scull Machine Shop* as foreman and manager. Andrew Scull, on the other hand, was a sea captain by profession and did not like the repair business. His idea was to pay a certain portion of the expenses through the repair work and, at the same time, to develop the factory along the regular lines of manufacturing.

Johnson, in the meantime, resigned his position of foreman of the company and went out on a "scouting" expedition throughout the West. He soon realized that the opportunities back East held far greater potentialities for a young mechanic, and that while employment was easily obtained in the West and wages a bit higher, still the opportunities to rise above the ranks

Fig. 8. Johnson's Type "C" Talking Machine.

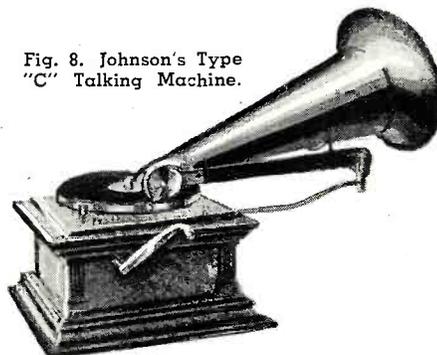


Fig. 9. This Victor "Royal" sold at \$15.00 list price.



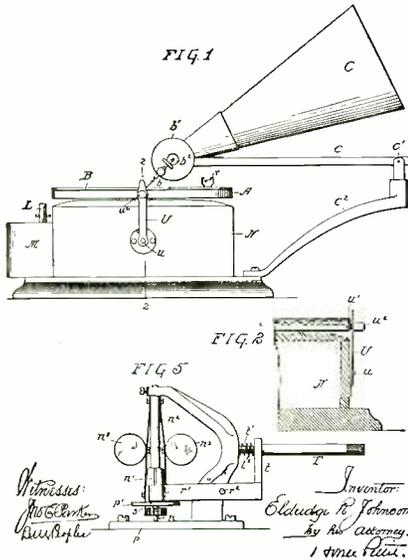


Fig. 2. Johnson's original patent drawings.

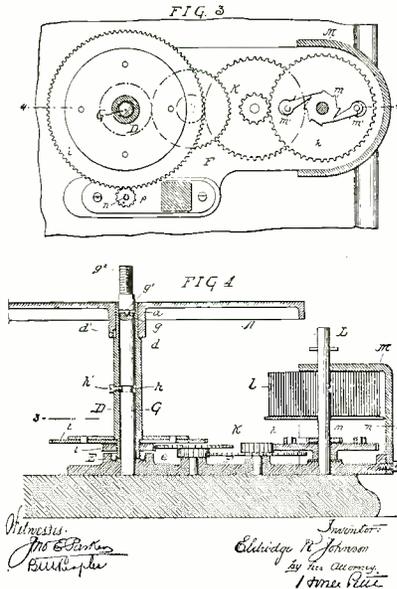


Fig. 3. Patent which was filed Aug. 19, 1897.

of a wage earner were not so plentiful. He came back to Philadelphia in 1891 and Scull sent for him soon after his arrival. Scull had been unable to market a book-binding machine because of excessive manufacturing costs. He found himself in a bad financial position and pleaded with Johnson to again take charge of the machine shop and to share in the profits.

It soon became apparent to both of them that the machine shop could not be made to yield sufficient profit to support the two of them. It then became a question of which one should leave. Scull, accordingly, sold his interest to Johnson, who, being a practical machinist, then had a better chance to succeed. A corporation was then founded called the *New Jersey Wire Stitching Machine Company*. Their first efforts were to sell a book-binder or wire-stitcher. Johnson gained a wealth of experience in his undertaking and, although the company did not produce any outstanding profit, it did provide him with valuable know-how and whetted his appetite for further exploit.

Part of his early business included the manufacture of experimental

models of new inventions. Inventors in the early days were literally poverty stricken and they turned to the small machine shops for help in developing their invention models. It was during this phase of Johnson's business that one of the very early types of talking machines was brought into the shop for alterations. The instrument was badly designed, in Johnson's opinion, and sounded much like a "partially educated parrot with a sore throat and a cold in his head." But the little wheezy instrument caught his attention and held it fast and hard. This was exactly what Johnson was looking for and together with a chain of favorable circumstances provided Johnson with his great opportunity, and he was stricken with a virulent form of "talking machine fever." Berliner, of course, had given the world a basic improvement in the talking machine since Mr. Edison's original discovery, and Johnson happened to be there at the right time to give this great discovery the needed improvements and refinements, and to manufacture a product in such form and design that it would become popular with the buying public. Johnson was able to improve greatly upon the

tone produced by the early instrument. He spent a great deal of time in developing an improved reproducer.

He later got into difficulties with the *Berliner Company* over the complicated question of Berliner patents. The litigation and dispute that followed eventually led to the formation of the *Victor Talking Machine Company* so that the Berliner patents could be merged with Johnson's interests, improvements, and patents, and combined into one corporation.

Eldridge Johnson applied for a patent on an improved gramophone and actuating device, on August 19, 1897. This was granted Mar. 22, 1898. His device, Figs. 2 and 3, is practically identical to the improved gramophone of Berliner. Johnson had been making the motor drive for the Berliner machines for some time prior to his application. His invention pointed to improvements in sound recording and reproducing machines of like nature in which a record disc or cylinder is propelled by power and had, for its principal object, to provide an improved form of mechanism for effecting the rotation of the disc under the reproducing-stylus.

His invention also provided improvements in the mechanism for supporting and rotating the record-disc and for adjusting and regulating the rotations of the latter. The drawings, Figs. 2 and 3, show the sectional elevation of his device. A circular table or platform, was designed on which was placed the record-disc and which was formed by a continuous record-groove by a needle or stylus and a diaphragm vibrated by sound-waves in the usual manner. The table and disc were rotated under a stylus secured to a casing and connected at one end to a suitable diaphragm. This terminated in a trumpet or earpiece. This mechanism was carried by an arm, pivoted to a support and so arranged that it was free to travel during rotation of the disc.

The turntable had a central hub, which rested upon a shoulder, and was keyed to a sleeve. A vertical post extended from the base of the operating mechanism and had at its end a conical depression or recess.

To the sleeve was secured a gear-wheel which was driven by a train of gearing from a gear-wheel and in turn carried by a winding-post, secured at one end of a spiral spring.

(Continued on page 104)

Fig. 10. Victor "Monarch" was replaced by the "Improved Monarch" model.

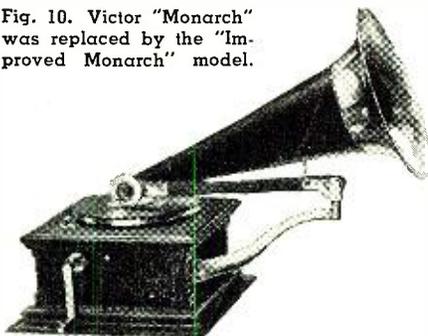
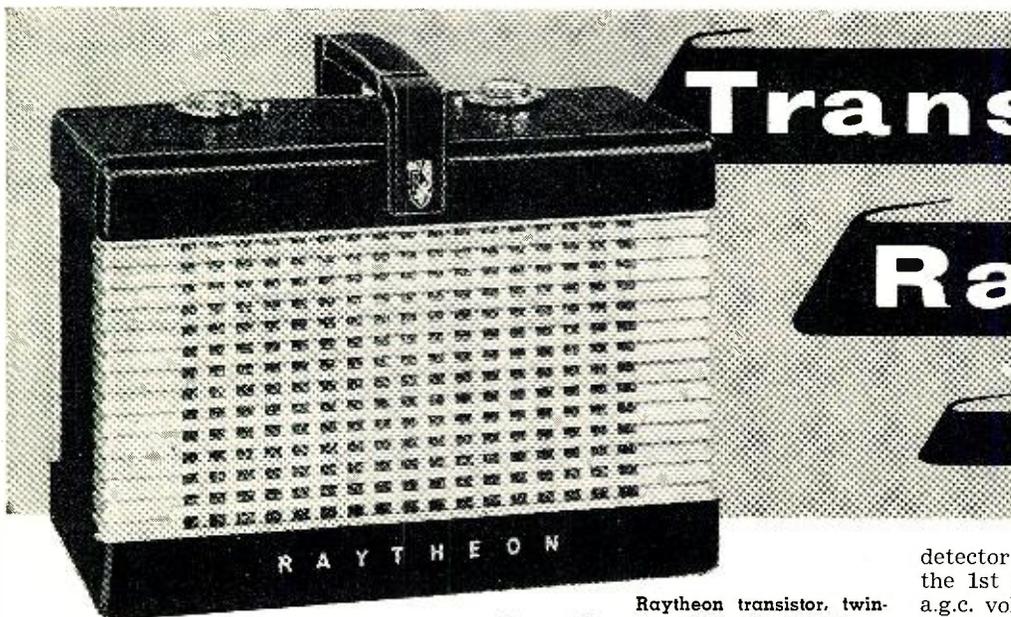


Fig. 11. Victor's "Improved Monarch" model first introduced in year 1901.



Fig. 12. The "Monarch, Jr." was characterized by a special ribbed tone arm.





Transistor Radios

By MILTON S. KIVER *

Raytheon transistor, twin-speaker set; batteries will last for 2500 hours.

Part 2. Three more transistor portables analyzed in detail. A must for radio service technicians.

IN last month's article, the operational features of the *Regency* Model TR-1 transistor radio receiver were discussed, together with an analysis of the manner in which a.g.c. is applied to i.f. amplifiers. In this article three more transistor receivers are examined.

The first receiver, whose schematic diagram is shown in Fig. 1, is designed along somewhat similar lines as the *Regency* set but it contains a greater number of stages. The lineup includes a converter, three i.f. amplifiers, a germanium diode detector, and two audio amplifier stages. The maximum power output is 115 milliwatts, which is more than ample for this particular purpose. The "B+" voltage is 12 volts and the current drain, at low levels, is 5 milliamperes. At high peak levels it may go as high as 20 milliamperes. A pair of *Eveready* W-456 type batteries could be expected to have a life in excess of 500 hours if used at the rate of 2 hours a day.

This circuit was developed by the *Hazeltine Corporation*, an independent research and licensing company, and will probably be used with or without modifications by some commercial manufacturers of radio sets.

The transistors used in the converter, i.f., and first audio stages are all 2N98's. This is an *n-p-n* type of transistor. In the output stage, 2N43A transistors are employed. These are *p-n-p* units.

The converter stage is similar to the same stage in the previous receiver. In order to intercept as much signal as is possible, the ferrite rod on which the antenna coil is wound is $\frac{1}{2}$ inch in diameter and 8 inches long. The main winding on the antenna coil contains 90 turns and is tuned by a 180 μ fd.

variable capacitor. The tuning range extends from 535 kc. to 1650 kc. A smaller, six-turn secondary winding then transfers the signal from the primary to the base of the converter transistor, V_1 .

The oscillator transformer, T_1 , is connected between collector and emitter of V_1 . The emitter is tapped up 13 turns on the 130-turn tuned secondary winding. The primary of the oscillator transformer is untuned, connecting to the collector at one end and the input i.f. transformer, T_2 , at the other end. The frequency of the i.f. produced in V_1 is 455 kc. R_2 and C_2 form the collector decoupling filter, with R_2 chosen to limit the collector dissipation to a safe value in case the oscillator portion of this stage should cease to function. R_1 brings the d.c. voltage to the base of V_1 and its value is so selected that the collector current is between 0.5 and 1 milliamperes.

There are three stages of i.f., with an over-all gain of approximately 20 db per stage. Each transistor has its emitter grounded (*via* a resistor). The same interstage transformer is used throughout and in each only the primary is tuned. The collector is tapped down on the primary winding to a point where its 10,000 ohms is matched. The secondary of each transformer is untuned in order to match the 500-ohm input impedance of the following stage. The only variation among transformers occurs in T_3 , where the secondary impedance is altered to match the loading of the diode detector.

An a.g.c. bias is applied only to the base of the 1st i.f. amplifier. A negative voltage is obtained from the diode

detector and fed back to the base of the 1st i.f. transistor. Note that this a.g.c. voltage is applied in series with a positive d.c. voltage (through R_{13}) and it is the latter which establishes the bias on the 1st i.f. transistor base when no signal is being received. When a signal is received, the a.g.c. voltage reduces the positive biasing voltage by an amount dependent upon signal intensity. The method of control here is I_e (emitter current control).

The same i.f. stage also has a small stabilizing resistor in the emitter lead. Its value is lower than the corresponding resistors in the emitter leads of the other i.f. stages and the reason for this, as discussed previously, is to insure effective a.g.c. Base bias for the other i.f. transistor amplifiers is provided in each instance by a voltage divider.

The detector is a germanium diode (1N64 or equivalent) with the 2500-ohm volume control as its d.c. load. A .02- μ fd. capacitor, C_{10} , acts as an i.f. bypass. The a.g.c. bias is fed through the combination of R_{14} and C_6 .

The audio voltage developed across the volume control is applied to the base of the 1st audio amplifier. R_{11} and R_{16} form a voltage divider to provide the proper base voltage for this transistor. A 1000-ohm stabilizing resistor is employed in the emitter lead, but it is shunted with a 25- μ fd. capacitor to prevent signal degeneration.

The output stage is a common-emitter push-pull class B amplifier. To reduce the crossover distortion, a small amount of forward bias is used. This voltage is obtained from R_{16} , a 100-ohm resistor located in the collector circuit of the previous audio amplifier stage. This bias source makes it unnecessary to add an additional bleeder across the battery supply. Some stabilization and degeneration are produced by the 27-ohm resistor, R_{20} , in the common emitter return. The audio frequency response is limited by C_{13} , the .1- μ fd. capacitor across the output transformer. The two 2N43A transistors are *p-n-p* units and this is the reason the center tap of the output transformer primary is grounded. This connection makes the collector negative with respect to the base of each unit.

* Author of "AM-FM Servicing Short Cuts," Howard W. Sams & Co., "TV and FM Receiver Servicing," D. Van Nostrand Co., and other books.

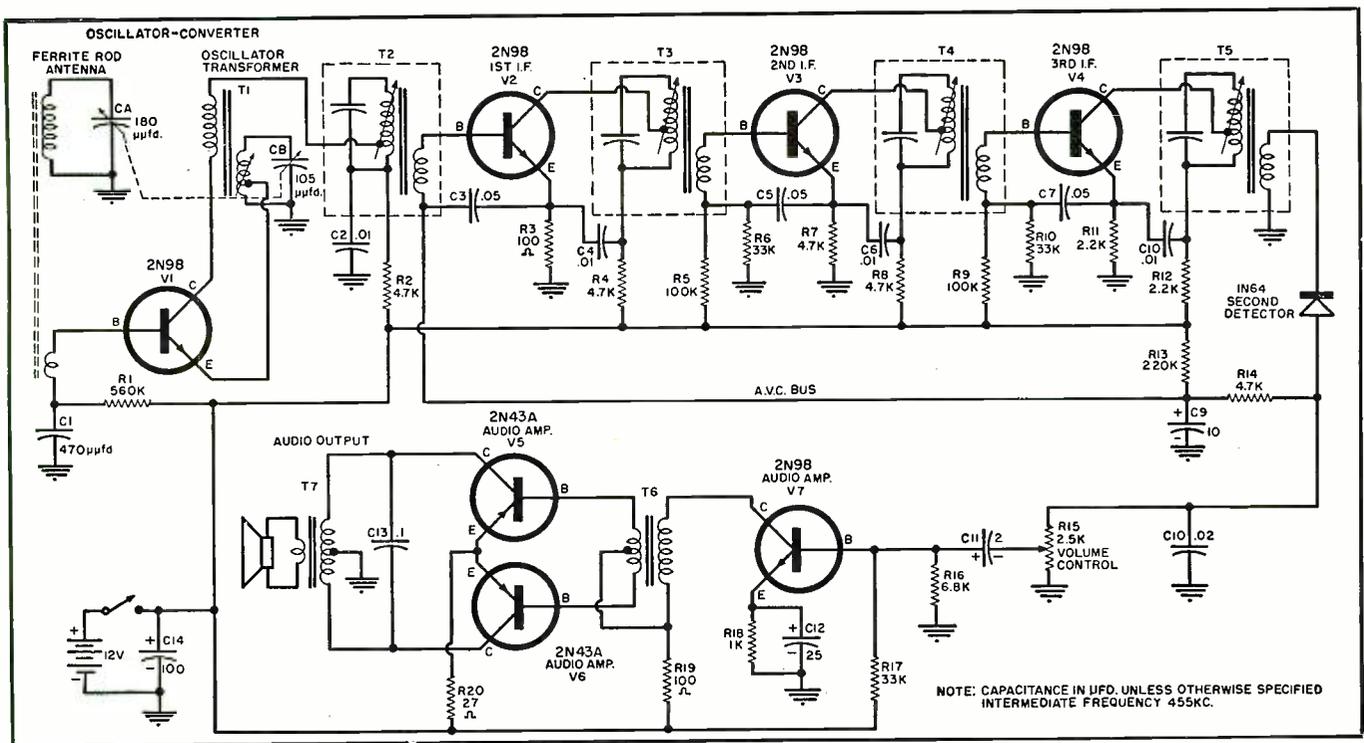


Fig. 1. Portable transistor receiver with three i.f. stages and a push-pull audio output stage. Both "p-n-p" and "n-p-n" transistors are used.

An interesting feature of this receiver is the lack of neutralizing capacitors in the i.f. stages. 2N98 transistors are specifically designed for higher frequency application and the relatively small collector-base feedback capacitance permits these units to be used at the 455 kc. i.f. without neutralization.

Raytheon Receivers

The schematic diagram of another transistor portable radio is shown in Fig. 2. This circuit contains a separate mixer and oscillator, two i.f. stages, a

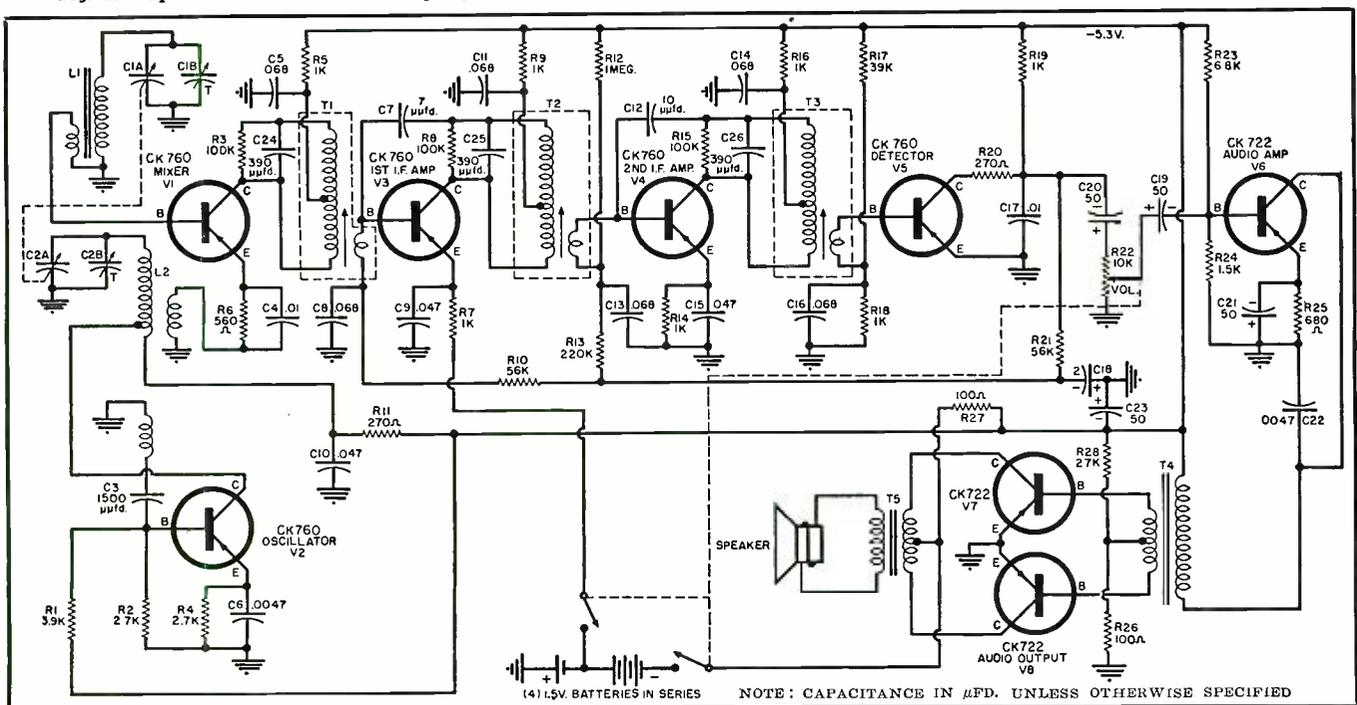
transistor second detector, an audio amplifier, and a class B push-pull audio output amplifier. The d.c. power is supplied by four 1½-volt flashlight batteries, and the audio power output to the speaker is in the vicinity of 100 milliwatts.

The mixer stage receives the incoming signal at its base and the local oscillator signal at the emitter. Concerning this oscillator, the feedback of energy from the collector of V₂ to the base is accomplished by means of the small tickler coil that is connected to the 1500-μmfd. base capacitor. The col-

lector itself is tapped down on L₂ so that an impedance match can be secured while, at the same time, the "Q" of the coil is not loaded down to the point where frequency stability and tracking are affected.

The oscillator output is inductively coupled to the secondary of L₂ and then transferred *via* C₄ to the emitter of the mixer stage. The 560-ohm resistor paralleling C₄ serves to stabilize V₁. The mixer combines the oscillator voltage with the incoming signal, received *via* the base, and the resultant i.f. signal appears in the collector cir-

Fig. 2. Raytheon transistor radio using separate oscillator and mixer transistors and only two i.f. stages. Transistors are "p-n-p."



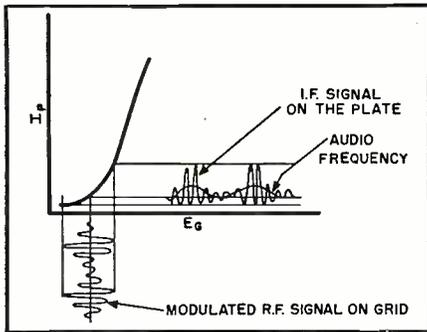


Fig. 3. The mode of operation of a vacuum-tube power detector is shown here.

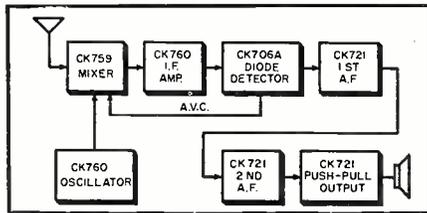


Fig. 4. Block diagram of a Raytheon transistor portable using one i.f. stage and two audio stages plus the push-pull output stage for more gain.

circuit and is transferred by T_1 to the 1st i.f. amplifier. R_5 and C_3 form a decoupling filter to prevent the signal from reaching the "B—" line, with R_5 chosen to limit the collector dissipation to a safe value should the oscillator fail to function properly.

The two i.f. stages employ grounded-emitter arrangements and both stages are a.g.c. controlled. The a.g.c. voltage is obtained from a class B power detector and applied to each base. Since these are $p-n-p$ transistors, the base

should be negative with respect to the emitter. A negative voltage is supplied to each base from the d.c. battery line. To vary the gain of each stage, the output voltage from the detector becomes more positive as the incoming signal level increases. This has the effect of reducing the bias between the base and emitter and, in essence, lowers the emitter and collector currents through the transistor. As the current decreases, the gain of the stage drops. In short, I_c control is employed.

In the first i.f. stage, the bottom end of the emitter resistor, R_7 , connects to the -1.5 -volt terminal on the battery. An additional -55 volt develops across the 1000-ohm emitter resistor, so that the total emitter voltage with respect to ground is -2.05 volts. The voltage of the base is -2.2 volts and this is obtained through the a.g.c. line and the connection of this line to R_{10} . The latter resistor ties in, at the top, to the -5.3 -volt line from the battery. The net bias, then, between base and emitter is .15 volt with the base more negative than the emitter. When the a.g.c. bias is active, upon the arrival of a signal, it will act to reduce the bias difference between base and emitter.

The collector of the first i.f. stage receives its bias voltage via R_6 . Voltage of the collector is -4.8 volts with respect to chassis.

In the second i.f. stage, the actual base and emitter voltage values are different, but the base-to-emitter voltage remains the same.

The reason for returning the emitter of V_3 to a negative tap on the battery is that it permits the gain of this stage to be reduced sufficiently to pre-

vent overload of the second i.f. or the detector. In the second i.f. stage, the emitter resistor is returned to ground and because of this, the a.g.c. voltage cannot reduce the transistor current to as small a value as it can in the first stage.

The i.f. frequency is 455 kc. C_7 (7 $\mu\text{fd.}$) and C_{12} (10 $\mu\text{fd.}$) are neutralizing capacitors.

The stage following the 2nd i.f. is the second detector; a CK760 transistor is employed here in a class B power detector arrangement. This type of detector was once fairly popular in vacuum-tube circuits and a good deal of this popularity stemmed from the fact that such a detector also amplifies the signal. It is this latter advantage which accounts for its use here where 10 db of gain is obtained. It would be simpler and cheaper to use a germanium diode, as in the two previous sets, but a diode introduces a loss, and gain here is important. In vacuum-tube receivers, the class B power detector is no longer used because sufficient prior amplification is available so that detector gain is not required, because diodes are cheaper, and because a vacuum-tube power detector introduces a considerable amount of distortion on relatively weak signals. In the transistor class B detector, less distortion is introduced because transistor characteristic curves are considerably more linear than vacuum-tube characteristic curves. As a matter of fact, transistors will give essentially linear detection at smaller power levels than even diodes. Not to be overlooked, also, is the ability of a transistor detector to supply more a.g.c. control power than a diode detector.

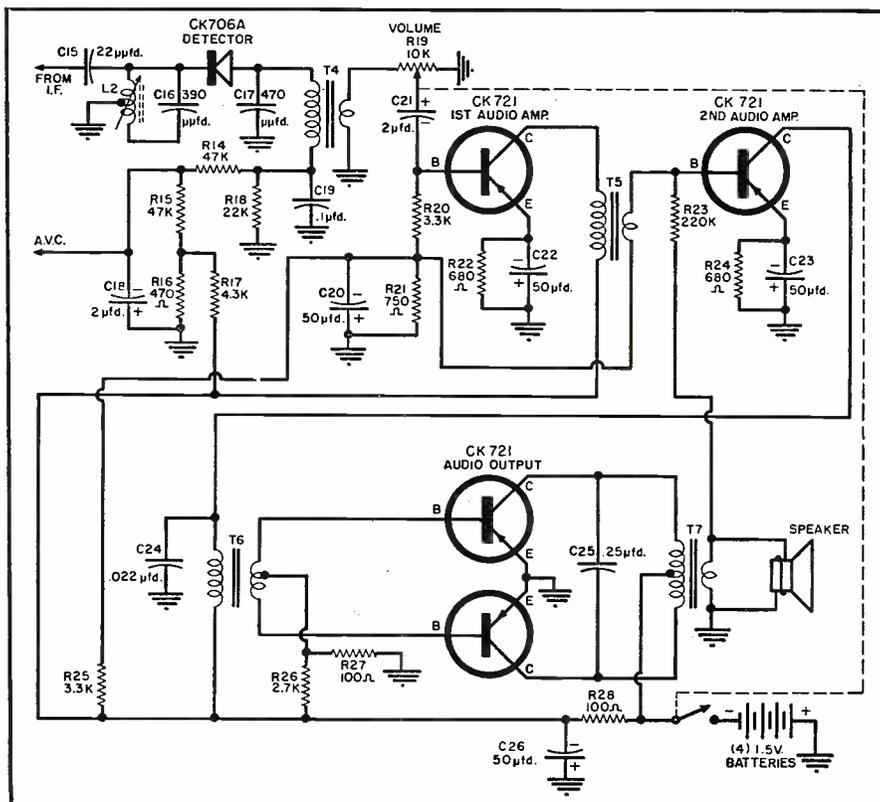
For those readers who may not be familiar with power detectors, the following explanation is given. The E_g-I_p characteristic curve for a triode is given in Fig. 3 and if the tube is biased close to the cut-off point, then the incoming signal applied to the grid, will vary back and forth about this point. However, the negative half of the input signal will operate over the curved portion of the characteristic, producing considerably less plate current than the positive half cycles of signal. (Portions of the negative half of the signal will drive the tube to cut-off.) Essentially, the signal is rectified (i.e., detected) and if the i.f. component is removed, the desired audio intelligence is obtained.

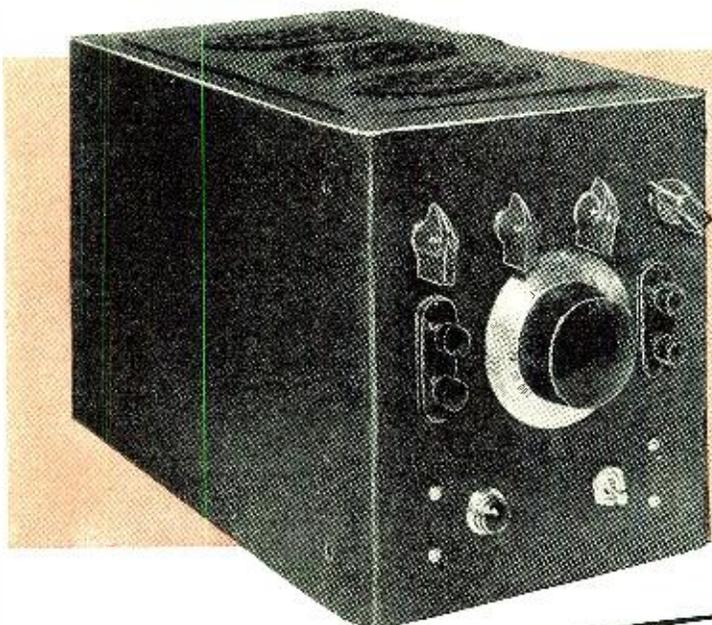
In the transistor detector of Fig. 2, the emitter is connected directly to ground. The potential of the base is established by the divider network of R_{17} and R_{18} and this voltage is so low that the stage is close to cut-off. Under no-signal conditions, the collector voltage is very close to the full "B—" voltage. The a.g.c. line connects also to the collector of V_3 (through R_{21}) and it is through this connection that the base elements of V_3 and V_4 receive their operating voltages.

When a signal is received, the collector current of the detector increases

(Continued on page 153)

Fig. 5. Partial schematic diagram of the Raytheon transistor receiver in Fig. 4.





A Wide-Range Distortion Analyzer

Construction details on a fairly simple harmonic analyzer which possesses acceptable accuracy for many applications.

By **JOSEPH A. HUIE**

AS A result of the steadily increasing interest in high-fidelity, numerous articles have appeared describing the construction of audio test gear. Coupled with this is the increased availability of test equipment in kit form. One instrument, however, not often found is the wide-range distortion analyzer. This article describes such an instrument which is simple to construct and capable of measuring total harmonic distortion to 0.2 percent over a frequency range of 40 cps to 15 kc. when used with a suitable audio voltmeter and signal generator.

The distortion analyzer is a valuable tool in maintaining broadcast equipment at top performance. The service technician will find it useful in servicing the latest hi-fi equipment. To the amateur audio enthusiast the analyzer provides a means of checking amplifier performance to see if it really comes up to expectations.

Distortion

Before getting into the circuitry of the analyzer, a brief review of distortion fundamentals may help in understanding the limitations and sources of error in measurements made with the equipment described. Distortion is defined broadly as any change in waveform between the input and output of a system.

There are three general classifications of distortion:¹

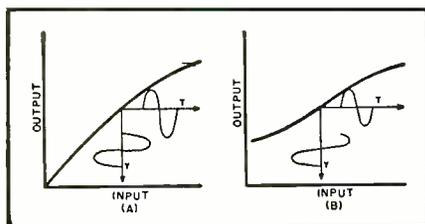
1. Frequency distortion, which is present when the relative amplitudes of the various frequency components of a waveform are changed.
2. Phase distortion, which is present when the relative phase of the various frequency components of a waveform are changed.
3. Non-linear distortion. This form is that distortion which occurs when the output *versus* input characteristic of a system is other than a straight line.

The non-linear distortion introduced by an amplifier or system is what we are interested in here.

When a sine wave is applied to a non-linear amplifier, distortion is manifest by the presence of new frequency components in the output. It can be shown mathematically that these new frequencies will be harmonically related to the applied frequency. Which harmonics will be present and their relative amplitudes would be determined by the type and degree of non-linearity. A transmission characteristic like that of Fig. 1A, for instance, would tend to introduce even harmonics, while that in Fig. 1B would introduce odd harmonics.

Besides introducing harmonics, non-linear distortion can show itself in another form. If two separate frequencies are applied to a non-linear amplifier, the output will contain, along with the harmonics of the applied frequencies, components equal to the sum and difference of the applied frequencies.

Fig. 1. Two typical non-linear transmission characteristics. (A) Characteristics tending to introduce even harmonics and (B) those tending to introduce odd harmonics.



A practical example of these two forms of non-linear distortion could be taken if we apply frequencies of 60 cps and 1000 cps to our non-linear amplifier. The output might then contain: 60 and 1000 cps fundamentals; harmonic distortion components of 120, 180, 2000, and 3000 cps; and intermodulation distortion components of 880, 940, 1060, 1120, 1940, and 2060 cps. Everything but the 60 cps and 1000 cps frequencies is the distortion generated by the amplifier.

These two forms of non-linear distortion, harmonic and intermodulation, are usually expressed in quantity as a percentage. The per-cent total harmonic distortion is equal to the r.m.s. value of all the harmonic distortion voltages divided by the r.m.s. value of the fundamental voltage.

$$\% \text{ total harmonic distortion} = \frac{\sqrt{E_2^2 + E_3^2 + E_4^2 + \dots}}{E_1} \times 100$$

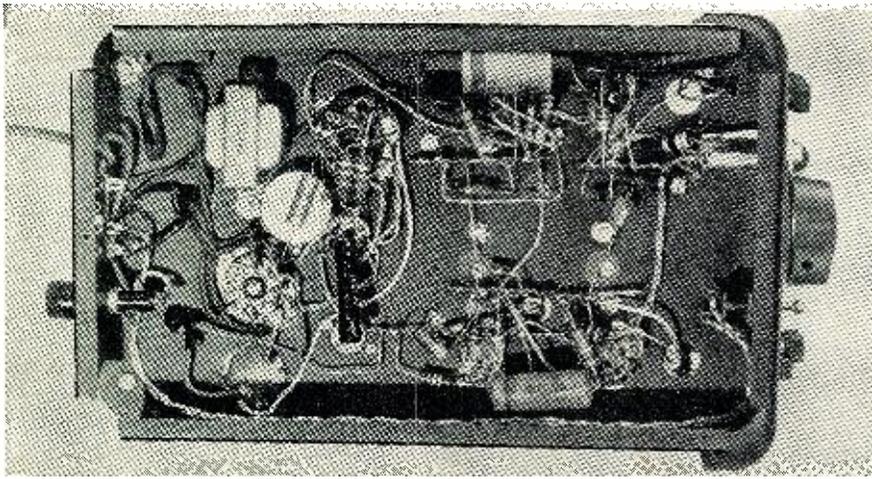
where: E_1 = the r.m.s. value of fundamental

E_2 = the r.m.s. value of 2nd harmonic

E_3 = the r.m.s. value of 3rd harmonic, etc.

In intermodulation distortion measurements a high- and a low-frequency signal are applied to the system under test. The per-cent intermodulation distortion is usually defined as the r.m.s. per-cent modulation of the high-frequency signal.

Thus the two common ways of expressing measured distortion are per-cent total harmonic and per-cent



↑ Bottom view of analyzer. See text for special precautions required when wiring.

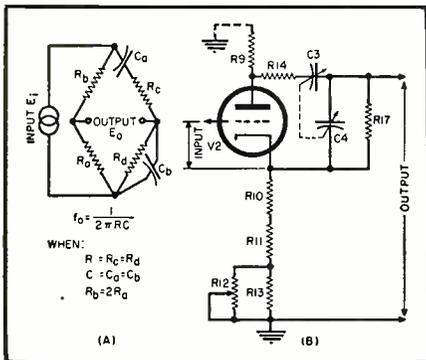


Fig. 2. A Wien bridge circuit. (A) Simplified circuit, and (B) the circuit used in the distortion analyzer discussed in text.

intermodulation. Both indicate the non-linearity of a system. In pre-high-fidelity audio, amplifier non-linearity was usually indicated by per-cent total harmonic distortion at a single frequency, usually at 400 cps or 1000 cps. This method, however, could grossly misrepresent the quality of an amplifier because usually audio amplifiers exhibit a characteristic wherein the amount of distortion or non-linearity present varies with frequency. The case is usually such that at the mid-frequencies (400 to 1000 cps) harmonic distortion is lowest. Although the harmonic distortion of an amplifier may be only 1% at 1000 cps at rated power, the distortion at 50 cps and 5000 cps may be well over 5%. A single frequency measurement of harmonic distortion gives very limited information as to the quality of an amplifying system.

By using the intermodulation meth-

od of measuring distortion, however, a single measurement can give a much better indication of over-all quality than a single harmonic measurement. This is because in the intermodulation method a high and a low frequency are applied simultaneously to the system under test. Thus the system is checked at the high and low end in one test. This method lends itself very nicely to quick checks of over-all quality such as on the production line, in recording, and broadcast systems.

A very comprehensive check of amplifier and system quality, however, is by measurement of harmonic distortion at selected frequencies throughout the audio range. This method has long been used in specifying broadcast amplifier quality and is considered standard by the Federal Communications Commission. The instrument described, when used with an audio oscillator and voltmeter, will measure total harmonic distortion over the entire audio range from 40 cps to 15 kc.

The "total" method described here is identical with that used in several commercial distortion analyzers and was found quite satisfactory. A sine-wave signal from a low distortion oscillator is fed into the amplifier or system to be checked. The output is measured with an audio voltmeter and then fed through a selective filter that eliminates the fundamental frequency but passes the harmonics unattenuated. The harmonics are then measured with the voltmeter and the per-cent total distortion read directly from the meter.

Circuitry

This distortion analyzer is essentially a variable frequency Wien bridge filter. It consists of four vacuum tube amplifiers as seen in the schematic. The input tube is a 6AU6 voltage amplifier with about 15 db feedback through cathode degeneration to reduce distortion generated in this stage. The second stage provides the input voltage for the Wien bridge filter. The unbalanced bridge output is fed to the grid of amplifier V_3 . The cathode-follower output 6C4 provides a low impedance source for the external voltmeter and also for the feedback resistor which loops the four stages back to the input tube cathode. The low impedance output is necessary so the stray capacity of the voltmeter leads will not limit the high frequency response of the system and so negligible fundamental frequency voltage will appear in the output through the feedback loop when the bridge is balanced.

The heart of the analyzer is the Wien bridge. The reader is probably somewhat familiar with the Wien bridge as it is used in the feedback loop of the common RC audio oscillator. Fig. 2A shows a simplified circuit. The bridge is balanced, that is, the output voltage drops to zero, when:

$$f_0 = 1 / (2\pi RC); 2R_a = R_b$$

where:

$$R = R_c = R_d \text{ and } C = C_A = C_B$$

At frequencies other than f_0 the

FREQUENCY	H-P ANALYZER	UNIT DESCRIBED
100 cps	0.16% Dist.	0.13% Dist.
100 cps	0.77%	0.66%
100 cps	3.0%	2.9%
100 cps	7.7%	7.5%
1 kc.	0.16%	0.14%
1 kc.	0.58%	0.50%
1 kc.	3.8%	3.6%
1 kc.	7.4%	7.0%
10 kc.	0.12%	0.15%
10 kc.	0.60%	0.50%
10 kc.	3.0%	2.9%
10 kc.	6.0%	5.7%

Table 1. A comparison of distortion measurements made with the analyzer described and those made with a Hewlett-Packard Model 330B distortion analyzer instrument.

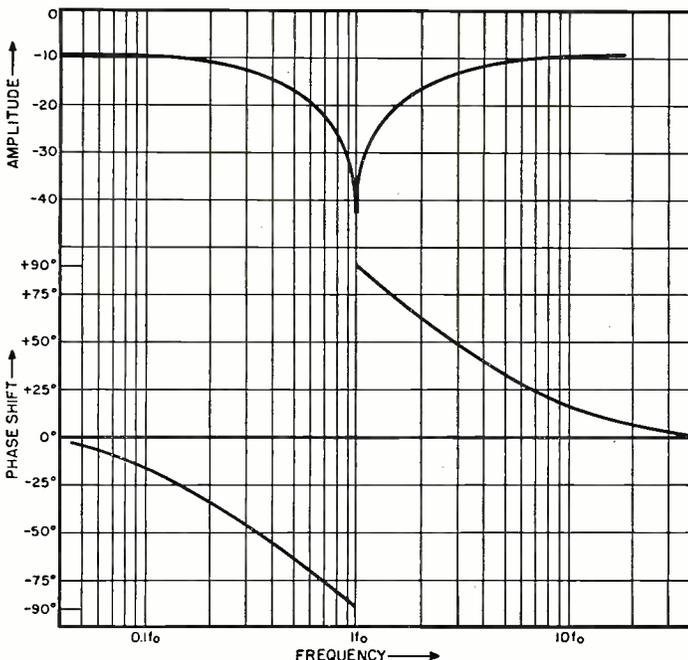


Fig. 3. Theoretical phase and amplitude response of a Wien bridge. Zero db level equals the input signal.

bridge is unbalanced and the output voltage (E_o) approaches $\frac{1}{3} E_i$ at frequencies much higher or lower than f_o . Fig. 3 shows a plot of the theoretical amplitude and phase response characteristics of the unloaded Wien bridge.

The circuitry of the bridge in this application is shown in Fig. 2B. The input to the bridge is the voltage between the cathode and plate of V_2 . Plate resistor R_0 corresponds to R_b in the simplified circuit of Fig. 2A. R_{10} , R_{11} , R_{12} , and R_{13} go to make up R_a . The frequency is covered in the conventional three decades so the ganged tuning capacitors must cover a 10 to 1 range in capacity. The parts list calls for a maximum value of 470 $\mu\text{fd.}$ for the dual tuning capacitor. This particular capacitor was used because it was easily available. Changing the value will merely change the frequency range according to the formula: $f_o = 1/(2\pi RC)$. C_3 and C_1 of course must be the same capacity and track reasonably well.

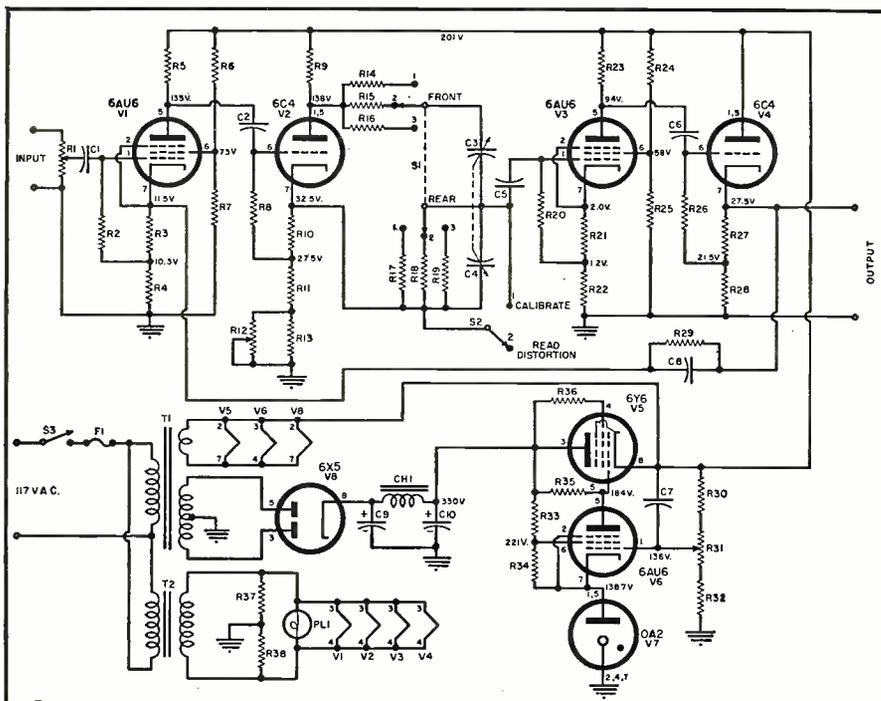
R_{14} , R_{15} , etc. are specified as 1% tolerance units. This was done so that one frequency calibration would hold for all three bands. If the builder is willing to sacrifice accuracy of calibration, 5% values would be satisfactory and a lot cheaper. At first it might appear wider tolerance resistors would throw the bridge off balance. The balance control R_{12} , however, will compensate for the resistors and variable capacitor being slightly off the precise desired values.

To sharpen the null of the Wien bridge filter about 15 db of negative feedback is used around the entire circuit. R_{20} provides the feedback from the output to the cathode of V_1 . Low frequency stability is assured by proper choice of coupling capacitors and the elimination of screen bypass capacitors. C_8 adjusts the loop's high-frequency response to insure high-frequency stability. The measured frequency response curves at various null frequencies are shown in Fig. 4. From the curves it can be seen that the response to the second and third harmonics of the null frequency is down less than 1 db except at the very high frequencies. This means the error in distortion measurement due to undesired harmonic attenuation is under 10 per-cent over most of the frequency range.

S_2 is used to switch the Wien bridge in and out of the circuit. When the bridge is out of the circuit (S_2 in "calibrate" position), the unit functions as a wide-range amplifier with a gain of approximately 20 db. Frequency response is plotted at D of Fig. 4.

An electronically-regulated power source is used to supply the plate voltage for all tubes. This is to prevent line voltage fluctuations from causing erratic meter movement during low-distortion measurements. The regulator circuit requires a separate 6-volt heater source held at the regulated d.c. potential (200 volts). This precaution

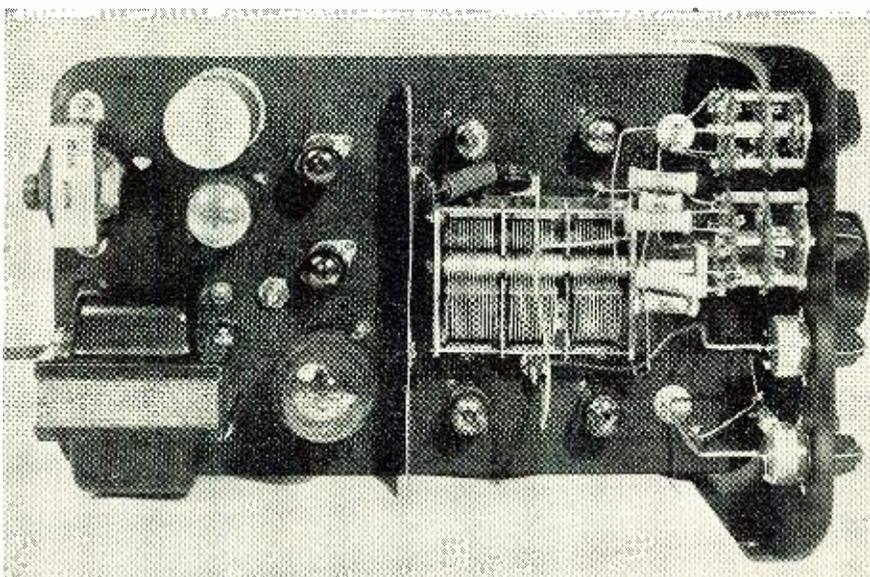
(Continued on page 122)



- R_1 —100,000 ohm pot
- R_2, R_8, R_{20} —1 megohm, $\frac{1}{2}$ w. res.
- R_3, R_{12} —390 ohm, $\frac{1}{2}$ w. res.
- R_4 —3300 ohm, $\frac{1}{2}$ w. res.
- R_5 —33,000 ohm, $\frac{1}{2}$ w. res.
- R_6, R_{21} —33,000 ohm, 1 w. res.
- R_7 —27,000 ohm, 1 w. res.
- R_9 —39,000 ohm, $\frac{1}{2}$ w. res.
- R_{10} —2700 ohm, $\frac{1}{2}$ w. res.
- R_{11} —15,000 ohm, $\frac{1}{2}$ w. res.
- R_{12} —10,000 ohm pot
- R_{13} —8200 ohm, $\frac{1}{2}$ w. res.
- R_{14}, R_{17} —10 megohm, $\frac{1}{2}$ w. res. $\pm 1\%$
- R_{15}, R_{18} —1 megohm, $\frac{1}{2}$ w. res. $\pm 1\%$
- R_{16}, R_{19} —100,000 ohm, $\frac{1}{2}$ w. res. $\pm 1\%$
- R_{20} —10 megohm, $\frac{1}{2}$ w. res.
- R_{22} —680 ohm, $\frac{1}{2}$ w. res.
- R_{23} —82,000 ohm, $\frac{1}{2}$ w. res.
- R_{25} —18,000 ohm, $\frac{1}{2}$ w. res.
- R_{27} —1200 ohm, $\frac{1}{2}$ w. res.
- R_{28} —4700 ohm, $\frac{1}{2}$ w. res.
- R_{29} —82,000 ohm, $\frac{1}{2}$ w. res.
- R_{30}, R_{32} —47,000 ohm, $\frac{1}{2}$ w. res.
- R_{31} —50,000 ohm pot
- R_{35} —9000 ohm, 4 w. wirewound res.
- R_{34} —8000 ohm, 4 w. wirewound res.
- R_{36} —270,000 ohm, $\frac{1}{2}$ w. res.
- R_{38} —1000 ohm, 1 w. res.
- R_{37}, R_{38} —47 ohm, 1 w. res.
- C_1 —1 $\mu\text{fd.}$, 400 v. capacitor
- C_2 —5 $\mu\text{fd.}$, 200 v. capacitor
- C_3, C_4 —Dual var. air capacitor. 30 to 470 $\mu\text{fd.}$ per sec. (see text)
- C_5 —.05 $\mu\text{fd.}$, 200 v. capacitor
- C_6, C_7 —.01 $\mu\text{fd.}$, 200 v. capacitor
- C_8 —22 $\mu\text{fd.}$ mica capacitor
- C_9, C_{10} —40/40 $\mu\text{fd.}$, 450 v. elec. capacitor
- CH1—4 henry, 50 ma. filter choke
- T1—Power trans. 335-0-335 v. @ 50 ma.; 6.3 v. @ 3 amps.
- T2—Fil. trans. 6.3 v. @ 1.2 amps.
- PL—6.3 volt pilot lamp
- F1—1 amp. fuse
- S1—D.p. 3-pos. wafer switch
- S2—S.p.d.t. wafer switch
- S3—S.p.s.t. toggle switch
- V1, V5, V6—6AU6 tube
- V3, V4—6C4 tube
- V5—6Y6 tube
- V7—0A2/VR150 tube
- V8—6X5 tube

Schematic diagram of the distortion analyzer. It is useful for audio servicing, in broadcast studios, or in checking home hi-fi equipment.

Top view of unit showing placement of parts. Although photo shows a 3-gang capacitor, which author had, only a 2-gang unit is required.



Frequency Control

through

Variable Resistance

By HAROLD E. BRYAN

A novel method of tuning a circuit by means of a variable resistance. This technique has numerous applications.

DESIGNERS of electronic equipment employing oscillators have frequently wished for a simple method of controlling the tuning remotely. It often happens in the course of a design that a panel control is required, while the circuit layout is of such a nature as to create a considerable problem in mechanical linkage. Reactance tubes are well known, of course, and are admirably suited for many applications. However, a desire has frequently been expressed for a method which contains no critical circuits such as the phase-shifting networks of the reactance tubes, and one which is relatively easy to design and operate.

For certain applications, the circuits to be described meet these requirements quite well. Although they are very simple, it would appear that not many have thought of or used them to advantage. Very little was found in the literature concerning such methods of tuning and a number of engineers with whom the circuits were discussed expressed surprise at the fact that they had not thought of them before. In view of the general interest in and lack of knowledge of the operation of these circuits, the author felt it desirable to examine them more closely.

Two general types of circuits are available for the type of tuning to be described. These are the obvious ones of capacity variation and inductance variation. While the requirements of most applications will be met by the capacitance variation circuit, the second type has been included in order to cover those "unusual" applications that are always cropping up.

Capacitance Variation

The fundamental circuit of the capacitance variation method is shown in Fig. 1A. As can be seen, this differs from the usual circuit only in the addition of capacitor C_1 through the variable resistance R . Obviously, the effectiveness of this capacitor in determining the frequency will change as the resistance value is varied. The question, of course, is how much and in what manner. Inspection shows that when the resistance is zero the frequency will be lowest, being determined by the sum of C and C_1 . Similarly, when the resistance is infinite, the frequency will be determined solely by the value of C and will thus have its highest value.

The "Q" of the circuit will also be affected by the variation of the value of R . Since the "Q" will be maximum when R is both zero and infinity, it must of necessity reach a minimum

value at some frequency between these extremes. This is of considerable interest, since the stability and general operating excellence of the circuit will depend to some extent upon its "Q" value. In deriving the equations that follow, the inductors and capacitors were considered as lossless for simplicity's sake. Consequently, maximum "Q" will appear as infinity. This is not considered serious, since if the actual "Q" at points near the maximum values is required it may be obtained with a little extra work. If reasonably good components are used the effect will be negligible at other frequencies.

Considered as a parallel resonant circuit, the admittance of the circuit of Fig. 1A will be:

$$Y = j\omega C + \frac{1}{j\omega L} + \frac{1}{1 + jR\omega C_1}$$

If resonance is defined as a condition of unity power factor this equation may be solved for both the resistance required to establish a given frequency, and for the "Q" of the circuit at that frequency. Through a little manipulation and simplification these equations can be made "livable." The resistance R required to establish any given frequency can be expressed by:

$$R^2 = \frac{(k^2 - 1)a^2}{k^2\omega_1^2 C_1^2 (a^2 - k^2)}$$

where: $\omega_1^2 = 1/L(C + C_1)$

$\omega_2^2 = 1/LC$

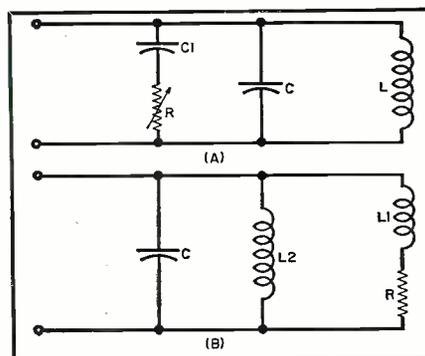
$a^2 = \omega_2^2/\omega_1^2$

$k^2 = \omega^2/\omega_1^2$

$\omega = 2\pi f$

In this equation the variables are k , representing frequency, and R , since all other factors are fixed. Thus, as k varies from a value of one to a value equal to that of a the resistance must vary from zero to infinity. Conversely, as R is changed the value of k , and the operating frequency, must change in order to satisfy the equation. Because when $k=1$ the operating frequency equals the lowest frequency f_1 , the resistance will be zero at that point and

Fig. 1. (A) Basic circuit of the capacitance variation method and (B) the inductance variation technique. Refer to the article.



infinite at the highest frequency. This verifies our previous observations.

The "Q" of the circuit is found from the equation

$$Q = \frac{a}{\sqrt{(a^2 - k^2)(k^2 - 1)}}$$

where the factors a and k are as previously defined. The "Q" of the circuit will go to infinity when $k=1$ and again when $k=a$, again confirming the conclusions reached by inspection.

Of interest to the designer is the minimum value of this "Q" and the frequency at which it occurs. It will be found that when the "Q" is at its minimum value the frequency will be determined by:

$$k^2 = (a^2 + 1)/2$$

and the "Q" at that frequency will be:

$$Q_m = 2a / (a^2 - 1)$$

From the standpoint of design, it would be desirable to determine the value of a for any desired minimum value of "Q". Solving for a , we find:

$$a = \frac{1 + \sqrt{1 + Q_m^2}}{Q_m}$$

or in more familiar terms:

$$C/C_1 = \frac{\sqrt{1 + Q_m^2} - 1}{2}$$

The curve of Fig. 3 shows the variation of Q_m with the value of a , the ratio of the two extreme frequencies.

As can be seen, the minimum value of "Q" drops rapidly as a is increased from unity, reaching a value of 10 when a is approximately 1.1. For many applications, this restriction in the usable tuning range may be too extreme, but where only a relatively small percentage change in frequency is required a minimum "Q" of 20 or more may be maintained. The minimum "Q" required will, of course, depend upon the application.

Fig. 2A illustrates the application of these equations to a low-frequency oscillator such as might be used for a beat frequency oscillator in a receiver. The value of a was chosen to provide a minimum "Q" of 15, which was considered adequate for the intended application. The frequency varies from 429 kc. at zero resistance to 458 kc. at infinite resistance. In practice these limits will not be achieved, particularly if a tube is used to provide the variable resistance. In low-frequency applications a variable resistor could probably be used satisfactorily if the maximum desired resistance is kept to a reasonable value. It will be noted that although the frequency is not a linear function of the resistance, reasonable linearity will be achieved over limited ranges of operation. Toward the high-frequency end of the curve, relatively large changes of resistance are required to produce fairly small frequency changes. This may be a desirable area of operation from the standpoint of stability since small drifts in resistance will result in small

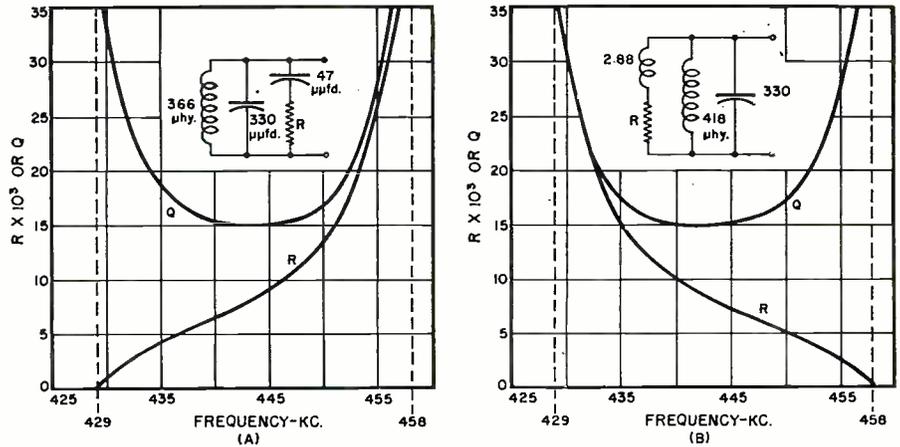


Fig. 2. (A) Application of the capacity variation equations to a low-frequency oscillator. (B) Inductance variation applied to the same problem as shown in (A).

frequency variations. On the other hand, in the vicinity of the minimum "Q" the frequency changes fairly rapidly with the resistance. This could conceivably be a desirable condition in some applications. In addition, the resistance is comparatively low in this region, making application to higher frequency circuits somewhat easier.

Inductance Variation

The basic circuit of the inductance variation method is shown in Fig 1B. This circuit differs from the foregoing in that an inductance is added through a variable resistor rather than a capacitor. The effectiveness of this inductance in determining the frequency of resonance will, as in the previous case, depend upon the value of the resistance.

Inspection shows that the resistance varies indirectly with the frequency, as opposed to the capacity variation method. Thus, when the resistance is zero the two inductances will act in parallel and the frequency will consequently be at its highest value. When the resistance is infinite only L_2 is effectively in the circuit and the frequency will be lowest. As in the previous case, the "Q" will be maximum at these two extremes and a minimum somewhere between.

The admittance of the circuit of Fig. 1B is:

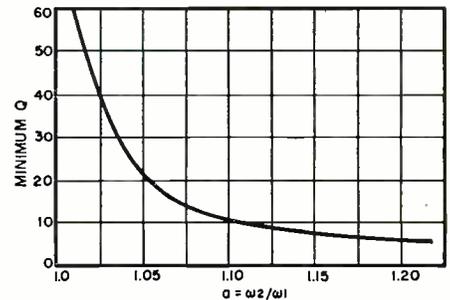


Fig. 3. Curve for determining minimum "Q" for both types of circuits. See article.

$$Y_i = j\omega C + \frac{1}{j\omega L_2} + \frac{1}{R + j\omega L_1}$$

The value of R may thus be expressed by:

$$R^2 = \frac{k^2 \omega_1^2 L_1^2 (a^2 - k^2)}{k^2 - 1}$$

and:

$$Q = \frac{k^2}{\sqrt{(k^2 - 1)(a^2 - k^2)}}$$

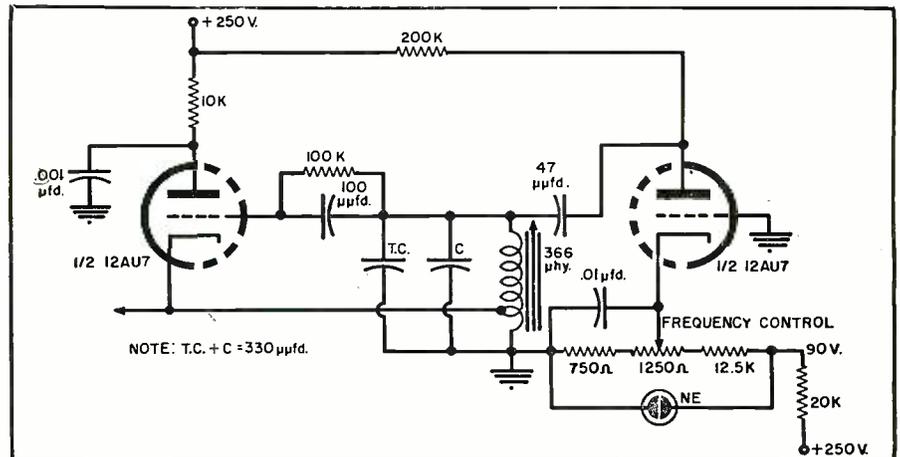
where:

$$\begin{aligned} \omega_1^2 &= 1/L_2 C \\ \omega_2^2 &= (L_1 + L_2) / L_1 L_2 C \\ a^2 &= \omega_2^2 / \omega_1^2 \\ k^2 &= \omega^2 / \omega_1^2 \end{aligned}$$

Examination of these equations shows that the resistance will be infinite when the operating frequency equals the lowest frequency ($k=1$) and zero when operating at the high-

(Continued on page 100)

Fig. 4. Circuit of a receiver b.i.o. using the capacitance variation method.



A Transistorized Signal Tracer

By LOUIS E. GARNER, JR.

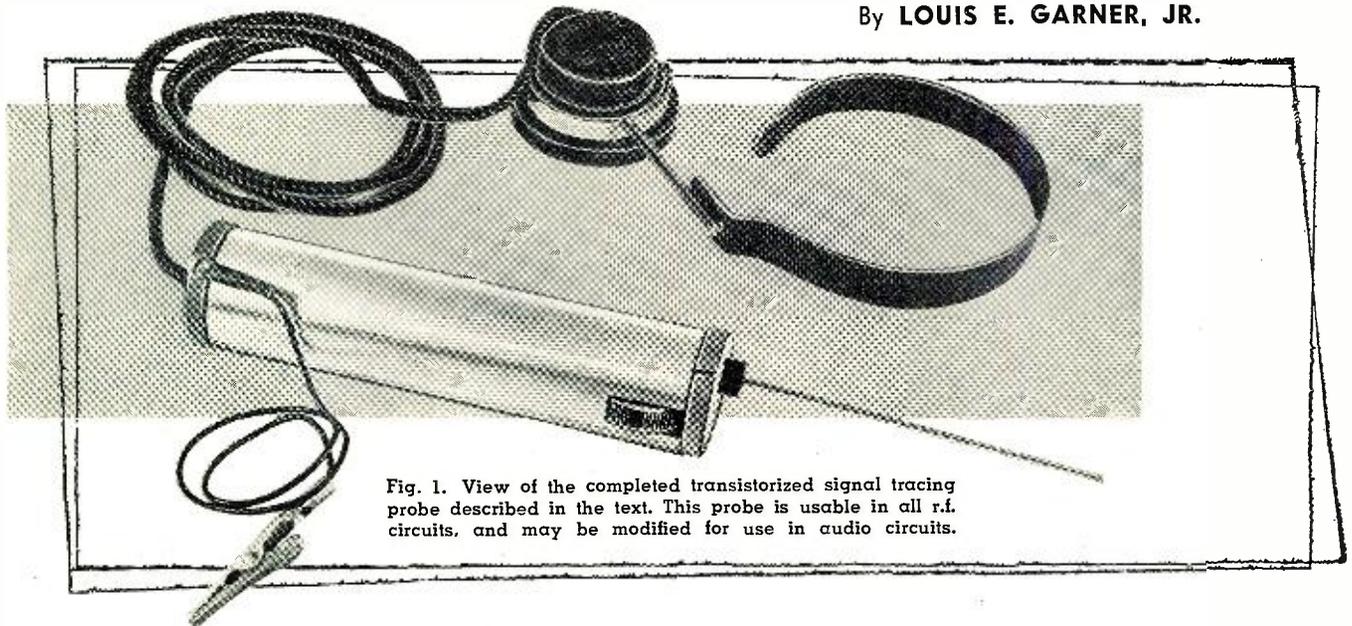


Fig. 1. View of the completed transistorized signal tracing probe described in the text. This probe is usable in all r.f. circuits, and may be modified for use in audio circuits.

Inexpensive and easy-to-build of standard parts, this unit is invaluable for radio servicing and other uses.

SIGNAL TRACING has long been recognized as one of the most powerful servicing techniques available to the service technician. By following a signal through a receiver, the technician can generally isolate the defective stage within a matter of minutes. Frequently, he can isolate the defective part just as quickly.

Unfortunately, most of the signal tracers offered to the service technician in the past have been fairly large and bulky. Few have been compact enough to include in the tool box. Not so the signal tracer shown in Fig. 1. Truly compact, the instrument easily fits within the average tool box—in fact, it is no larger than the probe supplied with many of the older vacuum-tube signal tracers. Yet it is a com-

plete, self-contained instrument, incorporating two stages of audio amplification, an r.f. detector, a gain control, and its own power supply.

