DESIGN DATA ON TRANSISTOR RADIOS

RADIO & TELEVISION NEWS

JANUARY
1956
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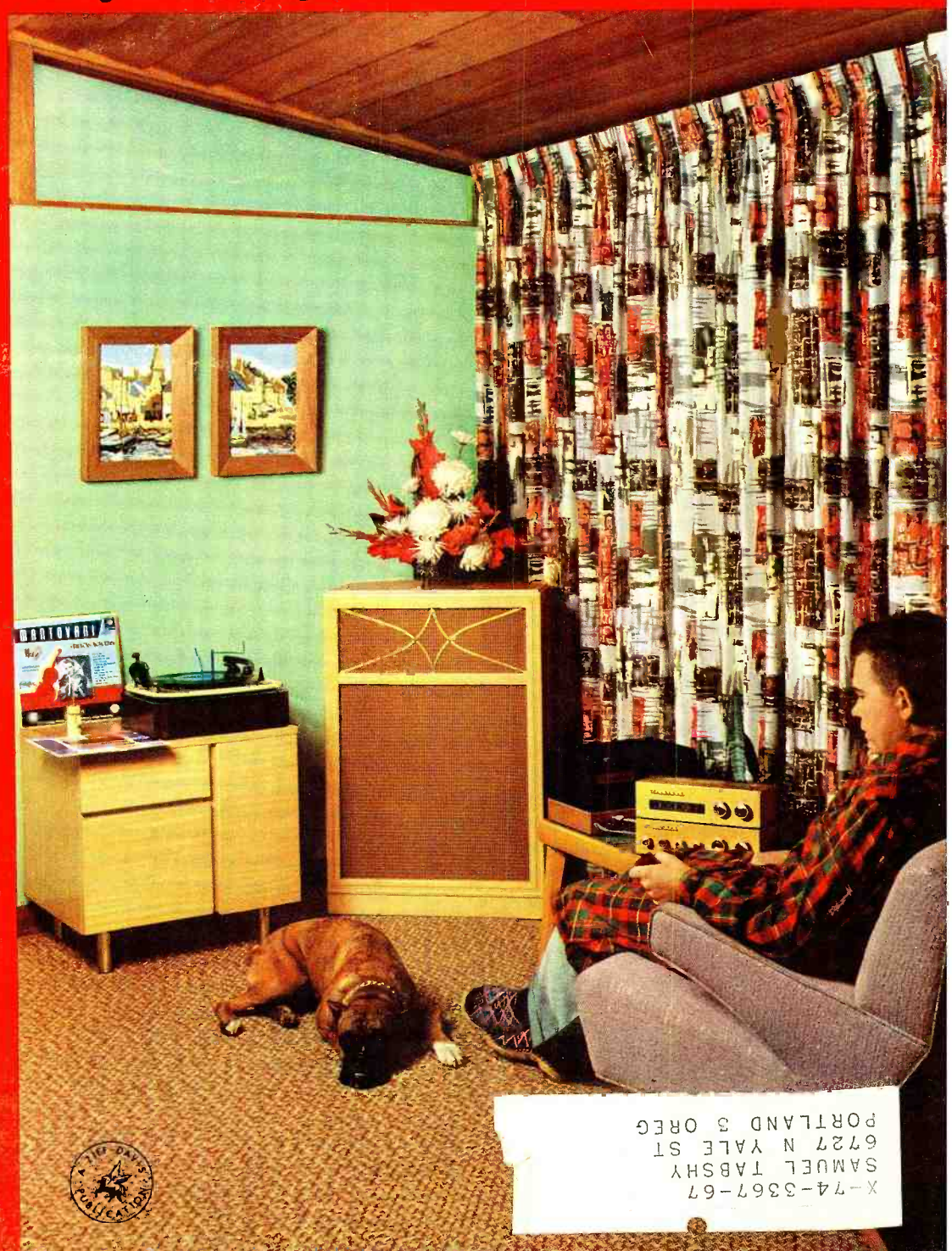
in U. S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE



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RAYTHEON "Lumilac" ALUMINIZED PICTURE TUBE REPLACEMENT GUIDE

RAYTHEON "Lumilac" ALUMINIZED PICTURE TUBE	REPLACES STANDARD TYPE	NECESSARY ADJUSTMENTS OR CHANGES
12KP4A	12KP4	None.
	12QP4	Ground conductive coating. Remove ion trap.
	12QP4A	Ground conductive coating. Remove ion trap.
	12RP4	Ground conductive coating. Remove ion trap.
16KP4A	16KP4	None.
	16QP4	Ground conductive coating. Change ion trap.
	16RP4	Check conductive coating contact.
	16TP4	Space may not be sufficient in some cases.
	16XP4	Ground conductive coating. Change ion trap.
17BP4B	17BP4	Ground conductive coating.
	17BP4A	None.
	17BP4C	None.
	17JP4	Do not exceed voltage rating.
17HP4B	17HP4	None.
	17HP4A	None.
	17RP4	None.
17LP4A	17LP4	None.
	17VP4	None.
20DP4C	20DP4A	None.
21ALP4A	21ALP4	None.
	21ALP4B	None.
	21ANP4	Ground conductive coating.
	21ANP4A	Ground conductive coating.
21AUP4A	21AUP4	None.
	21AUP4B	None.
21AVP4A	21AVP4	None.
	21AVP4B	None.
21EP4B	21EP4	Ground conductive coating.
	21EP4A	None.
21FP4C	21FP4	Ground conductive coating.
	21FP4A	None.
21YP4A	21AFP4	Ground conductive coating.
	21YP4	None.
21ZP4B	21ZP4	Ground conductive coating.
	21ZP4A	None.
24CP4A	24CP4	None.
	24QP4	None.
	24TP4	None.
	24XP4	Ground conductive coating.
24DP4A	24DP4	None.
27EP4	27GP4	None.
	27NP4	Add filter condenser.
27RP4	27GP4	Ground conductive coating.
	27NP4	None.

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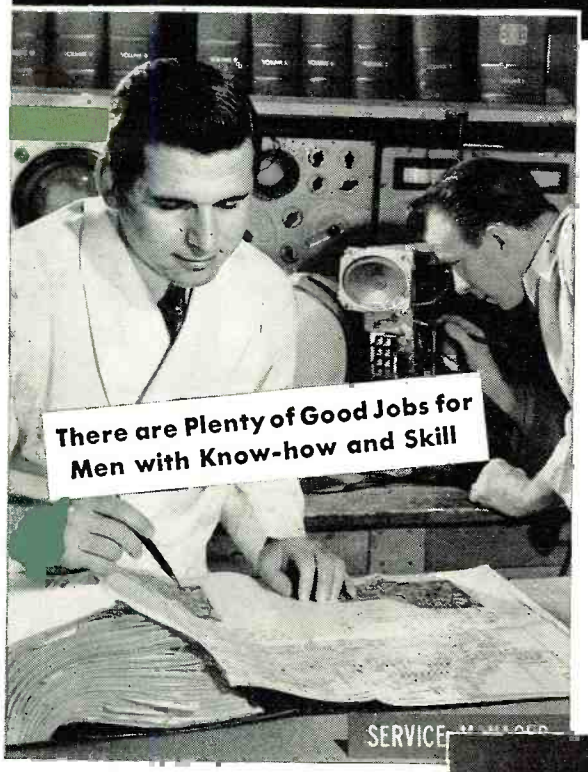

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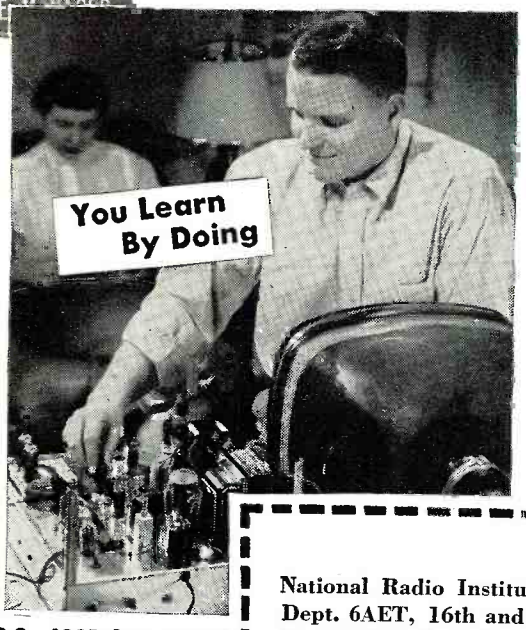

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COVER PHOTO: Home music systems are as varied as their users. This chap did as many are doing—bought part of his equipment assembled and the rest he constructed from some of the many good kits on the market now.
(Ektachrome by John Deetjen)

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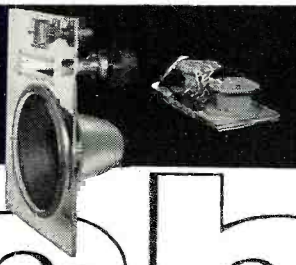

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Rebel
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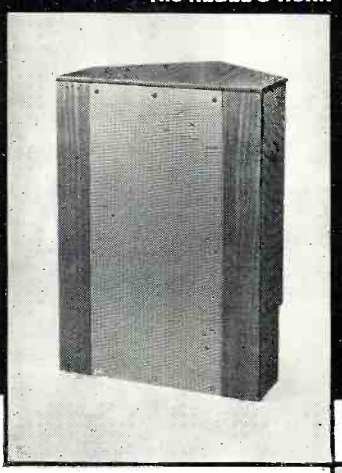
corner-folded horns

The REBEL 3 HORN



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kitform of the KR-3
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The K-15
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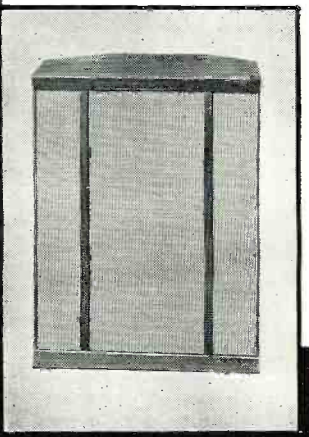
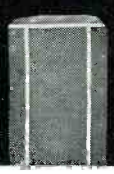


and Ortho-speaker systems

ORTHO describes a new series of multiple-unit speaker systems designed specifically for the Rebel horns. Each is a 3-way 3-speaker unit. Each includes a remarkable mid-range horn and crossover network of Klipsch design and manufacture. Write for additional information on these unusual Cabinart-Rebel speaker systems.



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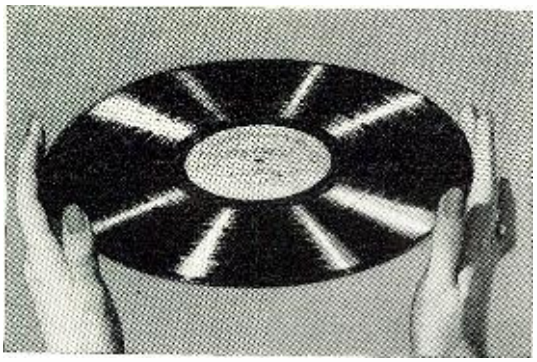

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For the RECORD

BY THE EDITOR

THE PART-TIME SERVICE TECHNICIAN

THE daily mail is seldom received without at least one letter from a "professional" service technician in which he condemns the "part time" operator who encroaches on his business. Too often these writers fail to remember that, in many cases, they themselves "cut their eye teeth" in radio service by engaging in part time maintenance of sets in their home neighborhoods.

These men, particularly in the early days, did not have a clientele which could support a full-time operation and it was necessary to earn a basic living in other fields of endeavor. We speak from our own experience in this respect.

Radio and television servicing is in no way different from many of the other service professions in which an excessive amount of capital is not needed to set up a business. It is certainly common knowledge that many Certified Public Accountants, commercial artists, professional engineers, etc., work for companies full time and, at the same time, build up a clientele of their own for future independent operations. This is an accepted practice in these respective trades. Why should it be frowned upon in TV servicing?

One objection to the part-time service operator brought against him by the "professional" is that he charges less than the full-time shop can for the same job. His overhead is extremely low since he most often operates out of his home or cellar, and he buys parts for the same price as the full-time shop, and charges less.

This, the "professional" charges, is unfair competition. However true this may be, the fact remains that if run properly a "downtown," full-time store has competitive advantages that the part-time operator cannot hope to attain. The store in the business section has prestige and location to begin with. What the operator does with these factors is a measure of his astuteness as a business man. No amount of griping about unfair competition will take the place of good and fair business practices.

Many times, a customer will take his set to a part-time operator because he feels that here he will get individual attention, that his set will not be part of an assembly-line service operation, and his complaints will not be brushed off with "the set is pretty old anyway, so what can you expect?" Because the part-time operator is anxious to build up a clientele, which means repeat business and recommendations to others, he will often spend some time adjusting the set and perhaps even cleaning it to bring it up to peak performance. How many established service shops follow this practice?

As far as charges are concerned, a professional shop with its experienced personnel should be able to handle average service jobs at least twice as fast as the part-time operator. It should take less time for the experienced bench man to diagnose a trouble to its source and, since the shop has a greater stock of parts on hand, less time for him to repair the trouble than his part-time counterpart. On the basis of this, the shop's charge should not be much greater than the part-time operator's if the latter is also working in a business-like fashion. And herein lies the key as to how the "professional" service technician and business operator can benefit himself as well as the servicing industry as a whole.

Many independent service operators all over the country have joined together in service associations for their mutual benefit. Where they are run by imaginative leaders and where they consist of an interested and alert membership, these trade associations have been able to improve the reputation of the service industry in the community as well as improve the business procedures of the members themselves. Why doesn't the service association in any particular locality invite the conscientious part-time service operators to join, perhaps as associate members, so that they can derive the benefits of associating with experienced businessmen. At the same time, the "professional" can impress upon the part-timer the importance of adequate pricing and the danger to his future development of cut-rate pricing, as many part-time operators have learned to their regret. The part-time operator must be made aware of the fact that once he undercuts and sells his services short, it will always be expected of him, no matter how high his overhead goes after he has started full-time operations.

And if it is his intention to go into full-time service operations when he has built up a clientele and reputation, the part-time operator must start at the beginning to establish a reputation for fairness and technical efficiency without which he can never grow. . . . . O. R.

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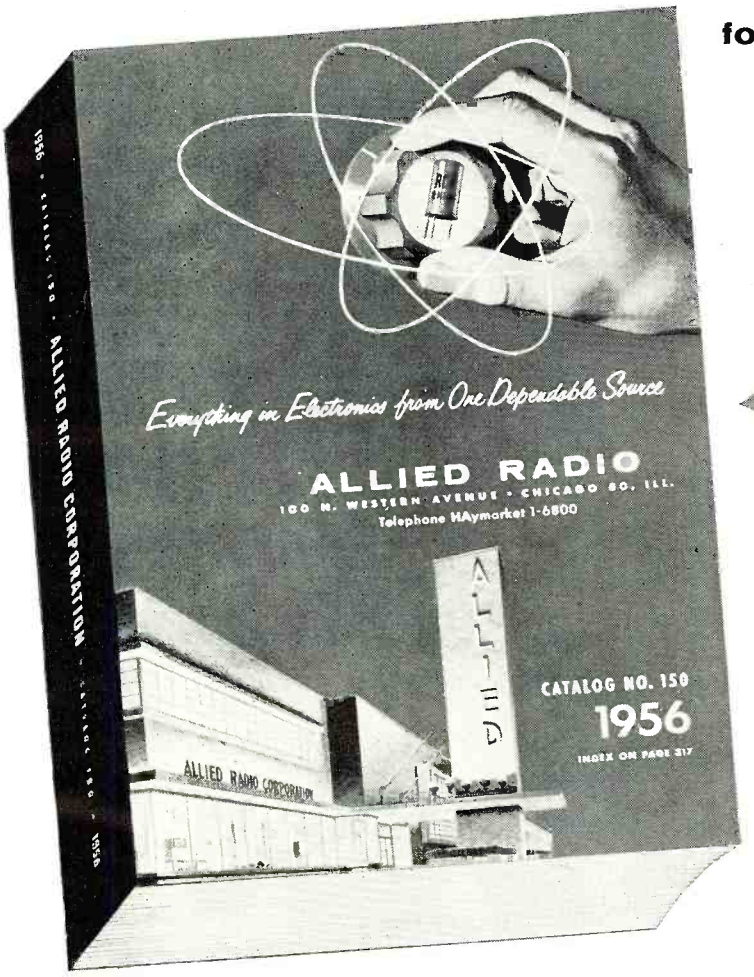

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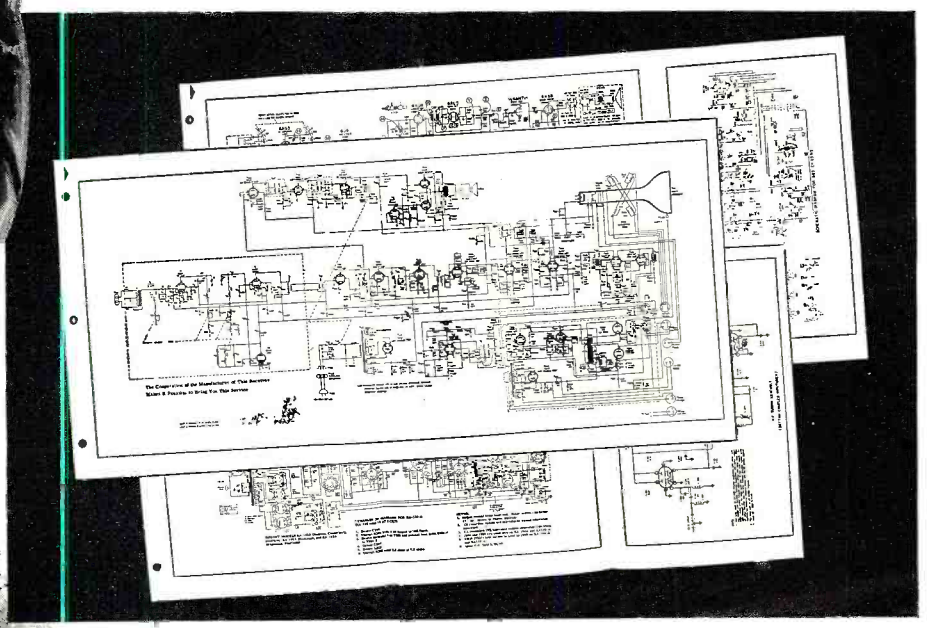

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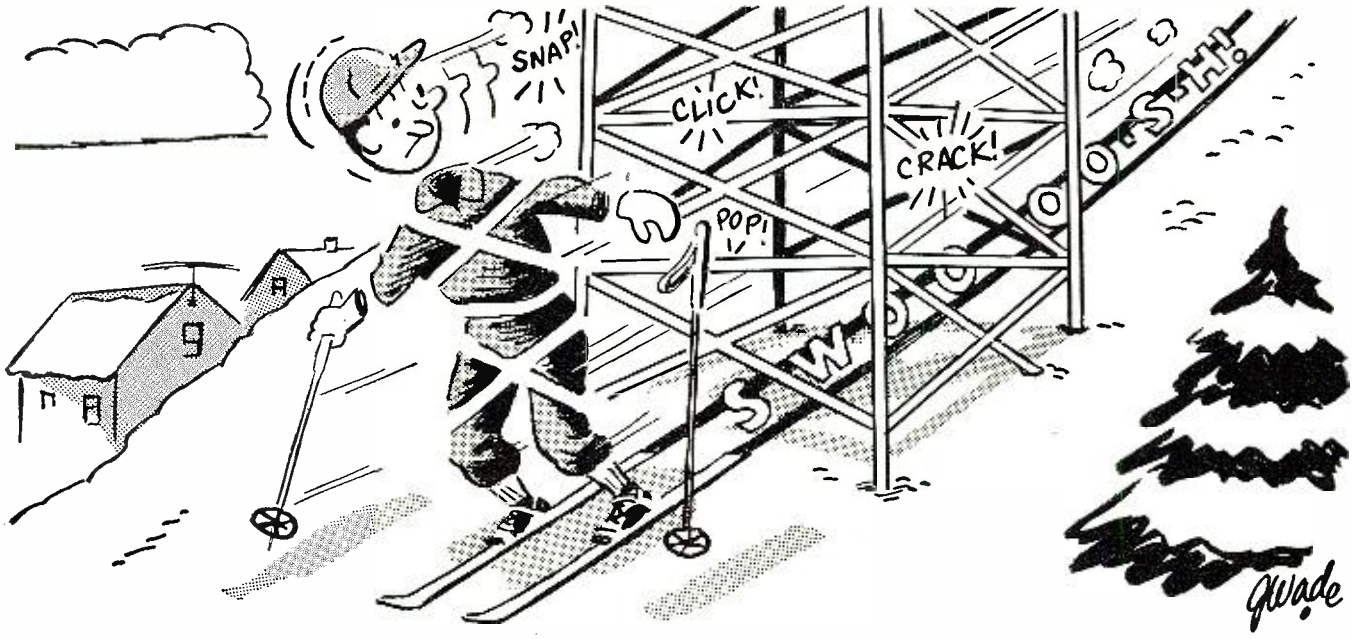

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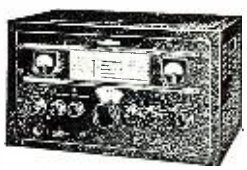

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Radio & Television Receiver

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by Ghirardi & Johnson
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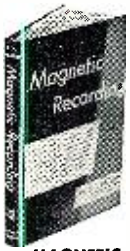

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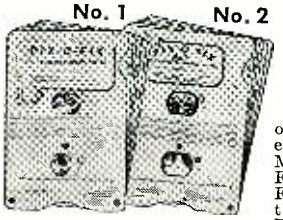

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Eliminate useless testing . . . Fix sets twice as fast!

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

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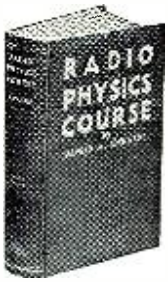

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972 pages, 508 illus., 856 self-test questions
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More service experts got their basic training from this big book than any other of its type!

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

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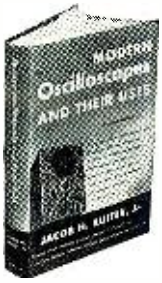

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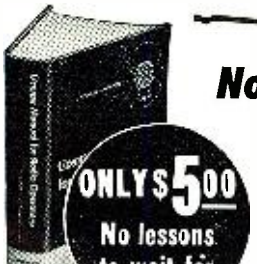
Oscilloscope experts get the BIG PAY jobs!



LICENSE MANUAL for Radio Operators
by J. R. Johnson (W2BDL)

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

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

Train for big pay in communication's most interesting jobs

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

TRY ANY BOOK 10 DAYS FREE!

Dept. RN-16, Rinehart & Company, Inc.,
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High gain: Low band, 7 to 9 DB. High band, 8.5 to 10.5 DB. (Single bay figures). Balanced for COLOR.

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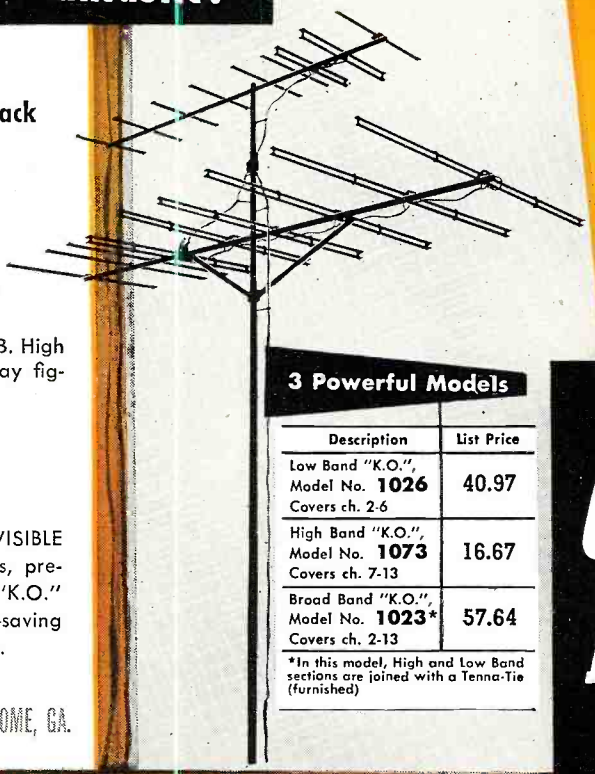

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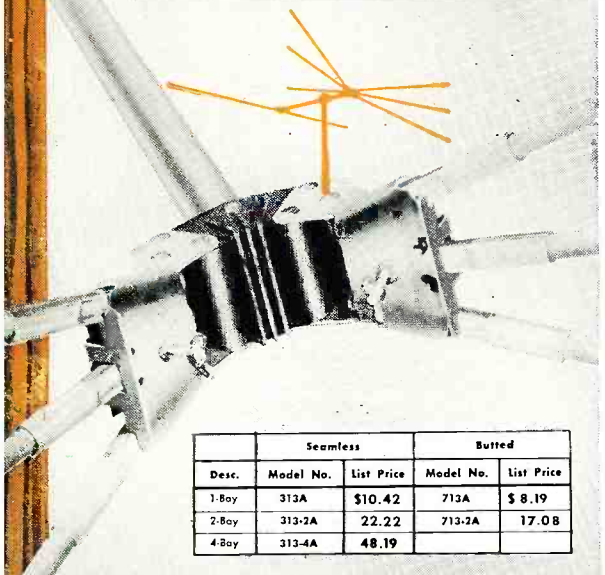

- ***"Super-Sembled"!***
- ***Re-designed!***
- ***Better than ever!***

Channel Master's Super Fan is the original fan antenna. Famous for its superb quality, it has been in continuous demand for six years. *Millions* are in current use.

- **Assembles with NO HARDWARE or tightening.**
- **Massive, heavy-duty, molded fan head. Unaffected by moisture and extreme temperatures.**
- **Reinforced elements. External sleeves prevent breakage.**

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Desc.	Model No.	List Price	Model No.	List Price
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4-Bay	313-4A	48.19		

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TV TRANSMISSION LINE

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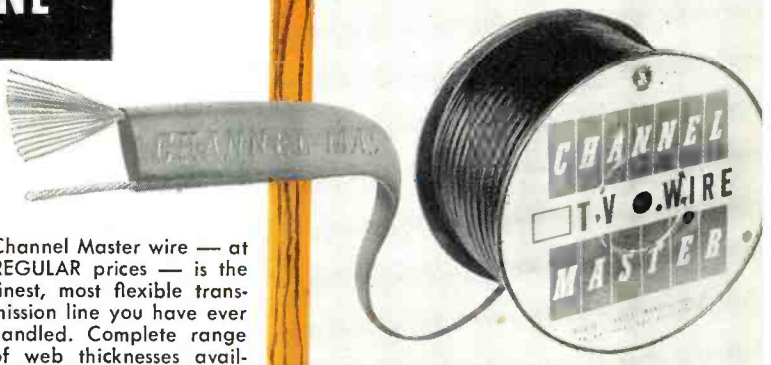
FLEX-APPEAL!

The first TV wire to give you the benefits of **20** strands per conductor (20/33 pure copper).



Channel Master wire — at REGULAR prices — is the finest, most flexible transmission line you have ever handled. Complete range of web thicknesses available. Colorful display packaging.

Two outstanding lines:
(both featuring exclusive 20-strand conductor):

"TWIN TWENTY"

- Marked every 10 feet. Saves time, ends waste.
- Full width.
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"CHALLENGER"

Fine quality transmission line at today's VERY LOWEST PRICES.

with EVERYTHING but the roof!

installation. From now on, guarantee customer satisfaction with a *COMPLETE CHANNEL MASTER INSTALLATION — FROM TOP TO BOTTOM.*

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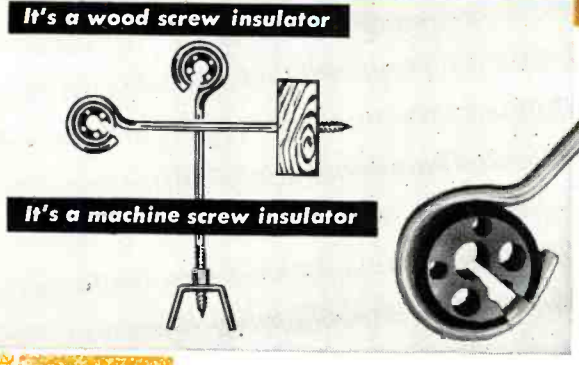
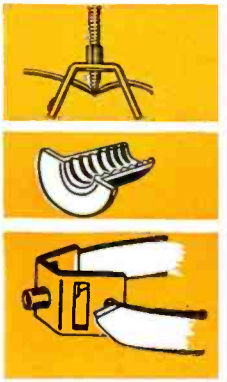
STANDOUT insulators

Featuring this revolutionary new 2 in 1 screw thread design!

Eliminates the need for stocking separate machine and wood screws. Cuts your inventory investment in standoffs by more than 65%.



- Needle sharp point, made possible by finer thread. Easier to work in wood. Prevents slipping on mast.
- STANDOUT buckle has **8** machined threads.
- Convenient "Taper-Tip" strapping, available in galvanized or stainless steel.



All popular types and sizes available, including full assortment of specialized hardware. See your Channel Master distributor

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE FORECAST THAT within five years after the TV freeze lift, at least 2000 telecasters would be on the air was shattered some weeks ago by a CBS consultant who told the Commission that a ceiling of 600 stations, plus perhaps some satellites, looked more realistic to him now. That number of operators could, he felt, adequately serve the nation.

Specifically, it was reported that 600 stations would take care of . . . "about 95% to 97% of the families of the country . . . without satellites . . . and the use of satellites . . . can push this figure fairly close to 100%." The expert noted that more than two-thirds of the 1800-odd channels set aside by the FCC would remain unused, or would be occupied only a short time by stations faced with bleak futures.

Ignoring the ultra-highs, the analyst pointed out that such operation was discounted since the bulk of the stations who would operate on the higher bands as program-originating points would find the going too rough to continue.

The maximum number of 600 was arrived at, the report said, by estimating the coverage of v.h.f. stations; this was set at from 50 to 75 miles. And, the study added: "Larger or smaller radii of coverage would lead to fewer economically supportable stations. Larger radii permit fewer stations to cover a given area, and shorter radii reduce the number of market centers than can support a station. That is, many market centers which can support a station with a 50-mile radius of coverage can no longer support one with a 25-mile radius of coverage."

However, one bright bit of hope was offered to the members of the Commission. Said the broadcast specialist: "In the long-run future . . . the economics of the industry may, and indeed probably will, change, so that a larger number of stations can eventually be supported. The minimum cost of running a station may decline and increased advertising revenues, particularly from local sources, will undoubtedly be forthcoming. Such was the history of radio broadcasting, and a similar development may be expected in television."

THE STRONG PREFERENCE for v.h.f. by a growing number of broadcasters and advertisers, and equally positive views of many in government and industry that u.h.f. has its place in the TV sun, have generated so much confusion in Washington that everyone is clamoring for an immediate public hearing.

Commissioner Rosel H. Hyde, who is anxious to have oral sessions, said that the blizzard of plans which have hit Washington, formally and informally, can only be resolved by an official bull-session. He felt that this was . . . "the only way that we can have all of the pertinent facts placed before us . . . to

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*
Massachusetts	Boston	WHMB	38	614-620	251
North Dakota	Minot	——	10	192-198	29.5
Ohio	Youngstown	——	73	824-830	16.6

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Florida	Orlando	WEAL-TV	18	494-500
Pennsylvania	Philadelphia	WPHD	23	524-530

CALL LETTER CHANGES

STATE	CITY	CALL	CHANNEL	FREQUENCY
Colorado	Denver	KTVR (Formerly KFEL-TV)	9	186-192
Nevada	Hayes Center	KHPL-TV (Formerly KHOK-TV)	6	82-88

*ERP=(effective radiated power, kw.)

EXPO PRESENTS

I. R. I. S.*

INFINITE REJECTION INTERFERENCE SYSTEM

the world's first fundamental and complete answer to the interference problem...

*** The Sensational I.R.I.S.**

gives infinite rejection of the interfering signal regardless of direction or channel or whether the interference is co-channel, adjacent channel or ghosts.

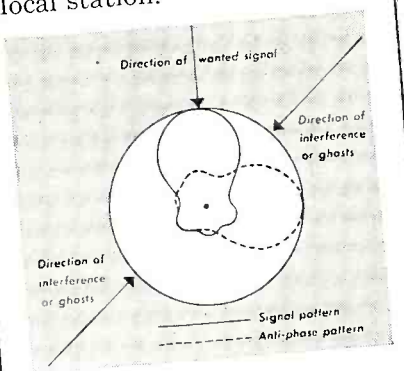
The rejection of the interfering signal is accomplished by opposing the interfering signal with a signal of equal amplitude but of opposite phase, thus producing complete cancellation. Simply rotate the upper section of the antenna to a position where the interference disappears.

Can be used either in a fixed installation or with rotor. All accessories and harness furnished for quick, easy installation.

The Famous EXPO Antenna

is used in I.R.I.S. with its fundamental unlimited bandwidth characteristic, thus insuring excellent performance throughout the 82 channels.

No more Venetian blinds, or ghosts or distortion from an interfering co-channel signal or "splatter" from a strong local station.



The combination of the principle of the exponential curve and the proved performance of I.R.I.S. offers an exceptional sales potential, both in antennas and TV sets. Now is the time to cash in on this exclusive opportunity.

EXPO-I.R.I.S. comes in the following models:

XO2R6 2-bay, 6 element EXPO-I.R.I.S. List $20.95

XO2R8 2-bay, 8 element EXPO-I.R.I.S. List $25.50

XO4CR6 4-bay, 6 element colinear EXPO-I.R.I.S. List $53.25

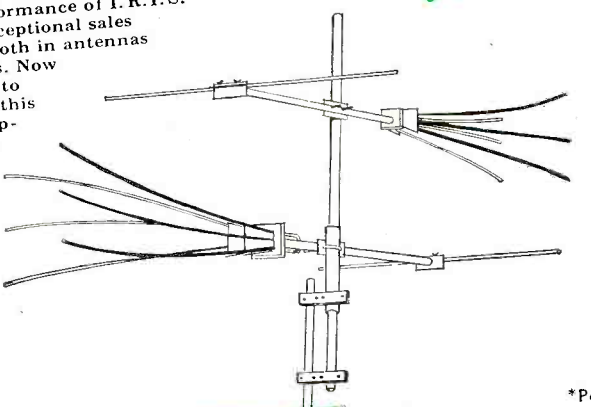
XO4CR8 4-bay, 8 element colinear EXPO-I.R.I.S. List $61.75

ORDER TODAY FROM YOUR DISTRIBUTOR

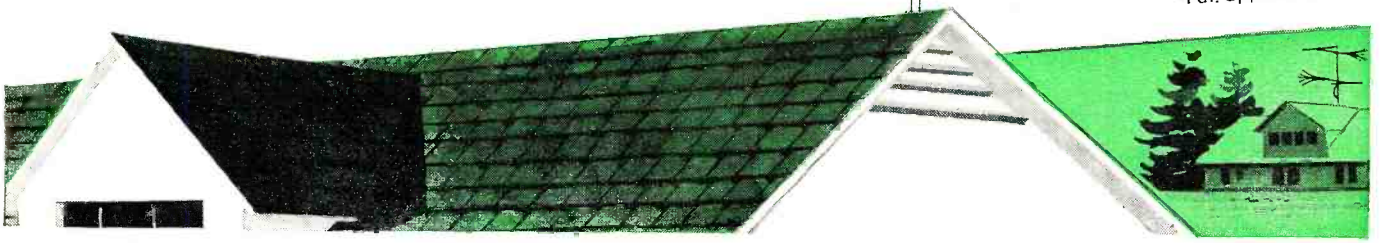
whom we will supply until official distributors are designated in your locality.

EXPO

HOLLOWAY ELECTRONICS CORP.
Fort Lauderdale, Florida



*Pat. applied for



permit us to reach well-considered decision. . . ." At such a hearing, he continued, all of the facts could be . . . "fully and accurately tested and developed."

Answering those who felt that the proposed hearings would lead to a new "freeze", the Commissioner said that the procedures . . . "should not . . . be permitted to take more than a few months."

Commenting on his personal views on the future of the high bands, Hyde said that even though u.h.f. is . . . "sick, it still remains as one of the basic foundations for the proper development of the industry." He based his opinion on the engineering views of those with . . . "tremendous experience." These experts, he said, have repeatedly declared that . . . "There is nothing fundamentally wrong with u.h.f. as a technical service."

U.H.F. BROADCASTERS have stormed the FCC with requests that hearings be held as quickly as possible and they warned the Commission that no action must be taken that . . . "would render the problem moot, and make consideration of any effective nationwide solutions of the u.h.f. problem impractical or impossible to attain."

Reviewing some of the v.h.f. expansion plans suggested, some of the high-band proponents said that even the FCC staff members agreed that the drop-in or squeeze-in v.h.f. ideas would all have a serious effect on the future of high-band operation. First, it was noted, such a program would eventually destroy the public's present multi-million dollar investment in antennas and converters. Any change in station separations would certainly rob stations of their existing service areas. In addition, it was felt that new interference problems would occur. According to some engineers of the Commission, the proposed directional antennas would cause trouble in the form of reflections from nearby structures.

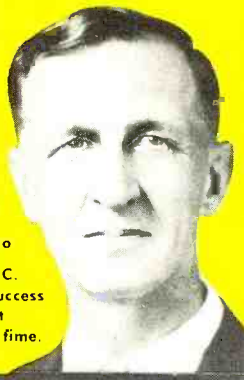
Support for the ultra-highs also came from a committee of RETMA, who advised the Commission that the television service, in their opinion . . . "needs both the u.h.f. and v.h.f. channels now assigned . . ." for complete coverage of the nation.

THE DEVELOPMENT OF A MOBILE, air-traffic control system that can be used at air fields in remote areas of the world, known as *project two wheels,* has been revealed by the Air Research and Development Command, Rome (N. Y.) Air Development Center at Griffiss Air Force Base.

Featured in the new setup are seven small trailer-mounted shelters which are lightweight and compact enough to permit transportation in a C-47 type aircraft, or which may be towed by jeep or truck for distances of several hundred miles.

The two-wheel trailers house an assortment of gear built for ruggedness, durability, and precision. The

(*Continued on page* 126)



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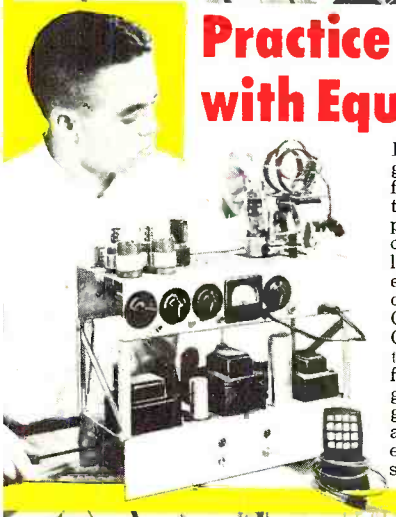
President
National Radio
Institute
Washington, D.C.
40 years of success
training men at
home in spare time.

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

Practice Broadcasting with Equipment I Send



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

Practice Servicing with Equipment I Send

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

Television Is Growing Fast Making New Jobs, Prosperity

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

AVAILABLE TO VETERANS UNDER G.I. BILL

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

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

Cut out and mail card NOW!