Since no power line connections are used, the instrument is especially well suited for work on a.c.-d.c. sets, auto radios, and portable receivers. It may also be used for such jobs as checking record players and p.a. amplifiers, television receivers, or any electronic equipment in which there is a signal that may be traced from stage to stage.

Circuit Description

The complete schematic diagram for the transistorized signal tracer is given in Fig. 2. Two *p-n-p* junction transistors and one germanium diode are

used in the circuit. Power is supplied by a two-cell mercury battery (B_1).

In operation, an r.f. signal picked up by the probe is coupled through d.c. blocking capacitor C_1 to the 1N34 diode detector CR_1 . The detected audio signal is applied, through isolating resistor R_1 , to the subminiature potentiometer R_2 , which serves as a gain control. R_1 is provided to keep the primary of transformer T_1 from acting as a d.c. "short" across the 1N34 detector when the center arm of R_2 is in its maximum gain position.

A portion of the audio signal appearing across R_2 (depending on the setting of this control) is applied to the primary of T_1 . This transformer serves to match the high impedance of R_2 and the detector to the comparatively low impedance of amplifier stage V_1 , a *p-n-p* transistor connected as a common emitter amplifier.

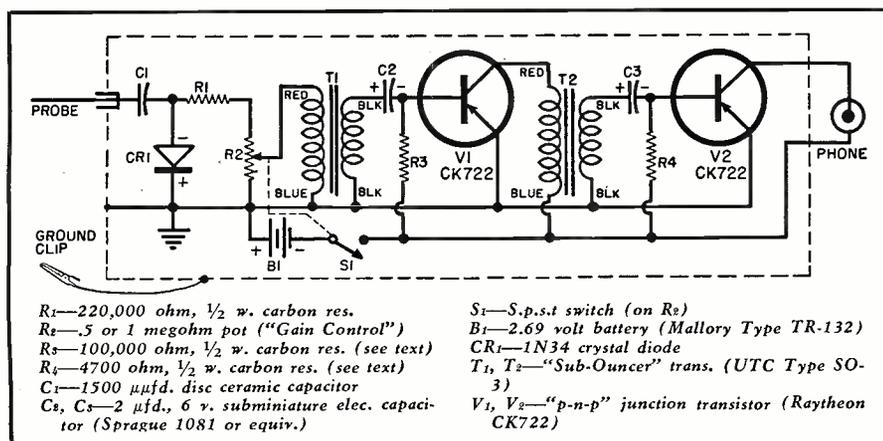
Capacitor C_2 is a subminiature electrolytic, used for coupling the secondary of T_1 to the base of V_1 . R_3 , returning to the negative side of the battery B_1 , serves as the base return resistor for this stage and determines the base bias current.

The collector of V_1 is connected to the primary of T_2 , an interstage audio transformer used to match the high output impedance of V_1 to the low impedance of the output stage, V_2 . C_3 and R_4 serve the same purposes as C_2 and R_3 , respectively, but for the second stage.

A *p-n-p* transistor, V_2 , is also used in the output stage and, like V_1 , is also connected as a common emitter amplifier. This stage is directly coupled to a magnetic headset, which serves as the output load.

A s.p.s.t. switch, mounted on R_2 , serves as the power switch.

Fig. 2. Complete schematic diagram and parts list for the transistorized probe.



Above and below chassis views are given in Figs. 3 and 5, respectively.

A small rectangular piece of fiber plate is used as a chassis. It is cut somewhat shorter than the case to accommodate the mercury battery. The battery itself is held in place by a small compression spring. Small rectangular holes are cut in the fiber chassis for the "Sub-Ouncer" transformers T_1 and T_2 . These two transformers, as well as the subminiature tube sockets used for the transistors, are cemented to the fiber plate with "Duco" cement.

Grounding to the case is accomplished by means of a ground lug mounted on one side of the fiber chassis and bent so that it bears against the case when the wired chassis is inserted in the tube. See Fig. 3. An external ground lead, made up of a piece of flexible wire and an alligator clip, is attached to the outside of the case with a sheet metal screw. The case itself is a piece of aluminum tubing fitted with metal end caps. A rectangular notch in the tube accommodates the gain control knob.

A phone tip jack is mounted on the front metal end cap. This jack holds the probe securely in place, yet permits easy removal for packing. The probe itself is a piece of straightened #12 tinned bus bar—a piece of brass or steel rod will serve as well.

Only nominal values are given for resistors R_3 and R_4 in the parts list. For best results, these resistors should be chosen experimentally to match the transistors used. Choose values which give the best compromise between high gain, low distortion, and minimum noise without exceeding the maximum collector current ratings for the transistors (5 milliamperes for the CK722).

Parts layout and lead dress are not especially critical, although standard good engineering practice should be followed. Care should be taken that the polarity of all connections is observed.

In order to avoid possible heat damage, use a hot, well-tinned soldering iron and complete each connection as quickly as possible. "Lap" joints should be used throughout.

The basic signal tracer circuit, as given in Fig. 2, may be easily modified to meet the special needs of the individual builder.

As designed, the signal tracer is intended to be used exclusively for checking r.f. circuits. A simple modification and the addition of a single component will permit the instrument's use as a combination a.f.-r.f. signal tracer. A s.p.s.t. switch is connected in series with the 1N34 detector—an inexpensive slide switch may be used here, if desired.

When the switch is closed, the detector is in the circuit, and r.f. signals may be checked. Opening the switch converts the instrument into an audio signal tracer.

Type CK722 transistors were used in the model because of their low cost and ready availability. However, other

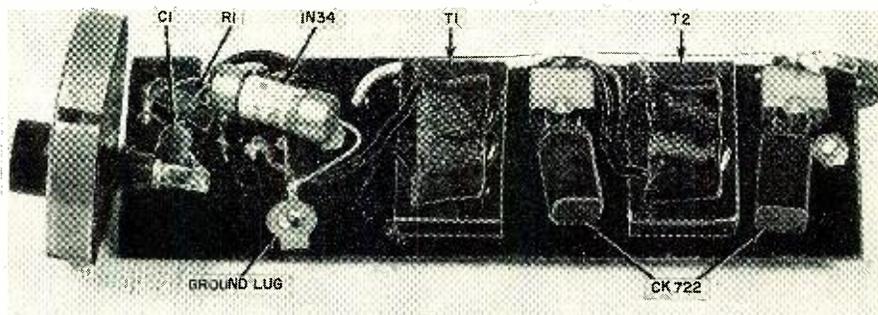


Fig. 3. View of the top of the chassis of the probe, showing placement of parts.

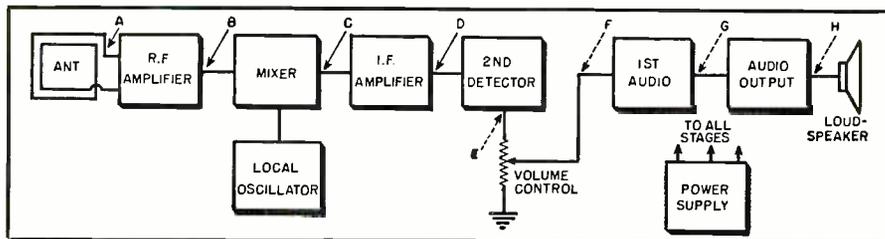


Fig. 4. Block diagram of a typical radio receiver showing the various points at which the transistorized probe could be used for signal tracing, stage-by-stage.

transistors may be used here without major circuit changes. As long as *p-n-p* junction transistors are employed, the only change necessary should be in the values of R_3 and R_4 . New values for these resistors may be best determined experimentally.

Somewhat higher gain should be obtained if type CK721 transistors are substituted for the type CK722.

Although the model is quite compact, a few changes in the parts used will permit the assembly of an even smaller unit. Simply substitute subminiature tantalum capacitors for the small electrolytics used, and replace the "Sub-Ouncer" transformers (T_1 and T_2) with either "Sub-Sub-Ouncers" or with special transistor type transformers.

Still other modifications are possible. A conventional zinc-carbon battery may be substituted for the mercury battery specified in the parts list. The initial cost will be lower, but battery life will not be as long. If a crystal earphone is used instead of a 1000-ohm magnetic headset, connect a 10,000-ohm, 1/2-watt resistor in the collector

circuit of the output stage and use a .01 μ fd. coupling capacitor to the earphone.

Using the Signal Tracer

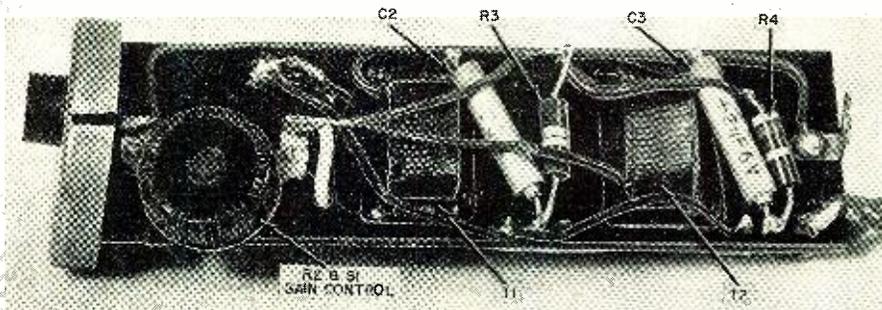
Once the wiring is completed and checked, the instrument may be given an operational test. Turn the gain control fully on and touch a metal object or an antenna lead with the probe. Strong, nearby broadcast stations should be heard. If there are no nearby stations, a signal generator may be used as a signal source for test purposes. Use a modulated signal.

To use the instrument in servicing, connect the ground lead to the chassis of the equipment being checked. The probe is then touched to check points in the equipment. With practice, one hand operation of the signal tracer is possible; the extended thumb may be used to adjust the gain control.

The basic signal tracing procedure is illustrated, in block diagram form, in Fig. 4. Assuming a receiver to be inoperative, a strong signal is supplied to the antenna. This may be either a

(Continued on page 125)

Fig. 5. Bottom view of the chassis. The gain control unit is made by Centralab.



METERING CIRCUITS FOR TUNING V.H.F. TRANSMITTERS

By JACK DARR

Simple method for checking and adjusting a v.h.f. transmitter without detuning the circuit tested.

A COMPARATIVELY simple low-frequency transmitter is hard enough to tune up properly to obtain the best output but when the complication of a very-high-frequency and several stages of frequency multiplication is added, the problem becomes really tough. The v.h.f. stages are so delicate that the addition of any

type of testing and measuring equipment detunes them to such an extent that they are sometimes completely inoperative when the meter is removed!

Fortunately, there is one easy way to check and adjust this kind of equipment. It has been in use in commercial two-way FM equipment for several years and is incorporated in practically all of the major makes in one form and another.

The average ham-shop is generally deficient in gear of the type needed for very sensitive v.h.f. measurements. With the method to be described, even relatively insensitive meters may be used. When building new equipment, provision may be made for the metering and this circuit can even be added to existing transmitters.

Basically, this circuit uses only one meter to check the alignment and tuning of any circuit by measuring only one of the operating constants: the grid current. As all frequency multiplier stages operate in class C, the amount of grid current drawn is a perfect indication of the tuning of the preceding stage and can even be used to check the performance of different tubes or tube types in any given circuit. The meter is switched into the grid return circuit of each stage in turn, beginning at the oscillator and winding up at the antenna. Let us set up a typical transmitter, and see how it works. (See Fig. 2.)

This is a partial schematic of an FM transmitter but the principle is the same with either FM or AM. Our transmitter uses a total of five stages: a quadrupler, a tripler, two doublers, and the final, not counting the oscillator. The grid circuits of each stage are returned to ground through the grid coils and a grid resistor, in this case 220,000 ohms. At the bottom end of each grid return, there is a 1000-ohm resistor, suitably bypassed by a .002 μ fd. capacitor: this is across the whole resistance network, to provide an r.f. ground for the coil. Plate coils are shown only for the tuning adjustments.

A multi-throw, single-pole switch is shown in the metering circuit. This switch should have as many positions as there are stages to be checked. From this switch, the leads go to a common phone jack and on to ground. The meter may be plugged into the jack and removed after all adjustments are completed, or permanently wired into the circuit as a "panel meter." If it is plugged in, it may be used for tuning the final; this will be discussed in just a moment.

The values given are for use with a 50 microampere movement. This is a rather sensitive and delicate movement, but one which is becoming increasingly common, as many commercial v.o.m.'s, such as *Triplet*, *Simpson*, *Hickok*, and others are using it. If a less sensitive meter is used, it might be necessary to adjust the size

(Continued on page 142)

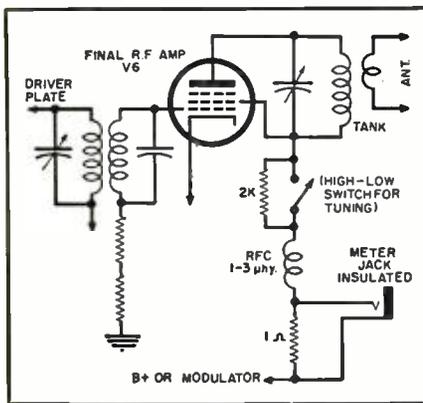


Fig. 1. Final stage of a typical transmitter showing placement of meter. If push-pull tubes are used, a s.p.d.t. switch may be used in the meter circuit to enable balancing the final tubes' plate currents.

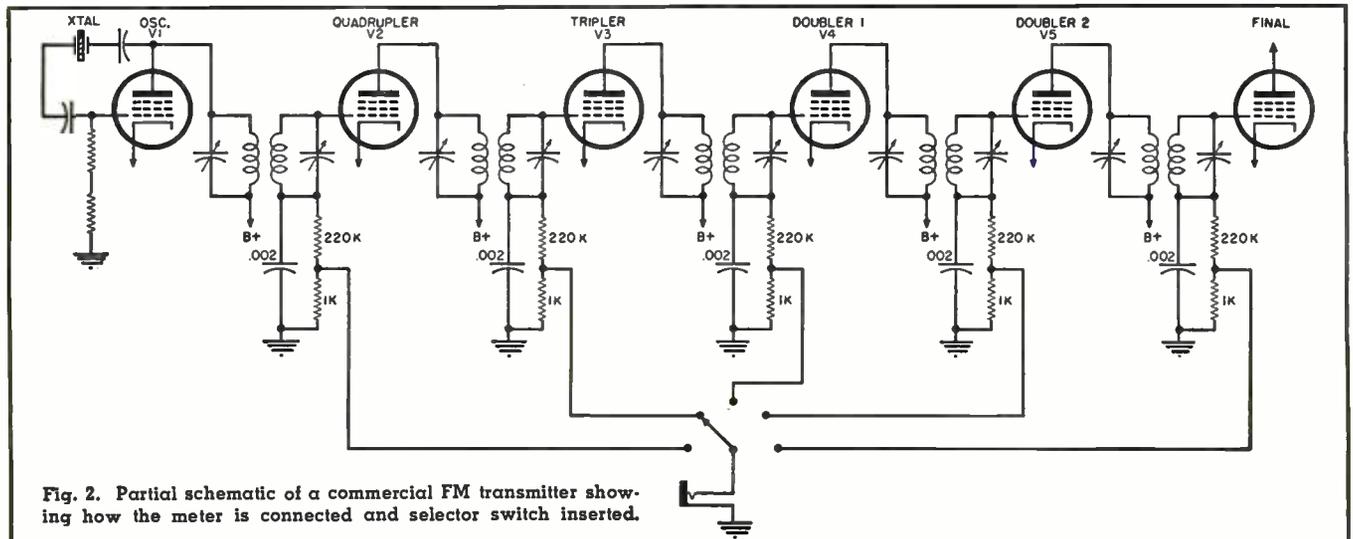


Fig. 2. Partial schematic of a commercial FM transmitter showing how the meter is connected and selector switch inserted.

Unusual Sounds



Equipment used in the various echo circuits. Microphone is of the filter type.

Sell Radio "Spots"

By
JACK THORNTON

SOUND effects—once a network dramatic show device—have become necessary for even the smallest radio station. Commercial departments are often called upon to create a “new sound” for spot announcements. Indeed, spot campaigns have been lost when some ear-catching effect was not ready. But local stations have difficulty creating many effects. Salesmen and front-office personnel are not ordinarily acquainted with audio circuitry, while operators may lack time to experiment. And, of course, expense must be considered. Engineers and commercial men alike will find here a simple outline of echo, variable speed recording, and filter microphone effects which can be easily produced with equipment at hand.

Echo Chambers

Echo and reverberative effects are useful in commercials. Your tape recorder will create them without the need for actual chambers. Basically, the echo involves feeding the tape recorder's output back into its input along with the sound for echo. Any of several setups will serve. They all require a tape recorder with separate recording and playback heads. Thus a machine with three or more heads—erase, record, playback—can be used without alteration. The machine on top of the console in the photograph is one of this type. Following the description of echo circuits, a simple and inexpensive method of adapting machines with only a single dual-purpose record-playback head will be described.

Fig. 1 illustrates the sound for echo being fed from a microphone through a mixing console into a tape machine input. The output of the machine's

Simple, standard equipment can be easily modified to provide an interesting variety of sound effects.

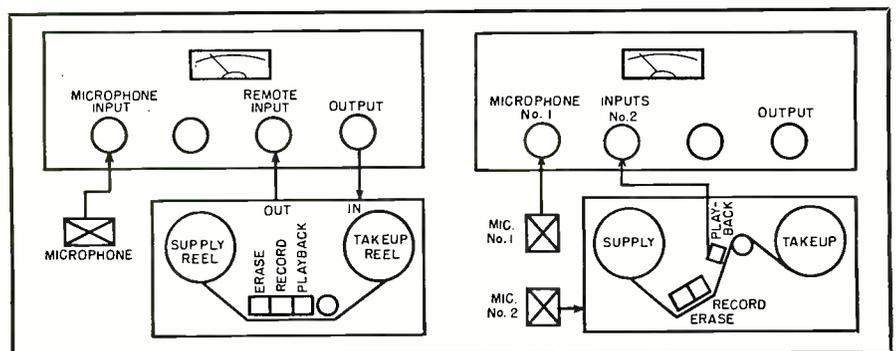
playback head and amplifier is fed into the console through a remote input, where it is mixed with the original sound's source. The controlled feedback thus set up should be monitored on a studio speaker or on earphones. Note that the *amount* of feedback, or echo, is controlled by the second input mixer. Anything from a slight “liveness” to a weird wail can be produced. The *time delay* involved is controlled either by varying the tape's speed or the spacing between the recording and playback heads. (This is covered more fully in a later paragraph on adding a playback head to a machine.) If you want a recording, the same tape used for the echo bears the material. If the echo is aired live, the tape serves only

to produce the effect and might as well be a short band spliced together to move continuously.

A useful variation of this setup is diagrammed in Fig. 2. You may not wish a reverberating echo, but rather desire the words to be repeated only once. (Outdoor public address systems sound like this if the sound from a distant loudspeaker reaches the hearer after that from a nearby speaker.) Place the tape recorder microphone and the control board microphone side by side. Feed the tape machine from its own microphone. At the control board, feed in both the original sound and the delayed signal from the tape. While not as striking as a reverberating echo,
(Continued on page 116)

Fig. 1. (Left) The basic echo circuit. Diagram is for machine with separate recording and playback amplifiers. A modified machine would feed into board microphone input.

Fig. 2. (Right) Echo variation. Machine diagrammed has additional head installed to work into a microphone input. Other type machine would feed a remote input. Refer to text.



ADMIRAL Television

Test Points

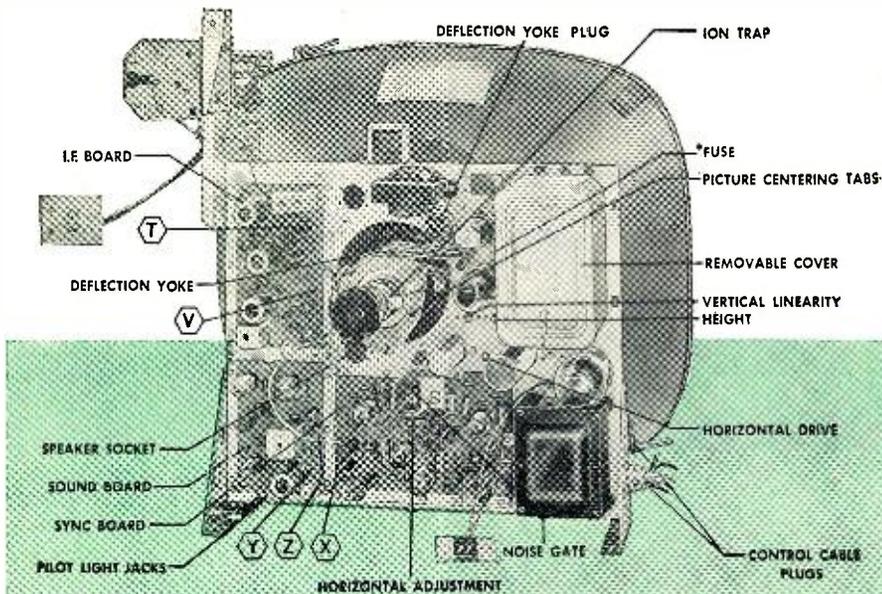


Fig. 1. Rear view of the Admiral 20Y4E TV chassis, typical of the firm's 1956 TV line. Note the various test points indicated.

By **T. P. CLEMENTS** and **HUGH S. WYETH**
Admiral Corporation, Service Division

Using the six regular test points provided will allow almost complete servicing of these printed-wiring sets.

ABOUT three-fourths of the circuitry in the 20Y4 series, the basic chassis used in 1956 *Admiral* television receivers, is dip-soldered printed wiring. The chassis is vertically mounted with all tubes and most component parts accessible by simply removing the cabinet back.

The easy-to-get-at components and the provision of test points permit fast troubleshooting, and even complete alignment, without removing the chassis. The picture tube is mounted separately from the chassis, so that the chassis can be removed without loosening or removing the picture tube. The chassis mounting brackets allow the chassis to be transported in either a vertical or horizontal position.

The back view of a representative 1956 chassis, the 20Y4E, used in 21-inch console and table models is shown in Fig. 1. This view shows the cascade turret tuner mounted in its "top tuning" position. This tuner uses the newly developed type 6BC8 twin triode as a cascade r.f. amplifier. This tube is a variable- μ type having a semi-remote cut-off characteristic and allows the r.f. amplifier to handle a wider range of signal strengths. In an emergency, a 6BZ7 tube can be used as a substitute, but under some conditions there may be more snow in the picture, or if the incoming signal is very strong there may be overloading, sync instability, and similar overload problems.

Three printed-wiring boards are used. At the upper left corner of the chassis (see Fig. 1) is an i.f. amplifier board using two type 6BZ6 pentodes as

the first and second i.f. amplifiers, and a 6AM8 as a third i.f. amplifier and video detector. Immediately below the i.f. board is the sound board which includes a 6AU6 4.5 mc. i.f. amplifier, a 6AL5 ratio detector, a 6AV6 sound amplifier, and a 6BF5 sound output. To the right of the sound board is the sync board which includes the 6AW8 video amplifier and sync inverter, the 6CS6 gated sync separator, the 6BH8 gated a.g.c. tube and vertical oscillator, the 6S4 vertical output, the 6AL5 horizontal sync discriminator, and the 12AU7 horizontal oscillator. Only the 6CU6 horizontal output amplifier, the 6AU4 damper, the 1B3 high-voltage rectifier, and the 5U4GA power-supply rectifier are assembled on the main chassis.

Although just about all components and tube sockets are accessible for use as test points, the following test points are specifically identified on the printed wiring boards and their locations are noted in Figs. 1 and 4:

"X"—r.f. amplifier a.g.c. voltage.

"T"—i.f. amplifier a.g.c. voltage.

"V"—video detector output voltage.

"Y"—voltage across ratio detector load.

"Z"—ratio detector output.

An additional test point, "W," is located on the tuner near the 6J6 oscillator-mixer tube as illustrated in Fig. 2. Also, in chassis having a built-in all-channel u.h.f. tuner, the v.h.f. tuner, r.f. amplifier, and mixer tubes become i.f. preamplifiers when receiving u.h.f. signals. In these chassis there is a test point "U" on the tuner which provides

the a.g.c. bias voltage applied to the 2nd i.f. preamplifier (v.h.f. mixer) when receiving u.h.f. signals. Test point "U" is normally used only when aligning the u.h.f. tuner.

Test points are of little value unless their use is understood. Starting with the tuner, following is a description of the troubles that can be found with the aid of the test points.

Test point "W" provides a measure of the tuner-mixer grid bias. Because the mixer grid bias is grid leak bias, a negative voltage will be measured at test point "W" which is proportional to the amplitude of the applied r.f. voltages. Since most of the r.f. voltage applied to the mixer grid is from the oscillator, the presence of a negative voltage of between 3 and 6 volts will show that the oscillator is working. The lower figure (3 volts) will occur on channels 7 through 13; the higher, on channels 2 through 6. If the oscillator is not oscillating, there will be little or no sound and there will be little or no snow. While these same symptoms could be caused by a defective video i.f. amplifier or video detector, if the voltage at test point "W" is much less than about 3 volts, it is more likely that the oscillator-mixer tube in the tuner is defective or the circuitry of this tube has a defect.

Measurement of a.g.c. bias voltage often provides clues to troubles with symptoms ranging from horizontal or vertical sync instability to sound buzz or washed-out pictures. The i.f. amplifier a.g.c. bias voltage can be checked at test point "T" and the r.f. amplifier a.g.c. bias can be measured at test point "X." Fig. 3 shows a rough graph of the i.f. and r.f. a.g.c. voltages for different signal levels. The exact a.g.c. voltages will vary for different production run numbers on 20Y4 series chassis because of production changes and tuner variations.

The actual values of a.g.c. voltages are often not as important as the relationship between r.f. and i.f. amplifier a.g.c. voltages. For instance, a low i.f. a.g.c. voltage and a high r.f. a.g.c. might indicate a grid-to-cathode short

in the first i.f. amplifier or perhaps a gassy i.f. amplifier tube. On the other hand, a high i.f. a.g.c. voltage and a low r.f. a.g.c. voltage might indicate a defective r.f. amplifier tube. Of course, if both r.f. and i.f. a.g.c. voltages are very low, the trouble is probably in the a.g.c. circuit itself. To be sure, it would be necessary to check the voltage at the video detector output, test point "V."

On signals ranging from medium to very strong, the d.c. voltage at test point "V" will be about -3 volts. If this voltage is much greater, then the a.g.c. tube may be defective. Under these conditions, the picture may be unstable horizontally. If the voltage at test point "V" is much less than -2 volts on a moderately strong signal, then the low a.g.c. voltages may be a result of a defective i.f. amplifier or video detector tube. If for some reason there is a great loss of gain in the 3rd i.f. amplifier or the video detector, chances are that the i.f. amplifier will be overloaded on a strong signal and vertical roll or other evidences of sync clipping may result.

A good example of a trouble that is sometimes difficult to isolate is when the a.g.c. bypass or filter capacitors become open or greatly decreased in capacity in receivers having gated a.g.c. This allows the 15,750 cps pulsed voltage used to gate or key the a.g.c. tube to appear on the a.g.c. bus. This may cause a slight to severe shading of the picture from left to right, "touchy" sync, or complete loss of horizontal synchronization. An oscilloscope check at test points "T" or "X" under these conditions would show horizontal pulses or a saw-tooth at one or both points. Sometimes horizontal weaving or bending of the picture can be a result of 60 cps voltage on the a.g.c. bus. Again, this trouble can be found with an oscilloscope.

Test point "V" at the video detector output is the key to quickly tracking down many troubles. It enables the technician who uses an oscilloscope to quickly determine whether a fault is in the tuner or i.f. amplifier, or at some point beyond the video detector. For example, suppose that a check at test point "V" showed the sync pulses were squeezed down so their amplitude was much less than about 25% of the total peak-to-peak amplitude of the composite video signal. This would indicate that the i.f. amplifiers were being overloaded, and a further check at test points "T" and "X" might reveal that the a.g.c. voltage at one or both points is too low. Further checks might uncover a shorted a.g.c. bypass capacitor, for example.

Sound troubles can be localized through the use of test points "Y" and "Z." The voltage at point "Y" will depend upon signal strength and on the adjustment of the fine-tuning control on the tuner, but will range from about one volt negative to as high as 25 volts negative on strong signals. The presence of a negative voltage at test point "Y" which varies with signal

strength would localize a "no sound" complaint to some point beyond the ratio detector. Here again, although only a d.c. voltage is supposed to be present at test point "Y," the answer to some sound troubles can be found by checking this point with an oscilloscope. For instance, if the electrolytic capacitor which is connected across the load of the ratio detector tube is open, it will cause a buzz in the sound, and this will show up in an oscilloscope check.

Test point "Z" is the sound output of the ratio detector, and the d.c. voltage at this point should be close to zero.

Aside from the regular test points there are a number of other easy-to-get-at points that are very handy in troubleshooting. The picture-tube socket is a good example. The output of the video amplifier can be measured at the picture-tube cathode (pin 11). By dividing the peak-to-peak voltage measured here by the peak-to-peak voltage measured at test point "V," the gain of the video amplifier can be checked. In the 20Y4 series chassis the video amplifier gain with the contrast control turned fully clockwise is about 24.

The full "B+" voltage from the power supply can be measured at either of the two large pins on the speaker socket. The sound output tube is connected in series with other tubes, including the 3rd i.f. amplifier and sync separator, insofar as "B+" distribution is concerned. For this reason, a defective sound output tube can affect the picture and synchronization as well as the sound. To determine whether the sound output tube is good as a series "B+" regulator, measure the voltage at the cathode, pin 2, of the 6BF5 sound output tube. It should be about 150 volts. In all except combination models which use a 6DG6T

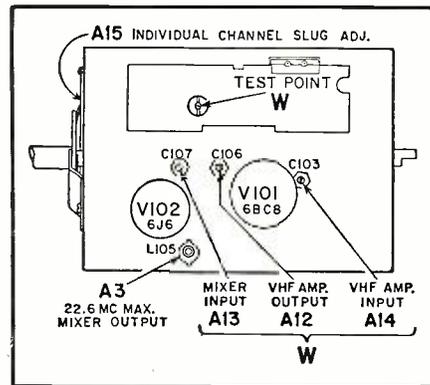


Fig. 2. Top view of the v.h.f. tuner used in many of the Admiral receivers.

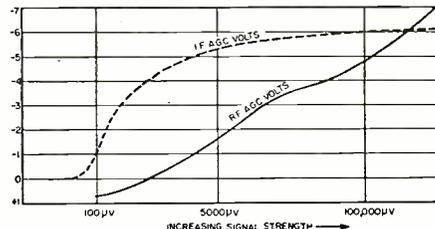


Fig. 3. Graph representing typical a.g.c. voltages (i.f. and r.f.) under strong, medium, and weak signal strength conditions.

sound output tube, this voltage can be measured from the back of the set.

Placing a trouble light behind a printed wiring board will actually allow the service technician to see through the board since it is made of translucent material. This makes it possible to see all the printed wiring connections between component parts, just as illustrated by Fig. 4.

Even without any printed service aids, the clean layout of the printed wiring boards in the new *Admiral* chassis, the accessibility of tubes and components, and the provision of test points should go a long way toward speeding up troubleshooting. -30-

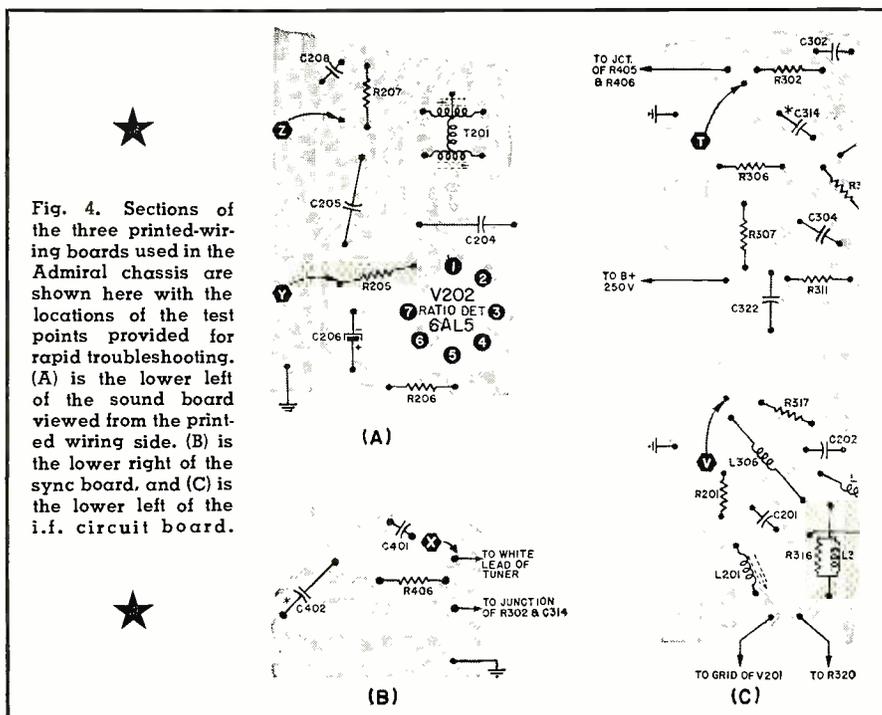


Fig. 4. Sections of the three printed-wiring boards used in the Admiral chassis are shown here with the locations of the test points provided for rapid troubleshooting. (A) is the lower left of the sound board viewed from the printed wiring side. (B) is the lower right of the sync board. and (C) is the lower left of the i.f. circuit board.

Certified RECORD REVUE

By **BERT WHYTE**

LAST month I used up most of my space with my annual yak-yak about the New York Audio Fair, and the reviews naturally suffered. As promised, this month will be devoted to records . . . as many as I can slip in. The reviews will be somewhat shorter than usual, but if I'm to keep up with the flood of new releases, that's the way it has to be! As you can imagine, I've been having myself a ball with some of the new equipment. Believe me, audio equipment is getting down to a fine point these days . . . the set-ups I have been using have now been refined to the stage where the limiting factor is the playback material.

I have everything so darn quiet now that when rumble is heard, for instance, I know that it is rumble *inherent in the recording* and not my system. The same can be said about wow and flutter and most noticeable has been the prominence of tape noise and hiss. In other words, in spite of what one might think to the contrary, it is possible to have equipment and discs so quiet that tape hiss can be heard against the *quieter* background of the disc! But don't get all excited . . . this is a condition largely the fault of a few careless record companies and the average recorded tape has a noise level considerably lower than the best discs, so don't throw away your tape recorder!

Equipment used this month: *Pickering* "Fluxvalve" cartridge; *Pickering* arm; *Components Corp.* turntable; *Marantz* preamp; *McIntosh* 60-watt amplifier; *Jensen* "Imperial" speaker; the *Stan White* "4-D" speaker. Tape equipment: *Amplex* 600 and 612 units.

STRAVINSKY

PETROUCHKA (Complete)

Minneapolis Symphony Orchestra conducted by *Antal Dorati*. Mercury MG-50058. RIAA curve. Price \$4.98.

Since 1949, the Ansermet/*London* recording of this work has been virtually unassailable and has become, in the short history of LP, a phonographic landmark. And deservedly so, for it was and is an extraordinary combination of superb reading and sound of unusual "presence." Up to this point, seven competitive recordings have appeared none of which engendered the slightest desire to change my affection for the Ansermet. With this present and eighth recording, the long reign of the Ansermet has come to an end for this is its equal in interpretation, superior in sound, and has the added virtue of completeness.

With *Mercury's* recent penchant for complete, uncut ballets, we are fortunate in hearing "Petrouchka" in its original form rather than as a "suite" from the score which has been the case in all previous recordings of the work. As such, this recording presents many new facets of "Petrouchka," and as *Dorati* adheres strictly to the original score indications for tempi, etc. even the familiar sections

are a little strange sounding to ears long conditioned to Ansermet's way with the suite. However it does not take long to realize that this is a much more graphic realization of the story and one is enchanted anew with this masterpiece.

Soundwise, as all good audiophiles know, the Ansermet disc was a demonstration show-piece which, as previously noted, held its own for six years. But good as it was, it pales to nothing before this stunning, this overwhelming sonic *tour-de-force*. When heard over a top wide-range high-fidelity system this is sound of spectacular brilliance and breathtaking realism. All the myriad elements in "Petrouchka" which lend themselves so well to hi-fi recording, are heard with new clarity and definition. The snare drum, so beloved in the old Ansermet, is ever more "snarly" and distinct. The trumpets, so widely used in their high register throughout this score, are beautifully clean and display no stridency which was a major drawback in previous recordings. The strings are clean-lined, all the wonderful Stravinsky winds . . . his flutes, piccolos, clarinets, and his beloved bassoon are vibrantly alive with "presence." Interesting too, was the piano section which in its flawless delineation gives rise to the thought of what the famed *Mercury* "Olympian" technique could accomplish with piano concerti!

Wrap all these wonderful sounds in spacious but not overdone acoustics, combine with ultra-wide frequency response and dynamic range and you have a recording which should stand the test of time even better than the *London* disc. Highly recommended to all and an absolute "must" for the Stravinskyite. Good surfaces and no rumble in my review copy.

GROFÉ

GRAND CANYON SUITE

COPLAND

EL SALON MEXICO

Boston Pops Orchestra conducted by *Arthur Fiedler*. Victor LM1928. RIAA curve. Price \$3.98.

This recording fills a long felt need for a really hi-fi version of the "Grand Canyon Suite," as well as giving us a bonus of the best "El Salon Mexico" available. The performances of *Fiedler* are of very high order even if he doesn't equal the titanic driving energy of *Toscanini* in the famous "Cloud-burst" section of the "Canyon." For those of you long fed up with "On the Trail" à la *Johnny of Philip Morris* fags, try listening to it as it is properly done on this disc. And to those of you who have never heard other than "On the Trail" section of the suite, I suggest hearing the whole thing . . . there are some very lovely things in this music

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.

especially the "Sunrise," "Painted Desert," and "Sunset" sections. It has been a long time since I have heard such wonderful playing from the Boston Symphony . . . simply exquisite string and wind playing. The splendidly clean sound, especially the strings, the wide frequency and dynamic range, and the properly spacious acoustics which create the wanted "wide open spaces" feeling in the "Suite," make for one of the most rewarding Boston Symphony discs now available.

HAYDN

THE CREATION

Vienna State Opera Chorus and Orchestra conducted by *Mogens Woldike* with *Teresa Stieh-Randall*, soprano; *Anton Dermota*, tenor; *Anny Felbermeyer*, soprano; *Paul Schoeffler*, baritone; *Fred Guthrie*, bass. Vanguard VRS471/472. RIAA curve. Price \$9.96. Two discs.

This is the third version of this Haydn masterpiece on LP, and as far as I'm concerned they can stop right here. The only proper word for this is the much-overworked "fabulous." This is one of those recordings where you instinctively know the participants involved are supremely conscientious and in their projection of the work, they are enjoying themselves. From all aspects . . . the authoritative and painstaking conducting of *Woldike*, the dedicated and beautiful singing of the wonderful soloists and the chorus, and the superlatively clean wide-range sound, this is the recording of choice. *Vanguard* is certainly to be complimented for undertaking such an ambitious project and for bringing together such an outstanding cast. Vocal purity and orchestral definition are the outstanding things in matters of sound and I am happy to note that the scourge of large scale choral works . . . the "blast" and choral/orchestral "blur and fusion" are almost totally absent. For oratorio lovers this is on the "must" list.

MOZART

SERENADE #4 IN D MAJOR

New Symphony Orchestra of London conducted by *Peter Maag*. London LL1206. RIAA curve. Price \$3.98.

Another *London* contribution to the Mozart Bicentennial and a good one. Youngish Mr. *Maag* evidently knows his way with Mozart and turns in an excellent performance, and the New Symphony Orchestra, not heard from for some time, does quite well even if the precision of the string section is somewhat less than perfect. Finely wrought sound, with exceptional string tone and very bright woodwinds plus an acoustic perspective that is spacious but in keeping with the score. Mozart *aficionados* will probably rejoice in this good-sounding version, since the only other LP of the "Serenade" is a miserable caricature of the work on the *Colosseum* label. Surfaces a little ticky in my copy.

LISZT

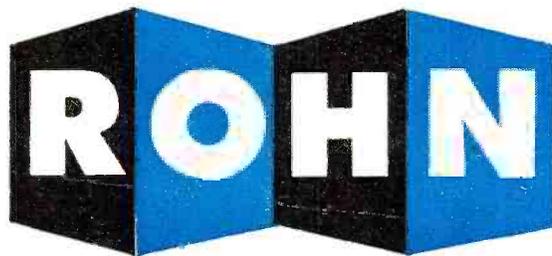
PIANO CONCERTO #1 HUNGARIAN FANTASIA

Philharmonia Orchestra conducted by *Otto Ackerman*, *Geza Anda*, pianist. Angel 35268. RIAA curve. Price \$4.98.

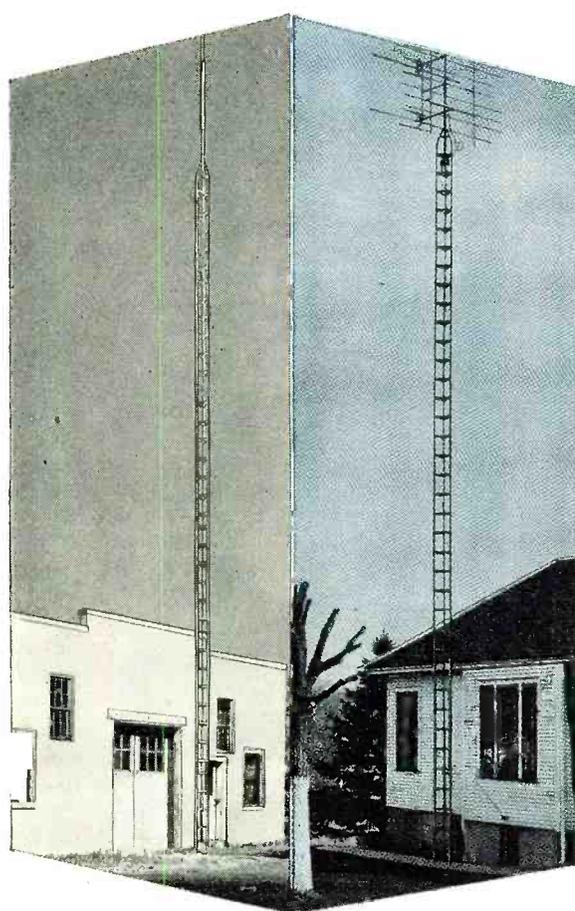
Lovers of the big romantic piano concerto will have a field day with this disc! It has one of the most "big-boned," robust piano sounds heard in some time, and is quite a switch from the usual *Angel* sound. *Geza Anda* who is proving himself as versatile in repertoire as he is good in talent, gives the most rousing performance of the "Concerto" available on LP. Noted in other recordings for his restraint and delicacy he essays the grandiose approach here and it comes off very well. With a steel-fingered, facile technique his reading thunders in properly Lisztian

(Continued on page 90)

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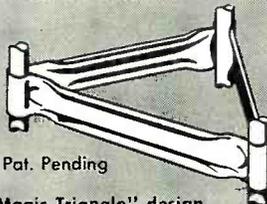


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NO. 6 TOWER

Features unexcelled 12½" equilateral "magic triangle" design with electric welding throughout. Self-supporting to 50', the Rohn No. 6 is ideal for home TV installation.



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Constructed for ease in shipping and storage. A 48' tower comes in six 8' sections bound together in a single 8' x 20" package! Self-supporting and available in 24' to 64' sizes.

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NO. 40 COMMUNICATIONS TOWER

For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized in this new Rohn Tower. The No. 40 is structurally sound so that you can install it for heights up to 300'; and is preferred for lesser heights when considerably greater strength is required because of excessive wind or antenna loading, etc. Check this tower for your requirements of this type. You'll find it just can't be beat, neither structurally nor price-wise!

Note: For lesser heights, use the Rohn No. 20 or No. 30 Tower . . . for experimental operation, use the Rohn "Fold-Over" Tower.

All Rohn Towers are quickly erected- shipped in easy-to-handle sections; and, Rohn-Designed accessories are available with each tower.

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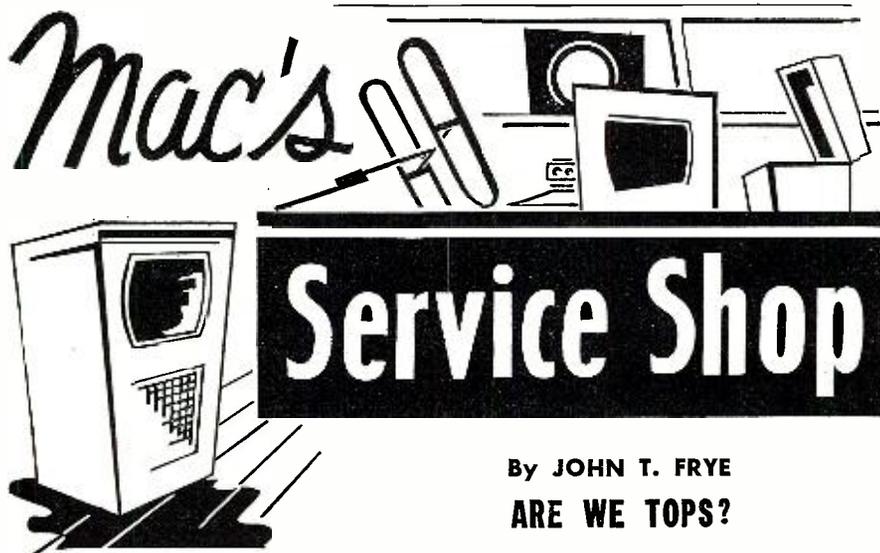
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By JOHN T. FRYE
ARE WE TOPS?

"MAC! Matilda! Come quick!" Barney yelled as he popped his red head inside the door of the service shop and as quickly withdrew it.

Mac dropped his solder gun on the bench; Matilda sprang up from her typewriter; and both rushed out into the wan sunshine that was slowly melting the February slush.

"Where's the wreck?" Mac demanded as he stared up and down the normal-looking street.

"Who said anything about a wreck?" Barney asked as he looked searchingly about. "I just saw the first robin, and I wanted you two for witnesses."

"You mean you dragged us out here in the cold just to see a bird?" Matilda demanded as she hugged her thinly-clad shoulders against the chilly breeze blowing off the melting snow.

"Not just a bird, a *robin*—and the first one this year," Barney explained heatedly. "You were too slow, and it's gone now, but I did see one."

"Of course you did!" Mac said with the exaggerated reassurance one employs with a child or the mentally deficient as he placed a soothing arm around Barney's shoulders. "Now you just come on inside and tell old Uncle Mac all about it."

"All right, you smart alecks," Barney growled as he shrugged off Mac's arm and stalked through the door of the service shop. "Have your fun, but I guess I know what I saw."

He sulked for a full half hour, which was a long time for the Irish lad with the sunny disposition; but then he could stand the silence no longer.

"Mac," he asked, "aren't Americans the best technicians in the world?"

"How do you mean?"

"Well, don't we have more know-how than any other nation when it comes to making things? Aren't our products the best?"

"That's a pretty broad claim," Mac said slowly; "what brings it up?"

"Last night after radio club a gang of the hams and hi-fi boys had a coffee-and-doughnuts session at the diner. Somehow we got on the subject of whether American products were tops

or not. I had always taken it pretty much for granted that they were, but some of the fellows put up a pretty stiff argument to the contrary.

"Take the manufacture of automobiles, for example, a field in which we might be expected to shine since we own three-fourths of all the automobiles in the world. Well, they said if you wanted and could afford the best, you did not buy an American stock car but instead purchased a foreign sports car or a *Rolls Royce*. One guy, who is a nut on automobiles, said proof of the supremacy of English cars was contained in '*Automobile Facts and Figures*' for 1954. In that year England made only one-sixth as many cars as we did, but she exported twice as many."

"A lot of other factors beside quality could influence those figures," Mac commented. "There's price, nearness to the European market, gas consumption in countries where gasoline is expensive, and so on."

"I used some of those arguments, but then they switched to our own field of electronics. If we are so smart electronically, they wanted to know, how come we let the English beat us to the discovery of radar? Next the hi-fi boys chimed in and claimed that England was out in front in the development of really high-quality audio equipment. They threw the Williamson amplifier at me, pointed out how many hi-fi magazine articles were written by English authors, and said that a couple of the best and most popular record players on the American market were made in England. To add insult to injury, one of the fellows who belongs to a tape correspondence club said that an English girl with whom he was corresponding had just purchased a new tape recorder and had sent him what she called the 'gen sheet.' This recorder cost almost exactly the equivalent in pounds that his own machine had cost in dollars; yet her machine specified a better frequency response at 3¼ ips than his claimed at 7½ ips; and at 7½ ips the frequency response of the English recorder was

nearly twice that of the best claimed for the better-than-average American home recorder."

"They were really pouring it on you, weren't they?" Mac said with a chuckle. "Just to make you feel worse, let me relate a little incident that happened only last month:

"A man brought in an English-made record changer for repair. It did not take long to spot the trouble: a small gear that had been pressed on a boss on another gear had worked loose. The owner had used this machine for many months, and the trouble could easily have been the result of 'man-handling' the changer. In order to remove the small assembly, I had to study the construction of the mechanism pretty thoroughly; and I was very much impressed with the good design and quality of workmanship. There was no skimping of material. The entire mechanism was put together with screws, and there was no reliance on spot-welding, bent-over tabs, or other devices that make for quick and cheap assembly but render the replacement of parts nearly impossible. Everything had apparently been done to make this changer operate perfectly when new and to keep it operating that way for a long time. As a single example, the rubber drive wheels were automatically removed from contact with the turntable when the changer shut itself off to prevent the development of pressure flat spots on those wheels.

"At any rate, I told the customer that since the changer was made abroad it would doubtless take a long time to get a replacement part; so I merely used a prick-punch to anchor the loose gear firmly in place and explained I was confident this part would never give any more trouble. At his insistence, though, I wrote to the U. S. distributor for the machine given in our service data and requested that a new part be sent C.O.D. About four days later I received an air mail letter from the distributor *apologizing* for the part failure! He went on to say that a new part was being sent air mail at no charge, and it arrived in the same mail!

"Remember this changer was not in warranty and that the trouble could easily have been caused by rough treatment. I had simply stated I needed a new part, nothing more. Contrast this with the case of that little receiver over there on the shelf. Over a month ago I ordered a new speaker for this radio that was purchased not quite a year ago. Apparently the distributor for this area did not have it in stock and back-ordered it from the factory. But why take a whole month to get a replacement part? My customer is thoroughly disgusted and swears he will never buy another product of that manufacture. The company that makes this set is one of the largest in the country and spends millions of dollars each year for radio, TV, magazine, and newspaper advertising; yet all the good-will they create in this fashion is

(Continued on page 178)

Heathkits

FOR THE ENTIRE ELECTRONICS INDUSTRY

more than 65 top-quality models to choose from, including such outstanding kit designs as . . .

THE
WORLD'S LEADING
MANUFACTURER
OF ELECTRONIC
KITS . . .

AMATEUR
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RADIO & TV
SERVICEMEN



INDUSTRIAL
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SCHOOLS



HI-FI
ENTHUSIASTS



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!

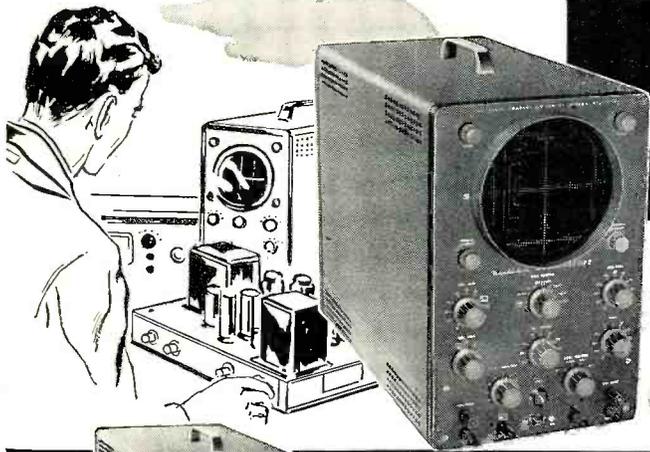
ONLY Heathkits CAN GIVE YOU ALL OF THESE DISTINCTIVE ADVANTAGES!

- ▶ *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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BENTON HARBOR 15, MICHIGAN



there is no substitute for
HEATHKIT QUALITY

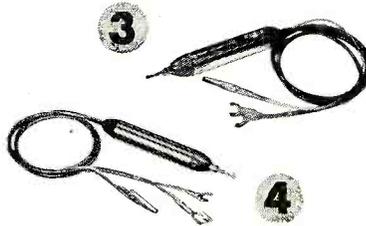
YOU GET MORE: All first-run, top quality parts—the latest in electronic design—complete and comprehensive step-by-step assembly instructions with large pictorial diagrams and assembly drawings. Proven performance through the production of thousands of kits.

MODEL O-10

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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 deflection amplifiers—and etched metal pre-attenuated input.

MODEL O-10
\$6950

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 pre-wired 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
\$4950

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
\$350

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
\$350

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.

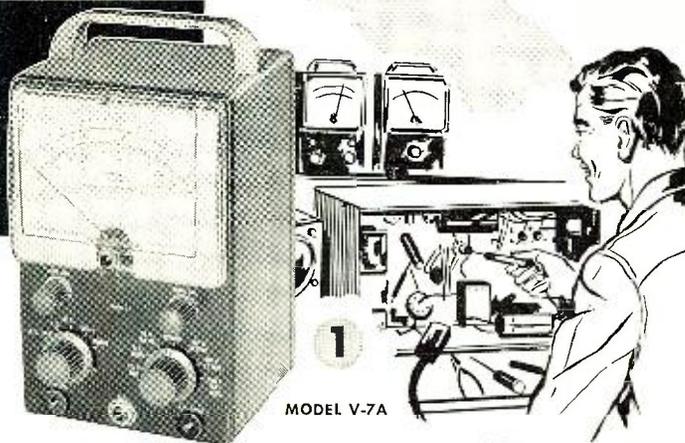
MODEL OL-1
\$2950

Shpg. Wt. 14 Lbs.

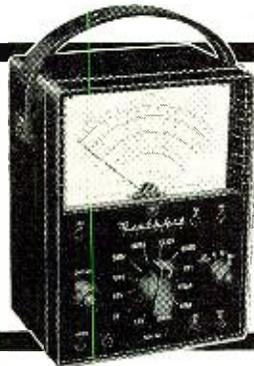
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fill your test requirements
WITH HEATHKITS

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.*



MODEL V-7A



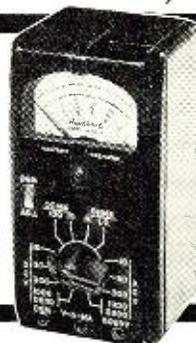
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1 *Heathkit* ETCHED CIRCUIT
VACUUM TUBE VOLTMETER KIT

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 μ 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

\$2450

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 μ a., 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 $4\frac{1}{2}$ " 50 μ a. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1

\$2950

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 $\pm 10\%$ accuracy. Uses etched circuits for increased circuit stability and ease of assembly. **\$350** NO. 309-C 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. **\$550** NO. 338-C 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. **\$450** NO. 336 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 μ a. 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. **\$1450** MODEL M-1 Shpg. Wt. 3 Lbs.

HEATH COMPANY

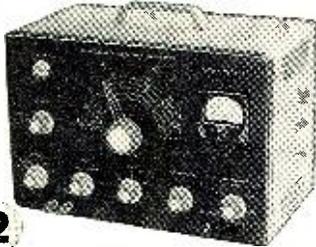
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Heathkit TV ALIGNMENT GENERATOR KIT



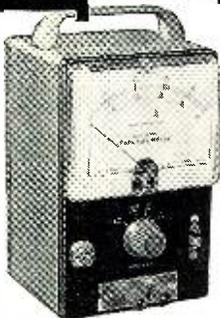
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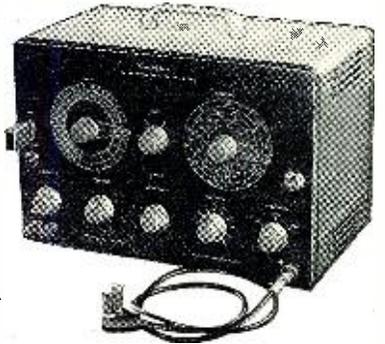
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**HEATH
COMPANY**
A SUBSIDIARY OF DAYSTROM INC.

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.

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 μ v. to 1 μ v. 200 μ a. 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 Shadow-graph 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.

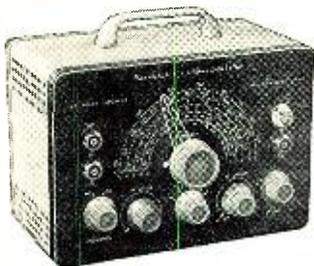
MODEL CM-1

\$29.50

Shpg. Wt. 7 Lbs.

BENTON HARBOR 15, MICHIGAN

RADIO & TELEVISION NEWS



MODEL SG-8 \$1950
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

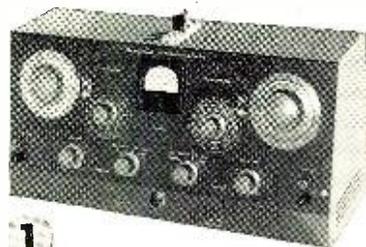
low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

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. 1/2% resistors and 1/2% 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.

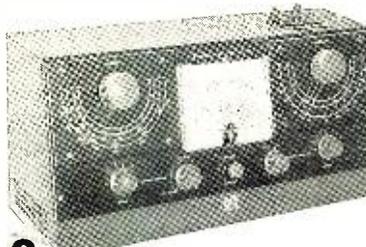
MODEL IB-2 \$5950
Shpg. Wt. 12 Lbs.



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 4 1/2" 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. Indispensable 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.

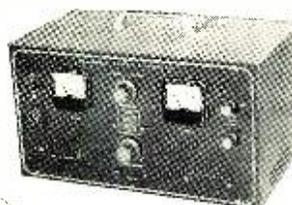
MODEL QM-1 \$4450
Shpg. Wt. 14 Lbs.



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 \$3150
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. Indispensable around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

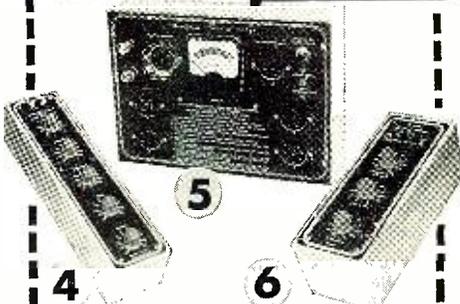
MODEL DR-1 \$1950
Shpg. Wt. 4 Lbs.

3

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 \$1450
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 \$1650
Shpg. Wt. 3 Lbs.

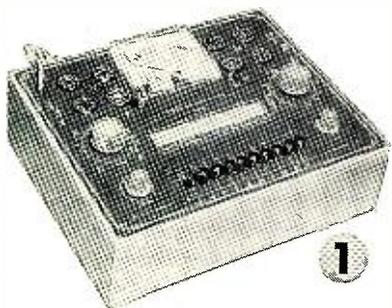
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HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

Heathkit TUBE CHECKER KIT



1

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.



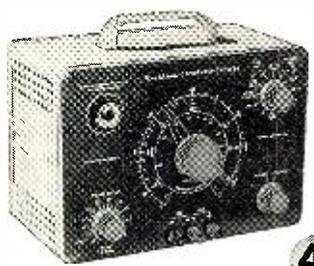
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3 Heathkit TV PICTURE TUBE TEST ADAPTER

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.



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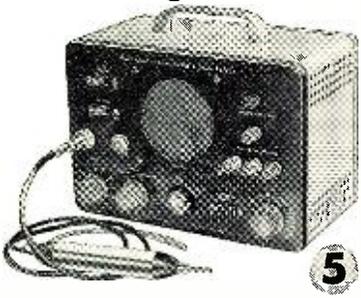
4 Heathkit . . . CONDENSER CHECKER KIT

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 mfd. 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 meg-ohms. 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

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.

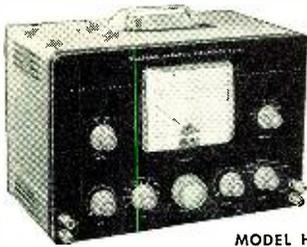
This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locator 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

RADIO & TELEVISION NEWS



MODEL HD-1

Shpg. Wt. 13 Lbs. **\$4950**

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

\$5950

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 $\pm 5\%$.

Output monitored on a large $4\frac{1}{2}$ " 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

\$3450

Shpg. Wt. 8 Lbs.



3 Heathkit AUDIO OSCILLATOR KIT

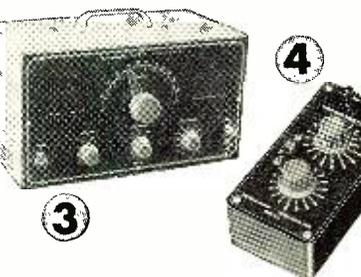
(SINE WAVE — SQUARE WAVE)

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

\$2450

Shpg. Wt. 10 Lbs.



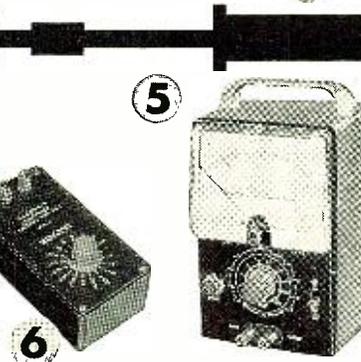
4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

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

\$550

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

\$2950

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

\$550

Shpg. Wt. 2 Lbs.



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HEATHKIT HAM GEAR

for high quality at moderate cost

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

MODEL DX-100



2



3



4

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 20⁷/₈" W. x 13³/₄" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
\$189⁵⁰
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 6¹/₂" W. x 7" D.

MODEL VF-1
\$19⁵⁰
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
\$29⁵⁰
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.

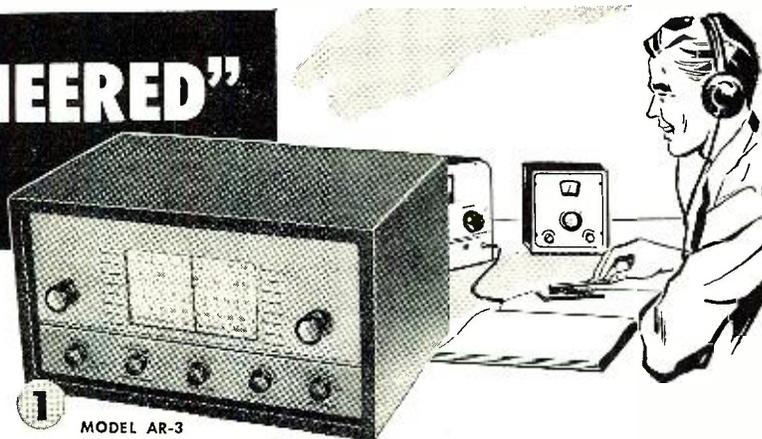
MODEL AC-1
\$14⁵⁰
Shpg. Wt. 4 Lbs.

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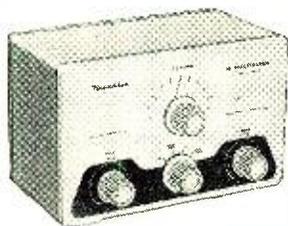
"AMATEUR-ENGINEERED"

Equipment For The Ham

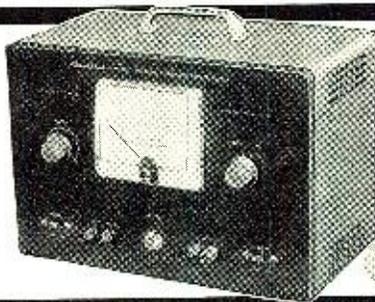
MODERN DESIGN: You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.



1 MODEL AR-3



2



3



4



5

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
\$27⁹⁵

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.x7½"W.x4½"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1
\$9⁹⁵

Shpg. Wt. 3 Lbs.

3 Heathkit VARIABLE VOLTAGE REGULATED POWER SUPPLY 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
\$35⁵⁰

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
\$14⁵⁰

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
\$19⁵⁰

Shpg. Wt. 4 lbs.

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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

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.

\$59⁷⁵

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.

\$79⁵⁰



2

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.

\$49⁷⁵

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.

\$69⁵⁰



3

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.

\$39⁷⁵

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.

\$59⁵⁰

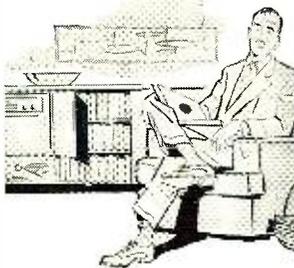
**HEATH
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RADIO & TELEVISION NEWS

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.

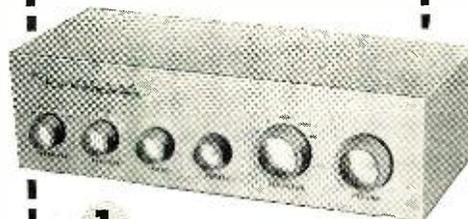
Output jack for tape recorder — separate bass control with 18 db boost and 12 db cut at 50 cps. — treble control offering 15 db boost and 20 db cut at 15,000 cps — special hum control to insure minimum hum level — and many other desirable features. Overall frequency response (with controls set to "flat" 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

\$197⁵

Shpg. Wt. 7 Lbs.



1

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

\$35⁵⁰

Shpg. Wt. 23 Lbs.



2

3 *Heathkit* 7 - WATT
AMPLIFIER KIT

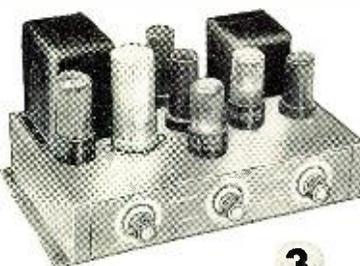
The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are $\pm 1\frac{1}{2}$ 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

\$16⁹⁵

Shpg. Wt. 10 Lbs.