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

NO STAMP NEEDED! WE PAY POSTAGE

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

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

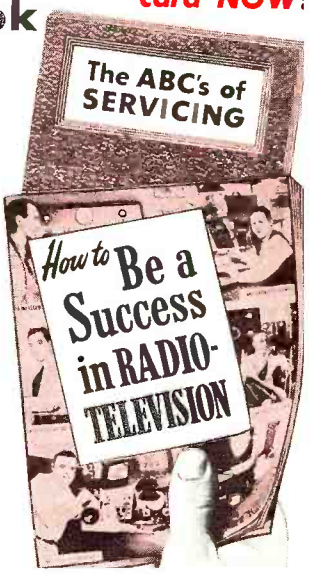
NAME.....AGE.....

ADDRESS.....

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

VETS write in date of discharge.....

K L M O P



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.

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

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

SEE OTHER SIDE

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 Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business

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

Extra Money in Spare Time

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

My Training Leads to Jobs Like These

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

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Washington 9, D. C.

Have Your Own Business

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

CBS

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

Guaranteed by Good Housekeeping

Show the CBS carton with the Good Housekeeping Guaranty Seal

January, 1956

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Danvers, Massachusetts
A DIVISION OF
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PACKED WITH BARGAINS

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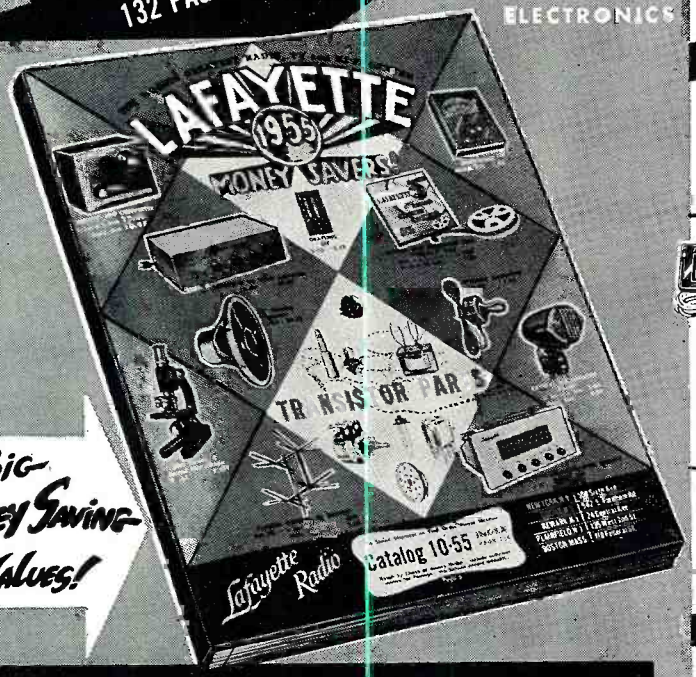
132 PAGE ELECTRONIC CATALOG

SAVE ON EVERYTHING IN ELECTRONICS



BIG MONEY SAVING VALUES!

NEW LAFAYETTE CATALOG GET YOURS NOW IT'S FREE

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — **ALL AT GREAT SAVINGS** — For the economy minded servicemen, dealer, engineer and technician. **CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.**

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HIGH-FIDELITY TURNOVER CARTRIDGE

2.75

Reg. Price ~~3.50~~

- 40-14000 CYCLE
- NEVER BEFORE AT SUCH A PRICE!

Lafayette brings you one of the finest high-fidelity turnover cartridges, AT AN UNBELIEVABLE PRICE! Frequency response from 40-14000 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, Garrad, VM, Collaro and tone arms of leading manufacturers of record changers and players.

PK-79 ..... Singly, Each **2.75**
In lots of 3, Each **2.50**

CRYSTAL MICROPHONE

COMPARE IT WITH ANY MIKE AT 2 to 3 TIMES THE PRICE

A quality crystal Microphone for PA systems, house recorders, etc. Frequency response 30 to 10,000 cycles. Output level —52 db. Provides ample output for use with low gain amplifiers. Complete with 5 ft. of shielded cable. Shpg. wt., 3½" lbs.

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SLIM HIGH OUTPUT DYNAMIC MICROPHONE

NEW!

Reg. Price ~~41.50~~ Net **9.95**

A pencil-slim design, high output PA Dynamic Microphone of exceptional quality, at a price that is ⅓ of the price of any comparable microphone on the market today. Very smooth response, 50-11,000 cycles. Omnidirectional, tiltable head. Switch on side gives choice of either high impedance (50,000 ohms) or low impedance (250 ohms). Instantly removable bracket permits use either on stand or as hand mike. Features exceptional mechanical strength. Cast case with satin chrome finish, ⅝"-27 thread, Acoustically-treated grille head, 8" long; 1¼" barrel diameter. Shipping weight 2 lbs.

PA-29.....In lots of 3, Each **9.95**
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TELEPHONE PICKUP

FOR RECORDING TELEPHONE CONVERSATIONS

Induction telephone pickup. Telephone conversations can now be picked up with no tapping of wires or special telephone circuits. Simply place the phone base, either cradle or upright type, on the pick-up platform and connect the leads to the high impedance input of any medium gain audio amplifier, or directly to any tape disc or wire recorder.

MS-16..... **2.95**

A NEW LIGHT WEIGHT DYNAMIC EARPHONE

Fits right into the ear. Ideal for use with radio sets, for private listening. DC resistance 2000 ohm impedance 5000 ohm with 3 ft of Plastic Cord.

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TRANSISTOR 455 KC I.F.

Specially designed for transistor circuits, only ½" square by ¾" high.

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In lots of 10, each **79¢**
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RAYTHEON TRANSISTOR

CK722
P-N-P
$0.99

TRANSISTOR LOOP ANTENNA

1.25

Fixed inductance tapped to match 400 ohm input. Covers 540-1650 kc with 365 mmf variable cond. size 9/16 x 4⅛".

MS-166 Net **1.25**

TRANSISTOR TYPE 2N107

P-N-P
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TRANSISTOR OSCILLATOR COIL

Supplies local OSC. energy to mixer stage. IF 455 KC. Use with 365 mmf cond. ⅝" x 1⅛" high.

MS-165 ..... Net **49¢**

New Price!

4.65

RAYTHEON TRANSISTOR CK-760 (2N112)

HIGH SENSITIVITY AC-DC MULTITESTER

20,000 OHMS PER VOLT DC and 10,000 OHMS PER VOLT AC

The New Lafayette High Sensitivity Multitester is a complete instrument (not a kit) packed with every desirable feature found in instruments costing twice as much. One of the most sensitive multitesters ever offered: **20,000 ohms per volt DC** and **10,000 ohms per volt AC**; having a highly sensitive 35 microamp meter. Check these full scale readings. **DC Volts:** 0-6; 0-12; 0-60; 0-300; 0-1200; 0-6000 volts at 20,000 ohms per volt. **AC Volts:** 0-6; 0-12; 0-60; 0-300; 0-1200 at 10,000 ohms per volt. DC current ranges: 60 microamp, 0-6; 0-60; 0-600 milliamps. **Resistance ranges:** 0-4; 0-40; 0-400K; 4 meg. ohms. **Decibel:** —20 to +17 db (0 = .774 volt). **Capacity:** 250 mmf-10 MF. **Inductance:** 20-1000 millihenry. Extreme versatility and accuracy; 1% precision resistors. ¾" meter; plastic front with metal bottom for ruggedness. Size: 5¾" x 3¾" x 2⅝"; complete with batteries and test leads. Shipping weight 4 lbs.

RW-30A ..... In lots of 3, Each **19.25**
Singly, Each **19.95**

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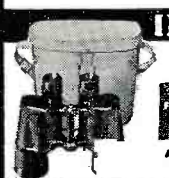

All have coated lenses — clamped in prisms — light weight all metal bodies. Complete with case and straps.

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ADD 10% FED. TAX TO PRICES

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F-183 —	7x,35	C.F....	NET 20.95
F-103 —	7x,50	I.F....	NET 21.50
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F-117 —	10x,35	C.F....	NET 23.95
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The CDR Rotor line is COMPLETE to every detail, with a model for every application! A distinct selling advantage because YOU can give your customer EXACTLY what is required! The RIGHT CDR Rotor for the RIGHT job.

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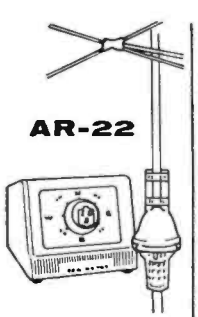
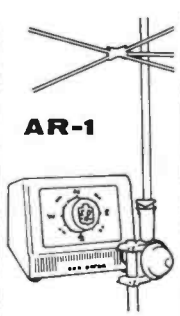
through an extensive coverage of audiences in every important TV market. Capture this pre-sold market by featuring these nationally advertised CDR ROTORS.



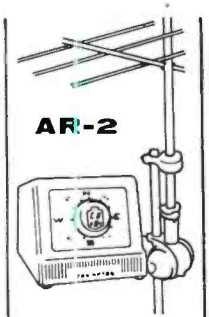
AR-22

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



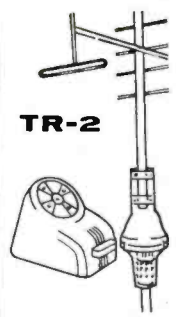
AR-1

Completely AUTOMATIC rotor, powerful and dependable Modern design cabinet 4 wire cable.



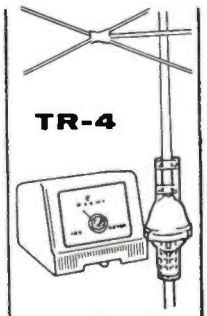
AR-2

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



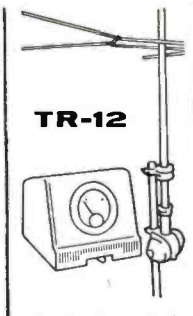
TR-2

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



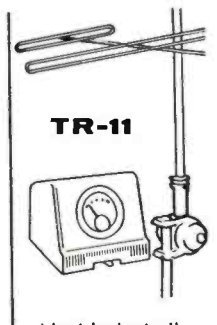
TR-4

Heavy-duty rotor, modern cabinet with METER control dial, 4 wire cable



TR-12

Combination value complete rotor with thrust bearing. Modern cabinet with meter control dial, uses 4 wire cable.

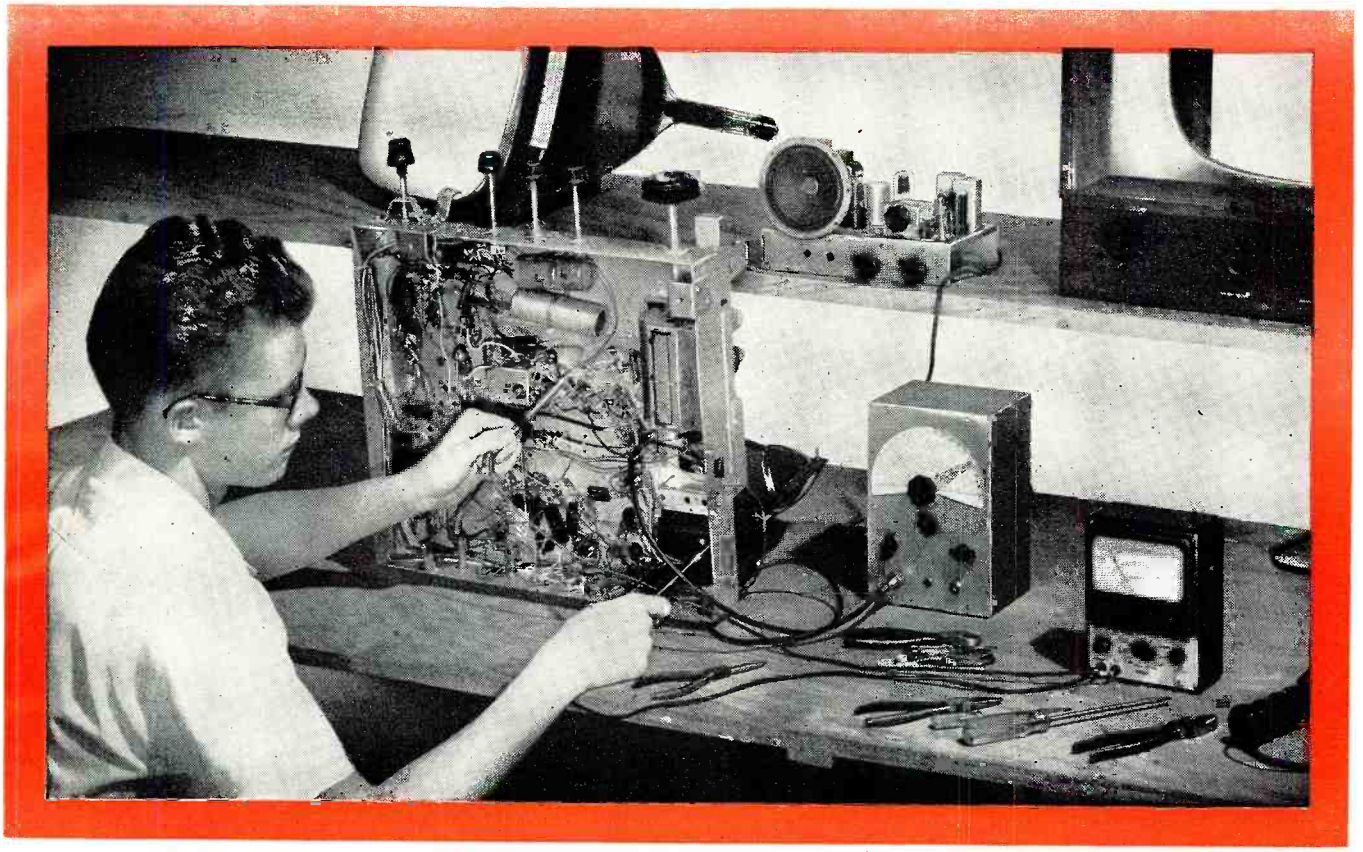


TR-11

Ideal budget all-purpose rotor, new modern cabinet featuring meter control dial, 4 wire cable.

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J

THE **RADIART** CORP.
CLEVELAND 13, OHIO



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

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

● **COURSE I—RADIO-TELEVISION ELECTRONICS**—starts you from the ground up to a solid working knowledge of electronics. Without any previous experience, you get a thorough training in radio theory and servicing techniques for AM, FM, home and car radios... plus an introduction to the fundamental theory and practices of television.

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

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

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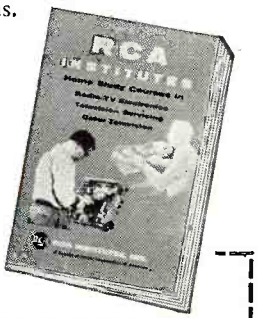

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List Price $129.50

$79.95

FREE! Five 1200' Reels Recording Tape with every Recorder ordered. Dealers—Stock Up Now.

Two Speed • Two Track • Featuring New "Plug-In" Recording Head

Here is one of the very few tape recorders with precision die-cast construction. Other features include the exclusive "Tape Guide" for perfect alignment and the pre-equalized heavy duty amplifier. Latest Model Electro-Voice crystal mike included.

Entire outfit is guaranteed to be distortion-free and deliver super-sensitive performance at either speed. Lowest wow and flutter, highest sound-to-noise ratio of any model 3 times its price.

Records and plays back at 3.75 or 7.5 inches per second. Handles both 5" and 7" reels. Records up to 3 hours on one mike, radio, TV or phono. Provisions for external speakers or monitoring headphone. Freq. response 50 to 7500 cps. Employs a full 5 tube amplifier. Carrying Case is finished in two-tone pin striped forest green. Operates on 115 V. AC 60 cy. Case size 14¾ x 11¾ x 8½". Weighs 24 lbs. Shpg. wt. 30 lbs.

HI-QUALITY RECORDING TAPE

PLASTIC BASE
1200' on 7" Dia. Reel

STOCK NO. X-249	Lots of 12, Ea.
Single, ea.....$2.19	$1.59
Lots of 6, ea....$1.79	

This famous brand tape regularly sells for $5.50—but Olson gives you a 71% discount. Perfect in every respect, this quality tape is famous for its low noise level and uniform output. Freq. response 50-15,000 cps—red oxide base—¼" wide. Reg. $1.25 seven inch plastic reel included—fits all recorders. Stock up now during this Giant Sale and get the Tape Buy of Your Life. Shpg. wt. (one doz.) 10 lbs.

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1800' TAPE ON 7" REEL

STOCK NO. X-583	Lots of 12, Ea.
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"GOLDEN GATE" 8" SPEAKER

With "Whizzer" Sound Disperser

Stock No. S-229 $4.95
List Price $12.50
Olson's Price, Ea.
2 for $9.50

Finely finished in all gold lacquer. Dealers, order these speakers for installation where space is a factor. Will outperform many 12" units. Employs two concentrically mounted cones for extremely smooth reproduction at high or low volume. Small cone in center of large cone is called a "Whizzer" and provides extended treble response, good overall balance and wide dispersion angle. Equipped with heavy Alnico 5 magnet and cover. Power handling capacity 8-10 watts. Response 40-12,500 cps. Speaker cone 8" diameter, voice coil 8 ohms. Shpg. wt. 5 lbs.

GENERAL ELECTRIC S1201A

HIGH FIDELITY 12" SPEAKER

Stock No. S-184 $14.99

DELIVERS 25 WATTS
FAMOUS GE MODEL S-1201A

Highly recommended by famous consumer research organizations. Reg. List $33.25. Provides clean, smooth frequency response over the range from 50-13,000 cps. Alnico 5 magnet weighs almost a FULL POUND and is guaranteed to deliver bass and treble notes distinctly. Non-varying 1¼" aluminum voice coil. 25 watts. Impedance 8 ohms. Operates perfectly on any Radio, TV or Amplifier. Shpg. wt. 12 lbs.

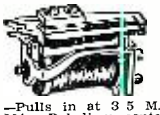
Little Champ Remote Speaker

with Volume Control
Reg. List Price $9.95

Stock No. S-233 $3.99 EA.
3 for $11.00

From your easy chair control volume or shut off either the speaker in TV set or the speaker built into the "Little Champ." Connects in one minute to any TV set, radio or record player regardless of make or model. Precision engineered PM speaker delivers all necessary volume at your chair or bedside. Completely assembled and supplied with 20 ft. of cable. Ready to operate—complete with hook-up instructions. Shpg. wt. 3 lbs.

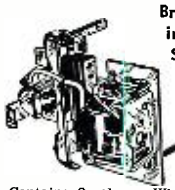
Single Pole—Double Throw Sensitive Plate Circuit Relay



Stock No. SW-64 $1.49 EA.
3 for $4.00

7500 Ohm DC Coil—Pulls in at 3.5 MA, drops out at 1.75 MA. Paladium contacts rated at 3 amps. Impregnated coil, treated for fungus and high humidity. Brand New—excellent for Remote Control, Photo-Electric Relay, Carrier Control Devices and many other uses. An unheard-of-price for a relay of this type. Shpg. wt. 1 lb.

STEPPER RELAY



Brand New—Original Cost $11.50
Stock No. SW-67

69c EA.
3 for $2.00

Here's an unusual buy in a relay that will serve many useful purposes. Contains 2 relays. When current is applied to No. 1 Relay it engages a brass piston which is driven along a precision track. After traveling 1½", the piston automatically signals Relay No. 2 which returns piston to original starting position. Ideal for tripping lens shutters, operating micro switches, or moving any light object 1½" by remote control. Operates on 15 to 24 volts DC. In transparent case. Size 4 x 4 x 3". Shpg. wt. 2 lbs.

LATCHING-TYPE RELAY

Made by Struthers-Dunn & Allied
Stock No. SW-66 **69c EA.**
3 for $2.00

Each unit contains 2 relays. Momentary voltage on one coil closes 2 contacts. Same voltage applied to other coil resets first relay. Operates on 12 Volts AC or DC. DPDT contacts will handle 6 amps. Removed from brand new equipment—fully guaranteed. Size 3½ x 2 x 1½". Shpg. wt. 2 lbs.

BASIC PLUG-IN AMPLIFIER

PUSH-PULL
Full 10 Watts Output
Stock No. AM-17
$7.95 EA. | 3 FOR $22.00

Designed to convert almost any receiver or amplifier with single tube output to push-pull high fidelity 10 watts output. Chassis contains all circuits required, including power supply and heavy duty output transformer. Uses two 6V6, one 5Y3, and one 6AT6. Chassis size 10" x 5". Converts almost any AC, AC-DC, or 3 way portable to a hi-fi radio, makes even the cheapest AC-DC radio sound like an expensive set. Output matches any 3.2-4 ohm speaker. Easy to install. Simply remove output tube from set and plug octal socket from amplifier into that socket. Connect set speaker to amplifier, that's all. AC accessory socket provided on top of chassis. Can also be used as booster PA amplifier, PA amplifier, modulator or converted to complete PA or hi-fi amplifier. Instructions included for use with sets using other than octal output tube. Operates on 115 V. AC 60 cy. Less tubes. Shpg. wt. 7 lbs.

SET OF WESTINGHOUSE TUBES FOR ABOVE AMPLIFIER.
STOCK NO. K-813, only..... $3.24

NEW SENCO TUBE CHECKER

Stock No. **$2.75**
TE-80

A must for servicing new series filament TV sets. Automatically checks all filaments including loctals and PICTURE tubes. Has built-in neon lamp and can be used as continuity and voltage tester too. Simple to use. Just plug tube into tester, if neon light glows, filament is good. In factory packed cartons. Shpg. wt. 2 lbs.

CABINET REPAIR KIT

Stock No. K-86 **$2.95**
Kit Only
REG. LIST $5.95

Now you can do a perfect cabinet refinishing job with this kit. No experience necessary. Contains everything you need for repairing dents, nicks or scratches in wood or plastic. You get 4 different shades of shellac sticks, bottle of French rubbing oil, alcohol burner, stainless steel spatula, felt rubbing block, and professional polish. Attractively packed and supplied with full instructions. Shpg. wt. 4 lbs.

9-PIECE DRILL KIT

Stock No. TL-9 **69c**

Set of 9 tempered carbon drill bits. Sizes 1/16" to ¼". Plastic holder included. Shpg. wt. 1 lb.

COMPLETE WIRE ASSORTMENT

Contains all the popular types of wire needed by the radio man. Notice that our price on the whole kit is less than HALF of the usual wholesale price.

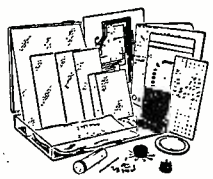
KIT CONTAINS	Reg. Wholesale
500 ft. Hook-up Wire, 5-100' Coils, assorted colors	$3.50
100 ft. Hi-Voltage Poly. Insulated cable, 30,000 volt	1.00
100 ft. Shielded wire for phones, etc.	3.50
100 ft. 2 conductor cable for intercoms and speaker extensions	2.00
100 ft. 18 gauge wire for heavy current loads	1.00
900 FEET, REG. WHOLESALE $11.00	

STOCK NO. W-244 $4.99
Your Cost Only

FREE! Wire Stripper With Each Kit.

FOR USE ON ALL SOLID OR STRANDED HOOK-UP WIRE, LINE CORD, ETC. Hardened and ground steel blades, cut with smooth shearing action, stripping or cutting wire neat and clean. Save time and effort on any type of construction or installation work. Adjustable calibrated stop on handle permits proper stripping each time. A tool suitable for production, service or experimental jobs.

PRINTED CIRCUIT KIT



Stock No. KB-27 EACH
$3.75 KIT

The latest marvel of electronics—now you can easily make your own printed circuits. Includes enough material to make several printed circuits of your own design. In addition, two circuit patterns are included to help you learn the techniques of printed circuitry. Kit consists of: 3 copper laminated boards, 4½" x 3", 4½" x 2", 3" x 2¼"; one each 7 and 9 pin printed circuit sockets, one pocket etchant; etching tray; tape resist; eyelets for terminals; one No. 52 drill for terminal holes; and complete illustrated instructions explaining theory use and construction. Shpg. wt. 3 lbs.

PANEL METERS

DC Ammeter—Records Charging Rates
Choice of 2 Movements

Stock No. TE-81 10 AMP
Stock No. TE-82 20 AMP

49c EA.
6 FOR $2.00
MAY BE ASSORTED

Brand New! Now available at less than manufacturing cost. Sturdy meters with shock resistant movements. Screw terminals and solder lugs. 2" Diameter. Handsome enamel finish. Choice of 10 or 20 Amp movements. Scales in 2 colors, read OFF—CHARGING—DANGER. Shpg. wt. 1 lb.

INTERPHONE AMPLIFIER

Signal Corps No. BC-709
Stock No. AM-15
$1.99 Special 3 for $5.00

Attention: Schools, Clubs, large Dealers—write for quantity price.

Brand new in factory sealed cartons. Original cost $32.00. Contains a wealth of valuable parts including 5 x 2½ x 8" aluminum case, 3S4 tube, socket, condensers, resistors, 4 jacks, input and output transformers, battery holders, etc. For operation on 2 flashlight cells and one 67½ volt battery.

Ready to operate or can be rewired for many other uses, such as: baby-sitter amplifier, SW or BC receiver, transceiver, crystal set audio amplifier, etc. The polished aluminum case alone is worth more than the $1.99. Get yours now—while they last. Circuit diagram and instruction book included. Shpg. wt. 7 lbs.

SHOCK MOUNTING ASSEMBLY FOR AMPLIFIER—Shpg. wt. 1 lb. 49c
STOCK NO. X-574, each.....

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BRAND NEW TV PICTURE TUBES

Guaranteed A Full Year • Individually Boxed • No Trade-In Required • Keep Your Old Tubes • Guarantee Registration Card Included

Factory Sealed Cartons. Every one guaranteed a FULL year and every one is shipped with manufacturers registration warranty card. Tubes carry the famous Olson Akrad label. No need to send in old tubes on trade-in. You can keep them and sell locally.

All tubes are standard in every respect and have magnetic focus and deflection. Cash in now on this unheard of bargain. Guaranteed perfect arrival by Railway Express.

STOCK No.	TYPE	OLSON SPECIAL
TU-8	10BP4	$10.95
TU-3	12LP4	12.95
TU-4	16KP4	16.95
TU-5	16RP4	16.95
TU-6	16TP4	16.95
TU-7	17BP4A	17.95

PHONO DRAWER SLIDE

Stock No. X-355
$1.19 PR.
3 Pr. $3.00

Made for expensive Dumont TV-Record Player Combinations. Used to mount changers in cabinets. Heavy Duty Construction. 18" long with a capacity of 50 lbs. Reg. List $4.00. Shpg. wt. Pr. 3 lbs.

TELEPHONE SET

Sound Powered

Includes Headset and Microphone

Stock No. M-98 **$3.95 SET**
2 Sets for $7.50

Brand New—original cost $30.00. No batteries needed—self powered. Permits 2-way talking up to 25 miles over any two-wire conductor. Each set contains a pair of sound powered high impedance dynamic headsets with felt padded rubber cushions and leather covered head-band. Both microphone and earphones have cone diaphragms and are extremely rugged and sensitive. Units may be removed from headsets to make efficient high powered miniature speakers. Useful for Antenna Installations where beaming of antenna is critical. Shpg. wt. 5 lbs.

AUTOMATIC TIME SWITCH

Stock No. X-582 **$7.95 EA.**
3 FOR $22.00

Regular $11.45. For accurate and dependable daily control of lights, signs, stokers, burners, valves, air conditioners, motors and other equipment where 2 or more on-off operations per day are required. Rugged synchronous clock type motor ensures years of dependable service. Heavy duty coin silver switch contacts handle up to 30 amps. Housed in heavy gauge grey wrinkle finish drawn steel case with cover equipped with a hasp for padlock or seal. Complete with 2 sets of completely adjustable die cast trippers. For 110-120 Volts, 50-60 cycle. Shpg. wt. 6 lbs.

TELEGRAPH KEY

Stock No. X-606 **89c** ea.

Pure coin silver contacts, heavy brass hardware. Fully adjustable. Base has threaded bushings for permanent mounting. Shpg. wt. 1 lb.

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Mail your order to 279 E. Market St., Akron 8, Ohio. Send remittance with order (add for postage 5c for each dollar's worth ordered—10c for each dollar's worth if you are more than 1000 miles away). OLSON REFUNDS EVERY CENT NOT USED. Or—send no money—we'll ship C.O.D. and you pay mail or expressman for merchandise and postage. ALL MERCHANDISE 100% GUARANTEED. PLEASE—MINIMUM ORDER $3.00.

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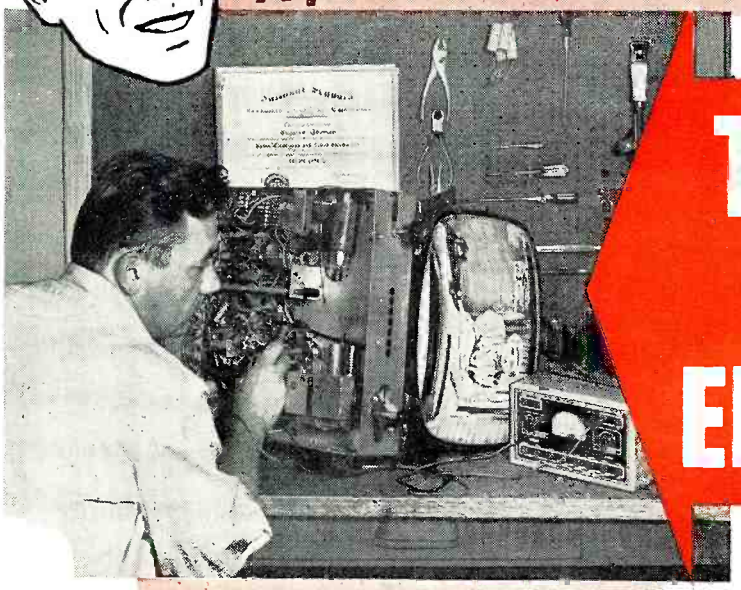

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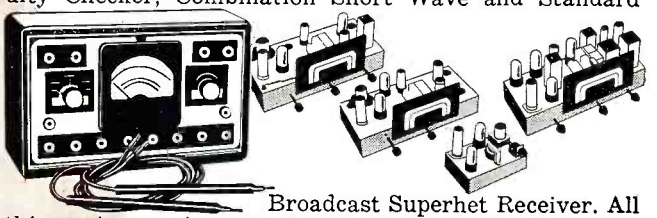
DRAFT AGE? Our home training helps you achieve specialized ratings and higher pay grades if you go in service.

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



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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!

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Wi hin he Industry

ROBERT L. WOLFF has been elected vice-president in charge of engineering for the *Centralab Division* of *Globe-Union Inc.*

He has been with the company since 1937 and has been director of product engineering since 1951.

At the same time Mr. Wolff's promotion was announced, the company also made public the appointment of W. S. Clark as division manager of the firm's "Badger" plant and of R. C. Anderson to a similar post at the "Keefe" plant.

* * *

JOSEPH A. DeMAMBRO of *DeMambro Radio Supply Co.,* Boston, has been elected president of the National Electronic Distributors Association (NEDA).

Serving with the new president will be Aaron Lippman of Newark, N. J. who was re-elected chairman of the board by acclamation. Other officers of the trade association include Leo I. Meyerson, *World Radio Laboratories, Inc.,* Council Bluffs, Iowa, first vice-president; Byron C. Deadman, *Northern Radio & Television Co.,* Green Bay, Wis., second vice-president; Victor N. Zachariah, *Zack Radio Supply Co.,* San Francisco, treasurer; and Meyer J. Spiro, *Meyers Electronics, Inc.,* Bluefield, W. Va., secretary.

L. B. Calamaras was re-appointed executive vice-president for a two-year term. The association maintains headquarters at 4704 W. Irving Park Road, Chicago 41, Illinois.

* * *

JACK WHITESIDE, general manager of *Simpson Electric Co.* of Chicago, has been promoted to the post of vice-president of the parent company, *American Gage & Machine Co.* in charge of the *Simpson Electric Division.*

Before joining the firm in 1945 he was employed in the laboratory of *General Electric Company* at Nela Park from 1936 to 1941 and at the Radiation Laboratory at MIT from 1941 to 1945.

He joined *Simpson* as a development engineer and was promoted to the post of general manager in September 1945.

* * *

EITEL-McCULLOUGH, INC. will add a new 17,000 square foot building, which will include facilities for the production of super klystron amplifier tubes up to twenty feet long, to its main San Bruno, California plant. Present plans call for completion of the building in early spring . . . **BRISTOL ENGINEERING CORPORATION** has negotiated a long-term lease on a three-story factory building in downtown Bristol, Pa. which will double its present working area . . . A five-million-dollar expansion program has begun at the main plant and offices of **STROMBERG-CARLSON COMPANY,** a division of **GENERAL DYNAMICS CORPORATION.** The program will add more than a quarter of a million square feet of floor space . . . **CBS-HYTRON** will build a completely modern 55,000 square foot warehouse in Chicago at Mannheim Road in Melrose Park. The new facility will be used to speed tube and transistor deliveries to dealers and distributors in the midwest . . . **SAMUEL KASS INC.,** New York jobber, has moved to new and larger quarters at 59-63 Moore Street, near Hudson Street, in New York City. The new location has 30,000 square feet of space.

* * *

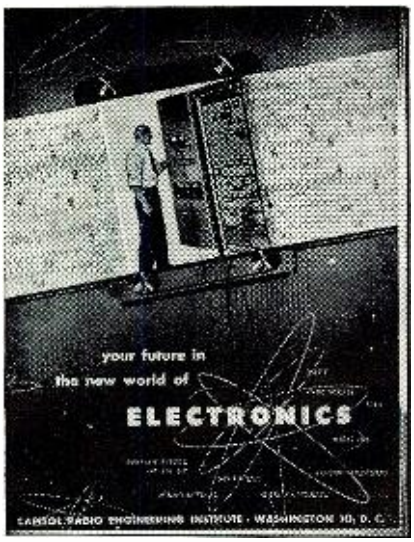
SAM SCHLUSSEL has been named to the newly-created post of sales manager, antennas and accessories, for *Channel Master Corp.,* Ellenville, New York manufacturer of antennas and antenna equipment.

Mr. Schlussel joined the firm five years ago as a project engineer in the antenna laboratory during which time he was responsible for the development of several of the company's best-selling antennas.

He was later named chief field and sales engineer and in this capacity was active in research, promotion, field testing, sales training, dealer education, and distributor relations.

* * *

AMERICAN RELAY & CONTROLS, INC. has been merged with **OHMITE MANUFACTURING COMPANY.** The parent firm will now manufacture the "Amrecon" relay line . . . **MUSICRAFT** has been established at 48 East Oak Street to handle the sale, installation, and servicing of high-fidelity equipment. The firm occupies all of the 7000 square feet of space in a remodeled four-story residence building on Chicago's near north side . . . **V. D. WALKER AND ASSOCIATES** has been established at 15219 Sunset Blvd., Pacific Palisades, California to offer counseling in all phases of industrial marketing . . . David Hafler has announced the formation of a new organization, **DYNA COMPANY,** with headquarters at 5142 Master Street, Philadelphia 31, Pa. Under the



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YOU CAN plod along for years, getting a paltry increase now and then, enjoying little security, finding your work dull and drab.

Then something happens. Things look up. You become more confident. Your earnings rise. You feel more important.

"Luck," some may say.

"Contacts," others may suggest.

But in your heart, you will know the answer: "Training." And it all may have started the moment you filled out a coupon requesting a copy of a free booklet named "Your Future in the New World of Electronics." From this data you get knowledge of where you stand in Electronics. Tremendous expansion leaves this gigantic industry pleading for trained men. Top manufacturers sold billions of dollars worth of electronic merchandise in 1955. By 1960, the radio-electronics industry should do no less than 10 billion dollars per year, not counting military orders.

Today there are over 97,000 radio-equipped police cars; at least 87,000 taxis are radio equipped; 37,730 civilian planes have radio; 35,000 American ships have radio.

Today there are over 122,000,000 radios in use. There are 37,000,000 TV sets and 413 TV stations in operation. Color TV is coming into its own. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

"Your Future in the New World of Electronics" shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

However, CREI does not promise you a "snap." With an accredited technical school such as this, you must *study* to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since its founding in 1927, CREI has provided thousands of professional radio men with technical educations. During World War II CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears, Roebuck and Co., Bendix Products Division, All-American Cables and Radio, Inc., and Radio Corporation of America.

CREI courses are prepared by recognized experts in a practical, easily understood manner. You get the benefit of time-tested materials, under the personal supervision of a CREI Staff Instructor, who *knows* and *teaches* you what industry wants. This is accomplished on your own time, during hours selected by you, and controlled by your own will power. This complete training is the reason that graduates find their CREI diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold top positions in America's leading firms. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply.

CREI resident instruction (day or night) is offered in Washington, D. C. New classes start once a month.
VETERANS: If you were discharged after June 27, 1950—let the new G.I. Bill of Rights help you obtain CREI resident instruction. Check the coupon for full information.

Now is the time of decision for you. Luck will not propel you forward unless it finds you trained. Contacts won't budge you an inch unless you have the skill to back them up. The answer is: Technical Training . . . and willingness to learn. Together they will bring you increased earning in this new Age of Electronics. Fill out the coupon below and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future— is up to you.

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.....

tradenames "Dynaco" and "Dynakit," the company will design and produce electronic components and equipment with particular emphasis on audio items for the high-fidelity market.

* * *

PERRY C. SMITH has been appointed manager of the Equipment Department of *Brush Electronics Company*, Cleveland.

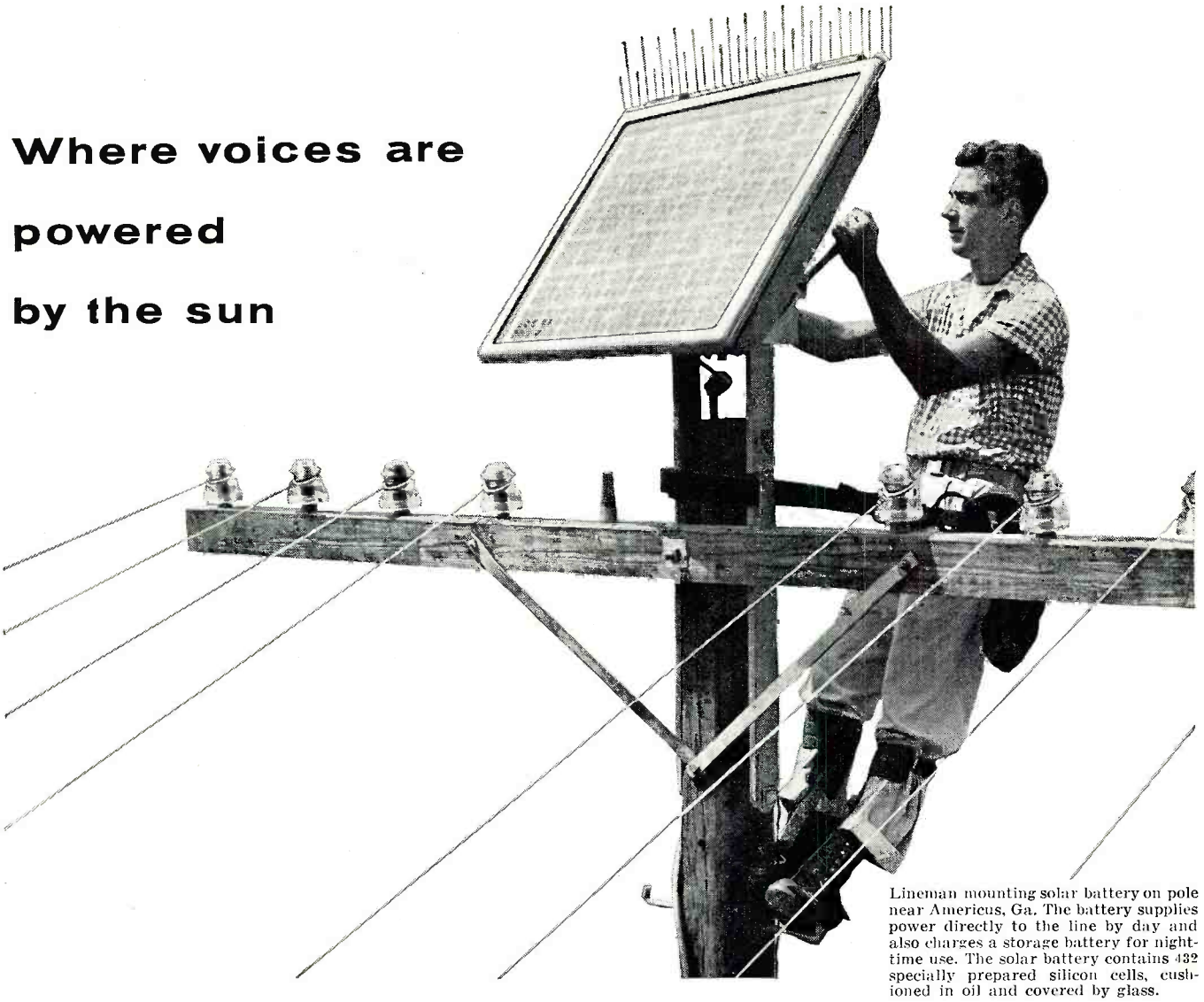
Mr. Smith, who joined the company early in 1955, was formerly general manager of the Electronics Instruments Division of the *Burroughs Corporation*. Prior to that he was manager of Scientific Instruments Engineering for the *Radio Corporation of America* in Camden.

In his new post he will direct the sales activities of the department which includes recording systems, amplifiers and direct-writing oscillographs, sound measurement instruments, industrial inspection equipment, and computer and tape storage devices.

* * *

FREDERICK D. OGILBY has been appointed vice-president, marketing, for *Philco Corporation*. He has been with the firm for over 20 years . . . **WILLIAM P. MAGINNIS** has been elected president of *Kuthe Laboratories, Inc.* of Newark, N.J. a subsidiary of *International Telephone and Telegraph Corporation*. He succeeds **DR. HERMAN KUTHE,** founder and first president, who has been elevated to chairman of the board . . . *Hoffman Electronics Corporation* has elevated **PAUL E. BRYANT** to the post of general sales manager of its radio division . . . *Brush Electronics Company Division* has named **JOHN H. HARRIS** to the post of vice-president in charge of planning and **WALLACE T. GRAY** general works manager . . . **A. ERIC THEIS** is now vice-president in charge of manufacturing, **CHARLES F. HEALEY** is vice-president in charge of administration, and **H. GORDON HAWTHORNE** is treasurer of *Servo Corporation of America* . . . *International Resistance Company* has appointed **GUY B. ENTREKIN** to the post of plant manager of its fifth and newest manufacturing branch plant located in Burlington, Iowa . . . **J. KNEELAND NUNAN** has been named to the new post of vice-president and general manager of the *Clevite Research Center* in Cleveland . . . *El-Tronics, Inc.* of Philadelphia has appointed **ARNOLD A. ZACHOW** to the post of vice-president in charge of operations . . . **ROBERT O. VAUGHN,** nationally-known electronics executive, has joined *National Aircraft Corporation* as vice-president. He was formerly with *Hoffman Laboratories, Inc.* . . . *Haydu Brothers,* a *Burroughs Corporation* subsidiary, has named **ARTHUR B. SHESSER** to the post of director of sales and **FRANK G. FERDINAND** to the position of sales manager of the cathode-ray tube division . . . **ALLEN S. JOHNSON** has joined the electronics division of *Thompson Products, Inc.* as assistant to the divi-

Where voices are powered by the sun

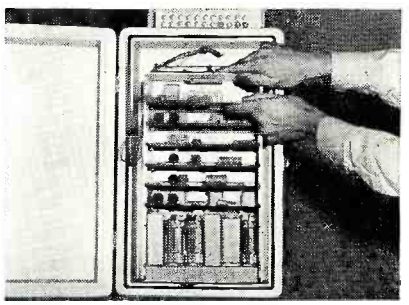


Lineman mounting solar battery on pole near Americus, Ga. The battery supplies power directly to the line by day and also charges a storage battery for nighttime use. The solar battery contains 432 specially prepared silicon cells, cushioned in oil and covered by glass.

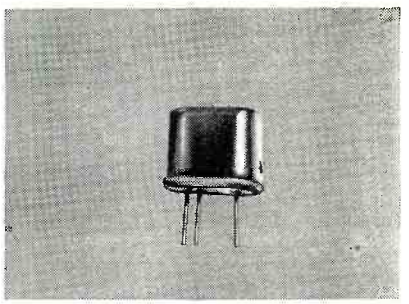
A new kind of telephone system developed by Bell Telephone Laboratories for rural areas is being operated experimentally by electric current derived from sunlight. Electric current is generated as sunlight falls on the Bell Solar Battery, which a lineman is seen adjusting in position.

The exciting achievement is made possible by two Laboratories inventions—the solar battery and the transistor. The new system uses transistors to the complete exclusion of electron tubes. Transistors require little power and this power can be easily supplied by the solar battery.

Compact and economical, the transistorized system can carry several voices simultaneously without interference. It has proved its ruggedness by standing up to heat, cold, rain and lightning. It promises more and improved telephone service for rural areas and it typifies the Laboratories' continuing efforts to make American telephony still better each year.



In sending and receiving terminals, transistors are used as oscillators, amplifiers and regulators, and for signaling.



One of the transistors (actual size) used in the new system. New ideas, new tools, new equipment and new methods had to be developed for this project.

BELL TELEPHONE LABORATORIES

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sion's manager. He was formerly with *Webster-Chicago Corp.* of Chicago . . . *National Company* has appointed **MARTIN W. ROGERS** to the post of director of quality control. He formerly held a similar post at *Raytheon* . . . *Fanon Electric Co., Inc.* has named **WALTER NACHTIGALL** to the newly-created post of advertising and sales manager for the audio firm . . . **VICE ADMIRAL CHARLES B. MOMSEN, USN (ret.)** has been engaged by *General Dynamics Corporation* to serve as a consultant in the firm's widespread activities. He will be available to work with engineers and designers of the *Stromberg-Carlson Company* on problems of marine applications of communication and electronics equipment . . . **CARL V. HAECKER,** sales promotion and displays manager for the *Radio Corporation of America,* died recently of a heart condition. He was a nationally-known authority on store merchandising, promotions, and point-of-sale displays . . . *Erie Resistor Corporation* has appointed **JAMES H. FOSTER** to the post of general manager of its expanding electromechanical division. He has been with the firm for five years . . . **EDWARD L. NELSON,** scientific chief of research and development for the Army Signal Corps, died recently of a heart attack at the age of 64 . . . **REAR ADMIRAL ERNEST ST. C. VON KLEECK,** former chief of staff and aide to the commandant of the Fourth Naval District, has been named assistant to the president of *El-Tronics, Inc.* . . . **J. E. VAN WAGENEN,** formerly sales manager of the company's semi-conductor products division, has been upped to the post of selenium product line manager for *Federal Telephone and Telegraph Corporation* of Clifton, N. J. . . . **JERRY MERICAN** has resigned as President and Sales Manager of *Precise Development Company,* Oceanside, N. Y. His immediate plans are indefinite, although he will remain in the electronics field . . . **OLIVER MUELLER** has been appointed Chief Engineer of the *Aircraft Controls Division, Gorn Electric Co.,* Stamford, Conn.

* * *

CHARLES McKINNEY has been appointed director of market-merchandising for both the tape recorder and background music divisions of *Magnecord, Inc.* His appointment is part of recent management plans for increased national distribution and promotional activity for both divisions.

Mr. McKinney will continue as director of advertising and public relations for the firm in addition to assuming his new duties. He was associated with *Raytheon* in a like post before joining the firm and prior to that operated his own merchandising and marketing firm in Chicago.

* * *

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(*Continued on page* 152)

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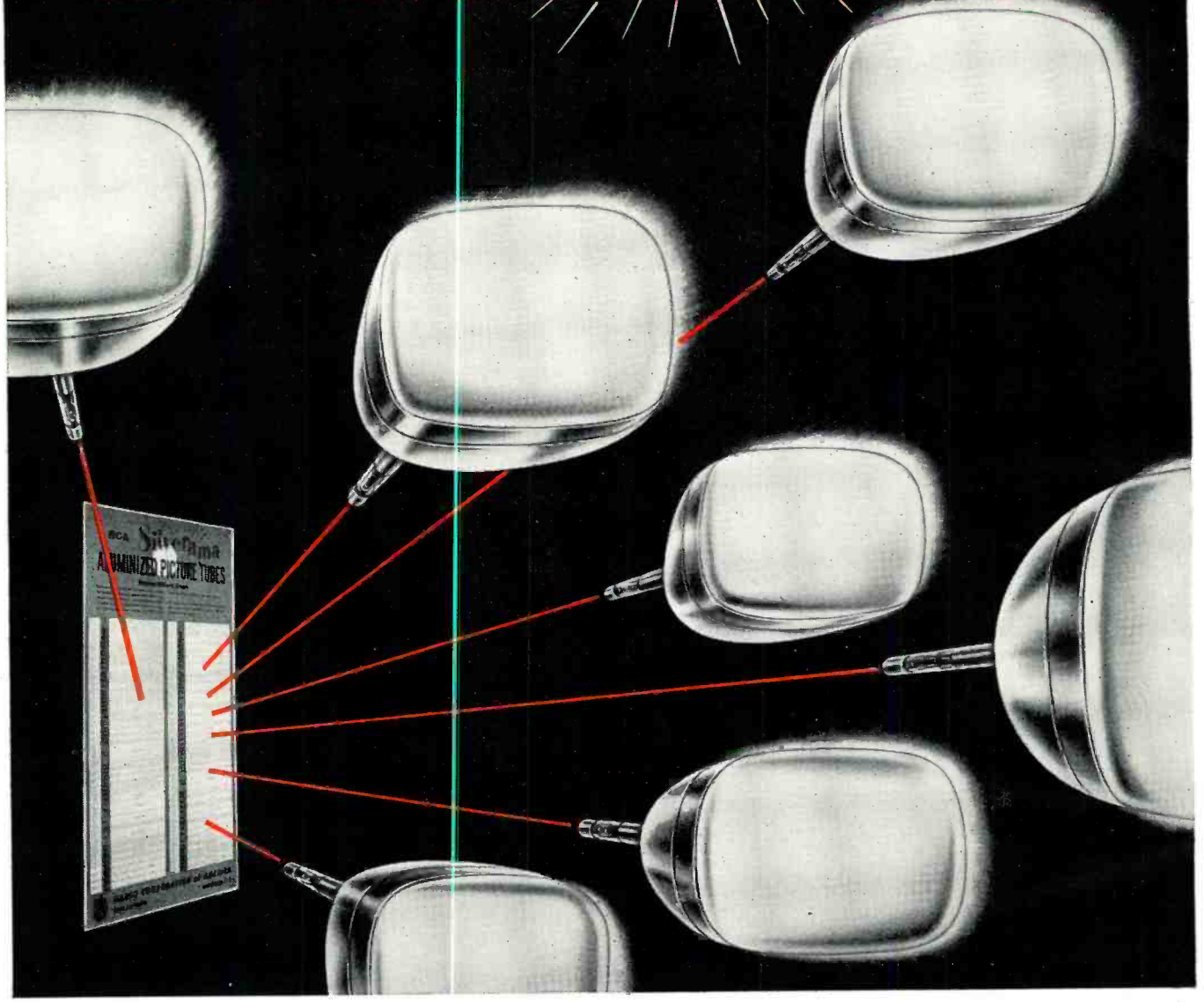

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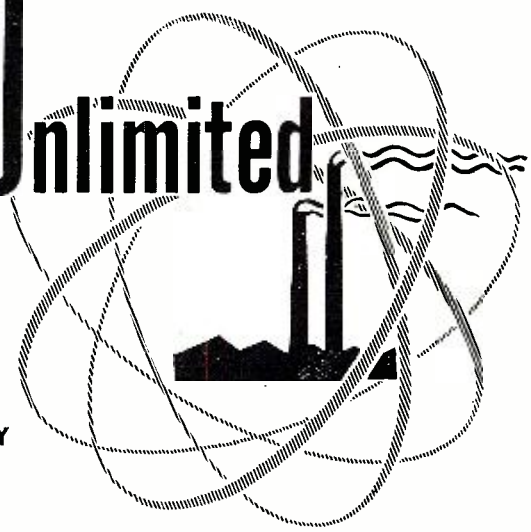
Electronics—Horizons Unlimited

a Guest Editorial



By **MICHAEL KOURDAY**
Investment Research Dept.
E. F. Hutton & Company

The radio-electronics industry, although big, is still young. Within the next ten years it should boast a sales volume of at least 20 billion dollars.

TO A NON-TECHNICAL observer of the electronics field, the single factor which makes it completely unique and fascinating is its capacity for almost infinite growth. Bound only by the limits of the mind of man, this infant industry has already far surpassed early expectations. By establishing a pattern of renewing its vigor through the periodic development of new aspects, it has assured itself of a continuing future. Despite its youth, electronics already ranks as one of our foremost industries, with an annual sales volume of $9 to $10 billion. Notwithstanding this remarkable record of growth, electronics can still be considered to be in the formative stages. Many observers predict that the industry will be able to boast a sales volume of $20 billion within the next ten years.

That such tremendous growth is entirely possible, indeed probable, may be discovered through a study of some of the facets of the electronics field. An examination of its major areas of operation offer clear evidence of the overall growth potential. These areas include: (1) radio manufacturing, (2) television manufacturing, (3) military electronics, (4) industrial electronics, (5) servicing and parts, and (6) broadcasting.

Radio—The Electronics Pioneer

Although the electronics industry was born in 1906 when Dr. DeForest invented the vacuum tube, it was the application of this tube in radio which provided the industry with its initial impetus. In 1919, when radio was still in the cradle stage, its annual sales were estimated to be in the area of $2 million. A decade later, 4.2 million sets valued at about $600 million were sold. Although mass production techniques soon resulted in declining dollar values, the number of sets sold continued to increase substantially, reaching a peak of 17 million in 1947. Inevitably, a saturation point was reached, and today, with an estimated 130 million receivers in use, radio no longer offers growth prospects. The importance of radio, however, in the total electronics picture should not be underestimated since normal demand, combined with a large replacement market, can support a sales volume of between $250 million and $300 million annually.

TV—Radio's Successor

Although radio expanded airplane fast, television by comparison seems to have been jet-propelled. In just three years, the television industry became a $1 billion business, rising from $50 million in sales at the factory level in 1947 to $1.3 billion in 1950. By way of contrast, it took the auto industry ten years and the commercial airlines 25 years to reach the $1 billion mark.

More important is the fact that TV's future is still extremely promising. For one thing, it can be expected that almost all of the nation's 47 million radio set homes will one day have a television set also—a potential market of 15 million TV sets. Also, the TV industry has reached an age where the obsolescence factor has become operative. A replacement demand of only 5% (due to obsolescence on the estimated 34 million sets now in use) will call for sales of 1.7 million sets. An added boost will be the introduction of a second set in many homes which should entail the sale of some 300,000 sets annually.

While these factors give considerable brightness to the future of TV, the real sparkle is added by the imminence of color. Although the high price makes it questionable as to just when this aspect will come into its own, it is almost certain that within the next ten years color TV will account for more than half of all sets manufactured. In 1955 it is expected that some 7.9 million receivers will be sold. With slightly higher prices (necessitated by rising material costs) 1955 should prove to be an outstanding year.

Undoubtedly, television will continue to be an important contributor to the electronics industry's growth for some time to come. After the sales saturation point has been reached, a continuing market will be provided by the fact that the normal replacement for TV will enable the industry to enjoy sales of about $1.5 billion to $2 billion annually—which would compare with a current sales volume at the manufacturing level of about $1 billion.

Military Electronics

The largest share of the electronics industry's products goes to feed the vast demands of modern "push-button" warfare. It is estimated that the military spends about 6% of its funds for electronic equipment, amounting to roughly $2.5 billion annually.

Although a good part of electronics' role in armaments is classified, its application in such items as airplanes, guided missiles, proximity fuses, and gunfire control systems is well known. In today's airplane, for instance, electronic products represent about half of the total value of the plane. In a modern bomber there may be found some 5000 tubes and 115,000 resistors and capacitors. Some of the functions which these electronic devices are able to perform are truly astounding. One such marvel is the computer, which is capable of piloting aircraft automatically, from takeoff to landing, on split-second scheduling.

As the electronics field continues to expand, the demand from this source is expected to grow rapidly. Estimates of foreseeable military requirements indicate government purchases of $3.2 billion a year in 1958-1960 and better

(*Continued on page* 111)

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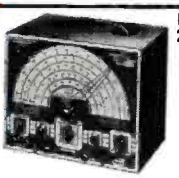

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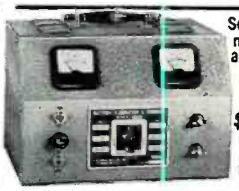

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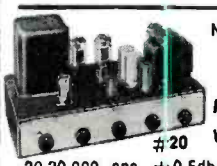

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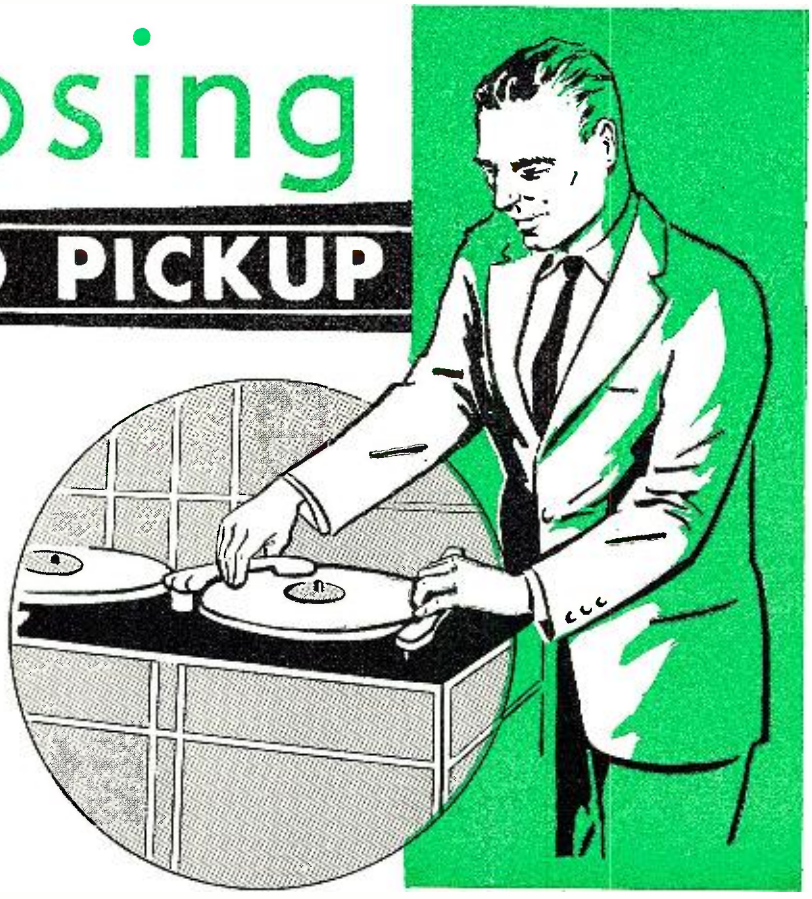
Choosing A PHONO PICKUP



By
N. H. CROWHURST

A detailed description of the operating principles of most of the major types of pickups with specific suggestions for picking a unit for your audio system.

A PERFECT pickup has not yet been designed and is not likely to be. So the best we can do is to find the nearest thing to perfection among the different varieties of cartridge available. Because none of them is perfect, the decision as to which one comes closest to perfection is a matter of personal choice. As in many other fields of endeavor, one school of thought claims the correct way of doing it and thinks any other way is incorrect. The fact sometimes remains that the man who adopts a method dubbed as "incorrect" often achieves results quite as good as, and sometimes better, than the man who adopts the supposedly "correct" method.

The whole field of audio has its own special jargon, but probably no part of the field has a greater concentration of specialized terms than the beginner encounters when he sets out to acquire a high-fidelity phonograph reproducing system. The only way to decide for yourself is to be well armed with a knowledge of the significance of the different technical terms involved, so as to know what to look for and listen for in each particular type of instrument.

Transducer Element

Let's start by considering the different methods by which the mechanical movement, picked up by the stylus, is transformed into electrical energy to be amplified by the system. This is chosen first because it is a very important point in achieving freedom from distortion. Also there are quite a number of names here, some of which have overlapping significance, so the newcomer can be confused as to just which type is which.

The method that has been in use the longest is called, variously, moving iron, magnetic, or variable reluctance. The term "moving iron" derives from the days of radio when there were just two kinds of loudspeaker. The older variety used a fixed coil with an iron armature that moved when signal currents were fed through the coil. The improved type of that day had the whole magnetic structure fixed and the coil was allowed to move with the audio signal currents in it. These types were designated respectively moving iron and moving coil. The same principle is applied to pickups where, in reverse, the movement causes the electrical currents instead of *vice versa*.

The term "moving iron" signifies that there is a moving armature with a fixed coil and that movement of the armature in some way varies the magnetic field passing through the fixed coil.

This construction is also called magnetic because the movement of the needle or stylus causes changes in the magnetic field which, in turn, generates an electrical output.

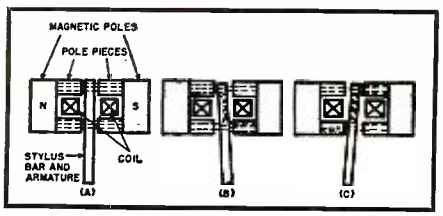
It is also called variable reluctance because reluctance is the quantity which causes the magnetic field to change. "Reluctance" is a term in magnetism similar to resistance in electricity. By changing the length of air gap in different alternate magnetic paths from the magnetic pole pieces, the reluctance of those paths changes and hence the magnetic field or flux changes its course. Fig. 1 illustrates the basic structure of a pickup of this type.

The next group comes under the general heading of dynamic. This is really an abbreviation for the full term electrodynamic which means that the audio output generated derives from movement of the electrical "conductor" in some way. In this group are two sub-groups, moving coil and ribbon, each of which employ the same basic principle. The chief difference lies in the fact that a coil contains a number of turns wound into a solid form, while a ribbon is a single half turn of flexible conductor that is free to move in the magnetic field.

In a pickup the moving coil or ribbon has to be extremely small in order to maintain good frequency response out to the high frequencies.

There are two basic ways in which the moving coil can move. These are illustrated in Fig. 2. In Fig. 2A the coil is rotated in the magnetic field in such

Fig. 1. Basic principle of moving iron, magnetic, or variable reluctance type pickup. At (A) the armature in its central position does not carry any magnetic field in the coil. At (B) some of the magnetic field, shown dotted, passes through the coil, because the armature is displaced. (C) Displacement in the opposite direction reverses the direction of field through coil.



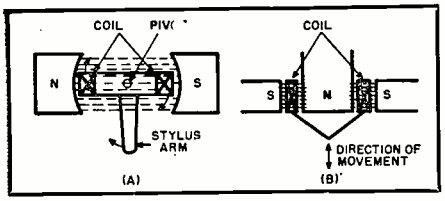


Fig. 2. Basic principles of moving coil pickups. At (A) the coil rocks about an axis due to the movement of the stylus. At (B) the whole coil moves as indicated.

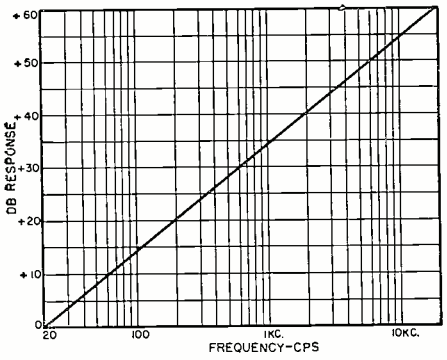


Fig. 3. Relation between constant-velocity and constant-amplitude characteristics. If a variable-frequency disc were recorded at constant amplitude and played back with a velocity-sensitive pickup, the response would follow the curve indicated above.

a way that the voltages developed in it, due to its rotation, are additive in the opposite sides of the coil. In the arrangement of Fig. 2B the coil follows a push-pull movement and in this case the whole of the coil is active in producing voltage because the whole of the coil is between a north and south pole. The latter construction is basically similar to that of a moving coil speaker except, of course, that it is very much smaller.

All the types so far mentioned use electromagnetic principles for transforming the mechanical movement into an electrical output. The difference lies in that the first type produces the electrical output by changing the configuration of the magnetic field, while the second (dynamic) type keeps the magnetic field constant—and it should be uniform throughout the area in which the coil moves—and produces the electrical output by moving the coil (or electrical conductor in the case of the ribbon) in the uniform magnetic field.

This is where our theorists would have us believe there is a right and wrong type. According to theory it is impossible to obtain a perfectly uniform change in the configuration of the magnetic field with the movement of the armature. Early studies of magnetism show that the attraction between poles of opposite kind is proportional (*a*) to the strengths of the poles and (*b*) inversely to the square of the distance between them.

If we consider the construction shown in Fig. 1, statement (*b*) means that in a condition of balance, where the distances are equal, as shown, all the magnetic pulls are uniform; but as soon as the armature gets a little off-balance it will tend to pull to one side or the other according to the direction of movement. This is overcome in practice by use of a centering force, which also often serves as damping, enabling the armature to be restored to its central position. Careful attention to the design of the magnetic field construction can also produce a magnetic centering force.

But whatever construction is used, it is theoretically impossible to obtain an electrical output that faithfully follows the mechanical input, because of the inherently nonlinear manner in which the magnetic field changes with movement of the armature. In practice, the fact that the phonograph needle or stylus moves such very small distances, in the course of playing a phonograph record, means that the effective linearity has to be maintained over a very small movement, and not over the entire distance through which the stylus *could* move before hitting both pole pieces. This fact means that, by very careful design, a close approximation to linearity can be achieved over the small amount of actual movement encountered in playing phonograph discs.

The protagonists of the dynamic, that is, the moving coil or ribbon type, phono pickup tell us that it is inherently linear, because, *if the coil moves in a uniform magnetic field* the output will always be proportional to the mechanical movement causing it no matter how far the stylus moves.

In practice there are many other things that enter into the design of a phono cartridge, which means that it is not an essential fact that a moving coil or ribbon cartridge is free from distortion, while a moving iron cartridge must have distortion. The electromechanical transducer effect is not the only thing that can cause distortion. The mechanical suspension arrangement, responsible for controlling the movement, can also cause distortion in the way the stylus moves, or follows the groove. This fact *can* mean that a moving coil may not give any better performance than a well-designed pickup of the magnetic or moving iron variety.

All of the pickups thus far discussed require some kind of damping or controlling element to center the movement of the mechanism. For satisfactory performance of the unit, this material has to possess both a stiffness, or compliance, and a resistance to movement, or damping. Various kinds of rubber and plastic materials are employed for this purpose.

At different times in the history of phonograph development, individual pickups have been built, which *at the time* possessed perfect damping. The big problem is that none of these damping materials so far produced will last indefinitely. Their qualities deteriorate with time, and hence the performance of the pickup will not maintain its "new" standard. Improved materials have been developed which considerably lengthen the time for which the pickup will give its "new" performance, but to date no material has been developed which will last indefinitely.

This means that any pickup in either of these classes has a limited life before the damping material must be renewed, if original performance is to be maintained. In practice, of course, the adoption of the plug-in cartridge idea has enabled the user to remove the old cartridge and plug in a new one of identical type, when performance begins to deteriorate.

Another feature that all the pickups discussed so far possess in common, is the use of the *velocity* principle. This means that the electrical output from the cartridge is dependent upon the *velocity* at which the stylus tip moves. Technically this means that the peak of an audio waveform occurs when the stylus tip is moving at its maximum velocity which will be the middle position of a fluctuation in the groove. When the stylus is not moving the output is zero momentarily.

This would appear to be just a matter of phase relation and, as such, would be comparatively unimportant, but there is another fact that derives from it. If we consider a theoretical disc on which a groove of varying frequency has been cut, and the amplitude of movement of the groove is the same at all frequencies, then obviously the stylus will have to move very much faster at the high frequencies to reach this amplitude than it does at the low frequencies. In fact, the velocity of movement, for constant amplitude, will be proportional to frequency. Since the output from this type of cartridge is proportional to velocity, this means that a constant-amplitude recording will produce an output rising at 6 db-per-octave, in order to be proportional to frequency, as shown in Fig. 3.

In practice, most of the cutter heads used for making recordings also employ the constant-velocity principle so that the recordings would be of constant velocity with frequency rather than constant amplitude, if it were not for the equalization employed, both in recording and playing back. If a completely constant-velocity principle were used in making recordings, the width of groove modulation would increase at low frequencies, inversely proportional to frequency.

Because this would result in prohibitive groove excursion, wasting record space at the low frequencies, the response is rolled off as part of the equalization characteristic on recording, and a corresponding low-frequency boost is introduced in the playback amplifier, following the pickup.

Similarly, because the very small excursion that results at high frequencies will not be much bigger than the little bits of dust that collect in the groove and cause noise, the high frequencies are pre-emphasized, so as to be of larger amplitude, before recording, and the playback equalizer introduces a high-frequency roll-off to bring these upper frequencies back to their correct normal relationship.

This means that, on the basis of our theoretical constant velocity recording, the record characteristic is as shown in Fig. 4A while the playback characteristic is complementary to it as shown in Fig. 4B. In practice there is a variety of equalization characteristics and those shown here are just typical of the general scheme.

There are other types of recording heads and pickups that employ a constant-amplitude principle, that is. the output is proportional at all frequencies to the *amplitude* of stylus movement. In Fig. 4B the result of playing a constant-velocity type disc through a constant-amplitude type pickup is shown dotted. It will be seen that not too much equalization will be necessary to bring this to a level response, because the equalization required will be the difference between the solid curve and the dotted line. This equalization is shown at Fig. 4C.

Popular types of pickups, using the amplitude principle, are the piezoelectric and the electrostatic. The piezoelectric types fall into two groups, the crystal and ceramic. Both employ a piezoelectric principle in which movement of the stylus sets up a voltage due to distortion of the piezoelectric material.

In the crystal type of cartridge the piezoelectric material is a Rochelle salt crystal. These were very popular in the thirties and gave reproduction that was quite pleasing compared with the best competitive forms at that time. However a crystal structure is always apt to have mechanical resonances of rather high "*Q*", which means that any peaks or valleys the mechanical system of the pickup introduces are apt to be rather severe.

They can be damped out to some extent but this is rather difficult. In modern design the construction of the pickup is such as to remove these resonances beyond the audio range.

The crystal type of cartridge has the disadvantage that Rochelle salt is extremely susceptible to high temperatures and moisture. Consequently they can easily deteriorate, if subjected to high temperatures or humid conditions. The ceramic type of cartridge employs a variety of ceramic in which the molecules have been polarized during manufacture under a strong electrostatic field. This produces a piezoelectric material which is not subject to temperature and humidity in the same way that Rochelle salt is.

With this basic type of element there is a limit to the amount the crystal or ceramic element can be distorted before its elastic limit is reached. Beyond this limit, further stress permanently distorts the element, until a stress in the opposite direction restores it to its original form. So, as the elastic limit of the material is approached, the relation between movement of the stylus and electrical output will cease to be linear and it will begin to introduce distortion.

The final choice of pickup cartridge to be discussed is the electrostatic type. It does not employ the simple electrostatic principle of producing a voltage by varying the capacitance of the plates with a constant charge. In this cartridge the capacitance between the plates, which the movement of the stylus varies, is part of an oscillatory circuit, operating as an r.f. generator. Variation of the stylus position modulates the frequency of r.f. oscillation, which is then demodulated, in the same way an FM receiver demodulates an FM carrier, and the output is available as an audio signal. This is the principle used in the *Weathers* cartridge.

While this technique very conveniently eliminates many of our mechanical problems, at the same time it really transfers them into the electrical circuit, because now our linearity is determined by the correct operation of the FM demodulator circuit.

Type of Stylus

So much for general transducer principles. Before we discuss the various characteristics of these pickups in general there are some features related to the contact between disc and stylus that require attention. One question that will arise concerns what stylus point to use.

In the early days of phonograph pickups, steel needles were used and the record manufacturers introduced abrasive material into their discs, which served the purpose of keeping the steel needle sharpened to the correct shape during the playing of one disc. The single-play type needles wore down sufficiently during this playing to make them unsuitable for a second playing and so the needle had to be changed after every disc. Failure to do this resulted in serious damage to the record due to the needle becoming unduly enlarged at its point.

The use of successively harder grades of steel resulted in needles that would play for a longer time before needing to be changed. First, needles were developed that would last ten playings and then the so-called "permanent" type, which was sold in packets of ten instead of boxes of a hundred. Of course the fact that you bought ten in a packet belied the title "permanent."

These facts serve to illustrate a basic principle in the use of phonograph discs for transcription of program material. The recorded information has to be transferred from the disc groove to a stylus by mechanical friction between the groove of the disc and the point of the stylus. This inevitably involves wear. The early attempt was to make the needle suffer more than the record so as to preserve the quality of the record longer. However the wear was always considerable, because the needle was harder than the record material and hence both had to wear to some extent.

The high frequencies invariably suffer more than the lower frequencies in the course of wear because they constitute much smaller deviations in the modulation of the groove. So the modern approach has been to reduce wear by reducing stylus pressure and using much harder stylus materials so as to minimize wear of both the disc and the stylus. Of course the degree of wear is still relative, because the mere fact that there is mechanical friction means that *some* wear must take place.

The successive development of sapphire and diamond styli has shown considerable improvement over the best hardened steel variety. The sapphire stylus will play much longer than the "permanent" needles just referred to, and the diamond stylus can be played over a thousand times without showing detectable wear.

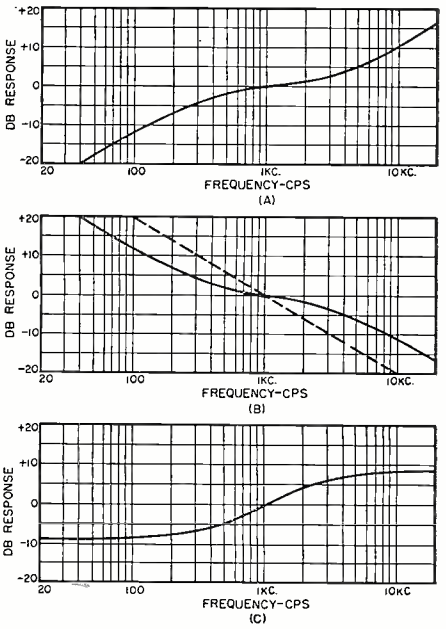
Because the styli are so hard any wear that takes place will occur in the disc. This, of course, is distributed over miles of groove, and hence can be quite small, if the pressure between the stylus and the groove is kept to a minimum.

Stylus Force

This pressure is called stylus force and a feature in the design of all pickups is the stylus force necessary to maintain tracking. The word "tracking" is applied to two different things in phonograph reproduction. The meaning intended here concerns the ability of the stylus to stay in the groove at all the modulation frequencies in the audio band. The other meaning has to do with correct tone arm mounting,

(*Continued on page* 147)

Fig. 4. Equalization characteristics associated with disc recording and playback. (A) Recording equalization for velocity-sensitive cutter head. (B) Playback (solid line) equalization for use with velocity-sensitive pickup and discs cut to the characteristic of (A). The dotted line is for a disc recorded at constant amplitude which would require this equalization for playback with velocity-sensitive pickup. (C) Playback equalization required for standard discs used with amplitude-sensitive pickup. This curve is the difference between solid and dotted lines of (B).



Transistor Radios

Part 1. For the first time, here is a complete analysis of the operation of all transistor radios now available.

By MILTON S. KIVER *

AMONG the first commercial equipment in which transistors are used are small, portable, radio broadcast receivers. This is a natural application since transistors lend themselves readily to compact, lightweight assemblies of the type required in such receivers. The portability feature is further enhanced by the fact that only small "B" batteries are required for power. Filament heating batteries, which vacuum tubes require and which occupy considerable space, are completely dispensed with here.

A number of manufacturers are now marketing transistor receivers (see above) and, in time, some of these units will be finding their way to the local service shop. As a first step in dealing with these sets, it behooves the technician to understand the basic operation of transistors in general. This material has already been covered in various articles in RADIO & TELEVISION NEWS and will not be repeated here. The next step is to consider transistor applications in various circuits, particularly those found in radio receivers, and that is the purpose of this article. We will see just what differences exist between vacuum-tube and transistor radios and, in most cases, why these differences arose. Once these are understood, then the technician will be able to apply specific servicing techniques intelligently and effectively.

The Regency Radio

The first transistorized portable radio receiver to appear commercially was the *Regency* Model TR-1, which took advantage of every space-saving feature afforded by transistors and associated miniature components. See Fig. 1. Over-all dimensions of the unit are 5 by 3 by 1¼ inches, enabling the entire set to fit easily into the pocket of a man's shirt. Weight of the set, with the batteries, is about 12 ounces.

The schematic diagram of this receiver is shown in Fig. 3. There are four transistors and five stages; the extra stage is the second detector and its function is performed by a germanium diode, here either a *Raytheon* CK706A or a *Tung-Sol* TS117. The transistors are of the *n-p-n*, germanium, grown-junction variety and three different types are used for the converter, i.f., and audio stages. All are made by *Texas Instruments, Inc.*

The first stage, containing transistor V_1, is essentially a self-oscillating converter. The input signal is picked up by a tuned ferrite-core coil which possesses a high *"Q."* A low-impedance winding on the antenna coil couples the signal to the base of V_1. Local oscillations are generated by a parallel resonant circuit connected to the emitter. The former is inductively coupled to a coil in the collector circuit. The low impedance emitter is tapped down on the tuned circuit in order to provide the proper impedance match without lowering the *"Q"* of the circuit.

The foregoing oscillator arrangement is a fairly common one. Its equivalent vacuum-tube circuit is shown in Fig. 2. With the incoming signal and the local oscillator voltage both being applied to the converter transistor, the appropriate i.f. signal is formed and then fed to T_1.

A 10,000-ohm resistor is placed in the emitter circuit to provide d.c. stabilization against temperature changes and variations among different replacement transistors. The positive voltage which the emitter current develops across R_2 is counterbalanced by a positive voltage fed to the base from the battery. The actual voltage difference between these two elements is only on the order of .1 volt or so. The proper biasing voltage for the collector of V_1 is obtained from a 2200 ohm resistor which is tied to the 22½-volt "B+" line. A .001 μfd. bypass capacitor, C_7, keeps the signal currents out of the d.c. distribution system.