3

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ELECTRONIC "ROBOT" COPIES CODE

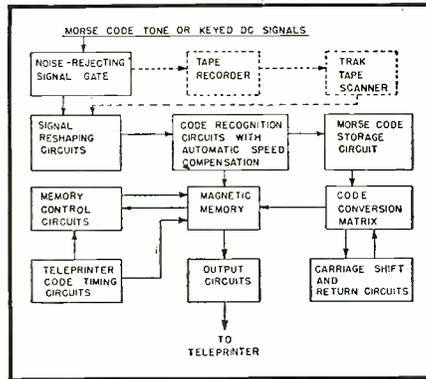
By **W. R. SMITH-VANIZ, JR.**
Vice-President, CGS Laboratories, Inc.

Details on an automatic device that converts International Morse Code directly into standard teleprinter page copy.

AFTER several years development work, CGS Laboratories of Stamford, Connecticut, publicly unveiled its "Trak" code converter—an all-electronic device which automatically translates Morse code signals into printed page copy on a teleprinter.

This Morse-to-teleprinter code converter is a special-purpose computer using both analog and digital techniques to perform the functions of a radio operator. It determines the speed at which the message is being sent and uses analog techniques to identify dots and dashes. Determining what character the dot-dash pattern represents, setting up the proper teleprinter code, and storing the message so that the printer can "copy behind" at high speeds are all digital operations.

In order to make use of a page printer, line feed and carriage return characters must be inserted at proper times into the output of the converter. To perform this function, the machine counts the letters of the text until the count reaches 64, after which the first word space is read into the printer as two carriage returns and a line feed. If the count reaches 72 without any



Block diagram of the "Trak" Morse-to-teleprinter code converter recently unveiled.

word space after 64, the carriage returns and line feed are delivered anyway and the word is broken.

While the three printer characters are being sent, the message itself is delayed in the memory until the printer is ready to receive it.

A somewhat similar operation occurs whenever a number or figure is received. For these characters, the printer must shift to the upper case posi-

Attending a demonstration of the first all-electronic Morse code converter are (from left to right): Carl G. Sontheimer, executive vice-president of CGS Laboratories; William R. Smith-Vaniz, Jr., vice-president of the company; Stanley Wolff, chief liaison engineer for CGS; and Captain N. Lucker, Jr., USN, Office of Joint Chiefs of Staff, Washington, D. C.



February, 1956

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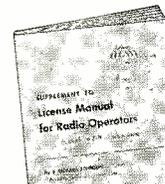
LICENSE MANUAL FOR RADIO OPERATORS by J. Richard Johnson (W2BDL) is a complete guide to FCC License Examination subjects. Best of all, it's written so you can easily understand and remember it. It states the questions . . . then gives you clear, concise answers.

This book covers ALL eight examination elements, not just some of them. Brings you full details of the latest communications laws . . . and all other pertinent data

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R-2

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tion before the character itself is printed. Whenever such a shift is required, either from letters to figures or vice versa, the message is delayed and the printer shift character is inserted ahead of it.

The memory is made necessary not only by the need for occasional addition of a "stunt function," but by the very nature of the two codes with which it must deal. In the Morse code, different characters require different lengths of time, while in the printer code, each character takes exactly as long as any other. Thus, in order to operate right up to the maximum speed of which the printer is capable, the shorter Morse characters (E, T, I, etc.) must be held up for a while until some longer characters (Q, J, Y, etc.) come along and allow the printer to "catch up." This is why operators copy behind, and this is why the converter must copy behind too.

The memory which allows the message to be stored until the printer catches up is a static magnetic shift register somewhat like those frequently found in large digital computers. It allows the printer to be behind the text by as much as ten characters.

The code converter is also supplied with an undulator inked tape scanner as optional equipment. A novel scanning arrangement repeatedly scans the entire width of the tape and produces accurate code signals even from tape which would offer great difficulty of visual interpretation by a skilled operator. Use of the scanner permits Morse code messages to be received from several sources simultaneously, stored conveniently, and subsequently transcribed through the code converter.

PACKARD-BELL SOUND PROBLEM
By MILTON A. KENNEDY, JR.

RECENTLY on an outside antenna installation job in a v.h.f.-u.h.f. area, a servicing problem arose which may be of help to other service technicians in similar circumstances. A combination u.h.f.-v.h.f. antenna was installed and the set was tried for operation on channels 6 and 61, the two local stations. The picture came in fine on both channels, but the sound on channel 6 was distorted, sounding somewhat like a leaky output coupling capacitor. The sound on channel 61 was clear.

The set was brought into the shop. Since the trouble was not on both channels, and since the set used a strip-type turret tuner, the v.h.f. strip was checked first. It was OK. Then, the front end was re-aligned for both channels without improving the sound.

After checking voltages and parts in the sound i.f. and detector stages, the first voltage amplifier and sound output stages were tested. Careful checking of the control grid of the output tube disclosed that the grid return resistor, which was supposed to be 180,000 ohms had gone up in value to over 300,000 ohms. Since in this area, channel 6 comes in much stronger than channel 61, the stronger signal from channel 6 apparently was causing a very large voltage drop across this grid resistor adding too much bias to the tube and causing the distortion.



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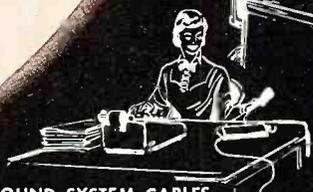
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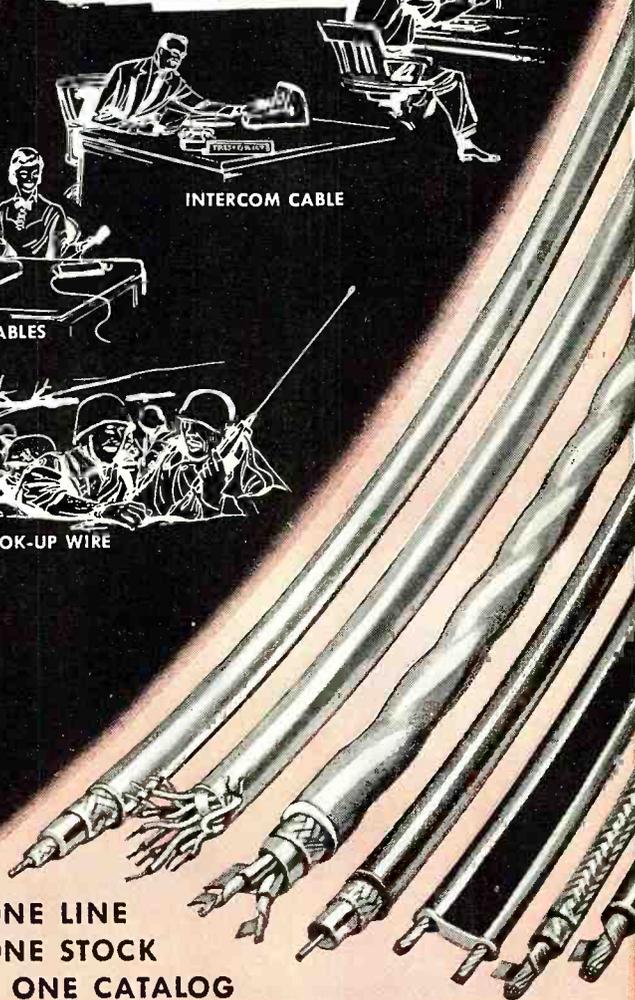
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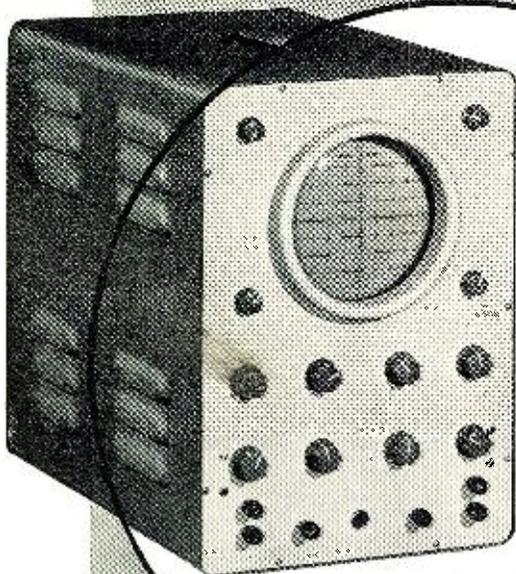
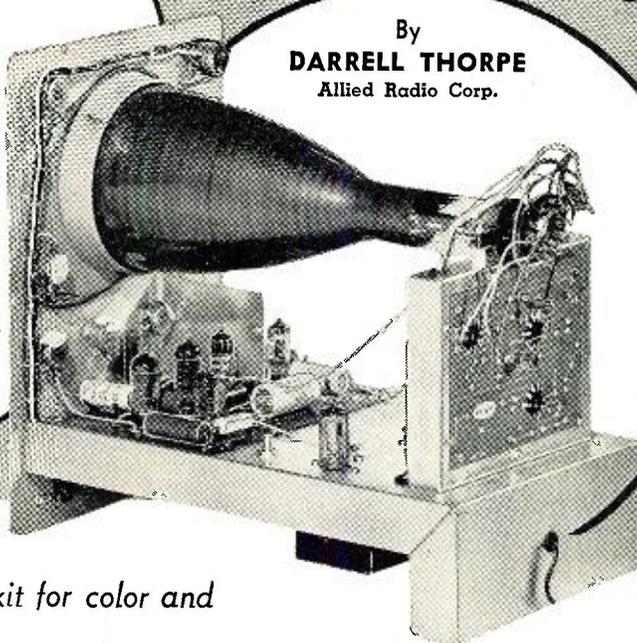


Fig. 1. External view of the assembled 5" oscilloscope available in kit form.

Fig. 2. Top view of the oscilloscope showing the two printed-wiring boards used and the laced-wiring harness furnished in the kit. Note the extreme neatness.

the "Knight" 5" Oscilloscope

By
DARRELL THORPE
Allied Radio Corp.



Design data on a new 5" oscilloscope kit for color and black-and-white TV servicing and other applications.

MORE and more, the oscilloscope is finding greater application in service work and for other uses where an inspection of signal waveform is a key to the operation of a circuit. The emphasis in new oscilloscopes is on wide-band operation, particularly for color TV work. A new wide-band scope available in kit form is shown in Fig. 1. The use in this kit of printed wiring and a laced-wiring harness (see Figs. 2 and 3) positively assures the kit builder that his oscilloscope will have the same characteristics as the engineering model.

This oscilloscope will accurately reproduce pulse waveforms with a rise time as short as .02 microsecond over a wide band of frequencies. The vertical sensitivity is 25 millivolts r.m.s. per inch. Typical applications for this scope are signal tracing in low level circuits, general null indicator, phase characteristic measurements in industrial applications, and sweep-frequency visual alignment of television receivers. All the necessary oscilloscope functions to do black-and-white and color television service work are included.

The ideal vertical input circuit to an oscilloscope would produce no loading effect upon the circuit being measured. This would require an input circuit that did not have any shunt capacitance and would have an infinite resistance to ground. Such a circuit is

actually never attained in practice.

The *Knight* wide-band oscilloscope has a very high input impedance, which presents negligible loading upon the circuit being measured. This high input impedance is attained by using a compensated input attenuator circuit. See Fig. 4. Two trimmer capacitors are provided to balance the attenuator so that it retains a 10:1 ratio, in all three positions, over a wide range of frequencies.

The signal voltage from the attenuator switch is fed to the grid of V_1 (6AB4), a cathode-follower stage. The cathode follower reproduces across a low impedance the same signal on its cathode as that which appears on its grid, without frequency discrimination. No gain in amplitude is produced in this stage. Since the attenuator switch has three steps with a ratio of 10:1, a continuous attenuator, the vertical gain control, is placed in the cathode of this stage. Blocking capacitor C_3 has a large value (.5 μ f.) and offers negligible impedance to low frequencies being amplified.

The vertical amplifier of the oscilloscope has a wide-band response and is able to pass without distortion the many frequency components that make up television pulses and sweep waveforms. The vertical amplifier response goes out to 5 mc. within ± 3 db. Compensation for high frequencies is accomplished by use of combination series

and shunt peaking. By a choice of proper values, maximum gain with good bandwidth is obtained. Initial amplification of the signal takes place in V_2 (6BQ7A). The two sections of V_2 are connected as a cascade amplifier. Further amplification is supplied by V_3 (12BH7), used in a push-pull amplifier circuit. A balanced vertical output amplifier is employed because, when a signal is applied to both vertical deflection plates, it makes possible proper focusing of the resultant trace across the entire screen, and eliminates much of the instability caused by line voltage fluctuations.

Although no phase inverter tube is employed, the signals at the plates of V_3 are 180 degrees out-of-phase. The method used to obtain this difference is rather interesting. The cathodes of both sections of V_3 are connected together and grounded through a common resistor R_{10} . The signal appears across the common cathode resistor in phase with the input signal. The grid of V_{3B} is at ground potential to the signal voltage, so that actually the signal goes to V_{3B} via the cathode resistor. When a signal is applied to the cathode of a tube, it will appear amplified at the plate in the same phase relationship as the input signal. Therefore, the signal appears at both plates, amplified but 180 degrees out-of-phase.

The horizontal amplifier is much simpler than the vertical amplifier.

The horizontal amplifier does not amplify the signal to be observed, it merely enables the signal to be displayed on the screen. In comparison to the vertical amplifier, the horizontal amplifier does not need to have as much gain or as wide a bandpass. The normal function of the horizontal amplifier is to amplify the time-base sweep obtained either internally or from an associated test instrument such as a television sweep generator. The horizontal amplifier in the oscilloscope whose circuit is shown in Fig. 4, consists of a cathode follower which feeds a triode amplifier which, in turn, drives a push-pull output stage. The push-pull output stage, except for minor deviations, functions the same as the vertical push-pull amplifier.

The internal time-base generator (saw-tooth) consists of V_4 and V_{5A} connected as an unbalanced multivibrator. The frequency of the multivibrator is variable from 15 cycles to 600 kc., by means of selectively connected capacitors (C_{17} to C_{21}) and a potentiometer (R_{60}). It is possible to lock in frequencies as high as 9 mc. This multivibrator is easily synchronized by introducing a voltage to the grid of V_4 . The amplitude of this voltage is controlled by R_{60} , the sync lock control. Provision is made for selecting three internal synchronizing signals or an external signal applied to a binding post on the front panel.

Return-trace blanking is accomplished by feeding a pulse from the plate of

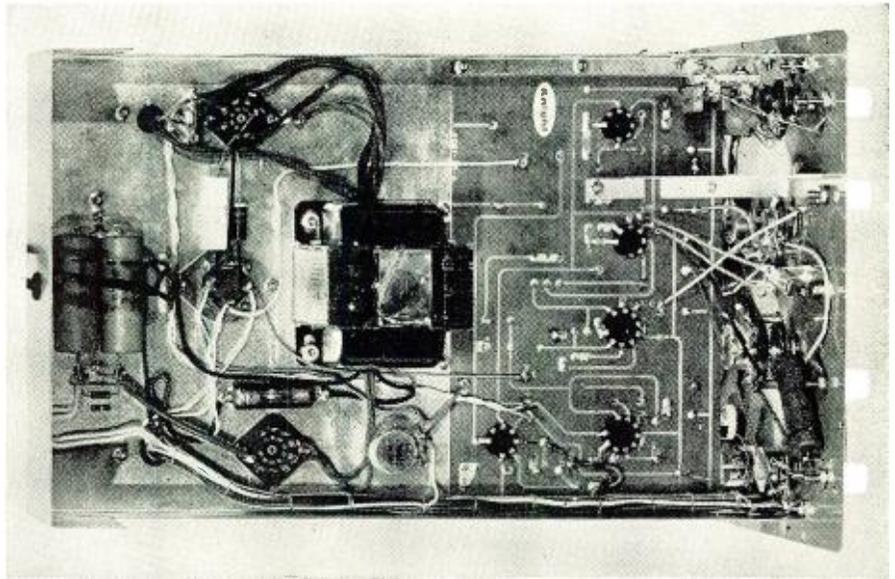


Fig. 3. Bottom view of the oscilloscope with all parts in place. The use of printed-wiring boards guarantees uniform lead dress and eliminates guesswork.

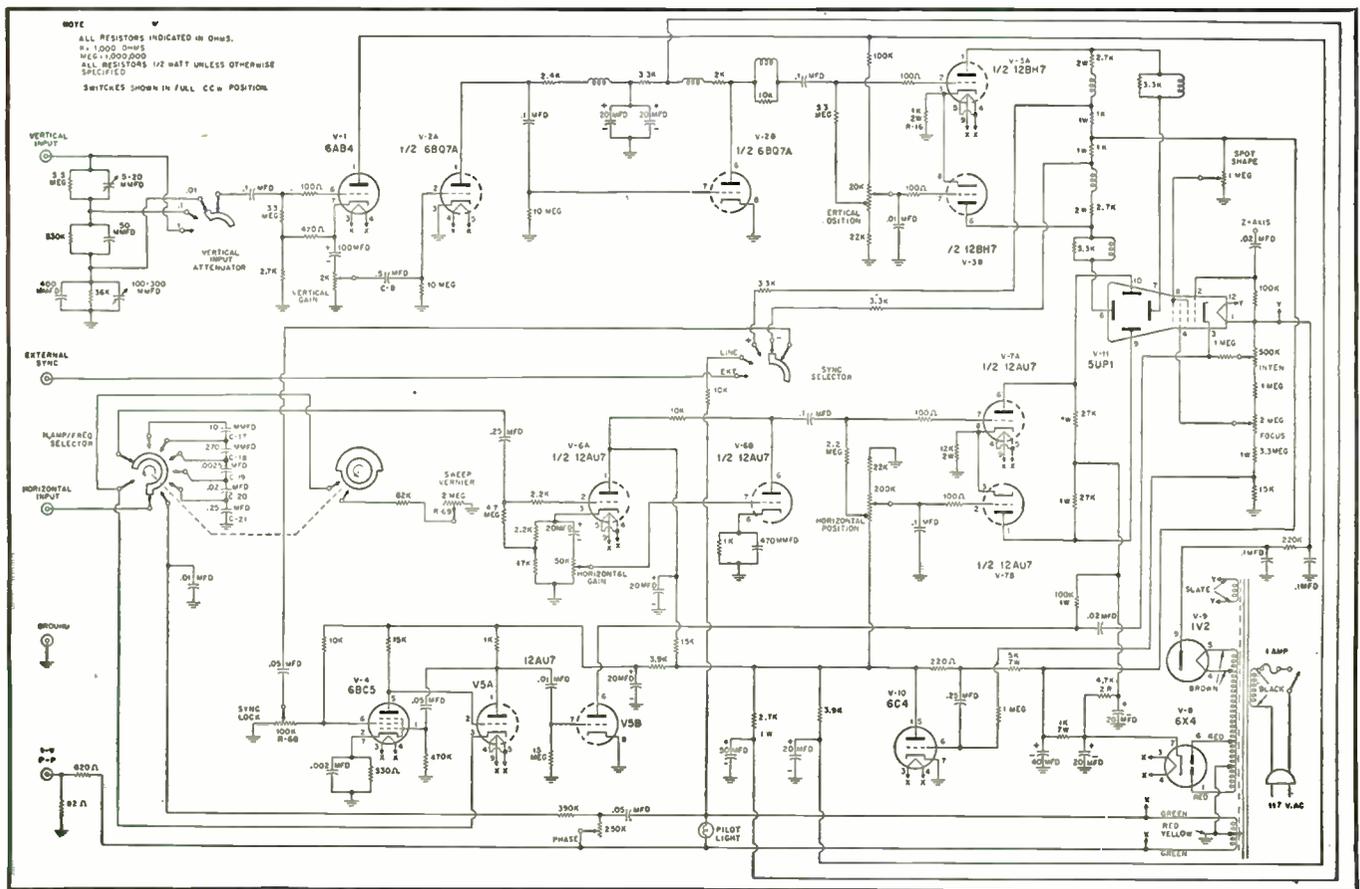
V_{5A} to the grid of V_{5B} . The pulse is amplified and then coupled to the cathode of the CRT to cut off the beam during retrace.

The power supply is made up of two separate sections. A low-voltage positive supply provides power for operating all amplifier stages and the sweep oscillator, as well as the positioning potentials for the CRT. A high-voltage negative supply furnishes the accelerating and focusing potentials for the

CRT. The low-voltage supply employs a 6X4 (V_9) as a full-wave rectifier. The high-voltage supply utilizes a 1V2 (V_6) connected as a half-wave rectifier to supply approximately 1400 volts, negative with respect to ground, to a voltage divider network.

With this new wide-band oscilloscope the service technician has a service tool at his disposal that will really assist him in the accurate and rapid analysis of TV circuits. -50-

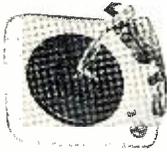
Fig. 4. Complete schematic diagram of the Knight 5" oscilloscope. Note that both the vertical and the horizontal output amplifiers are push-pull circuits. The compensated input attenuator and use of a cathode follower assure minimum loading.



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Certified Record Revue
(Continued from page 70)

manner and he makes of this oft-recorded warhorse an enjoyable experience. The "Fantasia" is less massive, but is nonetheless a good performance.

The sound of the piano here is the most impressive I have ever heard from *Angel* . . . very liquid and smooth yet very rich and broad. The piano/orchestra balance is slightly in favor of the piano but in spite of this there are no extraneous sounds from the piano action (hammers, pedals, etc). This slight favoring of the piano is actually an advantage, emphasizing the massiveness of the performance. Orchestral sound is excellent, with smooth strings, punchy brass, clean percussion. The famous triangle in the "Concerto" (it is nicknamed the "Triangle Concerto") is heard crisply and cleanly but is not subjected to the ridiculous overemphasis heard in several other recordings. All in all, a highly satisfactory recording that should win Anda many new admirers.

PORTRAIT OF THE WALTZ
Philharmonia Orchestra conducted by Igor Markevitch. Angel 35154. RIAA curve. Price \$4.98.

This disc is entirely different than you might expect . . . it is not another lightly confected dish of Strauss, but a *potpourri* of some of the most interesting waltzes in music. And as far as composers represented . . . you can hardly dismiss as "lightweights," such stalwarts as Mozart, Berlioz, Sibelius, Stravinsky to name a few of them on this disc. Some of the material is very familiar indeed, such as the "Danse Macabre" of Saint Saens, Liszt's "Mephisto Waltz," and Berlioz' "Valse des Sylphes," while for spice there are the rarely heard Busoni, "Tanzwalzer" and "Valse from Suite #2" by Stravinsky.

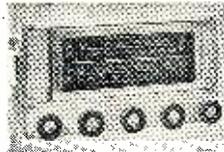
The prize on this disc is, believe it or not, the "Mephisto Waltz"! I know this cornball has been recorded *ad infinitum*, but the performance here by Markevitch is so excitingly good (and complete to a degree not apparent in other recordings) and the sound so stunningly realistic that the work is quite irresistible. Also outstanding is the Stravinsky waltz. Some orchestral playing here of breathtaking beauty and precision, and exquisite string tone, bright brass, sharply accented percussion and near perfect acoustics. I would say that the "Mephisto" is as good a vehicle for introducing people to classical music and hi-fi reproduction as I've encountered.

WILLIAM WALTON
TROILUS AND CRESSIDA
(EXCERPTS)
Philharmonia Orchestra conducted by Sir William Walton with Richard Lewis, tenor; Elizabeth Schwarzkopf, soprano. Angel 35273. RIAA curve. Price \$4.98.

Many voices are raised these days at the endless duplication of music in the standard repertoire. While admitting that these critics have a certain validity in their arguments, I would also point out that the failure of these same critics to support any new music is largely responsible for the timidity of the record companies and their culturally sterile, but economically wise, programming. I make these remarks in the hope that readers of this column will not shy from music that is new and unfamiliar, that titles like "Troilus and Cressida" however formidable-sounding they may seem, will be afforded an attentive ear and an open mind. Those who adopt such a policy will be rewarded more often than not, with musical riches like this present recording.

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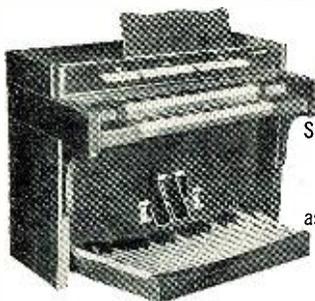
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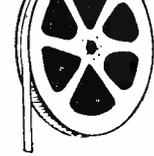
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to discover something new, something exciting and beautiful, something that does not supplant our appreciation of the classic Masters, but heightens and enriches our musical concepts. This modern opera by Walton is one of the most immediately ingratiating works I have ever heard . . . nothing in recent years has made up my musical mind so fast. My only negative reaction was that this is not the complete opera, but a number of scenes from it, and I long to hear the rest. The enterprising San Francisco Opera Company has premiered the work in this country and I hope that before long it will be in the repertoire of the New York Opera Company or the Met. Cast in a classic mold this score is everything a good opera should be . . . richly dramatic . . . tuneful and melodic, a good vehicle for the talents of exceptional singers. And "exceptional" certainly characterizes the splendid work of lovely Elizabeth Schwarzkopf as "Cressida" and Richard Lewis as "Troilus." Here are combined golden voices with first rate acting in as exciting a score as any by Verdi, Puccini, or Strauss. Probably a large part of the immediate regard I had for the work, was due to the utterly magnificent sound. The rich timbres of the voices, the clean, distortionless rendering of the clever orchestration, the splendid balance and acoustic correctness, all add up to one of the most outstanding examples of opera recording on LP. This is an ineffably lovely work and I urge all of you who have any inclinations toward opera to treat yourselves to a hearing. Ultra quiet surfaces greatly enhanced the illusion of "presence."

BRAHMS
CONCERTO IN D FOR VIOLIN AND ORCHESTRA

Chicago Symphony Orchestra conducted by Fritz Reiner with Jascha Heifetz, violinist. Victor LM1903. RIAA curve. Price \$3.98.

You might expect this to be a good recording, considering the personnel involved and happily this is true. In fact one might go so far as to say that this is quite the most satisfactory recording of the "Concerto" in the LP catalogue. Oh, there are a few things to quibble about . . . some of Reiner's tempi are questionable . . . but the slight faults are more than overcome by the meltingly sweet tone of the Heifetz violin, sounding better here in the felicitous acoustics of Orchestra Hall, than in any other of his recordings. Heifetz' mastery of his instrument is never more apparent than in his unhurried, poised traversal of this score. Add to this an excellent rapport between soloist and conductor and the superb playing Reiner elicits from the wonderful Chicago Orchestra and you have a reading that is quite irresistible. Soundwise, the disc has very little competition as *Victor* continues to exhibit its skill in recording the Chicago Orchestra. Over-all string tone has the rich resonance we have come to expect from this hall, along with the impressive brass sonorities and the weighty percussion. Ultra-wide frequency and dynamic range here with very low distortion, groove or otherwise, in evidence. A superior recording and highly recommended to you . . . but you should hear this same recording on *Victor* stereophonic tape! Absolutely stunning. I will review the tape shortly.

BORODIN
PRINCE IGOR (Complete Opera)
 National Opera (Belgrade) soloists, chorus, and orchestra conducted by Oscar Danon. London XLLA 30. RIAA curve. Price \$24.90. Five discs.

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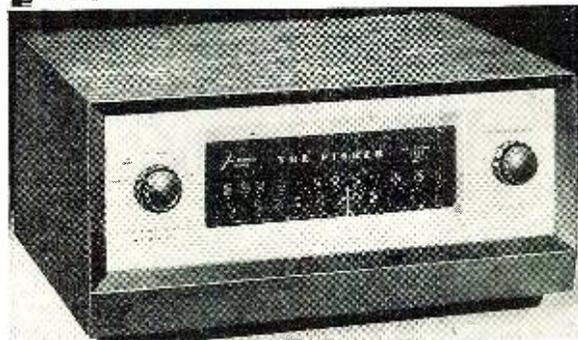
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successful one. It would be nigh impossible to give a detailed analysis of so huge a work in the limited space I have, but mention must be made of the excellence of the soloists and chorus . . . they are dedicated performers . . . the orchestra which though not up to many of our top groups, is a well disciplined group, conscientious in the execution of the score under the expert urgings of Oscar Danon.

Of course most listeners will be familiar with the “Dance of the Polovtsian Maidens” and the other well-known sections of the work and in this recording they are performed uncommonly well with uncommon zeal. But there is far more to the score than just these oft-concertized sections . . . and if you can spare the price and the time to wade through the five LP’s, you will find a tremendous wealth of new material that is infinitely interesting.

The sound here is quite good, surprisingly so in view of the fact that it was most probably made under conditions far less controlled than is usual with *London* records. String tone is good if a little edgy, brass is quite bright and punchy, winds are very smooth and with sweet intonation, percussion while not as weighty and powerful as is usual with *London*, is nonetheless very sharp and accurate. Best of all, the acoustics are as good as the *frr* label can give, and that means spaciousness with detail for a convincingly “live” sound. Frequency and dynamic range were about the equal of the standard *London* output, and groove distortion was minimal. I would have no hesitation in acquiring this work if you like it . . . duplications of magnum scores like this will be few and far between.

MOZART

VIOLIN CONCERTO #3 IN G

VIOLIN CONCERTO #7 IN E FLAT

Christian Ferras, violinist with the Stuttgart Chamber Orchestra conducted by Charles Munchinger. London LL1172. RIAA curve. Price \$3.98.

At the rate new Mozart recordings are being issued for the Mozart Bicentennial one might hesitate to make any decisions until all companies have been heard from. Well, I’ve never subscribed fully to any policy of “wait and see” . . . sometimes the wait can be inordinately long. That’s the way I feel about this recording . . . it has its share of faults but it is so superior to the other versions in the catalogue, that if you have a fondness for the works, endless deliberation would seem fruitless. Ferras is a young violinist of great sensitivity and he is far better off in the delicate tracery of Mozart than in some of the other repertoire he has been called upon to perform. His technique is agile, his tone sweet, not too fat nor too lean and he exhibits a most gifted sense of timing and phrasing. Recorded somewhat close-to, the violin is a little edgy at times, but otherwise is heard in good balance with the orchestra, is wonderfully realistic. Munchinger has a good sense of proportion here and his reading is quite straightforward and wholly satisfactory. Good frequency range, excellent dynamics, a little pre-echo is the only blemish in an otherwise excellent sounding recording.

BERLIOZ

SYMPHONIE FANTASTIQUE

Boston Symphony Orchestra conducted by Charles Munch. Victor LM1900. RIAA curve. Price \$3.98.

Hard to know where to place this recording, that is, it has all of the elements needed to make a definitive performance and yet it doesn’t quite make it. Munch is an unquestioned authority in Berlioz repertoire and this “Fantastique” is no exception. His reading has the proper blend of lightness and grace combined with the robust strength and crackling vigor necessary for successful projection

RADIO & TELEVISION NEWS

of the last movements. However Mr. Munch is hoist by his own petard as the tempi in the last movements threaten to run away with him. And engineering-wise, there has been too much of an attempt to elicit the last possible db from the score, which has resulted in some overcutting.

On the credit side, Munch gets some of the best Boston playing in recent memory and, for the large part, the sound is fairly satisfactory. Not the stunning brilliance of the Dorati/Mercury recording, or the measured smoothness of the von Karajan/Angel sound, this disc has its moments for the hi-fi fan in some big gong sounds and other percussive goodies in the last two movements. Summing up . . . Munch is still Munch and the performance must be considered near the top of the heap. Adding the balance of sound, it is outshone by several competitors.

DEBUSSY

LE MARTYRE DE SAINT SEBASTIEN
Soloists and choruses of the Radio-diffusion and Television Francaise with L'Orchestre du Theatre des Champs-Elysees conducted by D. E. Inghelbrecht. London-Ducretet-Thomson. DTL93040/41. RIAA curve. Price \$9.96. Two discs.

The London company does some fantastic things that would be considered sheer madness in this country. For instance here is Debussy's great "Martyrdom of Saint Sebastian" on their newly acquired Ducretet-Thomson label. From many angles this is a very fine recording and undoubtedly there will be many people who will wish to acquire it. What is hard to figure is why London issued this recording when their own magnificent recording of the work with Ansermet and Susan Danco is still fresh in memory since it was issued just a few short months ago! Well, it's not my job to figure out the wheelings and dealings of London Records . . . all I can do is report that this present recording is in many ways superior to the Ansermet reading but that in the over-all picture the Ansermet is still on top.

This has the advantage of the top authority on Debussy as conductor, old Inghelbrecht himself. And truly his sense of timing, his orchestral balance and other niceties, his treatment of choral/orchestral masses is inspired. But his orchestra does not measure up to the Ansermet group, nor can the soloists match the London talent. And soundwise while this has some gorgeous tonal effects with superb acoustics, the London disc is far ahead on matters of frequency response, dynamic range, lack of distortion, etc. Certainly this is the more authentically "French" performance and for those to whom this is important, the recording will probably find its widest audience.

LALO

SYMPHONIE ESPAGNOLE
Philharmonia Orchestra conducted by Jean Martinon with David Oistrakh, violinist. Angel 35205. RIAA curve. Price \$4.98.

It sure took a long time, but now we are getting a reasonable flow of Oistrakh recordings with the benefits of modern high-fidelity sound. This is the latest of several and I would say, the best of the batch as far as sound is concerned. In spite of the formidable Oistrakh reputation, this reading is not above a few others I could name. Frankly, I think the trouble is that the score is relatively "easy" compared to some other concerti and Oistrakh isn't as much on his mettle as he might be. Not that there is any sloppiness or evidence of a lackadaisical approach to the work. His tone is as flawlessly beautiful as ever, his technical mastery undiminished . . . I just feel his expressiveness is not as well projected in this recording as in some others.



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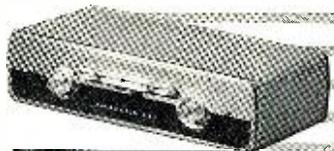
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Soundwise this is the top recording in the LP catalogue. The Oistrakh violin is reproduced with rich realism and almost no edginess, the orchestral strings are similarly good, woodwinds are especially smooth, all elements are in superb balance in an acoustic spaciousness that lends still further presence. Everything considered, this recording should meet the requirements of all but the most hypercritical music lover.

Jazz Corner

THE MAYNARD FERGUSON OCTET
EmArcy MG 36021. RIAA curve. Price \$3.98.

You haven't heard how high a trumpet can be blown until you dig this man Ferguson! This boy is really stratospheric, and along with this facility for the higher registers, a guy who knows how to knock out a solid tune. I can't begin to tell you who his sidemen are on this disc. I don't think Emarcy can either as most of the personnel involved are big names from other companies playing under pseudonyms. Whoever they are, they are the tops... technically an octet, they blow enough to sound like a big band bash. I've got a stereo recording of Ferguson I did when he was with Stan Kenton and even though we are comparing a single instrument and the disc holds up remarkably well... the stereo still has it. I wish Emarcy would start to issue stereotapes of some of its stuff. I think the type of stuff they issue would lend itself particularly well to stereo treatment.

Getting back to earth, this disc is comprised mainly of original stuff by the versatile Bill Holman who also arranged all the numbers. Of the "cool" school, some of them can get pretty wild and pretty far gone, but all are enjoyable as exercises in that medium. The sound, as is usual with Emarcy, is outstandingly good. Super-wide frequency range, close-to-recording with every instrument crystalline in detail, breathy rasp of the sax, the brazen brilliance of the Ferguson trumpet, the sharp, precise rap of the skins, this is the best in jazz recording being done today.

Tape Review

LENNY HERMAN AND THE MIGHTIEST LITTLE BAND IN THE LAND
Livingston Binaural Tape T-1083-BN.
Price \$10.00.

If a number of you nice people have been to stereo demonstrations and have left unimpressed, it was most likely a poorly run demonstration with the principal culprit poor source material. Find out if the place you heard the demonstration now has his new tape. Even the most bird-brained salesman would have a hard time lousing up a stereo demo with this tape. Of all the commercially available stereo tapes I have heard this does the finest job of imparting the directional and depth effects that characterize good stereo-sound.

Just a small combo, the Herman group puts out a lot of sound. In one number where the introduction is on accordion and piano, the accordion is definitely and positively to one side and the piano to the other. Admittedly the tape was recorded for maximum effect with what might seem to be overemphasis, but a listen is convincing evidence that it is merely good stereo in action. The repertoire is varied, ranging from "Love for Sale" to the "Song of India." Frequency response and dynamics are ultra-wide and of course through the magic of stereo and tape, there is no distortion I was able to hear. As played on my Ampex 612, equalization was no problem. Signal-to-noise ratio was quite good and all-in-all a very impressive tape.

Next month, another batch of good things to whet your appetite!

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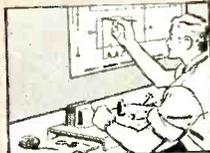
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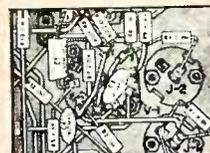
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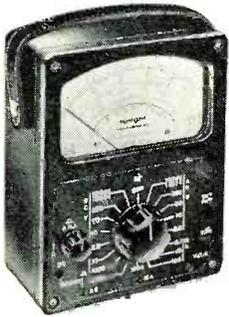
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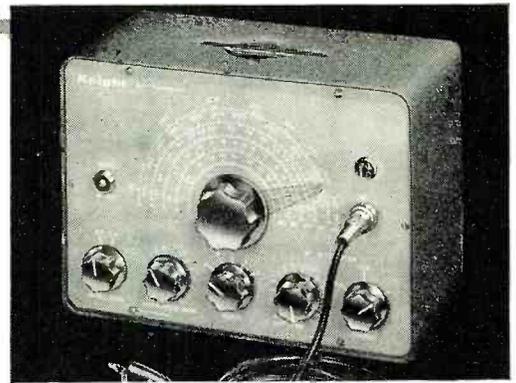
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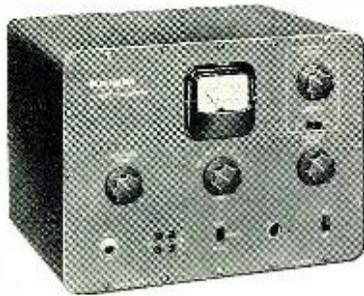
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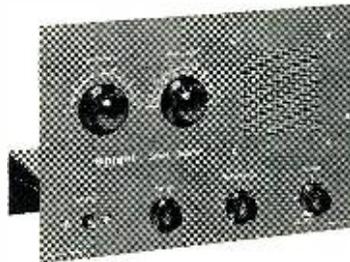
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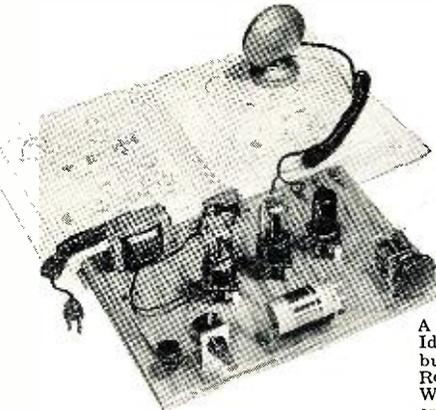
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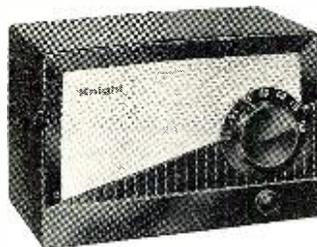
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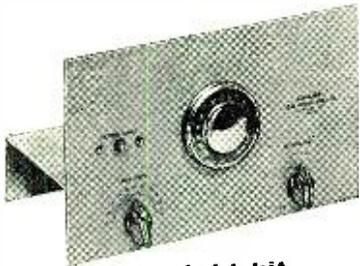
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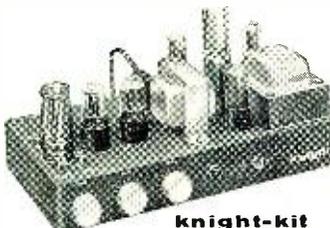
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Frequency Control (Continued from page 63)

est frequency ($k = a$). The "Q" will also be maximum at these two extreme frequencies, as inspection of the circuit indicates. The frequency for minimum "Q" is found from:

$$k^2 = 2a^2 / (a^2 + 1)$$

and the minimum "Q" value is:

$$Q_m = 2a / (a^2 - 1)$$

It will be noted this is the same equation as that obtained for the capacity variation method. Thus for a given spacing of the two extreme frequencies the minimum "Q" will be the same in both circuits.

For a given value of minimum "Q" the value for a will, of course, be as previously determined. The ratio of the inductances is:

$$L_2/L_1 = \frac{2 + 2\sqrt{1 + Q_m^2}}{Q_m^2}$$

Since the equations for minimum "Q" are the same in both circuits the curve of Fig 3 may be used for both circuits.

Fig. 2B illustrates the application of this circuit to the same problem as illustrated by Fig. 2A. The same frequencies and minimum "Q" were used in order to allow comparison of the two circuits. It will be noted that this curve is practically a mirror image of the previous one, the resistance being maximum at the low frequency end and *vice versa*. Approximately the same resistance values are obtained, although of course at different frequencies.

The circuit of a beat frequency oscillator constructed for a receiver using the capacitance variation circuit is shown in Fig. 4. The frequency of this circuit varies over a 3 kc. range as the tube bias is varied from 5 to 10 volts. The supply voltage for the resistance tube is regulated by means of the small neon tube since any change in voltage here will be reflected as a change in the frequency.

Two circuits, simple in design and operation, have been presented for remote tuning and similar applications. Choice of the circuit to be used will be dictated by the application since, operationally, there is little to dictate a choice.

There is no reason why these circuits cannot be applied to higher and lower frequencies than those discussed. Diodes may be more applicable in some cases as the resistance tube, or it may be possible to use ordinary variable resistors. In any case, especially at the higher frequencies, care must be exercised in the design to insure that the stray capacity which will shunt the resistance will not adversely affect the circuit operation. Since very low resistances may be used, theoretically down to zero, it would seem that the circuits could be applied to quite high frequencies for tuning, a.f.c., etc. —30—



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Tape Recording
(Continued from page 50)

for 15 ips machines, in terms of the playback bass boost characteristic.

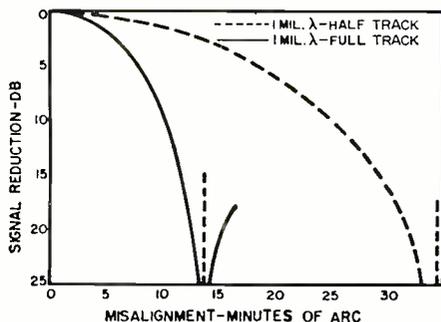
To enable users of tape recorders to keep their machines to standard, it would be helpful if standard induction tapes, one for each speed, were made under the aegis of a standards body such as M.R.I.A. Such a tape would contain a number of identified frequencies adequately covering the standard range, each frequency recorded at the level required by the standard induction characteristic for the given speed. (A tape of this kind, containing the NARTB magnetic induction characteristic for 15 ips recorders, is made by the *Dubbings Sales Corp.* This tape also contains other valuable test material.) To bring a machine to standard with respect to frequency range and equalization would require, in addition to a standard induction tape, equipment as simple as an audio oscillator and a vacuum-tube voltmeter. The procedure would be as follows.

1. In the playback preamplifier, equalization circuits would be adjusted so that playback of the standard induction tape would produce flat response over the standard range. The playback section of the machine would then be "standardized."

2. In the record preamplifier, equalization circuits would be adjusted so as to enable the machine to produce a tape which would play back flat through the "standardized" playback section.

It appears that it is also the task of a standards body to provide for standard azimuth alignment. As indicated in diagram, Fig. 6, a very slight difference in azimuth alignment between two machines produces considerable deterioration of treble response when a tape made on one is played back on the other. Although there are several azimuth alignment tapes on the market, they do not necessarily agree with each other to the desired degree. Consequently a standard azimuth alignment tape made under the supervision of an industry body seems an indispensable element in standardization. This tape could, of course, be combined with the standard induction tape on one reel. —30—

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



February, 1956

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Phonograph Evolution
(Continued from page 55)

The casing served to keep the spiral spring within a comparatively small space without materially interfering with the unwinding of its coils. A governor was arranged at one side of the train of gearing. A shaft for a pinion was arranged to intermesh with the gear-wheel. Any excessive speed of rotation was checked by frictional contact between the upper face of the disc and the rubber bearing-blocks carried by the arms. A threaded rod provided means for controlling the friction and, accordingly, the speed.

Eldridge Johnson's essential claims included a combination of a rotatable table, a driving-sleeve for said table, a mechanism for rotating said sleeve, a stationary supporting-post within said sleeve, and a step-supporting pin between the table and the top of said post. Johnson produced a line of instruments in the fall of 1900. One of the most interesting of these was the model (Fig. 4) known as the "Toy." This was a hand-driven talking machine and relied entirely upon rotation of a handle which was aided by the action of a simple adjustable governor. This machine was simplicity itself. The one in our own collection is still in mint condition and always provides a thrill to those who hear it in operation.

The type "B" Victor shown in Fig. 5 is usually connected with the trademark "His Master's Voice." The only difference between the model "B" and the painting of the trademark is that the latter does not show the fleur-de-lis carving on the box. This model used the improved Eldridge Johnson sound box (reproducer).

An economy model was produced, known as type "A" Victor, and sold for \$12.00 complete with brass horn. It is shown in Fig. 6. Principal economies were afforded by using a simple housing of metal for the motor drive. Note that the tone arm, which was made of solid oak, is now positioned in a flat plane, rather than standing on its edge as with the Victor "B."

The model "D" (Fig. 7) used many of the parts employed in the "Toy" machine but this model was provided with an improved horn and reproducer and used the supporting bracket and tone arm of the model "A."

The type "C" (Fig. 8) was a deluxe model and had a solid oak cabinet with an improved motor mounted entirely within the housing and also was provided with an outside crank at one side of the box. This model also used the improved Johnson reproducer.

The Victor Talking Machine Company was founded in 1901 by Eldridge Johnson and the original models of its talking machines are illustrated in Figs. 9 to 13. The lowest priced machine in the line was known as the Victor "Royal." It sold for \$15.00 complete with an all-brass horn. This

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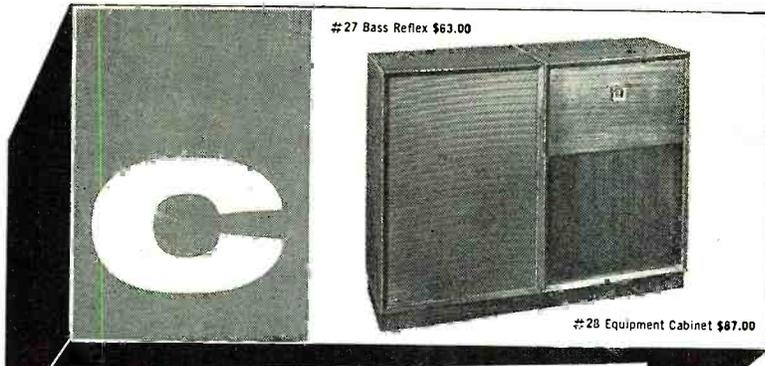
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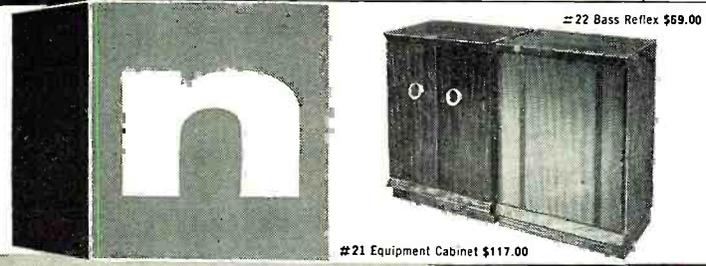
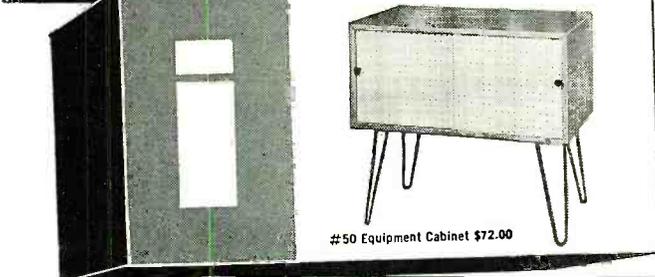
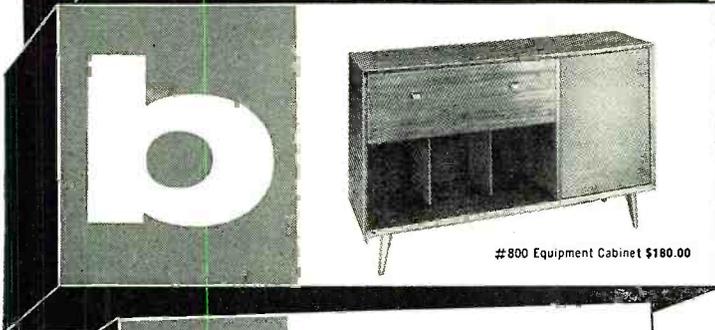
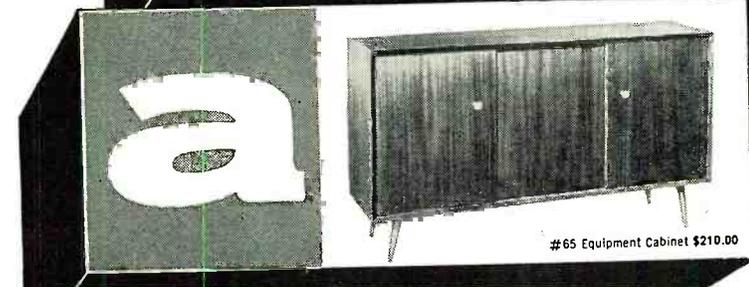
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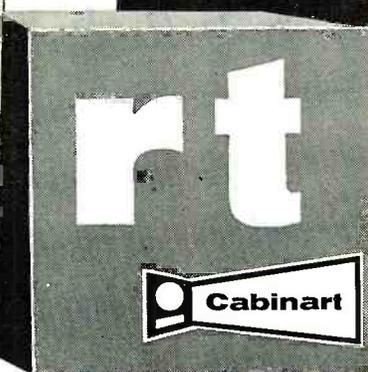
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machine (Fig. 9) was very similar to the improved gramophone of Berliner and together with Johnson's improved records provided far superior tonal quality.

Then followed four models of the Victor "Monarch." The first of these, shown in Fig. 10, was recalled in February of 1902 and was replaced with the improved "Monarch" shown in Fig. 11. The price was reduced at the same time from \$40.00 to \$35.00. This machine was equipped with a metal tone arm which was ribbed for stiffness, and a slightly larger horn was provided in order to produce more volume.

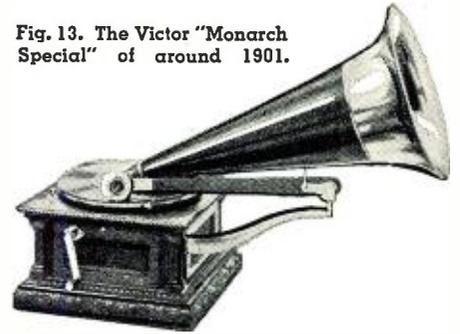
A smaller version of the line was found in the Victor "Monarch Junior," type "E" shown in Fig. 12. This model used a 7-inch turntable and would play all of the early Berliner records, as well as the improved records produced by Eldridge Johnson's firm.

The model shown in Fig. 13 was known as the Victor "Monarch Special" and sold for \$45.00 complete. It featured a heavy-duty drive motor and used a 10-inch turntable. Other refinements resulted in quieter operation, even though for economy a wood tone arm was used on this model.

The phonograph industry, as we know it today, owes a great part of its success to the foresight of Eldridge

Johnson. His objective was to improve upon the developments of his predecessors and to provide entertainment for the masses at reasonable cost. He apparently never considered his ma-

Fig. 13. The Victor "Monarch Special" of around 1901.



chines suitable for office use and confined his efforts solely to quality production of records and instruments that would meet with popular favor. The rapid development of Victor and the phonograph industry attests to the genius of Eldridge Johnson.

The following part in this series will be devoted to the spring-motor phonographs of Edison and the unusual methods employed in distributing cylinder records to the trade. His "Excelsior" nickel-in-the-slot phonograph—one of the original clockwork juke boxes—will be discussed.

(To be continued)

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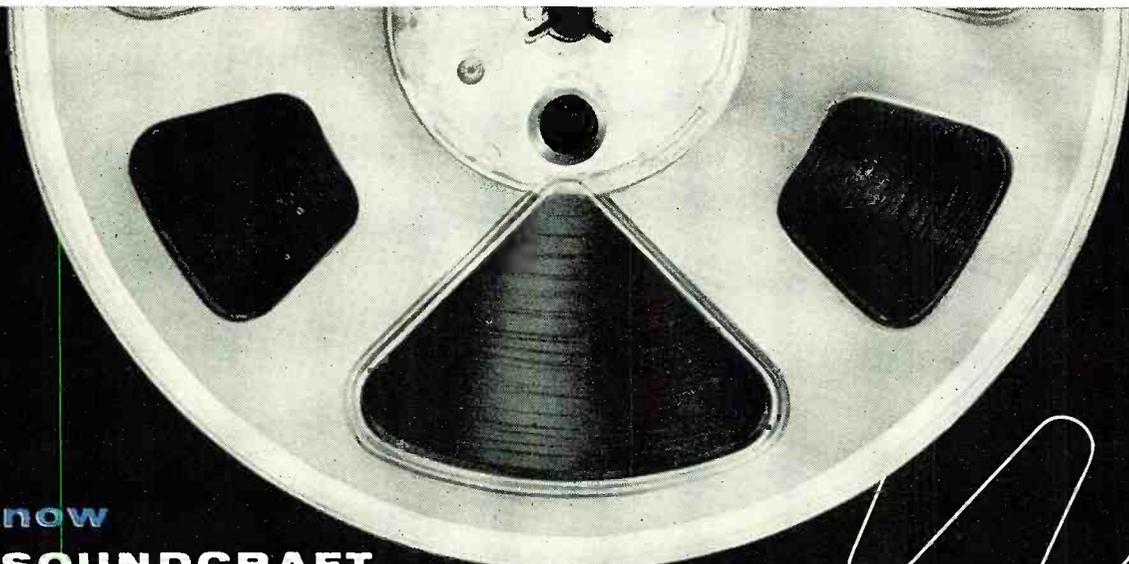
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The "Gypsy III," Cornell-Dubilier's "floating lab" for testing marine equipment.



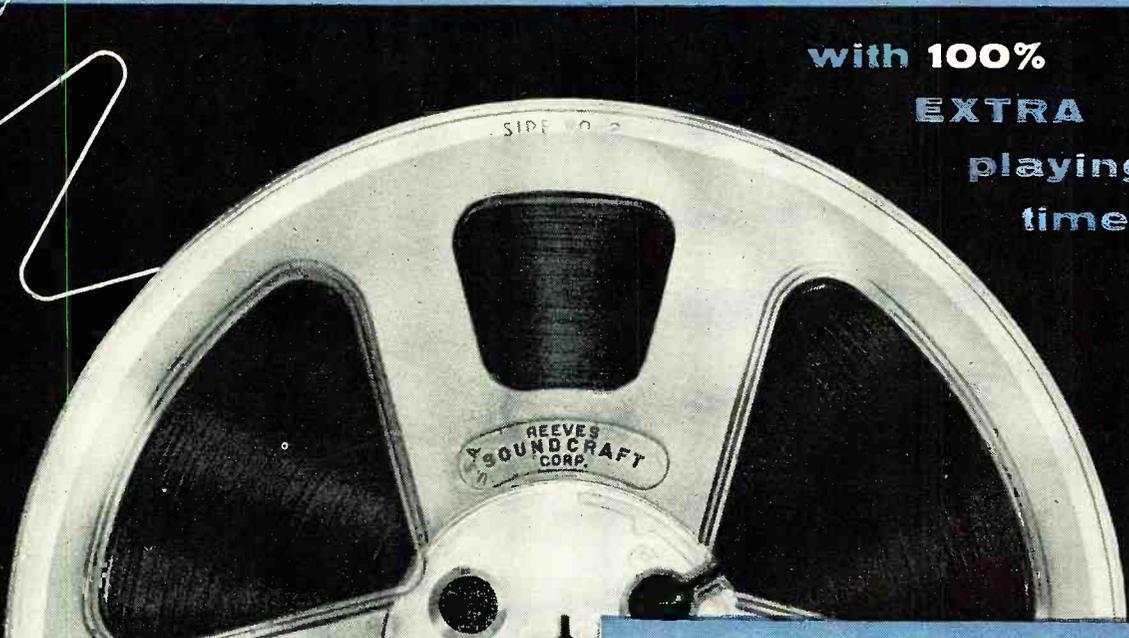


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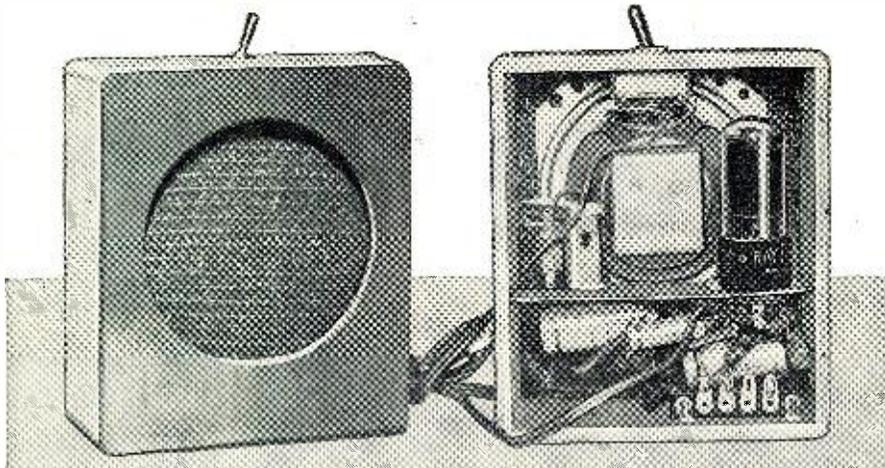
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Transistor-Tube Intercom



Front and rear views of the "master station." The "slave" stations simply consist of individual speakers housed in suitable cabinets.

By HOMER L. DAVIDSON

Construction details on a simple unit which can be used over distances up to hundreds of feet.

TO THE experimenter or novice constructor this little intercom unit is easy to build and requires a minimum number of parts. The parts used are all obtainable from your local radio supply house or jobber. A 45-ohm, four-inch speaker was used as the remote station. This unit does not have a call-back switch on it, since the d.p.d.t. switch in the master unit is left in the "listen" position. Through the d.p.d.t. switch the small speaker serves as a pickup microphone and feeds directly into an electrolytic capacitor at the

input of the CK722 transistor. By so doing, a matching transformer was eliminated.

The small transistor was wired up in an unusual way in the circuit, since negative voltages should be applied to the collector and base return resistor. To do this a positive 24 volts was taken from the "B" power supply, through a 220,000 ohm dropping resistor, and applied to the emitter terminal of V_1 . Also, this applies 24 volts to one side of the small remote speaker but, since there are no switches to

operate on this unit, a person cannot get shocked. Furthermore, 24 volts is very low voltage and is non-hazardous to most persons. The base return resistor is 100,000 ohms and the collector resistor 220,000 ohms. These values were adjusted in the circuit for loudest volume and greatest clarity. Three different transistors were tried in this circuit and all three operated equally well. The current drawn by the transistor is a little less than one milliampere—so there is no possibility of damage here.

From the collector pin of V_1 , a .01 μ f. paper capacitor couples the audio signal to the power amplifier tube, a 117L7GT. It is used here as an amplifier and a d.c. voltage supply. The grid resistor is a 470,000 ohm, one-half watt type. The tube is cathode biased with a 150 ohm fixed resistor and to get a little more gain an electrolytic capacitor was shunted around it. As can be seen from the diagram there is no volume control. The gain of both transistor and tube, as audio amplifiers, provided sufficient volume so that a person could be heard at least fifteen feet away from the remote unit. Also, the volume wasn't annoying in the master unit when left in the "call" position. This small unit was used from shop to house, which required about sixty feet of two-conductor wire.

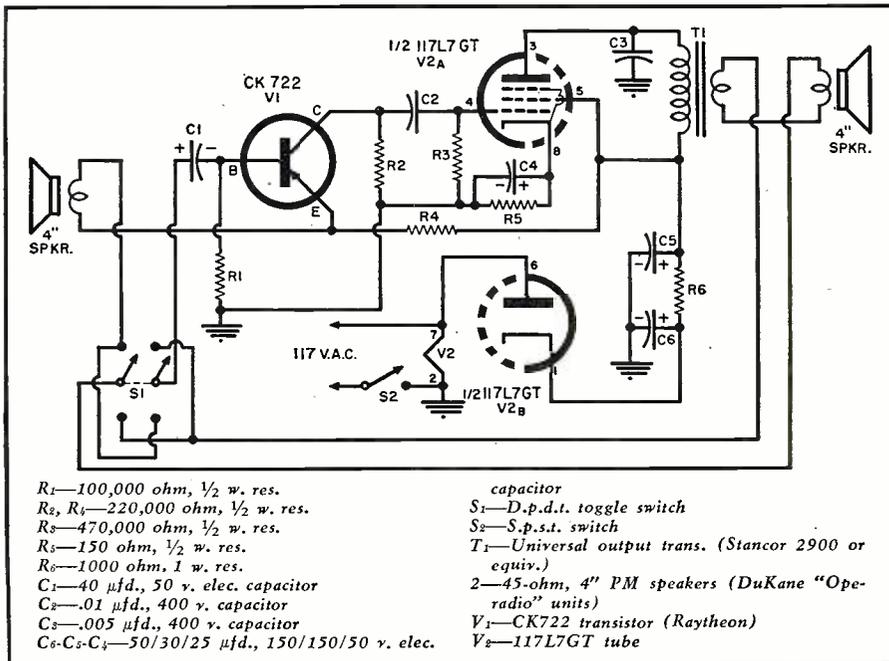
In the plate circuit a universal output transformer was employed to correctly match the 45-ohm speaker. Several types of speakers were used, but to get a good clear pickup the 45-ohm speaker worked best, with plenty of volume. The power supply furnishes about 117 volts to the plate and screen grid and is filtered with a capacitor-resistor network. A 30-50-25 μ f. electrolytic capacitor was employed here. The a.c. input was switched on by a single s.p.s.t. switch.

Mounting of the parts is not critical and all small components, as well as the transistor, were mounted under the chassis. The CK722 transistor was soldered directly into the circuit and a three-prong insulated jack was used for its mounting. The four-inch speaker, tube, and output transformer were mounted above the chassis.

A small homemade case was constructed from $\frac{1}{4}$ inch plywood and the over-all measurement of the master unit was $5\frac{1}{2}$ by $6\frac{1}{2}$ inches. The sides were nailed together with small brads and the front panel had a three-inch hole cut in it with a small coping saw. The remote unit contains only the four-inch PM speaker. This case was made from the same plywood stock, but measured only $4\frac{3}{4}$ inches by 5 inches in size. A terminal strip was mounted in the rear of the master unit, so the two-conductor wire could be soldered directly to it.

This little intercom has many uses, such as communication from house to shop, basement to kitchen, or barn to house. Several hundred feet of wire were attached to the unit to see if volume would diminish greatly, but it was not noticeable.

Complete schematic of intercom. No volume control has been incorporated in order to simplify construction. A single 117L7GT and a CK722 transistor are required.



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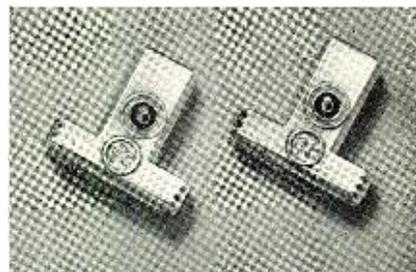
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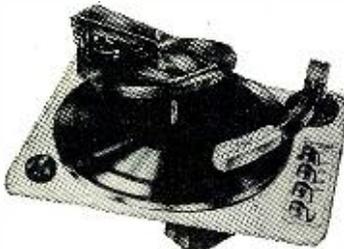
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Power Transistors
(Continued from page 40)

quiescent current, while medium-fidelity portable radios will operate with less bias. It is not inconceivable that a device could be invented which would automatically bias the last stage when a signal appears.

Complementary Amplifier Drivers

Driving a complementary amplifier is quite simple, because the input is single-ended. Since the power gain of typical amplifiers is quite small, the driver itself must usually be a medium- or high-power transistor.

An interesting circuit is shown in Fig. 6A. Here each output transistor is separately driven by one-half of a previous complementary pair of low-power transistors. The entire collector current of each driving transistor flows through the base of its respective output transistor. For this reason, biasing the output stage may be done by merely changing the bias on the driver stage. The driving transistors, as well as the output transistors, should be well matched for best results.

Another circuit in which each final-stage transistor is driven separately is shown in Fig. 6B. However, here both driver transistors are *p-n-p* units, one connected in grounded-emitter and the other in grounded-collector configuration, to provide the proper phase relationships. However, the input to the driver stage must be double-ended, so this circuit has its disadvantages.

These do not exhaust the possibilities for complementary amplifiers. This type of circuitry, employing both *p-n-p* and *n-p-n* transistors, is not analogous to any type of vacuum-tube operation and thus far has received too little attention. However, the advantages of the circuits will push them into promi-

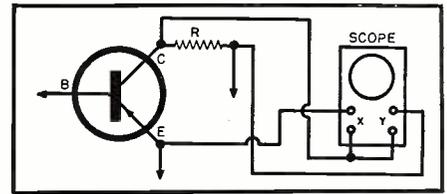


Fig. 8. Method for viewing transistor load line on an oscilloscope. Refer to article.

nence, up to the point where they are more common than either conventional class A or class AB amplifiers.