There are two stages in the i.f. system and both operate at 262 kc. This frequency is considerably below the 455 kc. common in vacuum-tube radio receivers and it possesses the disadvantage of making the receiver more susceptible to image frequency pickup. However, the lowered frequency of operation is advantageous in that it provides greater gain and more stability.

The primary of each i.f. transformer is tuned with a fixed capacitor while the secondary is untuned. This is done to match the high collector impedance of the preceding stage to the low input impedance of the following stage. Peaking of each i.f. coil is achieved by varying the position of its slug.

Each i.f. stage is neutralized by feeding back a voltage from the base of the following stage to the base of the preceding stage. The feedback occurs through a 560-ohm resistor and a 100 to 200 μμfd. series capacitor. The capacitor value is not specifically indicated because its exact value will depend upon the internal capacitance of the transistor and this will vary from unit to unit. Actually, what happens in this particular receiver is that whenever a replacement i.f. transistor is ordered from the set manufacturer, a suitable neutralizing capacitor is sent along, too, and both components must be replaced. Whether or not an i.f. stage will require neutralization de-

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

pends upon the collector-to-base capacitance of the transistor being used. In high-frequency transistors, this internal capacitance may be small enough so that the neutralization may not be needed, especially at the lower r.f. or i.f. frequencies. This is true in a receiver to be described presently. However, where this capacitance is large enough to cause noticeable feedback, neutralization, as shown in Fig. 3, must be used.

The a.g.c. is applied to the first i.f. stage only. A negative voltage is obtained from the second detector and applied to the base of V_2. Its purpose is to regulate the collector current and, with it, the stage gain. When the incoming signal becomes stronger, the negative a.g.c. voltage rises and this serves to reduce the collector current of V_2 and, with it, the gain. The opposite condition prevails when the signal level decreases. This method is quite effective and provides a wide range of control. (A discussion of automatic gain control in transistor receivers will be given after this analysis of the *Regency* Model TR-1.)

The base bias for the second i.f. stage is obtained from the emitter of the audio output stage (which here operates class A). This bias voltage is heavily bypassed by C_{21} and then further bypassed by C_{13}, a .05 μfd. capacitor.

Both i.f. stages are connected as grounded-emitter amplifiers. Furthermore, both emitters have d.c. stabilizing resistors. (If it were not for the presence of C_8, C_{11}, C_{13}, and C_{15}, signal degeneration would occur, also. As it is, only the d.c. portion of the current passes through R_5 and R_8.) Note, however, that the emitter resistor of the first i.f. stage is only 560 ohms in value whereas the emitter resistor of the second stage is 2700 ohms. The reason for this difference stems from the compromise that must be reached in the first i.f. stage between good a.g.c. action and the d.c. stability of the amplifier. A value of R_5 greater than 560 ohms (note the emitter resistor of the next i.f. stage) is desirable for stability purposes, but the degeneration that produces the stability would result in reduced gain control action.

The collectors of V_2 and V_3, each receive their operating voltages through 2200-ohm dropping resistors. C_{11} and C_{15}, at the top end of the resistors, serve as decoupling and bypass capacitors.

Following the 2nd i.f. stage is the second detector and this function is performed by a germanium diode. The load resistor for the detector is the volume control. Note the low impedance of the control, 1000 ohms; this low value is needed to match the input impedance of the audio output stage, V_4.

The final amplifier is operated with the emitter grounded through a 1000-ohm resistor. Base bias is obtained from the voltage divider network formed by R_{13} and R_{14}. The output transformer matches the 10,000-ohm collector impedance of V_4 to the low voice coil impedance of the miniature speaker. Diameter of the speaker is only 2¾ inches. Provision also exists for a small earphone plug which can be inserted into a small jack, J_1, on the side of the receiver. When the earphone is in use, the speaker is disconnected.

The total power for the receiver is furnished by a hearing-aid type of 22½-volt battery. Total current drain is on the order of 4 milliamperes.

The compactness of this receiver can be seen by an inspection of Fig. 1. All components, including the two-gang tuning capacitor and the speaker, are miniaturized. The operating voltage of electrolytic capacitors C_9, C_{21}, and C_{19} is 3 volts; of C_{17}, it is 25 volts.

Automatic Gain Control

The two most effective methods of controlling the gain of a transistor amplifier are to vary either the emitter current or the collector voltage. Fig. 4 illustrates the variation in gain that can be achieved by varying emitter current (I_e) or collector voltage (V_c)[1]. Now, to provide this control, a certain amount of d.c. power is necessary. This arises from the fact that to vary I_e or V_c requires current from the control source. In vacuum-tube amplifiers, little or no power is required because the control voltage is fed to the grid of a tube and this element draws no current since it is negative with respect to the cathode. A transistor, on the other

[1] "Automatic Gain Control of Transistor Amplifiers," by Chow and Stern, IRE Transactions on Broadcast and Television Receivers, Vol. BTR-1, No. 2, April, 1955.

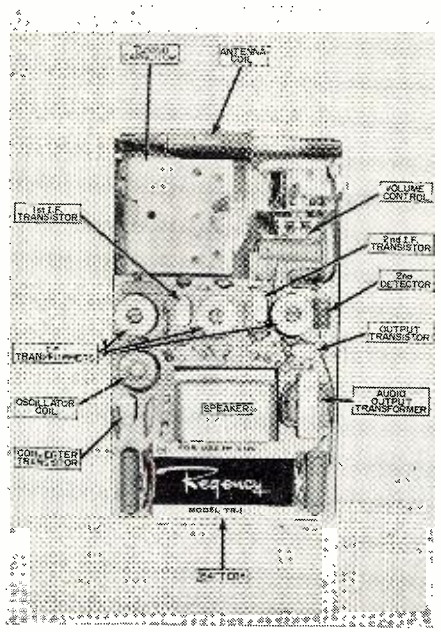


Fig. 1. Internal view of the Regency transistor radio Model TR-1 showing the location of the various components on the printed wiring board. Only the rear of the speaker magnet is shown.

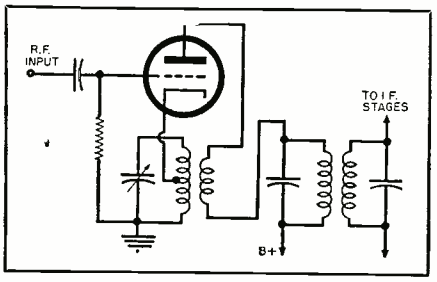


Fig. 2. The converter stage shown here is the equivalent vacuum-tube circuit of the transistor converter in Fig. 3.

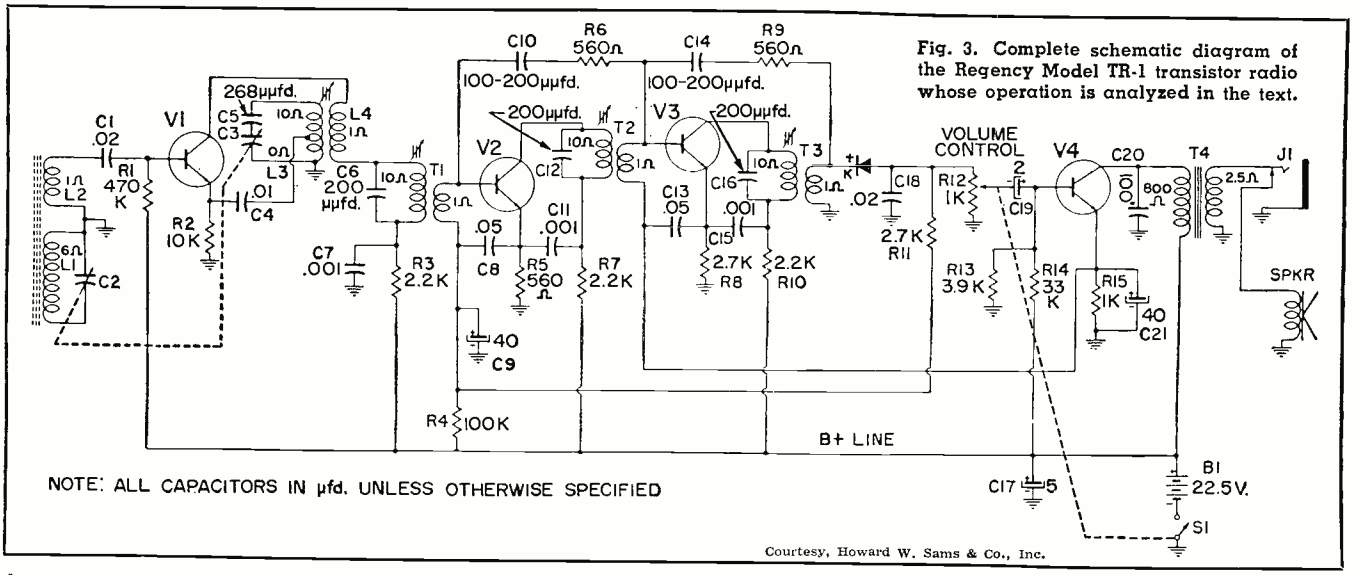


Fig. 3. Complete schematic diagram of the Regency Model TR-1 transistor radio whose operation is analyzed in the text.

Courtesy, Howard W. Sams & Co., Inc.

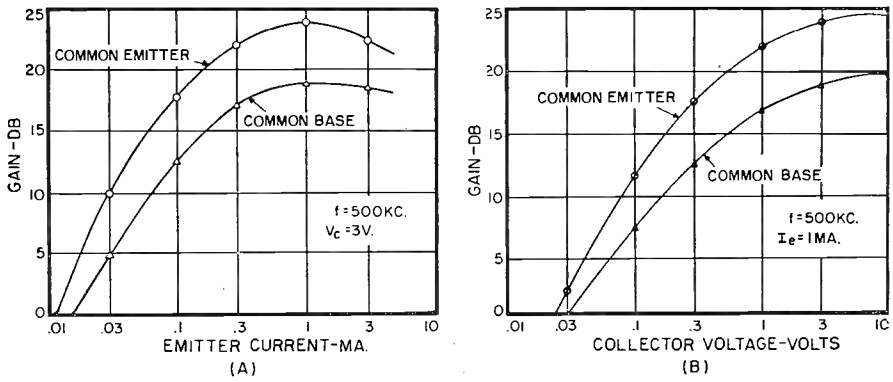


Fig. 4. Shown here is the way in which the gain of common emitter and common base transistor amplifiers vary with emitter current (A), and collector voltage (B).

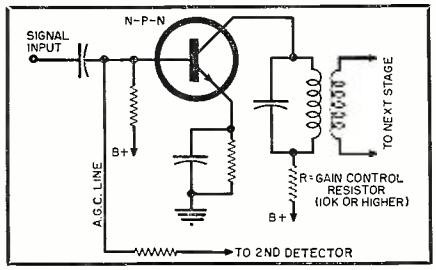


Fig. 5. Typical "n-p-n" transistor amplifier circuit with a.g.c. With resistor R in the circuit, collector voltage control is used; for emitter current a.g.c. a small resistor or no resistor is used with the collector.

hand, is a current-operated device and to alter its current, the control stage must supply a suitable amount of its own current. This, in turn, means that power must be expended.

The control voltage is almost invariably obtained from the second detector and so it is this stage which must supply the control power. To assist the detector in this respect, the controlled transistor i.f. amplifier is also made to function as a d.c. amplifier for the control signal. For example, in the stage shown in Fig. 5 (without resistor R), the emitter current is a.g.c. controlled. However, instead of varying the emitter current directly, the control voltage is applied to the base of the transistor and the resulting changes of d.c. base current are amplified and appear as larger changes of emitter current and gain. When the incoming signal is strong, then a voltage is fed back which serves to reduce the emitter current and the stage gain is reduced. (By reducing the emitter current, we also reduce the collector current and hence the strength of the signal developed across the output tuned circuit.) Conversely, when the incoming signal is weak, the voltage fed back is reduced in value, permitting more emitter current to flow and raising the gain.

If sufficient power is available in the detector circuit, an attempt can be made to control the emitter current directly by introducing the control voltage in the emitter circuit of the i.f. stage. However, in the absence of this power, the control voltage can be applied to the base of the i.f. stage, as shown.

The graph of Fig. 4B demonstrates that the gain of a transistor may be varied by changing the collector voltage. A circuit designed to achieve this is shown in Fig. 5 (with resistor R in the circuit). Note the presence of the resistor in the collector lead. The control voltage is again applied to the base and variations in base current appear as amplified variations of emitter and collector current. The resulting change in voltage across the resistor in the collector circuit also leads to changes in collector voltage and gain.

In order to effect control by this method, then, a resistor is needed in the collector circuit. There is, however, an even more significant difference between this system and the prior one. This concerns the polarity of the control voltage applied to the base of the controlled i.f. amplifier. In the previous method, the a.g.c. voltage served to *reduce* base and emitter currents when the incoming signal increased in amplitude. In the V_c control method, we follow the reverse practice. Now, the a.g.c. voltage is made to *increase* base and emitter (and collector) currents with increasing signal strength. This causes the voltage drop across the collector resistor to rise, reducing V_c and with it, the gain of the stage.

The object, in this method, is to control transistor gain by varying the collector voltage. To reduce the gain, we must reduce the collector voltage; on the other hand, to increase the gain, we raise the collector voltage. To achieve effective control, the collector resistor should have a value in the vicinity of 10,000 ohms or more. Too small a resistance value will not provide the desired range of control, while too high a resistance will lead to premature cut-off and distortion.

The best guide for the service technician to follow in attempting to identify the system of control is to determine what happens to the emitter current as the signal level rises. If the control voltage increases the emitter current with increasing signal level, then V_c control is being employed. Under these circumstances, a collector resistor will be found. But if the control voltage depresses the emitter current with signal level increase, then I_e control is being employed. A collector resistor may or may not be used, but if it is, then its value is usually under 10,000 ohms.

In the receiver whose schematic is shown in Fig. 3, I_e control is employed; *i.e.*, the a.g.c. voltage becomes increasingly negative with rising signal and this voltage, fed to the base of an *n-p-n* transistor, *reduces* the emitter current. The 2200-ohm collector resistor is low enough in value not to seriously affect collector current or transistor gain.

An i.f. system employing V_c control is shown in Fig. 6. Here, *n-p-n* transistors are employed in the two i.f. stages as well as in the detector. The detector, which we shall discuss next month in greater detail, is operated essentially in class B, so that it is biased close to cut-off.

The voltage drop across R_1 is such that the top end is positive with respect to the bottom end. When the average level of the signal rises, the voltage across R_1 increases also. This voltage, which is well filtered by a 30-μfd. capacitor so that the only variations are those due to slow changes in signal level, is fed back through a 1 millihenry choke to the base of the 1st i.f. amplifier. Since the transistor here is of the *n-p-n* variety, a positive rise in voltage will cause the base, emitter, and collector currents to rise. This, in turn, will increase the voltage drop across the 10,000-ohm collector resistor and reduce the collector voltage. The second i.f. stage is not controlled.

(To be continued)

Fig. 6. Schematic diagram of a two stage transistor i.f. amplifier followed by a transistor detector. Collector voltage (V_c) type a.g.c. is employed in this case.

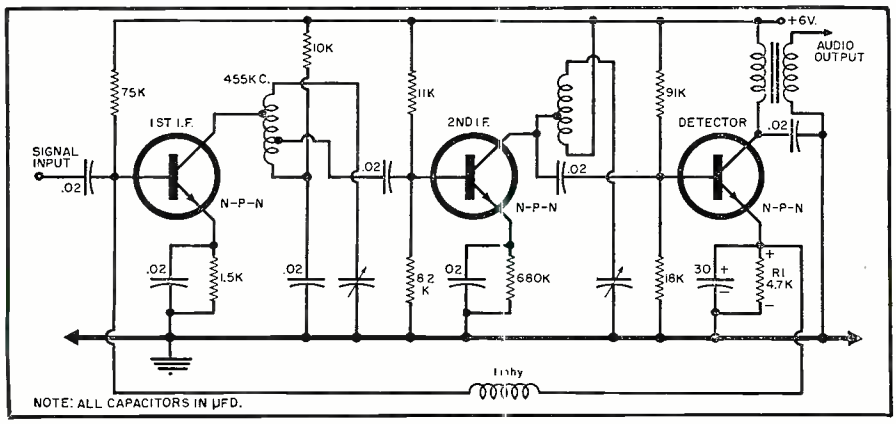
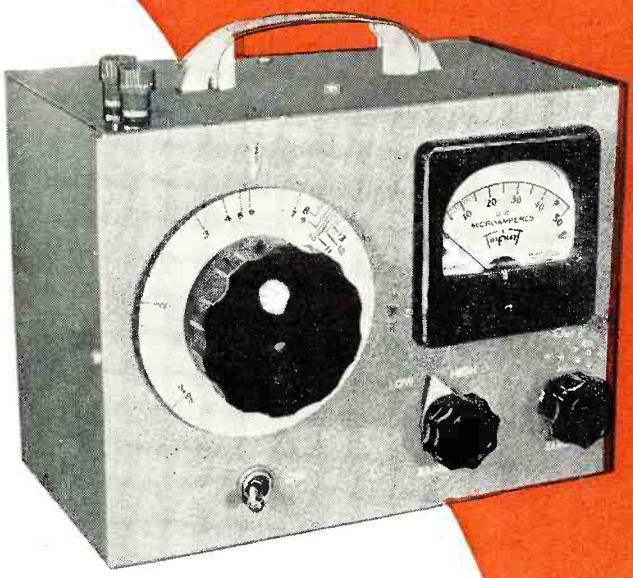


Fig. 1. Front view of instrument.



Transistorized TV Antenna Compass & Field Strength Meter

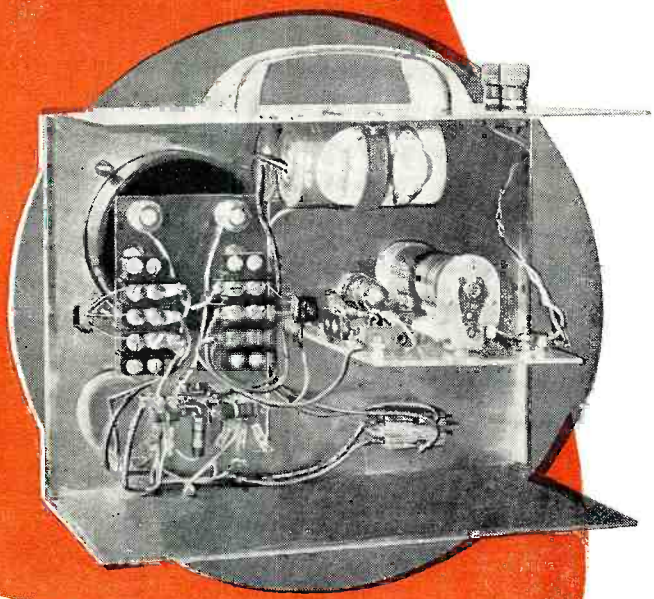


Fig. 2. The transistorized d.c. amplifier is mounted on the transparent polystyrene plate secured to back of the microammeter. Tuner is on shelf-plate to the right.

By **RUFUS P. TURNER, K6AI**

Complete details on a lightweight, low-current unit which has an r.f. sensitivity of 10 mv. full scale.

IMMEDIATELY after the commercial introduction of the germanium diode eight years ago, radio amateurs quickly recognized the usefulness of this component as a reliable detector in simple field strength meters. Aside from the diode, all that is required besides a pickup antenna is a coil-capacitor tuned circuit and a 0-1 d.c. milliammeter. The obvious advantages are: no power supply, no tubes, instantaneous operation, light weight, small size, and simple tuning. Many a TV technician in the interim has been exasperated that the same simple arrangement would not perform as well with a TV antenna, either for antenna positioning or field strength measurements. Doubly vexing was the fact that replacing the milliammeter with a more sensitive d.c. microammeter failed to boost the sensitivity enough to make conversation.

The transistor offered new hope. While conventional transistors will not operate at TV frequencies, it was felt that a transistor amplifier might be used to raise the feeble output of a diode detector sufficiently to drive a meter.

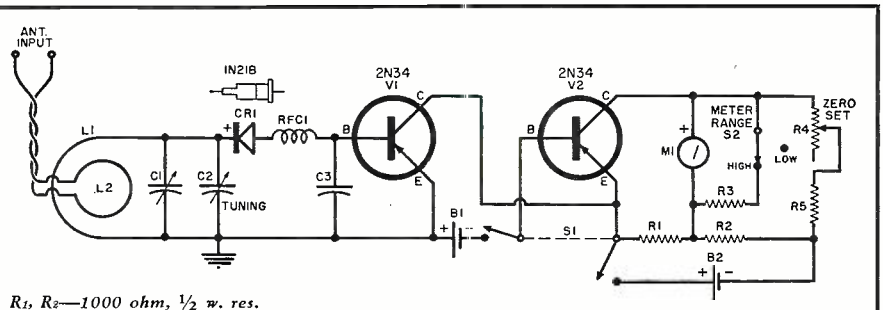
The author carried on developmental work along two lines in this direction. The first approach was to amplify the video buzz, coming from the diode, with a high-gain transistor audio amplifier, then to rectify the amplified signal and use the resulting d.c. to drive a milliammeter. This scheme proved unsatisfactory. First, the video signal seldom is constant unless a test pattern is being transmitted, and this causes the meter deflection to waver endlessly. Second, the problem of matching the low-impedance rectifier-meter circuit to the high output impedance of the transistor amplifier proved as much of a sticker as the original problem.

The second approach was use of a high-gain transistor d.c. amplifier to boost the d.c. output of the diode sufficiently to deflect the meter. This method proved superior, since the d.c. component is proportional to the average carrier, and substantial direct-current amplification is obtainable in fewer transistor stages, minus interstage impedance matching difficulties, than in transistorized a.c. amplifiers. The entire transistor-and-meter circuit effectively becomes an ultra-sensitive d.c. microammeter operated from the output of the diode detector of the simple field strength meter.

The author previously described an amateur field strength meter of this type[1], and transistorized sensitive d.c. microammeters have been described in the literature.[2,3] To adapt the transistorized amateur field strength meter to weak-signal TV service required only (1) provision for a tuned circuit for the TV frequencies, (2) substitution of a microammeter for the usual milliammeter, and (3) use of a 2-stage common-emitter amplifier containing high-*alpha* transistors.

The final instrument, which is described in this article, has a maximum full-scale r.f. sensitivity of 10 millivolts r.m.s., it operates from two 1½-volt flashlight cells capable of supplying power *continuously* more than 1 month, is small in size (8"x6"x4½", and can be made smaller), tunes to channels 2 to 13 and through all of the territory between channels, and weighs only 3½ pounds. Its compactness and light weight enable it to be carried to roof tops with ease.

The tuning range of the instrument is 48 to 226 megacycles. This continuous tuning range includes FM broadcast frequencies and the amateur 2- and 6-meter bands, in addition to the TV channels. Its high sensitivity should make possible the adjustment of amateur antennas fed from a signal gen-



R_1, R_2—1000 ohm, ½ w. res.
R_3—220 ohm, ½ w. res.
R_4—1000 ohm wirewound pot
R_5—820 ohm, ½ w. res.
C_1-C_2—100/100 μμfd. 2-gang var. capacitor, gangs connected in parallel (Hammarlund HFD-100, see text)
C_3—.002 μfd. mica capacitor
RFC_1—2½ mhy. r.f. choke
L_1—Hairpin loop, #20 bare copper wire, ⅜" separation between legs, 13/16" total over-all length
L_2—Single turn of insulated hookup wire, ¾" dia., spaced 1/16" from L_1
M_1—0-50 μa. d.c. microammeter (Triplett 327-T)
S_1—D.p.s.t. toggle switch
S_2—S.p.s.t. wafer switch
B_1, B_2—1½ volt jumbo flashlight cell (Ray-O-Vac 2LP)
CR_1—1N21B point-contact silicon diode (Sylvania)
V_1, V_2—2N34 junction transistor (Sylvania)

Fig. 3. Complete circuit of the transistorized TV field strength meter.

erator, instead of the transmitter, to reduce QRM. As a TVI locator and harmonic chaser, this instrument is a star performer.

Instrument Circuit

The complete circuit is shown in Fig. 3. The arrangement is seen to consist of a single tuned circuit, silicon diode detector, 2-stage direct-coupled transistor amplifier, and d.c. microammeter circuit.

The tuner consists of a hairpin loop inductance (L_1) and a 200-μμfd. variable capacitor, C_1-C_2. In order to prevent self-resonance within the tuning range, a frameless u.h.f.-type tuning capacitor is required. The most satisfactory units of this type were found to be the *Hammarlund* HF series. But since this type was not available in 200-μμfd., a dual 100-μμfd. unit (HFD-100) has been used with its two sections connected in parallel. The antenna is coupled into the loop through a ¾-inch-diameter, 1-turn coil, L_2, spaced 1/16 inch from L_1. The hairpin loop is made with No. 20 bare copper wire and is soldered directly to the tuning capacitor. The legs of the hairpin are separated by ⅜ inch; the over-all length of the hairpin is 13/16 inch.

The detector is a 1N21B point-contact silicon diode. This type is preferred to germanium diodes in this application because of its higher rectification efficiency (ratio of d.c. output voltage to peak applied r.f. voltage) at the higher television frequencies. The lowest r.f. input voltage which this diode will detect is around 1 millivolt r.m.s. The forward conduction curve of the crystal is quite flat at such low voltages, and at still lower potentials the rectification properties simply evaporate. However, this limiting value of approximately 1 millivolt appears to be a characteristic of all crystal diodes, silicon and germanium alike, although an occasional unit will rectify a ½-millivolt signal. Nevertheless, it is possible to "see" a 1-millivolt signal with this field strength meter, and since the FCC sets the fringe-area signal level at 500 microvolts (½ millivolt) per meter, this response is not bad when the simplicity of the instrument is considered.

The d.c. amplification is provided by the two transistors, V_1 and V_2, which are direct coupled. Each uses base input—emitter return for high current gain. The collector output current of the first transistor flows directly through the base-input circuit of the second transistor. Thus, the arrangement is a *current* amplifier in the strictest sense. It does not first convert current into voltage, as a tube-type amplifier does, and then amplify this voltage. The direct-coupled current scheme removes the necessity for "lossy" load resistors in coupling between stages. The over-all current gain of the 2-stage amplifier is better than 1000, which means that a diode d.c. output of less than 0.05 microampere will deflect the 0-50 d.c. microammeter to full scale.

The no-signal d.c. collector current (i_{co}) of the first transistor flows into the second transistor and is amplified some 25 to 40 times by the latter to produce a no-signal deflection of the microammeter. The no-signal collector current of the second transistor also deflects the meter. However, the zero-set adjustment bucks out the effects of both i_{co} components. The no-signal currents are low in the 2N34 transistors, so the i_{co} of V_1 does not drive V_2 into its low-amplification region. Tests on a number of transistor pairs proved this to be true, and for this reason the complication of an additional zero-set circuit in the first transistor stage was abandoned.

The transistor type was chosen for low i_{co}, high current amplification factors (*alpha* and *beta*), low noise, and low drift. The *Sylvania* 2N34 gave the best performance without special picking of transistors. No temperature compensation has been included in the circuit. However, the amount of drift of the meter deflection, due to heating, observed in field tests appears adequately compensated by occasional re-adjustment of the zero-set potentiometer. This has not been found to affect the calibration. It is the author's feeling that the re-adjustment is no more inconvenient than re-setting an ohmmeter before using.

The 0-50 d.c. microammeter, M_1, is connected in a 4-arm bridge circuit for zero setting. The bridge arms are R_1, R_2, R_4-R_5, and the internal collector resistance of transistor V_2. This arrangement is similar to the bridge zero-balancing circuit employed in vacuum-tube voltmeters. The meter range switch, S_2, shunts the meter with a 220-ohm resistor, R_3, to multiply the meter deflection by approximately 10 for handling strong signals. Cutting this resistor into the circuit disturbs the zero setting of the meter by less than 1% of full scale (1 small scale division). When switch S_2 is at its high-sensitivity (low-range) setting, any random fluctuation of the pointer due to transistor noise is less than one-quarter of a small scale division.

The battery drain is a matter of interest. With switch S_2 in its "Low" position, battery B_1 delivers 18 microamperes and B_2 1.6 milliamperes when an input r.f. signal deflects meter M_1 to full scale. With S_2 in its "High" position, B_1 delivers 30 microamperes and B_2 2 milliamperes. These low current drains make operation from flashlight cells entirely feasible, since the familiar jumbo-sized cell is capable of better than 2000 milliampere-hours service on a 24-hour per day continuous basis.

As illustrated here, the field strength meter is built in an aluminum box 8" long, 6" high, and 4½" deep (*LMB* No. 146). Figs. 1, 2, 5, and 6 show constructional details.

The tuner is built on a 3½"x3⅝" plate of 1/16" thick polystyrene. Fig. 5 shows details of the layout. In order to cover the tuning range and to avoid self-resonances, all leads within the tuner circuit must be kept as short as possible. The hairpin loop, L_1, is soldered directly to the front stator and rotor lugs of the tuning capacitor. The jumper between the two stator lugs is a short, *straight* piece of No. 20 wire. *Do not bend or loop this jumper;* keep it straight to minimize its inductance. The tip of the 1N21B diode is soldered directly to a stator lug of the tuning capacitor, to eliminate any lead length in this connection. To prevent heat injury to the crystal, hold its tip with long-nose pliers while making the soldered connection, and continue to hold it until completely cooled. A twisted-pair of insulated hookup wire is run between the lug terminals of coupling coil L_2 and the two insulated antenna binding posts mounted on the left top of the case.

The transistor amplifier is built on a 4"x2½" plate of 1/16"-thick polystyrene. This plate is held to the back of the microammeter by the meter screws, as shown in Fig. 6. On this plate are mounted the transistor sockets and resistors R_1, R_2, R_3, and R_5. Potentiometer R_4 and switch S_2 are mounted on the front panel of the instrument, as shown in Figs. 1 and 2. The transistor "sockets" are 3-terminal *Cinch-Jones* 3-140

barrier-type terminal strips. These screw strips offer the advantage of a solderless connection to the transistor leads, thereby removing all risk of heat-damaging the transistor. The transistors also can be removed easily from these connectors, if desired, for testing or for temporary use in other circuits. The author installed his transistors with their full pigtail lengths, as shown in Fig. 6. The pigtails then were bent slightly, as shown in Fig. 2, to position the transistors out of the way of other components.

The flashlight cells are fastened to the inside top of the case (See Fig. 2) by means of a strap made from discarded 300-ohm antenna ribbon. The carrying handle is a dime-store drawer-pull.

The 3-inch dial is a *National* Type O with a disc of white paper cemented over the regular metal dial plate and inscribed with the TV channel calibration.

Calibration

The best frequency-calibrating source will be an accurate r.f. signal generator covering the range 48 to 230 megacycles, preferably on fundamentals all the way. This instrument should be a standard oscillator and *not* a sweep generator. The signal need not be modulated. The generator output is connected to the "Antenna Input" terminals of the field strength meter.

The author's dial, as seen in Fig. 1, is graduated in channels 2 to 13 (with the lowest-frequency point, 48 mc., marked) corresponding to the *video carriers* of these channels. It is important to note, however, that the instrument also peaks up at the sound carriers separately. Table 1 lists the video frequencies which must be obtained successively from the signal generator.

To make the frequency calibration: Set switch S_2 to its "High" position. Throw switch S_1 to "on." Zero the meter by means of potentiometer R_4. Set the signal generator as closely as possible to 55.25 mc., the channel 2 video carrier frequency. Tune C_1-C_2 for peak deflection of meter M_1. Reduce the setting of the signal generator attenuator if the meter is overdriven. Mark this point 2 on the dial. Repeat at each of the other frequencies in Table 1, marking the dial with the corresponding TV channel number. If the builder has followed the specifications of the tuner carefully, no trouble should be experienced in covering the range. Should there be trouble, squeeze the hairpin together to reach a higher frequency; spread it apart to reach lower frequencies. Before the dial is permanently inked-in, the calibration may be checked by tuning-in several TV stations and making any required correction.

An inspection of the dial graduations visible in Fig. 1 shows some crowding at the high-frequency end of the tuning range. This is to be expected with the straight-line capacitance type of tuning capacitor. Some improvement might be afforded by a straight-line frequency unit, although some crowding will always be present with a tuning range as great as this one. Nevertheless, it is surprisingly easy to tune the stations in and out with the field strength meter and to hold them on-the-nose once they have been tuned-in. The tuning arrangement employed in this instrument resulted from the author's desire to cover the entire frequency range in one rotation of the dial. However, an individual builder can, for improved selectivity and tuning, incorporate a switch- or push-button-type tuner.

If desired, the meter scale may be calibrated in millivolts or microvolts by comparison with a second, calibrated field strength meter operated in parallel with this instrument. However, it must be remembered that the crystal diode response at the low r.f. signal-voltage levels involved is approximately square-law, not linear like the microammeter scale. Thus, one-half the signal strength appears at one-quarter of full scale, 1/10 signal at 1/100 full scale, and so on. Fig. 4 gives a comparison between the microammeter scale and ideal square-law response. Another important fact is that the rectification efficiency of the crystal decreases as the frequency increases. The actual amount varies with individual diodes. This results in a somewhat lower meter deflection for a given r.f. input at high frequencies, and for highest accuracy would necessitate applying a correction factor.

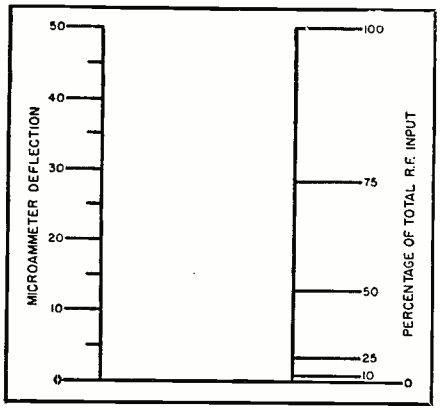


Fig. 4. Ideal square-law meter response.

TV CHANNEL	VIDEO CARRIER FREQUENCY (mc.)
2	55.25
3	61.25
4	67.25
5	77.25
6	83.25
7	175.25
8	181.25
9	187.25
10	193.25
11	199.25
12	205.25
13	211.25

Table 1. Video carrier frequencies corresponding to the TV broadcast channels.

REFERENCES

1. *Turner, Rufus, P.: "Transistors, Theory and Practice," Gernsback Publications, page 103.*
2. *Starke, Herbert F.: "The Transistor D.C. Amplifier,"* RADIO & TELEVISION NEWS, *December, 1953.*
3. *Turner, Rufus, P.: "Transistorized Voltmeter," Radio-Electronics, December, 1954.*

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Fig. 5. Over-all view of the simple channel tuner. Mounted on a polystyrene shelf-plate, this v.h.f. tuner is simple and has few components. Its construction is easily visible here.

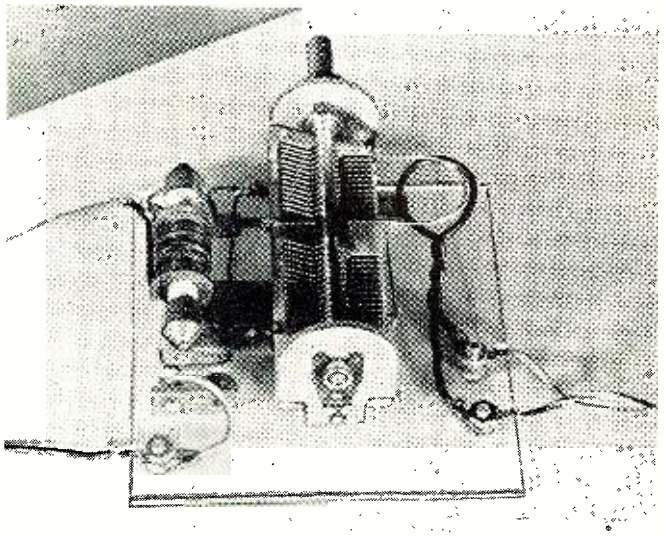
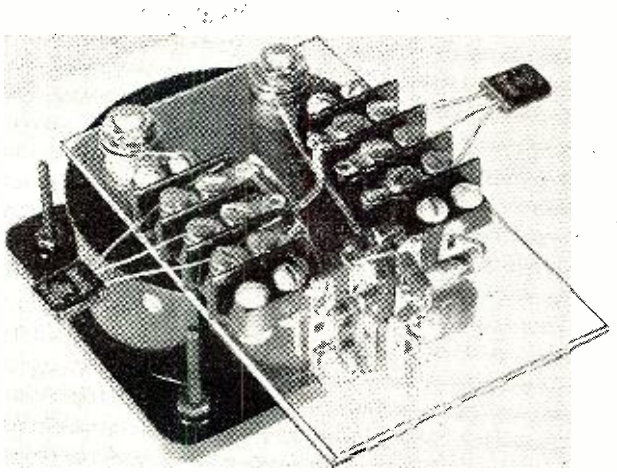


Fig. 6. The transistorized d.c. amplifier assembly. The entire unit, minus the zero-set potentiometer and range switch, is mounted on the polystyrene plate on back of the microammeter.



A Low-Cost Frequency Standard

By **PAUL S. LEDERER**

An inexpensive unit for the ham shack which uses two low-cost, readily-available surplus crystals.

A FREQUENCY standard is a desirable item for the electronics experimenter and amateur radio station operator. Unfortunately a good standard crystal is fairly expensive, about $8.00. It is possible, however, to build a high quality frequency standard using two crystals whose cost is less than one dollar for both.

After the last war, a great many crystals used by the Armed Forces were put on sale as surplus items. One particular type, for the SCR-508 in a FT-241 holder, was used for equipment operating on adjacent channels from 20.0 to 27.9 mc. These channels were 0.1 mc. apart. The crystals were ground so that the 54th harmonic of each was the desired channel frequency. The actual crystal fundamentals range from 370.370 kc. to 516.667 kc. Such crystals, taken one at a time are not very useful. However, the difference in frequency between two such crystals may be an even number without fractions. Since each channel is the 54th harmonic of the crystal, if the difference between two channels is exactly divisible by 54, the difference between the corresponding crystal fundamental frequencies is an even number without fractions.

Thus, for example, channel 8 is on 20.8 mc., channel 62 on 26.2 mc.; the difference between the two, 5.4 mc. when divided by 54 becomes 0.1 mc. or 100 kc. Therefore, if two oscillators were built using these two crystals and their outputs combined, a beat frequency of 100 kc. should result. Its accuracy would be a function of the accuracy of each crystal and of the effect of circuit components in the oscillators.

No information was available on the accuracy of the individual crystals and it was decided to build the oscillators and associated circuits and then measure the beat frequency obtained.

The result fully justified the labor involved.

As measured on a *Berkeley* Electronic Frequency Counter (with an accuracy of about ± 1 part in 10^5), the beat frequency using the crystals specified was 100,050 cps. $\pm$ 10 cps. Thus the absolute accuracy of the standard is 6 parts in 10^4, with a possible drift of $\pm$ 1 part in 10^4.

The circuit consists of two Pierce oscillators using a 6SL7 double triode. Mixing is accomplished in a common cathode resistor and choke combination. Output from the cathodes is fed through a low-pass filter into a parallel resonant circuit, tuned to 100 kc. It is amplified by a 6SH7 pentode. An additional 100 kc. parallel resonant circuit across the output of this pentode further helps to remove unwanted frequencies, resulting in a clean 100 kc. signal with an amplitude of about 12 volts r.m.s. The resonant circuit in the output is fairly critical of loading hence only a short, low-capacity cable should be used for coupling purposes. It may be advisable to isolate the output by using a cathode follower stage. This was omitted for lack of space.

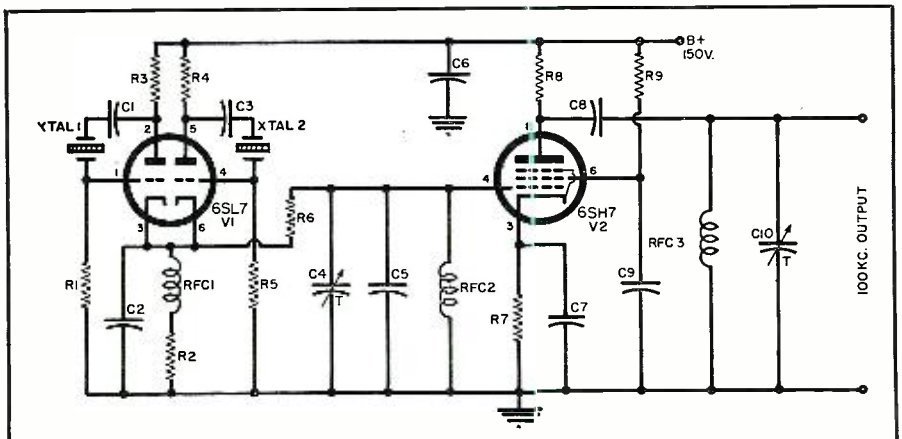
Frequencies other than 100 kc. may also be obtained by the proper combination of crystals; if the difference between two channels divided by 54 is equal to 0.5, the beat frequency will be 500 kc.

To simplify the problem of filtering, the two crystals should be chosen so that their fundamentals are much higher than the desired beat frequency.

The frequency standard is built on a small chassis and is powered by an external power supply. It draws 3 ma. at 150 volts regulated voltage. Voltage regulation is recommended (VR tube) to increase frequency stability.

One word of caution: these crystals are generally listed in advertisements by their fundamental frequency value with *fractions omitted.* For example, the crystal for channel 8 (20.8 mc.) whose actual fundamental frequency is 385.185 kc. will be listed as 385 kc., and the crystal for channel 62 (26.2 mc.) with an actual fundamental frequency of 485.185 kc. will be listed as 485 kc. The prospective builder of this crystal standard is therefore advised to either select the crystals by desired channel at the place where they are sold or else calculate the *exact* fundamental frequency of the crystal desired and then pick the correspondingly listed crystal. —30—

Complete schematic diagram of the low-cost, easy-to-build frequency standard.



R1, R5—470,000 ohm, ½ w. res.
R2—2200 ohm, ½ w. res.
R3, R4—47,000 ohm, ½ w. res.
R6—56,000 ohm, ½ w. res.
R7—820 ohm, ½ w. res.
R8—100,000 ohm, ½ w. res.
R9—150,000 ohm, ½ w. res.
C1, C3—820 μμfd. mica capacitor
C2—56 μμfd. mica capacitor
C4—40 μμfd. trimmer capacitor
C5—260 μμfd. mica capacitor
C6—.005 μfd., 200 v. capacitor
C7, C9—1 μfd., 200 v. capacitor
C8—750 μμfd. mica capacitor
C10—100 μμfd. trimmer capacitor
RFC1—1 mhy., 100 ma. air-core r.f. choke (National R50 or equiv.)
RFC2—8 mhy., 125 ma. r.f. choke (Bud CH-1281 or equiv.)
RFC3—16 mhy., 125 ma. r.f. choke (Bud CH-283 or equiv.)
Xtal.—Crystal (two required, see text)
V1—6SL7 tube
V2—6SH7 tube

Do You Need a Preamp-Control Unit?

By **BURT HINES**

To obtain maximum performance from your hi-fi system, you will need some form of preamp-equalizer unit—but "how elaborate must it be?" is a good question. Here are all of the facts—you make the decision.

AS THE display counters of most audio dealers will show, today there is an abundance of elaborate audio control units for the home music system. They present an imposing array of knobs, bars, buttons, and levers controlling a wide assortment of functions: "on-off" switching, gain control, input selection, record preamplification, record equalization, bass and treble control, variable bass and treble cut-off, loudness compensation, noise suppression, volume expansion, etc. These units are professional not only in appearance but also in design, construction, and materials. Therefore they are expensive, generally in the neighborhood of $100 or more.

Where cost is little or no limitation in assembling a home music system there probably is no harm in owning a complex control unit except for the difficulty of instructing friends and family in its use.

However, in most cases cost is a limitation and the 20-20,000 question is whether the complex control unit offers added listening pleasure commensurate with its price. Would it not be wiser to buy a simple control unit—or an amplifier or tuner incorporating simple controls—and use the saving in a manner that will give more pleasure per dollar, such as buying a better basic amplifier or a better speaker?

The audiophile must decide this for himself, particularly if his interest inclines as strongly to gadgets as to music. However, there is a good deal of evidence that a modest control unit with a minimum of knobs will deprive one of little if any listening pleasure.

If the average listener visits a sound salon he will find that the differences among speakers and among sources of sound are far more astounding than the nuances of a sophisticated control unit. If he switches from LP to RIAA record position, or turns on a loudness compensator instead of boosting the bass control, or introduces 7000 cycles sharp cut-off instead of gradual cut with the treble control—he will not be suddenly transported to heaven. He may or may not perceive the fine differences made possible by the expensive control unit. But let him switch from one speaker to another and in this department he will almost certainly find a dramatic call for the expenditure of the most money he can afford.

To do a basically satisfactory job a

Table 1. Equalization requirements for several commonly-used recording curves.

Frequency	RIAA (also NARTB, New AES, RCA "New Orthophonic")*	Old RCA**	Old AES***	London and Columbia LP†, ††	Columbia 78†††
30 cps	18.6 db	——	22.5 db	14.0 db	——
50	17.0	24.0 db	18.0	13.3	17.0 db
70	15.3	20.0	15.0	12.5	14.0
100	13.1	16.5	12.0	11.0	11.3
200	8.2	9.5	6.5	8.0	6.8
300	5.5	6.0	4.5	5.5	4.3
400	3.8	3.5	3.0	4.0	3.0
500	2.7	2.5	2.0	3.0	2.1
600	1.8	1.5	1.5	2.0	1.3
700	1.2	1.0	1.0	1.5	.8
800	.7	.5	.5	1.0	.5
900	.2	.2	.2	.5	.2
1,000	0	0	0	0	0
2,000	—2.6	—2.5	—2.2	—3.0	—2.7
3,000	—4.8	—4.5	—4.0	—5.5	—5.3
4,000	—6.6	—6.5	—5.5	—7.8	—7.1
5,000	—8.2	—8.0	—6.7	—9.5	—8.9
6,000	—9.6	—9.5	—8.0	—11.0	—10.2
7,000	—10.8	—11.0	—9.0	—12.5	—11.7
8,000	—11.9	—11.5	—10.0	—13.5	—12.9
9,000	—12.9	—12.0	—11.0	—14.5	—14.0
10,000	—13.7	—12.5	—12.0	—15.5	—15.0
11,000	—14.5	——	—13.0	—16.3	——
12,000	—15.3	——	—13.5	—17.0	——
13,000	—16.0	——	—14.0	—17.3	——
14,000	—16.6	——	—15.0	—17.5	——
15,000	—17.2	——	—15.5	——	——

*NARTB Engineering Handbook, 1949; Journal of the Audio Engineering Society, January 1954; RCA's " 'New Orthophonic' Recording Characteristic."
**RCA, "Disc Record Recording Characteristic," 1950.
***Audio Engineering, January 1951.
†London Records, Inc., "London Long Playing Records 33⅓ Microgroove Recording Characteristic;" Columbia Records, Inc., "Columbia LP Microgroove Recording Characteristic."
††Since these two curves are at no point more than .3 db apart, they are lumped together.
†††Columbia Records, Inc., "Recording Characteristic, Columbia 78 rpm Commercial Pressings."

Frequency	Old RCA	Old AES	London and Columbia	Columbia 78
30 cps	——	—3.9 db	4.6 db	——
50	—7.0 db	—1.0	3.7	0 db
70	—4.7	.3	2.8	1.3
100	—3.4	1.1	1.6	1.8
200	—1.3	1.7	.2	1.4
300	— .5	1.0	0	1.2
400	.3	.8	— .2	.8
500	.2	.7	— .3	.6
600	.3	.3	— .2	.5
700	.2	.2	— .3	.4
800	.2	.2	— .3	.2
900	0	0	— .3	0
1,000	0	0	0	0
2,000	— .1	— .4	.4	.1
3,000	— .3	— .8	.7	.5
4,000	— .1	—1.1	1.2	.5
5,000	— .2	—1.5	1.3	.7
6,000	— .1	—1.6	1.4	.6
7,000	.2	—1.8	1.7	.9
8,000	— .4	—1.9	1.6	1.0
9,000	— .9	—1.9	1.6	1.1
10,000	—1.2	—1.7	1.8	1.3
11,000	——	—1.5	1.8	——
12,000	——	—1.8	1.7	——
13,000	——	—2.0	1.3	——
14,000	——	—1.6	.9	——
15,000	——	—1.7	.4	——

Table 2. Deviations of various recording characteristics from the RIAA recording standard. This information is based on the tabulated data given in Table 1.

control unit need have but four knobs:

1. "On-off" switch and gain control.
2. Selector switch with at least one phono position for magnetic pickups and three positions for inputs such as radio, TV, tape, etc. A single phono position for magnetic pickups would provide a compromise record equalization curve, such as the RIAA characteristic.
3. Bass control.
4. Treble control.

Compared with complex control units, the outstanding lacks of such a simple affair are a multiplicity of record equalization settings and a loudness compensator. Other missing features, such as sharp cut-offs and noise suppressor, are of secondary importance inasmuch as they are essentially designed to compensate for defective equipment or program sources rather than to achieve correct balance in musical reproduction. That is, they are in the nature of frills, while record equalizers and loudness compensators are basic to the reproduction of music with the greatest possible similitude to the original performance.

Where the audio budget is limited it is reasonable that frills should be omitted and attention focussed on the essentials, namely proper record equalization and loudness compensation. The purpose of this article is to show that a simple control unit with a good set of bass and treble controls does not require a great multiplicity of record equalization settings or a loudness control in order to achieve correct musical balance.

Record Equalization

Let us assume that the control unit has but one phono position which provides RIAA equalization, the standard now accepted by most recording companies. Although this curve also correctly compensates NARTB, *RCA* "New Orthophonic," and the *New* AES recordings, it will deviate from other recording curves, several of which are presented in Table 1. The amount of deviation of these other curves from the RIAA standard is shown in Table 2.

Now for the vital question: How many db deviation constitutes an appreciable difference? Listening tests and expert opinion seem to indicate that for single tones only differences above 1.5 db begin to be significant. When mixed frequencies are involved, as in most music, a gradual attenuation or emphasis over the range from 1000 cycles down to 50 cycles or from 1000 cycles up to 10,000 cycles begins to be noticeable when about 3 db boost or cut exists at the range limits of 50 or 10,000 cycles, using 1000 cycles as a 0 db reference.

By the mixed frequency standard, Table 2 shows no significant deviation in the treble range for any of the curves, although there is significant low-end deviation for all but the *Columbia* 78 curve. By the single tone standard, there is significant deviation at both ends of the audio spectrum.

Using the more rigid single tone standard, it is possible to render all these deviations non-significant by making slight adjustments of the bass and treble controls from flat position. Fig. 1 shows some of the response curves effected by a set of good yet simple tone controls having the circuit configuration of Fig. 2. Using these response curves or interpolations between these curves, Table 3 shows the reduced deviations between the RIAA curve and other curves that can be achieved by correct tone control settings. No changes are shown for the *Columbia* 78 deviations given in Table 2 because only in the area of 100 cycles is there departure, a very slight one, from the 1.5 db standard.

It is to be seen in Table 3 that with one additional minor exception all the deviations fall within the 1.5 db standard, the exception being that at 200 cycles the Old AES curve is 1.7 rather than 1.5 db apart from the RIAA curve.

The question naturally arises as to how one can make the correct bass and treble control settings for proper record equalization; after all, in the expensive control units the individual record equalization settings are explicitly marked on the panel. The answer, as for all questions in audio, is that the decision must be made by ear. The important thing is that a correct setting for record equalization *can* be achieved by use of a single equalization curve in conjunction with the tone controls. How far these controls should be turned for record equalization should be no harder to decide than how far to turn them to compensate for room characteristics, program material characteristics, listening level, individual preferences as to musical balance, etc. The reader who does not own a complex control unit should quickly be disabused of the notion that such a unit always precisely compensates for different recording curves. He has only to read the record reviews in various journals to see how frequently bass or treble adjustment is required in addition to the prescribed setting for the record curve in question. How much adjustment is of course left by the reviewer and the control unit to the listener's ear.

Recording curves are not precise nor precisely followed. The published curves are generally stated as having a tolerance of ± 2 db. In practice it appears that even greater liberties are taken. A friend who is with a leading recording company states that he has seen engineers boost the treble far beyond the tolerance of the company's published curve.

Another factor to be considered is that the musical balance of the original recording can be significantly affected by studio acoustic conditions and microphone placement. Consequently, precise adherence to a curve both in recording and playback may nevertheless leave the recording out of balance in the estimation of a listener who has heard the same music played elsewhere.

Finally it must be considered that the departures of speakers from flat response are marked, with peaks and valleys of 5 db or more being common even in the best of speakers. Moreover, the frequencies at which different speakers exhibit their peaks and valleys differ radically from one speaker to another. Consequently, alongside the gross imperfections of speakers in terms of accurate response, minor deviations of a control unit from correct record equalization are of little moment.

Loudness Compensation

It is generally agreed that faithful reproduction of music at a sound in-

tensity level below the original performance level requires so-called loudness compensation. [1, 2, 3] The much discussed Fletcher-Munson curves show that as gain is reduced the human ear gives the illusion that bass frequencies, using 1000 cycles as a reference frequency, have dropped relatively more than high frequencies. Thus any given bass frequency requires a certain degree of boost when a home music system is operated at a sound level which, to the ear, is substantially below that of the original performance.

The loudness control seeks to reduce gain and at the same time automatically provide bass boost to the extent indicated necessary by the Fletcher-Munson curves. In short, it cuts bass frequencies at a lesser rate than frequencies above 1000 cycles.

However, the automatic loudness control is less automatic than it first appears. It requires a gain control, mounted either at the front or rear of the control unit (preferably at the front), which can be set so that the loudness control in its maximum position reproduces music at the original level as the ear hears it. But sound level varies from one record to another, from one type of musical selection to another, from a strong radio station to a weak one. Consequently, to achieve accurate loudness compensation for all sources of music one must continually manipulate the gain control in addition to the loudness control so that the latter may always represent original level at maximum rotation.

Therefore it may justifiably be asked: Why go to the additional circuitry, complexity, and expense of a loudness control if the bass control can supply the amount of boost required for loudness compensation? The purpose of this section is to show that a good bass control, with response curves such as those in Fig. 1, can supply the needed boost in nearly all practical circumstances.

References 1, 2, and 3 have convincingly demonstrated that the amount of bass compensation required is *not* that which will make a given bass frequency, say 50 cycles for present discussion, sound as loud as 1000 cycles at any intensity level. Actually a substantially smaller amount of compensation is required, compensation which seeks only to maintain the original loudness relationship of 50 cycles to 1000 cycles. Except in the case of music originally played at well above average intensity, the original level will generally cause 50 cycles to *sound* less intense than 1000 cycles even though each frequency is *produced* with equal measured intensity.

An example is helpful. For equal measured sound outputs, 50 cycles sounds about 6 db lower than 1000 cycles when 1000 cycles has a measured absolute level of 80 db (0 db = 10^{-16} watts/cm^2). But when 1000 cycles is at an absolute level of 60 db, 50 cycles sounds about 18 db lower than 1000 cycles. Therefore one must add 12 db boost at 50 cycles in order to restore the original 6 db loudness difference between 50 and 1000 cycles. It would be incorrect to boost 50 cycles 18 db.

The amount of loudness compensation required will of course vary directly with the degree of reduction from the original sound level. However, there is a practical, or one might say musical, limit to the extent of such reduction, as will shortly be shown, and correspondingly there is a limit to the required degree of loudness compensation. This compensation limit falls within the scope of the bass boost

(*Continued on page* 108)

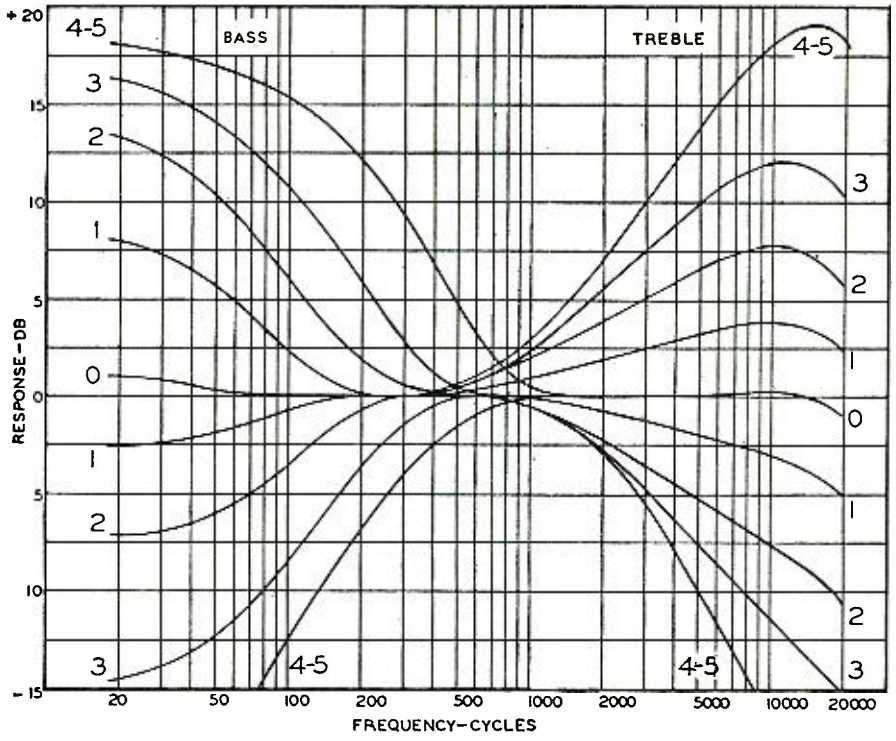


Fig. 1. Response curves effected by a set of good yet simple tone controls using the circuit of Fig. 2. Graph courtesy of Waveform, Inc., New York, N. Y.

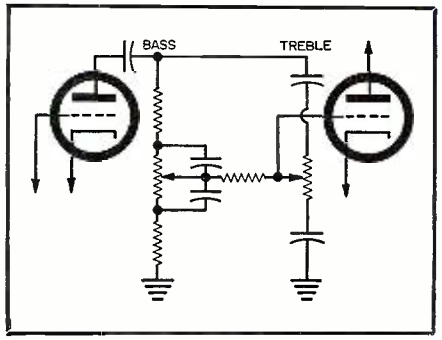


Fig. 2. Tone control circuit used in obtaining the curves shown in graph, Fig. 1.

Table 3. Adjusted deviations of various recording characteristics from the RIAA curve, based on data in Table 2 and response curves shown in Fig. 1.

Frequency	Old RCA	Old AES	London and Columbia	Columbia 78
30 cps	——	— .9 db	— .4 db	——
50	0 db	.5	— .5	0 db
70	1.3	.5	— .7	1.3
100	.4	1.1	— .6	1.8
200	— .5	1.7	0	1.4
300	— .5	1.0	0	1.2
400	.3	.8	— .2	.8
500	.2	.7	— .3	.6
600	.3	.3	— .2	.5
700	.2	.2	— .3	.4
800	.2	.2	— .3	.2
900	0	0	— .3	0
1,000	0	0	0	0
2,000	— .1	— .4	.4	.1
3,000	— .3	— .5	.7	.5
4,000	— .1	— .4	1.2	.5
5,000	— .1	— .5	1.3	.7
6,000	.2	— .4	1.3	.6
7,000	.7	— .4	1.5	.9
8,000	.3	— .3	1.3	1.0
9,000	0	— .1	1.2	1.1
10,000	— .2	.3	1.3	1.3
11,000	——	.4	1.2	——
12,000	——	0	1.0	——
13,000	——	— .3	.5	——
14,000	——	0	0	——
15,000	——	— .2	— .6	——

SYLVANIA TV Test Points for 1956

By
GEORGE C. CHERNISH, P.E.
Senior Engineer, TV Design
Sylvania Electric Products Inc.

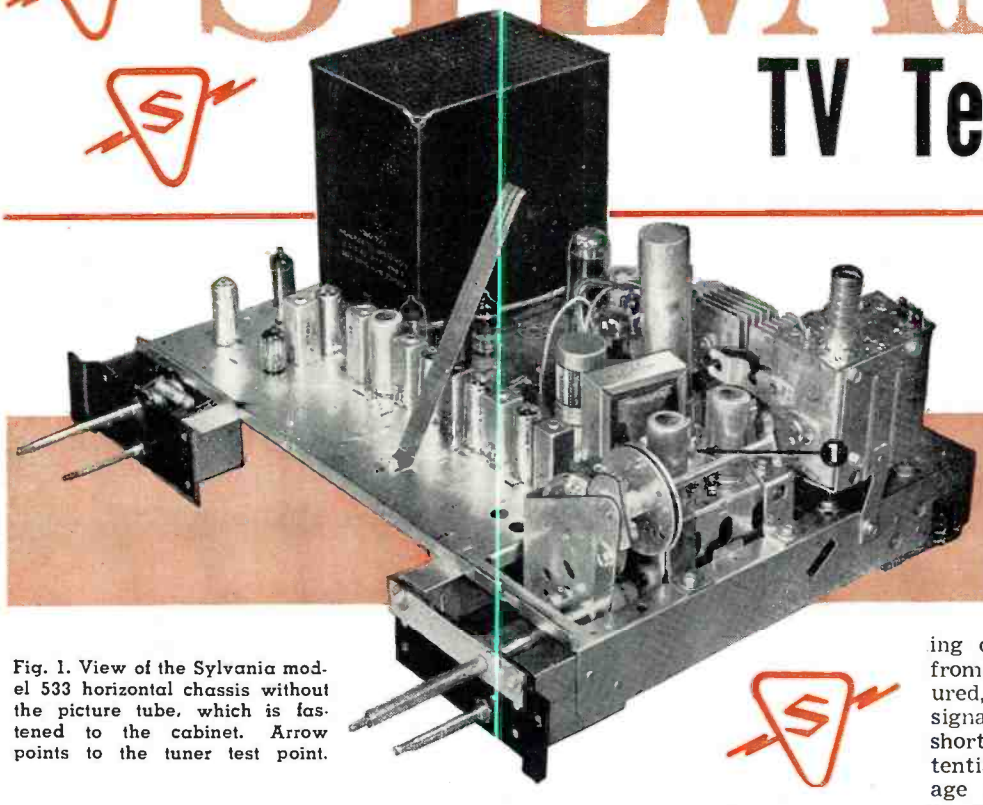


Fig. 1. View of the Sylvania model 533 horizontal chassis without the picture tube, which is fastened to the cabinet. Arrow points to the tuner test point.

Be an expert in the servicing of these TV receivers, by using the test points described in this article.

SYLVANIA engineers have designed two basic chassis for 1956. Model 532, used in the "leader" line, may be found in four table cabinet styles and two consoles, and is a vertical chassis. Model 533, a deluxe production, may be found in four table cabinet styles and three consoles, and is a horizontal chassis. Both were designed to operate picture tubes up to 24" without circuit changes of any kind. Both have cabinet-mounted picture tubes.

The horizontal chassis, shown in Fig. 1, can be removed in less time than it takes to pull off a back cover. In keeping with the current trend toward rapid servicing in the home, only two cabinet screws at the rear of the chassis need be removed. For this reason, few test points are provided on the top deck, although access can be gained readily to "B+," "B+ boost," a.g.c. line, and tuner connections.

Because of the high picture-tube potential employed (20 kv.), the back cover trips a safety switch on its removal which jumpers the high-voltage output to chassis ground.

Twin selenium rectifiers in a full-wave doubler circuit provide 260 volts of filtered "B+." Except for the "Halo-Light" tube which has its own source of power, all tubes are fed from a common heater transformer, thus providing parallel-heater operation. This chassis is provided with a four-stage i.f. strip utilizing 6BZ6 remote cut-off pentodes. Another feature is the use of a special vertical-blanking stage having its own triode and pulse circuitry.

Fig. 1 shows the first test point, the converter grid in the v.h.f. tuner. Normal voltage here, as read on a v.t.v.m., averages —1.5 volts. A zero reading, of course, indicates oscillator failure. If the oscillator has failed, check the other channels for output before blaming the whole tuner. Not infrequently, the tuner test point will reveal trouble on one channel only.

Occasionally, the technician may encounter another version of the tuner wherein the test point has a different internal connection. This is for r.f. alignment. A v.t.v.m. connected to the test point should read about +100 volts on this version.

Fig. 2 shows the other test points on the deluxe chassis. Test point 2 (pin 1 of V_3) is on the a.g.c. line. Depending on signal strength, a reading of from —.1 to —4 volts should be measured, becoming more negative as the signal increases. Look for a gassy or shorted i.f. tube when a positive potential is indicated. If the a.g.c. voltage seems unusually high, even on weak signals, chances are that an i.f. stage is regenerating.

For severe picture overloading, horizontal pulling, or negative picture, observe the a.g.c. voltage as you try tuning to a few channels. Remove and replace the antenna leads; when little or no change in voltage results, check components in the a.g.c. circuit, particularly the line bypass capacitors. If any of these is shorted, the r.f. or i.f. tubes will have insufficient bias and will operate at high gain.

Insufficient a.g.c. will result if any changes occur in the r.f., i.f., or video detector circuits. Since a.g.c. voltage is developed by the video signal, a gassy i.f. tube, for instance, could cause a deficiency. Sometimes, a tube will draw grid current which leaks into the a.g.c. line in opposition to the a.g.c. voltage. Worst offenders of this type seem to be r.f. tubes.

To adjust the a.g.c. control correctly on these receivers, tune in a strong channel, with minimum contrast and maximum brightness. Adjust the vertical hold control so that the picture rolls downward slowly, allowing the vertical blanking bar to be easily observed, as in Fig. 3. Next, turn the a.g.c. control clockwise until the sync pulse starts to become lighter, or the blanking bar becomes as black as the sync pulse. Then turn back the control to the point where the sync pulse becomes prominent on the blanking bar.

Test point 3 (pin 2 of V_8) is at the

output of the video detector. A v.t.v.m. reading of —3 volts indicates that the tuner and video i.f. strip are passing the signal with required gain. It does not, however, denote complete normalcy; for traps could be a little off, or the video signal itself could be contaminated with hum—not to mention sync and white compression.

Connect an oscilloscope isolated by a 33,000 ohm resistor to the test point and examine the video detector output wave. If the horizontal axis is indented, as by a sine wave, hum is modulating the signal. Sixty-cycle modulation denotes probable heater-to-cathode leakage in one of the tuner tubes, or in a tube in the video i.f. strip. If the offending frequency is 120 cycles, undue ripple has developed in the low-voltage power supply.

As a rule, hum on the video signal creates one or two wide, dark bars in the picture. Since the power supply has full-wave rectification, two bars would appear if ripple developed in the "B+." When only one dark bar is visible, tune the picture in and out with the fine tuning. A heater-to-cathode short (or leak) has developed in the video-handling tubes if the hum bar disappears with the picture. However, if the amplitude of the hum is very low, the black bars would not be discerned on the screen. Nevertheless, even a small ripple on the video can cause poor vertical hold.

With the scope synced at one-half the horizontal frequency, a peak-to-peak reading of 4 volts should be indicated at test point 3.

Test point 4 (pin 11 of V_{22}, the picture tube) takes us to the output of the video amplifier. A normal signal should provide 60 volts peak-to-peak. At any rate, the gain of this stage should approach 15. This may be determined by dividing the voltage measured here by the reading at test point 3. If the gain is below 13, replace the 12BY7, V_8.

When no output can be read at this test point, look for an open variable peaking coil (L_{207}, Fig. 4). An open here would remove "B+" from the 12BY7. On the other hand, if the gain is much over 20, look for an open series peaking coil. This would indicate that the operating point of the video amplifier tube has changed, thereby increasing the gain unduly. Consequently, the frequency response would be restricted, resulting in detriment to picture quality.

Whenever a variable peaking coil is replaced, the new coil must be adjusted in the following manner:

Tune in a strong signal, set the contrast control near maximum (not critical), and adjust the brightness for a somewhat dark picture. Then, connect a v.t.v.m. across the 2 μfd. electrolytic capacitor in the ratio detector. Adjust the fine tuning control until sound bars appear in the picture, then turn it back until the meter indicates the first dip in voltage. Be careful to adjust for the *first* minimum, since there will be a second and more-pronounced dip as the fine tuning is rotated further. Finally, adjust the variable peaking coil until there are little or no trailing whites or blacks following dark regions of the picture.

With a v.t.v.m. connected to pin 7 of V_{13} (test point 5), measure —.3 volt, plus or minus 10%. A reading on the oscilloscope here should average 10 volts peak-to-peak. This is at the grid of the horizontal sync clipper.

Examine the sync pulse closely for any sign of roughness in its contour. Unless the pulse appears clean, an aging 12AU7 is a likely suspect. If the characteristics of tubes and components drift to the point where faulty clipping occurs, fragments of noise and video information will penetrate the sync stages, causing erratic operation of the deflection system. A gassy tube in the front end or video i.f. sections will also roughen up the sync pulse. This could lead to pulling or weaving of the picture, with perhaps intermittent loss of stability.

If only the extreme upper portion of the picture weaves, it indicates that the sync pulse has been compressed. This, of course, can be detected on the scope. But loss of sync amplitude may occur in earlier stages. The noise inverter, for instance, could tend to clip sync, or alignment may have drifted to the point where the video carrier rides too low on the response curve. In general, however, when the picture (other than the very top) pulls horizontally,

Fig. 3. Vertical blanking showing the sync pulse, used for adjusting the a.g.c.

the trouble will lie in the sync separator.

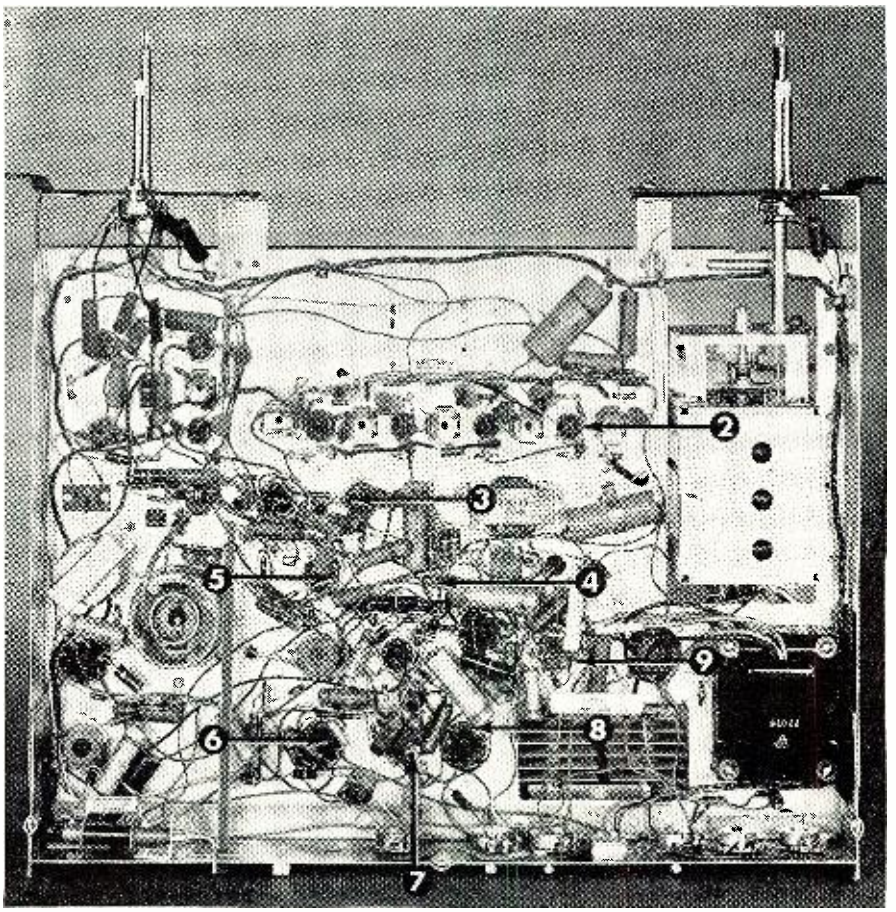
Horizontal sync trouble often originates in the horizontal oscillator stage. Test point 6, at pin 3 of V_{18}, should measure +6.8 volts on a v.t.v.m. A deficiency of 1 volt calls for a thorough check of the entire stage. Observe that all resistors here have a tolerance of only 10%. Measure these on an accurate ohmmeter and replace any whose value has drifted beyond this tolerance. An oscilloscope connected to this test point should give a reading of 325 volts peak-to-peak.

The a.f.c. test point (number 7 in Fig. 2) is at pin 1 of V_{17}. A scope sweeping at 7875 cycles should show 13 volts peak-to-peak at this point. Occasionally, when components age or are replaced, it may be necessary to re-align the a.f.c. stage, in which case the following procedure applies:

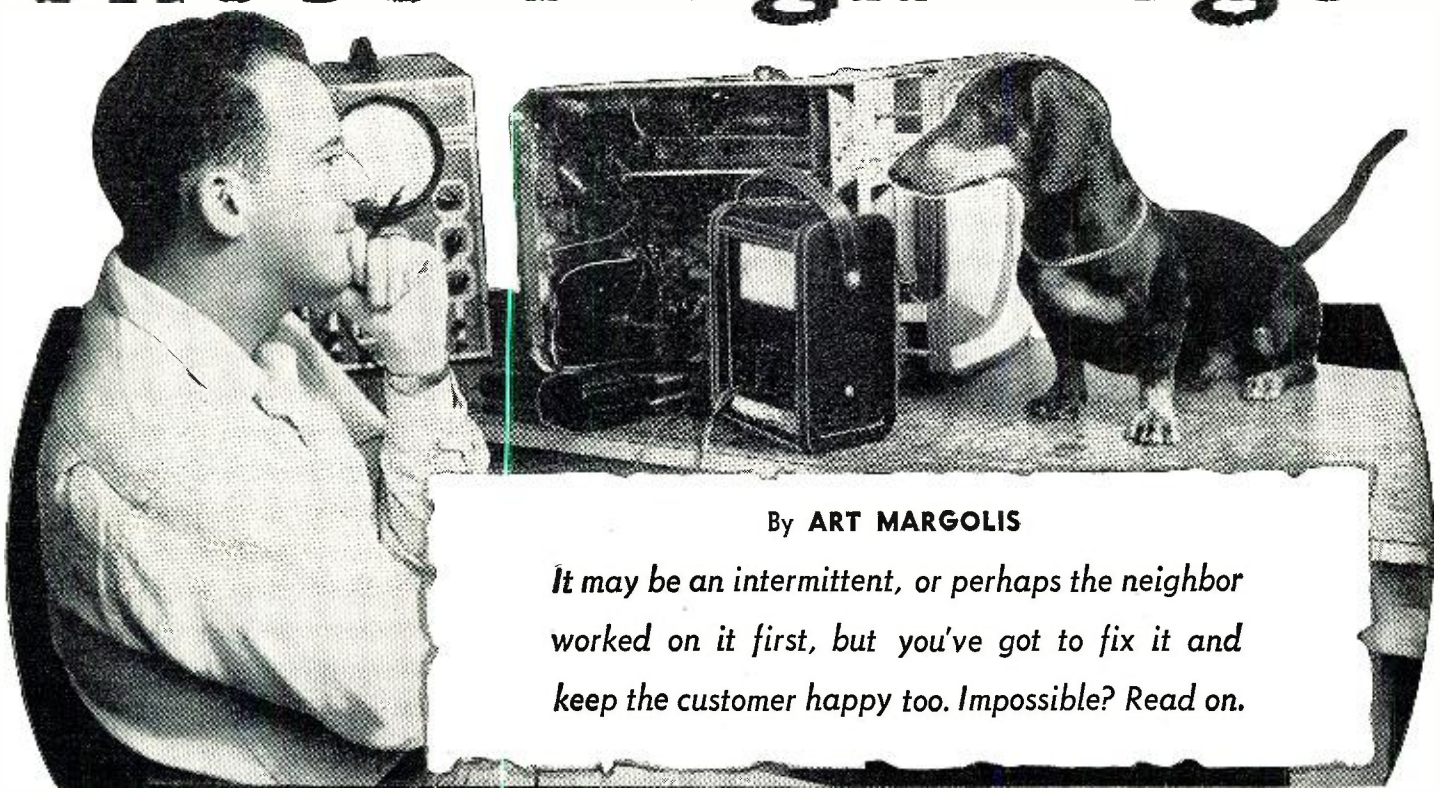
1. Tune in a strong channel.
2. Adjust the width control for approximately normal scan.
3. Short pin 8 of V_{13}, the 12AU7 horizontal sync clipper, to chassis ground. Connect a jumper across the terminals

(*Continued on page* 100)

Fig. 2. Underchassis view of Sylvania model 533 horizontal chassis showing the test points which, if used as explained in the text, will aid in servicing.



Those Tough Dogs



By **ART MARGOLIS**

It may be an intermittent, or perhaps the neighbor worked on it first, but you've got to fix it and keep the customer happy too. Impossible? Read on.

THE customer's shrill voice insisted, "I want my television set back! You've had it now over three weeks."

You wearily answer, "I'm just as anxious as you are ma'am to bring it back. But we are waiting for a factory part that should be here in the next couple of days."

She yells back, "Well it better be here soon, goodbye!" and her hanging up hurts your ear.

Then you pick yourself up from the desk, plunk yourself down by the bench, and look at the exposed underside of the "dog" in question. A fleeting bit of guilt crosses your mind. You have just told a little white lie. Suppose the irate set owner knew there was no hard-to-get part? Suppose she really knew the truth? You are stuck on a "dog." You don't know yet what is wrong.

Big shop or small, crackerjack troubleshooter or beginner, if you fix TV's, out of every hundred jobs there are going to be a few sets of the canine variety. They make you swear, curse, and pray. They awaken you in the middle of the night with new theories of attack. They shake your confidence in your abilities. They make TV service seem like the worst kind of endeavor. They are the jobs where every "B+" string leads to a dead end. Where every component is torture to "unbutton" and then checks good. Where the television-addicted customer is constantly on the phone trying to get the set back. Where you have to keep telling fibs for you cannot explain the reason for the delay is that you do not know what is wrong.

These TV "dogs" can be isolated into "breeds": the intermittent, the "one-in-a-million," the induced, and the eventual leaker. No doubt there are others.