Protecting the Transistor

Since power transistors don't grow on trees as yet, a subject of primary concern should be how to keep from burning them out.

Whatever power supply is used (line-operated or battery), the current and voltage should be continuously metered. Many troubles can be anticipated by watching the collector current. A gradual increase in collector current over a period of 30 seconds to one minute—watch out, you're at the beginning of thermal runaway and unless you do something soon the transistors will burn out. To prevent excessive current, circuits should always be fused, at a current somewhat less than the maximum recommended collector current. These fuses should not be of the "slow-blow" variety, for you want fast action in case of trouble. Even if in normal operation you blow a number of fuses, don't worry. They are much cheaper than transistors.

Fusing a transistor circuit is not absolute protection, however, since power peaks can get by fuses. A good way of observing power peaks is to continually monitor the load line on an oscilloscope. For a grounded-emitter stage, this load line is obtained by plotting the collector current vs the collector-to-emitter voltage. A circuit for doing this is shown in Fig. 8. The sampling

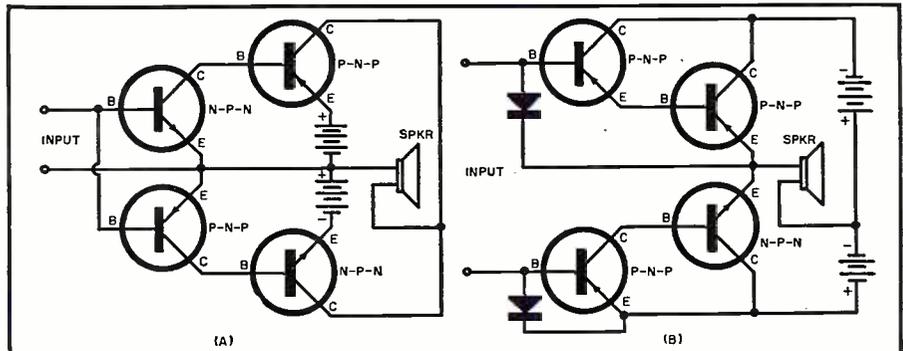
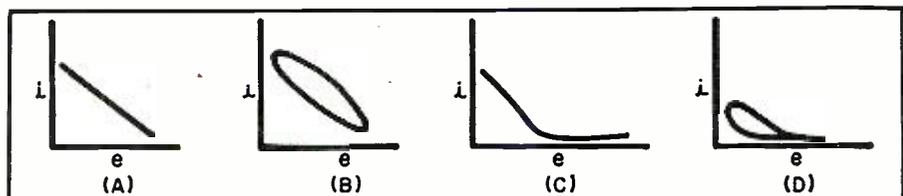


Fig. 6. (A) Complementary pair driving a complementary class B power amplifier. (B) Two "p-n-p" transistors driving a complementary class B power amplifier. See text.

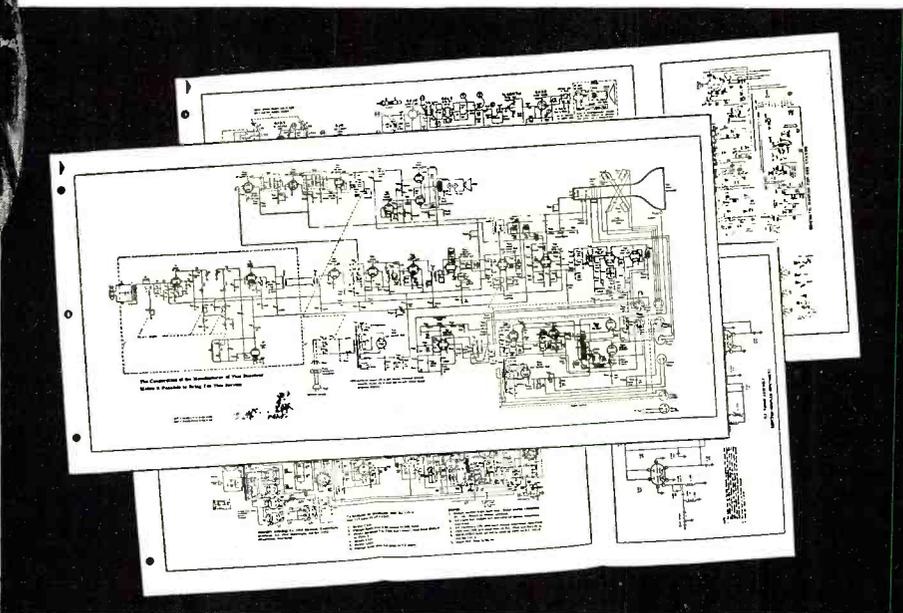
Fig. 7. (A & B) Load lines for a sine wave, class A, and (C & D) for class AB.





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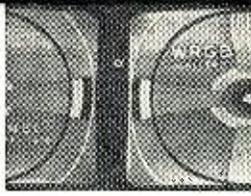
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CAUSE—Capacitance value of boost capacitor (connected to linearity coil) too low.



FAULT—Trapezoidal pattern.
CAUSE—Short in horizontal winding of Yoke.

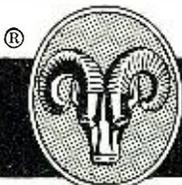


FAULT—Split picture.
CAUSE—Reversed AGC winding of H. Output Transformer; insufficient AGC voltage or reversed polarity.

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resistor R can be a 1 ohm, 1 watt, 5% for good results. However, if the load is only a few ohms the presence of 1 ohm may affect amplifier operation, so a smaller value should be used.

The scope pattern can be calibrated to read directly in volts and amperes, by using a voltage calibrator. The instantaneous power can be determined by multiplying the voltage and current at any point on the oscilloscope trace. If this power dissipation at any point exceeds the manufacturer's ratings, you're in for possible trouble.

With a sine wave input to the amplifier, a class A load line will look like Fig. 7A for a resistive load, and 7B for a reactive load.

Figs. 7C and 7D show the load lines for each transistor in a class AB amplifier; Fig. 7C for a resistive load, and Fig. 7D for a reactive load.

While designing a circuit, the transistors should always be fastened to a heat sink in accordance with the manufacturer's recommendations.

Any of the good transistor books now available have sections devoted to power transistors. Unfortunately, however, the field is so new that nothing specific can be found.

High-power transistors are now fulfilling a need for efficient, practical, power amplifiers for battery-operated devices. Numerous advantages are present as compared with vacuum-tube amplifiers.

In addition, power transistors are being used for power switching, power conversion units, battery-operated high-voltage power supplies, and driving servomechanisms. Audio applications are almost unlimited: amateur modulators, high-power drivers for vacuum tube class AB₂ amplifiers, portable audio equipment, portable public address systems, to mention but a few. In the future you'll be seeing more and more of power transistors. —30—

MORE POWER TRANSISTORS

AS WE go to press, we have just received information on two new sources of supply for power transistors.

CBS-Hytron

CBS has just announced a series of power transistors which are currently available to the industry.

Four variations, the types 2N155, 2N156, 2N157, and 2N158, are being offered and provide a wide range of current gain and operating supply voltage.

Full details are included in Bulletin E-259 now available from the company at Danvers, Massachusetts.

General Electric

G-E is now delivering sample quantities of germanium power transistors to electronic equipment manufacturers. Mass production of these radio power output devices is expected to begin in March at the company's Electronics Park Plant, Syracuse, N. Y.

According to Mr. Fancher, general manager of the semi-conductor products division, the company is delivering sample quantities of silicon types to the Air Force. It is expected that sample quantities of these devices will be made available to original equipment manufacturers during the second half of the year. —30—

RADIO & TELEVISION NEWS

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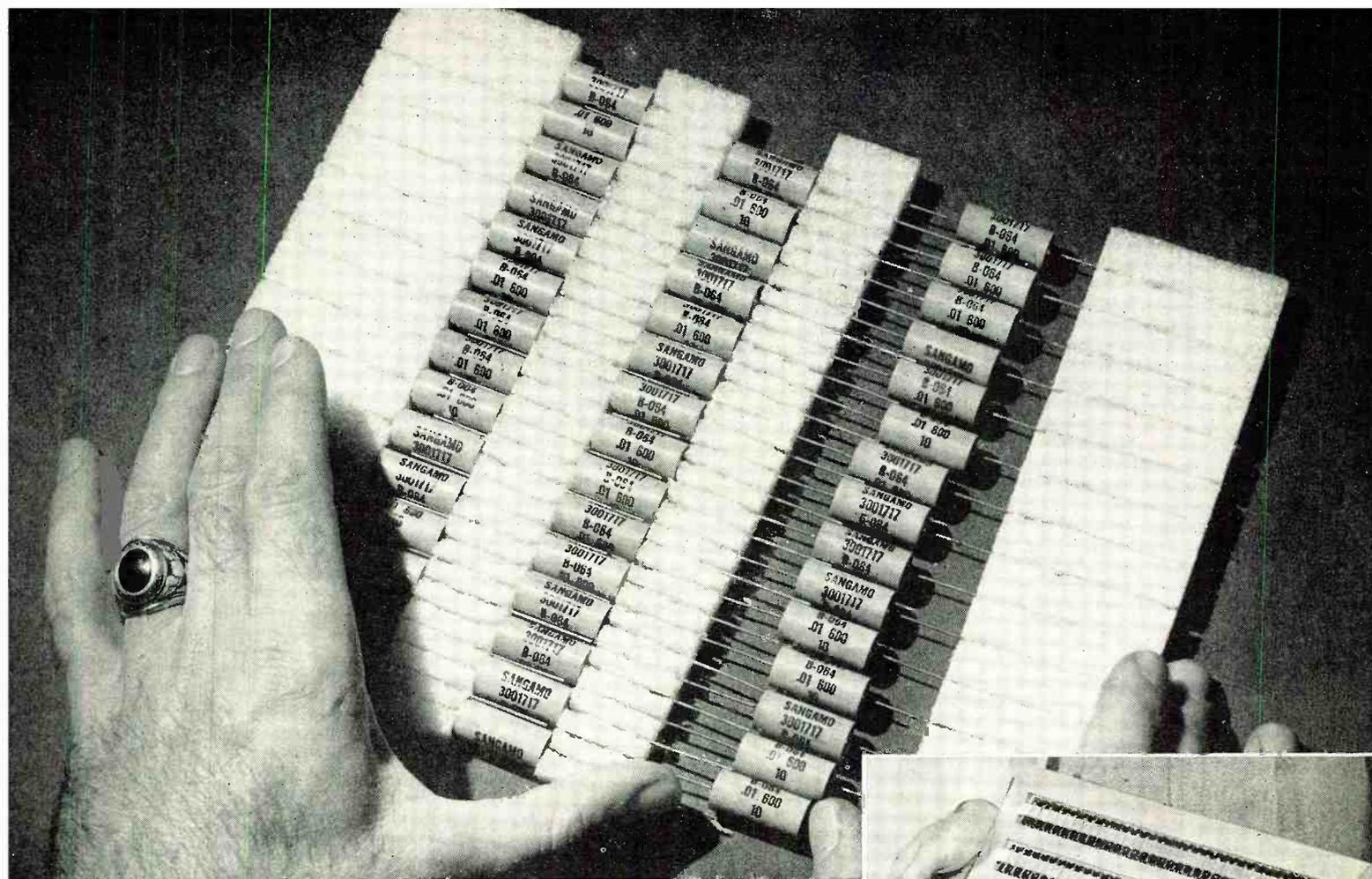
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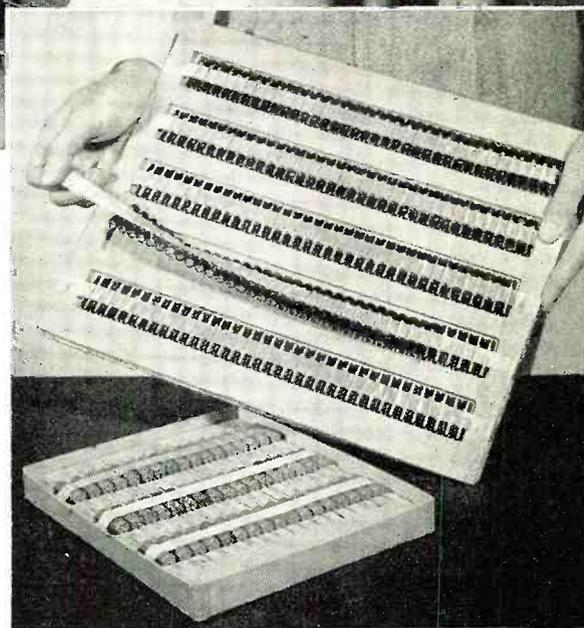
COMPRESSED GLASS SEALED TYPES—Packed in light-as-air Styrofoam which holds axial type leads straight . . . keeps shipping costs down. Capacitors are easily removed from packing to be fed to automatic fabricating machines.

Specially packaged capacitors speed automated chassis assembly

New methods of packaging capacitors for automatic machine assembly of printed electronic circuits have been developed by the Sangamo Electric Company. With this special packaging, there's no need for time-consuming straightening of wire leads or checking if close tolerances between leads have been maintained throughout shipping and handling. This special packing makes it easy to remove Sangamo Capacitors from their containers in uniform rows, with wire leads always straight.

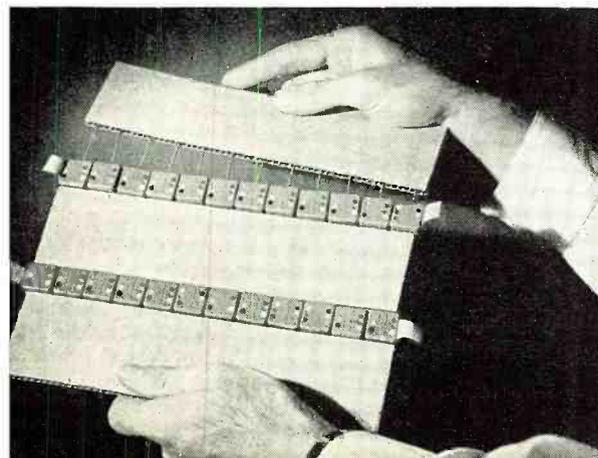
Here are a few examples of Sangamo packaging. Sangamo will be glad to discuss special packaging to fit your particular requirements. Write to the factory today.

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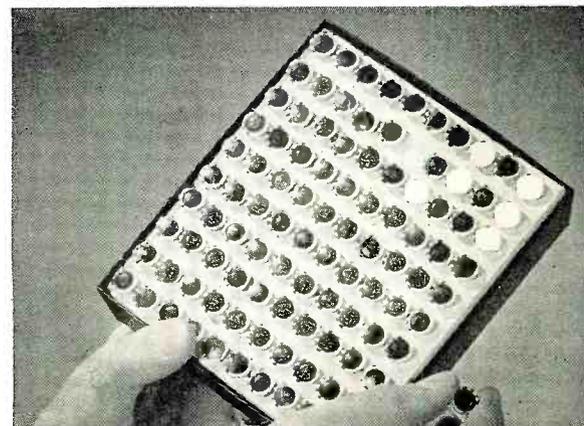
PLUG-IN PAPER TUBULARS—Attached to glass filament tape, uniform rows of these Type 36 paper tubulars can be lifted from the card and fed to assembly machines. Close tolerances between leads are maintained throughout shipping in spite of rough handling. Similarly-packaged standard paper tubulars, shown in the foreground, are also available.

SC56-J



WIRE LEAD MICA CAPACITORS—Packaged to keep pre-trimmed leads straight in transit. Taped for ease of handling and feeding through magazine of automatic machines.

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MS-31

MODULATING THE HEATHKIT AT-1

By **DALE WOLTERS**
Staff Eng., Station WOOD-TV

*By adding this simple circuit, 100% modulation can be
obtained up to a plate power input of about 25 watts.*

A HEATHKIT AT-1 transmitter, with modulation added to the original circuit, is a versatile little phone-c.w. rig. The modulator unit to be described was designed for utmost simplicity without sacrificing good speech quality, yet is compact enough to be mounted within the transmitter cabinet.

Modification of an AT-1 is easy and should appeal particularly to graduates from the Novice ranks who want to have a fling at phone—the inexpensive way.

As an inspection of the schematic and accompanying photographs will show, a 12AX7 is used as a high-gain speech amplifier. A single 6L6 functions as a class A plate modulator. An ordinary replacement-type push-pull output transformer is used as a modulation transformer. The "B+" and heater power for the modulator are supplied by the AT-1 power supply and operating controls are front-panel mounted.

In order to make room for the added components, a few changes must be made in the original transmitter. Most of these changes can be seen in the photographs. The filter choke is moved below decks to allow the modulation transformer to bolt in the vacated choke mounting holes. There is room for the choke between the filter capacitors and the final tube socket, although placement is fairly critical.

The oscillator plate coil is turned 90 degrees toward the bandswitch to al-

low a 6L6 to be mounted between it and the power transformer. The 12AX7 mounts between the coil and the front panel. Chassis punches are almost a necessity in making the tube socket holes. In addition, some re-routing of wiring will be necessary.

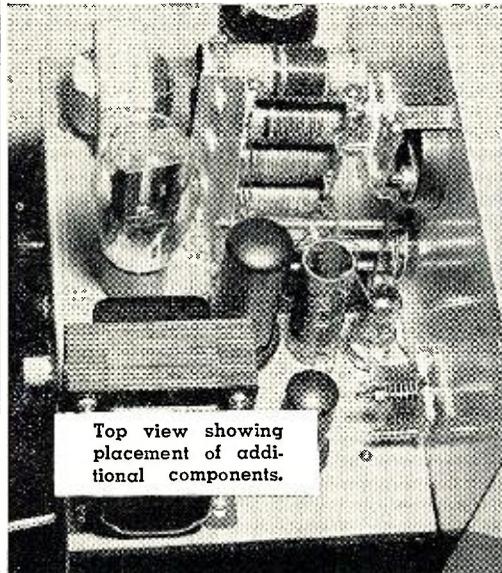
Next, mount the gain control and the "phone-c.w." switch on the front panel. Inspection of the photographs will show where each is mounted. The microphone jack is placed in the hole originally occupied by the a.c. cord. The addition of a fuse is a matter of choice, although it is recommended.

Wiring is simple and straightforward. No special precautions, other than shielding the microphone lead to the 12AX7 grid, need be observed. The use of solder lugs and tie points will be helpful.

Junkbox parts substitutions are OK except in the case of R_7 and R_8 . If a different output transformer is used, be sure it is capable of handling at least 65 ma. of primary current. It should also have a fairly high plate-to-plate impedance (at least 8000 ohms or more).

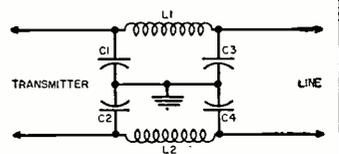
For best speech quality and adequate modulation percentage, do not load the final to more than 60 ma. on phone. If proximity of a metal 6L6 to the oscillator plate coil causes any difficulty in obtaining maximum grid drive on 10 meters, spread out the top turn or two of the coil.

When operating on phone, the AT-1 power supply is admittedly overloaded. However, in several months of operating, no difficulty has been experienced due to transformer overheating or breakdown. —30—



Top view showing
placement of additional
components.

Circuit diagram of the a.c. power line filter for preventing stray r.f. from feeding back into the power line from the transmitter.

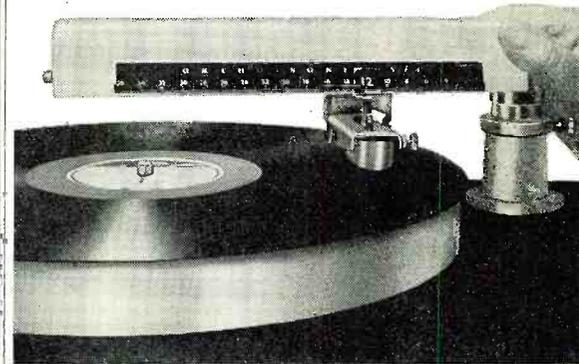


C_1, C_2 —.001 μ d. mica capacitor (in original AT-1 circuit)
 C_3, C_4 —.005 μ d. ceramic capacitor
 L_1, L_2 —35 t. #18 en. self-supporting, wound on $\frac{3}{8}$ " form

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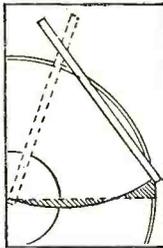


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How Conventional Tone Arms Create Tracking Error (See Shaded Area).

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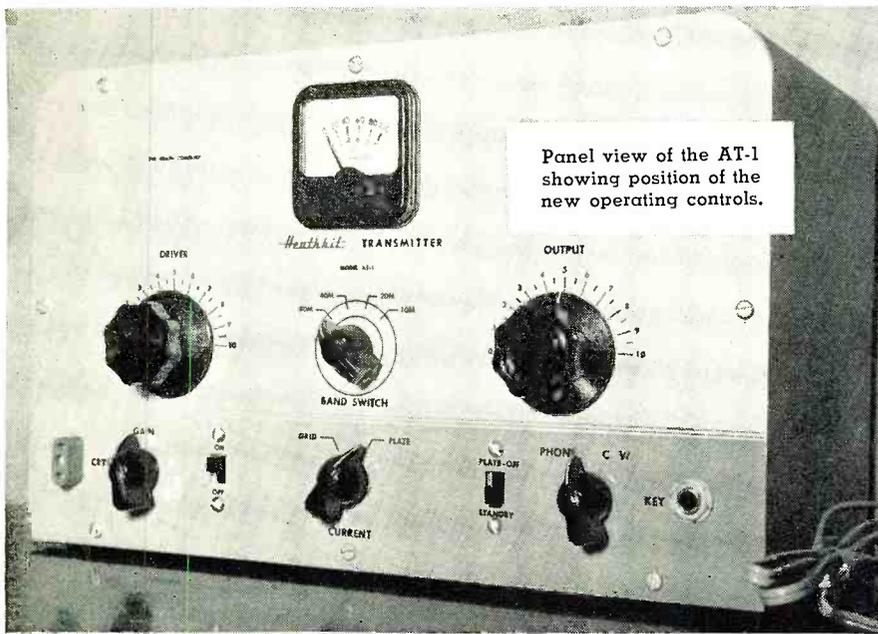
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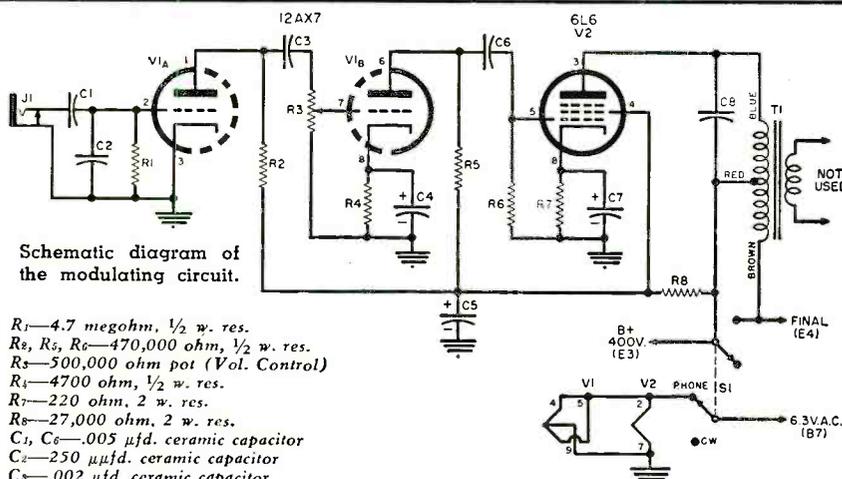
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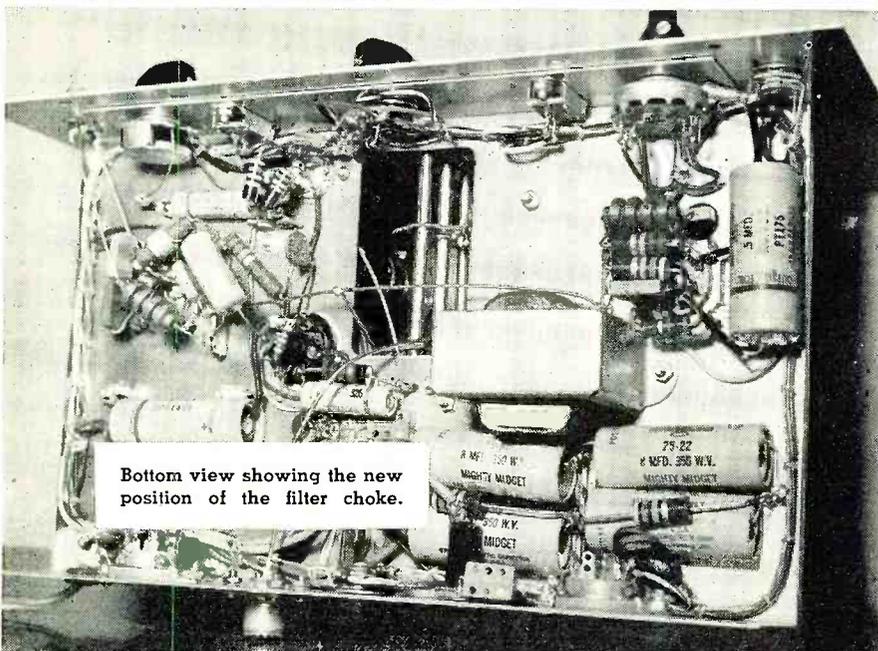
Panel view of the AT-1 showing position of the new operating controls.



Schematic diagram of the modulating circuit.

- R₁—4.7 megohm, 1/2 w. res.
- R₂, R₅, R₆—470,000 ohm, 1/2 w. res.
- R₃—500,000 ohm pot (Vol. Control)
- R₄—4700 ohm, 1/2 w. res.
- R₇—220 ohm, 2 w. res.
- R₈—27,000 ohm, 2 w. res.
- C₁, C₆—.005 μfd. ceramic capacitor
- C₂—250 μfd. ceramic capacitor
- C₃—.002 μfd. ceramic capacitor
- C₄, C₇—10 μfd., 25 v. elec. capacitor
- C₅—8 μfd., 450 v. elec. capacitor
- C₈—.01 μfd., 600 v. capacitor
- J₁—Phone jack
- S₁—Two-section, two-position non-shorting rotary switch (Mallory 3222J)

- T₁—Replacement-type output trans. (Stancor A-3824 or equiv., see text)
 - V₁—12AX7 tube
 - V₂—6L6 tube
- Note: E3, E4, and B7 on this schematic refer to Heath pictorial socket designations.



Bottom view showing the new position of the filter choke.

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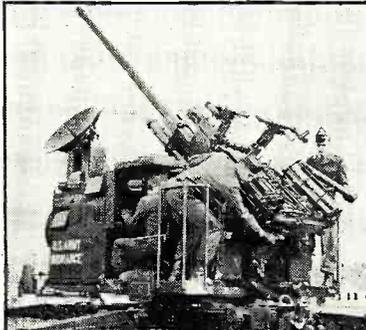
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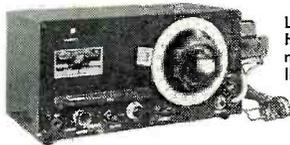
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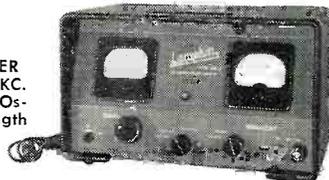
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Unusual Sounds (Continued from page 67)

this effect is not used as often and can be quite an attention-getter. Countless variations are possible. The tape recorder microphone may be a filter type. Acoustical effects are added when the tape output is fed to a speaker in a "live" room, the sound picked up and fed into the board for mixing. To record this group of effects a second recorder would be required.

Most tape machines can be used or adapted for these feedback circuits. If an examination of available machines shows one with separate recording and playback heads and amplifiers, no alteration is necessary. However, if your machine has only an erase head plus a dual-purpose record-playback head with a single dual-use amplifier, another playback pickup must be added past the original one. The machine at the side of the console in the photograph is typical of this type. Shielded leads connect the extra pickup with a microphone input of the control board. Thus an auxiliary amplifier is not needed. The additional head need not be the same make or model as the ones on the factory machine. A single-unit playback head of low impedance will match microphone inputs of standard consoles. If possible, mount it with wingnuts through a slot cut in the recorder's top. Some machines require removal of the pickup housing to make room. If space allows, a slot-mounted head that can be placed along the tape's travel is preferable since it allows adjustment of the time-delay. For, as noted earlier, the distance from recording head to playback head determines this delay. Head spacing of two or three inches at $7\frac{1}{2}$ ips tape speed produces a definite reverberation with individual words not clearly repeated unless they are short and staccato. Adjustable spacing expands the possibilities by allowing longer words or even phrases to repeat as they slowly diminish in volume.

There are, of course, other ways to set up these circuits. A studio console offers the quickest, most controllable, and flexible method. If desired, another type mixing amplifier can be used. Mechanical mixing will serve, but is more difficult to control and sometimes impairs quality. If direct mixing is used, feed the machine's output directly into its high-level input while feeding the low-level input with the microphone. The machine's recording volume control sets the recording level, while its playback control determines the amount of feedback echo. If using the high-level input "lifts" the microphone, push the plug into the high-level input only until it makes contact and not all the way in.

Variable Speed Recording

Novel announcements can be made by variable speed recording: speeding up or slowing down the voice slightly.

RADIO & TELEVISION NEWS



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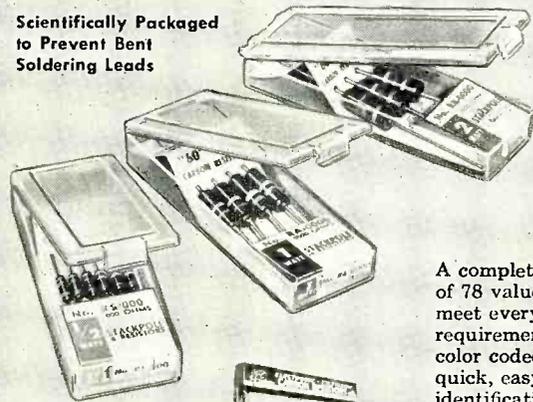
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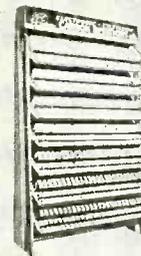
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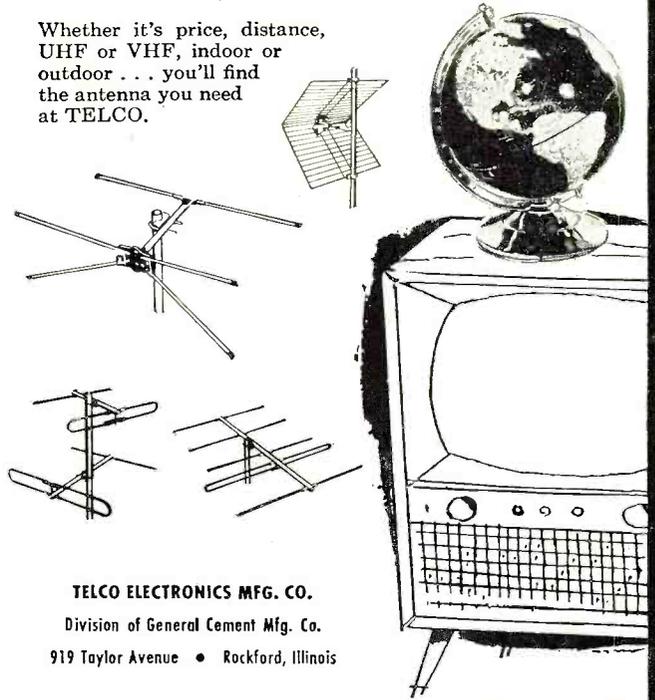
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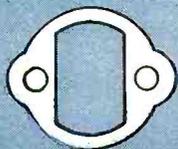
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You need not have a disc or tape recorder with variable speed motor, but your tape machine must have an exposed and removable drive capstan. (The wheel or shaft which drives the tape through the machine and determines its speed of travel.) For example, for a speeded-up voice, the speech must be recorded slow. Many machines have a two-speed arrangement; this is not satisfactory since recording at the slow speed and playing back at the fast speed makes the voice too rapid for understanding. Make a special drive capstan for this effect. Remove the regular capstan from its shaft. Wrap adhesive tape (not friction or Cellophane tape) around the capstan shaft tightly until it builds up to about three-fourths or five-eighths the diameter of the original capstan. Record your material. Remove the temporary capstan. Replace the original. The words will be speeded up enough for the desired effect, yet will be understandable.

If the voice is to be slowed down a bit, leave the original capstan on and wrap it with several tight layers of adhesive tape. Record, then remove the adhesive tape for playback. As in most shortcut methods, a little experimenting will be needed. If a great deal of variable speed work is to be done, a machinist can turn several odd-size drive capstans.

Filter Microphones

Commercial filter units are available for the production of a variety of effects. But for an inexpensive unit that will cover most situations, use an earphone as a microphone. Trial and error will show which model phone produces the sound wanted. A low impedance unit of "voice coil" construction rather than the usual metal-diaphragm type will give clearer reproduction. A metal diaphragm produces metallic sounds. A model such as the war surplus ANB-H-1 or similar type gives the carbon-mike effect needed for most situations. A shielded microphone cord may be used, but a common two-conductor lamp cord picks up no hum if kept short. Your regular microphone plug feeds the single earphone into a control board or tape recorder. A filter microphone is shown on the stand in the photograph.

The foregoing suggestions are just a sample of the type of stunts that can be performed by the audiophile or station engineer who understands his equipment and appreciates the interesting potentialities of his tape recorders, mixer units, microphones, etc. The author suggests that you experiment with your audio gear as the results are well worth the small investment in time and accessories required to set up such a system.

While these tricks do not represent technical perfection, they do offer a practical way for smaller radio stations to produce good sound gimmicks for commercial copy, and do it with little or no special equipment—a most important consideration!

—50—



"I just cleaned up my last case of TVI."

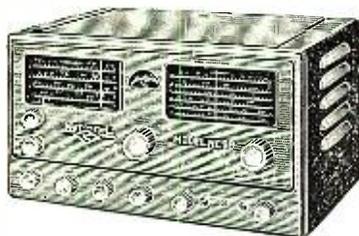
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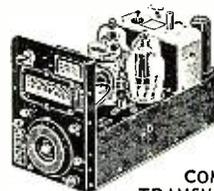
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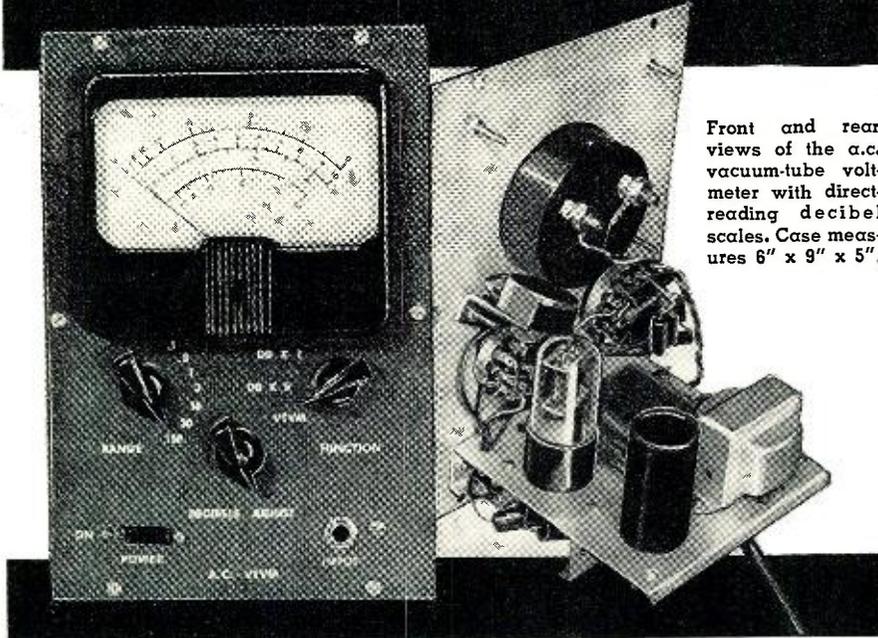


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An A.C. Vacuum-Tube Voltmeter



Front and rear views of the a.c. vacuum-tube voltmeter with direct-reading decibel scales. Case measures 6" x 9" x 5".

By SANFORD GRAY

A simple unit for the audio man. It has three db scales, high input impedance, response $\pm 1/4$ db from 20-20,000 cps.

HERE is an a.c. vacuum-tube voltmeter with direct reading decibel scales that the audio enthusiast should find useful. It can be used for designing equalization curves, for plotting frequency response, for calculating power output, and for many of those delicate a.c. measurements that the hi-fi fan finds necessary.

After designing several preamplifiers and plotting the equalization curves

by laboriously translating voltage ratios to decibels the author decided to build a direct reading decibel meter. A vacuum-tube rectifier in conjunction with a sensitive voltmeter and a similar crystal diode meter were considered as circuit possibilities. But both of these would have been limited to use with output or cathode-follower stages because of the low input impedance. Although the initial cost of a

vacuum-tube voltmeter would be more, the extra expenditure seemed justified since a vacuum-tube voltmeter could be used with either high or low impedance circuits. The meter described in this article is the result of this study.

The meter has a full-scale a.c. volts range of from .1 volt to 100 volts. Since most good multimeters have a.c. ranges to at least 1000 volts it was decided not to extend the range beyond 100 volts because this meter was designed primarily for audio measurements. It also has three direct reading decibel scales with a control for setting the needle to zero on any scale. The frequency response of the meter is flat within $1/4$ decibel from 20 to 20,000 cycles.

The meter uses a simple two-stage RC-coupled triode amplifier with inverse feedback around both stages to raise the input impedance and extend the frequency range. A microampere meter is in the feedback loop. Power is supplied by a half-wave selenium rectifier and a small power transformer of the type used in preamps and TV boosters. The transformer isolates the meter from the line and prevents the possibility of a "hot" case.

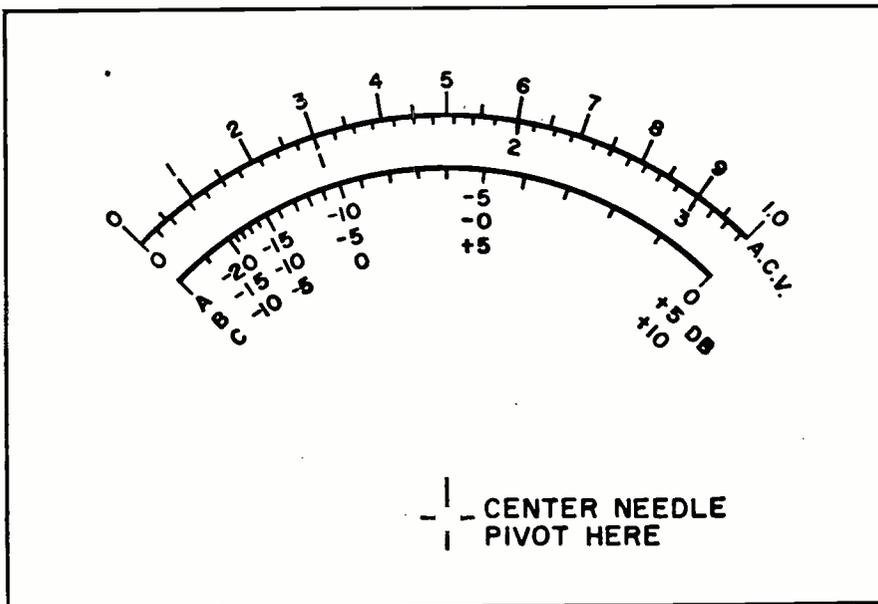
A three-position function switch selects either of two decibel ranges or the vacuum-tube voltmeter function. R_1 and R_2 provide a 1 to 5 ratio on the decibel scales. These resistors may have a $\pm 10\%$ tolerance because this ratio is not critical. The resistors in the voltage divider for the a.c. volts scale should have a tolerance of $\pm 1\%$.

The meter used by the author is a 350 microampere, $4\frac{1}{2}$ inch rectangular movement from a war surplus vacuum-tube voltmeter. A 500 or 200 microampere movement would work as well since the feedback control can be adjusted to compensate for the difference. A 200 microampere movement would have better frequency response because more feedback would be necessary to reduce the gain of the circuit. If a 200 μ a. movement is used a 220-ohm resistor must be placed between the 250-ohm potentiometer and ground.

A 6 by 9 by 5 inch aluminum carrying case was used to house the instrument. The 6SN7 tube, power transformer, filter capacitor, and 1 μ fd. bathtub capacitor are mounted on a 4 by $5\frac{1}{8}$ by 1 inch aluminum chassis. The $5\frac{1}{8}$ inch side is bolted to the front panel and the rear apron is bent up to form an extension of the chassis. The feedback control is mounted on a bracket fastened to one of the lower meter mounting screws. This should be a wirewound control. The decibel adjust control can be any linear-taper volume control but one of the molded composition potentiometers will give longer and more reliable service.

The meter face may be traced from the one accompanying this article or, if a different size is used, may be redrawn from the information in Table 1.

Meter scale for v.t.v.m. It may be traced and glued to face of $4\frac{1}{2}$ " rectangular meter. See Table 1 if other meter is used.



— | — CENTER NEEDLE PIVOT HERE

A coat of wrinkle varnish will give the instrument a professional appearance. The lettering was done with the kind of decal that can be made permanent by the application of lacquer thinner after the decals have dried out thoroughly.

To calibrate the meter, set the function switch to v.t.v.m. and the range switch to 30 volts. Connect the meter to the 5-volt winding of a power transformer. If the needle reads over 10 volts, increase the feedback by adjusting the feedback control. Next turn the range switch to 10 volts and set the needle to read 5 volts by adjusting the feedback control.

Operation

To determine the characteristics of various equalization networks, a steady audio signal is needed. An audio oscillator or any of the steady-state frequency records on the market may be used. The frequency record has the advantage of showing pickup performance as well as the characteristics of the network; however an audio oscillator is usually quicker and more convenient to use.

In using an audio oscillator to determine the frequency response of a given network, set the oscillator on 30 cycles. This is usually the lowest note that information on the various curves gives. Now set the needle to zero on Scale A. As the frequency is increased note the decrease in the readings. Since most equalization curves call for a drop of around 17 decibels from 30 cycles to 1000 cycles it is easier to read the scale if the needle is reset to zero at 1000 cycles when the oscillator reaches this point. Again note the drop in response as the frequency is increased. For graphs, paper that has a logarithmic horizontal axis and a linear vertical axis should be used. The three-cycle log paper that is available at most drafting supply houses will give room for 10 to 10,000 cycles which should be sufficient for most purposes. If a graph of the entire audible range is needed, special audio graph paper is available from "Clarkstan" (Pacific Transducer Corp., 11921 S. W. Pico Blvd., Los Angeles 64, Cal.)

When a steady-state frequency record is used, the needle should be set to zero on Scale B at a frequency of 1000 cycles. If the characteristics of the network conform to those of the record, the needle should not deviate from zero. This, however, is an ideal that is seldom attained. A deviation of ± 1 decibel from 100 to 8000 cycles and ± 2 decibels from 30 to 10,000 cycles is usually considered adequate. When designing a network with a different curve from that of the frequency record simply add or subtract the difference in the two curves: the difference should conform to the difference shown by the meter. For instance, at 30 cycles the RIAA playback curve is almost 4 decibels lower than the AES curve. The meter should read minus 4 decibels at this frequency if the record is cut to the AES curve and

% OF FULL-SCALE DEFLECTION		% OF FULL-SCALE DEFLECTION		DECIBELS		
	VOLTS			A	B	C
100	10	100		0	5	10
90	9	89		-1	4	9
80	8	79		-2	3	8
70	7	71		-3	2	7
60	6	63		-4	1	6
50	5	56		-5	0	5
40	4	50		-6	-1	4
30	3	45		-7	-2	3
20	2	40		-8	-3	2
10	1	35		-9	-4	1
0	0	32		-10	-5	0
		28		-11	-6	-1
		25		-12	-7	-2
		22		-13	-8	-3
		20		-14	-9	-4
		18		-15	-10	-5
		10		-20	-15	-10

Table 1. If a 4½" meter is not used, the dial scale will have to be redrawn from this data. Note that 3 v. point falls at 9 v. point, not 10 v. point.

the network is designed to reproduce the RIAA curve. At 8000 cycles the treble equalization is 1.7 decibels less than that of the AES curve. The meter should read minus 1.7 decibels at this frequency.

Remember when using a frequency record that when the playback curve of the network being tested is below the playback curve of the record it will be a minus quantity. When the curve of the network is above the record playback curve it will be a positive quantity. This holds true both above and below the 1000 cycle point where the curve crosses the zero reference line.

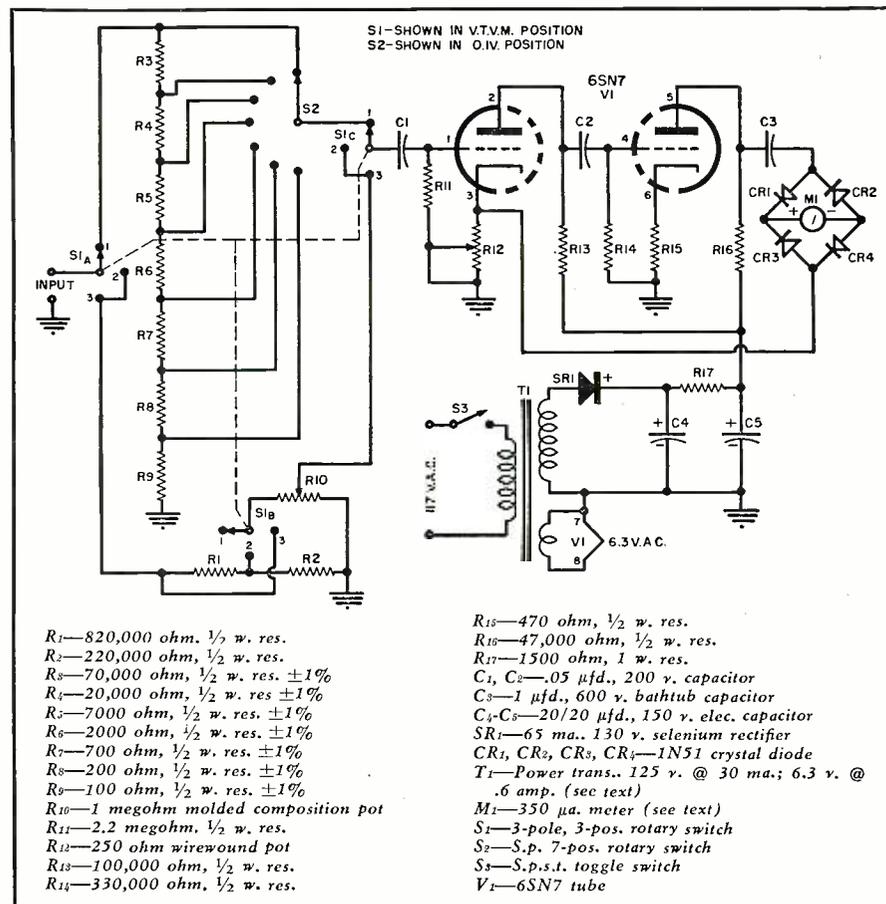
When testing an amplifier for frequency response, connect a noninductive load across its output and an audio oscillator across its input. First connect the meter across the input of

the amplifier and set the needle to zero on Scale B. Run the oscillator through its range to see if loading the oscillator with the amplifier affects the response of the oscillator. If it does, make a note of any deviation. Then connect the meter across the output of the amplifier, reset the needle to zero on Scale B, and run the test again. The test may be repeated with the speaker replacing the noninductive load to see how the response of the amplifier holds up under actual load conditions.

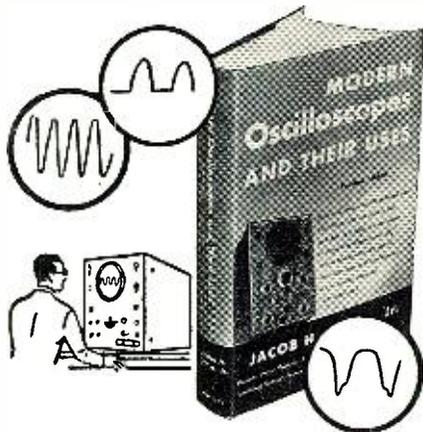
To measure the output of an amplifier, simply connect the meter across the output of the amplifier and feed a signal into it. The power can be calculated from the formula, $P = E^2 / R$ where E is the voltage across the load and R is the resistance of the load.

-30-

Complete schematic diagram of the a.c. vacuum-tube voltmeter for audio service work. Resistors R_3 through R_9 must be of the $\pm 1\%$ precision type. See article.



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Distortion Analyzer (Continued from page 61)

assures that no tube is operated with a d.c. heater-to-cathode voltage greater than its rating. In this unit an interesting substitution was made for the regular type filter choke specified. A small output transformer of the 5-watt variety from the junk box was used with open secondary. Normally the primary inductance of these low priced units is on the order of a few henrys, plenty for filtering purposes.

Construction

The construction of the distortion analyzer is quite straightforward and only a few precautions are necessary to assure satisfactory performance. First, the dual tuning capacitor frame must be insulated from the chassis. The problem, however, is a little more than just keeping a high resistance d.c. path between the frame and ground. Because the frame is large it can have a relatively large capacity to ground if mounted too near the chassis. This tends to limit the high-frequency response of the system. Mounting the capacitor about one-half inch above the chassis proved to be entirely satisfactory. An insulated coupling is required in connecting the capacitor shaft to the front panel dial to prevent body capacitance to ground from affecting the tuning.

The second construction problem is also concerned with the variable capacitor. It is very susceptible to capacitive 60-cycle pickup since the frame is floating above ground and tied through C_s to the grid of V_s . This grid is several megohms away from ground on the low-frequency band which means only a small amount of capacitive coupling from some 60-cycle source will cause a relatively large hum voltage to appear. The only solution is to keep the 60-cycle coupling very low. This means the variable capacitor should be mounted as far from

the power supply as possible and the whole unit housed in a grounded metal cabinet. In our case the tuning capacitor was mounted three inches from the power transformer, with a grounded metal shield inserted between the two. This kept the hum output to a sufficiently low value, 0.004 volt, at the worst. This is 68 db below the nominal output of 10 volts. Incidentally, it might be mentioned that worse conditions exist when the Wien bridge is tuned for 60 cps. Then, since the gain of the system is zero at 60 cps, there is no negative feedback to buck the hum introduced.

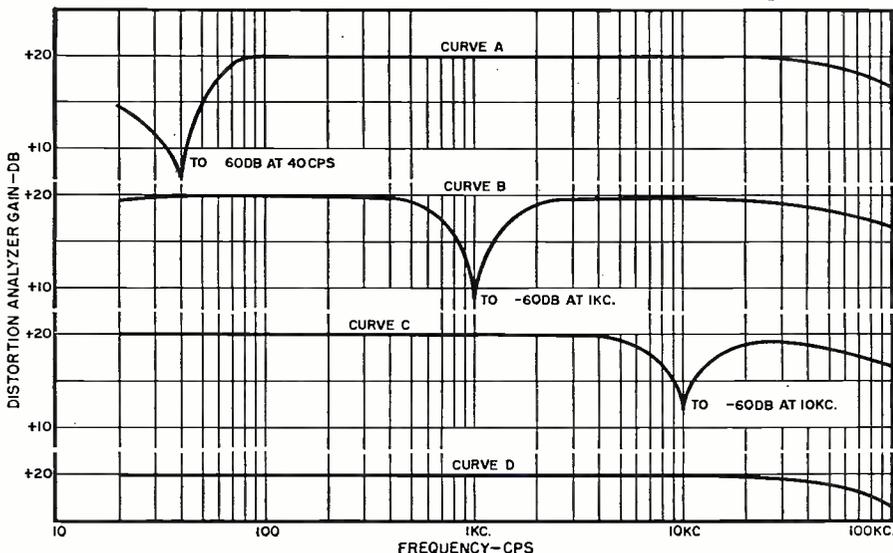
Outside of the two precautions just mentioned no difficulty should be encountered in reproducing the circuit if reasonable care is taken in wiring. One additional note—the capacitor tuning dial should be geared down about 5 to 1 to insure ease of bridge adjustment.

Before describing the distortion measurement procedure, a few words should be said on the voltmeter to be used with this analyzer. Ideally the meter required would respond inherently to the r.m.s. value of an a.c. waveform. A thermocouple meter or a full-wave, square-law vacuum-tube voltmeter would fall in this category. Normally meters that cover the desired voltage ranges with high impedance input are not available.

The best compromise is to use one of the common audio voltmeters that responds to the average value of a waveform. This will, of course, introduce some error in distortion measurement depending on the phasing and amplitudes of the harmonics. In general, though, the error caused in using an average responding meter is under $\pm 15\%$. A peak responding meter should not be used as it may cause errors as great as 40% and over.

The meter should be flat in frequency response from 40 cps to 45 kc. and capable of measuring from 10 to 0.01 volts with good accuracy. A very good meter for the purpose is that described by Lawrence Fleming in his article, “An Electronic A.C. Volt-

Fig. 4. Measured frequency response of distortion analyzer. (A) Null at 40 cps; (B) Null at 1 kc.; (C) Null at 10 kc.; and (D) Response with the Wien bridge bypassed.



meter," in the February, 1951 issue of RADIO & TELEVISION NEWS or the Heathkit AV-2 which uses the same type circuit. Both use a full-wave rectifier circuit to respond to the average value of the applied wave and are calibrated to indicate the r.m.s. value of a sine wave.

Operation

Once the distortion analyzer has been constructed only frequency calibration with a good audio oscillator is necessary before it's ready to go. The procedure for measuring distortion is simple.

1. Connect a low distortion audio generator to the input of the amplifier to be tested and adjust for the desired level.
2. Connect the output of the amplifier to the distortion analyzer and voltmeter to the analyzer.
3. Turn S_2 to "Calibrate" position (#1), Wien bridge bypassed.
4. Adjust the analyzer gain control to give a voltmeter reading of 10 volts.
5. Turn S_2 to "Read Distortion" position (#2).
6. Adjust the tuning capacitor and balance control R_{12} for a minimum reading on the voltmeter.
7. The voltmeter reading when multiplied by 10 will give the distortion directly in per-cent.

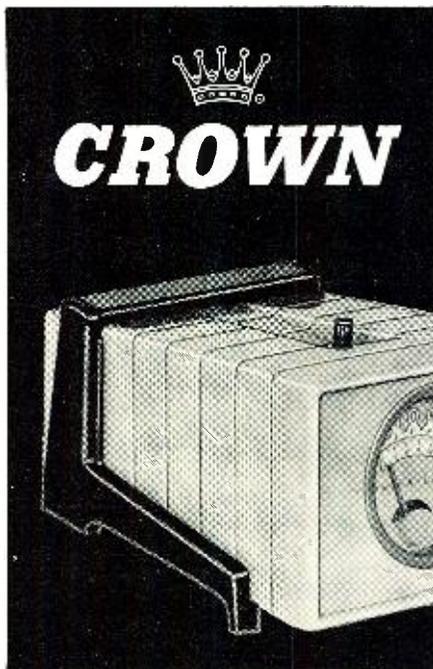
Assuming a zero distortion signal generator, the distortion measurement accuracy with this unit will be within about -30 to +20% up to 10 kc., slightly higher at 15 kc. This figure was arrived at by allowing a minus 10% error due to undesired harmonic attenuation in the analyzer. A $\pm 15\%$ error was allowed for meter waveform error and $\pm 5\%$ error was allowed for meter calibration. In most cases, however, the error in measurement will be less than that just indicated. Table 1 compares distortion measurements made with a Hewlett-Packard 330B distortion analyzer and those made with this unit using a Ballantine 300 voltmeter. Differences at the higher distortion percentages probably were due to differences in voltmeter calibration and rectification characteristics. At the very low distortion values both instruments were hard to balance and read due to noise fluctuations in the signal. From these figures, the useful lower limit of distortion measurement was taken to be about 0.2%. Measurements below this figure can be made, but the accuracy becomes questionable as instrument noise and distortion begin to influence the readings.

The reasonably sharp filter characteristics of the unit described here can be put to work in uses other than distortion measurement. As an example, the author found it very satisfactory in eliminating the annoying whistles which often accompany night-time AM reception.

REFERENCE

1. Albert, A. R.: "Electrical Communication." -30-

February, 1956



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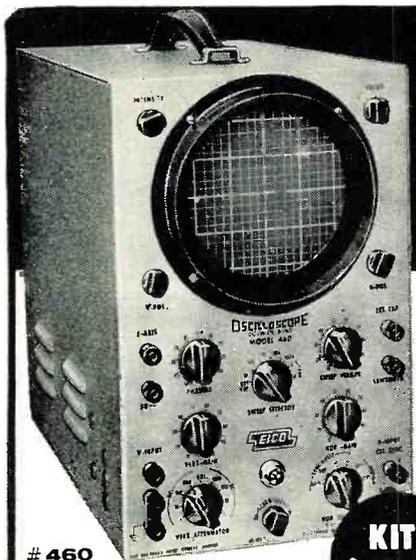
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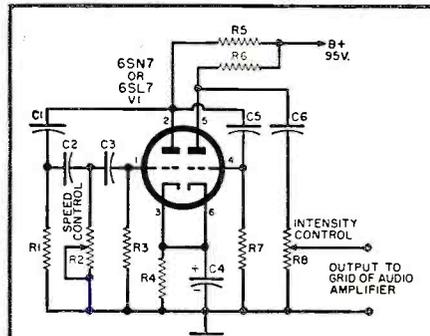
The unit consists of a phase-shift oscillator, operating in a range of 6-15 cps (by varying R₂). R₂ is called the "speed control" when mounted on the amplifier. This low-frequency oscillation is a good sine wave with no harmonics, if built with care. The second half of the tube is used as a buffer-amplifier to isolate the oscillator and keep frequency of oscillation constant.

The output is coupled to the grid of a single-ended audio amplifier through the intensity control (R₅). The unit can be used to modulate a push-pull amplifier by making the cathode circuit of the buffer-amplifier common to the cathode circuit of the push-pull audio amplifier.

Use care in construction to keep hum and distortion as low as possible and the output as close to a sine wave as possible. Use a piece of bus bar to make a common ground connection for both the amplifier and oscillator; all ground connections should be made to it. The entire unit may be constructed on the chassis of the amplifier, if spare room is available. If there is no room, a small piece of metal attached to the main chassis, may be used. If none of these are possible, then a separate small chassis, which is kept on the bottom of the cabinet may be used. This chassis may be constructed of metal or plastic with equally good results. Both controls, speed and intensity, should be mounted on the main control panel of the amplifier.

The author has built three of these units over a period of three years and has found all the units work with a wide variation in values of components. The 6SN7 can be interchanged with a 6SL7. Keep "B+" low for a more sinusoidal wave. Because the oscillator is of the resistance-capacitance type, cost is kept to a minimum.

Schematic of simple vibrato circuit.



- R₁, R₃, R₆—220,000 ohm, 1/2 w. res.
- R₂, R₄—500,000 ohm pot
- R₅—2200 ohm, 1/2 w. res.
- R₇—100,000 ohm, 1/2 w. res.
- R₈—3.3 megohm, 1/2 w. res.
- C₁, C₂, C₃—.05 μfd., 200 v. capacitor
- C₄—20 μfd., 50 v. elec. capacitor
- C₅, C₆—.1 μfd., 200 v. capacitor
- V₁—6SN7 or 6SL7 tube

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Signal Tracer

(Continued from page 65)

local broadcast station or the output of a signal generator. The signal tracer is used to check for the presence of an r.f. signal at points A, B, C, and D, and for the presence of an audio signal at points E, F, G, and H. If the signal is found to be absent at any point, the technician knows that the trouble is in the stage just ahead of that point.

For example, if the technician finds there is a signal present at point C, but no signal at point D, he knows that the trouble is in the i.f. amplifier stage. Further tests may then be made in that stage to isolate the trouble to a defective part.

A signal tracer may be used for effectively testing the condition of bypass and coupling capacitors under operating conditions. To test a coupling capacitor, check for the presence of a signal at the plate of the stage preceding the capacitor. Check again at the grid of the following stage. If the coupling capacitor between the two stages is open, a strong signal will be received when the plate circuit is checked and a weak signal when the grid circuit is checked. Under some conditions, the signal may even be absent on the grid.

A screen-grid or cathode bypass capacitor may be checked for an open by using the signal tracer to determine if there is a signal present at the bypassed point (screen-grid or cathode tube terminal). The presence of a strong signal indicates that the bypass capacitor at that point is not effective.

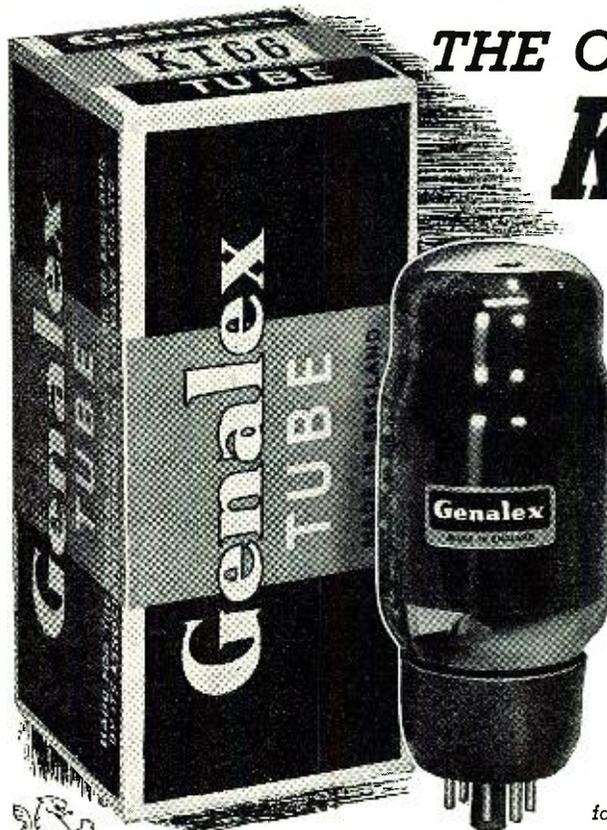
When using the transistorized signal tracer (or any signal tracer, for that matter), the technician should first become familiar with the operation of the instrument by trying it on a receiver known to be in good operating condition. Otherwise, false conclusions may be drawn as to the condition of the receiver or as to the operation of the instrument.

First, when checking r.f. circuits, remember that the probe will cause a certain amount of detuning. In highly selective (high "Q") circuits, the detuning may be sufficient to cause the effect of a weak signal.

Secondly, remember that the gain of the transistorized signal tracer will not be quite as high as with corresponding vacuum-tube instruments—at least if CK722 transistors are used. The gain should be sufficient for most service work, however, provided the technician is aware of the lower gain and takes it into account in his tests.

Finally, if the output of the signal tracer seems distorted when you check a particular point in a receiver, don't immediately assume that the distortion is in the receiver. It is possible to cause distortion in the signal tracer itself if the gain control is turned too high when powerful signals are being checked. Try turning the gain down and rechecking the receiver.

-30-



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The name **GENALEX** on the tube and carton is your guarantee that you are buying the original **KT66**... world-famous power tetrode, often referred to as the finest audio tube ever made! The **GENALEX KT66** is the hallmark of the finest amplifiers. For example, it is supplied as original equipment in the famous **HEATH ULTRA LINEAR AMPLIFIER KIT**, Heathkit No. **W-5M**. Identical pins and connections as **6L6** tubes. Only \$3.50 net

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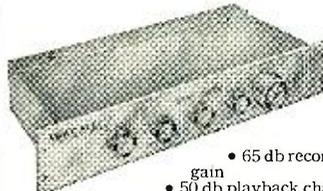
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- NARTB, of course!

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 Bass and Treble Tone Controls
 Input for Xtal or Dynamic Mike
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With GU-14Y, 12" Coax Speaker...\$32.95
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 With Imperial IV System...\$39.95

With SP-12125CR...\$44.95 With HF-33GE...\$69.95

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7 3/8" x 10 1/2" x 7 3/8" 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 ship, wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, \$22.95.

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. Three 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. 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" mid-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. 75 lbs. Stock No. HF-44GE, \$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. Sales price, \$59.95 (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 one compensating control. Model HF-55GE, Sale price \$69.95 (specify cabinet finish).

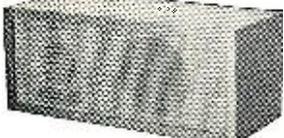
DELUXE CONSOLE SPEAKER SYSTEM \$89.50

15" UTAH WOOFER—8" GE—2-5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity console speaker system. Has 15" Utah woofer with 21 oz. Alnico V magnet, 8" 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 mahogany finish. Cabinet size, 43" high, 31" wide and 23" deep. Has 3/4" 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



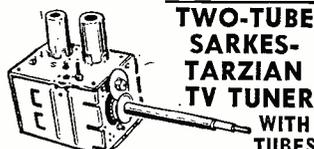
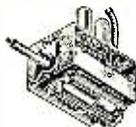
New 1955 Model IMPERIAL IV, High Fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 2 1/2" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 ohm. Alnico V magnet and curvilinear cone with 8 ohm voice coil and a 5" tweeter. Response up to 15,000 cps. Model IV Imperial \$19.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

FAMOUS STANDARD COIL CASCODE TUNERS

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 is the best for reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with 27" or 41/4" shaft length. A tremendous purchase makes our low \$12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price \$12.95 each, 2 for \$25.00.

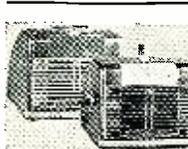
Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.

SALE PRICE
\$12.95



TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES \$7.95 EA., 2 FOR \$15.00

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel TV tuner. 21-25 mc. Popular in many makes. Ideal for general replacement use. Has 6J6 and 6BQ5 tubes. Used in CBS, Arvin, Crosley, etc. Makes a good replacement for one tube tuners. 3 1/8" shaft. Takes SCK-2 knob set described above. Sale price, \$7.95 each, 2 for \$15.00 with tubes.