A new 21" *CBS-Columbia* vertical chassis arrived on the bench one morning. A visual inspection seemed to reveal the trouble. A tiny 100 $\mu\mu$fd. mica from "B+" to ground was blackened. It had evidently shorted, pumping "B+" through itself to ground. Two resistors, a 1000 ohm and a 4500 ohm in its immediate vicinity were open, see Fig. 1. The shorted mica must have caused excessive "B+" to pass through the resistors.

The three disfigured components were replaced, and the set turned on. A raster promptly appeared. When an antenna was attached, video flickered on and audio blasted. All was well.

Just as the finishing touches were being applied to the job, it happened. The video went snowy and herringboned; the sound garbled. Then they both "conked out" altogether. Just as suddenly, they came on again. Two hours later it did it again. This easy one had turned into an intermittent. Two days later it was still acting the same way.

Right then and there we paused and put into action our simple but effective "pressure alleviating policy." We called the set owner and explained, "Your set is almost completed. However there are still a few small things wrong with it and before we send it back we want it to be perfect. It will probably consume some time so if you'd like information call in periodically and we will give you a progress report. Please have patience and we're sure you'll be pleased with your TV."

It was a week until we were able to pin this one down by a substitution and cook method. The 4.5 mc. intercarrier trap was located in the same can as the 3rd i.f. transformer. The 4.5 mc. trap was also directly in line with the two "deceased" resistors. The "B+" surge which had damaged them had also impaired the trap operation. As it opened up intermittently it affected the i.f. transformer's inductance and, thus, the video and audio symptoms.

A new can restored the original good performance. Even more pleasing, that one short phone call had enabled the customer to contain herself and still remain a recommendation producer.

One of the worst types of electronic "dogs" is a set that has been worked over by a nontechnician with a soldering iron. This special trouble class we call induced. As soon as we realize we have one of these, we set the record straight with the customer and won't accept the repair without a complete understanding.

We pulled a 17" *Philco* that was burning out the 3rd i.f. 6AU6, 6CB6 r.f. amplifier, and 12AV7 mixer-oscillator tubes as fast as we could insert their miniature prongs into their sockets. Underchassis examination revealed that the 1300-ohm wirewound, 9-watt "B+" load resistor was no longer in place. Instead, an 1800-ohm, 4-watt unit had been substituted (see Fig. 2). A glance at the set's schematic showed that the incorrect replacement was tied to a wrong filter. In place of the .7 ampere fuse there was a twenty ampere one. Big solder blobs were dotted throughout as mute evidence of

some previous mystery worker who had been both eager and misdirected.

We called the customer before starting and explained, "Someone has done quite a lot of damage to your television receiver. We will be glad to do the repair but because of the circumstances the price will probably be a bit higher than usual and the job will take a little longer than normal." She was well aware of what had happened and confessed that her next door neighbor had tried to fix the set but ran into difficulties. She gave us the "go ahead."

We allocated an hour every afternoon to this "dog." In eight days it was working again but it had been a real struggle. The first thing we found was that the "B+" dropping resistor was heating up because it wasn't rated high enough. As it got hot its resistance decreased tremendously in negative temperature globar fashion. This threw better than three-hundred volts onto the third i.f. which was supposed to get only 135 volts, the r.f. amplifier which should have had but 155 volts, and the mixer-oscillator where 125 and 80 volts respectively were normal. These plates drew excessive cathode electrons and burned out. The heavy current flow would undoubtedly blow the .7 ampere fuse which was why the twenty ampere one was inserted.

We changed the resistor to its proper value and the fuse remained intact and a raster came on, but still no audio or video. In carefully checking wire by wire, component by component, six wrong connections were uncovered. A new 12AV7 video tube brought in the picture and a new 7C5 audio output tube returned the sound. However, the video was weak and negative.

After hours more of wire by wire scrutiny, an 1800-ohm video plate resistor was found to be missing. A "B+" line that had no business being there, was tied to that same video amplifier plate. This was evidently the neighbor novice's first big confusion that started the whole mess. Removal of the line and the addition of a new resistor did it. The picture and sound snapped back.

It's hard to describe the feeling of cloud sailing a TV service technician gets after licking a tough "dog." It's also hard to depict the stomach-turning despair that occurs when he is stuck on a stubborn television set and there seems to be no answer. To ask for help is also an admission of defeat. Yet eventually, every one of us, no matter how expert, is going to run into a "dog" that will successfully resist every effort hour after hour after hour.

Is it a sensible business move to keep banging your head against the bench? When a general practitioner MD runs into something that for the moment stumps him does he take chances and keep plugging at it? No! He calls for a specialist. Well, a TV technician who works on thousands of makes and models is in a sense a general practitioner. The boys in the distributor service shops who work on only one make day-in, day-out are specialists on that particular make. Also they are very able and quite anxious to help you with your real bad "dogs." Our company makes liberal use of their skills.

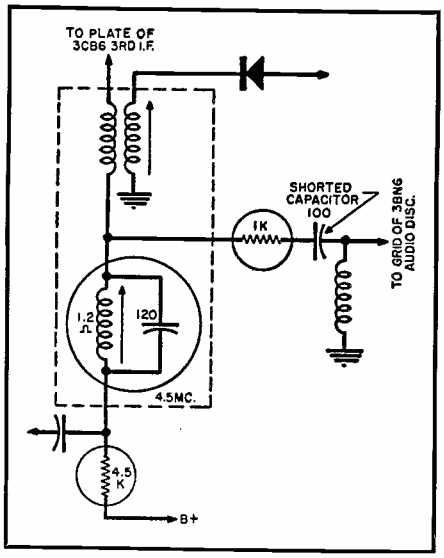
A 21" *G-E* came into the shop a few weeks ago after the owner described these symptoms. As long as he had owned the set the sync was unstable. There was a slight pulling horizontally and the vertical sync was never as stable as it should be. Whenever the customer turned the contrast control complete sync loss would occur for a few seconds. Now, he said, it was impossible altogether.

When the set was first turned on the picture came in crisp and clear for about a minute. Then it started to pull sideways like a carnival mirror. The video overloaded, the picture went negative, the sound buzzed, it lost sync, then suddenly, miraculously cleaned up to perfection. It kept doing this.

There were three definite clues to the trouble. One, a.g.c. overloading; two, snow; and three, a seeming loss of frequency response. We looked for one likely part that would cause all that and sure enough found it, a peaking coil in the a.g.c. line, see Fig. 3. The theory underlying the video destruction fell into place. The coil was upsetting the sensitive bias of the r.f. amplifier thus giving snow. It was removing the a.g.c. bias on the i.f.'s, thus overloading the video. It was also hurting the frequency response of the picture which is its original function. A new coil stopped all that.

However, if the contrast control was turned either up or down, sync would be lost for a few seconds. We looked for another bad part. A week later we were still in the same fix. Then, we called the *G-E* distributor and got a benchman on the phone. We didn't think he could help but told him our troubles anyway. Without even hesitating to take a breath, he told us to change a .1 μfd. capacitor that was next in series with the peaking coil to a .05 μfd. He explained that the loss of sync was due to the .1 μfd. capacitor making the time constant of the circuit too long so that the a.g.c. re-adjusted itself too slowly. The modification would speed it up. It did!

Fig. 1. The shorted capacitor indicated in this partial schematic diagram of a 21" CBS-Columbia TV receiver, allowed excessive "B+" to pass through this circuit, damaging the resistors and trap.



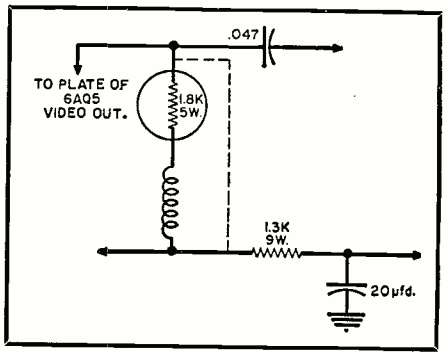


Fig. 2. The dotted line shows the wiring mistake which was made by a neighbor on a customer's 17" Philco TV receiver. This started a chain of rewiring and replacements that resulted in a "dog."

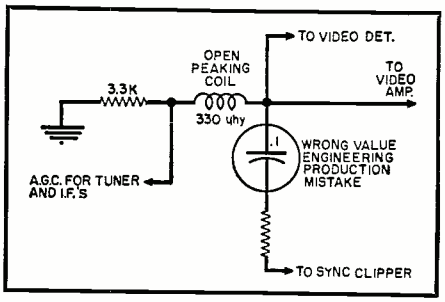


Fig. 3. Consultation with the local G-E distributor's service department helped service the set whose partial diagram is shown here. An incorrect capacitor inserted at the factory, caused the trouble.

The unfortunate thing about "dogs" is, not only do we have such a conflict with them technically, but quite often we can't get the price the job is actually worth.

A 12" *Emerson* that we repaired not long ago was an example of this. The original symptoms looked innocent enough, one of the series heater strings did not light up. The 25W4 had a heater-to-cathode short and a 55-ohm heater resistor open (see Fig. 4). After they were replaced, only half of the defunct string came back on. Two of the tubes that did come on, a 25L6 and a 12BH7, lighted up like they were about to explode. The set was shut off. After much resistance checking, a 1500 μμfd. capacitor from the heater string to ground was found which measured 320 ohms. It was sending "B+" through the heaters of the tubes. After it was changed and the set turned on again the 25L6 and 12BH7 lighted up again.

Some more resistance checking showed the trouble to be only a heater-to-cathode short in the 12BH7. A new tube, and the string came on properly. However, there was no sound or video, only a 60-cycle hum bar. That was easy to fix, a 6AU6 i.f. tube which had

(*Continued on page* 94)

A HOME MUSIC SYSTEM

Basic units used in hi-fi system—Garrard Model RC80 record changer, Heathkits: WA-P2 preamplifier, W-5M power amplifier, and FM-3 FM tuner.

One of a thousand or more combinations that could be assembled to make up your hi-fi music system.

THE scene depicted on this month's cover is fairly typical of what is taking place in hundreds of thousands of living rooms throughout the country. While the actual equipment may vary in complexity from home to home—this installation might be considered "representative" since the hi-fi fan has selected his components from the offerings of several manufacturers and has assembled his own "system."

Hi-fi fans can be roughly grouped into two classifications. The first type is the dyed-in-the-wool audiophile, like the man on the cover, whose pride and joy is in building some of his own equipment and assembling all the components into a unified "system." He makes a real effort to study the operation of each of his units so that he can speak with some authority on this interesting medium.

The other type of hi-fi fan, although no less eager in his pursuit of his hobby, lacks the technical "know-how" or the self-confidence to build his own equipment. He is the type of audiophile who will buy a "packaged" unit consisting of one or two cabinets which will house the components selected and assembled for him.

His reasons for wanting a "complete deal" range all the way from a lighter touch on his pocketbook to a feeling of inadequacy when it comes to assembling such systems. Often his lack of confidence in his ability to interconnect the various components comprising a hi-fi system is misplaced since the job is relatively simple. Most units nowadays come complete with clear and explicit instructions for hooking them up. The awe with which "electronics" is viewed by many is still a deterrent to some people.

The fact that many such "packaged" systems are lower in price than the total cost of individually-assembled units indicates that the ultimate in sound reproduction is not obtained. For the most part, these are well-engineered jobs whose development "at a price" is a real tribute to the manufacturer's skill. Emphasis is placed on mass production and the marketing of such units brings the equipment within the budgets of many who could not otherwise enjoy such luxury. For the most part, packaged systems selling for $600 and up offer sound reproduction of highest quality.

This month's cover depicts what can be considered a typical setup for the average serious audiophile. Although the units are laid out in the corner of the room for photographic purposes, in an actual installation, the power amplifier, record changer, preamp, and tuner might be cabineted in some type of housing that would suit the home decor or meet the esthetic requirements of the owner. There is another, more current trend which dictates that tuners, preamps, and record changers were meant to be "seen as well as heard." In such instances the units are cabineted in attractive housings with handsome front panel escutcheons and matching enclosures. The power amplifier, on the other hand, continues to be housed in a cabinet, a closet, or some out-of-the-way place where it can do its work unobtrusively.

The units shown on the cover are, from left to right (clockwise), the *Garrard* Model RC80 record changer which sells for $49.50 less cartridge (with a *General Electric* variable reluctance cartridge, sapphire needle, the price $56.50), the *Jensen* "Tri-Plex" enclosure (TP200) and multiple speaker system, the *Heath* Model W-5M power amplifier which comes in kit form for $59.75, the *Heath* WA-P2 preamplifier kit (at $19.75), and the *Heath* Model FM-3 FM tuner which sells for $24.50 as a kit. Thus a high-fidelity music system is available for a total investment of $160.50, excluding the speaker or speakers and enclosure. In addition, if an over-all cabinet is required to house all of the equipment, it would mean an additional expenditure.

The cost of the speaker network and enclosure varies considerably. They can be obtained for as little as $45.00 or as much as $1000 or more. The audiophile has a wide choice and final decision will obviously depend on the amount of money available for investment in this component.

The setup shown on this month's cover is only one of literally hundreds of systems that could be assembled from the many components on the market—some ready to be installed or, like the *Heath* units shown, available only in kit form. If the job of building audio equipment, simple though it may be, strikes terror in the hearts of would-be system owners, there is always the helpful neighbor with a flare for things electronic or a local service shop which can whip the units together in jig time for a modest fee.

With all of the choices now available to the music lover—everyone can "get into the act" at his own level. —30—

New Tube Tester Data

Bring your roll chart up to date for the new tube types. Future data will cover other service-type tube testers.

MANY service technicians and other users of tube testers cannot test many of the new tube types currently in use in TV receivers and other equipment because they have not replaced the old roll chart originally furnished with the instrument with a new one. Almost all tube tester manufacturers make up new roll charts for their instruments every year and these may be obtained simply by writing to the manufacturer and requesting the latest one for your model. They are nominally priced. In almost every case, a new roll chart can be inserted in the tube tester in a matter of minutes.

Between the time when the last roll chart was printed for a particular tube tester and the next one will be available, new tubes make their appearance. Since these are not covered by the last roll chart, the technician will not know where to set his tube tester switches for a proper test. The data published here and in succeeding issues will furnish this information for most of the commercially available tube testers.

In the table below for the *Knight* tube tester, the numbers in dark type indicate the necessary settings for the "short" test. —30—

JACKSON MODEL 715/115

TUBE TYPE	FILAMENT	X	PLATE	YZ
3A2	3	23467	37	8 Q
3BA6	3	—	14	2 LMS
3BZ6	3	—	26	3 JKMQ
3CF6	3	—	30	2 LMS
4BC8	4.2	—	17	2 LR
			17	4 NR
5B8	5	—	18	9 LR
			32	7 MOQ
5BE8	5	—	20	4 JNPS
			18	3 KR
6AS8	6.3	—	43	7 JKLR
			27	4 Q
6AU8	6.3	—	18	9 LR
			32	7 NOQ
6AX8	6.3	—	35	5 RS
			10	2 PS
6AZ8	6.3	—	30	2 JLQ
			20	6 PR
6BA8	6.3	—	23	7 JOR
			20	9 LR
6BC4	6.3	3567	35	4 RS
6BC8	6.3	—	17	2 LR
			17	4 NR
6CB5	6.3	235	8	8 JMPS
6CM7	6.3	—	11	2 OS
			28	4 NR
6CN7	6.3	7	30	6 NQ
			30	2 Q
			30	3 Q
6DE6	6.3	—	30	2 LMS
6DG6	6.3	—	8	2 JLMS
6DN6	6.3	—	15	8 MPR
6CS7	6.3	—	18	2 S
			18	4 NS
12AB5	12.6	46	18	7 JKS
12AV5	12.6	36	8	4 NPS
12BR7	12.6	7	25	2 LQ
			30	4 Q
			30	5 Q
12BV7	12.6	47	20	5 JOR
12C5	12.6	2	15	5 KMR
12CR6	12.6	—	22	2 JMNR
			33	6 Q
12CS6	12.6	—	26	2 LMNS
25CA5	25	6	16	5 KMR
25DN6	25	—	15	8 MPR
6550	6.3	—	8	2 JLMS

JACKSON MODEL 648

TUBE TYPE	FILAMENT	D	E	PLATE TEST
3BZ6	3	AC1234	567	16 WY
4BC8	4.2	A123	A45	39 V
		A127	A89	39 V
5BE8	5	A1237	AC680	50 V
		A123	AC45	68 Z
6AZ8	6.3	A128	AC345	16 WY
		A129	AC67	34 WZ
6BA8	6.3	A128	679	32 WZ
		124	A35	25 WZ
6BC8	6.3	A123	A45	39 V
		A127	A89	39 V
6CM7	6.3	A123	A89	65 V
		126	A47	35 Z
6CN7	6.3	A128	A79	32 WX
		123	5	60 X
			4	60 X
6CS7	6.3	126	AC34	35 Z
		127	A89	70 Z
6DN6	6.3	124	AB369	18 V
12AB5	12.6	129	B346	35 W
12CR6	12.6	AC123	AC456	25 YZ
		C123	7	80 X
25DN6	25	124	AB369	18 V

KNIGHT MODEL 142

TUBE TYPE	A	B-FILAMENT	C-LOAD	LEVER POSITION UP	LEVER POSITION DOWN
2AF4 (Adapt BX)	2	2.5	21	**1267**	**45**
3BY6 (Adapt BX)	2	5	20	16	**24**
3BY6 Test 2	1	5	27	57	**24**
3BZ6 (Adapt BX)	2	5	20	1567	**24**
3CF6 (Adapt BX) (No open element test on pins 5 and 7)	1	5	19	1567	**24**
4BQ7A Tests 1-2 (Use BY adapter)	2-2	5	20-20	12-67	**34-48**
4BZ7 Tests 1-2 (Use BY adapter)	2-2	5	21-20	67-12	**48-34**
5AM8 Tests 1-2	2-1	5	20-19	2369-8	**15-57**
5AN8 Tests 1-2	2-2	5	21-20	12-678	**35-59**
5AQ5	3	5	20	**1567**	**24**
5AT8 Tests 1-2	2-2	5	21-20	12-6789	**35-35**
5AU4 Tests 1-2	3-3	5	25-25	4-6	**8-2**
5AV8 Tests 1-2	2-2	5	21-20	23-689	**15-57**
5B8 Tests 1-2 (No open element test on pin 9)	2-2	5	21-21	23-689	**15-12357**
5BK7A Tests 1-2	2-2	5	20-20	67-12	**58-35**
5J6 Tests 1-2	2-2	5	20-20	16-25	**47-47**
5U8 Tests 1-2 (No open element test on pin 6)	2-2	5	20-20	19-236	**58-57**
5V6	3	5	21	345	**178**
5X8 Tests 1-2	2-2	5	22-21	23-789	**56-156**
6AN6 Tests 1-2	1-1	6.3	23-23	2-3	**67-67**
6AN6 Tests 3-4	1-1	6.3	23-23	4-5	**67-67**
6AR8 (No open element test on pins 8 and 9)	2	6.3	20	3689	**1257**
6AU8 Tests 1-2 (No open element test on pin 9)	2-2	6.3	21-21	23-789	**14-46**
6AX8 Tests 1-2 (No open element test on pin 6)	2-2	6.3	20-20	19-236	**58-57**
6CB5	2	6.3	22	**1458**	**236**
6CG7 Tests 1-2	2-2	6.3	23-23	12-67	**34-48**
6DA6	3	6.3	18	1567	**24**
12AV5-GA	3	12.6	18	158	**23**
12BK5	2	12.6	21	**1378**	**45**
19AU4	4	19.6	18	5	**38**
21A6 (No open element test on pin 0)	3	19.6	16	**1267890**	**35**
25BK5	2	25	21	**1378**	**46**
25CA5	3	25	17	**2567**	**14**
25CU6	3	25	17	450	**78**
5690 Tests 1-2	3-3	6.3	17-17	3-5	**24-78**
6463 Tests 1-2	2-2	6.3	21-21	13-68	**245-457**
6550	3	6.3	17	345	**78**

An Improved "3D" Converter

Top chassis view of the simplified "3D" converter. This improved version incorporates a self-contained power supply which will also operate a separate tuner or preamp to be used with this system.

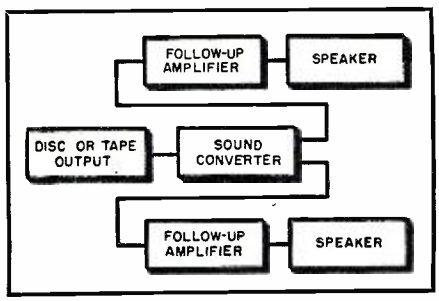
By **JOSEPH CHERNOF**

A simplified and improved version of a circuit originally described in the November 1954 issue.

SINCE publication of the author's article, "The Poor Man's 3D Converter," in the November, 1954 issue of RADIO & TELEVISION NEWS, a number of interesting comments have been received from readers who have constructed and experimented with the unit.

On the basis of this material and other work, a new unit has been developed which has proved to be a considerable improvement over the original. An internal power supply has been added and provisions have been made for utilizing the unit to supply power to a separate preamp or tuner in a custom installation. Separate audio inputs are provided to accommodate both low-and high-level audio signals. The bass predominant channel gain has been reduced to bring it more in line with that of the treble predominant channel. Feedback has been added to the input preamp stages to improve their frequency response and linearity. Low-frequency performance of the unit has been improved by using larger coupling capacitors. Capacitor C_6 has been made larger to provide a smoother crossover for the bass and treble channels.

Fig. 1. Block diagram of the complete "3D" system. Although dual output amplifiers and speakers are required, ordinary units will work as well as high-fidelity equipment.



The original "3D" converter was designed to provide the audio experimenter with a means of capturing the illusion of depth and liveness associated with true stereophonic or binaural sound at a fraction of the cost and complication involved in assembling either one of these two systems.

The "3D" converter attempts to convert ordinary monaural sound, as supplied from phono pickup or tape, to simulated stereophonic sound. This is accomplished by electronically separating the single sound input channel into two separate output channels, sufficiently different in phase and frequency structure from each other to simulate, say, the sound output of a symphonic orchestra as picked up by two separate microphones on a live recording stage.

The two sound output channels from the converter are followed by two separate external amplifiers and speaker systems so that recombination of the synthetic stereophonic sound takes place only at the ears of the listener as is the case with true binaural or stereophonic sound.

A block diagram of the complete "3D" system is shown in Fig. 1. While dual output amplifiers and speakers are required, very ordinary units used in this system will give results superior in most respects to a high quality monaural sound system. One possibility would be to use the audio section of a good console radio or TV set for the second sound channel.

The schematic diagram of the improved unit is shown in Fig. 2, with typical operating voltages indicated on it. The first two stages utilize both sections of a 12AX7 twin-triode in a conventional preamp circuit. Ample gain is available for a magnetic cartridge or other low-level signal source. No attempt is made to incorporate any specific means of equalization since a complete "3D" system will have a multitude of tone and volume controls on the various units to accomplish this.

The output of the preamp stages is fed through the master gain control, R_9. High level input signals from a crystal or ceramic cartridge or tuner are fed in at this point. In this connection, the jumper between terminals 2 and 3 of J_1, a 4-terminal *Jones* barrier strip, is removed. From the master gain control, the amplified input signal is coupled to the grids of triode sections V_{2A} and V_{2B} which comprise the bass and treble predominant channels respectively. Each channel has its own gain control.

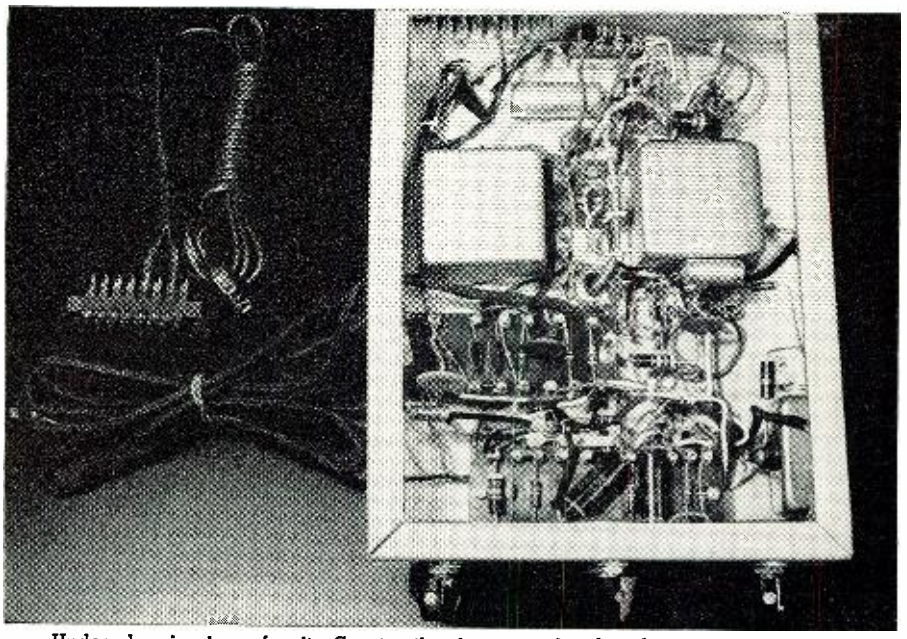
The phase and frequency structure of the original signal are modified by means of selective feedback in each of the two channel amplifiers to provide the desired stereophonic effects. The separate outputs of V_{2A} and V_{2B} are coupled to individual cathode-fol-

lower triode sections, V_{3A} and V_{3B}, to provide isolation and also to permit the follow-up amplifiers to be located at some distance from the converter.

The power supply is conventional in design, using a 6X4 rectifier and a *Triad* R-7A power transformer. Very heavy filtering and decoupling networks are used. Since the total "B" current drain of the unit is very low, less than 6 ma., filter resistors are used rather than chokes.

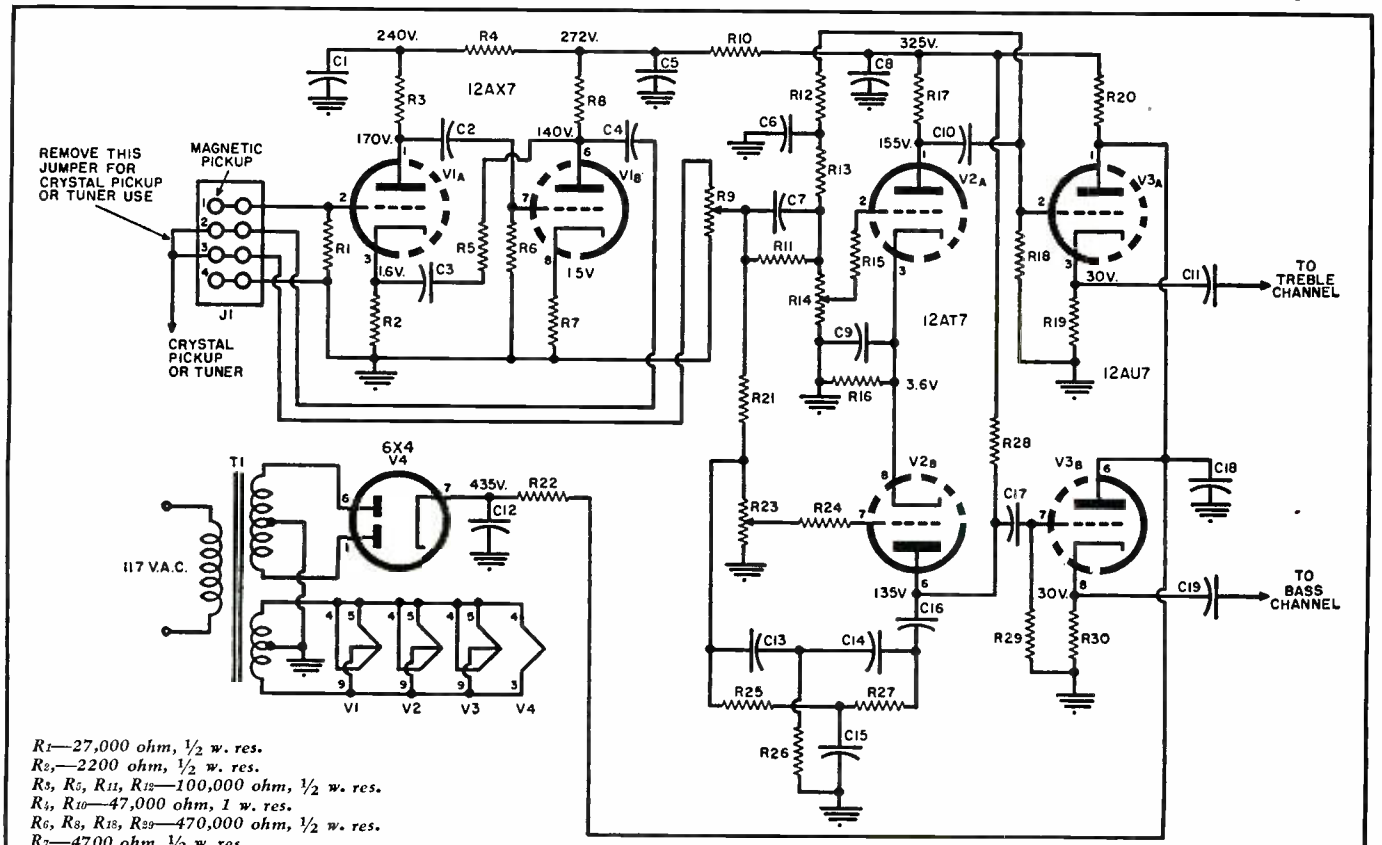
As shown in the accompanying photos, a 15-pin male *Winchester* connector is mounted on the rear of the unit. The a.c. power is supplied through the associated female connector. This arrangement allows the unit to plug into a complete sound assembly, with a common "on-off" switch for several units. It also provides a handy outlet for "B" or filament power to be taken out of the unit to operate an external preamp or tuner as well as a very flexible means for connecting input signals into the unit for a custom installation where all wiring is to be concealed. Conventional parts and construction are used throughout except that disc ceramic capacitors are used instead of tubulars to conserve space.

Readers who have wondered whether or not stereophonic sound is for them can make the experiment with this equipment without investing a fortune in stereophonic head and pickups, dual amplifiers, and double speaker systems. While no claims are made that this "3D" converter is anything but a *simulated* stereophonic system, it will provide a fairly good idea of the *type* of performance that you can expect from a true stereo setup. —30—



Under chassis view of unit. Construction is conventional and no problems should be encountered by the builder. Disc ceramic capacitors are used to conserve space.

Fig. 2. Schematic diagram and parts list covering an improved "3D" converter. Standard, easily obtainable parts are used throughout.



R_1—27,000 ohm, ½ w. res.
R_2,—2200 ohm, ½ w. res.
R_3, R_5, R_{11}, R_{15}—100,000 ohm, ½ w. res.
R_4, R_{10}—47,000 ohm, 1 w. res.
R_6, R_8, R_{18}, R_{29}—470,000 ohm, ½ w. res.
R_7—4700 ohm, ½ w. res.
R_9, R_{14}, R_{23}—500,000 ohm audio taper pot
R_{13}, R_{17}, R_{28}—220,000 ohm ½ w. res.
R_{19}, R_{19}, R_{24}, R_{30}—47,000 ohm, ½ w. res.
R_{16}—2000 ohm, ½ w. res.
R_{20}—22,000 ohm, 2 w. res.
R_{21}—680,000 ohm, ½ w. res.
R_{22}—15,000 ohm, 2 w. res.
R_{25}, R_{27}—2.2 megohm, ½ w. res.
R_{26}—10,000 ohm, ½ w. res.
C_1—.5 μfd., 400 v. capacitor

C_2, C_4—.047 μfd., 200 v. capacitor
C_3—.005 μfd., 400 v. disc ceramic capacitor
C_5, C_8—2 μfd., 600 v. bathtub capacitor
C_6, C_{16}—.03 μfd., 400 v. disc ceramic capacitor
C_7—250 μμfd., 400 v. disc ceramic capacitor
C_9—25 μfd., 50 v. bathtub capacitor
C_{10}, C_{11}—.01 μfd., 400 v. disc ceramic capacitor
C_{12}, C_{18}—8 μfd., 450 v. elec. capacitor
C_{13}, C_{14}—.005 μfd., 400 v. disc ceramic capacitor

C_{15}—.02 μfd., 400 v. disc ceramic capacitor
C_{17}, C_{19}—.1 μfd., 400 v. tubular capacitor
T_1—Power trans. 300-0-300 v. @ 50 ma.; 5 v. @ 2 amps.; 6.3 v. c.t. @ 2 amps. (5 volt winding not used. Triad R-7A)
J_1—4-terminal barrier strip (Jones)
V_1—12AX7 tube
V_2—12AT7 tube
V_3—12AU7 tube
V_4—6X4 tube

EVOLUTION of the PHONOGRAPH

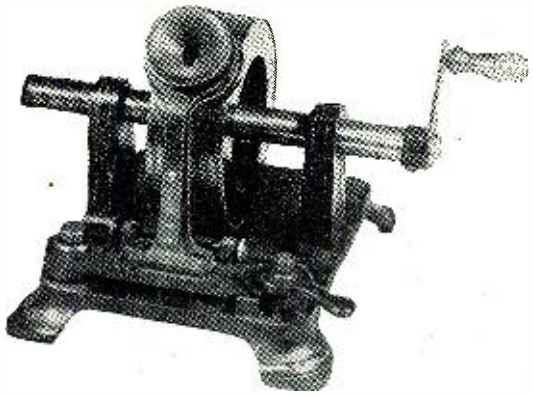


Fig. 3. A single diaphragm and stylus simplified the phono of 1878.

Part 3. Earliest phonographs were hand-powered, electric-powered, foot-powered, and water-powered.

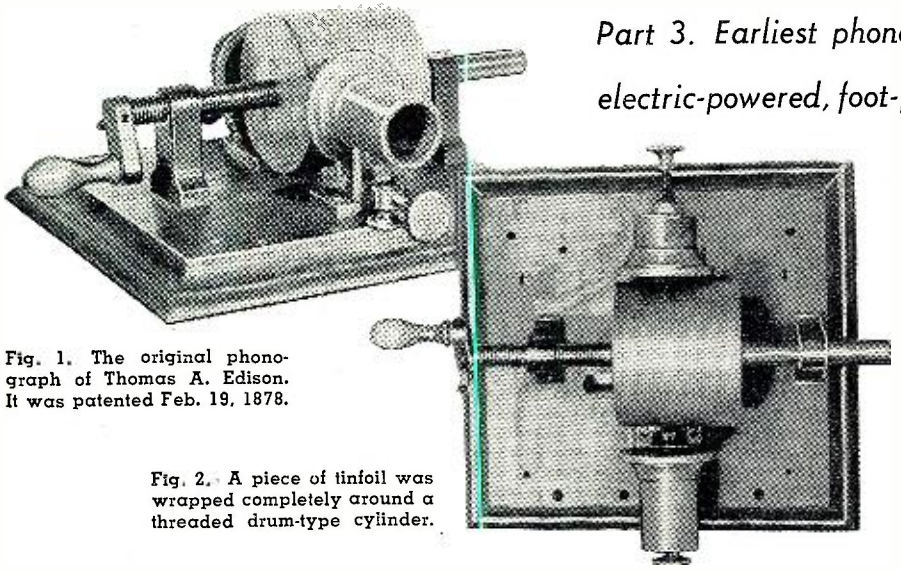


Fig. 1. The original phonograph of Thomas A. Edison. It was patented Feb. 19, 1878.

Fig. 2. A piece of tinfoil was wrapped completely around a threaded drum-type cylinder.

THE original tinfoil phonograph of *Edison* was first developed in the year 1877. A complete description of and operation applying to this discovery are revealed in Part 1 of this series. Edison's original machine, Fig. 1, employed a metal drum on which a thin sheet of tinfoil was wrapped. Sound was indented into the foil by means of a stylus actuated by a thin metal diaphragm.

The setscrew shown in Fig. 1 below the recorder permitted adjustments to be made in the stylus pressure. Attached to this recorder was a flexible tube which terminated in a rubber mouthpiece. A bird's-eye view of the tinfoil machine, Fig. 2, shows a similar arrangement of the reproducer used in the playing back of the sound previously recorded on the foil. Another setscrew was provided beneath the reproducer so that lateral adjustment could be made and accordingly to provide flexibility to the reproducing stylus. This was of steel and attached to the center of a thin diaphragm. This is the actual machine on which Edison recorded "Mary Had a Little Lamb" on August 15, 1877. The original model was loaned to the *South Kensington Museum* in London, and was returned to Edison many years later on October 20, 1928. It may be seen at the *Thomas A. Edison Foundation Museum* in West Orange, New Jersey, where this and other early developments of Edison are on permanent display. Its curator, Mr. Norman Speiden, is a renowned authority on the inventions of Thomas A. Edison and will welcome our technically-minded readers who are interested in the inventions of the "Wizard of Menlo Park."

Edison produced a smaller model of his tinfoil phonograph the following year in 1878, Fig. 3, and this contained a few minor improvements over his original machine. It employed cast metal parts comprising a heavy base and the necessary supports for the driving screw. This particular model combined the functions of recording and reproducing with one diaphragm. Simplification resulted in greater economy and compactness, making this machine more popular with the purchaser. In operation, the metal assembly supporting the mouthpiece and reproducer could be swung away from the cylinder so that a sheet of tinfoil could be wrapped thereon. A locking device held the assembly firmly in place during use. Lateral adjusting screws were provided, so that the stylus could be accurately centered to the groove on the large cylinder drum. Only a very few of this model was produced.

In order to publicize the wonders of the phonograph, a quantity of demonstration machines was manufactured, Fig. 4, late in the year 1878. About six hundred of these were made to demonstrate the principle of the phonograph. It was indeed a cumbersome device. It employed a long shaft comprising the feedscrew, a drive wheel, and a weighted wheel required to stabilize the rotation. This model also employed a single diaphragm which was used as shown with a rubber mouthpiece for recording. During reproduction, the mouthpiece was either left in place for close listening, or could be removed and replaced with a flexible rubber hose and attachment to fit the ear. Note the old-fashioned grease cups mounted on top of the shaft supporting members. Under the feedscrew, on the left side of the shaft, looking at the illustration, may be seen a "half nut" which engaged the feedscrew to drive it laterally during operation. It was disengaged from the feedscrew by the small lever seen directly below the part supporting the "half nut." Many of these replicas are still to be found in this country, and we'd like to locate one for our own personal collection, from which we may draw vital historical information for the preparation of this series.

Edison's search for new things distracted his interest following the development of the tinfoil phonograph, and the great inventor went on to pursue other ideas. Accordingly, it was not until 1887 that his interest in the phonograph was again revived to the point where competition from Bell and Tainter, as well as Berliner, literally forced him back into the phonograph business. It was during the year 1887 that Ezra T. Gilliand manufactured small quantities of Edison machines, Fig. 5, in a small shop on Bloomfield Avenue, Bloomfield, New Jersey. This phonograph was designed for the wax cylinder records and was driven by a hand-made electric motor and powered

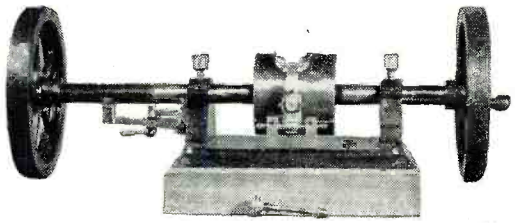
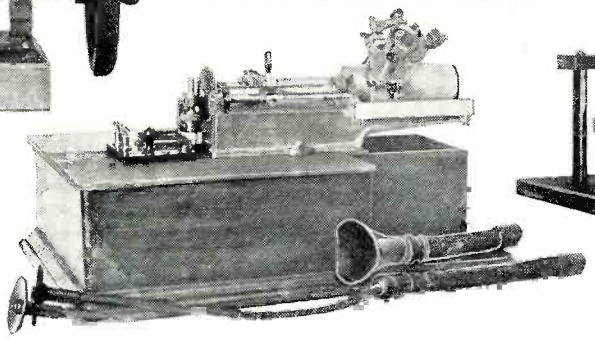


Fig. 4. About 600 of this model were made to demonstrate Edison's invention.