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Powerful 3 station master. Chrome plated metal case 7 1/2" 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. \$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.

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 cascade 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 GE-6B continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price...\$5.95

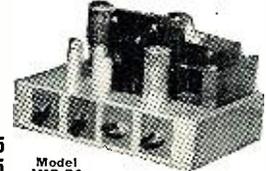
Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price...\$6.95

IMPERIAL 30 WATT AMPLIFIER \$29.95

NEW 1956 MODEL

Push-Pull 6L6 Output Tubes
 Response 15-20,000 CPS
 Bass and Treble Tone Controls
 Compensated Gain for G.E. Gart.
 Input for Xtal or Dynamic Mike

With GU-14Y, 12" Coax Speaker...\$39.95
 With P15-CR, 15" Coax Speaker...\$49.95
 With Imperial IV Speaker System...\$46.95
 With SP12125CR...\$51.95 With HF-33GE...\$76.95



New 1956 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A \$300.00 list value for only \$29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to \$15.00 if purchased separately. Gold color chassis is 12 1/2" x 7 3/4" x 7 3/4" high. Complete with tubes: 6AT6, 6AU6, 6C4, 12AU7, 2-6L6GA, plus 5U4G rectifier. Stock No. IMP-30, 30 watt Imperial High-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs., Sale price only \$29.95.

25 WATT HI-FI SPEAKER SYSTEM



2-12" Woofers
2-5" Tweeters
Power Supply
and L-C Crossover Network

SALE PRICE \$24.95

25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance crossover 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 15,000 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. SP-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 IMP-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 ohm. Alnico V magnet with wide range curvilinear 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" Hi-Fi woofer. Has 21 1/2 oz. Alnico V magnet with one piece cone and 1 1/4", 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.

NEW—LOW COST

HIGH FIDELITY MICROPHONES

Special Sale! Model M28-KT, high quality imported crystal lapel microphone. Very trim and neat in appearance. Polished chrome case 1 1/2" x 5/8" thick with clip on back and 5 ft. shielded plastic cable. Hi-Fi response, comparable or better than lapel microphones selling for \$10 to \$15 net. Shipped with 3 connectors; pin plug, phone plug and screw-on type. A fine addition to any tape recorder or audio amplifier. Stock No. M28-KT, Sale price, \$3.99.

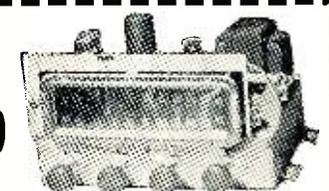
Deluxe Model M14-KT, High Fidelity imported crystal microphone for use with any amplifier or tape recorder. Attractive brilliant finish. Combination of polished chrome and opalescent tan lacquer. Has full swivel head and 5 ft. shielded plastic cable. A fine addition to any amplifier or tape recorder. Comparable to microphones selling for \$15 to \$25 net. Shipped with plugs to fit most recorders and amplifiers. Stock No. M14-KT, Sale price, \$7.95. Fits standard 5/8" mike stand.

Model M20-KT, all purpose crystal microphone. Hi-Fi response. A terrific imported value. Comparable or better than microphones selling for \$10 to \$12 net. Fits standard 5/8" mike stand. Shipped with pin plug, phone plug and screw-on connector. Stock No. M20-KT, Sale price, \$4.95.



AIR KING FM-AM TUNER

SELF POWERED
 Use with any Audio Amplifier
SALE PRICE \$24.99



Air King factory built, 6 tube self-powered FM-AM radio tuner. Receives broadcast 540 to 1620 kc and FM 88 to 108 mc. Use with any Hi-Fi audio amplifier or connect it to your TV set for FM-AM reception. Selector switch has 4 positions for TV-Phono-FM and AM. The controls are volume-on-off, tone and tuning. With tubes: 12AT7, 2-6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11 1/2" x 7 1/2" x 6 1/2" high. Illuminated slide rule dial 7 1/2" x 2 1/2", with escutcheon plate and knobs. Self powered with its own power transformer. Air King FM-AM tuner chassis No. 703 has used in our King model 17K1C combination TV-Radio-Phono with power supply added. Note: A separate audio amplifier is required to operate a speaker. Stock No. AIR-K6, self-powered FM-AM tuner, complete with tubes, knobs and diagram. Ship. wt. 10 lbs. Sale price, \$24.99.

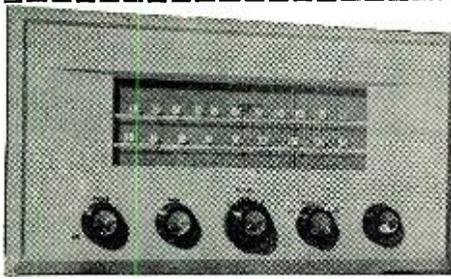
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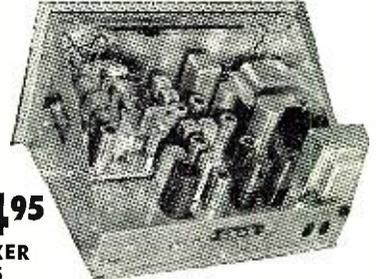
14 TUBE ESPEY HI-FI CUSTOM FM-AM CHASSIS \$84⁹⁵

LATEST 1956 MODEL WITH RESPONSE FROM 10 TO 22,000 CPS



NEW MODEL HF-250C. A FULL HIGH FIDELITY AUDIO AMPLIFIER AND FM-AM TUNER—ALL ON ONE CHASSIS

- ★ PUSH-PULL 6V6 OUTPUT
- ★ TWIN TONE CONTROLS
- ★ INPUTS FOR CRYSTAL OR V.R. PHONO, TAPE OR TV
- ★ WILLIAMSON TYPE CIRCUIT
- ★ ULTRA-LINEAR RESPONSE



WITH MONARCH UAGU CHANGER \$112.95

ESPEY MODEL HF-250C

With 12" Phillips Model 9760M Speaker... \$99.95

With 12" Phillips Model 9762M Speaker... \$119.95

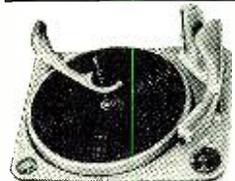
Buy either of these new Duotone "Norcops" speakers with your Espey chassis. Made by Phillips of Holland. Features Ticonal magnet, improved cone design, built-in mechanical cross-over and copper ring fitted into air gap keeps voice coil impedance independent of frequency.

Model 9760M, \$34.95 list 12" Phillips speaker, response 30 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only \$99.95.

Model 9762M, \$99.95 list 12" Phillips speaker, response 22 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only \$119.95.

With 15" Utah Coaxial PM Speaker... \$99.95

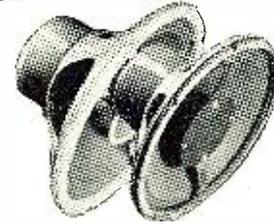
New 1956 model, 14 tube FM-AM chassis. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt radio. You could spend \$200 to \$250 for a separate tuner and amplifier and not have the quality of this 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. 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. Beautifully edge lighted flywheel inertia slide dial. Size: 7 3/4" x 3 3/2" x 10" 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.



NEW IMPORTED MONARCH HIGH FIDELITY AUTOMATIC CHANGER WITH GOLDRING #500 VAR. REL. CARTRIDGE

SALE PRICE **\$29⁹⁵**

Monarch Model UAGU—new, imported high fidelity 3 speed automatic record changer. Plays 7", 10" and 12" records automatically. Intermixes records of the same speed in any order. Features a 4 pole high fidelity motor eliminating rumble and wow. Pickup automatically returns to rest and motor turns off after last record has played. Full size 10" turntable has molded rubber pallet for better record cushioning. Base size, 10 7/8" x 12 3/4". Tone arm is counter balanced to assure minimum record wear. The changer features, at no added cost the regular \$9.90 net value Goldring #500 variable reluctance cartridge for the finest high fidelity record reproduction. Output 10 millivolts. Response, 20 to 16,500 cps. It requires the same input gain as popular American made variable reluctance cartridges. Model UAGU, Monarch automatic changer with Goldring cartridge, ship. wt. 15 lbs. Sale price, \$29.95. Large spindle for 45 RPM records, \$1.88 extra.

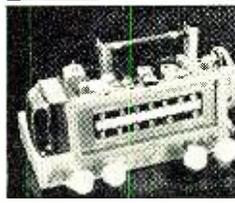


McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

\$12⁹⁵ \$23⁹⁵

12-inch Model CU-14Y 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 5" 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 2 1/2 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.



HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER

BOTH FOR **\$44⁹⁵**

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, 6X4A15. American made 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.

WEBCOR 3 SPEED CHANGER MODEL 140-16 WITH 2 NEEDLE FLIPOVER CARTRIDGE

\$24⁹⁵

New Model 140-16, Webster-Chicago 3 speed automatic record changer with Astatic 66-TMY, 2 needle flipover crystal cartridge. Plays all 3 speeds and all 3 size records. Shuts off automatically after last record. Has neutral position to prevent damaging drive wheels when changer is not in use. 3 3/8" x 12" wide, 7 1/2" high overall, 2 1/2" below motor board and 4 1/2" above. Model 140-16. Ship. wt. 12 lbs. Sales price, \$24.95.



9-TUBE HI-FIDELITY 12 Watts Audio Dual Tone Controls

\$39⁹⁵

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 500 mil power trans. 9 1/2" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9 1/2" 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.

MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE

SALE PRICE \$9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with tubes and instructions. Operates on 90 volts A.C. 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.



NEW—SMALL VOLT-OHM METER 2000 OHMS PER VOLT AC-DC WITH TEST LEADS

McGEE SCOP SALE PRICE **\$9⁹⁵**

New, small Volt-Ohm meter 5 1/4" tall, 3 5/8" wide and 1 1/2" thick, 3 1/4" 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 0 to 1.5 megohms in 2 ranges; Decibels minus 20 to plus 16 (odd .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 of 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, 6 1/4" tall, 4 1/2" wide and 2 5/8" thick, 2000 ohms per volt. Similar in appearance to Model TP-5, except that it is larger, has 3 1/2" meter and 4 resistance ranges instead of 2. Model MT-1A. Ship. wt. 2 lbs. Sale price, \$12.95 each, 2 for \$25.00.

NEW 6-TUBE, 12-VOLT UNIVERSAL MOUNTING AUTO RADIO

WITH 5" x 7" OR 6" x 9" SPEAKER SALE PRICE **\$29⁹⁹**

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 cut-out 5 1/2" long x 2 1/2" high; two control holes on 7" centers. A minimum of 6 3/4" depth behind dash. When mounted underdash it extends only 2 1/2" below. Overall size: 9" wide, 4 1/4" high and 7 1/4" 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, \$39.99 for the radio complete with 6x9" speaker. 3 section top cowl antenna, \$2.29 extra.

NEW 12-VOLT MODEL WITH SPEAKER \$29.99

Model AH-1259, 12 volt universal mounting auto radio. This is the same set as pictured above (AH-759), except, made for 12 volt model 1955 and 1956 cars. Stock No. AH-1259 with 6x9" or 5x7" speaker, \$29.99. Stock No. RP-2322, 6x9" rear seat speaker kit for 12 volt cars, \$4.99 extra.

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That electronic miracle, your TV set, picks a world of entertainment out of the air at the fantastic speed of 120 pictures a second!

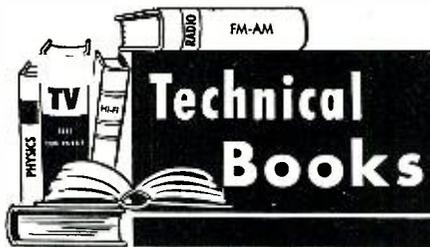
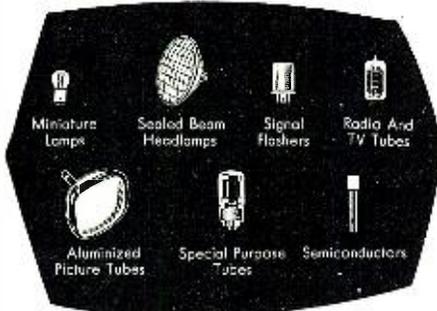
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"ELECTRONIC CIRCUITS" by Thomas L. Martin, Jr. Published by *Prentice-Hall, Inc.*, Englewood Cliffs, N. J. 707 pages. Price \$12.35.

The author has summarized this book as follows: "Electronic components can be represented by simple equivalent circuits. Electronic circuit design is thereby reduced to ordinary circuit design and is no longer a problem in electronics."

There are three main parts to the book. The Introduction serves to introduce the principles of equivalent circuits and the elements of electric circuit theory based on the complex frequency and Laplace transform approach. Part 2, titled "Class A Circuits," covers circuits requiring continuous operation of the electronic component. The circuits of Part 3, "Operation in the Switching Mode", nearly all require discontinuous operation of the electronic component.

The book is designed to appeal to practicing engineers and physicists, and may be used as a text at the graduate or undergraduate level. Necessary background includes elementary calculus and an introductory course in electronics, while a course in a.c. circuit theory will be very helpful.

* * *

"RADIO PROJECTS" by Abraham Marcus. Published by *Prentice-Hall, Inc.*, Englewood Cliffs, N. J. 74 pages. Price \$3.50.

This is an ideal "project" book for the Scout leader, the boys' club counselor, the teacher of freshman physics courses, and others concerned with imparting a basic knowledge of radio to the tyro. The book covers soldering techniques, crystal detector and diode detector receiver construction, building a regenerative receiver, a.c. power supplies, an a.f. amplifier, a t.r.f. tuner, an a.c.-d.c. superhet, and a code oscillator. Three appendices give the color code for mica capacitors, fixed resistors, and the International Morse Code.

Accepted radio practices are adhered to throughout so that the student, while completing a specific and workable project, learns the correct method of assembling and wiring electronic circuits.

* * *

"AUDIO AMPLIFIERS & ASSOCIATED EQUIPMENT" by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. Price \$3.95. Paper bound. Vol. 6.

This is a special compilation of the company's "Photofact" folders covering amplifiers, preamps, and AM-FM tuners manufactured during the years

1953 and 1954. Each unit covered is listed by model number, manufacturer, type, tubes, and power requirements. The device is pictured and then the necessary parts list, above and below chassis views, and schematics are presented on each unit. A cumulative index covering this and the previous volumes makes it easy to locate information on any of the well-known units in the hands of the public today.

* * *

"CITIZENS RADIO BAND COMMUNICATION FOR IDAHO" by Lloyd B. Craine. Published by University of Idaho, Moscow, Idaho. 35 pages. Paper bound. Single copies free of charge.

This bulletin, published by the Engineering Experiment Station at the University of Idaho, summarizes a series of experiments that were conducted on Citizens Band equipment. It covers frequencies, classes of equipment, licensing requirements, simplex and duplex operation, selective calling, various systems, commercially-available equipment for this service, and other pertinent data including performance characteristics under various conditions in the field. The selection of a system to fit a known communication need is also outlined.

* * *

"SPECIALIZED HI-FI AM-FM TUNER MANUAL" by the Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 208 pages. Price \$3.50. Vol. 1.

The current enthusiasm for all things "audio" has generated a new market for the services of radio and television technicians. In order to successfully handle this type of repair business the technician should have access to authoritative service data. This volume covers the AM-FM tuners produced during the years 1950 through 1955 by such firms as *Altec-Lansing, Bell, Bogen, Browning, Capehart, Espey, Fisher, Freed-Eismann, Gotham, Granco, Hallicrafters, Harman-Kardon, Heath, Magnavox, National, Pilot, RCA, Radio Craftsmen, Regency, Sargent-Rayment, and Stromberg-Carlson.*

Specifications, tube location guides, schematics, and other needed information is provided on each of the tuners covered.

* * *

"THE LONG PLAYING RECORD GUIDE" by Warren De Motte. Published by *Dell Books*, New York. 448 pages. Price 50 cents. Paper bound.

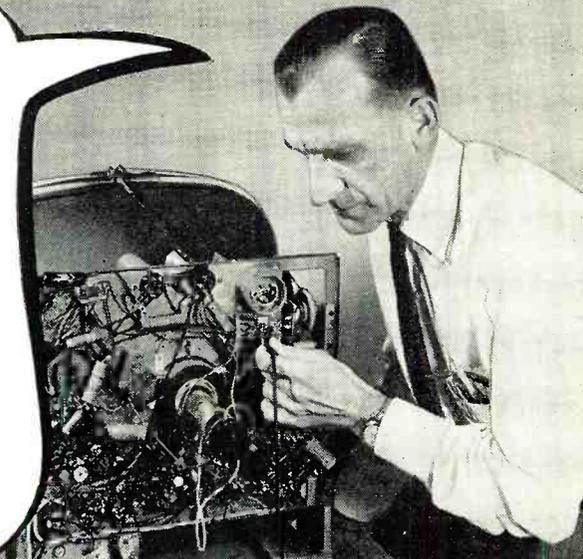
This handy, pocket-size book is a "condensed" catalogue of more than 7000 orchestral, vocal, and chamber music recordings. Its value lies not only in the fact that it covers all labels but carries a brief analysis of the work as well. The material is arranged alphabetically by composer with the available recordings and recording artists listed by label and catalogue number.

* * *

"FUNDAMENTALS OF TELEVISION ENGINEERING" by Glenn M. Glasford. Published by *McGraw-Hill Book*

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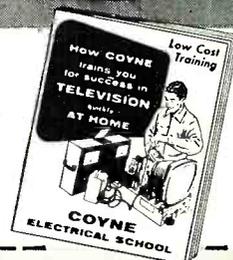
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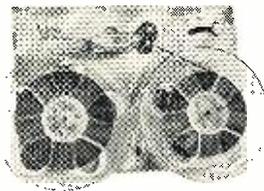
- Power Response (20W): ± 0.5 db 20-20,000 cps; ± 1.5 db 10-40,000 cps.
- Frequency Response ($\frac{1}{4}$ W): ± 0.5 db 13-35,000 cps; ± 1.5 db 7-50,000 cps.
- Rated Power Output: 20 w (34 w peak).
- IM Distortion: (60 cps: 6 kc/4:1) at rated power: 1.3%.
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* * *

"FREQUENCY MODULATION" edited by Alexander Schure. Published by John F. Rider Publisher, Inc., New York. 45 pages. Price \$.90. Paper bound.

This little treatise on frequency modulation is based on a course given at New York Technical Institute to its trainees. It is designed to provide a comprehensive review of the more important principles of FM. The concepts, designs, and theory differences between FM and AM are pointed out to permit a logical extension of familiar AM developments in the study of FM. The presentation is clear, concise, and on the whole, non-mathematical. Test questions are included at the end of each chapter for self-checking.

* * *

"RADIO AMATEUR QUESTION AND ANSWER LICENSE GUIDE" by Martin Schwartz. Published by American Electronics Company, 1203 Bryant Ave., New York 59. 32 pages. Price 50 cents. Paper bound.

This is a new edition of the handy "Ameco" guide of previous years. It includes material on the FCC-type multiple choice questions, typical FCC-type practice exams, questions grouped by subjects, and details on license requirements for the Novice, technician, and general classes. The material has been brought up-to-date to conform to current licensing requirements.

* * *

"ELECTRONIC TRANSFORMERS AND CIRCUITS" by Reuben Lee. Published by John Wiley & Sons, Inc., New York. 360 pages. Price \$7.50. Second edition.

A collection of the most useful data on the design of transformers for electronic apparatus and on the effects of transformer characteristics on electronic circuits. The second edition has been expanded to cover new developments in magnetic amplifiers, pulse circuits, reactor surges, toroid cores, r.f. power supplies, wide-band transformers, and charging chokes.

* * *

"TRANSISTORS AND OTHER CRYSTAL VALVES" by T. R. Scott. Published by Macdonald & Evans Ltd., England. Available in the U. S. from Essential Books, Inc., 16-00 Pollitt Drive, Fair Lawn, N. J. 258 pages. Price \$7.20.

The object of this book is to give engineers a clear picture of the general stage of transistor development

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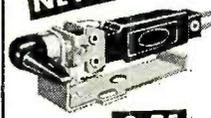
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NEW!
 • 40-14000 CYCLE
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Lafayette brings you one of the finest high-fidelity turnover cartridges, AT AN UNBELIEVABLE PRICE! Frequency response from 40-14,000 cycles + 2 db. Has 2 sapphire styli to play all speeds. Needle pressure only 5 grams on LP cond 12-15 grams on 78. Output is .5 volts. Complete with turnover mechanism and knob, fits Webster, Garrard, VM, Collaro and tone arms of leading manufacturers of record changers and players.

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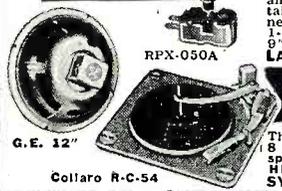
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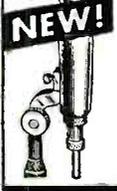
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• Checks Shorts, Leakage, and Gain
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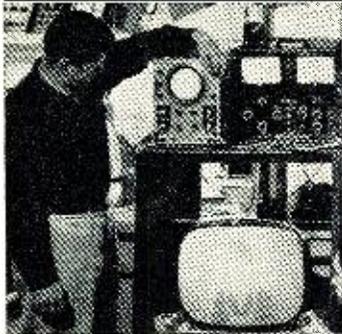
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at the present time. It is intended primarily for the circuit design engineer and is aimed particularly at informing him of the potentialities and limitations of transistors. An extensive bibliography is included.

* * *

"COLOR TELEVISION STANDARDS" by Donald G. Fink. Published by McGraw-Hill Book Company, Inc., New York. 520 pages. Price \$8.50.

An authoritative statement of underlying factors relating to the choice of color television standards, and the effect of the standards on broadcasting and receiving equipment. This material has been compiled from the Proceedings of the second National Television Systems Committee.

* * *

"TV REPAIR QUESTIONS AND ANSWERS" by Sidney Platt. Published by John F. Rider Publisher, Inc., New York. 120 pages. Price \$2.10. Paper bound. Vol. 3 (Sync and Sweep Circuits).

This is the third volume in the current "Q & A" series covering television receiver circuitry. This handy book covers vertical sync systems, vertical oscillators, horizontal sync systems, horizontal oscillators, and a.f.c. circuits. The same technique used in the earlier volumes is employed here with the question, answer, and then an amplifying discussion covering each point. The text is illustrated with scope patterns, partial schematics, etc.

* * *

"TV FIELD SERVICE MANUAL" edited by Harold Alsberg. Published by John F. Rider Publisher, Inc., New York. 137 pages. Price \$2.40. Paper bound (Vol. 5).

This newest volume in the current series is designed for the technician who makes home service calls and covers the receivers manufactured by Motorola and Philco. For every receiver model and chassis covered, there is an individual listing of trouble symptoms as well as directions for their cure. Tube lists are included and help to identify the function and correct type of each tube in the receiver in question.

Those who used the earlier volumes will find the same convenience in this compact, spiral bound manual.

* * *

"COLOR TELEVISION RECEIVER PRACTICES" by Hazeltine Corp. Laboratories Staff. Published by John F. Rider Publisher, Inc., New York. 194 pages. Price \$4.50 (paper) and \$6.00 (cloth).

This text has been derived from a series of intensive lectures on color television principles given by Hazeltine for the benefit of visiting engineers. It covers the fundamentals of a color TV system, details on the standard transmitted signal, and a complete discussion of the various receiver circuits. A good working knowledge of monochrome receiver circuitry is prerequisite to an understanding of this text which is designed for technicians and engineers.

-30-

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Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep as precision range calibrator. PRF rate 300-1500 per sec. Trigger input 15V @ 100V per microsec. rise. Trigger output 120V (+20V). Can be used to detect "jitter" in trigger divider circuits and modulator trigger pulse, also determining and adjusting division rate. Self-contained in metal case 8" x 12 1/2" x 16" deep. For 110V 50 to 1200 cycles AC. Demilitarized. NEW, with all tubes including crystals and C. R. Tube.

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BC-1151-B INDICATOR complete with all tubes, NEW, demilitarized. **\$11.95**

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A Real Hot Buy for HAMS! This complete RF Amplifier section can be easily converted for 2, 10, 15 meter, or used as exciter for higher power RF Amplifier. 3 type 815 tubes included: Xtal Oscillator and Buffer Tripler; Final. Tubes alone worth more than our low price for entire unit! ALL BRAND NEW, in original sealed carton—shpg. wt. 10 lbs.

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Hurry—Limited Quantity!



AGFA ANSCO BUBBLE SEXTANT

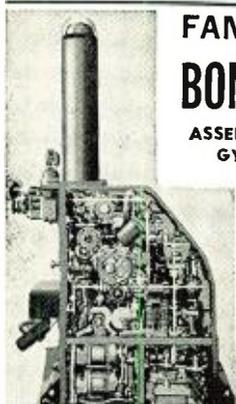
Made for U. S. Armed Forces

Actually worth \$150 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case, recording discs, flashlight with rheostat for using sextant at night. 2X telescope for faint stars, and Allen wrench. Only, **\$9.95**

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Comes in three units—the main body and two attachable periscopes, 22 and 68 inches high, alternate parts of an intricate optical system made by Eastman-Kodak Co. Main body is 35x26x14 inches. Contains at least 8 27 VDC motors, electric heater and temp. control, precision sextant, dozens of switches and controls, hundreds of fine gears and driving rods all types. Shipping wt. 250 lbs.
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Ham Special! Famous BC-645 XMITTER-RECEIVER



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Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over \$100—yours for practically a song! You get it all, in original factory carton. BRAND NEW, complete with 17 tubes, less power supply. Conversion instructions included. **\$29.50**
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Complete set of 10 Plugs **\$5.50**
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HEADPHONES

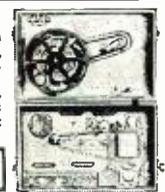
Model	Description	Excellent Used	BRAND NEW
H5-23	High Impedance	\$2.25	\$4.35
H5-33	Low Impedance	1.79	4.65
H5-30	Low Imp. (featherwt.)	1.49	1.85
H-16/U	High Imp. (2 units)	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack		.88

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	\$5.45	\$7.95
T-30	Carbon Throat Mike	.33	.69
T-45	Navy Lip Mike		.99
R5-38	Navy Type	2.25	4.95
T-24	Carbon Mike		3.95

TG-34A CODE KEYS

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.



BRAND NEW, in original carton. **\$16.88**

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BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW, in original carton. **\$8.88**
Used, with tubes... **\$5.95**

BC-442 ANTENNA RELAY UNIT

Wonderful Value! Consists of 3/4 amp 2 1/2" RF Ammeter (antenna current indicator), 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW **\$2.24**



MOBILE TRANSCIEVER DYNAMOTOR

Special Buy! Output 625 Volts DC @ 225 Ma. Input 12 1/2 V @ 1.7 Amps, DC. Size 8 1/2 x 4 1/4 x 4". BRAND NEW **\$10.95**
Excellent Used... **\$8.95**

OTHER DYNAMOTOR VALUES: Excellent

Type	Input	Output	Used	BRAND NEW
DM-64A	14V 5.1A	275V 1.50A		\$7.95
DM-40	14V 3.4A	172V 1.38A	1.95	3.95
DM-42A	14V 4.6A	515/1030/2/8	8.95	12.95
		MA 215/260		
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-34D	12V 2.8A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	6.95	9.95
DM-28	28V	224V .07A	1.95	4.95
DM-53A	28V 1.4A	220V .080A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
PE-86	28V 1.25A	250V .060A	2.95	5.24

2-VOLT "PACKAGE"

1-2V. 20 Amp. Hr. Willard Storage Battery... **\$1.95**
1-2V. 7 prong Synchronous Plug-in Vibrator... **1.49**
1-Quart Bottle Electrolyte (for 2 cells)... **1.45**
ALL BRAND NEW! Combination Price... **\$3.99**

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. BRAND NEW. 3 3/8" x 1-13/16" x 2 3/4". Uses Standard Electrolyte... Only **\$1.85**

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BC-946-B BROADCAST RECEIVER



520 to 1500 Kc broadcast band. 6 tubes: 3-12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 volt or 32 volt use. Two IF stages, 3-gang tuning cond. in sealed carton, with all tubes. BRAND NEW **\$19.95**

SCR-274 COMMAND EQUIPMENT

Type	Description	Used	Excellent Used	BRAND NEW
BC-453	Receiver 190-550 Kc	\$9.95	\$11.95	\$14.95
BC-454	Receiver 3-6 Mc	7.19	8.29	11.95
BD-455	Receiver 6-9 Mc	5.25	7.95	9.95
BC-456	Modulator 4-5.3 Mc	2.24	2.75	4.24
BC-457	Transmitter 4-5.3 Mc	7.95	11.95	12.95
BC-458	Transmitter 5.3-7 Mc	5.95	7.95	8.95
BC-459	Transmitter 7-9.1 Mc	7.95	8.95	11.95
BC-450	3-Receiver Control Box		1.49	1.95
BC-451	Transmitter Control Box		1.25	1.49
BC-596	Transmitter 3-4 Mc		14.75	19.50

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes, control box... **\$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal... **\$12.45**

LORAN APN-4



FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat, or of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export **\$129.50**

packed. COMPLETE

R-65/APN-9 LORAN Receiver-Indicator

Furnishes position data at greater distances from transmitting stations than is possible by any other methods. Accurate to within 1% of distance from ground transmitters. Operates entirely by radio. Complete in one case. BRAND NEW export packed **\$295.00**



ARC-5/R-28 RECEIVER

2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Loured alum. cabinet 7 3/8 x 4 7/8 x 1 1/4". Complete with 10 tubes and 4 xtals. Excel. Cond... **\$14.95**

ARC-5/T-23 TRANSMITTER

Companion for above, incl. 2-832A, 2-1625 tubes and 4 xtals... **\$22.50**

BC-221 FREQ. METER CASE

Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105. 2 ballast tubes, relay, cable, etc. Inside front: 9 3/4 x 7 1/2 x 7 3/8". Inside rear: 2" deep. Shock-mounted. BRAND NEW, (Add 50c for packing) **\$3.45**

Original Crystal for BC-221 **\$8.45**
1000 Kc BRAND NEW

CARDWELL TUNING CONDENSER for BC-221 Freq. Meter. Massive, precision construction, overall 4 x 3 x 3". 31 plates. Worm gear drive. BRAND NEW, special **\$4.88**

NAVY BU-2 TRANSCIEVER

TERRIFIC BUY for Hams, experimenters! COMPIRES CKP-46ADN Radio Receiver; CKP-50AEH Modulation Monitor; and CKP-35ABF Power Oscillator. Has more than 40 tubes! Complete with calibration charts, in metal cabinet 30" high, 20" wide, 20" deep. Wt. 250 lbs. BRAND NEW, export packed, including **\$89.50** tubes, all yours for only

BENDIX DIRECTION FINDER

MN-26-C. 12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises: **\$16.50**
MN-26-C Receiver complete with 12 tubes... **\$4.25**
MN-20 Rotating Loop... **\$4.25**
MN-52 Azimuth Control Box... **2.95**

MN26Y DIRECTION FINDER

150 to 7 Mc. Complete with tubes, motor; original manuals. BRAND NEW... **\$21.95**

SCR-522

Terrific buy! VHF Transmitter-Receiver, complete with all components. 100-156 Mc. 4 channels. Xtal-controlled, Amplitude modulated voice. They're going fast! Excellent condition. **\$39.50**



SCR-522 Transmitter-Receiver, complete with all 18 tubes. COMBINATION... Special Receiver Only, with all tubes... **\$21.25**
Transmitter Only, with all tubes... **\$24.50**



Superior's New
Model TC-55

FOR

The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester. The Professional Serviceman, who needs an extra Tube Tester for outside calls. The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap"

Checks for shorts and leakages between all elements
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, es-

pecially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.

One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

\$26⁹⁵
NET



Superior's new
Model TV-11

TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyatron 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.

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 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.

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.

\$47⁵⁰
NET



Superior's
New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

★ Employs improved TRANS-CONDUCTANCE circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ SAFETY BUTTON—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY. Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetodes, whether made of Germanium or Silicon either point contact or junction contact types. Model TV-12 housed in handsome rugged portable cabinet sells for only

\$72⁵⁰
NET

ALSO TESTS TRANSISTORS!

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 makeshift 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 electro-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!!

- 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

\$15⁸⁵
NET

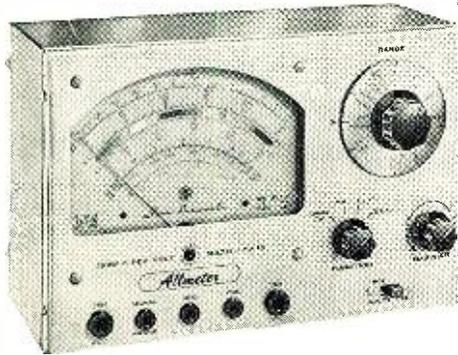
EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

20,000 OHMS PER VOLT

Superior's New Model TV-60

A M E R



FEATURES

- ✓ A sensitive, accurate Volt-Ohm-Milliammeter with giant meter and mirrored scale.
- ✓ An accurate direct-reading Capacity meter.
- ✓ A Kilovoltmeter.
- ✓ An R.F. Signal Tracer.
- ✓ An Audio Signal Tracer.
- ✓ Giant recessed 1/2 inch 40 Microampere meter with mirrored scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.
- ✓ The line cord, used only when making Capacity measurements, need be plugged in

Includes services never before provided by an instrument of this type. Read and compare features and specifications below!

- only when using that service. It is out of the way, stored in its plicofilm compartment at all other times.
- ✓ A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.
- ✓ Selected, 1% zero temperature coefficient metallized resistors are used as multipliers assuring unchanging accurate readings on all ranges.
- ✓ Use of the latest type of printed circuit guarantees maintenance of top quality standard in the production runs of this precise instrument.
- ✓ A new improved type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.
- ✓ Simply plug-in the R.F. probe and convert the Model TV-60 into an efficient R.F. SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I.F. circuits of A.M., F.M., and TV receivers.
- ✓ Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers etc.

SPECIFICATIONS

- 8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.
- 7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
- 3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.
- 2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.
- 5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliampères, 0 to 15 Amperes.
- 3 DECIBEL RANGES: - 6 db to + 58 db

R. F. SIGNAL TRACER SERVICE:

Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE:

Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe, Plicofilm bag for all above accessories is also included. Price complete. Nothing else to buy. Only

\$52⁵⁰
NET

Superior's New Model TV-50

GENOMETER

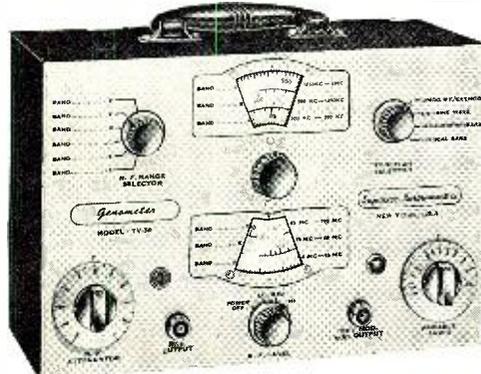
A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:
A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV
7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 50 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV 50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.



CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

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.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 282.5 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

\$47⁵⁰
NET

SHIPPED ON APPROVAL NO MONEY WITH ORDER - NO C.O.D.

Try any of the instruments on this or on the facing page 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-201, 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 TV-60.....Total Price \$52.50
\$12.50 within 10 days. Balance \$40.00
monthly for 5 months.
- Model TV-11.....Total Price \$47.50
\$11.50 within 10 days. Balance \$36.00
monthly for 6 months.

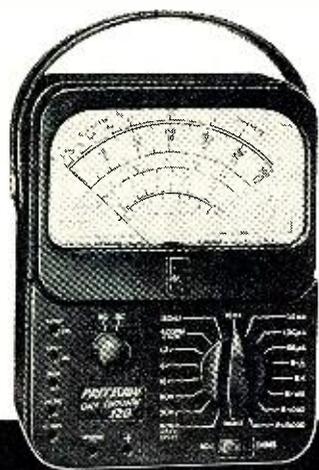
- Model TV-40.....Total Price \$15.85
\$3.95 within 10 days, Balance \$4.00
monthly for 3 months.
- Model TV-50.....Total Price \$47.50
\$11.50 within 10 days. Balance \$36.00
monthly for 6 months.

- Model TC-55.....Total Price \$26.95
\$6.95 within 10 days. Balance \$5.00
monthly for 4 months.
- Model TV-12.....Total Price \$72.50
\$22.50 within 10 days. Balance \$10.00
monthly for 5 months.

Name.....
Address.....
City.....Zone.....State.....

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU



THE
PRECISION MODEL **120**

GIVES YOU WHAT YOU WANTED
IN A
**HIGH SENSITIVITY
MULTI-RANGE TEST SET**

20,000 OHMS PER VOLT D.C.
5,000 OHMS PER VOLT A.C.

The '120' gives you . . .

- ✓ MORE RANGES
- ✓ AN EXTRA-LOW RESISTANCE RANGE
- ✓ AN EXTRA-LOW VOLTAGE RANGE
- ✓ AN EXTENDED LOW CURRENT RANGE
- ✓ A LARGER METER SCALE FACE
- ✓ SIMPLE, POSITIVE RANGE SELECTION
- ✓ POSITIVE CONTACT JACKS and PLUGS

Compare These Wide Spread Ranges
and Special Features:

- ★ 8 DC VOLTAGE RANGES: 20,000 ohms per volt.
- ★ 8 AC VOLTAGE RANGES: 5,000 ohms per volt.
0-1.2-3-12-60-300-600-1200-6000 volts.
- ★ 8 AC OUTPUT RANGES: same as AC volt ranges.
Built-in 600 volt blocking capacitor.
- ★ 7 DC CURRENT RANGES:
0-60-300 Microamperes, 0-1-2-12-120-600 Ma.
0-12 Amperes.
- ★ 5 RESISTANCE RANGES: self-contained.
0-200-2000-200,000 ohms. 0-2-20 megohms.
- ★ 8 DECIBEL RANGES: -20 DB to +77DB,
0 DB = 1 Milliwatt, 600 ohms.
- ★ EXTRA LARGE 5/4" RUGGED 'PACE' METER:
40 microamperes sensitivity, 2% accuracy.
- ★ 1% MULTIPLIERS and SHUNTS:
Wire-wound and deposited film types.
- ★ TWO JACKS SERVE ALL STANDARD RANGES:
Separately identified and isolated jacks
provide for extra high-ranges.
- ★ "TRANSIT" SAFETY POSITION on range selector
protects meter during transport and storage.
- ★ CUSTOM-MOLDED PHENOLIC CASE and PANEL:
Compact, laboratory styled instrument.

MODEL 120 . . . complete with internal ohmmeter
batteries, banana-plug test leads, and detailed
operating manual. Overall case dimensions,
5 3/8 x 7 x 3 1/8" Net Price \$39.95

PRECISION Apparatus Company, Inc.

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THE liveliest subject in the replacement industry is the "do-it-yourself" tube checkers and the long-range effect they may have on the distribution of replacement tubes.

When "do-it-yourself" tube checkers first appear in an area, the first reaction of service operators is to boycott the manufacturers whose tubes are stocked in them and the distributors who were responsible for placing them. They soon learn, however, that the machines are stocked with tubes of many brands. This indicates to them that this new effort to encourage set owners to service their own sets is not a carefully conceived plan of some receiving tube manufacturer to deprive technicians of service business.

In areas where detailed studies have been made, sales of tubes through these self-servicing checkers was very good when they were first placed in chain drug stores and other traffic outlets that are open eighteen hours a day, seven days a week. Part-time technicians were hurt more than the full-time service businesses. This would indicate that set owners who shopped for low-cost service jumped at the chance to save even two dollars for a service call when they discovered they could check their own tubes and buy replacements.

Another factor that is evident in the sale of tubes through drug stores is the high percentage of the volume that is done on Saturday evenings and Sundays when service is not available from established service businesses.

After a few months of operation, some service businesses note a slight decrease in the percentage of calls completed in the home with a higher ratio of jobs requiring shop service. In the course of time, evidences of bad judgment on the part of set owners show up in major service jobs caused by improper replacement of tubes or attempts to make circuit adjustments.

In some metropolitan areas, service shops situated in good street traffic locations have noticed a decided drop in their over-the-counter tube sales. This, however, would not indicate an increase in the number of set owners who are trying to service their own sets. Customers who bought tubes over-the-counter from these shops were already servicing their own sets.

They probably found it more convenient to get tubes from "do-it-yourself" testers closer to their homes.

While service operators are perturbed over the immediate effect these machines will have on their businesses, manufacturers and parts distributors are concerned with the long-range effect on the entire distribution structure. Dollar-wise, from one-third to one-half of a parts distributor's volume is in tube sales. Any decided shift in distribution that would reduce this volume materially would have a serious effect on his business.

Assuming that the volume of business that could be built up with these checkers in chain drug stores and supermarkets would be sufficient to interest management in their potential, the marketing shift that would occur would pull the rug out from under the distribution of tubes as it is now handled for the replacement market. When the distribution of products moves into the hands of the dollar-volume merchandisers in the chain drug and supermarket businesses, the small independent distributors and dealers pass out of the picture. They cannot compete against the mass buying and merchandising power of the large chain combinations.

The experience of service operators in areas where these tube checkers have been on location for some time leads to the conclusion that they are no serious threat to the service industry. A long-range study of the effect of these checkers made by the Indianapolis Television Technicians Association resulted in the following report issued by their president, Robert M. Sickels:

"1. There is no reason for established service operators to become alarmed about the inroads these 'do-it-yourself' checkers will make on our business.

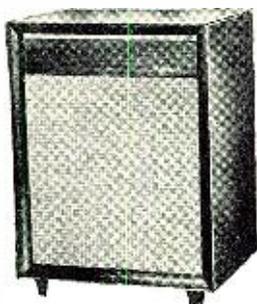
"2. People who yield to the temptation to service their own sets are either goofing up the job or buying tubes unnecessarily. They are not likely to make these same mistakes a second time.

"3. At the slow rate these machines sell tubes, it is going to take a heck of a long time to amortize them.

"4. One cost not generally considered in this business is that of insur-

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- Handcrafted cabinet in mahogany or blonde
- 15W output at less than 2% distortion
- G. E. Reluctance pickup
- 4 pole shaded VM motor
- 3 metal backed speakers, 12", 8" and 3 1/2"
- 12 tube AM-FM radio

ALL FOR **\$149⁹⁵** in mahogany
\$159⁹⁵ in blonde

Other Olympic high fidelity Radios and Phonos from 112.50 & up

SONIC CAPRI PHONOGRAPH



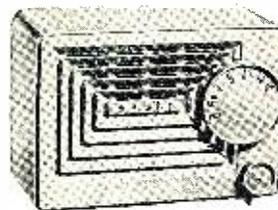
- Unbreakable plastic
- Guaranteed for 5 years against breakage
- 3 speed player for all records
- Precision built stereosonic sound
- Retractable tone arm
- Available in sea foam green and pearl grey

Lots of 6 **\$14.95** Ea.

Available with built-in 5-tube radio.

Lots of 6 **\$22.95** Ea.

SONIC "PEE-WEE" RADIO



- 5 tube radio
- 4" PM speaker
- 2 IF stages
- Built-in loop antenna
- Available in ivory, red, green and grey

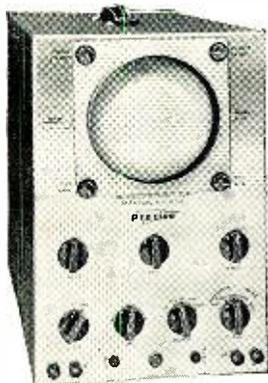
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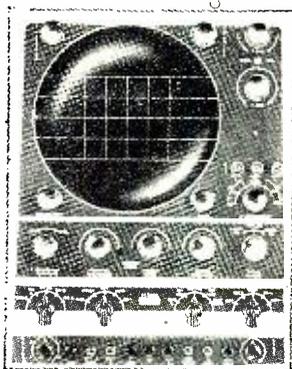
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- Has frequency compensated vertical and horizontal attenuators along with identical vertical & horizontal amplifiers (within 1db through 500KC).
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- Basic sensitivity is approximately 250 millivolts per inch.
- Sweep rate from approximately 10 cycles to 100KC. Hard vacuum type sweep circuit.

Price **\$49.95**



No. 308K 8 1/2" OSCILLOSCOPE

- Does everything more expensive commercial scopes can do and does it better.
- Full 8 1/2" tube designed specially for this model.
- Voltage regulated.
- Electronic magnifier allows any part of a signal to be magnified up to 10 times equivalent to 70" of horizontal deflection.
- High frequency—Low Frequency—Normal Frequency—Synchronization Circuit.
- Separate intensifier anode.
- PLUS dozens of other features found only in more expensive scopes.

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No. 111K TUBE TESTER

- CHECKS BOTH EMISSION & GM SEPARATELY
- Allows filament current to be measured directly on the meter.
- Checks AC-DC tubes & indicates "Voltage Savings."
- Tests horizontal sweep tubes by pulse emission.
- Tests all tubes for emission and GM at the flick of a switch.
- Short tests simply made without complicated switch manipulation.
- Measures tube bias directly.
- Tests all types of tubes including latest types & cathode ray tubes.

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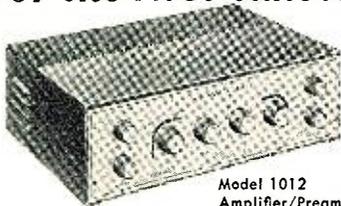
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Amplifier/Preamp

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Here is an entirely new concept in high fidelity enjoyment created by Newcomb, the originator of the "compact" design. Amplifier/preamp units and AM-FM tuners in beautiful new satin gold finish, so small they fit your convenient chairside table top. Makes expensive built-ins unnecessary. No technical knowledge necessary to connect. Performance to please the most ardent hi-fi fan. Combination amplifier/preamp units available in 10, 12, or 20 watt output, with all the exclusive recognized Newcomb features. Not only technically superb but audibly better.

Economical high-efficiency AM-FM tuner, or deluxe model with many advanced features available in matching design.

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THE SOUND OF QUALITY SINCE 1937

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NAME

ADDRESS

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

ance on the machines. The premiums are pretty high.

"5. Inventory records must be kept. This is a nuisance.

"6. Store personnel where these tubes are installed lack the technical knowledge to sell tubes successfully.

"7. The 'do-it-yourself' craze, like all other fads, is a tricky thing to gamble on. It could get an impecunious or unwary operator into trouble.

"8. Everything considered, this business is not as rosy as it is painted. It would take a considerable investment and a lot of sales pressure to ever make a living at it."

These checkers are on location in all stores of a prominent drugstore chain in the Indianapolis area. The operators of this group of checkers had one of the machines in a booth at the recent annual Indianapolis Hobby Show to interest hobbyists in servicing their own TV sets. The display and demonstration did not excite much interest.

Service Licensing

The controlling factor in the success or failure of independent electronic service businesses to continue on as a factor in the electronic industry is the set-owning public. Irrespective of what may be said or done to indoctrinate the public with the importance of dealing with an ethically-operated, competently-staffed service company, final success will be determined by what the public will buy.

Many service operators are of the opinion that licensing in one form or another is the only way that gyms and incompetents can be driven out of the business. By making it legally impossible for the unethical and the fringe technicians to operate, they reason, the public will be forced to buy competent service.

The Association of Television Service Companies of Cincinnati, faced recently with the prospect of a city ordinance to license service shops and technicians, have set up a plan for self-licensing which they are hopeful the majority of service shops in the Cincinnati area will accept. In his letter submitting the ATSCO Licensing Agreement to all electronic service shops in the Greater Cincinnati area, Richard E. Miller, Sr., president of the association, said:

"We are engaged in a young industry—a rapidly growing industry—a very special industry. Special because it deals directly with the consumer on a product which he can't bear to be without and yet is a non-essential. This places us in a very peculiar position—one of constant scrutiny and criticism. Consequently it is up to us to take whatever action is required to gain the confidence and esteem of the general public."

Following are some of the highlights of the ATSCO Licensing Agreement:

- "1. Adherence to ATSCO Code of Ethics.
- "2. Adherence to BBB Advertising Code.
- "3. Proof of possession of adequate

service test equipment of all types.

"4. Proof of possession of adequate service data.

"5. Proof of possession of adequate stock of replacement parts.

"6. Must be run by a television technician himself or employ a minimum of one full-time qualified television technician as required under Item 7 below.

"7. To qualify for the title 'television technician' you must have: a. A minimum of four years or 8000 hours of practical experience in TV servicing and pass oral and/or written examinations as required by the board of governors; or, b., a minimum of 4000 hours of practical experience in TV servicing plus credentials from an accredited TV service school or equivalent and pass oral and/or written examinations as required by the board of governors.

"8. To qualify for the title 'television serviceman' you must have: a. A minimum of two years or 2000 hours of practical experience in TV servicing; or, b., a minimum of 1000 hours of practical experience in TV servicing plus credentials from an accredited TV service school, and pass oral and/or written examinations as required by the board of governors.

"9. To qualify for the title 'apprentice television serviceman' you must have credentials from an accredited TV service school, plus three months experience in a TV shop or in the field under the supervision of a qualified TV technician.

"10. Anyone with less experience than required by items 7, 8, and 9 shall be called a 'television trainee.' A television trainee shall be under the direct supervision of a TV serviceman or a TV technician.

"11. Must operate from a place of business in a location zoned for business with free access for the public, or in a location not in conflict with local zoning ordinances.

"12. Must have at the place of business a business telephone listed with the telephone company in the company name and address.

"13. Must operate during regularly established hours, said hours to be on register with the board of governors.

"14. Must issue a standard guarantee of 90 days on parts and service, (in writing whenever requested).

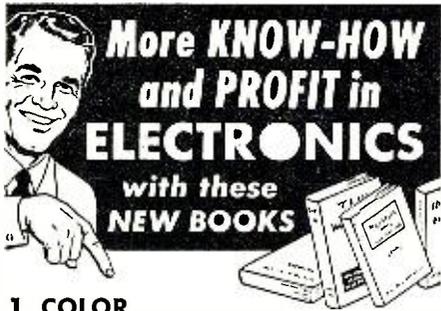
"15. Must carry adequate insurance on customers' property or furnish proof of financial responsibility.

"16. Must willingly and promptly follow up on all recalls.

"17. Must have a State of Ohio Vendor's License Number.

"18. Where an ATSCO member does not fully qualify, he may be issued a conditional license at the discretion of the board of governors for one year at which time he must furnish proof of fulfillment on all points. Item six excluded.

"19. An official ATSCO Service Business License shall be issued to all companies meeting these qualifications. License shall remain the prop-



1 COLOR TELEVISION FUNDAMENTALS

Simplified Manual Fully Explains Color TV! With your background in black-and-white TV you can now be ready for a big future in COLOR TV. Clear-cut guide gives you practical explanations of color theory, the FCC-approved color system, simplified discussions of actual circuits in use today, a step-by-step breakdown of several commercial receivers — PLUS information on installation, alignment, and servicing procedures. *By Milton S. Kiver, author of "Television Simplified," etc. 312 pp., 220 illus., \$6.00*

2 REPAIRING RECORD CHANGERS

Fix All Types of Record Changers Like an Expert! Practical, how-to-do-it guide covers repair of all models of record changers, including portable phonos, hi-fi units, and magnetic tape recorders. Clearly explains the action of pickups, needles, motors, drives, etc. Also tells about setting up your own business. *etc. By Eugene Ecklund, Allen B. DuMont Labs. 278 pp., 202 illus., \$5.95*

3 PRACTICAL RADIO SERVICING

Trains You in Expert Servicing — From Beginning, to top skill! Deals with most common types of radio in use—small a-c/d-c receivers, phonos, portables, etc. Gives circuit theory, servicing methods, and graded job sheets for practical experience. *By William Marcus, Corona Jr. H. S., N. Y. C., co-author of Elements of Radio; and Alex Levy, Chelsea Voc. H. S., N. Y. C., co-author of Elements of Radio Servicing. 565 pp., 473 illus., \$8.50*

4 RADIO OPERATING QUESTIONS AND ANSWERS

Tested Help for Passing FCC Examinations! Quick, practical help for getting your commercial radio operator's license. Gives you correct answers to all questions—including new and revised ones in the current FCC Study Guide, plus much other material. *By J. L. Hornung, Cmdr., U. S. Naval Reserve (Inactive); and Alexander A. McKenzie, Assoc. Editor, Electronics, Twelfth Ed. 571 pp., 142 illus., over 1900 answers, \$6.00*

5 ELEMENTS OF ELECTRONICS

Gives you the Basic Background for Work in Any Electronic Field! Outlines the basic theory you must have before going on to advanced work in radio, television, radar, etc. Uses only simple math. Covers electricity and magnetism, vacuum tubes, various types of circuits, power supplies, and various components. *By Henry V. Hickey, Chief Radio Elec., U. S. Navy; and William M. Villines, Lt. (jg), U. S. Navy. 487 pp., 408 illus., \$6.50*

6 TRANSISTORS: Theory and Practice

Fully Explains This New Electronic Miracle! Here's coverage of theory, practical applications, and manufacture of transistors. Discusses both silicon and germanium types—how they are made, how they work, and how to use them. Goes step-by-step from basic concepts to advanced topics. *from basic concepts to advanced topics. By A. Coblenz, Transistor Product Co.; and H. L. Owens, Signal Corps Engineering Labs. 313 pp., 115 illus., \$6.00*

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erty of ATSCO and be subject to recall for just cause.

"20. All employees of qualifying companies shall be issued cards clearly stating their qualifications such as TV trainee, TV apprentice serviceman, TV serviceman, and TV technician.

"21. License fee shall be \$15.00 per shop plus \$2.50 per man, TV trainees excepted.

"22. License fee shall be payable one year in advance, effective Jan. 1, 1956.

"23. As of Jan. 1, 1956, all ATSCO members shall be fully qualified or have received a conditional license.

"24. As of Jan. 1, 1957, all ATSCO members shall have fulfilled all the requirements of this license in order to remain members of ATSCO."

Business Realities

The biggest problem in front of electronic service operators is that of finding and keeping good field service technicians. Graduates of radio-electronic trade schools find a ready market for their services in electronic manufacturing concerns. Service operators find it necessary to train their men from scratch with the hope of being able to keep them after they become proficient technicians.

The crux of the matter is that of wages and stability of employment. The former is controlled by the average level of service charges in any

area. The latter is influenced by the extent of the service base built up to provide a reasonably uniform volume of business throughout the year.

The increasing pressures being brought to bear by service operators for some type of licensing for businesses and technicians stems largely from the necessity for bringing about an average level of service charges that is in relation to the costs of doing business when technicians are paid adequate wages. Wherever there is extensive advertising of low, inadequate charges for home or shop service, ethically-operated shops are faced with the necessity of using the pricing tactics of the unethical technicians or operating on the basis of a sub-standard income.

To maintain a consistent level of business a service operator must advertise and promote his business aggressively. But where an ethical business must operate on a basis of low-ceiling service charges there is no income available to pay for the necessary advertising and sales promotion.

While consumer education on the subject of paying adequate charges for electronic service performed by ethically operated, competent service shops is vitally necessary, there is also a dire need for positive measures to control the activities of the gyms and incompetents who migrate in and out of the electronic service business. —30—

A TWO-TRANSISTOR PREAMPLIFIER

THOSE who have been looking for a compact preamp to be used with magnetic pickups will be interested in the circuit diagrammed in Fig. 1. This unit can also be used as a preamp in conjunction with the transistorized power amplifier described on page 87 of our January issue.

This unit was specifically designed for the hobbyist or the experimenter who wants to obtain some basic knowledge of transistor operation. Obviously, quality-wise, it does not compare with vacuum-tube type preamplifiers.

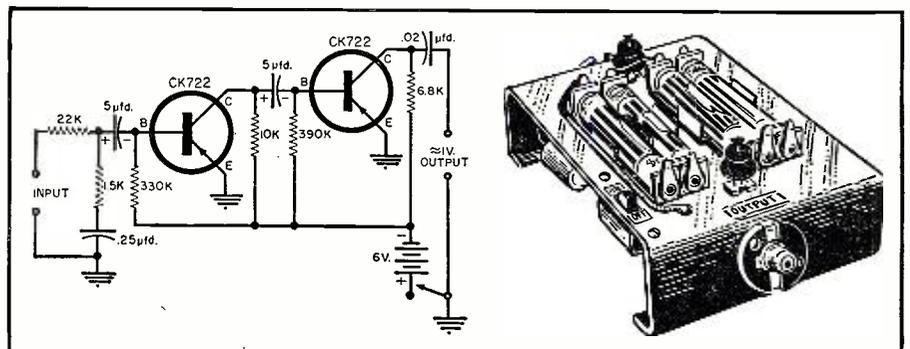
Although its frequency response does not follow any of the more commonly-used recording characteristics, it will provide fairly good performance when used as a preamp between a magnetic cartridge and many power amplifiers.

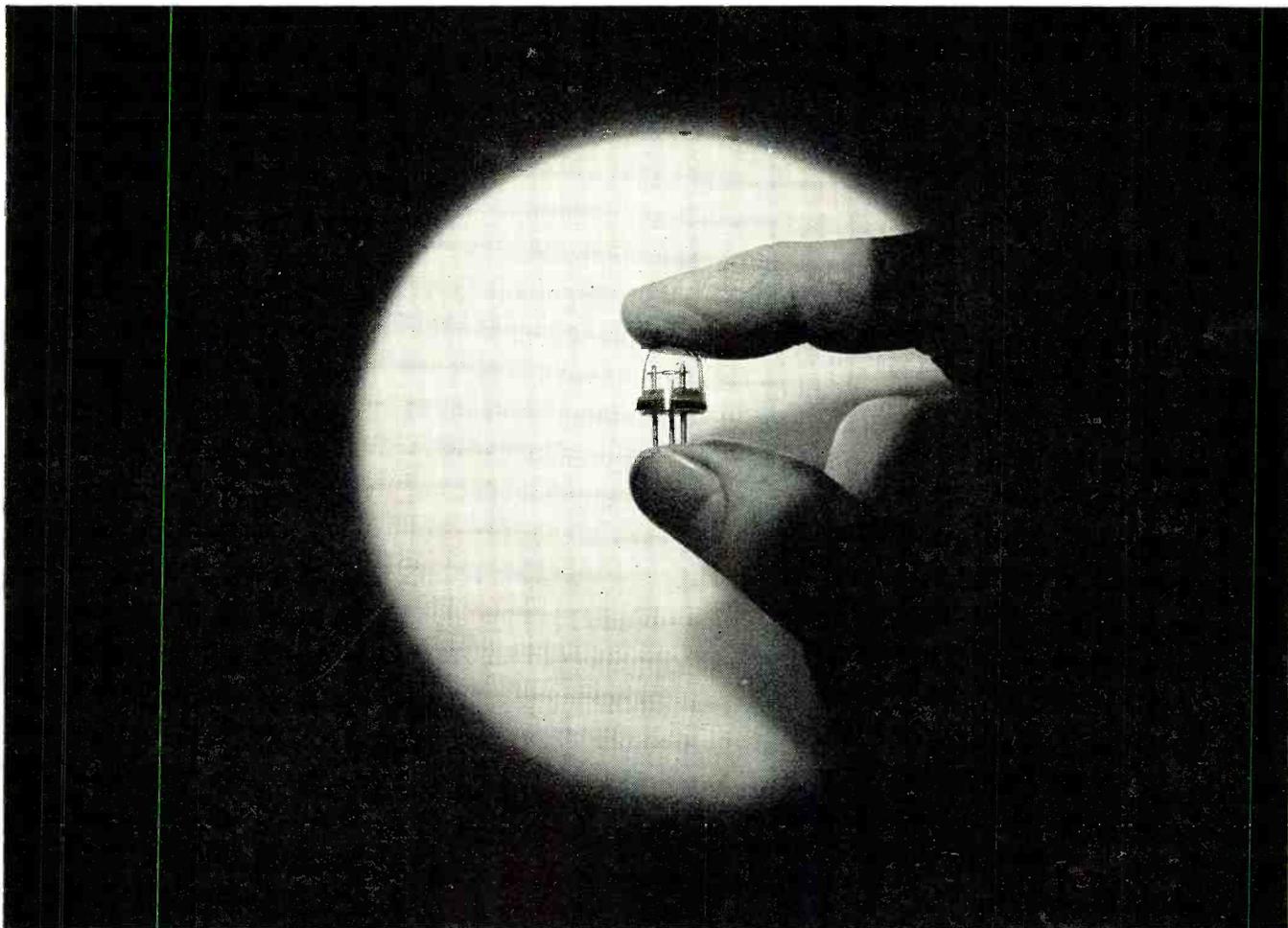
One problem arises, however, when this circuit is used with a wide-band power amplifier and that is with regard to background noise due to the transistors. If the power amplifier incorporates

a tone control so that the high-frequency response can be cut off, transistor noise can be reduced to a negligible figure. Some means of varying the volume output is necessary.

All of the component parts required for the preamp can be mounted on an aluminum chassis measuring as little as 3" x 4" x 1" if parts are selected carefully with an eye to small size. By building the unit in a small space, the preamp can be installed under the tone arm of many record playing setups. Hum pickup is, in most cases, sufficiently low to permit this installation technique if desired.

All of the parts needed to build this preamp are standard and may be obtained at any well-stocked parts house. If the builder wishes to take advantage of the convenience of a packaged circuit, Lafayette Radio, 100 Sixth Ave., New York 13, N. Y. is offering the preamp as a kit (KT-71) for \$8.95 complete. —30—





Experimental model of Bell's new high-frequency transistor. It has a cut-off frequency of at least 500 mc and can be used to amplify 2500 independent voices simultaneously.

THE TRANSISTOR

that smashed a frequency barrier

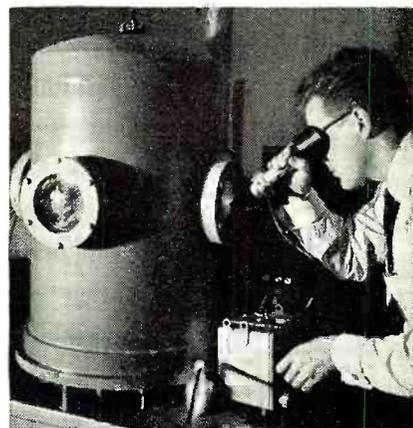
A new transistor invented at Bell Telephone Laboratories can provide broadband, high-frequency amplification never before possible with transistors. The big leap in frequency is made possible by a diffusion process that earlier enabled Laboratories scientists to create the Bell Solar Battery.

This transistor is a 3-layer semiconductor "sandwich." High-frequency operation is obtained by making the central layer exceedingly thin. This was difficult to do

economically by any known method.

The new diffusion process, however, easily produces microscopic layers of controllable thickness. Thus it opens the way to the broad application of high-frequency transistors for use in telephony, FM, TV, guided missiles, electronic brains and computers.

The new transistor shows once again how Bell Laboratories creates significant advances and then develops them into ever more useful tools for telephony and the nation.



A Bell scientist checks temperature as arsenic vapor diffuses into germanium, creating $4/100,000$ -in. layer.

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February, 1956

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ANY TUBE **43^c** ea.

0Z4	6AQ5	6SA7	12SA7
155	6AQ6	6SJ7	12SJ7
1T4	6AT6	6SN7	12SK7
1U4	6AU6	6SQ7	12SN7
1U5	6AV6	6V6	12SQ7
3AL5	6BA6	6W4	25L6
3AU6	6BC5	6X4	25W4
3BC5	6BF5	6X5	35Y4
3Q5	6C4	7C5	35Z5
354	6C5	7C6	50A5
3V4	6CB6	7N7	50B5
5U4G	6F6	12AL5	50C5
5Y3	6H6	12AT6	50L6
5Z3	6J5	12AU6	50Y7
6AB4	6K6	12AV6	117Z3
6AG5	6K7	12BA6	
6AL5	6S4	12BE6	

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ANY TUBE **64^c** ea.

1B3	6T8
1R5	6V3
154	6W6
1X2	6X8
5V4	6Y6G
6AC7	7F7
6AG7	7Q7
6AH4	12AU7
6AK5	12AV7
6AU5	12AX4
6AV5	12AX7
6AX4	12A27
6BA7	12BZ7
6BD5	12BY7
6J6	12SL7
65L7	12SR7
65R7	

ANY TUBE **75^c** ea.

6AF4	6CD6G
6AM8	6CU6
6AN8	6CF6
6BG6G	6U8
6BK5	19AU4
6BK7	19T8
6BL7	19BG6G
6BQ6	25BQ6
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Metering Circuits (Continued from page 66)

of the shunting resistors to increase the readings. A v.t.v.m. may also be used here on its 3-volt d.c. range. One of the v.t.v.m. adapters recently described in the *G-E* "Ham News" will also work well.

Let's align this transmitter. Disabling the final stage to prevent excessive plate current from damaging the tubes (either switch in a resistor of about 2000 ohms in the plate and screen supply, or pull the final tubes), we begin by switching the meter into the grid circuit of the first multiplier stage, V_2 . Naturally, any grid current read here will be the result of the r.f. supplied by the oscillator, V_1 , and will indicate the oscillator output. The grid of the tube, in a sense, serves as a rectifier, and we're reading the rectified output. Bear in mind that a defective tube or lack of operating potential on either V_1 or V_2 will result in no reading!

For simplicity's sake, we've shown a Pierce oscillator, as this very dependable circuit is being widely used in commercial equipment, but any type of oscillator can be used. First, the plate adjustments in the oscillator stage are tuned for the point of highest reading on the meter; next the grid tuning of the first multiplier is adjusted, also for highest reading. Bear in mind that this is always a "quantitative" not "qualitative" reading. It makes no difference whether the indication is one unit or one hundred; half scale or full scale. All we're after is a *peak!* The actual value of the reading is determined by many things; the amount of drive on the stage, tube type, voltages on the stage, and many others. However, for tuning adjustment, all we want is a peak.