Fig. 5. A two-volt wet cell powered this early cylinder phonograph.



By
OLIVER READ
Editor
RADIO & TELEVISION NEWS
and
JAMES RILEY

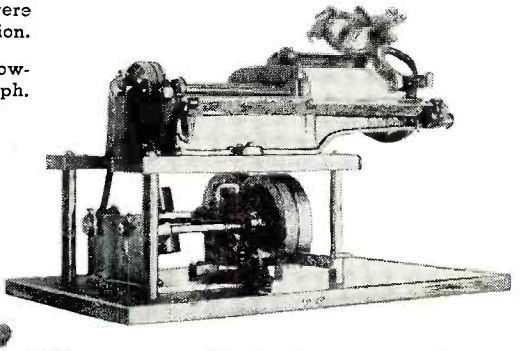


Fig. 6. The first "treadle phonograph" of Edison, Circa 1888.

by means of a wet cell. A tapered friction wheel was mounted directly to the shaft of the motor, resulting in a right-angle drive to a rubber-tired wheel on the shaft comprising the feedscrew and the mandrel upon which the wax cylinder was mounted. The feedscrew was a separate assembly and was coupled to the drive shaft by means of belt and pulley. This phonograph used Edison's "spectacle-type" recorder and reproducer. This device employed two separate diaphragm assemblies; one was used for recording, the other for reproduction. The box shown directly beneath the mandrel was to gather shavings of wax from the rotating cylinder when it was being scraped for further use. Note the small scale mounted in front of the cylinder. This was intended to be used for spot reference and as a guide to designate to the operator any particular sounds that appeared on the cylinder. Accessories included those shown on Fig. 5, comprising a speaking tube and a flexible hose which terminated to two rubber tubes and to special ear pieces. This model is now quite rare.

Next in order of development was the "Treadle Phonograph" of Edison, Fig. 6. This model was first produced in 1888. For the most part, this machine was quite similar to its predecessors, the main difference being in the mode of operation. Reference to the illustration shows a hard wood base of solid oak, upon which was mounted a support shelf for the phonograph mechanism. Mounted to the base was a simple treadle device comprising an operating lever which was pumped up and down by hand, which in turn rotated a shaft upon which was mounted two heavy flywheels. Its action was similar to that of a steam locomotive. A governor was coupled to the drive shaft and served to stabilize the rotation. A flat leather belt coupled the driving mechanism to the main shaft of the phonograph, as shown. This model also used Edison's "spectacle-type" recorder-reproducer. Only a few of this model were ever made.

The first foot-powered Edison model was produced in the fall of 1888, Fig. 7, whereby the phonograph is mounted to a foot-treadle stand resembling the old-fashioned sewing machine. As a

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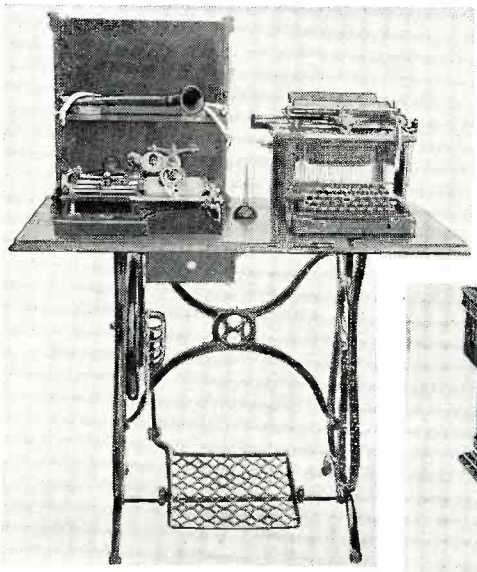
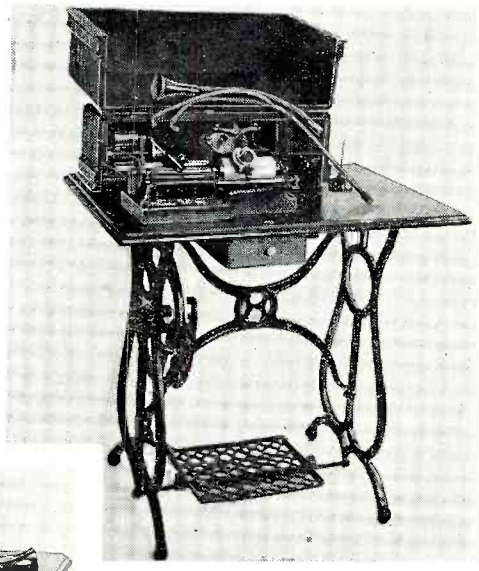
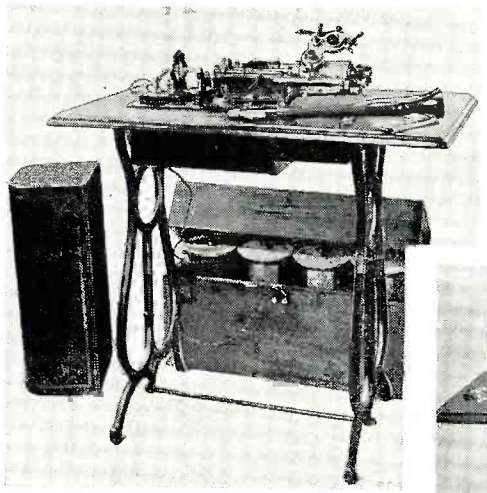


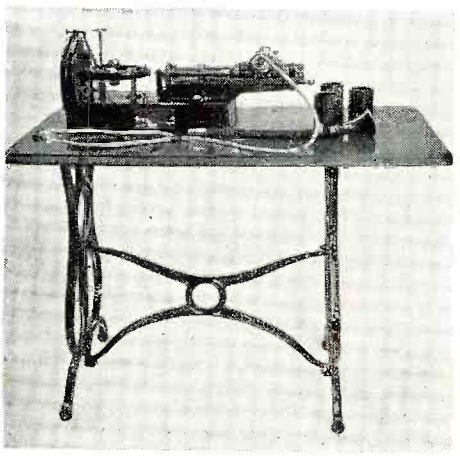
← Fig. 7. Foot-powered treadle phonograph and typewriter of the year 1888.



→ Fig. 8. The improved Edison "treadle phonograph" for office dictating.

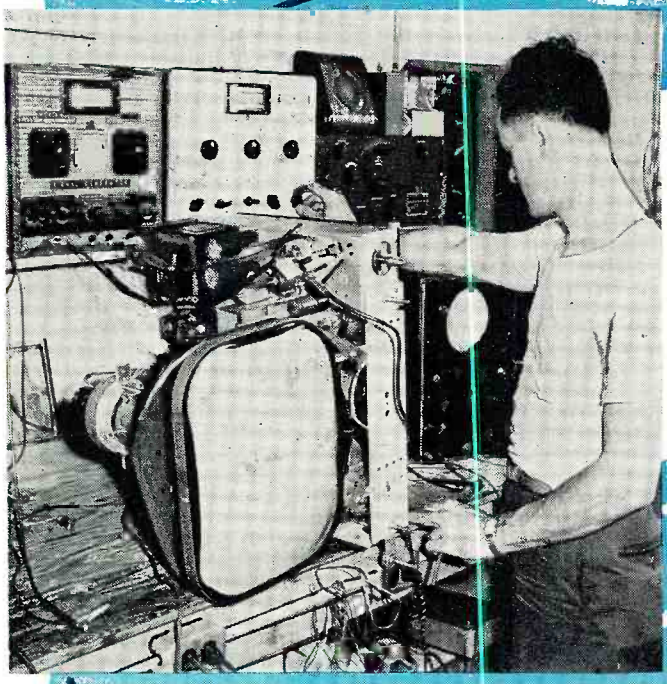


← Fig. 9. Model "Class M" Edison battery phono produced in 1889.



→ Fig. 10. This novel phonograph was operated by water pressure from the house faucet.

TV Signal Tracing with a Scope



The oscilloscope, a sweep frequency generator, and a crystal diode probe are all the instruments required for signal tracing all circuits of a TV.

The oscilloscope is very valuable for TV servicing if properly used. Here is a key to its application.

By **WALTER H. BUCHSBAUM**
Television Consultant
RADIO & TELEVISION NEWS

THOSE of our readers who have done extensive radio servicing will remember the signal tracer and the technique of tracing a signal from the antenna through to the loudspeaker and so checking the performance of each stage. TV work rarely requires a complete signal tracing, but this same method is invaluable when a really difficult job comes along.

While in radio servicing, a good detector and audio amplifier were sufficient; for the TV signal tracing system, more complex equipment is needed. Most well equipped TV service shops have all the instruments necessary; a signal generator (preferably a sweep frequency generator), a crystal diode probe, a v.t.v.m., and a good oscilloscope. The latter should have good sensitivity. With this equipment and a knowledge of the receiver stage functions almost any defect can be located.

Typical Defects

It is always helpful to localize a defect to a particular receiver section and this is also true of the signal tracing method. For example, if the defect is found to be a loss of high voltage there is usually no need to consider any but the horizontal sweep section. Similarly, the presence of a stable raster on the picture tube excludes the horizontal and vertical sweep sections as trouble spots. Whenever possible, the defect should be localized by a few voltage checks and some logical reasoning.

The basic block diagram shown in Fig. 1 illustrates the major functions of the various sections. Note the arrows indicating how a defect in one section can affect the performance of another portion. The video amplifier, for example, can cause poor picture quality in conjunction with the i.f. section, but it can also cause poor synchronization together with the sync separator or any of the sweep sections. Hum in the audio section can be due to the power supply, the i.f. section, the video amplifier, or even the vertical sweep section. The power supply can cause defects in any other section as indicated by the three arrows. Simple voltage measurements will usually show up incorrect operating voltages. Where hum seems due to the power supply it appears also in the receiver section which passes this trouble on to the picture.

From the preceding it appears that most troubles can be referred to at least a few receiver sections, which are subject to signal tracing first. There are, however, defects which are not limited to just a few sections and then an over-all signal tracing is indicated. Typical troubles of this type are slow fading in and out of the picture, and intermittent severe distortion of the entire picture. Such defects are hard to describe, but the service technician who has once encountered such a "pumping" or spastic condition is not likely to forget its appearance and the subsequent hard work needed to find the defective part. Rather than take "potshots" at the receiver by replacing first one part and then another, a systematic signal tracing method is the answer.

Power Supply

Measuring voltages is routine, but often insufficient to show failures which are of the intermittent type. For this reason the power supply should be checked not only for correct voltages, but the scope should be connected to each "B+" bus in turn for a few minutes with the set operating on a station signal. This will show up any variations in voltage as well as excessive hum and modulation of the "B+" by vertical, horizontal, or video signals. Not only the output of the rectifiers, but also the "B+" points at the various filter and decoupling capacitors should be monitored in this manner.

A certain amount of 120 cps hum is inherent in every set and this will appear on the scope as shown in Fig. 3A. The amplitude of this hum is very important. Whenever it exceeds .5 volt peak-to-peak, poor filtering is indicated. If the oscilloscope does not contain a calibrating voltage, the 6.3 volts across the heater of a tube in the TV set can be used as reference, remembering that this appears as 18 volts peak-to-peak on the scope.

When some other signal is visible, in addition to the 120 cps hum, try to bypass some of the electrolytics with a .1 μfd. paper capacitor. Occasionally, the output stage of the audio section is part of the "B+" voltage divider and

a defect in that circuit causes sound modulation of the "B+" voltage. Again, the oscilloscope picture will clearly show this defect and permit tracing it right to the defective component.

The scope picture in Fig. 3B shows a typical instance where the vertical sweep signal rides through to some extent on the "B+". In the receiver this causes an audible buzz as well as uneven shading of the picture. Such a buzz cannot be eliminated by alignment of the i.f. or sound discriminator, nor does the power supply filtering take care of it. The real culprit here was an open 10 μfd. capacitor connected in the "B+" return of the vertical output transformer. By signal tracing the hum on the "B+" line it became apparent that it was most pronounced on that part of the "B+" distribution system which goes directly to the vertical output circuit.

It is difficult to illustrate the appearance of a "B+" "jumping" such as may be caused by intermittent breakdown in some component. Fig. 3C was obtained by taking multiple exposures of the oscilloscope picture indicating this effect. Here, the ripple on the "B+" line was about 1 volt. At times, the jump in "B+" level is on the order of several volts. This defect resulted in a variation in brightness as well as size of the TV picture, and would occur at about 1 second intervals during receiver warmup. After about 10 minutes operation, the picture became steady and no defect was apparent.

Signal tracing with the scope showed that "B+" points which had their own decoupling network were not affected by the "jumping." Connecting the scope to the cathode of the horizontal output tube showed that the current through that tube varied greatly in step with the "jumping." Next, the scope was connected to the screen grid of this tube. Here the "jumping" was extremely severe. ,

Removing the horizontal output tube from the chassis did not cure the variations in the "B+" line, and at the screen grid terminal of this tube socket the scope picture "jumped" as violently as before. Disconnecting the .25 μfd. screen bypass capacitor cured the defect immediately. Although this capacitor measured correctly on a capacitor tester, the high screen voltage apparently caused internal arcing during warmup. Replacement with a new capacitor completed this repair job.

Signal Circuits

Many service technicians feel that the scope cannot be used to troubleshoot the r.f. and i.f. sections. Actually, the oscilloscope is ideally suited for carefully checking each of these stages for gain, alignment, stability, and interference. A sweep frequency generator and a crystal diode probe are needed as well as the scope. The generator is used to supply a signal strong enough for the crystal probe to detect, since station signals may not have enough amplitude in the r.f. and first

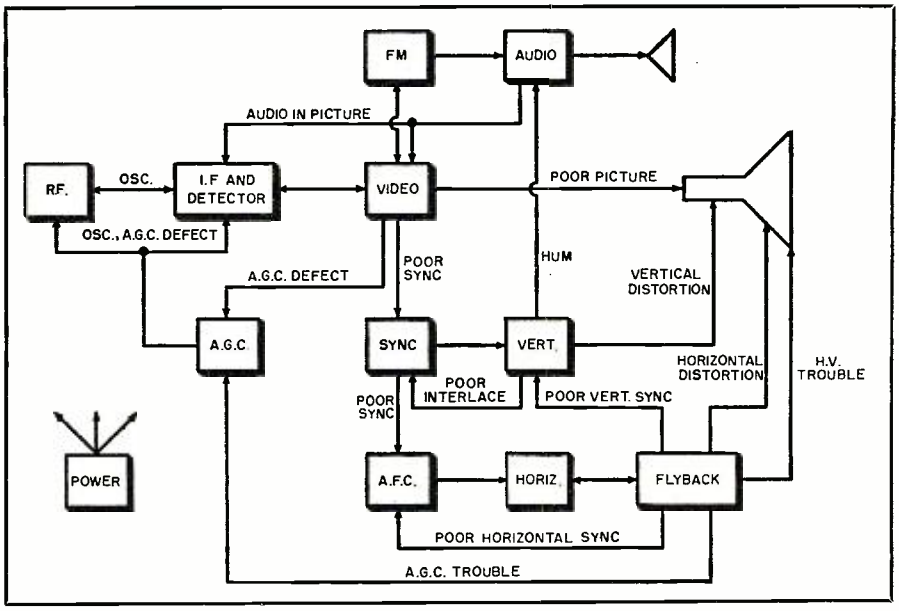


Fig. 1. Block diagram of the various sections of a TV receiver showing the way in which a defect in one section can affect the operation of one or more other sections.

i.f. stages to be visible on the scope. In most of the tests to be outlined the sweep generator is tuned to some unused channel and connected to the antenna terminals.

Signal tracing the r.f. and i.f. stages is indicated when either the picture or sound appear defective and no trouble has been found in the video or audio sections. In other words, in cases of poor picture resolution, smearing, weak picture, etc., the video amplifier is traced through first and then the r.f. and i.f. sections are checked.

The first test will not require the sweep generator. A station signal is observed on the picture tube and at the same time the scope is connected to the output of the video detector. This may show hum or other variations such as interference (which would also appear on the TV picture tube). Try replacing i.f. tubes, the r.f. amplifier tube in the tuner, and finally the oscillator tube. Temporarily connect a filter capacitor across the a.g.c. bus, but be sure that the positive terminal of the electrolytic goes to ground and the negative terminal to the a.g.c. bias point. Another quick check involves shunting a .01 μfd. capacitor from each i.f. heater to ground to eliminate any regeneration in that circuit.

Next, check on the over-all r.f.-i.f. frequency response. Fig. 2 is a typical response curve which, while not too bad, is also not quite correct. The peak near the sound i.f. gives extra gain to the high-frequency portions of the picture and, in conjunction with excessive

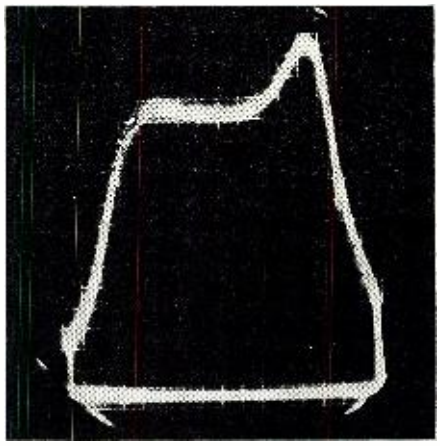
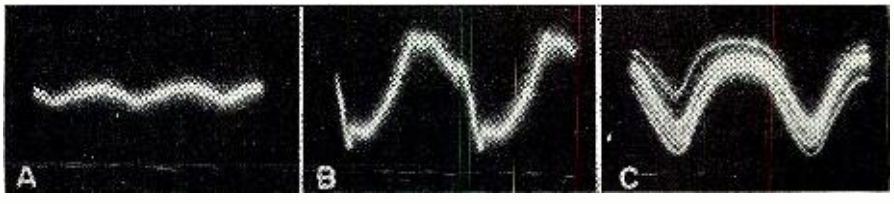


Fig. 2. Typical response curve of a TV i.f. strip. Note the peak on the right which can result in ringing.

peaking in the video stages this might appear as ringing or a sharply defined ghost image.

If the response curve appears particularly good, this may be due to overloading of some i.f. stage. Reduce the amplitude of the sweep generator output until the scope presentation appears almost submerged in noise. Then increase the sweep generator output gradually, observing the response curve and checking the a.g.c. bias with the v.t.v.m. If the receiver uses keyed a.g.c. the bias must be supplied by a battery. For about 3 volts of bias the response curve should be undistorted. When the bias voltage reaches 5 to 6 volts, no overloading should appear.

Fig. 3. (A) shows the trace on a scope for 120 cps hum; (B) shows a case of excessive "B+" ripple with superimposed vertical sweep signals; (C) shows "B+" jitter.



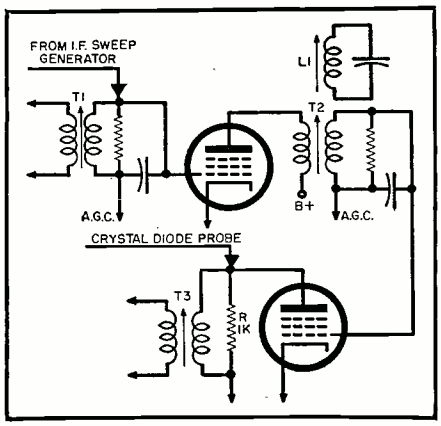


Fig. 4. To check the gain of an i.f. stage and its frequency response with an oscilloscope, connect the sweep generator and scope probe as shown.

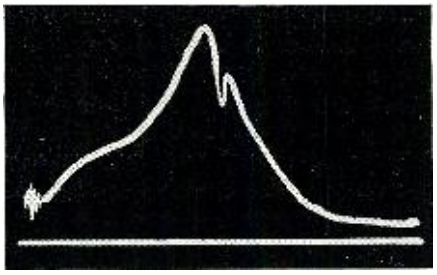


Fig. 5. Typical response of a single i.f. stage of the type shown in Fig. 4.

If the response curve appears to overload irrespective of bias, then one of the first i.f. stages or the r.f. amplifier and mixer are not getting proper bias on their control grids. A conclusive check of the a.g.c. efficiency can be made by comparing the bias voltage required from the battery to avoid overloading with that obtained on a station signal which shows the effects of overloading. When the set has an a.g.c. control, the setting of that potentiometer should be carefully checked to permit reception of the weakest signal and avoid overloading on the strongest signals. Regeneration, hum, or other defects due to the a.g.c. will also be localized by the substitution of battery bias and careful comparison with station signals.

In sets where the i.f. gain appears questionable or intermittent and tubes have been replaced, a stage-by-stage test is indicated. First check the overall frequency response. Then use a crystal diode probe and connect it to the output of the last i.f. stage and observe the scope pattern. Moving the probe to the grid of that i.f. stage should result in a lower amplitude and differently peaked scope trace.

If one particular stage is suspected, connect the sweep generator to the grid of that stage, switching its selector knob to the i.f. band. Fig. 4 shows where to connect the sweep generator to the grid of a typical i.f. stage and also how the crystal diode probe is connected across the load of the following i.f. stage. To reduce the effect of the second stage, a 1000-ohm resistor, R, is temporarily connected across the tuned output circuit of that stage, as shown in Fig. 4. By this method, the response curve of only one stage is observed and gain measurements as well as a check of the tuned network is possible.

A typical single stage response curve is shown in Fig. 5. The sharp dip in the curve is due to a tuned trap circuit similar to L_1 shown in Fig. 4. The lower, secondary peak could be due to the output network (T_3) across which the 1000-ohm resistor is connected. At the extreme left, the marker frequency signal is just visible.

Sweep Circuits

Every active service technician is familiar with the adjustment of the "synchroguide" a.f.c. circuit by means of the scope. Similarly, the waveshapes encountered in the vertical sweep section are familiar because most circuit diagrams illustrate their correct form.

There are variations in these waveforms which indicate certain defects and are useful in troubleshooting. A good example is the two horizontal sweep signals shown in Figs. 6A and 6B. The waveform in Fig. 6A is the normal one at the grid of the horizontal output tube of a TV receiver using a conventional ferrite core flyback circuit. Fig. 6B shows the same waveform but with reduced amplitude and a little wiggle at the start of the sawtooth. The picture may appear fairly normal on strong signals, but on weaker stations there will be some vertical lines at the left of the screen. Changing tubes may not clear up this defect and tracing the signal through to the plate and cathode of the damping diode may reveal that the ringing is strongest at the "hot" side of the deflection yoke. (In making these checks it is necessary to use a high-voltage probe with the scope since the pulse at the deflection yoke may go up to 5000 volts in some sets.) Usually, this type of defect is due to crosstalk, ringing, or poor damping in the deflection yoke. The 56 $\mu\mu$fd. (or thereabout) capacitor and any resistor in the yoke circuit should be replaced before the deflection yoke itself is replaced.

Another use for the scope is to check the effect of the vertical sweep on the horizontal and *vice versa*. Horizontal hum due to either the power supply or the vertical sweep can be simply detected by setting the scope for about 30 cps and checking the various points in the horizontal a.f.c. and sweep circuits for the presence of 60 cps signals.

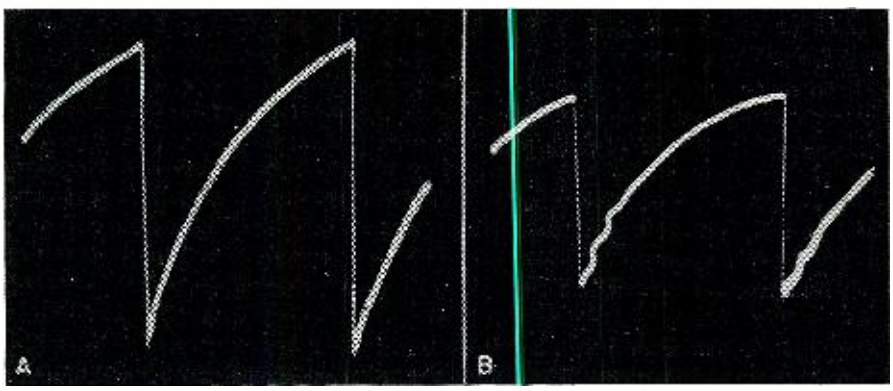
Poor interlace of the vertical lines is often due to loss of the correct vertical pulse. This can be checked by connecting the scope to the vertical integrating network and observing two successive synchronizing pulses. They should differ slightly in spacing. Often this is not apparent because the vertical sweep signal rides through and obliterates the serrated timing pulses which make up the vertical sync pulse. Occasionally, radiation from the horizontal flyback supply or an open capacitor in the integrating network causes the horizontal signals to obliterate the serrated pulses and produce poor interlace. All these troublesome service jobs are best handled by using the scope for signal tracing.

The synchronizing pulses, video signal, and blanking pulses can all be traced with the scope, and most circuit diagrams show the correct waveshapes. "Jitter" or other forms of instability in the video section can easily be spotted with the scope by using the 60 or 30 cps sweep setting. To observe overloading or clipping of the video signal, the scope should be set for about 15 kc. to show the waveform corresponding to a single line. Noise interference and any noise clipping action, as well as the operation of the d.c. restorer circuit may also be observed in this manner.

In the audio section, to trace distortion, a sine wave or pulse from a signal generator is injected at the input and traced with a scope through to the audio output transformer secondary. Feedback, microphonics, and hum can be traced with the scope and localized by removing tubes and disconnecting parts until the defective one is identified.

The oscilloscope permits us to "look inside" the circuitry and follow each signal through every component and tube. Whether a sweep or video signal is traced through the receiver, the changes it undergoes become apparent on the scope. Thorough troubleshooting of a TV set for hidden defects is usually unnecessary, but when a difficult service job is encountered, the signal tracing method is invaluable. —30—

Fig. 6. Horizontal waveforms at the input to horizontal output amplifier. (A) shows the correct waveform, (B) shows an attenuated sweep signal with incorrect shape.



Tubeless Scope Calibrator

By **EDWIN BOHR**

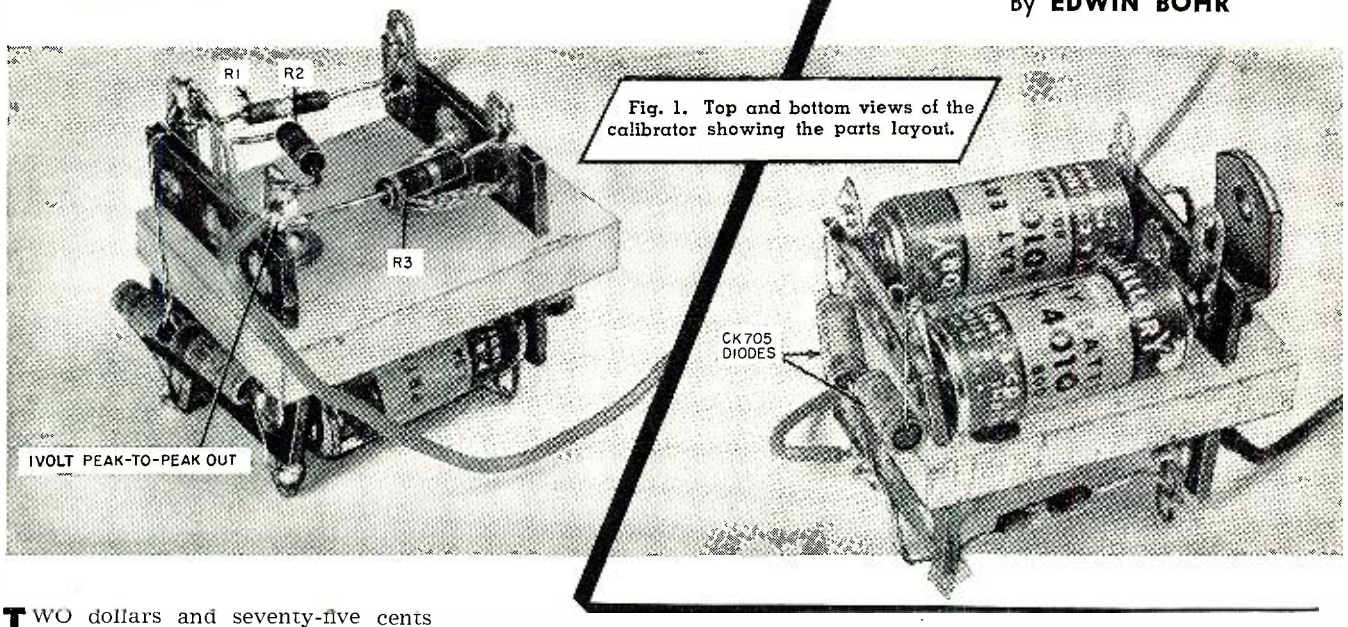


Fig. 1. Top and bottom views of the calibrator showing the parts layout.

This accurate, tubeless calibrator is simple to build, and enables you to use your scope to measure voltage.

TWO dollars and seventy-five cents will buy all the parts to build the oscilloscope voltage calibrator shown in Fig. 1. The calibrator can be added to kit-built or other scopes that do not feature some sort of built-in calibration source.

The unit described in this article furnishes a clipped sine wave of accurate peak-to-peak amplitude. This clipped sine wave, when fed into the oscilloscope, provides a means for calibrating the grid on the face of the scope.

Since the calibrator uses no vacuum tubes, essentially no extra power drain is placed on the scope. There is enough extra room inside almost any scope housing for the calibrator which measures only 1¾ x 1¼ x 1½ inches.

Mercury cells establish the clipping level of two germanium diodes biased in their reverse directions, see Fig. 2. A six-volt r.m.s. signal from the heater winding on the scope power transformer is fed through R_1 to the diodes. The two diodes can not conduct until the a.c. signal exceeds the backward bias from the mercury cells. When the a.c. signal from the heater winding reaches the bias level of the diodes, the diodes begin to conduct and clamp the output voltage to this level.

The mercury cell, unlike ordinary dry cells, maintains a constant potential, varying only a few millivolts, over a wide range of age and temperature conditions. As a voltage reference, the mercury cell is infinitely superior to the gaseous regulator tube—such as the 0A2, for example—ordinarily used in calibrators.

Germanium diodes make the low-working-voltage calibrator circuit possible. Vacuum tube diodes, because they produce an e.m.f. of their own (contact potential), are not suitable for this circuit. This contact potential reaches a volt in high impedance circuits and its value is very unstable. Calibrator circuits using vacuum tubes must operate at a hundred volts or more. This way the contact potential is reduced to a very small percentage of the total signal. Fortunately, germanium diodes do not display these particular deleterious effects. This permits the design of low voltage circuits.

Basically, the calibrator circuit of Fig. 2 is very accurate. The diodes introduce the greatest error in the peak-to-peak output, since the diodes are not perfect rectifiers, nor perfectly uniform in characteristics. Lest the magnitude of this error be misunderstood, it can be kept within .1 volt.

The e.m.f. of the mercury cell is 1.345 volts. So, the clipper peak-to-peak output is twice this value or 2.7 volts. A divider, R_3 and R_2, attenuates the clipped wave to one volt peak-to-peak at point "B." The ratio of these resistors should be $R_3 : R_2 = 1 : 1.7$. The values in the parts list are not exactly in this ratio because the closest commercial five per-cent resistor values were used in construction. If one per-cent resistors are chosen, for greater accuracy, they should follow this ratio.

Construction

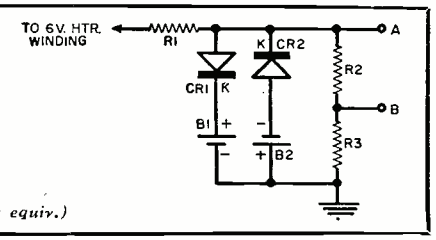
A small piece of plastic, one-quarter inch thick, is the chassis for the calibrator. An angle bracket grounds and mounts the unit to the scope chassis or front panel. Two terminal strips act as clamps for the mercury cells. The terminal strips are spaced slightly closer than the length of the mercury cells, providing a friction fit. The outside case of the mercury cell is *positive* and the *center button is negative*. Two small dots of red lacquer on the plastic indicate which way the mercury cells should be mounted.

The CK705 is a general purpose diode very similar to and replaceable with the 1N34. The CK705 is smaller than the 1N34 and hermetically sealed. Also, its leads do not conduct heat into the diode as fast as some other types. But, it is still advisable when soldering these into the circuit to carry away excess heat by grasping the diode lead

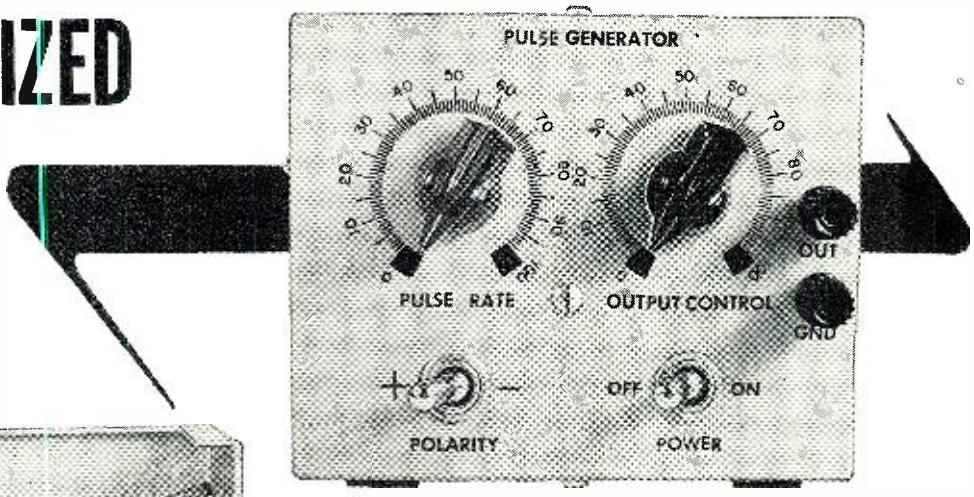
(*Continued on page* 110)

Fig. 2. Schematic diagram and parts list for the complete scope calibrator. The output at point "A" is 2.7 volts; at point "B", it is 1 volt.

R_1—100,000 ohm, ½ w. res.
R_2—200,000 ohm, ½ w. res. ±5% (see text)
R_3—120,000 ohm, ½ w. res. ±5% (see text)
B_1, B_2—Mercury cell (Mallory RM4010)
CR_1, CR_2—Germanium diode (Raytheon CK705 or equiv.)



A TRANSISTORIZED PULSE GENERATOR



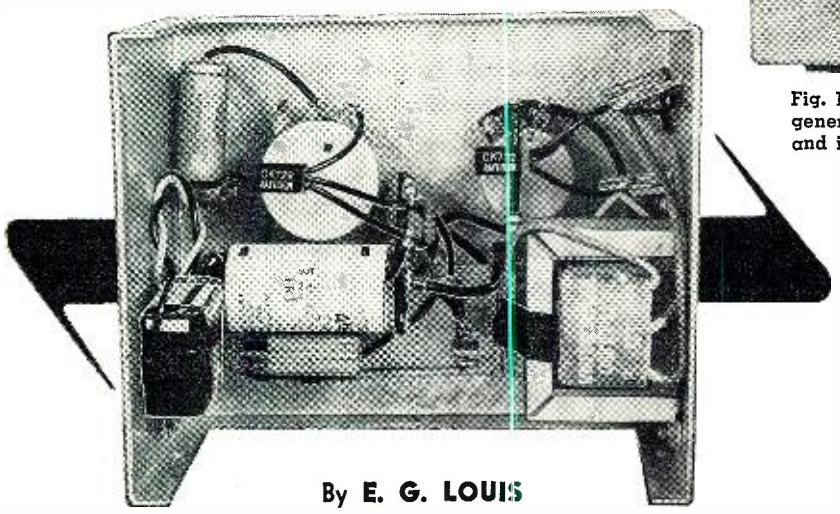


Fig. 1. Two views of the author's home-built pulse generator. It is built into a 3" x 4" x 5" case and is powered by one hearing-aid type battery.

By E. G. LOUIS

Build this pocket-sized test instrument which is useful in a wide variety of lab and service tasks.

AS NEW laboratory techniques are worked out and new circuits developed, the need for specialized test equipment rapidly changes so that "special" equipment often becomes "standard." For example, pulse generators, once found only in the larger laboratories, are gradually coming to be considered as "standard" pieces of test equipment for all labs. In some cases, pulse generators are used as much as oscilloscopes and v.t.v.m.'s, "standard" equipment items of long standing.

Most pulse generators are characterized by their large physical size and their voracious appetite for electrical power.

Not so the instrument shown in Fig. 1. Although delivering either positive- or negative-going pulses over a wide frequency range (100 to 6000 pulses-per-second . . . other ranges are easily obtained), and with good output amplitude (12-15 volts peak across a 10,000 ohm load), the over-all case size is only 3"x4"x5" and the power requirements are so small that it is practical to power it with a self-contained hearing-aid type battery!

In addition to its small size and low power requirements, the instrument shown has many other advantages. Highly efficient, it doesn't generate large quantities of surplus heat to increase the discomfort in a crowded lab or work shop. Light in weight and quite rugged, the instrument is ideally suited for portable and field work. It may, literally, be "slipped in an overcoat pocket."

The instrument shown also has the advantage of requiring neither "warm-up" time nor "stand-by" power. It is ready to use as soon as the power switch is thrown "on."

All these features have been made possible by designing the unit around the highly efficient *Raytheon* type CK-722 (*p-n-p*) junction transistors.

Standard, commercially available components are used throughout and the circuit is sufficiently simple so that the average technician should have little or no difficulty in building a similar or duplicate unit in one or two days.

Circuit Description

Basically, this transistorized pulse generator consists of one transistor connected as a blocking oscillator followed by a second transistor serving both as a clipper and as a buffer-amplifier.

Referring to the schematic diagram of Fig. 2, the first CK722 transistor is connected in a *grounded emitter* blocking oscillator circuit, with transformer T_1 providing the necessary energy feedback to start and sustain oscillation.

A stepdown turns ratio is provided to match the high collector circuit impedance to the low input impedance of the base-emitter circuit.

In operation, the "blocking" action occurs through the rapid charge of C_1 through the base-emitter circuit of the transistor and the secondary of T_1, and the gradual discharge of this capacitor through R_1 and R_2. The blocking rate is determined essentially by the RC time constant of the circuit made up of C_1, R_1, and R_2.

By making R_1 adjustable, the circuit time constant and, hence, the blocking rate, can be changed. R_1 thus serves as the "Pulse Rate" control.

R_2 is provided to limit the maximum blocking frequency and to protect the transistor from overload.

A signal is obtained from the blocking oscillator stage by means of a tap on T_1 and is applied, through coupling capacitor C_2, to the base of the second transistor, which serves to shape and amplify it.