After this stage is peaked, switch the meter into the next stage and repeat the process. The order of alignment must *always* be from oscillator toward antenna, never in the other direction, although individual stages may be repeated after a tube change or other adjustments. Ordinarily, the readings will tend to increase in numerical value as we go toward the antenna, however, if there is no actual loss the set is probably operating normally. If the stage under test is a frequency multiplier the readings will naturally be lower than for a straight amplifier stage; a tripler will read lower than a doubler, etc.

One very valuable feature of this setup is the "facilitation of maintenance," as one manual puts it. In smaller words, you have a built-in troubleshooter. If any stage is not functioning properly, you merely plug in the meter and run over the different switch positions, from the oscillator on up. The bad stage will be located immediately. The efficiency of home-wound coils and circuits may be easily tested by checking the readings obtained against those of another type coil, etc.

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For checking final plate current, where the actual value may run as high as 200 ma. or more, a variation of this circuit is employed. A shunting resistor, this time a very small one, is inserted in series with the plate return and the meter connected across it. One popular commercial transmitter uses a 1-ohm resistor, with a 50-microampere meter movement. This results in a reading of around 27 μ a., with an actual plate current of 200 ma. The internal resistance of the meter movement used will alter this reading greatly, due to the change in the ratios of shunt current and meter current. Here again, a v.t.v.m. may be used. If the resistor used is highly accurate, the voltage drop may be converted to plate current by Ohm's Law. Another and possibly simpler method involves the use of a separate calibration meter, inserted into the circuit at the same time. The current is varied by changing the transmitter loading and the readings on the test meter noted, as compared with the actual plate current being drawn. Once done carefully, these calibrations will hold.

The meter jack used for this last test must be very well insulated from the chassis, as both sides are "hot" with the final plate voltage, and an insulated phone plug must be used on the meter. Never make the mistake of using a plug with a metal sleeve! (Never mind how I know!)

This circuit is capable of infinite variation, of course, and the one best suited to your particular need should be used. The meter may be panel mounted and a selector switch installed. It may be plugged in when needed, permitting the use of the meter for other tests. If a selector switch of the right type is not available, ordinary pin jacks may be connected into the circuit near each stage, and the hot lead of the meter plugged into each stage, in turn, while the return is connected to the chassis. This method is used in at least two makes of commercial transmitters, while others use the selector switch method.

If the frequency of the final stage is well up into the v.h.f. region, up to 150-200 mc., it may be necessary to use an r.f. choke, as shown in Fig. 1, of 1 to 3 μ hy. to prevent disturbance of the circuit by the meter. This may also be necessary in the last multiplier stage if the frequency is high. Experimentation will determine need. -30-

"VOICEPONDENCE CLUB"

THE Voicepondence Club, one of the country's oldest tape recording exchange organizations, has recently been incorporated under the laws of the state of Virginia as a non-profit organization.

Control of the Club's assets rests in the hands of three trustees who represent the group's some 600 members in the U.S. and 39 foreign countries. The U.S. is divided into 13 districts with a deputy at the head. These deputies form the Club's board of advisors.

For full details on membership, write C. E. Owen, Jr., Secty., Noel, Va. -30-

February, 1956



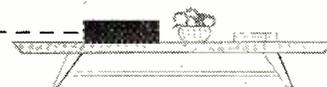
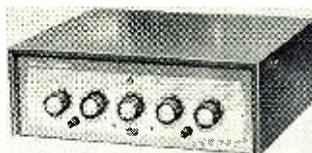
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The new General Electric Convertible is a dual-chassis design. In a single, amazingly flexible and low cost unit there's a powerful amplifier, with 20 watts of undistorted output—plus a pre-amp with seven panel-mounted controls. It gives you sound as it was meant to be heard.

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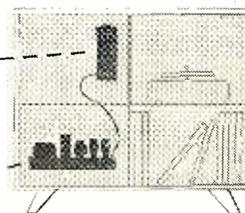
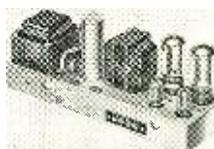
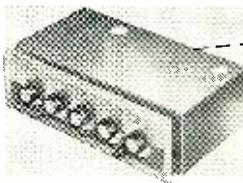
design, the amplifier and pre-amp may be mounted independently in built-in systems. Or, as one complete unit, the handsome Convertible may be placed on a bookshelf or table.

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A professional EICO Service-Engineered tube tester and merchandiser at a rock-bottom price. Large 4½ inch full-vision meter. Tests conventional and TV tubes, including 9-pin miniatures. New lever-action switches—test every tube element. Illuminated "Speed

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TAPE TRANSPORT

Telectrosonic Corporation, 35-18 37th Street, Long Island City 1, New York has developed a new tape transport unit especially for custom installation. The unit is supplied with tape trans-



port, recording amplifier, playback preamplifier, and erase oscillator.

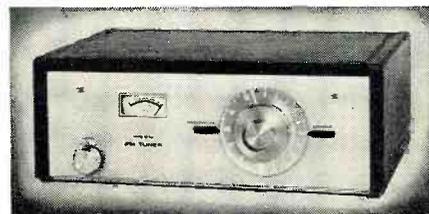
Operational features include dual speeds of 7.5 ips and 3.75 ips; 7" diameter reel capacity for up to 2 hours play; single function control for record, idle, and play; preset recording level; and output jack for power amplifier connection.

The Model 220 has an output of 1 volt, frequency response from 50 to 12,000 cps ± 3 db at 7.5 ips; signal-to-noise ratio of 45 db (NARTB standard), less than 2 per-cent distortion, flutter and wow of less than .3 per-cent, low input for crystal or dynamic microphones, and a high input for line input from tuner, TV, radio, or record player.

WIDE-BAND FM TUNER

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass. has developed a new wide-band FM tuner which is designed to meet the demand for a moderately priced unit of good quality.

The Type 311 includes automatic gain control, a tuning meter, a new



planetary drive tuning mechanism, and edge-lighted lucite tuning dial.

The wide-band design permits extreme selectivity to separate stations. Spurious cross-modulation responses caused by strong local signals are rejected by more than 80 db. The tuner provides 3 μ v. sensitivity for 20 db

quieting, a 2 mc. wide-band detector and limiters, 80 db rejection of spurious cross-modulation responses by strong local signals, a.g.c., low impedance output permitting cables up to 70 feet in length to the amplifier, and provisions for multiplex. A free bulletin on this tuner is available on request.

50-WATT AMPLIFIER KIT

Dyna Company, 5142 Master Street, Philadelphia 31, Pa. is now in production on a new high-power amplifier which is being offered in kit form as the "Dynakit Mark II."

The circuit is designed around the company's A-430 output transformer. It uses only three audio tubes to deliver 50 watts of power (100 watts peak) at less than 1 per-cent IM distortion with full power available throughout the entire 20 cps to 20 kc. audio spectrum.

The small number of stages reduces phase shift to unusually low values, providing a substantial margin of stability without need to restrict the frequency response.

The amplifier measures only 9" x 9" x 6½" high. Construction of the unit is



facilitated and simplified by use of a pre-assembled printed circuit board on which most of the audio components are mounted. Complete step-by-step directions and pictorial diagrams are supplied with each kit.

HI-FI ACCESSORIES

Insuline Corp. of America, 186 Granite Street, Manchester, N. H. has recently introduced two new accessory items designed expressly for the audiophile.

The first is a dual hi-fi connecting cord which makes the interconnection of many types of hi-fi equipment easy and quick. It features a double end with convenient spade lugs on one end and a phono pin plug on the other. It is catalogued as the No. 2394.

The second unit is a quality shielded, low-capacity connecting cord whose

RADIO & TELEVISION NEWS

XCELITE Hand Tools
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These new XCELITE TRANSVERSE CUTTERS are specifically designed for work on the miniature and sub-miniature sets now becoming so popular. Thin nose gets in like our long-nose pliers—narrow-yet-tough blades cut flush to a surface! Spring return means you don't have to get your whole hand into chassis. Drop-forged strength. Keen, hand-honed blades. Available chrome-plated, too. There's an XCELITE special-purpose plier for every job. Ask your supplier!



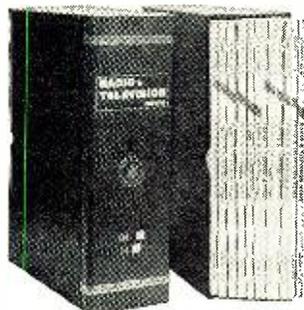
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You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn proper chassis layout. You will build radio circuits, perform jobs, and conduct experiments to trouble-shoot radios. You will learn code. You will receive training for F.C.C. Novice License. You will learn High Fidelity.

In brief, you will receive a practical basic education in Radio, worth many times the small price you pay.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by Armed Forces Personnel and Veterans throughout the world.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are included, and identified by name, illustration and diagram. Every step involved in building these sets is carefully explained.

"LEARN BY DOING"—PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio, Transmission, Radio Reception, Audio Amplification and servicing by Signal Tracing is clearly explained. Every part is identified by illustration and diagram. You will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radio circuits, perform jobs, and conduct experiments to illustrate the principles which you learn. These circuits are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced multi-tube radio sets and doing work like a professional Radio Technician. Altogether you will build Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector Circuits—16 in all. These sets operate on 105-125 V. AC/DC. For use in Foreign Countries having 210-250 Volt Source, and Adaptor for 210-250 V. AC/DC operation is available.

THE PROGRESSIVE RADIO "EDU-KIT" IS COMPLETE

You will receive every part necessary to build 16 different radio circuits. Our "Edu-Kits" contain all tubes, tube sockets, chassis, variable, electrolytic, and paper condensers, resistors, tie strips, coils, hardware, tubing, Instruction Manuals, Printed Circuit Materials, etc. Selenium rectification is used throughout. No solder or wire included.

Every part that you need is included. These parts are individually packaged, so that you can easily identify every item. A soldering iron is included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided. All parts are guaranteed, brand new, carefully selected and matched.

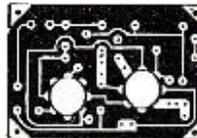
In addition, the "Edu-Kit" now contains lessons for servicing with the Progressive Signal Tracer and Signal Injector, F.C.C. instructions, quizzes, High Fidelity Instructions.

TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer and Signal Injector. You will receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the "Edu-Kit." Here is your opportunity to learn radio quickly and easily and have others pay for it.

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You build a Printed Circuit Signal Injector, a servicing instrument that can detect many Radio and TV troubles. A Printed Circuit is a special insulated board on which has been deposited a conducting material which takes the place of wiring. Various parts are plugged in and soldered to terminals. This new process is now popular in commercial radios, TV, hearing aids, industrial electronics, etc.



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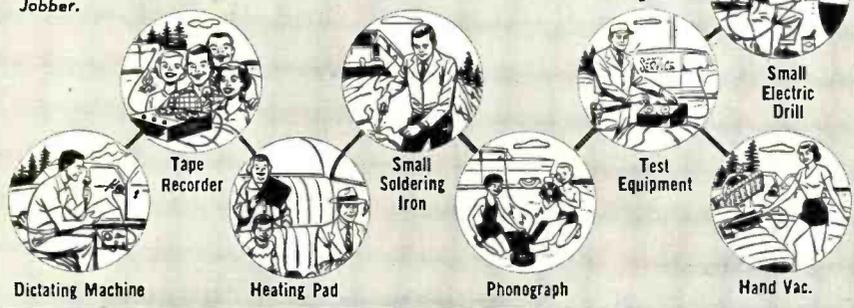
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In Canada write: Atlas Radio Corp., Ltd. 560 King St. West, Toronto 28, Ont.
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design insures minimum leakage. The ends are equipped with sturdy insulated phono pin plugs for noise-free connections and durability. This cord is available in 18, 36, and 72 inch lengths as catalogue numbers 2386, 2388, and 2398, respectively.

FM TUNER KIT

Heath Company, Benton Harbor, Michigan is currently offering a new FM tuner kit, the Model FM-3.

Sensitivity is better than 10 μ v. for 20 db of quieting and it employs a completely modern tube line-up for high gain and stable operation. The tuner incorporates its own power supply and



has provision for low-level or high-level output at low impedance.

The tuner matches the company's WA-P2 preamplifier in color, styling, and physical size. It features a g.c., a highly stabilized oscillator, and illuminated tuning dial. The i.f. and ratio transformers are pre-aligned and the front-end tuning unit is pre-assembled and aligned. The tube lineup includes a 6BQ7A, 6U8, two 6CB6's, a 6AL5, a 6C4, and a 6X4.

Write the company for full details on this tuner kit.

15" SPEAKER LINE

Racon Electric Co., Inc., 1261 Broadway, New York 1, New York has entered the high-fidelity field with a new line of high-compliance speakers.

The new "Hi-C" line employs a new principle in cone suspension which gives them extremely large motions, lowers



the resonant frequency (24 cycles), and introduces pneumatic damping, resulting in smooth and linear response.

The "Hi-C" suspension results in practically a "free-edge" cone, having great flexibility without encountering mechanical restraints or magnetic non-linearity. A special cellular formulation of plastic is used between the cone edge and the supporting basket.

Currently the line is available in

RADIO & TELEVISION NEWS

Acrosound

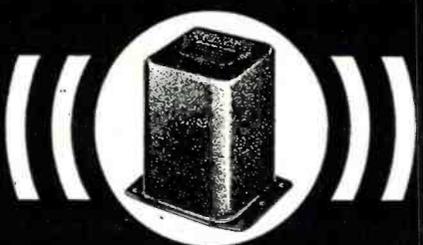
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OUTPUT TRANSFORMERS

Acrosound output transformers with Acro-developed Ultra-Linear amplifiers assure the finest in sound. Lows are more articulate, transient qualities of highs are preserved and reproduced with sparkling realism.

Percentage of screen winding is carefully chosen to minimize distortion at high and low output levels. Screen and plate winding sections are interleaved and tightly coupled for maximum power output over the greatest bandwidth.

For new highs in performance use the TO-330 transformer with 6550 or EL-34/6CA7 output tubes in the Ultra-Linear Williamson circuit. Details and catalog upon request.



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Precision stylus pressure gauges available in 2 models calibrated from 2 to 15 grams or 3 to 30 grams each way from center position. **\$9⁸⁵**

The extra indicator "hand" will remain at the maximum reading of the device until reset by a knob on the dial face.

CORRECT STYLUS PRESSURE NOT ONLY GUARANTEES MINIMUM STYLUS AND RECORD WEAR, BUT ASSURES SOUND PICK-UP AT MINIMUM DISTORTION.

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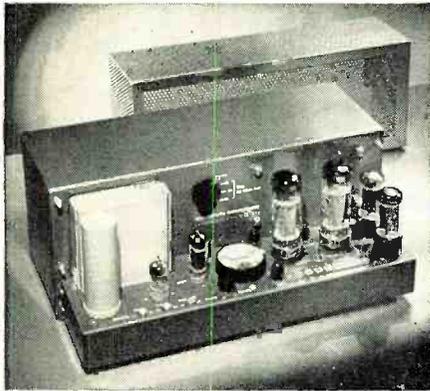
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GEORGE SCHERR CO., Inc.
200-RT LAFAYETTE ST., NEW YORK, N. Y.

three fifteen-inch models; a woofer, a wide-range dual cone, and a triaxial model. Eight- and twelve-inch models are under development.

MARANTZ AMPLIFIER

Marantz Company, 44-15 Vernon Blvd., Long Island City, New York has recently introduced a new power amplifier which provides either 40-watt "Ultra-Linear" operation (80 watts



peak) or 20-watt triode operation for speaker systems of lower power rating.

Response at 40 watts is from 20 cps to 20 kc. $\pm .2$ db and 15 cps to 40 kc. ± 1 db. At 1 watt response is from 2 cps to 55 kc. ± 1 db. The response is rolled off approximately 2.5 db at 100 kc. to control transient response. The unit features two high-gain inputs and one preamp input, and 4, 8, or 16-ohm outputs. Hum is better than 90 db below 40 watts.

For full performance specifications on this unit, write the manufacturer direct.

PHONO DRIVE KIT

General Cement Mfg. Co., 919 Taylor Avenue, Rockford, Illinois is doing its part to help service technicians obtain their fair share of the growing record player repair business by introducing a handy phono and recorder drive kit, the "G-C P400 Phono Kit".

The company claims that the 51 exact replacement drives in the new kit permit the servicing of the majority of record changers and tape recorders now on the market. A complete reference chart, suitable for wall mounting, is packed with each kit. The kit (Catalogue No. P400) is packed in a clear plastic storage box.

RAULAND AMPLIFIER

The Rauland-Borg Corporation, 3515 West Addison St., Chicago 18, Ill. has



recently released a new 20-watt amplifier, the Model 1520.

Housed in a new "space saver" cabinet only 4" high, the enclosure comes in charcoal black with marbled gold effect. The unit is available with extension shafts for behind-panel mounting

NEW



PHAOSTRON

NONE FINER

"777"

V. T. V. M.

(VACUUM TUBE VOLTMETER)

The MODEL "777" V.T.V.M. is a completely self-contained, ready-to-use test instrument. Its accessories and the HF co-ax cable, DC Probe, AC line cord and instruction book all fit in the genuine California Saddle Leather carrying case that is furnished with the instrument.

42 Unduplicated Ranges

Illuminated Dial (5000 hour self-contained lamps)

Die Cast Chrome Finished Bezel

Metal Case, unbreakable, ultra compact

Doubly Shielded, time proven 200 microamp movement

Permanent Accuracy... 3% DC, 5% AC

Large, Easy to Read Scales 4 1/8" Long

Color Coded Scales: green—ohms;

black—AC, DC; Red—P. to P.

2 Zero Center Scales for FM Discriminator Alignment

Separate Range and Function Switches

Only 2 Jacks for All Measurements

New, High Style, Easy-to-Use Chrome Bar Knobs

Dual Purpose Handle also serves as AC line cord reel

"777" V.T.V.M. complete with Coaxial Cable, DC Probes and Leather Case at your PARTS DISTRIBUTOR **\$69⁹⁵**

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A Rugged Crystal

We have the DC-34 holder you can use with a 1/2" adapter—man! what output—a big 1/2" piece of quartz that really oscillates—ground by skilled craftsmen and counted to your exact frequency by our electronic counter.

NOVICE BANDS **79c**
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HAM BANDS IN DC-34
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FT-241
FT-243
DC-34
FT-171 **50c**
EACH

Send postcard for free list
of frequencies.

DC-34 HOLDERS

1690	2175	2360	2685	3000	3412	3790	4030	4275
1705	2195	2375	2710	3010	3422	3792	4035	4305
1720	2202	2390	2711	3023	3462	3825	4055	4310
1770	2215	2395	2732	3027	3480	3830	4065	4325
1790	2220	2415	2745	3055	3520	3855	4085	4345
1810	2235	2422	2775	3095	3540	3870	4095	4350
1830	2240	2435	2807	3117	3575	3885	4115	4370
1850	2255	2466	2816	3149	3580	3895	4130	4380
1870	2258	2467	2831	3161	3610	3905	4135	4397
2050	2260	2491	2851	3190	3630	3925	4150	4405
2065	2275	2514	2863	3279	3655	3935	4155	4415
2082	2280	2527	2894	3280	3665	3945	4175	4435
2090	2282	2540	2899	3311	3695	3950	4177	4440
2105	2295	2559	2925	3317	3702	3965	4192	
2106	2300	2587	2926	3345	3705	3988	4210	
2142	2326	2605	2960	3365	3745	3995	4215	
2155	2335	2625	2971	3385	3765	4012	4235	
2174	2355	2643	2980	3395	3775	4015	4255	

FT-243 HOLDERS **50c**
5675KC-8650KC IN 25KC STEPS

FT-241 LATTICE XTALS **50c**
ALL FREQ. FROM 370-540KC
500KC CRYSTALS \$1.00

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"The biggest buy in the U. S."

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where custom installation is desired.

The Model 1520 has a frequency response of 20 to 40,000 cps \pm .5 db. Harmonic distortion is no more than .5 per cent measured with the secondary (16 ohms) of the output transformer properly loaded. The IM distortion is less than .5 per cent at listening levels and less than 2 per cent at rated output. There are six response curves available from four crossover and four roll-off positions: Eur., AES, *ffrr*, RIAA, 78 (Pop), and Quiet (scratch reduction). Five inputs are available.

The amplifier measures 15 1/2" wide, 11" deep, and 4" high. Full details from the manufacturer on request.

COMPENSATOR-PREAMP

McIntosh Laboratory, Inc., 320 Water Street, Binghamton, New York is marketing a new "professional" audio compensator and preamp which has



been designed for use in custom home music systems.

Ingenious bass and treble switches produce an extremely wide degree of sound shading so that the listener may reproduce music to suit his taste. The C-8 also provides separate knobs furnishing bass and treble boost and de-emphasis. An aural compensator preserves the low and high frequencies in proper balance to compensate for the human ear characteristics at low listening levels.

A rumble filter cuts out low-frequency disturbances which may result from noisy turntables. Five input channels provide for any sound source, including two phonograph cartridges.

A data sheet on the C-8 is available upon request.

G-E SPEAKER

General Electric Company, Electronics Park, Syracuse, New York has announced the development of a new loudspeaker which is capable of maximum performance over long periods of time and under the most adverse conditions of humidity.

The new speaker is equipped with an aluminum voice coil, the cone is waterproofed, and the gasket is varnish-impregnated chip-board. Designed specifically for installation in passenger aircraft for p.a. use, the speaker is equipped with a 45-ohm voice coil to insure maximum intelligibility.

"WEATHER-BALANCED" TAPE

Minnesota Mining and Manufacturing Co., 900 Fauquier Street, St. Paul 6, Minn. is now offering a new "weather-balanced" magnetic tape which provides 50 per cent more recording time

than conventional tapes and features a more durable polyester backing.

The major features of the new No. 150 tape is its one-mil polyester "weather-balanced" backing made from Du Pont "Mylar" film for resistance to changes in temperature and humidity and also for greater strength. As a result, the company is recommending it for all critical recording applications where long-play is also a requirement.

Full details on this new Scotch No. 150 will be supplied by the manufacturer upon request.

AUDIO OUTPUT TRANSFORMER

Dyna Company, 5142 Master St., Philadelphia 31, Pa. has announced the availability of a new line of high-fidelity audio output transformers which feature a unique para-coupled winding arrangement which provides good quality and performance at moderate cost.

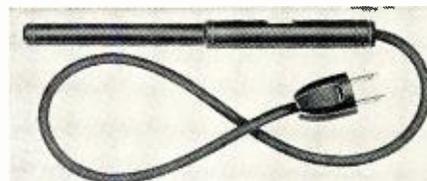
The first unit of the line, the "Dyna-co" A-430, matches 6550 tubes or 6CA7/EL-34 tubes in circuit configurations furnishing from 50 to 100 watts. It is recommended for use in connecting Williamson-type amplifiers of 50 watt power capabilities using either of the above-mentioned tube tubes.

The transformer has a guaranteed frequency response \pm 1 db from 6 to 60,000 cps. Complete data on the transformer plus circuitry for converting Williamson-type amplifiers to higher power are available from the company.

ERASING PENCIL

As an accessory for film or tape recording, the Cinema Engineering Company Division, Aerovox Corporation, Burbank, California is now offering its "Magnetic Erasing Pencil," Type 8905.

This device is most practical for erasing limited small areas when it is necessary to erase a syllable or part



of a word. It operates on 115 volts, a.c., 60-cycles at 10 watts and comes complete with press-to-operate switch and six feet of cord.

Dimensions of the device are similar to a king-size fountain pen. It is finished in a black phenolic material.

CUSTOM TAPE RECORDER

A new tape recorder unit designed specifically for custom installations has been introduced by Telectrosonic Corporation, 35-18 37th Street, Long Island City 1, New York as its "Custom 220".

The unit comes complete with tape transport, recording amplifier, playback preamplifier, and erase oscillator. Operational features include dual speeds of 7 1/2 and 3 3/4 ips; 7" diameter reel capacity for up to two hours play;

a single function control for record, idle, and play; preset recording level; and 1-volt output jack for power amplifier connection.

Frequency response is from 50 to 12,000 cps, ± 3 db at $7\frac{1}{2}$ ips. The unit



is supplied either as a chassis for custom installation or with a hardwood base to permit the recorder to be used separately.

ANTI-STATIC CARTRIDGE

Fenton Company, 15 Moore Street, New York 4, New York is now merchandising two new phono cartridges that incorporate a special antistatic feature.

The "Fen-tone" B&O-350A professional magnetic cartridge and the P-12A+ extended range high-fidelity crystal cartridge both are available with a $\frac{1}{2}$ to 1 microgram of radioactive material sealed inside a gold-silver laminate near the stylus. The radiated α -rays effectively ionize the air at the contact point of the stylus and record, thus dissipating static electricity at its source.

NEW ALTEC TUNERS

Altec Lansing Corporation, 161 Sixth Ave., New York 13, New York is currently offering two new high-fidelity tuners to the audio trade.

The 304A is an AM-FM tuner of exceptional selectivity, stability, and free-



dom from drift while the 305A is a straight AM tuner. Both units are available in blonde and mahogany finishes which are matched to the company's other furniture-cabineted components.

TURNTABLE-TONE ARM

Gray Research and Development Company, Manchester, Conn. is now marketing a new turntable and tone arm combination which features a cue light in the arm rest for illuminating the record changing process.

February, 1956

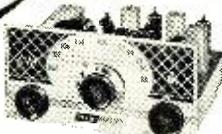
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New

HI-FI FM TUNER

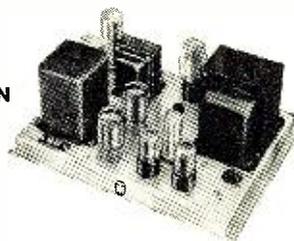


Self-contained power supply • Tuning range 87-109 Mc • 200Kc IF bandwidth • Grounded-grid RF stage • AFC with front-control cutoff • Microvernier tuning • No-drift ratio detector • 4 uv sensitivity for 20 db quieting • Standard de-emphasis network • .8 volt RMS cathode-follower output • 3.2 volt RMS high-impedance output • 300 ohm input impedance • Switch-controlled AC receptacle for auxiliary equipment.

Model FM-18, complete with punched chassis, tubes, and hardware (less wire and solder).....\$29.50

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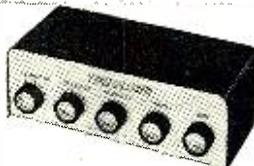


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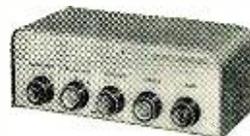


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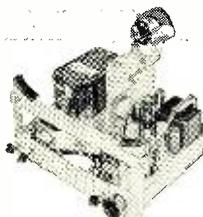


4 input channels • Separate bass and treble controls • 3-position equalizer • AC outlet for auxiliary equipment • Powered by main amplifier.

Model TM-17P, complete.....\$19.95

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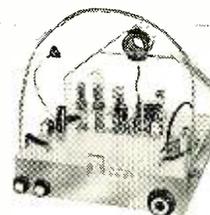
630-TYPE TV KIT



Advanced Cascode turret • AFC horizontal sync. • 3-stage sync. amplifier, clipper and separator • 4-stage stagger-tuned video IF • Adjacent-channel trap • 2-stage video amplifier • Direct-coupled keyed AGC circuit • 5 microvolt sensitivity • For 21" to 27" (90°) picture tube.

Model 630-9, complete with all components, brackets, speaker, and tubes (less kine, wire and solder).....\$159.50

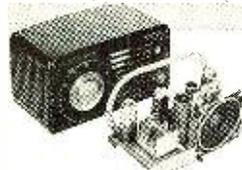
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CRAFT KIT



Super-selective 12-channel turret tuner • IF section completely wired and aligned • 9 microvolt sensitivity • 3-stage stagger-tuned IF • AGC • Syncro-guide AFC with horizontal hold • Ceramic core horizontal output xmfr with beam power amplifier. For L.V. electrostatic kines 17"—21".

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Model 3B5K, complete with tubes and handsome bakelite cabinet (less wire and solder).....\$19.95



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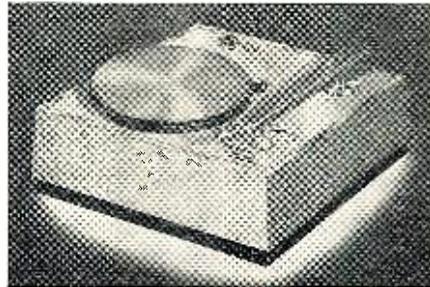
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Cramer Electronics, 811 Boylston St., Boston, Mass.
Electronic Whis., 2345 Sherman Av., N.W. Wash., D.C.
Slate & Co., 2755 Webster Ave., Bronx, New York
Dorosin Dist. Corp., 10 W. 13th St., N. Y. C.
Hudson Radio, 48 W. 48th St., N. Y. C.

Manufactured by
DYNAMIC ELECTRONICS, NEW YORK, INC.
FOREST HILLS, LONG ISLAND, N. Y.

The unit is being offered in a choice of pedestals in red, yellow, green, or pebble gray. The top of the motor-board is finished in "satin copper." The turntable comes equipped with the company's 108C viscous damped tone



arm. The turntable will handle records up to 12" in diameter and will play 16" professional transcriptions. The turntable operates at all three standard speeds.

Full specifications on this new unit will be supplied by the company on request. —30—

Spot Radio News

(Continued from page 14)

struction, instead of the conventional plates, said to give more output per pound, has been announced by the Air Research and Development Command Headquarters.

In pile-type construction each cell is an individual battery which prevents intercell action, due to contact between cells through the electrolyte. With this type of construction, an individual filler hole is required for each cell. In a dry-charged condition they are capable of shelf storage for months.

The dry-charged system is activated manually by a vacuum pump and special reservoir units which have hypodermic-type needles for piercing the cell seals. A valve is tripped automatically to allow the proper amount of electrolyte into the battery. This procedure has been found to insure rapid and complete wetting of all portions of both positive and negative elements.

The pile-type designs have been constructed in three sizes: .1, 3, and 12 ampere hours. The latter size shows a yield of over 70 ampere hours per pound and five watt hours per cubic inch.

ARDC HAS ALSO REVEALED the development of a high-powered radar set, which, it is said, can be erected in less than three hours by a crew of thirty men.

Designed for early warning and long-range detection, the search system has a capability of seeing aircraft at high altitudes, and may be used for interception purposes, when coupled with a height-finding radar of comparable range capability.

The equipment can be transported to the field in nine trucks and two trailers, which comprise a self-supporting radar system for tactical use. Included are shelters for the housing

of operational components, as well as operating personnel.

The antenna is erected with a powered winch attached to one of the nine trucks. Sections of the antenna, a 25-foot long, 14-foot high affair, are joined together manually at ground level. The winch is then used to pull the antenna into operating position on top of its pedestal and tower. The antenna is supported on the ground by four outriggers; during operation it is continuously rotated 360 degrees.

One of the features of the new radar system is a lightweight reinforced plastic shelter, 32-foot long, which houses the operational equipment.

IN TIME FOR THE NAVY'S *Operation Deepfreeze* Antarctic expedition is a balloon-raised antenna system for the Navy's new icebreakers. To be installed on the *USS Glacier*, the antenna, called the "*Skyhook*," will have 1200-feet of wire raised vertically by small zeppelin-type balloons about 30-feet long. The antenna system is expected to provide the ship with a reliable communication range of 1500 miles, under difficult polar conditions. The new antenna will also be used for aerological studies and weather observations.

CRYSTALS, in the form of barium-titanite sandwiches, have come to the aid of the human heart. The Bureau of Standards has found that a barium-titanite (piezoelectric) accelerometer, with an output that is electrically differentiated, can be used to study the action of the heart.

Unlike most instruments used in ballistocardiography, the Bureau's device, called a *jerkmeter*, does not require a fixed reference point. Thus, it is inherently isolated from extraneous motions, such as building or operating-table vibrations.

The instrument, actually a transducer, gives an electrical output proportional to jerk, the time derivative of acceleration. Jerk has been measured in connection with elevator and vehicle riding comfort, as well as in various physiological studies. The present development was undertaken to obtain measurements of the third time-derivative of the displacement of a reclining patient. The motion of interest is due to the inertial forces generated by the flow of blood and is therefore intimately related to the function (and malfunction) of the heart.

Previous studies have shown that the important frequencies for ballistocardiography extend from zero to about 20 cycles-per-second. Certain muscular tremors of high frequency, apparently unrelated to heart action, make it necessary for the jerkmeter-frequency response to drop off as rapidly as possible above 20 cps. In the Bureau's unit, very fast drop-off is achieved by taking advantage of the mechanical resonance of the accelerometer and by properly selecting the time constant (*RC*) of the differentiator.

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3Q4	6AX5GT	6K6GT	7C5	12SG7	50A5
3S4	6AH4GT	6L6	7C6	12SJ7GT	50B5
3V4	6BA6	6S4	7E7	12SK7	50C5
SU4G	6BC5	6S8GT	7F7	12SL7GT	50L6GT
SV4G	6BE6	6SA7	7F8	12SN7GT	117L7GT
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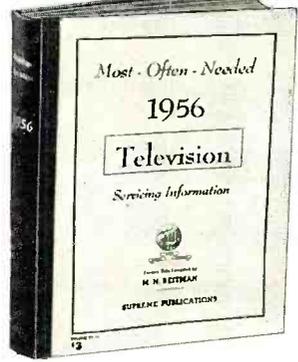
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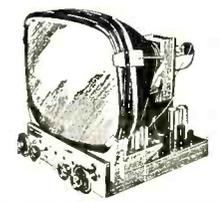
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 New Television Servicing Course, complete, only \$3.

I am enclosing \$..... Send postpaid.
 Send C.O.D. I am enclosing \$..... deposit.

Name:

Address:

Supreme Publications
 Sold by All Leading Parts Jobbers

February, 1956

PEAK VALUES!

SMALL PIONEER GENEMOTORS

Ideal for Amateur or Commercial Service 5.5 to 6 volt DC input output 400 volts at 175 MA. cont. of 275 MA intermittent duty. Comes complete with A & B filters, RF hash filter & internal cooling fan.....each **\$19.95**
Same as above—with 11.5 to 12 volt DC input.....each **\$12.95**

1" MINIATURE METER

High quality meter made by International Instrument Co. Mounts in a 1" hole like a pilot light. Basic movement 0-10 mils. Can be shunted to any milliamm range.
0-10 Mil. Special..... **\$2.95**

WESTON 1 1/2" MINIATURE METER

MODEL 1011—A fine meter suitable for compact grid dipper, field strength, many other applications. 0-500 Microamps.....ea. **\$4.50**
0-1 Milliamm..... **\$3.95**

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1000 series, silver plated contacts, D.P.D.T.—has third set of contacts normally open. Insulated throughout with Isolantite. Operates on 110 Volts AC 60 cycles. BRAND NEW.....each **\$2.95**
2 for **\$5.50**

ALLIED 110 VAC 50 cy 12 V. DYNAMOTOR CONTACTOR. A rugged relay RELAY. 4 Pole D.T. Con- 50 amp. contacts. Will tacts pure silver. 15 start any 12V Dynamotor. amp. **\$1.75** Heavy contacts... **\$1.75 ea.**

G. E. RELAY CONTROL

(Ideal for Model Controls, Etc.)

Contains a sigma midgeet 8,000 ohm, relay (trips at less than 2 MA), high impedance choke, bimetal strip, neon pilot and many useful parts.
The sensitive relay alone is worth much more than the total **\$1.25** Each 10 for **\$9.90**

SENSITIVE RELAY

5000 ohm coil operates on 1 ma, adjustable contacts, adjustable armature tension. SPDT-Bake-lite base. Ideal for model work.
Can also be used on AC. Draws ea. **\$1.75**
4 mill AC @ 110 V. Ideal for burglar alarm.....5 for **\$7.50**

WESTON MODEL 1021 H. S. 2 1/2" meter with a basic 0-1 mil movement. **\$2.95**
SPECIAL

OIL CONDENSER SPECIALS BRAND NEW

2 MFD 600 VDC \$.50	2 MFD 2000 VDC \$ 1.50
4 MFD 600 VDC .75	4 MFD 2000 VDC 3.50
8 MFD 600 VDC .95	1 MFD 3000 VDC 1.85
10 MFD 600 VDC 1.19	4 MFD 3000 VDC 6.95
2 MFD 1000 VDC .85	1 MFD 3600 VDC 2.25
4 MFD 1000 VDC 1.25	4 MFD 4000 VDC 7.95
8 MFD 1000 VDC 1.50	5 MFD 330 AC (1000 DC) .95
6 MFD 1500 VDC 1.95	8 MFD 660 AC (2000 DC) 1.95
10 MFD 1400 VDC 2.50	

NEW PANEL METERS

G.E., WESTINGHOUSE, W.E., SIMPSON, etc.

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0-100 Microamp.	\$5.95	25-0-25 Volts DC.....	3.95
100-0-100 Microamp.	3.95	0-1 1/2 Milliamps.	3.95
0-40 Volts DC.....	4.49	15-0-15 Milliamps.	3.95
0-1 Mil.	3.95	0-1 Milliamp (Basic) ..	3.95
0-1 1/2 Mil.	2.95	0-300 Milliamps.	3.95
0-35 Mil.	2.95	0-500 Milliamps.	3.95
0-200 Mil AC.....	2.95	0-15 Amps DC.....	2.95
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0-15 Volts AC.....	3.95		
0-300 Volt AC.....	3.95		
10 to +60dB.....	3.95		
0-4 Amps R.F.	3.49		

SHIELDED CHOKES

12 Henry 150 Ma.....	\$1.65
8 Henry 200 Ma.....	1.95
Thordarson 15 Henry 200 Ma.....	2.25
6 Henry 300 Ma.....	2.95
6 Henry 1200 Ma (12KV ins.).....	22.50

WESTINGHOUSE RF meter 2 1/2" bakelite case. Int. thermo. Scale linear from 1-9 amps, 0-3 amps. **\$2.95 ea.; 2 for \$5.50**
WESTON MODEL 506. 2 1/2" Sq. bakelite case. An outstanding value from 0-40 Volts. **2 for \$5.50**

READ 'N' SAVE BARGAINS

500 MMF CERAMIC CONDENSERS.....10 for **\$5.50**
150 MMF Var. Cond. micalex insul. db..... **.69**
SANGAMO P21 .001 50V VOLTS WORKING..... **.95**
TRANSMITTING MICA CONDENSER..... **.75**
25 WIRE WOUND RESISTORS in KIT..... **1.95**
01 MMF 100V VDC MICAS..... **5 for .95**
0004 2500 VDC MICAS..... **5 for .95**
025 600 V. MICAS..... **5 for .95**
100,000 OHM 100 WATT RESIST..... **4.45**
GLOBAR 9 OHM 100 WATT (non-inductive) **.6 for 1.45**
OHALITE WIRE WOUND (non-inductive) 250 OHM 100 WATT **5 ea. \$2.50 ea.; 5 for 2.50**
1 MFD Oil Condenser 400 VDC. **25 ea.; 10 for 2.50**

ALL MERCHANDISE SOLD ON A 10 DAY MONEY BACK GUARANTEE BASIS

Min. Order \$3.00—25% with Order—F.O.B. New York.

PEAK ELECTRONICS CO.

66 West Broadway, New York 7, N. Y.
Phone WOrth 2-5439

NEW TV STATIONS ON THE AIR

(As of January 25, 1956)

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.)
Idaho	Lewiston	KLEW-TV	3	60-66	15
North Dakota	Grand Forks	KNOX-TV	10	192-198	30
Tennessee	Memphis	WREC-TV	3	60-66	100
Canadian Stations	Wingham, Ont.	CKNX-TV	8	180-186	36
	Jonquiere, Que.	CKRS-TV	12	204-210	20

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 475 (116 of which are u. h. f.).

The jerkmeter makes use of a load- and the load resistance. The low-frequency jerk sensitivity is thus independent of the capacitance of the circuit. This has been found to be an advantage, since the input capacitances of amplifiers suitable for the jerkmeter's use are not always readily measured.

The crystal sandwich element is attached near the clamped end of the cantilever by means of three metal straps. To minimize the effect of the element's temperature sensitivity and to provide an adjustable viscous damping, the cantilever is enclosed in a container filled with a silicone fluid. The fluid was chosen on the basis of tests and theoretical considerations, which determined the viscosity necessary for satisfactory damping.

Response of the jerkmeter has been made independent, within two percent, down to 1 cps, by means of a capacitive shunt and cathode follower. In a test, two transducers were mounted back-to-back on the end of a long cantilever bar. The other end of the bar was clamped in a vise. By changing the free length of the bar, and by changing bars, a test-frequency range from 1 to 60 cps was covered. Over its flat frequency range, the sensitivity of the jerkmeter (voltage output per unit jerk) is the product of the accelerometer charge sensitivity

and the load resistance. The low-frequency jerk sensitivity is thus independent of the capacitance of the circuit. This has been found to be an advantage, since the input capacitances of amplifiers suitable for the jerkmeter's use are not always readily measured.

THE STATION-GRANT SLOW-DOWN, developed months ago by the v.h.f.-u.h.f. allocation wrangle, continued as the year drew to a close; with little relief in sight, until possibly the Spring of '56, when the hearing decision may be made. As we went to press, actions taken were few, as noted in table below.

A GOVERNMENT-FINANCED half-billion dollar international TV network, with both transmitters and receivers located in those countries who do not now have TV, was proposed recently by NBC's new board chairman, Sylvester Weaver.

Said Weaver: "A TV transmitter and sets (10,000 to a country) would not cost much more than a million dollars; and for a few million dollars in each country, one could even give them a color closed-circuit setup, which would even be more fantastic and powerful a system..." to advance culture and disseminate vital information.

A vital tool, this TV. . . . L. W.

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Idaho	Twin Falls	---	13	210-216	12.3
Montana	Billings	KGHL-TV	8	180-186	87.1
New York	Buffalo	---	59	740-746	25.1
Tennessee	Memphis	---	10	192-198	26.9

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Alaska	Juneau	KINY-TV	8	180-186
Nevada	Las Vegas	KSHO-TV	13	210-216
Ohio	Youngstown	WXTV	73	824-830
North Dakota	Minot	KMOT	10	192-198

CALL LETTER CHANGES

STATE	CITY	CALL	CHANNEL	FREQUENCY
Tennessee	Knoxville	WTVK (Formerly WTSK-TV)	26	542-548
Louisiana	Shreveport	KSLA (Formerly KCIS)	12	204-210

*ERP=(effective radiated power, kw.)

Transistor Radios
(Continued from page 58)

and since this is a *p-n-p* transistor, electron flow will be from the battery to the collector. This will produce a voltage drop across R_{10} such that the collector will become *less* negative or more positive. This change will be transmitted to the bases of the controlled i.f. amplifiers and result in a current decrease through these transistors. In this way the gain of the two i.f. stages is controlled. R_{21} , R_{13} , R_{10} , C_{18} , C_{13} , and C_8 serve to filter out any audio components of the a.g.c. voltage and to establish the time constant of this network.

The remainder of this receiver circuit is fairly straightforward and will present little difficulty. The signal from the detector appears across the volume control, R_{22} , and is taken from here and applied to the base of V_6 , the audio amplifier. R_{23} and R_{21} form a voltage divider network to provide the desired bias for the stage. A stabilizing resistor is present in the emitter circuit and this is suitably bypassed by a 50- μ f. capacitor. The .0047- μ f. capacitor from collector to ground serves to remove any stray i.f. voltage that may have reached this point.

The final stage is a class B push-pull output amplifier. The full -6 volts is applied to the collector elements to obtain the desired power output. A small base-to-emitter bias is used to minimize crossover distortion and to make it easier to substitute other CK722 transistors should replacement become necessary. The no-signal current for the push-pull amplifier is about 1 milliampere plus 1.8 milliamperes in the bias bleeder. At maximum rated output, the current drain of this stage is about 28 milliamperes.

In another model developed by *Raytheon*, a somewhat modified arrangement is employed. See Figs. 4 and 5. There is only one i.f. stage and a germanium diode serves as the second detector. However, following the second detector there are two audio amplifiers and a push-pull output stage.

Note, too, from Fig. 5, that transformer coupling is employed throughout the entire audio system, including between the detector and the first audio amplifier, to increase the gain.

The a.g.c. voltage in this receiver is applied to the mixer rather than the i.f. amplifier. When questioned about this, *Raytheon* engineers indicated that better over-all control action could be obtained with this approach than if the a.g.c. voltage had been applied to the i.f. stage. However, it is necessary with this method to employ a separate oscillator; in a combined converter, a change in a.g.c. bias would cause the oscillator frequency to shift.

Part 3 of this series will appear in the April issue. The March Special Service Feature Issue will carry an article on the actual servicing of transistor radios.



"Servicing TV Sweep Systems"

only **\$2.75** ORDER TODAY



Having Trouble with Sweep Systems?

This book **TROUBLE-SHOOTS** for you—makes you an expert on Sweep Systems

Describes the operation, circuit function and circuit variation of the different types of vertical and horizontal sweep systems common to most TV receivers. Describes best methods of analyzing circuits and trouble-shooting the vertical and horizontal sweep systems; fully supported by helpful photographs, waveforms and service hints covering specific troubles. Also discusses construction of transformers, coils and deflection yokes. 212 pages 5½ x 8½"; fully illustrated. Only **\$2.75**

USE HANDY ORDER FORM BELOW

Sams books cover every phase of Electronics for the service technician, engineer, student or experimenter. Listed below are a few of the many valuable Sams books available at electronic parts distributors and leading book stores.

SERVICING TV SWEEP SYSTEMS.....\$2.75

- Color Television for the Service Technician.** Prepares you for the day when you will be installing and servicing color TV. 116 pages, 8½ x 11"..... **\$2.50**
- Analyzing and Tracing TV Circuits.** Presents a new approach to TV servicing. 168 pages, 8½ x 11"..... **\$3.00**
- TV Service Data Handbook.** Most frequently needed charts, tables and formulas required in TV servicing and installation. 112 pages, 5½ x 8½"..... **\$1.50**
- TV Test Instruments.** How to operate each test instrument used in TV service work. 175 pages, 8½ x 11"..... **\$3.00**
- TV Servicing Timesavers.** Outlines handy service techniques gained from actual experience. Quick reference. 124 pages, 5½ x 8½"..... **\$1.50**
- Fundamentals of Color Television.** Complete up-to-date explanation of Color TV. Easy to understand. 224 pages, 5½ x 8½"..... **\$2.00**
- Photofact Television Course.** Gives a clear, complete understanding of TV principles, operation, practice. Used by thousands of students. 208 pages, 8½ x 11"..... **\$3.00**
- TV Servicing Short-cuts.** Actual service case histories show you how to solve similar troubles in any receiver. 100 pages, 5½ x 8½"..... **\$1.50**
- UHF Antennas, Converters & Tuners.** Covers all antenna types, transmission lines, matching networks. UHF converters, tuners. 136 pages, 5½ x 8½"..... **\$1.50**
- Servicing TV in the Customer's Home.** Short-cut methods for repairs in the field. 128 pages, 5½ x 8½"..... **\$1.75**
- Pay As You See TV.** A clear exposition of the facts. Four informative chapters present the case for this new development in TV entertainment. 96 pages, 5½ x 8½"..... **\$1.50**

- Video Handbook.** Exhaustive coverage of entire subject of TV. Covers design, construction, production, installation, operation and service. 892 pages, 5 x 7"..... **\$5.95**

TV Tube Location Guides:

- Vol. 5.** Shows tube positions and functions in hundreds of TV receivers; helps locate faulty tube quickly. Invaluable in service work. 200 pages, 5½ x 8½"..... **\$2.00**
- Vol. 4.** Covers receivers produced in 1952-1953. 192 pages, 5½ x 8½"..... **\$2.00**
- Vol. 3.** Covers receivers produced in 1951-1952. 192 pages, 5½ x 8½"..... **\$2.00**
- Vol. 2.** Covers receivers produced in 1950-1951. 208 pages, 5½ x 8½"..... **\$2.00**
- Vol. 1.** Covers receivers produced in 1948-49-50. 208 pages, 5½ x 8½"..... **\$2.00**

COYNE BOOKS

Distributed by Howard W. Sams & Co., Inc.

- TV Servicing Cyclopedic.....\$5.95**
- Latest Testing Instruments for Servicing Radio-TV.....\$3.25**
- Practical TV Servicing and Trouble-Shooting Manual.....\$4.25**
- Technical Dictionary.....\$2.00**
- TV and Radio Handbook.....\$2.75**
- Bigger Profits in TV.....\$1.50**
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AMERICAN TELEVISION & RADIO CO. ST. PAUL, MINN.

introduces the
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ATR TV

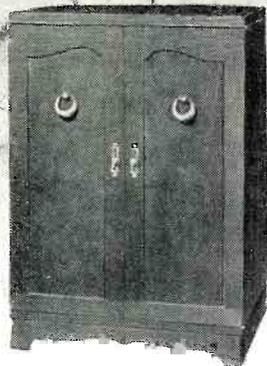
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WRITE TODAY FOR COLORFUL
BROCHURE SHOWING THE
NEW LINE OF ATR TV SETS

ALSO MANUFACTURERS OF DC-AC INVERTERS,
"A" BATTERY ELIMINATORS, AUTO RADIO VIBRATORS

ATR AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA-U. S. A.



TV REMOTE CONTROL

Sentinel Radio Corporation of Evanston, Illinois is currently boosting its new remote control device for television receivers with the help of Adele Jergens, M-G-M star, and a whole series of wall banners, counter cards, and other sales-producing devices.

Write the company direct or con-



tact your local Sentinel distributor for details on the promotion material currently available.

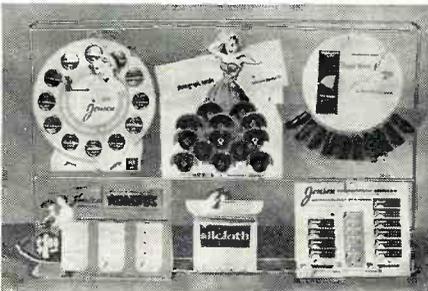
SUPREME MANUAL DISPLAY

Supreme Publications, 1760 Balsam Road, Highland Park, Ill. is now offering distributors an attractive, compact display stand which houses a small stock of the firm's line of service manuals as well as serving as an attention-getter at the point of sale.

DEALER-JOBBER DISPLAY

Jensen Industries, Inc., 7333 West Harrison, Forest Park, Illinois is now offering a sturdy chrome-plated wire frame which has been designed especially for dealer-jobber use.

The hanging rack comes pre-assembled and provides space for attaching counter cards of the company's



needles or accessories. Because of its heavy gauge construction the display is expected to be long-lived and durable.

FIBERGLAS DROP CLOTH

CBS-Hytron of Danvers, Mass. is currently introducing a new Fiber-

glas drop cloth to protect floors and rugs while the service technician repairs radio and television sets.

This blue and white drop cloth, which measures 37" x 48", is fire re-



sistant and protects against drops of hot solder. It can be used to cover a chassis carried in the rain, it is easy to clean, and folds compactly into a tube caddy.

The cloth, which carries the message "We use CBS tubes—The tubes with the Good Housekeeping Guaranty Seal," is being made available to service dealers through the company's tube distributors.

NEW OXFORD PACKAGE

Oxford Electric Corp., 3911 S. Michigan Avenue, Chicago, Illinois is now offering its line of replacement speakers in a completely-redesigned package.

The boxes, which are attractively designed in yellow and blue, are ex-



cellent for display purposes and for maintaining easy inventory. Each box has ample room for clearly indicating model number, size of speaker, field, voice-coil impedance, watts, and price.

For additional information on the boxes, literature, or other details on the speaker line, write the company direct.

PRODUCT PORTFOLIOS

JFD Manufacturing Co., Inc., 6101 16th Avenue, Brooklyn 4, New York is now providing service dealers with two handy new product portfolios, each covering an important phase of the dealer's business.

The first of these publications presents information on a complete line of ten different types of indoor antennas. The folio contains a price schedule and two-color reference sheets. The second booklet is a comprehensive presentation of the company's line of UL-approved lightning arresters.

RADIO & TELEVISION NEWS



If servicing is one of your interests . . .
you can't afford to miss next month's big
SPECIAL SERVICE FEATURE ISSUE

Designed primarily to meet the special needs of the service technician . . . or if you just want to keep posted on every development in this vital area—

MARCH RADIO & TELEVISION NEWS brings you the most complete roundup of service articles, features and news we've ever published.

From cover to cover, the SPECIAL SERVICE FEATURE ISSUE of RADIO & TELEVISION NEWS tells you how to broaden the scope of a servicing business . . . how to use your present equipment and "know how" to expand into allied fields . . . how to take advantage of the daily opportunities that are developing in electronics.

Here are just a few of the many articles you'll want to read:

- HOW TO REPAIR TRANSISTOR RADIOS
- SERVICING AUTO TUNERS
- REPAIRING SERVICING INSTRUMENTS
- NEW TYPE UHF AMPLIFIER TUBE FOR UHF TUNERS
- SUGGESTIONS FOR TUBE INVENTORY
- HOW TO SERVICE RECORD CHANGERS
- NEW TUBES IN TV
- PRIZE-WINNING SERVICE SHOP LAYOUTS
- HOW TO ELIMINATE TV RETRACE LINES
- ART OF PULLING A CHASSIS
- REVIEW OF SERVICE TECHNIQUES
- HORIZONTAL SWEEP QUESTIONS & ANSWERS
- INTERFERENCE IN B-&W TV CAUSED BY COLOR TELECASTS

DON'T MISS THE MARCH SPECIAL SERVICE ISSUE ON SALE FEBRUARY 28!



366 MADISON AVENUE

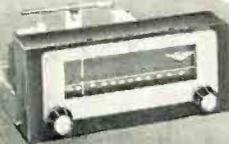
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HIGH FIDELITY ARKAY KITS

LABORATORY
TESTED



Arkay FM-AM Tuner Kit

7 tube circuit plus selenium rectifier includes separate mixer and oscillator stages, 3 double tuned IF stages with Foster-Seeley discriminator and grounded grid amplifier for excellent response characteristics:

Sensitivity & Selectivity—FM 5 μ v for 30db quieting, 200 kc bandwidth 6db down. AM 25 μ v with 8 kc bandwidth 6db down.

Frequency Response —
FM \pm 5db 20-20,000 cps
AM \pm 3db 20-5000 cps
Image rejection —30db minimum
Hum Level — -65db:

AFC control and defeat. **\$25.95**
Available in FM only. Model FM6

Arkay FL-10 High Fidelity Amplifier Pre-Amp Kit;

Unity coupled pushpull 12 watt output; frequency response \pm 2db 20-20,000 cps with extremely low IM and Harmonic distortion; 5 position input selector with record equalizer; loudness, bass, and treble controls; tapped output; extremely low noise level; completely enclosed—no cabinet problem; for clean, flexible, brilliant audio.

\$28.95



Write for technical information on this model.

Arkay A-12 High Fidelity Amplifier Kit Featuring

12 watt output—push pull 6V6's; frequency response \pm 1db 20-20,000 cps with low distortion; 5 inputs, master controlled at front panel; tapped output transformer; separate bass and treble control, each with maximum db boost and cut; built-in Pre-Amplifier; ideal for home installations.

\$22.95

OTHER PRODUCTS IN THE ARKAY LINE OF KITS

- Radios • Testing Equipment
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- Geiger Counters
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Visit your local distributor for these wonderful kits and write today for the special FREE Radio Kits Catalogue and list of dealers. Your copy will be sent by return mail with no obligation. Write to

Radio Kits Inc., Dept. R-11
120 Cedar Street New York

Free counter display units are provided for each of the two product categories. Both portfolios are available from the company distributors or from the company direct. Address requests to Edward Finkel, sales manager of the firm, at the company address.

THOMPSON SALES PROGRAM

The Commercial Product Sales Department, Electronics Division, *Thompson Products, Inc.*, Cleveland, Ohio has developed a well-integrated sales program that provides good point-of-sale material and powerful package identification.

The company has redesigned the shipping and display carton for its "Superrotor" line of antenna rotators.



The new carton utilizes packaging as an effective means of advertising and displaying the product. Each carton is designed to hold one complete rotator and its control unit. One end of the carton folds out into a die-cut handle which makes it easier to carry.

The exterior has a silver-gray background imprinted in black and gold for the "Automatic" model carton and blue and gold for the other models.

HI-FI PROMOTION

National Company, Inc. of Malden, Massachusetts has announced the availability of a hi-fi promotion package for its dealers.

The company is supplying, as loose-leaf enclosures in an attractive binder, a complete array of promotional material. This includes a 24-systems dial display which shows the hi-fi enthusiast the many combinations of equipment in the company's line; reprints of trade magazine articles on the products; a two-color decal and a satin banner; and a catalogue containing a full description and specifications on all equipment.

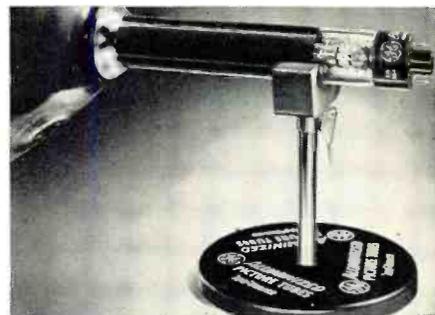
Convenient inventory sheets and order forms are also available to dealers.

"NEK-REST"

The Tube Department of *General Electric Company* has come up with a new time-saving aid for service technicians in the form of a picture tube "Nek-Rest."

Distributed through the company's

regular tube channels, this new service aid eliminates fumbling for the right size prop to hold the neck of a television picture tube. The unit is



easily adjusted to hold a picture tube neck securely and firmly at just the right height on the service bench.

Rubber wedges are supplied with each "Nek-Rest" to keep round tubes from rolling. The base of the unit carries an advertising message regarding the firm's line of aluminized picture tubes.

NEWSPAPER MATS

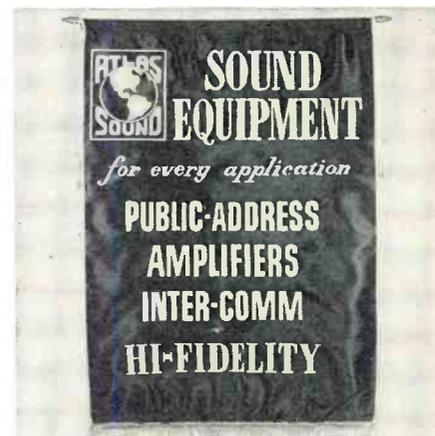
Philco Corporation, Philadelphia, Pa. is now offering full-page color advertisements in mat form to its television receiver distributors.

The four-color advertisement features the company's line of 22 light finish television models and has been made available as a dramatic full-page dealer listing newspaper advertisement.

SOUND PROMOTION

Atlas Sound Corp., 1449 39th Street, Brooklyn 18, New York is making available a promotion package which has been especially designed for the audio industry.

The package is comprised of three parts: several mailing pieces devoted to new and popular sound equipment in the company's line; proposal covers for use in submitting business-like and effective estimates to prospects; and a blue-and-gold satin banner for window or wall display. The banner measures 24" x 16" and its copy is



wide enough to enhance its use in advertising sound rentals or installations on location.

The complete promotion package is available to sound specialists for \$1.00 net.

LIFETIME GUARANTEED TUBES

BRAND NEW PICTURE TUBES

- RCA Licensed
- One Year Unconditional Guarantee

Type	Price	Type	Price
10BP4	\$11.90	17BP4	\$20.63
12LP4	\$14.38	19AP4	\$24.81
14BP4	\$16.86	21AP4	\$28.79
16RP4	\$19.38	21EP4	\$28.79
16LP4	\$19.38	24AP4	\$42.50

Picture Tubes shipped F.O.B. Harrison, N. J. Above types are most popular. However you may order any equivalent size at the same price.

LOOK WHAT YOU GET FREE!

FREE BONUS BOX With Every \$25 Order

- 1 RCA Cheater Cord
- 10 Assorted resistors
- 10 assorted 2 color "blank" tube cartons
- 1 6BQ6GT tube
- 1 6AU6 tube
- 1 6CB6 tube

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Wakemaster clock radio with famous Sessions clock movement wakes you to music or alarm. May be purchased outright from MAJOR BRAND for \$17.95. In ivory or rust.

FREE GIFT CERTIFICATE* worth \$5 toward the purchase of any of our merchandise on future orders will be sent with any order of \$50 or more.

* Free Gift Certificate cannot be used to obtain another certificate unless order is \$55 or more.

WE PAY ALL POSTAGE on orders shipped in USA, Territories and APO's. Send only purchase price of merchandise. Please include approximate postage on foreign shipments. All orders subject to prior sale. Add 25c handling on orders under \$5.00. Quantity users write for special discount.

Write For FREE Tube List—Order Blank—and FREE Sample Tube Carton. We want Y-O-U On Our Mailing List!

NEW INDOOR ANTENNA

Both UHF and VHF. Brings better reception than most outdoor antennas. Use on top of TV.

List Price \$9.95

Your Price

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THIS AD IS WORTH M-O-N-E-Y

Clip out this ad and attach it to your order. Three 6SN7GT's will be shipped FREE with any order of \$10 or more.

HERE'S HOW LIFETIME GUARANTEED TUBES SAVE YOU MONEY!

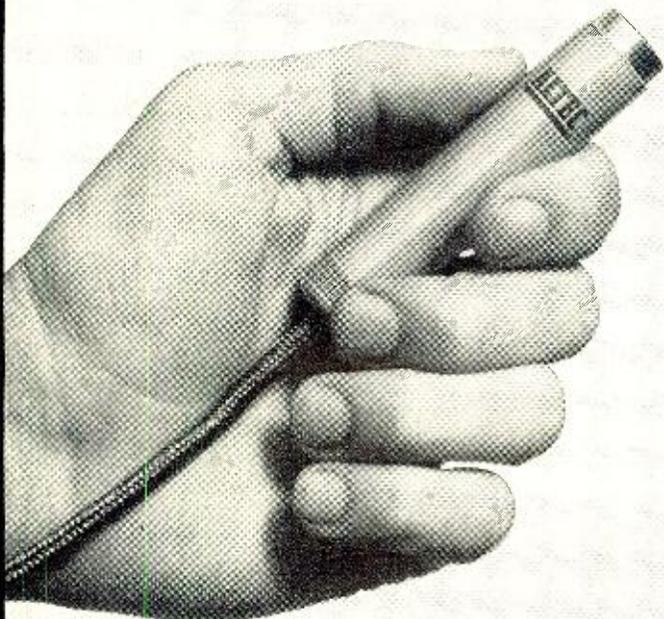
- We Guarantee to Replace Tubes Labeled MAJOR BRAND Forever
- Each Tube Individually Boxed and Guaranteed
- Over A Half Million Tubes Always In Stock
- Immediate Shipment
- Free Postage On All Orders With Full Remittance
- There are fewer "call backs"
- There are no "out of date" tubes
- "Peak Performance" testing in our fully equipped Testing Department before shipment guarantees quality

024	.43	5AW4	.75	6BL7GT	.75	6X4	.34	12SK7	.45
1A4P	.33	5J5	.69	6B6	.75	6X5	.34	12SN7GT	.56
1A7GT	.43	5T4	.69	6B06GT	.78	6X8	.73	12SO7	.37
1B3GT	.65	5U4G	.43	6B07	.78	6Y6G	.55	12SR7	.45
1C5GT	.41	5U8	.7	6BY5G	.58	7A4	.53	12V6GT	.45
1D5P	.43	5V4G	.59	6B27	.88	7A5	.53	12X6	.45
1E7GT	.41	5Y3	.31	6C4	.37	7A6	.45	14A7	.42
1G6GT	.41	5Y4G	.36	6C5	.35	7A7	.43	14B6	.38
1H4G	.43	5Z3	.41	6CB6	.49	7A8	.45	14C7	.50
1H5GT	.47	6A7	.57	6CD6G	1.15	7B5	.39	19B6GG	1.15
1H6GT	.47	6A8	.48	6C7	.43	7B6	.42	19T8	.65
1L4	.45	6AB4	.43	6E5	.44	7B7	.41	24A	.80
1L6	.55	6AC7	.67	6F5	.37	7B8	.45	25AV5GT	.78
1L7	.47	6AD7	.48	6G7	.39	7C4	.39	25BQ6GT	.78
1L8A	.47	6AG5	.50	6G6	.40	7C5	.42	25L6GT	.47
1L8B	.57	6AG7	.69	6H6	.38	7C6	.43	25W4GT	.43
1L8C	.47	6AH6	.48	6I7	.43	7E7	.50	25Z5	.37
1L8D	.47	6AJ5	.70	6J5	.39	7E5	.45	25Z6	.37
1L8E	.57	6AK5	.54	6J6	.47	7E6	.55	27	.25
1L8F	.57	6AL5	.48	6K7	.42	7E7	.55	35A5	.46
1L8G	.57	6AQ5	.46	6J8G	.85	7F7	.59	35B5	.50
1LH4	.64	6AR5	.46	6K6GT	.37	7F8	.70	35C5	.50
1LH5	.47	6AS5	.48	6K7	.42	7K7	.75	35L6GT	.47
1LH6	.50	6AS6	1.70	6K8	.65	7H7	.50	35W4	.34
1LH7	.50	6AS7G	2.19	6L6	.68	7J7	.75	35Y4	.34
1LH8	.42	6AT6	.39	6L7	.42	7K7	.75	35Z3	.39
1LH9	.50	6AU4GT	.65	6N7	.60	7L7	.75	35Z5GT	.34
1LH10	.47	6AUSGT	.59	6O7	.40	7N7	.50	37	.29
1LH11	.42	6AU6	.42	6P7	.40	12AT6	.37	50A5	.46
1LH12	.65	6AV5GT	.65	6SA7	.45	12AT7	.66	50B5	.50
1X2	.61	6AV6	.39	6SC7	.48	12AZ7	.63	50C5	.50
2A3	.55	6A4GT	.80	6SG7	.41	12B6	.48	50L6GT	.43
2A5	.57	6AX5GT	.77	6SH7	.43	12U7	.53	50P6GT	.42
2A7	.55	6B4G	.52	6SJ7	.43	12AV6	.35	75	.42
3A4	.51	6B6	.69	6SK7	.40	12AX4GT	.65	77	.38
3A5	.50	6B8G	.47	6SL7GT	.55	12AX7	.58	80	.34
3AL5	.45	6BA7	.58	6SN7GT	.55	12AX7	.58	80	.34
3AU6	.46	6B7	.47	6S7	.42	12B7	.67	78	.38
3BC7	.54	6BC7	.80	6SR7	.42	12BA6	.46	84/624	.44
3BN6	.70	6BE6	.45	6SS7	.41	12BD6	.48	117L7GT	1.09
3CB6	.52	6BF6	.49	6T4	.68	12B7	.61	117N7GT	1.09
3C4	.46	6BF6	.50	6T8	.68	12BH7	.60	117P7GT	1.09
3Q5GT	.57	5B6GG	1.15	6U8	.75	12BY7	.65	117Z3	.65
3V4	.47	6B16	.50	6V3	.80	12C6	.61	117Z6GT	.35
4B7	.89	6BK5	.68	6V6GT	.39	12D6	.65		
4BQ7	.89	6BK5	.68	6W4GT	.39	12SA7	.45		
4B27	.95	6BK7	.76	6W6GT	.53	12S7	.45		

Write Dept. RN-2

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BROADCAST FIDELITY-FINGERTIP SIZE!

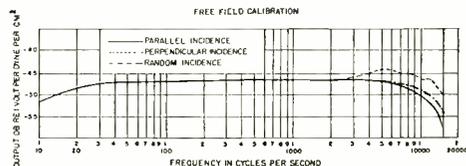


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18.00	10FP4	14.00	31.25	19AP4A	20.75
16.25	121P4A	13.50	27.40	20CP4	18.95
28.95	12UP4	14.50	33.00	21AP4	22.25
18.15	14CP4	13.40	33.25	21MP4	23.50
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STAN-BURN RADIO and ELECTRONICS CO.
558 CONEY ISLAND AVE. • B'KLYN 18, N. Y.

Turntable or Changer?

(Continued from page 45)

ord changer to achieve a performance as good as is possible with a simple turntable.

Choice of Record Changer

Assuming for the moment that you have decided that you will have a record changer, you are still left with the problem of which kind to buy. There is a wide variety of methods of changing, as well as variations in such matters as accommodation for different size discs and different speeds of recording. Some record changers provide automatic facilities for playing all three sizes of discs intermixed, 7", 10", and 12". Some only provide for playing 7" 45 rpm discs separately. The last mentioned would seem to be the more practical arrangement.

When playing 10" and 12" discs intermixed, they should all be either 78 or 33 rpm discs, because the record changer can only adjust for different *size* in discs and not for different *turntable speeds*. It has no means of knowing automatically whether the groove recorded on the disc is an LP micro-groove for 33 rpm playing or the standard groove for 78 rpm playing. But it is quite feasible to put on a stack of discs of mixed size 10" or 12", all of the same playing speed, whether 33 or 78 rpm, and let the record changer set the pickup position for each size as it comes to play. This is probably an asset.

There seems to be no practical means of making the record changer switch automatically from one speed to another, hence the 7" disc which uses a different speed, 45 rpm, is best kept separate for playing. It becomes rather complicated when you try to mix 45's with either 78's or with 33's. You may want to do either, so an additional thing has to be set on the record changer, to determine which speed it is to use for playing 10" or 12" discs. As most readers are probably aware, the more automatic facilities a device carries, the more chance there is that something will go wrong. So it is better, especially with a thing requiring such critical precision performance as a record changer, to keep to simpler types of device.

Another factor in this matter is the purpose for which the 45 rpm, 7" discs were introduced. They were primarily invented for use in record changing machines, and their widest application today is probably in juke boxes. The large central hole was designed so that a different kind of a record changing mechanism could be used to enable much quicker changing from one record to the next. As a considerable amount of program material is available alternatively on 45 rpm or another size and speed of recording, there is not much advantage in buying a 45 unless its specific purpose is going to be utilized.

SERVICEMEN! TECHNICIANS! at last!

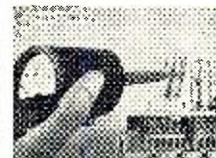
a professional instrument designed for testing a T.V. ABOVE and BELOW chassis!

THE VIDEO PROBE METER!

Saves TWO HOURS PER DAY when used in shop for under chassis work.



With the attachable pick-up loop, (where sufficient signal is available) the Probe Meter can detect and indicate radiation of signal thru I.F. and video amp tubes. (Simply slide loop over tube being tested.) Where internally shielded tubes are encountered, remove tube and insert probe tip into grid pin of socket.



List Price
\$31.50

Can accurately trace and indicate the following T.V. circuits,—(from tuner to pix tube) R.F., I.F., Det., Video, Sync., local osc., Hz. osc., Hz. Drive, audio output, sound I.F. (Signal tracing radios.)

EXCELLENT FOR TRACING AND COMPARING COLOR T.V. CIRCUITS.

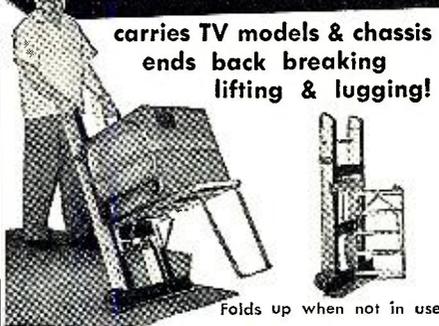
ADDITIONAL FEATURES

Voltmeter, 0-500V. D.C., 20,000 Ohms/volt.

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NEW folding platform attachment fits all YEATS dollies



carries TV models & chassis ends back breaking lifting & lugging!

Folds up when not in use!

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SEND postcard for full information on our complete line TODAY!

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RADIO & TELEVISION NEWS

For this reason, a record changer of three-speed type is likely to give the best continuous playing performance if it utilizes the large center hole for the speed changing mechanism with the 45 size. This type of mechanism can make the change quicker than the type which uses the small center hole and some kind of slide down arrangement controlled from the outer edge. In addition is the fact that the 45 rpm disc needs a center piece to block the large hole and provide a small hole for operation on the changer if this method is used. This enables the two sizes of the discs to be used more interchangeably, but tends to destroy the advantage of the 45 rpm disc which was of providing quick change at minimum interval between playing of the various numbers making up the program.

To take most advantage of the 45 rpm disc the best way is to use one of the small record changers designed for use only on this size.

So what have we decided? If we want a device that will play our records with a minimum of effort we must go for the record changer, so as to avoid having to get up from the armchair to change the disc every time. In making this selection we recognize that we will probably sacrifice something of the quality available by using a simple, high-quality turntable.

If we are connoisseurs of music we shall prefer the simple, high-quality turntables and look for the one that will give the greatest freedom from wow and rumble. Of the three principal types of drive currently being manufactured, it is difficult to say that one type is inherently better than any of the other types, although it would seem easier to design a good drive at low cost using either the idler pulley or belt drive directly to the rim instead of the gear drive to the turntable shaft.

This is speaking as a general principle. However, there is at least one good turntable on the market using shaft drive, that achieves a figure for wow and rumble which compares favorably with any other design. It employs a precision gear drive running in oil. This would certainly seem to offer the potential of long wear without replacement which would, in this case, be an advantage over the other types of drive.

A useful device provided on some turntables for manual operation is a retractable hub in the center which pops up to center 45 rpm discs and drops down out of the way when 33 or 78 rpm discs with the small center hole are placed on the table.

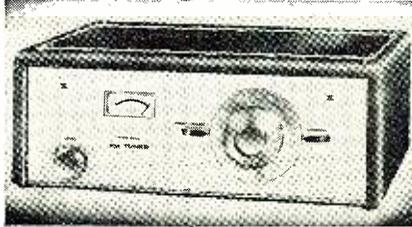
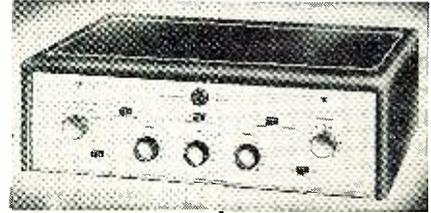
An important feature in the rim drive type is the method of mounting used for the idler wheel. In the case of belt drive, the method of mounting the motor is important. This must be arranged so as to provide adequate mechanical filtering and allow complete freedom of movement to absorb all kinds of mechanical vibrations or speed fluctuations that might otherwise be transferred to the turntable and get

February, 1956

h.h. Scott

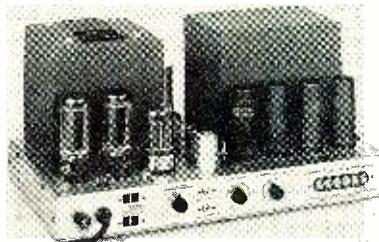
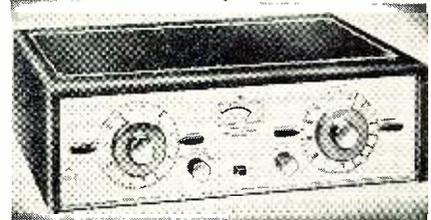
AWARD WINNING AUDIO COMPONENTS

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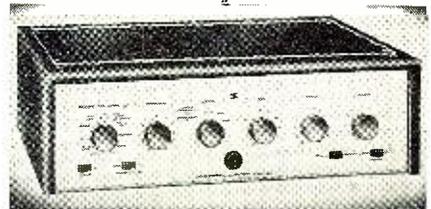
311 FM TUNER — Moderately priced, this FM tuner features new wide-band circuits which audio experts have called "the most significant development in tuner design for years." These circuits allow you to separate stations so close together that ordinary tuners would pass right over them. Absolutely free from drift, the 311 has 3 micro-volt sensitivity for outstanding reception in even the weakest signal areas. **\$99.95* net.**

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210-D DYNAURAL LABORATORY AMPLIFIER — The powerful 30-watt 210-D is the most complete amplifier made. It incorporates a flexible record equalizer, wide range controls and a preamplifier that accommodates two magnetic pickups. Features include versatile tape-recording facilities and a unique dynamic noise suppressor. This amplifier's features and refinements make it "first choice" among connoisseurs. **\$169.95* net.**



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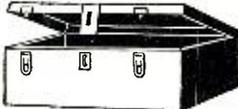


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1B3GT	.73	6AT8	.72	7H7	.59
1L4A	.59	6AU6	.46	7J7	.79
1LC5	.59	6AU7	.61	7K7	.69
1LE3	.59	6AV5GT	.83	7N7	.69
1LH4	.69	6AV6	.40	7Q7	.66
1LN5	.59	6AW8	.83	7S7	.79
1RS	.62	6AX4GT	.65	7Y4	.69
1S5	.51	6AX7	.64	12A4	.60
1U4	.59	6B6	.49	12A5	.37
1U5	.50	6BC5	.54	12AQ5	.52
1X2A	.68	6BC7	.82	12AT6	.41
2A4	.26	6BW8	.83	12B7	.79
2D21	1.20	6BG6	1.25	12AU6	.46
3A3	.80	6BH6	.53	12A0V	.60
3AL5	.57	6BQ6	.45	12AV6	.39
3AU6	.46	6BK5	.80	12B7	.79
3AV6	.41	6BK7	.80	12AX4	.67
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3BZ6	.56	6BQ7	.90	12BF6	.39
3C6	.54	6BZ7	.90	12C6	.90
3C56	.52	6C2	.90	12BK5	.70
3Q4	.59	6C4	.40	12BQ6GT	.99
3S4	.58	6C6	.58	12BY7	.66
3V4	.58	6CD6	1.11	12BZ7	.65
4BQ7	.90	6CF6	.64	12CR6	.51
4BZ7	.96	6CS6	.64	12CUG	.90
5AM8	.75	6CU6	.98	12D6	.51
5AN8	.78	6HG7	.41	12S17M	.67
5A25	.52	6HGT	.64	12SK7GT	.63
5AT8	.75	6J6	.64	12SL7GT	.59
5BK7A	.82	6K6GT	.45	12SN7GT	.59
5J6	.66	6L6	.45	12SQ7GT	.56
5T4	.79	6Q7	.45	12S0GT	.44
5T8	.81	6S4	.48	12W6	.63
5U4GB	.55	6SA7GT	.55	12X4	.38
5U8	.78	6S7GT	.50	12Y7	.63
5V4	.71	6SK7GT	.53	14B6	.63
5V6	.50	6SL7GT	.67	14R7	.79
5X8	.75	6SN7GT	.59	19A04	.76
5Y3GT	.75	6SQ7GT	.46	19B6	1.39
6AB4	.47	6T4	.80	19T8	.69
6AC7M	.86	6U8	.78	25AV5GT	.83
6AF4	.90	6V6GT	.50	25BQ6GT	.98
6AG5	.66	6V8	.86	25CD6	1.44
6AG7M	.99	6W4GT	.47	25CUG	1.01
6AH4	.67	6W6GT	.57	25L6GT	.51
6AK5	.95	6X4	.37	35B5	.52
6AK6	.59	6X5GT	.37	35C6GT	.51
6AL5	.42	6X8	.79	35W4	.47
6AM8	.78	7A5	.65	35Y4	.59
6AN4	.64	7A6	.69	35Z4	.59
6AN8	.78	7A7	.69	3Z55GT	.47
6AQ5	.50	7A8	.69	50A5	.52
6AQ6	.66	7AG7	.69	50B7	.52
6AQ7	.70	7AU7	.61	50C5	.51
6AR5	.45	7B7	.49	50L6GT	.61
6AS5	.50	7C6	.59	117Z5	.45
		7C7	.59		

FREE Tube & Parts Catalog Listing Over 400 Tube Types. Write Dept. RN-2

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PLEASE: Send full remittance. Allow for postage and save C.O.D. charges. Unused money refunded. Subject to prior sale.



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added to the reproduced music as wow and rumble. The idler wheel must be able to float in such a way as not to transmit any vibration to the drive and at the same time absorb all speed fluctuation in the drive from the motor.

Fortunately in this part of the audio field we have plenty of good products from which to choose. It is principally a matter of deciding which of them will suit your particular purpose best. For listening to continuous music in armchair comfort, a good record changer can give a high degree of satisfaction; for the best possible reproduction, if you are a musical connoisseur, a good turntable offers the best prospects. Make your selection by listening to many units—all the while watching for the defects we have outlined. The record playing device that sounds best to your ears is definitely the unit for you to buy. If you want both facilities, a good idea would be to use a good turntable for connoisseur appreciation, and a 45 rpm changer for providing continuous "background" program. If space is seriously limited this would be an argument for a three-speed changer with manual facility.

AMPLIFIER OSCILLATION

By O. RAMSAUR

HI-FI audio amplifiers with considerable negative feedback are often addicted to high-frequency oscillation when the loudspeaker leads are long or consist of several leads in parallel, especially when shielded leads are used.

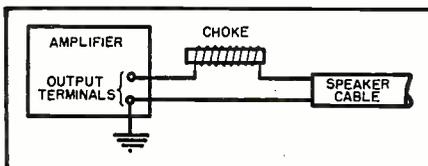
The reason is that the distributed capacity of the leads causes a phase shift in the output transformer in such a direction that, combined with the phase shift in the amplifier due to interelectrode and other stray capacities, it results in positive feedback at frequencies of 100 kc. and higher.

Such oscillation has been cured in several amplifiers by the simple expedient of connecting a small air-core choke in the "hot" speaker lead. This shifts the phase in the opposite direction and maintains negative feedback at the higher frequencies.

The choke is made by winding about 50 turns of No. 18 d.c.c. or similar wire on a piece of 3/4" dowel rod about 4" long. It must be connected outside the feedback loop; so the most convenient place to connect it is between the output terminal and the hot speaker lead, as shown in the diagram.

Tendency for a particular amplifier to oscillate can be detected by connecting a .1 μfd. paper capacitor across the output terminals (with either the loudspeaker or a dummy resistance load also connected to avoid damaging the amplifier) and observing the output waveform on an oscilloscope.

Simple cure for high-frequency oscillation in amplifiers with negative feedback.



SAVE TIME...



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Senco UNIVERSAL TV Jumper Cord

Carry only one Jumper Cord for all TV Sets

- Extends Power from back of TV Set—no more moving of furniture to get to the wall plug
- Turn set off from rear
- No more winding and unwinding cords
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- Fits many speakers, focus coils, etc.

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- Complete international shortwave and AM standard broadcast bands
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- Compact size, yet has every fine performance specification

Write today for catalog and list of shortwave programs.

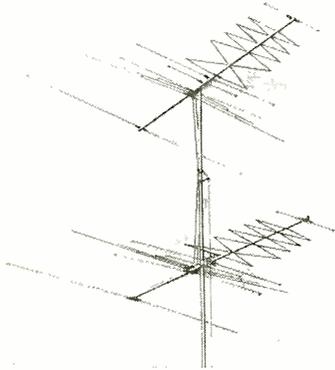
BROWNING L-500 . . . \$8750

browning LABORATORIES, INC. 750 Main Street, Winchester, Mass. Export Div., 25 Warren St., New York, N. Y., U. S. A. CABLE: SIMONTRICE

Antenna News

FRINGE AREA ANTENNA

JFD Manufacturing Co., Inc., Brooklyn, N. Y., has introduced a new all-channel, fringe area TV antenna, called the "Power Helix." The antenna com-



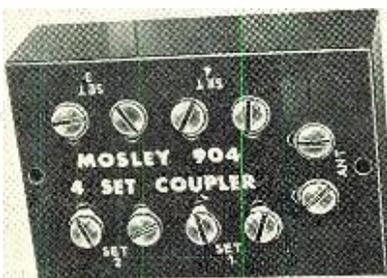
bines a helix for the u.h.f. and high-band v.h.f. channels with a flat-plane dipole system for the v.h.f. low band.

The dipole system consists of one long element, measuring one-half wavelength on channel 2 connected to another element cut to one-half the wavelength of channel 5. This assures reception of channels 2 to 5. For channel 6, the back section of the helix is combined with a specially designed harness.

The antenna is furnished either in a single-bay version, the Model PX911, or a two-bay version, the Model PX-911S. The latter includes 96" stacking bars.

FOUR-SET COUPLER

Mosley Electronics, Inc., 8622 St. Charles Rock Road, St. Louis, Mo., has announced the availability of the Model 904 4-set TV coupler. This unit enables



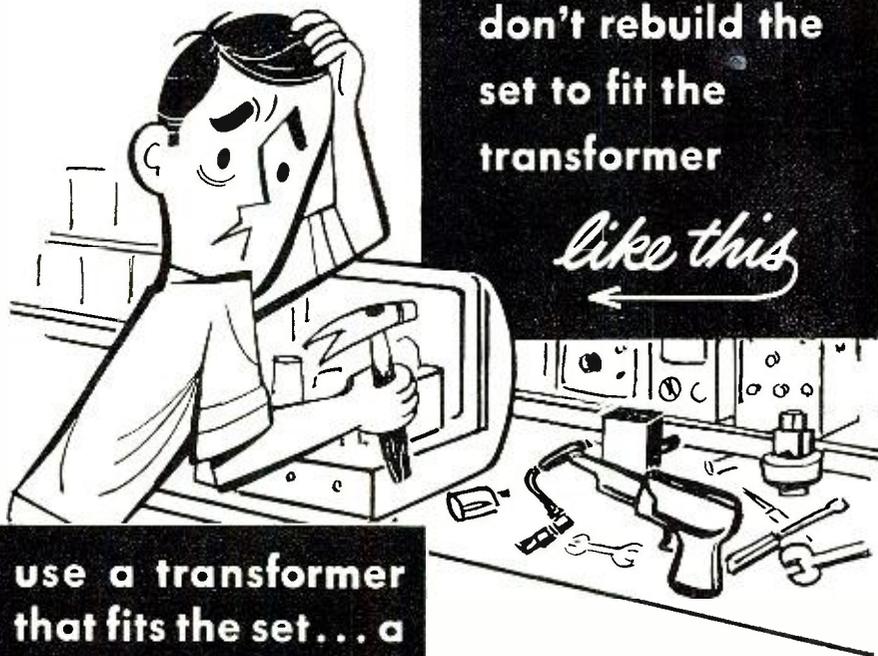
up to four TV sets to be coupled to one antenna with a minimum of interaction and radiation between sets.

Losses in the coupler are so low that it may be used satisfactorily, according to the manufacturer, even in weak signal areas.

NEW CABLE TAP

Jerrold Electronics Corp., 23rd and Chestnut Streets, Philadelphia 3, Pa., has developed a device for making permanent, weatherproof cable taps with-

February, 1956



use a transformer that fits the set... a **STANCOR** verified exact replacement TRANSFORMER

FREE STANCOR TV Transformer Catalog and Replacement Guide listing replacement data on virtually all TV sets in use today, with hundreds of **VERIFIED** exact replacement applications.

EXPORT SALES:
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THE NEW No-Noise TUNER TONIC

Volume Control and Contact Restorer with Perma-Film



Cleans, lubricates, protects — not a carbon-tet solution. Still available in the new 6 oz. spray can. Net to servicemen—\$2.25

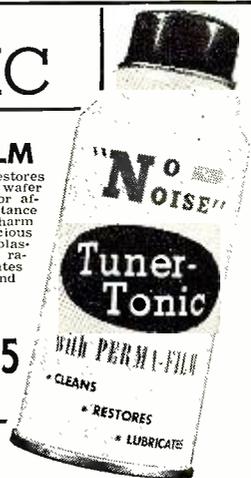


Also available in 8 oz. bottles and quart cans. At your nearest distributor.

with **PERMA-FILM**

Cleans, lubricates, restores all tuners including wafer type. Won't change or affect capacitors, inductance or resistance. Won't harm insulations or precious metals, nor attack plastics. For television, radio and FM. Eliminates all noise, oxidation and dirt indefinitely. Non-toxic. Not to non-inflammable, insures trouble-free performance. Extra economical because a small amount does the job!

\$3.25



2 oz. bottle. Net to servicemen **1.00**

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"Credit Bonus
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- 30 POPULAR BULBS. Wide variety standard, miniature, screw & bayonet types. 1.1 thru 6 volts. Some pilot lite sockets. 2000 pilot lite sockets. \$4 value! Wt. 1/2 lb. \$1
- G-E PRE-AMP EQUALIZER KIT. Chassis, condensers, resistors, wire, socket and schematic. Comes less 6SC7 tube (69c). \$1 Wt. 1 lb. Reg. \$4.50.
- 2-TUBE PHONO AMPLIFIER KIT. Includes all parts (except 50L6 & 35Z5 tubes) and schematic. Excellent tone, volume. Wt. 1 lb. Reg. \$2.98. \$1
- 15 ROTARY SWITCHES. Scoop! Wide variety contacts, single and dual gangs. Wt. 2 lbs. Reg. \$14.
- WEN 25-FT. ROLLS insulated; solid & stranded. #18 to 24 Ass'd. color. Wt. 1 lb. Reg. \$3. \$1
- 25 SLUG-TUNED COILS. Variety of radio, TV, slug-tuned coils—width, inductance, etc. \$1.50 ea. Wt. 1 lb. Reg. \$14. \$1
- 10 TV & RADIO IF XFMRs. Popular replacement IF's. Some trimmer types. Wt. 2 lbs. Reg. \$8.50. \$1
- 60 CHOKES & COILS. 15 popular types Radio, TV, lab. "ham" units. Wt. 1 lb. Reg. \$21. \$1
- 20 POWER RESISTORS. Wirewound canohm & tubular. 20 values. 10,000 ohms; 5 to 50 w. Wt. 1 lb. Reg. \$12. \$1
- 2000 PCS. HARDWARE. Screws, washers, lugs, grommets, etc. Wt. 3 lbs. Reg. \$11. \$1
- 25 INSTR. KNOBS. Ass'd. bakelite round, knurled, pointer, skirted. Ept. types. Set screw & brass insert. Wt. 2 lbs. Reg. \$12. \$1
- 40 MOULDED CAPACITORS. Ceramic & black enameled. Wide variety values: .001 to 0.1 mf up to 1000 V. Wt. 2 lbs. Reg. \$15. \$1
- 60 MICA CONDENSERS. Postage stamp type. 25 values: .00001 to .01 mf. Many silver. \$2.00 Wt. 1/2 lb. Reg. \$17. \$1
- 60 TUBULAR CONDENSERS. 25 values: .00025 to 1 mf. to 150 V. Oils & enameled. too! Wt. 2 lbs. Reg. \$2. \$1
- 60 CARBON RESISTORS. Enamelled. 35 values: 15 ohms to 10 meg; 1/2, 1 & 2 w. Many 1 & 5/8". Wt. 1/2 lb. Reg. \$18. \$1
- 15 PRECISION RESISTORS. 15 values up to 100 meg! Carbo-film & WV. 1/2, 1 & 2 Wt. 1/2 lb. Reg. \$18. \$1
- 50 CERAMIC CONDENSERS. 25 values in disc, button & tubular ceramics; 5 mm to .01 mf. to 1000V. Duals; too! Wt. 1/2 lb. Reg. \$15. \$1
- 125 CARBON RESISTORS. Uninsulated. 30 values: 100 ohms to 1 meg; 1/2, 1 & 2 w. Many 5/8". Wt. 1 lb. Reg. \$1 \$21.
- 10 ELECTROLYTICS, FP & tubular. 8 to 1000mf up to 450 V. Multiple sections. too! Some \$2.50 ea. Wt. 2 lbs. Reg. \$18. \$1
- 150 RADIO PARTS! Large asst. of coils, electrolytic capacitors, paper, moulded & mica condensers, resistors! Wt. 1 lb. Reg. \$30. \$1
- 10 SWITCHES—panel, push and micro types. Ten "ON-OFF" plates included. Wt. 2 lbs. Reg. \$12. \$1
- 60 TERM. STRIPS, & BOARDS. Wide variety, 1 to 12 solder lug points. Bonding posts, too! Builders' must! Wt. 1 lb. Reg. \$6. \$1
- DIODE KIT #1. One each: 1N21, 1N22, 1N23, 1N48 in poly \$1. Reg. \$11.
- DIODE KIT #2. One each: 1N34A, 1N48, 1N51, 1N81 in poly \$1. Reg. \$4.16.
- 25 TUBE SOCKETS. Subminiatures, 7 & 9-pin types. 4, 7, 8 pins. Wt. 1 lb. Reg. \$9. \$1
- 1000 PCS. SPAGHETTI. Pre-cut for shop use in lengths: 1/8, 3/16, 1/4, 5/16, 3/8, 7/16" steel socket wrenches in plastic case. Wt. 1/2 lb. \$3.30 value. \$1
- 8-PC. NUTDRIVER KIT. Plastic handles: 3/16, 7/32, 1/2, 5/16, 11/32, 3/8, 7/16" steel socket wrenches in plastic case. Wt. 1/2 lb. \$3.30 value. \$1
- 40 TRIMMERS. Popular mica compression trimmers in 12 ass'd. values. Sintered dial trimmers. \$1 Wt. 1 lb. Reg. \$16. \$1
- 10 XMITTING MICAS. Ass'd. values: .00025 to .01 mf. 600 to 2500WV. Some low loss too! Ham must! Wt. 1 lb. Reg. \$1 \$27.
- 3 CAR RADIO ASSEMBLIES. Permeability tuned front ends. Cover BC band. Push button controls. Wt. 2 lbs. Worth \$3 ea. \$1
- 100 CERAMIC INSULATORS. Wonderful assortment stand-off, panel and bushings. Wt. 3 lbs. \$1 Reg. \$15. \$1

Other Specials for February

- POWER SUPPLY KIT—300 VDC @ 70 MA; 6.3 @ 3 A. Complete with chassis, transformer, tube, resistors, capacitors, sockets, wire, switch & cord. \$3.88 diagrams. Wt. 5 lbs. Reg. \$17. \$1
- AC-DC RECTIFIER, 100 MA. \$1.78
- AC-DC RECTIFIER, 65 MA. \$1.15
- 2-TUBE AMPLIFIER, completely wired! Fine tone. Volume control, output transformer. (Less 50L6 & 35Z5 tubes). Wt. 2 lbs. Reg. \$3.80
- WESTON 0-100 MICROAMP METER. 2" x 1 3/4". Clear plastic case. Hundreds of uses. Wt. only 2 oz. Reg. \$14. \$3.33
- 0-60 MINUTE TIMER. Clear bell alarm. Wt. 2 lbs. Reg. \$6. \$1.19
- TELECHRON 12-HOUR CLOCK & TIMER. Turns radio, TV, lights "ON" or "OFF" within 12 hours. Instructions incl. Wt. 3 lbs. Reg. \$10. \$2.69

HOW TO ORDER

Check items wanted. Return entire ad with check or M.O. incl. sufficient postage, excess returned. C.O.D. orders 25% down. Rated, net 30 days. RN-2

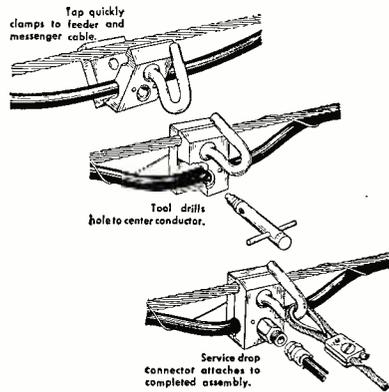
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City Zone State

Enclosed \$.....for kits, \$.....Postage.

LEKTRON SPECIALTIES

28 GARDNER STREET CHELSEA 50, MASS.
VISIT OUR NEW SHOWROOM AT 131 EVERETT AVE., CHELSEA

out severing the cable or stripping leads. The "Pressure Tap," as it is called, may be applied to coax or single-conductor solid or stranded cables. When coax is used, connection is auto-



matically made to the center conductor as well as to all outer conductors. Shunt capacitance is held to less than 1.5 μ fd.

The mechanics of applying the cable tap are shown in the accompanying diagram. For recommendations on the use of the cable tap for any particular application write to the manufacturer.

SMALL OUTDOOR ANTENNA

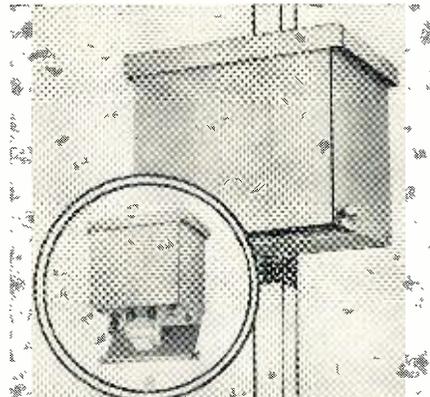
Snyder Mfg. Co., Philadelphia, Pa., announces production of a new outdoor TV antenna for v.h.f. and u.h.f. Called



the "Torque-Tenna," it weighs only 27 ounces and is extremely small in size. The "Torque-Tenna" comes completely assembled and individually boxed. For additional information write to the manufacturer requesting data on the Model AX100.

ANTENNA MOUNTED BOOSTER

Blonder-Tongue Labs., Inc., 526-536 North Avenue, Westfield, N. J., is producing a broadband v.h.f. antenna-



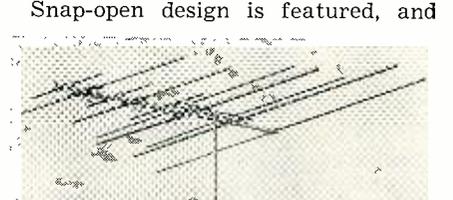
mounted TV booster, the Model AB, featuring more than 25 db gain on all channels. The unit is contained in a weatherproof housing and operates automatically through its power unit near the TV set.

Heavy-duty 300-ohm line carries a.c. power up to the antenna-mounted unit and also carries amplified TV signals down to the receiver. The gain of the booster is sufficient to overcome line loss of 2200 feet on the low band and 1400 feet on the high band.

A mast-mounting bracket and straps are furnished. A swing-down chassis design simplifies servicing of the unit.

YAGI ANTENNA

Clear Beam Antenna Corp., 21341 Roscoe Blvd., Canoga Park, Cal., is marketing a new all-channel v.h.f. yagi antenna, the "Sky Sweep" Model MYS80. Effectively a ten-element yagi, the length of the elements is varied to provide broadband reception. Snap-open design is featured, and



stacking bars are available in three sizes: YS20-33 for the high band, YS20-86 for the low band, and YS20-66 for all band.

ANTENNA PACKAGE

Snyder Mfg. Co., 2218 W. Ontario St., Philadelphia, Pa. is now offering its new line of gaily colored auto radio antennas in a unique triangular, three-color counter display unit which is designed to hold the three different Fiberglas colored antennas.

The line itself is available in sea green (Model F8-G), oriental red



(Model F8-R) and Caribbean blue (Model F8-B). They are breakproof, corrosionproof, and fadeproof. The single mast stands 36 inches high.

TV MOUNTS-ACCESSORIES

Kenwood Engineering Co., Inc., Kenilworth, N. J., has recently released a 16-page catalogue which lists the firm's line of television mounts and accessories that are available through distributors.

Included in the publication are all types of antenna mounts, wall brackets, chimney mounting units and hardware, mast anchors, guy wire accessories and hardware, tubing, and other items.

Four pages of the catalogue are devoted to new products.

NOW—OPERATE BEACON RECEIVER FROM 12 VOLT

BC-1206CM BEACON RECEIVER: 200-100 KC. Tubes: 135 KC IF, operates from 24 VDC—**\$9.95**

For 12 Volt operation, use this PM DYNAMOTOR—12 VDC input, output 24 VDC. Size: 2 1/2" x 4" x 7" Dyn. Only: **\$4.95**
Combination: BC-1206 and Dyn. **\$12.95**



DYNAMOTORS & GENERATORS:

DM-42 Heavy Duty Mobile DYNAMOTOR: 14 V. input; output 1030 VDC—260 MA & 515 V. 215 MA @ 6 VDC. Approx. half of Voltage. Prices: NEW: \$9.95—Used: \$4.95.

INPUT VOLTS:	OUTPUT VOLTS:	MA.	STOCK NO.	PRICES:
12	220	80	DM-34	\$2.95
12	625	225	DM-35	\$4.95
12	230	90	PE-133	4.95
12 or 24	230	100	DA-12	8.95
12 or 24	540	450	DA-14	14.95
14	375	150	BD-83	3.95
14 VDC	330	150	BD-87	3.95
14	1000	50	DM-25	8.95
14	1000	350	BD-77	14.95
24	250	60	PE-86	8.95
28	1000	350	PE-73	8.95

12 to 24 VDC PM Dynamotor—Supplies 24 VDC 2 A. from 12 VDC, also 500 V 50 MA. @ 6 VDC will supply 12 VDC & 250 V 50 MA. **\$4.95**

GN-45 HAND CRANK GENERATOR—Supplies 6.3 VDC and approx. 250 to 500 VDC. Complete with legs, seat and Hand Cranks which have to be turned 50 to 70 RPM to supply voltage (Used with BC-654) Complete Set: **\$9.95**

TRANSFORMERS—115 V. 60 CYCLE PRI.:

600 VCT/100 MA—6.3 V/5 A.: 5 V/3 A.	\$4.95
350 VCT/40 MA—6.3 V/2.4 A.: 6.3 V/6.	(Rect. 6 x 5) 1.75
1500 VCT/350 MA—Tapped at 600.	9.95
1300 VCT/350 MA—5 inches Sq.	6.95
940 VCT/500 MA—5" x 5" x 5".	5.95
700 VCT/150 MA—5 V/3 A.: 6.3 V/4.5 A. CSD.	3.95
2500 V/0.15 A.: 2.5 V/175 A.: 6.3 V/6 A.	5.95
1890 V/12.6 MA—Tapped 2.5 V 2 A.	5.95
1100 V/80 MA—7.5 VCT/3.25 A.	5.95
9 Volt CT—35 Amp.—Tapped 4.5 V.	7.95
12 Volt—Two separate windings—4 amp each.	5.95
28 Volt 8 Amp.—Tapped 4 Volt.	5.95
5 V/2 A.: 5 V/2 A.: 5 V/2 A.: & 5 V/6 A.	2.95
600-0-600 VAC—200 MA. 12.5 V. 2 A.: 12.5 V. @ 2 A.: 5 V. @ 3 A. #H-108—Price.	8.95
250-0-250 VAC—50 MA. 24 V. 1 A.: and 6.3 V. 1 A. #H-109—Price.	4.95

CURRENT TRANSFORMER—Ratio 150 to 5: 25 to 60 cycle. West Style 81R691. **\$ 8.95**
CONSTANT VOLTAGE REGULATOR—115 Volt 60 cycle, 80 VA. Sola #30726. **12.95**

Choke—12.5 Hy/100 MA.	\$1.95
Choke—5 Hy/200 MA—80 Ohm.	1.25
Choke—8 Hy/150 MA—200 Ohm—Open Frame.	1.25
Choke—5 Hy/150 MA—85 Ohm.	1.50

FM TRANSMITTER

27 to 38.9 MC

BC-924—TRANSMITTER: Four preselected Channels, M.O. Control, 30 Watt slug tuned Coils, high & low Switch. Uses 2/815 tubes, 2/6S37, 1/6SL7, 1/6V6, 1/6V5, 1/6AG7, 1/VR-150. Voltage required 12 or 24 V. and 400 V. @ 400 MA. Size: 11" x 11" x 11". **\$24.95**
18". With Schematic. NEW: **\$24.95**

Address Dept. RN, \$5.00 Order Minimum & 25% Deposit on C.O.D.'s. Prices are F.O.B., Lima, O.

NOTE—For Items Previously Advertised, See Our Classified Section Below:

PANORAMIC ADAPTER And OSCILLOSCOPE

ID-60/APA-10—Two units in one Panadapter & Scope with three inputs for feeding IF Freq. of 455 KC, 5.2 MC, or 30 MC from receivers for viewing on 3" scope tube. Can also be used as regular scope; has vertical and horizontal push pull Amplifier inputs. Complete with 21 Tubes. Operates from 115 V. 400 cycle. **\$49.50**

METERS:

WESTON AC AMMETER:

(Pictured) In portable leather case, with Test Leads, 2 1/2", 0-15 AC and 0-3 AC Scale. **\$5.95**



DC AMMETER HOYT: In portable metal case, with Test Leads, 4 1/2", Fan Mirrored Scale 0-15 ADC. **\$4.95**

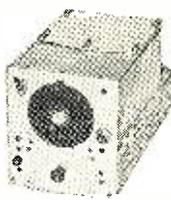
DB METER—10 to Plus 6, Westinghouse 3", NC-35 Imp. 600 ohms @ 1000 cycle.	4.95
0-3 RF AMMETER IS-128; 2 1/2" Rd.	NEW: 2.95
0-8 Amp RF w/Thermocouple IS-89; 2 1/2" Rd.	4.95
0-15 AC-DC—2 1/2" Rd.; IS-122.	4.95
0-500 MA DC—2 1/2" Rd.; IS-22.	4.95
0-150 V. 60 cycle; Simpson; 3 1/2" Rd.	3.95
0-250 MA DC—DeJure, 3" Sq.	3.95
OUTPUT—5 Ranges, 4000 ohm Imp.—Used.	4.95

CLASSIFIED ITEMS:

BC-212G Amplifier—2/6C5 tubes.	NEW: \$ 1.95
BC-216 Amplifier—6F7 & 39/44.	USED: 1.50
BC-229/429 Receiver—2500-7700 KC w/Coils.	U: 6.95
BC-230 Transmitter—2500-7700 KC w/Coils.	U: 8.95
BC-347 Amplifier—1/6F8G tube.	N: \$3.95; U: 1.95
BC-357 Beacon Rec.—75 MC.	N: \$4.95; U: 2.95
BC-367 Amplifier—2/6V6 tubes.	N: \$4.95; U: 2.95
BC-375 Transmitter.	Used: 29.95
Tuning Units f/BC-375; TU-5-6-7-8-9-10-26.	U: Ea. 2.95
Cables f/BC-375/BC-191, PL-61, 64, 59 ea.	end: Ea. 2.75
BC-442 Antenna Relay Box—w/Cond.	New: 2.95
BC-500 Trans. & Receiver—25 Watt, 20-28 MC.	59.50
BC-604 Transmitter—20 to 28 MC.	Used: 9.95
SCR-625 Mine Detector—Reconditioned.	49.95
BC-654 Transceiver—3800 to 5800 KC.	Used: 34.95
RM-12 Remote Control Box F/BC-669.	4.95
CD-5; 5 Cable F/BC-669.	2.75
BC-709 Amplifier—Batt. Operated.	New: 1.95
BC-745 Transceiver—3 to 6 MC.	Used: 14.95
BC-966 IFF—160 to 211 MC. 13 tubes.	Used: 5.95
BC-1206 Receiver—200 to 400 Kc.	New: 9.95
RI/ARR-I Receiver—Converts to 2 or 6 Meters	2.95
RT-7/APN-I Altimeter—440 MC.	Used: 9.95
RT-34/APS-13 Transcv. Comp. less tubes.	U: 3.95
T-121 Transmitter—34 MC with Coder.	9.95
Range Beam Filter, Navy Type \$1.95; FL-8 Used.	1.49
EE-8 Field Telephones—Checked.	Used: 14.95
RM-21 Radio-Telephone—Remote Control.	Used: 10.95
BD-72 Portable 12 Line Switchboard.	Used: 39.95
Sound Powered Head & Chest Set—Checked.	3.95
T-17 Microphone—Clean, Aided, Checked.	3.95
HS-30 Headset—Hearing Aid, Type—L.N.	1.50
CD-874 Cord—f/HS-30—Low Imp. w/PL-55.	U: .59
CD-605 Cord—f/HS-30—High Imp. w/PL-55.	N: .79
CD-307 Cord—w/PL-55 & JK-26.	.59
CD-318 Cord—2/PL-68, JK-48, & SW-141.	U: .89

BROADCAST RECEIVER

NAVY TYPE—520-1500 KC. NEW: \$19.95
LIKE NEW: \$14.95
Q 5 or NAVY TYPE—190-550 KC. NEW: \$12.95
R-28/ARC-5 REC.—100-156 MC. w/Tubes. USED: \$10.95
T-23/ARC-5 TRANS.—100-156 MC. Used. \$14.95



NAVY TYPE COMMAND TRANSMITTER—2.1-3 MC. New: \$7.95; Used: \$5.95
NAVY TYPE COMM. TRANS.—3-4 MC. USED: \$12.95
BC-458 TRANS.—5.3-7 MC. NEW: \$5.95—USED: \$3.95
Navy Type Trans.—7-9 MC. New: \$7.95—Used: \$5.95
BC-1206—200 to 400 KC. **\$9.95**

TG-34A KEYS

TG-34A KEYS—115 or 230 Volts at 50 to 60 cycles—an automatic unit for reproducing audible code practice signals previously recorded in ink on paper tape. By use of the self contained speaker, the unit will provide code practice signals to one or more persons—or provide a keying oscillator for use with a hand key. Unit is compact in portable carrying case, and complete with Tubes, Photo Cell and Operating Manual. Size: 10 1/2" x 10 1/2" x 15 1/2". Shipping weight: **\$16.95**
45 lbs. **NEW: \$16.95**

TG-10 KEYS—Same function as TG-34A—only larger—using 2/6N7—2/6L6—2/6S7—1/5U4G Tubes and 1/923 Photo Cell. Housed in standard Metal Cabinet, can be removed for 19" rack mtg. Size: 17" H x 24" W x 18 1/2" D. **\$14.95**
Price—USED, TESTED. Only

BLANK PAPER TAPES FOR CODE RECORDERS: 3/8" Wide, in 900 Foot Rolls—Prices: 25¢ Each—or 6 Rolls 1/\$1.00—30 Rolls 1/\$5.00—60 Rolls 1/\$5.00

HIGH FREQUENCY RECEIVER

R-74/CRW-2 RECEIVER—53 to 88 MC—For remotely controlled radio systems on preselected freq. Complete with tubes & 24 Volt Dyn. Size: 9 1/2" x 8" x 4 1/2". **NEW: \$9.95**

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TRYLON TOWER—Triangle Galvanized Steel Tower—12 1/2" Base, 30 Ft. High—in 10 Ft. Sections. (Two Towers may be put together for 60 Ft.) Knocked down—Complete with Hardware, two 50 Ft. and one 80 Ft. Guys, three 5 Ft. Anchors, and Base Plate. Each section weighs 45 lbs. Complete with Erection Manual. Shipping Weight: Approx. 350 lbs. F.O.B. **\$31.95**
Ky. Price.

MAST BASES—INSULATED:

MP-22 BASE—(Illustrated) Ins. spring action; direction of bracket can be raised or lowered easily.	\$2.95
MP-S-33 BASE—Insulated type with heavy coil spring and 5" dia. Ins. Requires 2" hole for mounting. Weight: 9 lbs.	\$5.95
MP-48 BASE—Insulated type base with heavy coil spring. Requires 1 3/4" mounting hole. Weight: 11 lbs.	\$4.95

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, copper coated, painted in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section **@ 50¢ Each**
Larger Diameter Section: MS-54. **75¢**

TRANSMITTER & MODULATOR 67 to 74 MC

BC-463—20 Watt, Crystal Control—Complete with 16 Tubes: 1/815, 8/1215, 2/12SN7, 2/6V6, 2/6L6, & 1/VR-150. Also Output Meter, Crystal Modulation Trans., Motor, & Fan. **USED: \$16.95**

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KW PLATE TRANSFORMER

4700 Volts CT @ 350 mills. Pri. 115 V 60 cy. Made by CHICAGO TRANSF. CO. Fully shielded, type FS case. **\$21.95**

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5 henry 400 ma. 10 KV ins. Full case. \$ 4.95
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H.V. POWER SUPPLY KIT

Transformer and 2 400 ma chokes described above plus 2 2 mfd 4000 volt oil condensers. **\$32.95**

2 Mfd 4000 VDC

Oil Condenser Ceramic Ins. **\$2.95 ea.** 2 for \$5.90

1 1/2 INCH SQUARE METER

0-500 microamps. high accuracy. **\$3.95**

STANDARD POWER TRANSFORMER

1000 Volt CT at 250 ma., 6.3 volt at 4 amp., 8.3 volt at 3 amp., 5 volt 3 amp. Pri. 110 volt, 60 cy. Full case. Brand new. Price. **\$4.95**
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WESTERN ELECTRIC

4 quadrant phase shift capacitor. **\$14.75**
#D1S0734

FILAMENT TRANS.

6.3 Volts @ 8 Amp & 6.3 Volts @ 1 amp 110 V. 60 cycle Pri. **\$1.39**

1" Milliammeter

Mounts into 1" hole. 10 mill basic, easily shunted to other ranges. Free shunt wire. Your choice 0-10 ma **\$3.95**
5-0-5 ma.

1" Microammeter

0-200 microamps. Same type as 1" milliammeter. Mounted in rubber casing which may be removed if desired. **\$5.95**

H. D. 12 VOLT DYNAMOTOR

500 volts output at 400 ma. Mounted on filter base with fuses, starting relay, etc. Has switch for 24 volt operation also. **\$17.95**
DM49AX. Brand New

G. E. RELAY CONTROL

(Ideal for Model Controls, Etc.) Contains a sigma midget 8,000 ohm, relay (trips at less than 2 Ma), high impedance choke, bimetal strip, neon pilot and many useful parts. The sensitive relay alone is worth much more than the total low price of **\$1.25** Each 10 for **\$9.90**
FREE Model Control Book with Purchase of 10.

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RF relay with low loss ins. Switches to either of 2 type 831R coax receptacles. Latching device removes voltage after actuated, permitting operation from 12 volts DC to 115 AC. Mounted in **\$1.95** aluminum case. Terrific Value. 2 for \$3.50

12-14 VOLT DYNAMOTOR

375 Volt at 250 Ma. with Filter **\$7.75**

MALLORY VIBROPACK

12 Volt Input. 200 Volt at 100 Ma. Out. Small Size **\$4.95**

MOBILE DYNAMOTORS

OUTPUT	DUTY	CONT. DUTY	FILTER	PRICE
400 VDC	275 Mills	175 Mills	with	\$19.95
400 VDC	300 Mills	200 Mills	less	14.95
425 VDC	375 Mills	275 Mills	less	24.50
11.5 to 12 VOLT DC INPUT				
400 VDC	275 Mills	175 Mills	with	12.95
625 VDC	225 Mills	175 Mills	less	11.75

PANEL METERS

WESTON, G.E., SIMPSON, etc.

2" METERS		3" METERS	
0-100 Microamp.	\$5.95	0-1.5 Milliamp.	\$2.95
100-0-100 Microamp.	4.95	0-10 Milliamp.	2.95
0-150 Microamp.	4.50	0-50 Milliamp.	3.95
0-4 Amp RF.	2.95	0-200 Milliamp.	3.95
0-1 Milliamp.	3.95	0-300 Milliamp.	3.95
0-1.5 Milliamp.	2.95	0-500 Milliamp.	3.95
0-5 Milliamp.	2.95	0-150 Volts AC.	4.95
10-0-10 Amp DC.	2.95	0-15 Amps DC.	2.95
DB 0 to +15.	2.95		
0-300 Volt AC.	3.95		

OIL CONDENSER BARGAINS

1 mfd 600 VDC	.25	6 mfd 1500 vdc	\$1.95
2 mfd 600 VDC	.45	10 mfd 1400 vdc.	2.50
4 mfd 600 vdc.	.75	2 mfd 2000 vdc.	1.50
8 mfd 600 vdc.	.85	5 mfd 2000 vdc.	2.25
10 mfd 600 vdc.	.90	4 mfd 2000 vdc.	2.85
1 mfd 1000 vdc.	.60	1 mfd 3000 vdc.	1.85
2 mfd 1000 vdc.	.75	3 mfd 4000 vdc.	4.95
4 mfd 1000 vdc.	1.25	8 mfd 600 vdc.	1.35
8 mfd 1000 vdc.	1.35		

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Kit of 10 TRANSMITTING MICAS. 1.00
9 Ohm 100 watt Non-inductive resistors. 6 for .45
100,000 ohm, 100 watt bleeder res. 2 for .89
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6-12 VOLT DC RELAY DPDT. .79
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Within the Industry

(Continued from page 32)

principally for the electronic, chemical, and aircraft industries. A new plant is planned for Huntsville, Alabama with initial operations scheduled for late 1956 . . . **ELECTROCRAFT**, 3741 N. Kedzie Avenue, Chicago 18, Illinois is a new firm established especially for the manufacture of phone plugs and jacks . . . **NEW YORK TRANSFORMER CO., INC.** of Alpha, New Jersey, has acquired **TARTAK ELECTRONICS** of Burbank, California as its West Coast subsidiary. It will now be known as **NYT ELECTRONICS** . . . **ELECTROMATION CO.** has purchased **KINEVOX, INC.**, Burbank, California, manufacturer of synchronous magnetic recording equipment. It will operate as a division of the parent firm . . . **CLEVITE CORPORATION** of Cleveland has purchased **INTERMETAL G.m.b.H.** of Dusseldorf, Germany, the second largest company in Europe engaged in the development and manufacture of transistors and diodes. The German firm will be operated in conjunction with the parent company's **TRANSISTOR PRODUCTS, INC.** subsidiary in Waltham, Mass. The Waltham division's corporate name is being changed to **CLEVITE TRANSISTOR PRODUCTS** . . . **INSULINE CORPORATION OF AMERICA** of Manchester, N. H. has become a subsidiary of **Van NORMAN COMPANY**, Springfield, Massachusetts, machine tool maker . . . The plant and equipment of **COLUMBIA INDUSTRIES, INC.** at Columbia, Pa. has been purchased by Robert P. Turner, Jr. The new company will be known as **COLUMBIA PRODUCTS INC.** and will continue to manufacture metal cabinets and bases and will eventually fabricate wood cabinets, both for the TV trade.

C. J. HUNT has joined **Zenith Radio Corporation** as vice-president and manager of distribution. Prior to his new post, Mr. Hunt was vice-president in charge of radio-television at **Stromberg-Carlson**. He joined the Rochester receiver maker in 1928 serving as sales representative and distributor contact man in the Philadelphia area.

He is a member of the executive committee of the set division of **RETMA**, of the National Association of Music Merchants, and the National Federation of Sales Executives. He will now make his headquarters in Chicago.



RETMA has issued an invitation to all manufacturers of phonographs and record players to participate in its program to improve the quality of statistical information by submitting data on factory sales of all types of record playing equipment.

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TRANS-ATOMIC TRANSISTOR RADIO KIT \$9.95
Earphone for Kit 1.00 add'l

Works like magic indoors, outdoors . . . anywhere! So small, fits into your palm, pocket or purse. Economical, too . . . works for months on 10c flashlight batteries. Contains genuine Germanium Transistor, Germanium Diode, Slide Rule Dial for precision tuning, world famous Loopstick antenna for added power, unsurpassed reception. Comes pre-punched, complete with instructions. Only a screwdriver is needed for quick, easy assembly. Send check or money order (No COD).
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\$1.00	\$3.00	\$13.50	\$25

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of data covering 1955 and then, henceforth, the compilation of such information on a monthly basis.

* * *

DONALD C. DUNCAN has been named general manager of the *Berkeley Division of Beckman Instruments, Inc.* while Thomas Allinson has been appointed manager of the *Berkeley Division*, located in Richmond, California. Mr. Allinson will report to Mr. Duncan who will continue to serve as general manager of the company's "Heli-pot" and "Arga" divisions in South Pasadena.



Mr. Duncan holds degrees in both electrical and mechanical engineering from Pennsylvania State University. He was an industrial control test engineer for *General Electric Company* in 1940 and from 1941 to 1945 served with the Navy Bureau of Ships as an electrical engineer.

* * *

DR. WILLIAM SHOCKLEY, formerly director of transistor physics research at *Bell Telephone Laboratories* since 1954, will head a new research group at *Beckman Instruments, Inc.* which will work toward the further development of semi-conductors . . . **OTTO PASCHKES**, president and founder of *Astron Corporation*, passed away recently after a long illness . . . **SAMUEL YURMAN** is the new sales manager for *Kenwood Engineering Co., Inc.* of Kenilworth, N. J. . . . *International Resistance Company* has elected **HARRY A. EHLE** to the post of executive vice-president and **JESSE MARSTEN** as senior vice-president. Both men have been with the company many years . . . **JOHN F. GIBBS** is the new general sales manager of *Gray Research and Development Company*. He was formerly with *Allen D. Cardwell Electronics Productions Corp.* . . . *Service Instrument Company* has named **ROBERT BAUM** head of its new product design department. He was formerly with *Cook Electric Company* of Chicago . . . **DR. W. CRAWFORD DUNLAP, JR.** has been named a consultant in the semi-conductor field at *General Electric Company's* Electronics Laboratory in Syracuse, N. Y. . . . *Standard Coil Products Co., Inc.* has named **ARTHUR H. FORBES** assistant distributor sales manager . . . **A. C. ELLES** has been appointed general sales manager of *I.D.E.A., Inc.* of Indianapolis. He will coordinate the sales activities of the firm's three divisions . . . *Radio Corporation of America* has elected three new vice-presidents: **DR. DOUGLAS H. EWING** for *RCA Laboratories*; **CHARLES P. BAXTER** vice-president and general manager of the television division; and **JAMES M. TONEY** vice-president and general manager of the radio and "Victrola" division of the company . . . **JOHN J. KAUL** is the new sales manager for *Terado Company* of St. Paul, Minn. . . . **ERIC FIRTH** is the new national distributor sales super-

February, 1956

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Radio & Television TROUBLESHOOTING AND REPAIR by Ghirardi & Johnson is far and away the world's most modern, easily understood guide. Step by step, it takes you through each service procedure . . . from locating troubles with less testing to repairing them promptly by fully-approved professional methods . . . the kind that enable you to handle tough jobs as sick as you now do the easy ones.

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LEARN BASIC CIRCUITS FULLY... and watch service "headaches" disappear

It's amazing how much easier and faster you can repair radios, television sets and even industrial electronic equipment when you know all about circuits and what makes each one "tick."

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stand their peculiarities and likely "troublespots" . . . and shows how to eliminate useless testing and guesswork in making repairs.

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 I am enclosing \$1.00. Rush me your dealer's card and big Catalog Today. If I am not completely satisfied with your plan, I understand that I can return the Dealer's Card and Catalog for refund, and if I decide to order, my \$1.00 will be deductible from my first order.
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MAIL TODAY!

visor for the *Advance Relay Co.*, an *Elgin National Watch Company* subsidiary . . . **RICHARD J. MAHLER** has been appointed vice-president in charge of sales and engineering at *Ronette Acoustical Corporation* . . . **ABRAHAM A. VOGEL**, controller of *Emerson Radio and Phonograph Corporation*, has been elected a vice-president of the company . . . *Radio Receptor Co.* has appointed **SEYMOUR D. GURIAN** to the post of sales manager of the engineering products division of the firm . . . **JOSEPHUS A. BRIGGS** has joined *Cook Electric Company*. He recently retired from the U.S. Navy with the rank of rear admiral. He will be stationed in Washington, D.C. . . . *Brush Electronics Company* has named **JOHN H. HARRIS** vice-president in charge of planning and **WALLACE T. GRAY** general works manager . . . **CHARLES B. GRAHAM** has joined *Fairchild Recording Equipment Company* as manager of distribution and promotion for the high-fidelity division . . . *Electro-Voice, Inc.* has made four new appointments of interest to the industry. **HOWARD T. SOUTHER** is the new marketing director, **WEBSTER F. SOULES**, administrative assistant, **GEORGE R. RILEY** manager of distributor sales division, and **CULLEN H. MACPHERSON** manager of high-fidelity products . . . **ROBERT S. HOOD** is the new vice-president in charge of manufacturing for *Gertsch Products, Inc.* . . . Election of **CARL A. DUFFY** as vice-president of the service division has been announced by *Packard-Bell Company* . . . **GEORGE GROUNDS** has joined *Berlant Instruments* as quality control supervisor . . . **E. F. GIGUERE** is the new vice-president in charge of sales for *Transistor Products, Inc.* while **ALLEN J. DUSAULT** has been named general sales manager of the firm . . . **GEORGE W. KEOWN** has been named vice-president of *Tung-Sol Electric, Inc.* and will assume the sales responsibilities recently relinquished by **RAYMOND E. CARLSON**.

BERNARD DRESKIN has been named president of *Industrial Instruments, Inc.* of Cedar Grove, N. J., manufacturers of equipment for automation, electrical equipment and electrolytic conductivity measuring devices. He was formerly vice-president of the firm.



Prior to joining the company in 1941, Mr. Dreskin was associated with *Solar Manufacturing, Automatic Manufacturing, and Federal Telephone*.

AFCEA's 10th annual convention will be held May 24, 25, and 26 at the Hotel Statler in Boston with the Boston Chapter of Armed Forces Communications and Electronics Assn. as host.

The exhibits will be set up in the First Corps Cadet Armory across the street from the Statler. This year's theme is "Military and Industry: Partners in Progress."

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Puts out 1,000 V. @ 350 ma. 12 V. @ 25 amps. Generator may be driven from fan belt of car, an auxiliary pulley on rear wheel, or by a direct coupled gasoline engine. Great unit for Field Day! **\$12.95**
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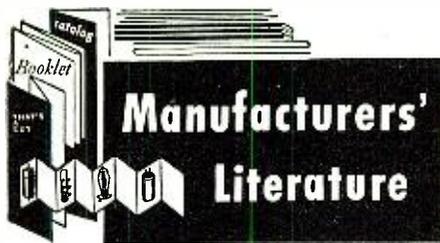


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SSB APPLICATION DATA
Eitel-McCullough, Inc. of San Bruno, California has recently published a compact, 24-page bulletin which lists the single-sideband ratings for the firm's "Eimac" tubes and discusses other technical topics in this increasingly popular field.

The new publication, entitled "Single Sideband," is available without charge upon application to the company's Technical Services Department.

PISTON CAPACITOR

JFD Manufacturing Co., Inc., 6101 Sixteenth Avenue, Brooklyn 4, New York has available a data sheet covering its "engineer's experimental kit" of variable piston capacitors.

In addition to describing the kit, the sheet gives characteristics for the ten units included in the kit. The kit contains one each of the company's VC5, VC11, VC12, VC1G, VC3G, VC4G, VC8G, VC11G, VC13G, and VC30G piston capacitors.

NEW NEEDLE GUIDE

Recoton Corporation, 52-35 Barnett Avenue, Long Island City, New York has announced the publication of a fifth edition of its "Simplified Replacement Needle Reference Guide."

This newest guide consists of a cover chart for quick reference, a section listing all of the popular cartridges and their needle replacements, a section which lists all popular phonographs and their correct needle replacements, and finally, a complete catalogue of the firm's line of needles, cartridges, recording tape, recording blanks and phono accessories.

The guide is available from the manufacturer at \$2.50 a copy.

UTC CATALOGUE

United Transformer Company, 150 Varick Street, New York 13, New York, has issued a new 36-page catalogue covering its line of transformers, reactors, and filters.

In addition to providing full details on standard and semi-standard units in the firm's line, this new publication carries details on the company's "dot" series of miniature transistor transformers, the new line of miniature pulse transformers, and a wide variety of hermetic power components for military and industrial use (including plate, filament, power transformers, and filter reactors).

RADIO SHACK CATALOGUE

Radio Shack Corporation, 167 Washington Street, Boston 8, Mass. and 230-234 Crown Street, New Haven 10,



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10FP4 \$14.95	or A \$18.75	19AP4 \$23.95	19DP4
12LP4	16EP4 \$19.45	19DP4	or A \$23.50
or A \$13.95	16GP4 \$19.25	19FP4 \$24.25	20CP4
12QP4 \$13.95	16HP4	or A \$24.50	or A \$24.50
12JP4 \$13.25	or A \$18.75	21AP4 \$27.95	21EP4A \$27.50
12UP4 \$14.95	16JP4	21FP4 \$28.25	21YP4 \$28.25
14BP4	or A \$18.75	24AP4 \$44.95	
or A \$15.95	16LP4		
14CP4 \$15.95	or A \$18.75		
15DP4 (for Du- mont) \$17.95	16KP4 \$18.50		
16AP4	16RP4 \$18.50		
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0D3/VR150 .90	6A84 .45	6SJ7 .43	12SL7GT .59	12SN7GT .53	12SQ7 .35	12V6GT .44	12X4 .35
0Z4 .44	6AC7 .65	6SK7 .44	12Y6GT .44	14A7 .39	14B6 .49	14C6 .59	14E6 .59
1A4P .30	6AF4 .85	6SL7GT .53	14F8 .49	14N7 .49	14P8 .44	14R8 .49	14T8 .49
1A7GT .45	6AG5 .50	6SN7GT .53	14Y6GT .44	15A6 .49	15B6 .49	15C6 .49	15D6 .49
1A2 .65	6AG7 .75	6SQ7 .37	15E6 .49	15F6 .49	15G6 .49	15H6 .49	15I6 .49
1B3GT .65	6AH4GT .65	6S7 .43	15J6 .49	15K6 .49	15L6 .49	15M6 .49	15N6 .49
1B4P .90	6AH6 .65	6TA .89	15O6 .49	15P6 .49	15Q6 .49	15R6 .49	15S6 .49
1C5GT .45	6AK5 .57	6TB .65	15T6 .49	15U6 .49	15V6 .49	15W6 .49	15X6 .49
1D5GP .40	6AL5 .38	6U8 .73	15Y6 .49	16A6 .49	16B6 .49	16C6 .49	16D6 .49
1E7GT .40	6AN4 1.25	6V3 .77	16E6 .49	16F6 .49	16G6 .49	16H6 .49	16I6 .49
1E8GT .40	6AN8 .99	6V6GT .44	16J6 .49	16K6 .49	16L6 .49	16M6 .49	16N6 .49
1H4G .35	6AQ5 .45	6W4GT .55	16O6 .49	16P6 .49	16Q6 .49	16R6 .49	16S6 .49
1H5GT .45	6AS6 1.50	6W6GT .55	16T6 .49	16U6 .49	16V6 .49	16W6 .49	16X6 .49
1L4 .47	6AT6 .36	6X4 .35	16Y6 .49	17A6 .49	17B6 .49	17C6 .49	17D6 .49
1L6 .55	6AU4GT .70	6X5GT .35	17E6 .49	17F6 .49	17G6 .49	17H6 .49	17I6 .49
1LA4 .55	6AU5GT .60	6X8 .75	17J6 .49	17K6 .49	17L6 .49	17M6 .49	17N6 .49
1LA6 .55	6AU6 .40	6Y6G .49	17O6 .49	17P6 .49	17Q6 .49	17R6 .49	17S6 .49
1LB4 .55	6AU7 .85	7A4 .44	17T6 .49	17U6 .49	17V6 .49	17W6 .49	17X6 .49
1LC6 .51	6AV5GT .65	7A5 .53	17Y6 .49	18A6 .49	18B6 .49	18C6 .49	18D6 .49
1LH4 .55	6AV6 .36	7A6 .44	18E6 .49	18F6 .49	18G6 .49	18H6 .49	18I6 .49
1LN5 .51	6AX4GT .65	7A7 .44	18J6 .49	18K6 .49	18L6 .49	18M6 .49	18N6 .49
1NS6GT .53	6AX5GT .59	7B4 .43	18O6 .49	18P6 .49	18Q6 .49	18R6 .49	18S6 .49
1R5 .58	6B8 .75	7B5 .40	18T6 .49	18U6 .49	18V6 .49	18W6 .49	18X6 .49
1S5 .41	6BA6 .45	7B6 .44	18Y6 .49	19A6 .49	19B6 .49	19C6 .49	19D6 .49
1T4 .49	6BA7 .55	7B7 .44	19E6 .49	19F6 .49	19G6 .49	19H6 .49	19I6 .49
1T5GT .57	6BC5 .50	7B8 .44	19J6 .49	19K6 .49	19L6 .49	19M6 .49	19N6 .49
1U4 .55	6BE6 .46	7C4 .44	19O6 .49	19P6 .49	19Q6 .49	19R6 .49	19S6 .49
1U5 .41	6BF5 .42	7C5 .44	19T6 .49	19U6 .49	19V6 .49	19W6 .49	19X6 .49
1V2 .63	6BG6G 1.10	7C6 .44	19Y6 .49	20A6 .49	20B6 .49	20C6 .49	20D6 .49
1X2 .65	6BH6 .52	7E5 .59	20E6 .49	20F6 .49	20G6 .49	20H6 .49	20I6 .49
1X7 .50	6BJ6 .49	7F7 .59	20J6 .49	20K6 .49	20L6 .49	20M6 .49	20N6 .49
2X2A .55	6BK5 .65	7F8 .69	20O6 .49	20P6 .49	20Q6 .49	20R6 .49	20S6 .49
3A4 .55	6BK7 .75	7H7 .69	20T6 .49	20U6 .49	20V6 .49	20W6 .49	20X6 .49
3A5 .55	6BL7GT .69	7J7 .69	20Y6 .49	21A6 .49	21B6 .49	21C6 .49	21D6 .49
3AL5 .48	6BN6 .60	7K7 .69	21E6 .49	21F6 .49	21G6 .49	21H6 .49	21I6 .49
3AU6 .48	6BQ6GT .75	7N7 .54	21J6 .49	21K6 .49	21L6 .49	21M6 .49	21N6 .49
3BC5 .56	6BQ7 .80	7X7 .69	21O6 .49	21P6 .49	21Q6 .49	21R6 .49	21S6 .49
3BN6 .65	6BY5G .60	7Y4 .39	21T6 .49	21U6 .49	21V6 .49	21W6 .49	21X6 .49
3CB6 .56	6BZ7 .80	7Z4 .39	21Y6 .49	22A6 .49	22B6 .49	22C6 .49	22D6 .49
3Q4 .45	6C4 .35	12AT6 .38	22E6 .49	22F6 .49	22G6 .49	22H6 .49	22I6 .49
3Q5GT .55	6CB6 .50	12A7 .65	22J6 .49	22K6 .49	22L6 .49	22M6 .49	22N6 .49
3S4 .52	6CD6G 1.10	12AU6 .42	22O6 .49	22P6 .49	22Q6 .49	22R6 .49	22S6 .49
3V4 .52	6CU6 .90	12AU7 .52	22T6 .49	22U6 .49	22V6 .49	22W6 .49	22X6 .49
4BQ7 .92	6D6 .45	12AV6 .38	22Y6 .49	23A6 .49	23B6 .49	23C6 .49	23D6 .49
4BZ7 .97	6F6 .40	12AV7 .73	23E6 .49	23F6 .49	23G6 .49	23H6 .49	23I6 .49
5AQ5 .52	6H6 .42	12AX4GT .67	23J6 .49	23K6 .49	23L6 .49	23M6 .49	23N6 .49
5J6 .60	6J4 1.50	12AX7 .69	23O6 .49	23P6 .49	23Q6 .49	23R6 .49	23S6 .49
5U4G .45	6J5 .38	12A27 .65	23T6 .49	23U6 .49	23V6 .49	23W6 .49	23X6 .49
5U8 .68	6J6 .50	12B4 .65	23Y6 .49	24A6 .49	24B6 .49	24C6 .49	24D6 .49
5Y4G .56	6K6GT .36	12BA6 .45	24E6 .49	24F6 .49	24G6 .49	24H6 .49	24I6 .49
5V6GT .52	6L6 .65	12BA7 .59	24J6 .49	24K6 .49	24L6 .49	24M6 .49	24N6 .49
5X8 .78	658GT .74	12BE6 .45	24O6 .49	24P6 .49	24Q6 .49	24R6 .49	24S6 .49
5Y3 .29	6SA7 .44	12BH7 .59	24T6 .49	24U6 .49	24V6 .49	24W6 .49	24X6 .49
5Y4G .35	6SC7 .50	12BY7 .64	24Y6 .49	25A6 .49	25B6 .49	25C6 .49	25D6 .49
5Z3 .40	6SF5 .60	12CU6 1.09	25E6 .49	25F6 .49	25G6 .49	25H6 .49	25I6 .49

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City, Zone, State

Rinehart Books are sold by leading book stores

Connecticut has just released copies of its 1956 catalogue which this year totals some 224 pages.

A special convenience feature of this new catalogue is the front-cover listing of manufacturers and a thumb index for the rapid location of specific components.

Thousands of standard items are described and illustrated in this new publication including tubes, transistors, relays, batteries, switches, transformers, inductors, capacitors, resistors, wire, connectors, tools, testers, amateur equipment, hi-fi gear of all types, p.a. equipment, and books. A main index is also included.

HEATHKITS FOR 1956

A comprehensive listing of test instruments, amateur equipment, and high-fidelity gear—all available in kit form—is contained in the new and colorful 52-page brochure recently released by *Heath Company*, Benton Harbor, Michigan.

Entitled "Heathkits for 1956," the booklet describes each item in the firm's line in careful detail and includes not only electrical and mechanical specifications on each unit but gives physical dimensions and shipping weights along with prices and other pertinent details.

A copy of this new publication, which includes order blanks and information for ordering and figuring shipping charges, will be sent without charge upon request.

RCA AMPLIFIER DATA

The Engineering Products Division, *Radio Corporation of America*, Camden 2, New Jersey has made available catalogue sheets which describe its newly designed 30- and 15-watt power amplifiers.

Catalogue S.3027 covers the MI-12154 30-watt amplifier which features four mike inputs and one phono input. S.3026 deals with the MI-12155 30-watt unit which has two mike inputs and one phono input.

The third data sheet, S.3023, covers the MI-12156 15-watt unit with two mike and one phono inputs. These catalogue sheets include application and descriptive information, schematics, dimension drawings, and complete equipment specifications.

ALLIED'S HI-FI CATALOGUE

Allied Radio Corporation, 100 N. Western Avenue, Chicago 80, Illinois, has announced the publication of a new high-fidelity catalogue which combines an extensive, illustrated information section explaining high-fidelity with listings of hi-fi music systems and separate components.

Entitled "This Is High Fidelity," the 100-page booklet is written in non-technical language. Explanations of the functions of the basic units of a home hi-fi music system are also included.

Music systems to meet all budgets and tastes are listed in the booklet as "packaged systems" and, in addition, a

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Want Edison Tin-foil, Treadle, and Water-Power models. (Do NOT want any Edisons made after 1900)

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wide assortment of the more elaborate individual components are described and illustrated in detail.

Copies of this new catalogue are available without charge on request.

"HI-FI LIBRARY"

Of interest to audiophiles who enjoy building their own equipment is the "High-Fidelity Library" being offered by Chicago Standard Transformer Corporation, Addison Street & Elston Avenue, Chicago 18, Illinois.

Construction information on three popular high-fidelity amplifiers is included in the "Library." Details for building the 8-watt *Stancor-Williamson*, the 25-watt *Stancor-Williamson* "Ultra-Linear," and the 100-watt *Chicago* "Super-Range" amplifiers are given.

The publication includes performance curves, schematics, parts lists, chassis layout diagrams, and other useful construction data for these amplifiers. Copies of the "Library" are available without charge.

PULSE TRANSFORMERS

Aladdin Radio Industries, Inc., 709 Murfreesboro Road, Nashville 2, Tennessee, is currently offering a copy of its Bulletin 10A80, which describes in detail the firm's new line of miniature pulse transformers housed in porcelain ferrite sleeves.

The bulletin explains the construction of these units and cites the advantages of this type of assembly. Application engineering notes for the various applications of these devices are also included along with circuit diagrams and other pertinent data.

RETMA SERVICES

Publication of a booklet detailing the membership services and activities of the organization has been announced by the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C.

Within the seven chapters of "RETMA Membership Services and Activities" are outlined the various functions of the organization and a number of its accomplishments on behalf of the industry. Chapters also summarize the growth of the Association in line with industry requirements and explains the procedure whereby a company may become an RETMA member.

The services provided to the industry by the five RETMA departments are detailed along with a discussion of the benefits to be derived from RETMA member-service publications and the Association's public relations activities.

HARMAN-KARDON CATALOGUE

Harman-Kardon, Inc., of Westbury, Long Island, New York, is now offering copies of its new 17-page, full-color catalogue containing information on its complete line of high-fidelity equipment.

Profusely illustrated, each unit is pictured in an appropriate setting with

COMMAND ARC-5 TRANSMITTER BC-458



Brand New.... \$495
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Command Equipment (274N-ARC5, ATA)

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7-9.1 MC		3.95	5.95
100-156 Modulation		14.95	
BC 456 Modulator		2.95	4.95
MD 7 Modulator			7.95

LORAN EQUIPMENT

Marine or Airborne Long Range Navigational equipment! Determine the exact geographic position of your boat or airplane!
AN/APN4 Loran set. Frequency range 1700-3000 KC, complete with TDGB/APN4 indicator, 30B/APN4 receiver, crystal and plugs.
Complete Brand New.....\$129.50
AN/APN-9 Brand New.....\$295.00
(Quantity prices available—write)
R-24/ARCS—Broadcast Receiver—520 to 1500 KC. broadcast band. 6 tubes: 3-12SK7, 12SK7, 12A6, 12K8, for dynamometer operation. Easily converted to 110 volt or 32 volt use. Two IF stages, 3-gang tuning cond. Brand new in sealed carton with tubes and instruction manual, less dynamometer.
Exc. New.....\$14.95
New.....\$19.95

MN-26-C Remote Controlled Navigational Receiver. Manual DF in any one of three frequency bands. 150 to 1500 KC. 24V. Self contained dynamometer supply. Complete installation, including receiver, control box, loop, azimuth control. Left-Right Indicator, plugs, loop transmission line and flex. shafts, oper. & main manual. Ideal for use in boats, etc.
BRAND NEW.....\$39.50
MN-20-E Loop. Brand New.....4.95
MN-52 Crank Drive. New.....2.50
MN-26-C as is for parts.....6.95
MN-26-C Revs. New.....12.95
MN-28-C Control Box for above.....6.95
New.....ea.

\$4500 HI-FI Headset for only \$4.95

Uses annular grooved plastic fiber cones with voice coils as in speakers and padded chamois earmuffs to obtain spacing for correct acoustical load.
Gives finest music reproduction. 600 ohms. Checked out.
Exc. w/earpads.....each 4.95

Radio Receiver 11-tube UHF tunable 234-258 MC receiver with schematic.
Complete with tubes 3 ea. of 6AK5, 7 ea. of 9001, 1 ea. of 12A6. Like new. \$6.00
Less Tubes.....\$2.95—2 for \$5.95

3" dual scale panel-meter. 0-1 MA movement calibrated. 0-1 KV and 0-10 MA.
Used—\$1.95 ea. New—\$2.95 ea.

A Sweet Oscilloscope Deal

INDICATOR UNIT. For conversion to test scope, panadapter, analyzer, etc. Double deck chassis. 5CP1 mounted in tube shield. Less small tubes and crystal, but complete with 5CP1.
Exc. cond.....each \$9.95

25 watt phone—CW 5 tube transmitter. Frequency range 2-9 MC. Two 815 tubes in circuit. One as modulator and one as RF output. Ideal for C. A. P., Mobile. Excellent condition, with tubes. Less TU's.
Wt. 24 lbs.....\$9.95

BC442—Antenna

Relay Unit complete with 50 MMF 5 AMP CONDENSER. New.....\$3.95 ea.
Less Condenser.....\$1.95 ea.

MP-28 modulation & power supply for the TA-12 transmitter. Complete with 4 tubes. Dynamometer has an output of 540 V. DC @ 450 ma. Input at 28 V. DC.
With dynamometer.....\$14.95

HS-23 Hi-Imp headphones—Used, exc. ea. \$2.95
TS-F1 Handset—Excellent Model.....\$2.49
TS-9 Handset—Complete with cord & Butterfly switch. Brand New Original Cartons.....\$6.95
10 for.....\$60.00
T-26 Mobile Chest Mike. Brand new.....\$1.29
TU26—Excellent.....\$1.95

BC-375 XMITTERS

200 to 500 KC., 1500 to 12500 KC., using plug-in units. 100 Watts. Voice and C.W. Complete with tubes. Less tuning unit. Used.
exc. cond.....\$14.95

12 V. DC DYNAMOTOR For Ham-mobile, Mobile PA Systems, Marine X'mttrs., Etc. Output 625 V. DC at 225 ma. These Dynamotors are NEW-UNUSED, Sig. Corp. Type DM-35, and ruggedly designed for long service. Ideally suited for application in portable or mobile transmitters, sound systems, etc. Incorporates mtz. plate and condenser. Dim.: 8" long x 4 1/2" deep x 4" high. Shpg. wt. 17 lbs. PRICED REAL LOW for New Material.....New \$12.45
Used.....8.45
SAME DYNO AS ABOVE EXCEPT 28V DC Input.....Used 4.95

BC 906 Cavity type freq. meter. 144 mc to 235 mc. Complete with antenna and operating manual—Brand new—Orig. factory pack.....\$14.95 ea.

SURPRISE PACKAGE

20 lbs. of MISCELLANEOUS ELECTRONIC EQUIPMENT—WORTH MUCH MORE than this low price of ONLY.....\$1.95

RG-8/U—COAXIAL CABLE—52 ohms, 50 ft. lengths with connectors, each end.....\$2.95

OIL FILLED CAPACITORS

All from 600 to 1000 volts. 2 mfd at 1000 VDC. 4 mfd at 600 VDC. 4—4 mfd at 600 VDC. 8 mfd at 600 VDC. 12 mfd at 600 VDC. 20 mfd at 600 VDC, plus others.
10 for.....\$5.95

LEEDS NORTHRUP

Variable self inductance coil, 55 to 460 MH P/M 10MH. Brand New.....\$24.95

DYNAMOTORS

Type	Input	Output	Used	New
BD-83	12 VDC	375-150 MA.	\$1.95	\$4.95
DM-35	12 VDC	625 VDC 225 MA	9.95	12.95
DM-37	24 VDC	625 VDC 225 MA	6.95	9.95
DM-64	12 VDC	275 VDC 150 MA	3.95	5.95
DM-34	12 VDC	220V 80 MA.	2.95	4.95

MOBILE HEAVY DUTY DYNAMOTOR: 14 V. INPUT-output: 1030 VDC 260 MA. Tapped 515 V. 215 MA. use or 6 V DC INPUT-500 V. 175 MA. While they last—DM-42—Excel. Condition. \$4.95
Brand New.....\$9.95

METER—3"-0-5 Ma. 270° Indication—By Pass Shunt and add scale. Excellent Condition. 95c
6 for.....\$5.00

BRAND NEW

10 tubes for \$2.50

Includes, 316A, 211, 801, 6C4, 6SK7GT, 954, 955, 957, 9006, 6SH7, 1629, 1625, 1626.

5CP1 3BP1 { \$2.95 ea.
5BP1 3CP1 { 4 for \$10.00
5AP1

LARGE CHAMOIS EAR CUSHIONS

For your headphones—brand new.....\$1.49

APG 5 or 15 CAVITY

10 Cm. 2C43 osc Xmitter, 2C40 Loc. Osc. Rec. 1B27 TR; tubes 2400 to 3000 MCS, less tubes.
Price.....\$4.95

BEACON RECEIVER BC-1206-C

Complete with 5 tubes. Tubes 195 KC to 420 KC. IF Frequency—135 KC. Receiver Sensitivity—3 Microvolts for 10 Milliwatts output. Output Impedance—300 Ohms and 4000 Ohms. Volume Control—RF Gain Control. Power Supply—24-28 Volts Aeroplane Battery, Current—7.5 Amperes.
BRAND NEW, with Tubes.....\$9.95

FM WOBULATOR CAPACITOR

Frequency modulation unit with a permanent magnetic field and a moving coil mechanism driving a metal diaphragm supported at its rim. This diaphragm acts as a moving plate of the frequency modulator capacitor. W/instructions, build TV sweep sig. gen. BRAND NEW.....\$2.75
2 for only.....\$4.95

AN/APR5A—Airborne superhet radar search rec. Freq. range 1000 to 6100 MC. Rec. has a 10 MC IF band width operating from 80/115V AC, single phase 60 to 2600 cps. and one amp. at 26V DC—complete with.....\$250.00

Lavoie VHF 2-Tube battery operated portable frequency meter, designed to measure frequencies from 300-600 MC. This unit is used for variety of measurements on VHF circuits. Unit has a 0-200 microamp meter, time switch. All in metal carrying case, with modulation, Excellent.....\$14.95

RA-10DA Compass and Communication Receiver—Frequency range: 150-1100 KC; 2.0-10.0 MC. Complete with tubes, dynamometer and control box, New.....\$49.50

CRYSTAL—100 KC......\$2.95

CRYSTALS: Ft-241; FT-243; DC-34; DC-35; 100 assorted.....per kit \$9.95

MG-149F—110V AC, 400 cycle-750 VA Inverter, Used.....each \$9.95

WRITE FOR NEW BULLETIN AND PRICES.

ALL ITEMS F.O.B. CHICAGO

25% Deposit required with orders

R W ELECTRONICS

Dept. N, 2430 S. Michigan Ave., Chicago 16, Ill.
PHONE: CALumet 5-1281-2-3

HERSHEL SPECIALS

All New MYSTERY PACKAGE
of ELECTRONIC PARTS

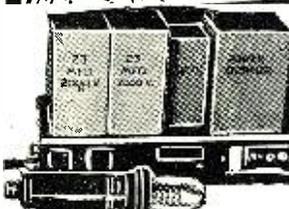
Worth \$40.00
Our Price **\$395**
Ship. Wt. 20 lbs.

IT'S the surprise of your life! 20 pounds of BRAND NEW usable Govt. surplus. The ideal gift for hams, etc.

BRAND NEW Electronic PHOTO FLASH

100 Watt Sec. Ship. Wt. 60 lbs.

\$29.95



Operates on any 12 or 24 VDC source. Complete with ignition coil, trigger, housing and strobe light. Assembly includes 20' cord, with SYLVANIA A-1073 200 Watt Bulb (Similar to Sylvania 4330) Extra parts Kit has Extra 1073 bulb, fuses, vibrator. Instruction Manual.

ARC-5 COMMAND TRANSMITTER

YOUR CHOICE **\$6.95**

2.1 to 3 MC. 7 to 9 MC. Brand New in Cartons. with tubes.

HOTTEST BUY IN THE COUNTRY



OIL CONDENSER \$1.65

2 MFD. 300 VDC. Pyranol Oil W/ mounting Brackets 1-1 Mfd. 3000 VDC. New removed from equip. Size 4 3/4" x 1 1/4" x 2 1/2"



PHOTO ELECTRIC CELL 95¢

CE Vacuum Cell used in AMPRO Sound Projector. Also useful for opening garage doors and Alarm Systems.



GE Pyranol Oil CONDENSER 95¢

12 MFD. 330 VAC. 60 Cy. Removed from Equip. NEW



Modulation & Driver Transformer BRAND NEW BOTH UNITS ONLY

Modulation trans. 815 class AB2 56 Watt output. Driver 6SN7 to Modulator... **\$4.95**



RCA OUTPUT TRANSFORMER P.P. 6L6's 25 WATTS. PRI. 5000 ohms - output SEC. = 1 500 ohms 2 600 ohms. Sidetone 15 to 15,000 cy. flat. \$1.95



SWING CHOKE 2H-7H 550 MA THORPARSON \$5.95 T48003.



HI GAIN DYNAMIC MIKE KIT

Uses UTC transformer & Western Electric Mike. Ideal for Hams, PA., CAP. Recording Mobile Equip. 250 to 60 to 7500 CPS. Diagram Furnished **\$1.95**



KIT 1. HARDWARE

Over 1,000 pcs. Assorted. For Radio & TV **99¢**



KIT 7. TOGGLE AND SLIDE SWITCHES

23 Assorted D.P.S.T. - D.P.D.T. S.P.S.T., etc. **\$3.25**



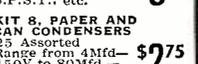
KIT 2. CERAMICONS

100 Assorted 75 mmfd. to 6,000 mmfd. **\$2.50**



KIT 8. PAPER AND CAN CONDENSERS

25 Assorted Range from 4Mfd - 120V to 50Mfd. - 450V. **\$2.75**



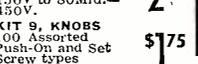
KIT 4. Rotary Switches

25 Assorted Terrific Buy! **\$2.50**



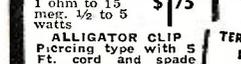
KIT 9. KNOBS

100 Assorted Push-On and Set Screw types **\$1.75**



KIT 5. RESISTORS

100 Assorted 1 ohm to 15 meg. 1/2 to 5 watts **\$1.75**



TERMS: Cash with order or 25% DOWN - BALANCE C.O.D. ALL PRICES NET F.O.B. DETROIT MINIMUM ORDER \$2.00

HERSHEL RADIO CO. 3240 GRAND RIVER Detroit 8, Michigan Phone TYler 8-9400

CODE SENDING SPEED

Be a "key" man. Learn how to send and receive messages in code by telegraph and radio. Commerce needs thousands of men for jobs. Good pay, adventure, interesting work. Learn at home quickly through famous Candler System. Quality for Amateur or Commercial License. Write for FREE BOOK. CANDLER SYSTEM CO. Dept. 2-B, Box 625, Denver 1, Colo., U.S.A.



NOW IN STOCK at TV PARTS, INC.

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EICO

COLOR & BLACK & WHITE 5" - 5 MC SCOPE

KIT \$79.95 Wired \$129.50



brief specifications and descriptive highlights of one particular aspect or feature which makes it a high-fidelity instrument.

Copies of this new catalogue may be obtained from the manufacturer or from hi-fi dealers throughout the country.

COMMUNICATIONS ANTENNAS

Ward Products Corp., Ashtabula, Ohio, has available a new two-color catalogue which lists the firm's line of communications antennas for mobile and amateur radio applications.

The catalogue, Form 54-295, is available either from the company's representatives and distributors throughout the country or from the company direct.

WESTON TEST EQUIPMENT

Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey, has announced publication of a new catalogue which illustrates and describes the firm's complete line of test equipment.

Catalogue R36A includes all instruments for servicing TV, radio, and other communications equipment, as well as all industrial electronic and electrical equipment. The publication also describes the company's simplified method of visual alignment, an accurate and money-saving procedure for servicing TV receivers.

PATENT TIPS

C. G. S. Laboratories, Inc., 391 Ludlow Street, Stamford, Connecticut, has issued a new booklet as a public service to the engineering profession.

The booklet, entitled "Preparing for Patent-Hood," details the nature of an invention and the various steps necessary in processing a patent application. The booklet was prepared by Elton T. Barrett, president of the company, who for many years was a practicing attorney in New York before assuming his present executive position.

Engineers are invited to write for a copy of this little handbook which will be sent free of charge.

"NEOMATIC" RELAYS

A new brochure illustrating a line of rugged, subminiature relays designed for a wide variety of precision applications has been issued by Elgin-Neomatic, Inc., 2435 North Naomi Street, Burbank, California.

The brochure includes the company's "neomite," world's smallest precision relay, the first built in a standard transistor case for transistorized circuitry. Also featured are the VK and VR series, lightweight compact units with good vibration resistance due to counterbalanced armature design.

RCA TUBE MANUAL

A revised and enlarged edition of the "RCA Receiving Tube Manual RC-17" is now available from the Tube Division of Radio Corporation of America, Harrison, New Jersey.

Material in this new 336-page edition has been augmented to keep abreast of the technological advances in electronic fields. One of the features is a 26-page supplement covering 51 newly added tube types including types developed especially for use in TV receiver circuits.

The revised edition is now available through RCA tube distributors or from the Commercial Engineering Section of the Tube Division. The price is 60 cents a copy.

STANDARD CIRCUIT MODULES

Aerovox Corporation's Module Division, 1200 Jefferson Davis Highway, Arlington, Virginia, has just issued a comprehensive bulletin entitled "Modulized Standard Circuits," which will be of interest to the engineering fraternity.

This new publication illustrates and describes modules for video limiter, low-level cathode follower, common cathode mixer or dual-cathode follower, cascade intermediate video amplifier, triode video driver amplifier, PRF multivibrator, and d.c. regulator plus or minus 300 volt circuits.

This bulletin is available to those in professional radio-electronics who write on business letterheads.

SUN'S 1956 CATALOGUE

Sun Radio & Electronics Co., Inc., 650 Sixth Avenue, New York 11, New York, is now making copies of its 1956 catalogue available to industrial users, schools, laboratories, government bureaus, AM-FM and TV broadcasters, and the armed forces.

Catalogue 56 contains 144 pages of useful information of interest to procurement and engineering personnel engaged in electronic design and production. The publication has been designed for quick, easy use. A triple index system enables the user to locate any part by manufacturer, specific product, or general category. To avoid confusion, original manufacturers' part numbers are used in most cases to identify the product.

A 60-page supplement to this general catalogue will be published at a later date. The catalogue is available without charge to those writing on their business letterheads.

SHURE BROCHURE

For music lovers interested in high-fidelity reproduction, Shure Brothers, Inc., 225 West Huron Street, Chicago 10, Illinois, is now offering an attractive, informative, and analytical brochure on its new "Music Lovers" phonograph pickup cartridge.

The booklet explains the function and importance of the phono pickup cartridge in a hi-fi system, the potentialities of barium titanate cartridges for hi-fi reproduction, and then goes on to describe the cartridge including a typical installation, the unique needle-shift design, and the simple method of replacing needles.

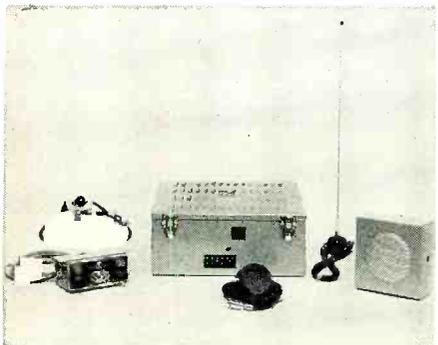
Copies of the booklet are available without charge.

What's New in Radio

"AIRPORT CONTROLLER"

Communications Company, Inc., 300 Greco Avenue, Coral Gables, Florida has announced the availability of its new Model 278-6/12 airport "Controller."

This latest model in the 278 series of equipment designed especially for



airport vehicles and ground stations, features a v.h.f.-AM two-way radio unit for use in ramp jeeps, electricians' trucks, crash trucks, tow tractors, snow plows, executive cars,

police cars, and other airport vehicles. The radio unit can be moved from a 6 to a 12 volt vehicle without any change in the equipment itself. All the changing is done by a heavy-duty female type plug which is permanently installed in the vehicle.

The equipment is powered by a heavy-duty, long-life vibrator power supply which completely eliminates the need for a dynamotor and permits a low standby battery drain of only 8 amperes on 6 volt operation.

For full technical specifications on this equipment, write the company for a copy of its catalogue sheet.

HIGH-TEMPERATURE RECTIFIERS

The Rectifier Division of *Sarkes Tarzian Inc.*, 415 North College Ave., Bloomington, Indiana has announced the development of a new series of high-temperature selenium rectifiers which will operate at cell temperatures of 150 degrees C.

A wide variety of sizes and operating characteristics is currently available in the new line. Complete specifications are available from the company on request.

TV SIGNAL GENERATOR

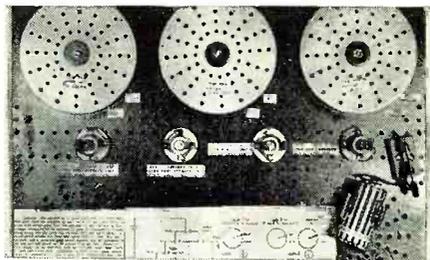
Electronic Measurements Corporation, 280 Lafayette Street, New York 12, New York has developed a new signal generator for color and monochrome servicing, the *EMC Model 800*.

Combined in one compact, easy-to-use instrument are all the servicing

(Continued on page 172)

ELECTRIC BRAIN KIT

Can you think faster than this Machine?



Control Panel of GENIAC set up to do a problem in check valve research.

Be careful before you answer. GENIAC the first electrical brain construction kit is equipped to play tic-tac-toe, cipher and encipher codes, convert from binary to decimal, reason (in syllogisms) as well as add, subtract, multiply and divide. Specific problems in a variety of fields—actuarial, policy claim settlement, physics, etc., can be set up and solved with the components. Connections are solderless and are completely explained with templates in the manual. This covers 33 circuits and shows how new ones can be designed.

You will find building and using GENIACS a wonderful experience. One kit user wrote us: "This kit has opened up a new world of thinking to me." You actually see how computing, problem solving, and game play (Tic-tac-toe, nim, etc.) can be analyzed with Boolean Algebra and the algebraic solutions transformed directly into circuit diagrams. You create from over 400 specially designed and manufactured components a machine that solves problems faster than you can express them.

Schools and colleges, teachers of science or math, engineering, philosophy or psychology will find these excellent demonstrators of circuitry, solutions in symbolic logic, theory of numbers, cybernetics, and automation.

Note: Teachers take advantage of our 10% discount to educational institutions and for group purchases.

SEND for your GENIAC kit now. Only \$19.95 with over four hundred components and parts, fully illustrated manual and wiring diagrams. We guarantee that if you do not want to keep GENIAC after one week you can return it for full refund plus shipping costs.

MAIL THIS COUPON

SCIENCE KITS, Dept. RT-24, Oliver Garfield Co.
126 Lexington Ave., N.Y. 16, N.Y.

Please send me:

1 GENIAC Electric Brain Construction Kit and Manual.

\$19.95 (East of Mississippi)

\$20.95 (Elsewhere in United States)

\$21.95 (Outside the United States)

Returnable in seven days for full refund if not satisfied. I

enclose \$..... in full payment. My name and address are attached.

SAVE!

BIG MONEY AT STANLEY

PARTS &

TUBES

INTRODUCING Stanley's Sensational Coupon Premium Offer!

For every dollar you spend for parts or tubes you'll receive a coupon redeemable for FREE gifts! These gifts include electrical appliances, etc.! Use them or sell them over the counter.

TERMS: 25% deposit required on all orders, balance C.O.D. Save C.O.D. charges, send full remittance plus postage with order. All unused money refunded with order. NO MINIMUM ORDER.

Stanley ELECTRONICS CORP.

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• 900,000 RADIO & TV TUBES		• INDIVIDUALLY BOXED		• ONE YEAR RTMA GUARANTEE		• BEST BRANDS AVAILABLE		• SAME DAY SERVICE	
TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
024	.45	31F4	.69	GAUG	.43	6F6	.40	6X4	.35
183GT	.79	304A	.55	6AV5GT	.75	6H6GT	.40	6X5	.39
11L4	.51	305GT	.63	6AX5GT	.59	6J4	2.00	6X5GT	.35
11L6	.51	3V4	.58	6B4E	.49	6B4E	.49	6Y6	.60
11A4	.57	5T4	.70	6BA6	.49	6J6	.49	6Y6G	.60
11B4	.66	5U4G	.49	6BE6	.50	6J7	.45	7A4	.47
11C6	.66	5V4G	.49	6BE6	.46	6K6GT	.39	7A5	.47
11D5	.57	5Y3GT	.49	6B6GG	1.18	6K7	.40	7A6	.50
11E3	.57	5Y4G	.43	6BH6	.53	6L7	.44	7A7	.45
11G5	.57	5Z5	.58	6BJ6	.49	6N7	.50	7B8	.46
11M4	.66	5Z4	.54	6BK5	.70	6Q7	.45	7B5	.41
11N5	.47	6A7	.59	6BK7A	.78	6S4	.48	7B7	.43
11S5	.57	6B8	.59	6BN5	.59	6S7	.43	7C5	.44
1R4	.66	6AB4	.45	6BL7GT	.77	6S4GT	.50	7C4	.40
1R5	.51	6AG4	.80	6BQ6GT	.80	6SC7	.50	7C5	.44
1S4	.59	6AG5	.52	6BQ7A	.80	6S7	.43	7C5	.44
1S5	.51	6AH6	.80	6BZ7	.90	6SH7	.45	7F8	.70
1T4	.50	6AK5	.80	6BYS6	.60	6S17GT	.45	7Y4	.35
1U5	.57	6AL5	.42	6C4	.39	6T6	.50	12A76	.68
1V	.50	6AL7GT	.70	6C5	.36	6L7GT	.70	12A77	.68
1X2A	.62	6AS5	2.00	6C6	.50	6S7GT	.57	12A8	.46
20Z1	1.00	6AS6	2.00	6C6G	.51	6S8GT	.44	12A8	.46
2V3G	.80	6AS7G	2.25	6C6GG	1.18	6V6GT	.48	12A8	.46
2X2A	.90	6AT6	.40	6D6	.50	6W4GT	.40	12AX7	.60
30E	.45	6A5GT	.70	6E5	.46	6W6GT	.53	12AY7	.53
								25Z5	.42
								25Z6GT	.42
								28A5	.70
								28B6	.46
								28C7	.48
								28D7	.64
								28E7	.52
								28F7	.47
								28G7GT	.50
								28H7	.50
								28J7GT	.60
								28K7GT	.57
								28L7GT	.40
								28M7GT	.48
								28N7GT	.48
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								28U7GT	.48
								28V7GT	.48
								28W7GT	.48
								28X7GT	.48
								28Y7GT	.48
								28Z7GT	.48

Dumont and RCA licensed CATHODE TUBES

All brand new • One year guarantee • Discounts for the Quantity Purchaser

Type	List Price	Price
10BP4	\$19.95	\$11.99
12LP4	24.25	14.99
14BP4	26.50	15.99
16AP4	44.75	19.99
16EP4	34.25	21.75
16HP4	28.35	18.99
16LP4	41.50	17.99
17BP4	32.00	19.00
17LP4	34.00	18.00
19AP4	48.75	23.00
20CP4	39.00	24.00
21AP4	47.00	22.00
21EP4	39.00	24.00
21FP4	40.75	24.00
24AP4	120.00	42.00

Write for Free TUBE and PARTS LIST. Subject to prior sale. Special purpose and transmitter tubes



Reg. \$4.95 5-pc. SYLVANIA REPAIR KIT. Inc. flashlight head, Phillips and flat head screwdrivers, alignment tool and case; with every order of \$25 or more.

Picture Tube Brightener \$1.19 ea. Lots of 3, ea. \$1.09
SAVE MORE ON SPEAKERS!

4" PM for small radios and intercoms. Lots of 10 each \$2.99
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12" Heavy Duty PM with big powerful magnet \$6.95
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AC-DC PHONO AMPLIFIER—3 TUBE Features tone and volume controls—2 watt output includes line cord and diagram. Completely wired ready to use. Uses 50B5, 35W4, 12AT6. Lots of 3 \$2.99 ea. Lots of 3 \$2.49 ea.

RESISTOR KIT 100 assorted resistors in most wanted ohms. RMA coded in 1/2, 1, 2 watt. \$1.50. Kit, ea. 99c
CHEATER CORD UL Approved Standard Lots of 10 ea. Holes. For Every Make Set. A must for every serviceman. ea. 33c 27c

FREE with \$3 order or More!

PRACTICAL ALL PURPOSE ELECTRIC TESTER Equipped with genuine GE neon glow lamp. Tests loads from 30 volts to 500 volts. AC or DC. Use it in the home, factory, shop, garage, etc.

TV ANTENNA KIT

Double Bay Conical Antenna 2-5 ft. mast sections, 60 ft. twin lead, 1 Chimney mount, 1 lightning arrester, 5 wood screw standoffs—3 1/2", 2 wood screw standoffs—5 1/2", 2 mast standoffs. 16 Elements. LIST PRICE \$21.95. \$13.50

WELLER DUAL-LITE SOLDER GUN KIT

100 watt gun provides the proper heat for most applications. Dual spot light illuminates work. Kit includes gun, wire soldering brush, soldering aid. Kester solder \$5.83

Visilite TV Tube Checker and CONTINUITY TESTER Automatically checks all tubes, tests electrical devices such as fuses, lamps, resistors. \$3.85

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TG 10 CODE KEYS

Same function as the TG34A, but larger and more audio output. Can be used as a high power audio amplifier or for group instruction of code. In a standard metal cabinet 11" x 24" x 8 1/2". Used, less tubes and photo cell. Metal cabinet alone worth the price. While they last \$9.95
 Same as above, excel., tested, with tubes. \$14.95
PRACTICE CODE TAPE for TG34A and TG10 Keys. On 16 mm 400 ft. reels, #1, #3, #5, #6, #7, #8, #11, #13, #15. New \$1.25 in metal container. Ea.

701-A TETRODE. SIMILAR TO 4-125 A 4-250 A

Diagram and Information for Amateur Use with Order

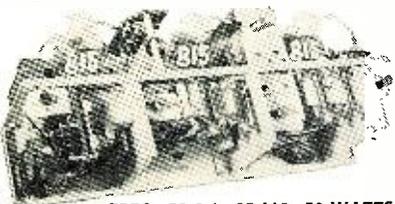
A dandy K.W. SSB final—fil: 8 V. @ 7.5 amps. plate: 3000 V. @ 200 MA, screen: 250 V. @ 50 MA. Just 10 W. to drive pair 1 K.W. A.M. phone. Max. input 600 W. per tube, class C. amplif. \$2.95 EA. 2 FOR \$5.00.

BC221 FREQUENCY METER CASE

Brand new in original carton with all contents and size the same as adv. in previous issues. But priced now at only \$2.25

BC-221 TECHNICAL MANUAL—NEW, Prepaid \$1.25

A REAL SCOOP—6 METER TRANSMITTER



FREQ. 53.3 to 95 MC. 50 WATTS

Complete rf doubles and amplifier section, with 3—815 tubes. Used as xtal osc. buffer, tripler, and final. Easily converted for 2, 10, or 20 meter. Can be used to drive higher power amplifier. Wt. 10 lbs. Brand new in original carton \$13.95

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 3.6 MC BC 454 Excellent 5.95
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TRANSMITTERS
 2.1-3 MC ARC/5 Brand New 5.95
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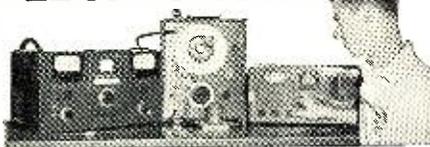
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 ANTENNA RELAY UNIT. RE-2/ARC-5. SAME AS BC-442. SWITCHING. 0-10 RP METER AND 50 MMF VACUUM CONDENSER. NEW \$3.75

NOTE 25% deposit—bal. C.O.D. or mail full price, allow for postage and save plenty on C.O.D. collection charges.

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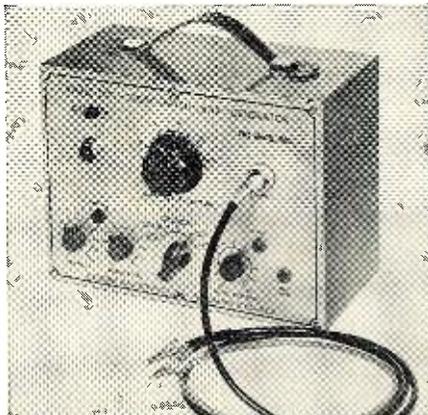


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VALPARAISO TECHNICAL INSTITUTE
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functions of a dot generator, cross-hatch generator, and bar generator. The Model 800 produces white dots on the TV screen of any monochrome or color receiver for the adjustment of color convergence of the tri-gun color tube. It will also produce a cross-hatch pattern and a variable number of bars for the adjustment of width and height controls.

The Model 800 comes completely wired and tested with all the neces-



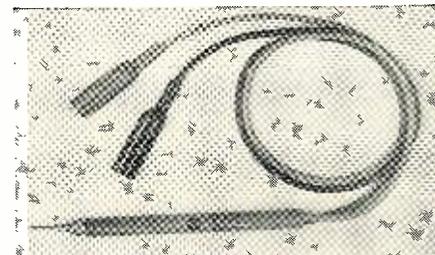
sary leads. Full technical details are available from the company on request.

"GENAPROBE"

Talley Electronic Development Company, 800 Schmidt Bldg., Cincinnati 2, Ohio has developed a compact, audio-frequency generator which is housed in a standard 3/8" x 4" instrument test probe.

Known as the "Genaprobe," the instrument is designed for technicians who need an audio generator and voltage indicator in their work. Attached to the probe are two 20" flexible rubber-covered test leads with #60 Mueller alligator clips and plastic shields. Both test leads and clip shields are color coded red and black for instant polarity indication. The tip end of the probe is equipped with a standard phone tip.

The instrument can be used in tracing circuits in radio and television receivers, record players, high-fidelity equipment, intercoms, and p.a. systems. It may also be used in produc-



tion line testing and virtually any application where an audio frequency signal, of good waveform, is required.

TUBE PIN LOCATOR

Airport Television & Radio Co., 188 Airport Road, Reno, Nevada has developed a simplified vacuum tube computer which has been tradenamed "Quick-Way Tube Pin Locator."

The new unit is claimed to be the

Since 1933



Yokes



Flybacks



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authentic replacements for Television . . .

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quickest method yet devised for determining what each tube pin signifies at the socket base. The unit operates with a simple turn of the dial which covers hundreds of tube types. When set to the correct tube number, it automatically selects all pin locations at once. Tubes covered by the computer are of the receiving type used in radio, television, amateur radio, high-fidelity amplifiers, counters, and other electronic equipment.

A new tube log is also imprinted on the computer face to eliminate obsolescence.

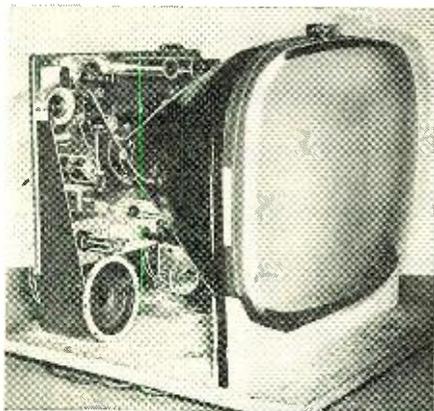
VERTICAL CHASSIS KIT

Radio Kits Inc., 120 Cedar Street, New York, N. Y., maker of radio, audio, and meter kits, has added a television kit to its line which features vertical chassis construction and a turret-type tuner.

The 12-channel tuner employs a 3BC5 r.f. amplifier and a 5U8 triode-pentode mixer oscillator. Separate oscillator frequency adjustments are provided for each channel. The tuner may be adapted for u.h.f. reception by inserting u.h.f. strips in the turret drum.

The new kit, the "Arkay" Model 14T21, offers a 21" television unit which is simple to assemble and operates from 105-125 volts, 50-60 cycles.

One unique feature of these new



kits is that the manufacturer guarantees that if instructions are followed by the assembler, the unit will operate correctly. The guarantee covers all parts. The firm maintains a service department that will service these kits in the event of trouble.

MOBILE GAIN ANTENNA

A new rooftop antenna for the 450-470 mc. range has been developed by the *Andrew Corporation*, 363 East 75th Street, Chicago 19, Illinois.

According to the company this mobile antenna effectively multiplies mobile transmitter power by 1.5 without adding cost to the mobile communication unit or increasing battery drain.

The inductive-tuned 9/16 wave radiator has 1.3 db measured gain. Use of RG-8U feed cable (optional) gives an additional .5 db measured gain, making a total effective gain of 1.8 db compared to conventional quarter-wave rooftop antenna with RG-58/U cable.

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FOR LATEST TYPE
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INTERCEPTORS.



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The new MOSLEY 4-Set TV Coupler is especially designed for metropolitan television areas . . . the major multi-set market!

A bridging type resistive circuit distributes the signal equally to each output and provides effective isolation between sets to eliminate interaction. Signal transfer is excellent due to the constant impedance design.

The MOSLEY Type 904 TV Coupler will serve in a multitude of uses. Its low cost and simplicity of installation makes it your key to greater profits!

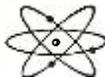
MOSLEY Type 904, 4-Set TV Coupler. . . . List Price \$6.25

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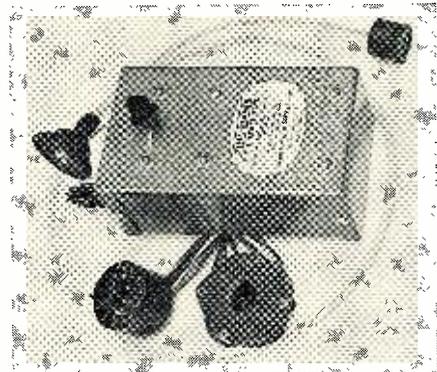
- Electronics
- Chemical
- Aeronautical
- Civil
- Mechanical
- Electrical

Name
Address

The antenna has a stainless steel radiator supported by a molded plastic insulator which mounts in a single 7/8" hole. The antenna is supplied complete with coaxial cable and connectors.

"DYNA-BEAMER"

Tampa Video Service, Inc., 6105 Interbay Boulevard, Tampa 9, Florida



is currently offering a unique CRT reactivator, the "Dyna-Beamer."

According to the manufacturer, the device restores to satisfactory service up to 75 per-cent of repairable picture tubes in the home or shop without removing the CRT from the set. In addition, the unit will clear grid to cathode shorts. It will also indicate whether "no raster" or "dim raster" is due to a bad picture tube or improper grid bias in the set.

The unit measures only 2" x 3" x 5" and will fit into most tube caddies with ease. Write the manufacturer for a data sheet on this "Dyna-Beamer." It is available without charge.

TUBE TESTER

Jackson Electrical Instrument Co., 16-18 South Patterson Blvd., Dayton 2, Ohio has developed an unusual new tube tester which features a number of plug-in accessories. These accessories may be added at any time and do not interfere with basic tube test procedures.

The "Customatic Forty-Niner" features a plug-in unit which, when wired to the basic instrument, pro-



vides connections to the various power supply voltages and meter through a ten-contact connector. The connector is plugged into the desired accessory which is then slipped into the instrument's accessory port and held in place with a quick-action, air-plane-type fastener.

Currently available accessories in-

**DYNAK T
50 WATT POWER
AMPLIFIER KIT**



✓ FINEST QUALITY

New circuit designed by David Hafler using the Dynaco A-430 output transformer, sets new performance standards both on the test bench and in listening tests.

✓ EASIEST TO ASSEMBLE

Uses pre-assembled printed circuit board and simple physical arrangement. Only 9" x 9" x 6 7/8" high without sacrifice of performance, and can be assembled in 3 hours.

✓ HIGHEST POWER

50 watts at less than 1% IM for listening ease. 100 watts peak. Full power available 20 cps to 20 kc.

✓ GREATEST VALUE

\$69.75 complete with all top quality components.

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DYNA COMPANY

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Electronic STROBOSCOPE Stops Motion; w 1021 Tube	18.95
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Adj. Time DELAY Thermal RELAY; 5-180 SEC. 15A	.50
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8uf/1KV \$1.35; 225 uf/3000V	.65
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clude a high resistance shorts tester, which measures inter-element leakage to 2 megohms, a heater current tester, and a selenium rectifier checker. Soon-to-be-made-available accessories include a signal tracer, r.f. oscillator, and a capacitor tester.

NEW GEIGER COUNTER

Nuclear Instrument and Chemical Corporation, 229 West Erie Street, Chicago 10, Illinois has added a new portable Geiger counter to its line of uranium prospecting instruments.

The Model 2612L features a sensitive Geiger probe which may be mounted in the handle of the unit or may be removed for surveying crevices, drill holes, cave walls, etc.

Three ranges cover intensities of .2, 2, and 20 mr/hr. full scale and a radium source is supplied to permit calibration of the unit at any time. A .1% uranium ore sample in a sealed container and an identical empty container permit an estimate of the per-



cent of uranium in a discovery. A carrying strap and crystal earphones are also supplied with the instrument.

RECHARGEABLE DRY CELLS

Gould-National Batteries, E-1201 First National Bank Building, St. Paul 1, Minnesota, has developed a nickel-cadmium rechargeable dry type battery which is available in various sizes from a standard "D" type cell to a very small button-type cell of 10 millimeters diameter.

The batteries are hermetically sealed and do not corrode or leak. Capacities range from 4 ampere hours to 7 milliampere hours and all have an average voltage output of 1.2 volts. Any d.c. current may be used to recharge the cells with the advantage that the cells cannot be overcharged provided the specified charging rate is used. The cells may be placed in series and parallel to provide higher voltages and capacities.

TRANSISTOR POWER PACK

The use of new circuit techniques in the design of its new Model 212-A transistor power pack has enabled *Electronic Measurements Company* of Eatontown, New Jersey to produce a unit which is only 3½" tall and weighing 14 pounds to provide from 0 to 100 volts d.c. at 100 ma.

Two approximately calibrated controls sweep 0 to 100 volts and 0 to 10 volts respectively, to permit precise adjustment from 0 to 100 volts. A modulation input is provided to per-

February, 1956

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A unique feature is the remote control connection provided whereby the



unit may be controlled from a distance by inserting resistance across a two-terminal line. Voltage is controlled according to $E_o = KR$ where K is constant and R is the inserted resistance. A typical application would be tube testing with automation.

TWO-SET COUPLER

Anchor Products Company, 2712 W. Montrose Ave., Chicago 18, Illinois is currently marketing a two-set television coupler of the high-frequency transformer type.

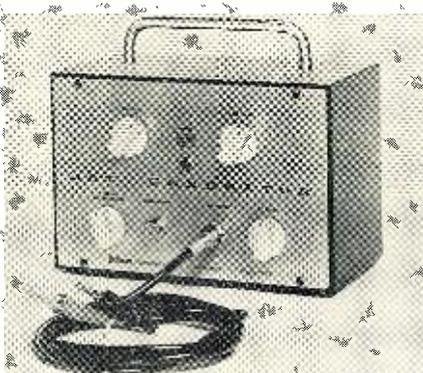
The Model C-202 coupler has a matched impedance of 300 ohms which makes possible the use of one antenna for two television sets by transferring the signal from one antenna to both sets with remarkably little signal loss. At the same time the coupler provides maximum isolation between the two sets, minimizing interference and insuring good reception.

The unit is completely insulated, with solderless connections for easy and safe installations.

DOT GENERATOR KIT

The Hoffman Radio Division of Hoffman Electronics Corporation, 3761 S. Hill Street, Los Angeles 7, California is now offering a new white dot generator in kit form.

Essential to the proper color convergence adjustment of any color receiver, the new dot generator (Model CD) has been designed for maximum ease of assembly by the service technician. Sockets and terminals are pre-riveted on the chassis to simplify assembly of the unit. Dots can be fed directly to the antenna terminals of



the color receiver, eliminating the necessity of hooking into the actual circuitry of the receiver chassis.

The unit measures 5" x 9" x 6" and weighs just 6 1/2 pounds.

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Communications Equipment Sales, Communications Equipment Department, Radio Corporation of America,



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6633 Enright • St. Louis 5, Mo.

Camden, New Jersey has developed a new style mobile radio microphone which has been especially designed to provide users with quicker, easier, more efficient two-way radio operation.

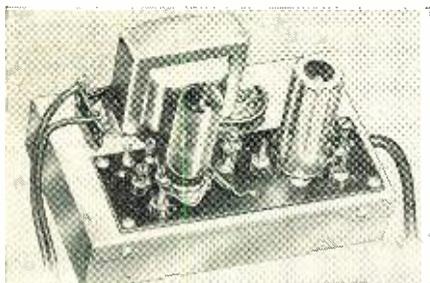
Tradenamed the "Redhead" because of its brightly colored mouthpiece, the new device was developed to meet the need for a hand-held carbon mike which nullifies the muffling effect of the hand, simplifies hand holding and hanging operations, and can be operated with equal convenience in either right or left hand.

It operates with greater output, lower distortion, and improved response over the frequency range of 200 to 3000 cps. The unit features an elongated taper handle that nestles in the palm of the hand and raises the mouthpiece well above the cupped fingers. A positive-action push-to-talk trigger bar is centered in the handle for easy operation by either hand.

SIX-METER CONVERTER

Marshall Manufacturing Co., 1406 Venice Blvd., Los Angeles 6, California has just introduced a newly-developed 6-meter converter which will enable operators to receive six meters on any standard short-wave receiver.

One of the major features of the new unit is its small size. It measures only 5" long by 3 1/4" wide by about 3 1/2" high. It features a specially de-



signed low-noise, push-pull 6J6 r.f. amplifier into a 6J6 oscillator-mixer, giving a balanced line input and coaxial output. All adjustments are slug-tuned. With an output frequency ranging from 21 to 25 mc., the unit is sold completely wired with a.c. power supply and tubes.

PC RESISTORS

Resistance Products Company, 914 S. 13th Street, Harrisburg, Pa. is in production on a line of precision wire-wound miniature resistors engineered expressly for use with printed circuits.

These new Type P resistors are single-ended units made for easy and rapid mounting on printed circuit panels with no support other than the wire leads required. The resistors can be safely operated at full rated load in ambient temperatures up to 125 degrees C. Sizes are available rated at from 1/10 watt up to 1 watt. They are being supplied in six sizes in a variety of resistance values.

Write the company for details on the units currently available in the Type P line.

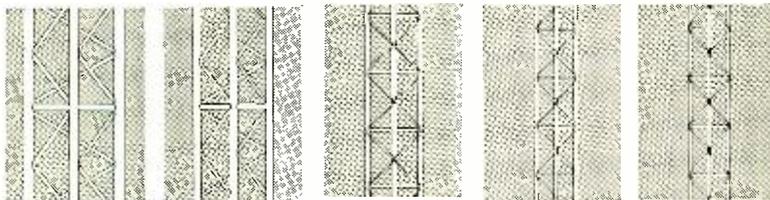
-30-

February, 1956

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Max Height	400 ft.	330 ft.	230 ft.	160 ft.	120 ft.	80 ft.
Max Guy Space	60 ft.	60 ft.	50 ft.	40 ft.	35 ft.	25 ft.
Legs	2" pipe	1 1/2" pipe	1" pipe	3/4" pipe	1/2" pipe	1/2" rod
Horizontals	1 1/4" pipe	1" pipe	3/4" pipe	1/2" rod	1/2" rod	3/8" rod
Diagonals	3/4" pipe	1/2" pipe	3/8" rod	5/16" rod	5/16" rod	1/4" rod

When maximum height and guy spacing are not exceeded, towers are rated for 40 lb. wind load.

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When writing for catalog, specify height of tower and type of antenna (make and model) you intend to use.

E-Z WAY TOWERS INC.

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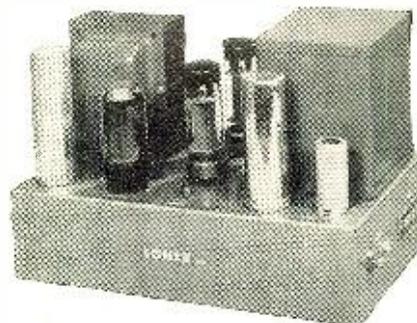
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people. They must be constantly working to achieve better design, better merchandising, and better service if that 'Made in America' slogan is to carry the same connotation of outstanding merit in the future that it has carried in the past."

"You make me feel a lot better," Barney confided. "Last night those fast-talkers had me hanging on the ropes, but now I see that they simply do not understand the basic philosophy of manufacturing here. We believe that it is better to produce a good sound quality product for the many than it is to produce a superlative quality product for the few. Not that we don't make first-class products for those who can afford it, but our 'good' products are so near our 'best' that the latter do not get much publicity. Yes, I feel better about the whole thing; and don't forget I saw my first robin this morning."

"So you say," Mac remarked with a teasing grin. -30-

SYLVANIA TV AWARDS

THE Fifth Annual Sylvania Awards were presented recently in New York to 30 programs and personalities who, in the decision of the judges, did the most to "advance creative television techniques during 1955."

Top winner for the year was "Peter Pan" starring Mary Martin and Cyril Ritchard. It also received top billing in the category "Show Most Entertaining to the Whole Family."

Other winners included the "\$64,000 Question," Sidney Poitier, "A Man is Ten Feet Tall," Julie Harris, José Ferrer, Ed Begley, "Patterns," Mildred Dunlock, "You'll Never Get Rich," "Ed Sullivan Show," "The Voice of Firestone," "Kraft Television Theatre," "The Search," "Focus on Delinquency," "Our Religious Roots," Presidential News Conference, Station WBX-TV, "Omnibus," "Mickey Mouse Club," "Children's Corner," "Home," and Sanka Coffee, Schweppes, and Dow Chemical for best commercials.

A special award was made to Sylvester L. Weaver, chairman of the board of NBC for "greatest contributions to creative television techniques." The industry as a whole was honored for its coverage of the floods in the northeast. -30-

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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. JA5, 36 Columbus Ave., New York 23, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

BC-348P RECEIVER, brand new, original carton, covers 6 bands, 200-500 kc., 1.5-18 mc. Designed for 28 v.d.c., easily converted to 117 v.a.c. \$75.00 f.o.b. New York. Box 51, % RADIO & TELEVISION NEWS.

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 South-ern Blvd., Bronx, N. Y.

FOR Sale—Complete T.V. Laboratory and library, tubes and books. Send for complete inventory. F. J. Stephens, Hollister, Mo.

HI-FIDELITY Specials: Collaro BC-54, Ronnette Flip Cartridge, Mounting Board—\$38.75 Prepaid. Monarch of England, Top Quality 4 pole Motor Changer, GE RPX-050—\$38.75 Prepaid. Any Diamond Stylus, \$13.75, Boxed, Year Warranty. LP Records, Fresh, Sealed RCA, Columbia, all brands. 20% Off, Prepaid, Send List. Our Best Buy Hi-Fi System—\$225.50 Prepaid. Write for Details. Fidelity Unlimited, 63-03 39th Avenue, Woodside 77, N. Y. Latest Webcor Changer-Flip Astatic Cartridge. \$26.75 prepaid.

TELEVISION Trade-ins. 12 to 17. \$19 up. Byron Bros., RD2, Sinking Spring, Pa.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality. Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

RECORDERS, Hi-fi lowest prices. Free catalogue. Klarston, 215 E. 88, New York 28.

NEW! Radio-Television Tube Base Pin Locator, Computer Type, \$1.00 Post-Paid. Distributors Wanted. Electronics, Box 827, Sparks, Nevada.

REPAIR Diagrams—Service Information—Illustrations! Radios—Record Changers—Recorders \$1.00. Televisions \$2.00. Give Make, Model, (Chassis Number). Rush? Air-Mail Add 20c, T.V. Miltie, Box 101-A Hicksville, New York.

SCINTILLATION Crystals. NE-101 Plastic Phosphors at new low cost, with instructions for use. Scintillation counter circuit \$1. Uranium Year-book \$2. Geiger tubes only \$5. Geiger counters \$37.50 to \$745. 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.

WANTED

WANTED—Electronic Tubes, all types. Also all types airborne electronic equipment: ART-13; BC-788; 1-152; 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-ophones, 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.

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.

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.

WANTED: ART-13 transmitters and parts—also ARC-1, ARC-3 and ARN-7. Have requirement for ARN-6 material, Iron Core Loops, need all types Collins and Bendix Aircraft Radio equipment. Florida Aircraft Radio & Marine, Inc. P. O. Box 205, International Airport Branch, Miami 48, Florida.

WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, I-152C, Collins, Bendix equipment, Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 40th St., New York City, telephone LExington 2-6254.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 56 Crosby St., N. Y. 12N, N. Y.

CASH for BC-610E, BC-614E, BC-939, BC-729, BC-221, BC-312, 348, TCS, AN/GRC-9 and higher, and parts for all these. Amber Industrial Corporation, Surplus Div., 75 Varick Street, N. Y.

REPAIRS AND SERVICING

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y. Ba. 7-2580.

TEST Equipment Repaired and Calibrated by Factory staff. All makes. Superior, Simpson, Triplett, Eico. Free estimate. Our Twentieth year. Douglas Instrument Laboratory, 176 Norfolk Avenue, Boston 19, Mass.

HELP WANTED

TELEVISION Jobs—Names and addresses of companies to contact, \$1.00. Fitzgerald, (Chicago Division), Dept. A-14, 815 Countryside Drive, Wheaton, Illinois.

BUSINESS OPPORTUNITIES

BUY Wholesale, 25,000 Items, Catalog 25c. Matthews, 1472-R5 Broadway, NYC 36.

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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. Free Catalog. Educational Exchange, Menlo, Georgia.

RECORDS

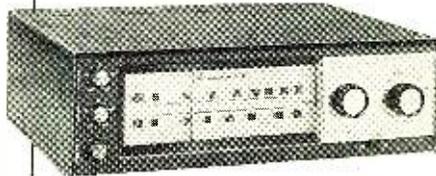
PHONOGRAPH Records Cheap. Catalogue. Paramount, NA—313 East Market, Wilkes-Barre, Penna.

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Tuner, Preamp and Amplifier in a single, compact BALANCED HI-FI unit at extremely low cost . . .

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Here's the quality unit for simplest installation—merely add speaker and record changer and have your complete, superb FM-AM-Phono home music system. No cabinet required—saves money, space, installation problems. You get the ultimate in wide-range musical enjoyment and you pay less for it. Features are outstanding. Response: FM \pm 0.5 db, 20 to 20,000 cps; AM, \pm 3.0 db, 20 to 5,000 cps; Phono, \pm 0.5 db, 20 to 20,000 cps. Sensitivity: FM, 3 mv. for 20 db of quieting; AM, 5 mv. for 0.5 watt output. Harmonic distortion: Radio input, less than 2%; Phono input, less than 0.7%. Separate front ends for AM and FM; tuned RF stage on FM; discriminator with dual limiters; AFC with defeat on function switch; FM dipole antenna; AM has RF stage, ferrite loop. Separate bass, treble controls; RIAA record equalization; choice of standard or equal loudness control; full 12 watts output, etc. Ultra-compact design, only 5 3/4" high; decorator-styled in handsome charcoal black with marbled gold finish. Fits anywhere beautifully. See and hear the "Golden Ensemble" soon.

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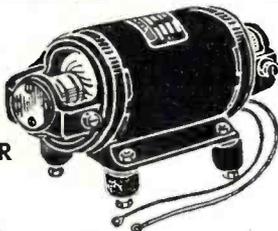


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Ideal for dispatch or switchboard use. Leaves hands free. Standard type F-1 carbon button transmitter. Regulation Western Electric type HA-1 magnetic earphone reproducer. Transmitter arm has earpiece holder equipped with transmitter cutoff switch. Accordion-type extension holder transports phone a full 14 1/2". Works into any standard telephone equipment. Shpg. wt. 10 lbs.

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Input 115 VDC @ 3.5 amps. Output 115 VAC @ 250 watts, 60 cps, enough to handle most TV sets, tape recorders, phonos, fluorescent lights, etc. With shock-mounted base. 10 1/4" x 5" x 4 1/2" diam. Shpg. wt. 23 lbs.

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Orig. \$27.50
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Standard equipment for any telephone switchboard. Complete with cable. Western Electric type 396A. Shpg. wt. 5 lbs.

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837	\$.69	Limit One Dozen
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BATTERY PORTABLE NOW ONLY **\$18.95**

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Smaller than a pack of cigarettes. Faithful reception within usual 25-mile primary FM station area. Low-drain circuit allows standard batteries to last many weeks in normal use. Sturdy, shock-resistant chassis and stainless steel battery contacts. French grey plastic case 2 1/2" x 2 3/4" x 3/8". Shpg. wt. 5 1/2 oz. Set of batteries for above.....\$2.29

THERMADOR KILOWATT MODULATION TRANSFORMER

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Ideal for 304TL or 304TH. Thermador #CS52156 Primary impedance 6600 ohms center-tapped at 500 ma. Two secondaries, rated at 4600 ohms @ 400 mls and 2300 ohms @ 800 mls respectively. Size 8" x 8" x 8 1/4" and weighs 55 lbs. Mounts upright with 4 screws. Complete with bracket and schematic.

R.C.A. SOUND POWER PHONES NAVY TYPES M & N

Worth \$45.00 NOW ONLY **\$4.95** USED

Two-way conversation over wired circuits up to 10 miles. Any number operate in parallel without loss of power. 22 ft. rubber cord, push-to-talk switch, Navy waterproof plug. Ideal for TV antenna installation, field tests, mining, etc. Shpg. wt. 7 lbs.

AC SYNCHRONOUS SELSYN MOTOR (BENDIX No. 4460A-4)

Worth \$75.00 ea. NOW ONLY **\$12.95** \$24.95 pr.

115 Volt, 50-60 cycle. Recommended for beam antenna rotation or other applications where high torque is required. Shpg. wt. 15 lbs.

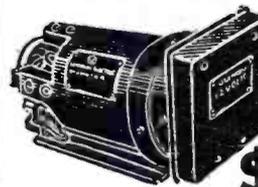
5 WATT MIKE-PHONO AC AMPLIFIER

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Separate mike and phono inputs and volume controls. Separate bass and treble controls. Finest quality components operating at well below ratings. 8 1/2" x 5" x 4 1/2" high. Shpg. wt. 6 lbs. complete with tubes.

250 WATT MOBILE DYNAMOTOR Worth \$89.50



YOUR COST **\$12.95**

Great for powering your mobile rig. Output is 1030 VDC @ 260 ma, 515 VDC @ 215 ma, 2 VDC, and 8 VDC. Input is 14 V @ 46 amp, 7500 rpm. Only 6 1/4" x 6 7/8" x 11 1/2" overall. Blower assembly and rack mount may be removed to reduce dimensions to 5" x 5 1/2" x 11 1/4". Slightly used, in excellent condition. Shpg. wt. 30 lbs.



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Converts easily to a hot VFO or 50 watt CW transmitter. Tuning range 3.0 to 4.0 MC. In aluminum case, 12" x 7" x 5 1/4" wide. Complete with tubes, crystal, wiring diagram, and conversion suggestions. Less power supply. Shpg. wt. 12 lbs. Power supply Kit for above, including all parts and schematic. Shpg. wt. 16 lbs.....\$9.95

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BC-357 Worth \$25.00 (slightly used) YOUR COST **\$4.95**

For remote control applications, such as opening garage doors. 75 MC carrier with 2700 cycle audio tone. With 12SC7 and 12C8 tubes. Easily changed to FCC approved 27.5 MC. No license needed to operate XMTR on this frequency. Shpg. wt. 5 lbs. Schematic supplied in case of each unit. Less power supply.

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List \$15.00
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Hand held low-impedance magnetic type. Output —84 db below 1 volt per microbar. Response is 100 to 7000 cps. Beige-finished diecast case. Shpg. wt. 1 lb. Matching XFMR for high impedance inputs.....\$0.89

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