A s.p.d.t. toggle switch (S_1) is provided to change the bias current of the second CK722 stage, and thus its mode of operation. When this switch is "open," the stage operates with "zero bias," since the base resistor, R_4, is returned directly to the emitter of the transistor.

Under these conditions, the stage acts to limit or "clip" the positive-going and to amplify and shape the negative-going portions of the applied signal. The amplified signal appears across load resistor R_5, but with positive polarity, due to the phase reversal of the stage.

By using a potentiometer for R_5, this resistor serves not only as the load resistor for the output clipper-amplifier, but also as the "Output" level control. The output signal is obtained through blocking capacitor C_3, with its amplitude dependent on the setting of R_5.

When S_1 is thrown to its "closed" position, R_3 is connected between the base of the transistor and the negative side of the power source, thus permitting a heavy base "bias" current to flow. This radical shift in "bias," in turn, modifies the operating character-

istics of the stage so that the negative-going portions of the applied signal are clipped and the positive-going portions are shaped and amplified.

This results in pulses of negative polarity appearing across load resistor R_5. S_1 thus serves as the pulse "Polarity" switch.

Power is supplied by a hearing-aid type battery, B_1, controlled by a s.p.s.t. toggle switch, S_2, serving as the "Power" switch. Capacitor C_4 is provided to insure a low impedance across the power source.

Output Signal Waveforms: The waveform of the output pulses obtained from the author's model are given in Fig. 3. The signals obtained from another unit should appear similar to these, *but may not be exact duplicates.*

A low-frequency (approximately 200 pulses-per-second) positive-going pulse is shown in Fig. 3A, and a high frequency (about 6000 pulses-per-second) positive-going pulse in Fig. 3B.

As can be readily observed by comparing these two illustrations, the pulse-width remains relatively constant (it appears narrower in Fig. 3A because of the lower repetition rate). The pulse width depends primarily on the characteristics of the transformer (T_1) in the blocking oscillator stage.

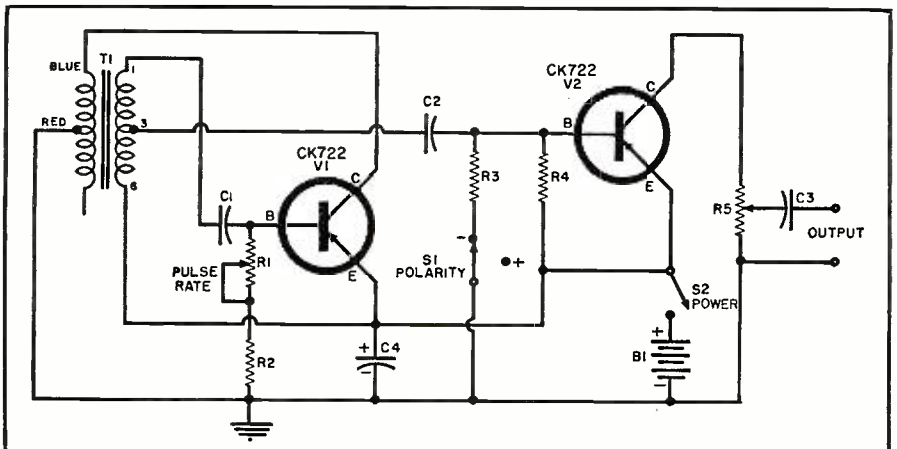
When the "Polarity" switch, S_1, is thrown so that negative-going output pulses are obtained, the shaping action of the output CK722 stage is not quite as good, so that the negative-going pulses are not quite as sharp as the positive-going pulses. Nonetheless, they are quite satisfactory for most practical work.

Typical high-frequency negative-going pulses (about 6000 pulses-per-second) are illustrated in Fig. 3C.

The maximum amplitude of the output pulses is approximately equal to the voltage of the power supply battery (B_1) because the output CK722 stage is driven over such extremely wide limits. On one peak the collector current is reduced to virtually zero, while on the other peak, the collector current reaches the maximum possible with the supply voltage and load resistor (R_5) used.

Construction Hints

The exterior and interior views (see Fig. 1) of the author's model are sufficient to indicate the general layout and parts placement. This layout need not be followed exactly, however, although standard, good wiring practice should be used.



R1—2 megohm carbon pot ("Pulse Rate" Control)
R2—27,000 ohm, ½ w. res.
R3—6800 ohm, ½ w. res. (see text)
R4—18,000 ohm, ½ w. res.
R5—10,000 ohm carbon pot ("Output" Control)
C1—.1 μfd., 200 v. capacitor
C2—.05 μfd., 200 v. capacitor
C3—.5 μfd., 200 v. capacitor
C4—100 μfd., 25 v. elec. capacitor
S1—S.p.d.t. toggle switch ("Polarity" Control)
S2—S.p.s.t. toggle switch ("Power" Control)
B1—15-volt hearing-aid battery (Burgess U10)
T1—Universal audio output transformer (Stancor #A-3856 or equiv., see text)
V1, V2—"p-n-p" junction transistor (Raytheon CK722)

Fig. 2. Complete schematic of pulse generator. It uses standard junction transistors.

Although the model was assembled in a standard 3"x4"x5" metal box, either a larger or smaller case may be used. If a smaller case is employed, the wiring will require somewhat greater care.

All controls and switches in the model were labeled using commercially available black decals protected, after application, by three coats of clear plastic. The plastic coating is easily applied with a standard "spray can."

The battery is held in place by a small "Z" bracket, with its connections made simply by soldering leads to its brass end terminals. A certain amount of care must be exercised when doing this to avoid overheating and shortening the life of the battery.

Scotch electrical tape was used to insulate the exposed battery terminals after the connecting leads were soldered in place.

Another builder might prefer to devise and construct a small "clip" or "socket" for the battery, so that it would not be necessary to use a soldering iron to remove or replace the unit.

As is readily observed in Fig. 1, the author installed the transistors in the model by simply soldering them in place. Should the prospective builder decide to follow a similar course, he should exercise special care to avoid accidentally overheating and damaging these components.

Transistors are especially sensitive to heat damage. Where they are to be soldered in place, the leads should not be cut too short, and the actual soldering should be done as quickly as possible, using a well-tinned and quite hot iron.

An alternative is to provide sockets for the transistors. Commercially available 5-pin subminiature tube sockets may be used for the CK722. Only three of the pins are required.

The primary connections of transformer T_1 are identified by color coded leads, while the secondary connections are identified by numbered terminals. The proper connections for the *Stancor* transformer used by the author are indicated in Fig. 2.

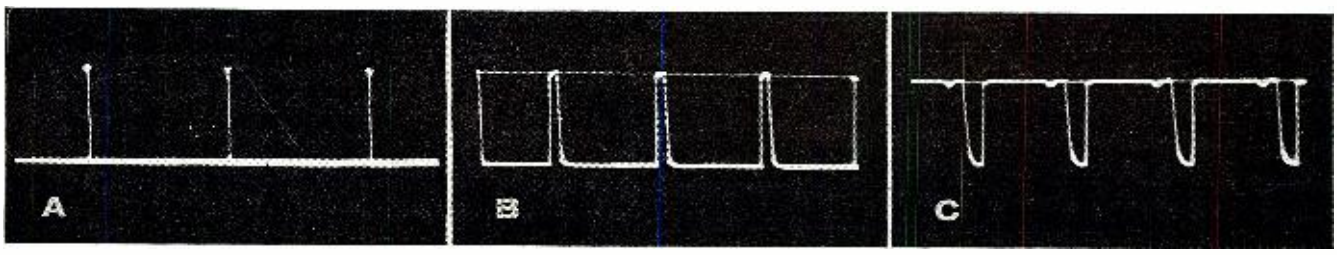
Parts Substitutions: A number of parts substitutions is permissible in order to change the operating characteristics of the transistorized pulse generator. We will discuss these later under "Circuit Modifications." However, in addition to these component changes, a number of other parts may be changed without modifying the basic circuit.

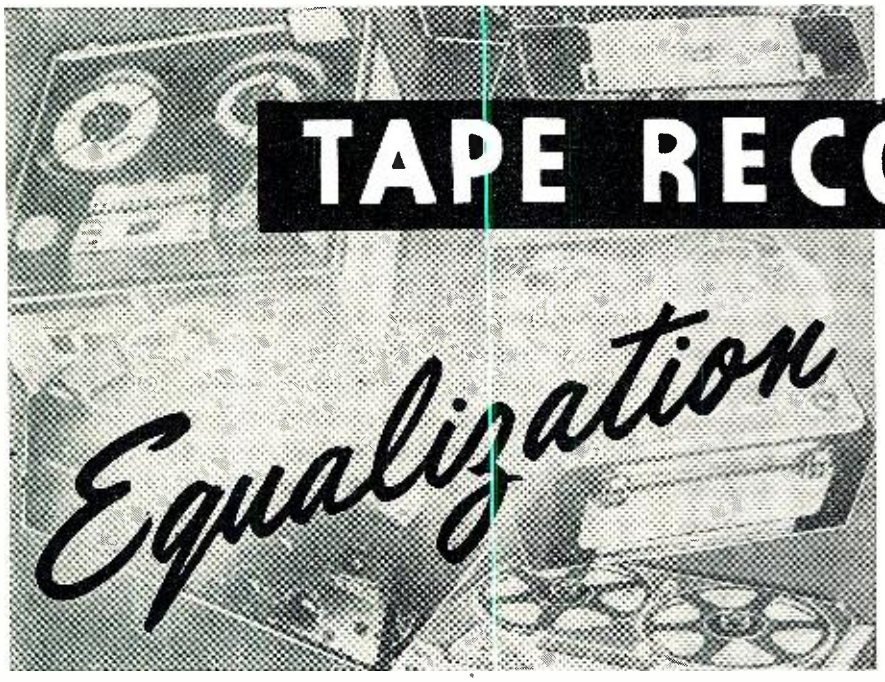
As mentioned earlier, either a larger or a slightly smaller case may be used without difficulty. In some instances, the builder may wish to wire the pulse generator into an existing piece of equipment.

Slide or rotary switches may be substituted for the toggle switches used as

(*Continued on page* 124)

Fig. 3. Waveform of output pulses obtained from the author's model. (A) Low-frequency (200 pps) positive-going pulse. (B) high-frequency (6000 pps) positive-going pulse, and (C) high-frequency, negative-going pulse (6000 pps).





TAPE RECORDING

Equalization

By **HERMAN BURSTEIN**

Part 5. Equalizing circuits play an important role in providing high signal-to-noise ratio and low distortion.

THUS far in this series, we have discussed the various elements of a tape recorder, record and playback losses, and the effects of bias current. We will now take up the all-important problem of equalization.

The record-playback response of a combination head or of a pair of heads, as illustrated in Fig. 1, may be equalized for essentially flat reproduction over most or all of the audio range by relatively simple circuits in the record and playback preamplifiers. But these circuits can take many forms with respect to location and frequency characteristics. In order to achieve a high signal-to-noise ratio and low distortion, which are just as important as wide frequency range, equalizing circuits must be determined with care, for there are many factors to be considered.

To make clear the factors and problems involved in equalization, this and the final article deal with:

1. Conflict among performance requirements
2. Optimum location of equalization circuits
3. Basic pattern of equalization
4. Example of equalization in an actual recorder
5. Maximum permissible record boost
6. Optimum recorded induction
7. The need for standard equalization

1. *Conflict Among Performance Requirements:* The requirements of wide frequency response, low distortion, and high signal-to-noise ratio are in conflict with each other, so that each can be obtained only at the expense of the others. Therefore the design of a tape recorder represents a balance among the three rather than a maximization of any one. The nature of the conflict can be illustrated as follows.

Assume it is desired to extend treble response. One way is to reduce bias current. But this results in greater distortion, unless the maximum permissible recording level, as indicated by the vu meter or tuning eye, is reduced, which means, in turn, a lower signal-to-noise ratio.

Assume it is desired to reduce distortion. This can be done by increasing bias current, but only at the cost of attenuated treble response. Or lower distortion can be had by reducing maximum permissible recording level, which means a lower signal-to-noise ratio.

Assume it is desired to increase the signal-to-noise ratio. Maximum permissible recording level can be raised, but this entails more distortion. To avoid increased distortion, bias current can be increased, but this impairs treble response.

The higher the tape speed, the more satisfactory and simple is the resolution of the conflict among performance requirements. As previously indicated, treble losses are largely related to wavelength, diminishing as wavelength increases. Higher tape speed means longer wavelength for any given frequency, so that treble losses become smaller. Therefore it is possible to use greater values of bias current at high speed, resulting in less distortion and/or permitting a higher level of signal to be recorded. Also, the frequency range can be expanded, if desired, because less treble equalization is needed.

2. *Location of Equalization Circuits:* Whether equalization circuits are placed in the record preamplifier or in the playback preamplifier makes a substantial difference with respect to signal-to-noise ratio and distortion. Circuit location is governed by the following general considerations.

A. *Bass Boost:* At a speed of 7.5 ips, roughly 30 db of bass boost is required, as indicated in Fig. 1.

Putting this much bass in the record preamplifier, considering the amount of audio energy present at low frequencies, would produce a tape with tremendous distortion, unless the signal level is reduced to a point at which the signal-to-noise ratio becomes unacceptably low. Therefore bass equalization must take place primarily in the playback preamplifier.

However, there is a drawback to this principle, its severity depending upon the quality of protection against hum afforded by the tape recorder. In playback, hum pickup by the playback head and hum in the first stage of the preamplifier can be a serious limitation on the signal-to-noise ratio. Consequently in some recorders (along the lines of the NARTB standard for 15 ips recorders, discussed later) the bass boost characteristic levels out at the very low end instead of continuing upward at the rate of 6 db-per-octave throughout the bass range. Correspondingly, if it is desired to maintain flat response all the way down, these machines provide a slight amount of bass boost in the record preamplifier. Such bass boost in record does not raise a serious threat of distortion because, as studies of the distribution of music and speech energy have shown, peak energies at the very low bass end are in most cases appreciably less than peak energies around 400 cps, where they reach a maximum.

B. *Treble Boost:* Treble boost should take place primarily in the record preamplifier because in playback it emphasizes tape hiss and noise in the first playback stage. Inasmuch as peak audio energies in the treble range are substantially lower than peak energies around 400 cps, considerable boost is permissible in record. Also, for a given percentage of distortion, the amount of record current that can be applied to the record head rises somewhat with frequency. However, as previously discussed, treble losses in record are of large magnitude, and there is consequently

a limit to the extent to which these losses can be compensated by treble boost in the record preamplifier. This limit occurs when treble boost begins to overload the tape and cause marked distortion.

3. *Basic Pattern of Equalization:* Fig. 3 shows, in generalized form, how equalization is achieved in a tape recorder.

Line *AB* represents the range over which essentially flat response is achieved. F_1 is the lowest frequency in this range, F_3 is the highest frequency, and F_2 is the "turnover" frequency, namely the point at which the 6 db-per-octave bass boost curve has attained a rise of 3 db.

Line *CD* represents the ideal response of a playback head, either one without any losses or else with such losses compensated in the playback preamplifier. This response assumes that magnetic induction on the tape is the same at all frequencies.

Line *CD* may be viewed as either bass droop or treble rise, depending where turnover point F_2 occurs. In other words, the constant velocity characteristic of the playback head may be used to supply part of the needed treble boost. In the case of recorders operating at 30 ips, this is often unnecessary. But for virtually all recorders operating at lower speeds, the constant velocity characteristic, *CD,* is used to supply a portion of the needed treble boost.

Curve *AE* defines the optimum induction that can be recorded on the tape without exceeding a specified amount of harmonic distortion, usually 1 or 2 per-cent in high grade recorders. Determination of optimum induction will be discussed next month. As the result of the record characteristic *AE* and the playback characteristic *CD,* the playback response without playback equalization is *CB*

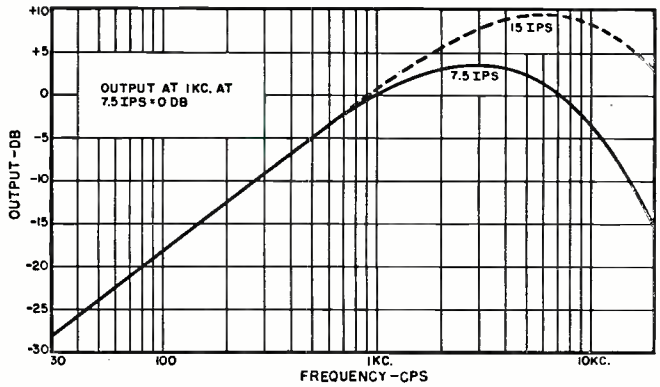


Fig. 1. The unequalized record-playback characteristic of a high quality record-playback tape head.

In order to compensate curve *CB* so as to achieve flat response, the complementary curve *FB* is required. In other words, *FB* is the required playback boost.

Since *FB* is determined by *CB,* and since *CB* in turn is determined by *AE,* it can be seen that curve *FB* is determined by curve *AE*. Thus the equalization of a tape recorder can be stated either in terms of the recorded magnetic induction or in terms of the playback bass boost characteristic. The latter is used to define the NARTB equalization standard, as discussed in the following section.

In sum, above the turnover point F_2, the playback head supplies the portion of treble boost which, for reasons given elsewhere, cannot be provided in the record preamplifier. The playback preamplifier supplies the bass boost which is needed below F_2 because of the playback head's constant velocity characteristic.

4. *Example of Equalization in an Actual Recorder:* The basic pattern of equalization shown in Fig. 3 is of help in clarifying the curves in Fig. 2, which describe the characteristics of a 15 ips tape recorder employing NARTB equalization.

First it is necessary to briefly describe the NARTB standard, which applies to 15 ips recorders as far as equalization and frequency range are concerned. It provides a specific bass boost curve for the playback preamplifier, indicates that losses in the playback head due to gap length or other factors should be compensated in the playback preamplifier, and then requires that the record preamplifier be equalized for flat response. As explained in the preceding section, the specification of a bass boost curve, in effect, defines how recorded induction should vary with frequency (see curves *FB* and *AE* of Fig. 3).

The NARTB bass boost characteristic is as follows. Using *RC* circuits, the playback preamplifier should develop a curve that has a first turnover point (3 db rise) at 3180 cps, continues to rise at a rate approaching 6 db-per-octave as frequency declines, and levels off at very low frequencies so that at 50 cps (second turnover point) bass boost is 3 db below the maximum amount achieved. The NARTB playback characteristic appears as Curve 4 in Fig. 2. This curve, as mentioned previously, applies to 15 ips recording.

Curve 1 in Fig. 2 shows the record

(*Continued on page* 140)

Fig. 2. Characteristics of a 15 ips recorder with NARTB equalization and flat from 30 to 15,000 cycles/second.

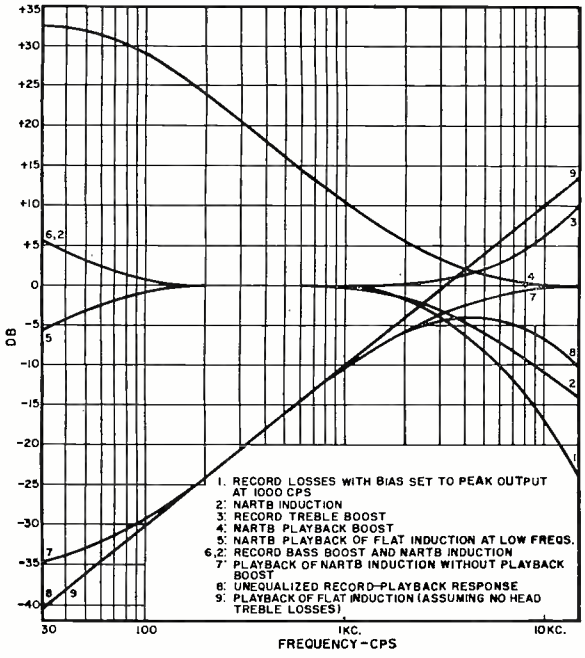
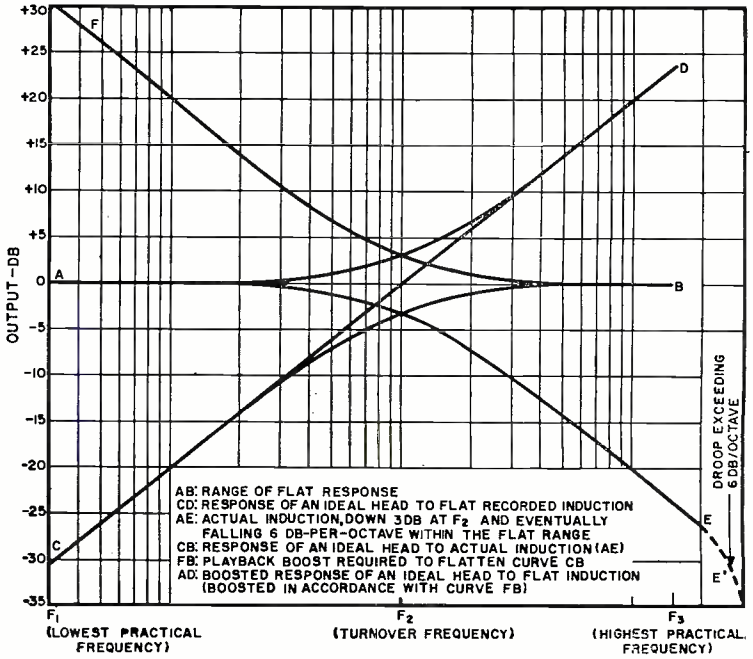


Fig. 3. The basic pattern of equalization for a tape recorder. This graph should be used in conjunction with the characteristic curves of Fig. 2.



A Transistor R.F. Frequency

Details on a fairly sensitive unit in which one transistor is both the detector and amplifier.

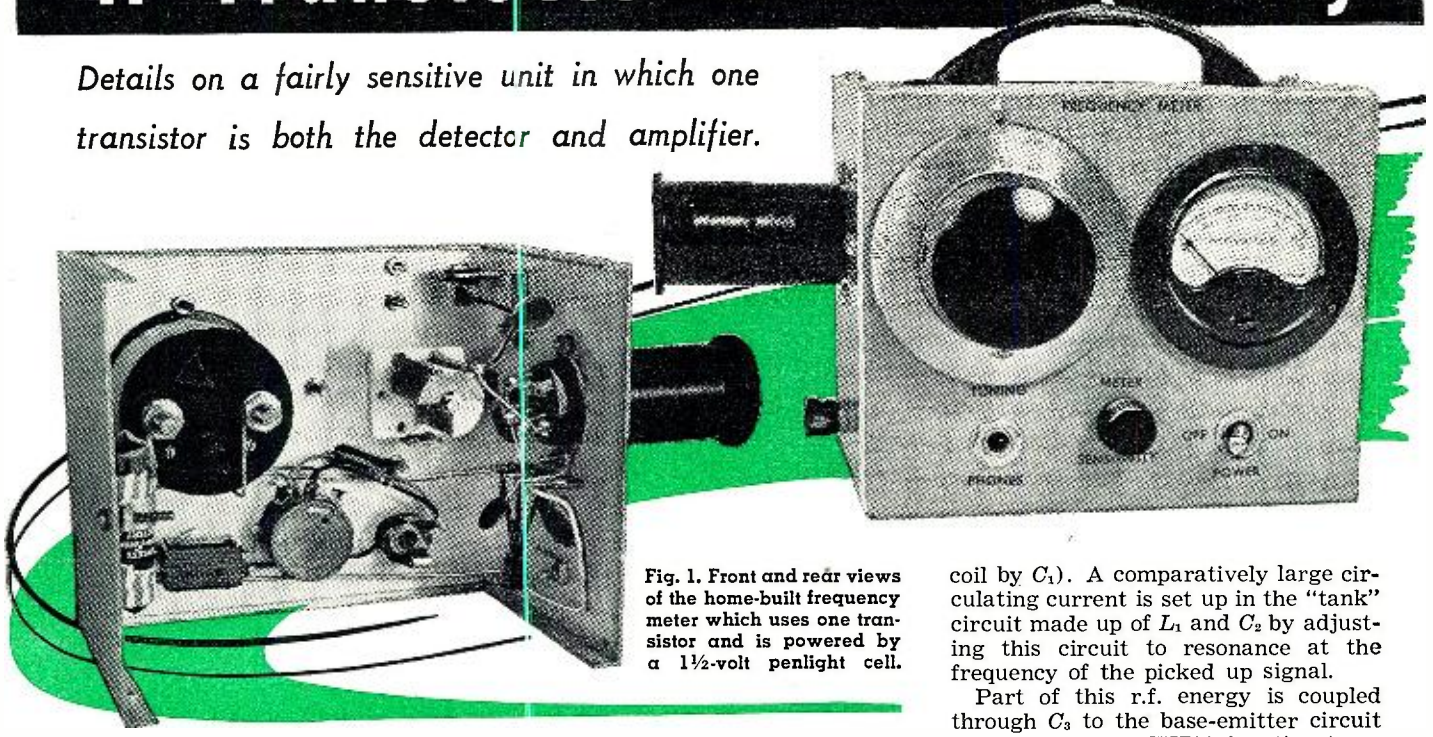


Fig. 1. Front and rear views of the home-built frequency meter which uses one transistor and is powered by a 1½-volt penlight cell.

PROBABLY one of the most popular pieces of test equipment found in the ham shack is the absorption wavemeter or frequency meter. These are generally of two types: the "simple" type consisting of little more than a tuned circuit and a small flashlight bulb, and the "deluxe" type, incorporating a tapped coil, a crystal diode, and a reasonably sensitive meter, together with provision for plugging in a pair of earphones for monitoring purposes.

Of the two types, the first is adequate for many tests around the transmitter and in reasonably close proximity to the various tank coils. However, it lacks the sensitivity needed for many types of measurements.

The second type, while considerably more sensitive, also has disadvantages, in most cases the sensitivity is controlled only by positioning the instrument with respect to the transmitter coils. When used around a reasonably powerful transmitter, needless "banging" of the meter pointer may result. In addition, the meter sensitivity is likely to drop appreciably when phones are plugged into the monitor jack.

Many of these disadvantages have been overcome in the frequency meter illustrated in Fig. 1. This unit has good sensitivity, but its sensitivity is easily adjusted to meet the specific measuring problem encountered. And, quite important, *the meter sensitivity does not change when a pair of earphones is plugged into the phones jack for monitoring.*

This last feature has been made possible by using a *Raytheon* junction transistor as a combination r.f. detector and d.c. amplifier. The use of the transistor has also made possible increased sensitivity.

Yet with all these features, the resulting instrument is still light in weight, simple in construction, and compact in size. In fact, the size of the case is determined primarily by the control panel requirements rather than by the internal space requirements of the circuit used.

Circuit Description

The complete schematic diagram of the transistorized r.f. frequency meter is given in Fig. 2. Referring to this diagram, the "heart" of the instrument is a tuned circuit made up of a tapped plug-in inductance coil, L_1, and tuning capacitor C_2.

C_1 is a coupling capacitor to the jack for an external "whip" antenna. C_3 is the coupling capacitor to the transistor detector-amplifier circuit. Capacitors C_4 and C_5 serve as r.f. bypasses, while C_6 serves as an audio bypass, bypassing the audio component of the detected and amplified signal around the meter circuit to ground (or to the earphones, when plugged in).

Resistor R_1 is the "base return" resistor for the transistor. R_2, a potentiometer, is shunted across the meter M_1 and serves as the "meter sensitivity" control. The last resistor used in the circuit, R_3, serves as a current limiting resistor, to prevent damaging overload of the meter and transistor.

Power is supplied by a penlight cell, B_1, controlled by toggle switch S_1.

In operation, r.f. energy is picked up either through inductive coupling to L_1 or through the antenna (coupled to the coil by C_1). A comparatively large circulating current is set up in the "tank" circuit made up of L_1 and C_2 by adjusting this circuit to resonance at the frequency of the picked up signal.

Part of this r.f. energy is coupled through C_3 to the base-emitter circuit of the *Raytheon* CK722 junction transistor. Rectification occurs here due to the diode action of the base and emitter, setting up a small d.c. base current. If there is any modulation present on the r.f. signal, the transistor base current will contain an a.c. component proportional to this modulation.

The flow of the base current permits a corresponding flow of collector current, although of much greater amplitude. This flow of current takes place over the path including S_1 (now closed), J_1 (and through the phones, if inserted in this jack), R_3, R_2, and the meter (connected in parallel), the collector-emitter circuit of the transistor, and the voltage source B_1.

Again, if modulation is present on the picked up r.f. signal, this current will also contain an a.c. component proportional to this modulation. The a.c. component is bypassed around R_3, R_2, and M_1 by means of C_6.

Meter sensitivity is adjusted by means of the shunt rheostat R_2. As this resistance is reduced in value, more of the collector current is bypassed around the meter and the meter sensitivity is *reduced*. As R_2 is increased in value, less of the collector current flows over this path and more flows through the meter, giving *increased* sensitivity as far as the meter reading is concerned.

Since the impedance of the collector current path is small compared to the internal impedance between the collector and emitter of the transistor, moderate increases in the external impedance have little or no effect on the amount of collector current flow. Therefore, inserting earphones into jack J_1 has virtually no effect on the

Meter

By **LOUIS E. GARNER, JR.**

meter reading or on circuit sensitivity, even though as much as 2000 ohms is added to the circuit impedance.

Both the antenna connection and the transistor "take-off" point are tapped down on coil L_1 to avoid reducing the "Q" of the tuned circuit and to minimize changes in tuning when the whip antenna is inserted in its jack. The transistor "take-off" point is tapped farther down on the coil than the antenna because of the low input impedance of the transistor. If this tap is made too far towards the "hot" end of the coil, circuit "Q" and sensitivity are reduced.

Since the maximum current drain from the penlight cell seldom exceeds one milliampere, battery life is virtually equal to the normal "shelf life" of the cell.

Construction Hints

Construction of the frequency meter shown is reasonably straightforward and no particular difficulties should be experienced by the skilled technician. However, it is essential that good wiring technique be followed.

Although leads in the collector-emitter circuit of the transistor may be made just about as long as desired, lead lengths in the r.f. circuit proper should be kept short and direct. In order to keep the lead to the transistor base short, the author mounted the transistor on a terminal strip right next to the coil socket. Refer to the interior view given in Fig. 1.

The transistor itself may be either wired directly into the circuit by means of its leads, or else a special transistor socket may be provided (use a standard 5-pin subminiature tube socket). If the transistor leads are soldered directly into the circuit, take special pains that these leads are not overheated during the wiring procedure. If possible, do not cut these leads shorter than one inch.

The layout and parts arrangement used by the author are apparent from the interior view given in Fig. 1, but this layout need not be followed exactly. Considerable modification of the circuit arrangement is possible at the discretion of the individual builder. For example, if it is desired to wire the assembly in a smaller case, the large vernier dial used by the author could be omitted and a smaller dial plate and knob used in its place. A smaller meter might be employed.

For the maximum in compactness, while still retaining the basic operating features and controls of the model, the power switch, S_1, could be combined with the "meter sensitivity" control R_2, and both this control and the phone jack mounted on the side of the case (rather than on the front panel). All of these steps, taken together, would permit assembling the basic circuit into a much smaller case size.

A large cable clamp was used to hold the penlight cell in place in the model, but any one of several alternative methods could be followed by the builder. A large fuse clip, for example, could well be used to hold the battery in place.

Parts Substitutions

Virtually none of the parts used in constructing the frequency meter is critical and the prospective builder can exercise a wide choice in building his own unit. Let us discuss the individual parts in order.

Coupling capacitor C_1 is not at all critical and any value from 100 $\mu\mu$fd. to .01 μfd. should work well here.

The coil, L_1, and tuning capacitor C_2, are somewhat critical in that the choice of these components should permit the user to cover the desired range of frequencies. Where more extensive frequency coverage is desired, a number of plug-in coils may be provided. (We will discuss the coil a little later.)

Coupling capacitor C_3 is not critical and good results can be obtained with almost any value from 50 $\mu\mu$fd. to 250 $\mu\mu$fd. Either a mica or ceramic capacitor may be used here.

Capacitors C_4 and C_5 are also not critical and values from .001 μfd. to .05 μfd. may be used here. Paper, mica, or ceramic types are all suitable.

Audio bypass capacitor C_6 may have any value from 0.1 μfd. up. Although the author used a "metallized" paper type, molded capacitors or conventional waxed tubulars might well be used here.

The resistors required are non-critical. R_1 may have any value from 6800 ohms to 18,000 ohms, although 10,000 to 12,000 ohms seems to be "optimum." R_2 may have a total resistance of from 1500 ohms to 10,000 ohms, and any taper may be used. R_3 may have any value from 470 ohms to 2200 ohms.

Even the battery voltage is not critical, and either a 1.2-volt mercury cell, a 1.5-volt penlight cell (or flashlight battery), a 3-volt dry cell (such as the *Burgess* type 422), or a 6-volt dry cell might be employed (such as the *RCA* type VS068 "A" battery).

Other meters may be substituted for the 0-200 microammeter used by the author. The only difference in operation will be a change in the over-all sensitivity of the instrument. An 0-50 or 0-100 microammeter will permit increased sensitivity, while an 0-500 microammeter or 0-1 milliammeter will give a unit with less sensitivity.

Coil Winding Data

The coil is wound using standard design procedure as described in the *"Radio Amateur's Handbook"* or in other standard reference sources. Choose a coil form and wire size suitable for the frequency range to be covered and for the tuning capacitor used.

The exact positions of the two taps are not too critical. However, the tap for the transistor (to which coupling capacitor C_3 is connected) *should not be more than one-fifth the total number of turns from the "cold" end of the coil.* Actually, a little less than this is preferred. For example, if a total of 100 turns is used, the lower tap should not be more than 20 turns from the grounded end of the coil, and 12 to 15 turns would be preferred.

The antenna tap (to which C_1 is connected) may be from one-quarter to one-third the total number of turns, although the higher the tap is made on the coil, the greater the de-tuning effect when the "whip" antenna is used. However, as the antenna tap is moved "up" on the coil, the pick-up sensitivity of the "whip" is improved. For maximum pick-up, the antenna tap may be omitted entirely and C_1 connected to the "hot" end of the coil. In this case, the de-tuning (when the "whip" antenna is inserted in its jack) is quite severe.

The coil used by the author consists of 72 turns of No. 26 enameled wire on a standard 1¼" 4-prong form. Taps are at 13 and 23 turns. Frequency coverage, with the capacitor used, is from 1.2 to 4.0 mc.

Operation and Calibration

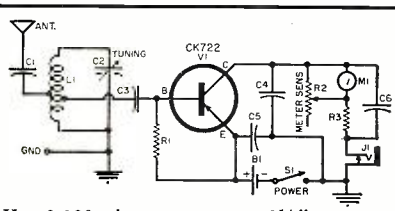
Before the completed instrument can be used properly as a frequency meter, it should be accurately calibrated. Calibration is most easily accomplished using a grid dip meter or a signal generator with good output.

First, check the output signal of the grid dip meter (or signal generator) by coupling it to a communications receiver and "zero-beating" against known broadcast stations, short-wave stations, or WWV. Once the accuracy of the grid dip meter is known, it can be coupled to the transistorized r.f. fre-

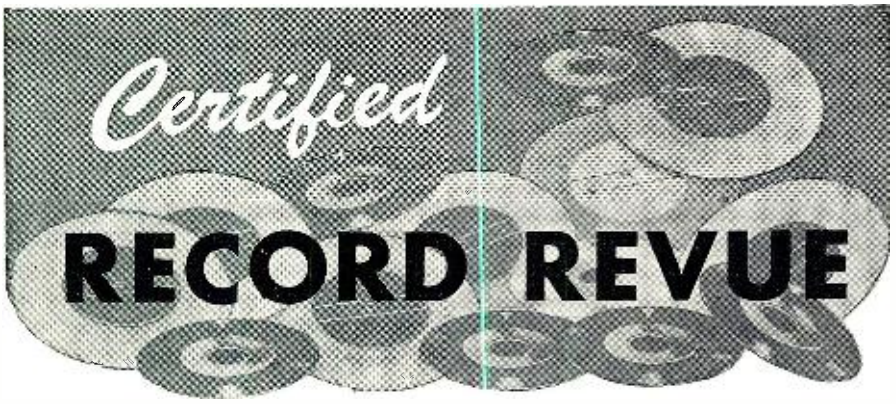
(*Continued on page* 103)

Fig. 2. Schematic of r.f. frequency meter. See text for possible parts substitutions.

R_1—10,000 ohm, ½ w. res.
R_2—5000 ohm carbon pot
R_3—1000 ohm, ½ w. res.
C_1—.005 µfd. disc ceramic capacitor
C_2—140 µµfd. tuning capacitor (Hammarlund HF-140)
C_3—100 µµfd. ceramic capacitor
C_4—.002 µfd. disc ceramic capacitor
C_5—.01 µfd. disc ceramic capacitor
C_6—.1 µfd., 200 v. metallized paper capacitor
L_1—Plug-in inductance coil (see text)
S_1—S.p.s.t. toggle switch
J_1—Closed circuit jack



M_1—0-200 microampere meter, 2½"
B_1—Standard penlight cell, 1½ volts
V_1—Junction transistor (Raytheon CK722)



By **BERT WHYTE**

THE New York Audio Fair, that ear-splitting clambake, has come and gone and it is time once again to report on the hi-fi goodies the manufacturers have whipped up for your aural delectation.

But first, a few general observations might be in order. As with all past Fairs, this one was characterized by excessively loud demonstrations. The level in some rooms was very close to the threshold of pain, especially in certain rooms where the equipment was hardly of the calibre necessary to support the level with low distortion.. As I admitted last year, a part of these stentorian levels is purely self defense . . . but in many cases this passion for excessive volume levels was carried far past the point of any reason. With interest in hi-fi sound increasing at a fantastic rate, thanks to a good press, one would imagine that attendance at a show like the Audio Fair would virtually guarantee a good sound demonstration. Even the most callow novice has a right to expect that when he attends an Audio Fair he hears purportedly the ne plus ultra, the cat's whiskers, the absolute last gasp in super hi-fi sound. I am very much afraid that the quality of sound that issued from a good many exhibit rooms could have done nothing but alienate a large segment of those people who were attending their first Fair. Durned if I didn't stand in a number of rooms where the distortion and imbalance were so bad you could almost taste it.

The remarks I made some years back about the indiscriminate labeling of almost any junky phonograph as "hi-fi," bear repeating now. In all truth, and sadly so, hi-fi has become a meaningless term as applied to a piece of equipment. Now, more than ever, let the buyer beware. If there was a remnant of conscience in the advertising of a few years ago, it is most certainly gone in today's blurbs. This caution may not apply to the "hep" readers of RADIO & TELEVISION NEWS, but the only way I can suggest to avoid the pitfalls of hi-fi buying is to deal with a reputable dealer whose business is principally hi-fi—not with the Johnny-come-lately outfit where, if bona-fide hi-fi equipment exists at all, it is subsidiary to his washing machines and refrigerators. In that kind of establishment, when the washing machine salesman can sandwich you in between his usual customers, he becomes a self-appointed audio expert and opens up his vast fund of hi-fi knowledge to you. In this whole business of buying hi-fi, most of what you do must be decided by trust. I sincerely believe that if you take the time and trouble to find out who in your area is a dealer of good reputation, you will usually find a knowledgeable audio consultant on hand to help you. Yes, use your own ears as a guide to what kind of sound you like, but don't be an ornery cuss. Listen to what the salesman has to say most carefully and you can usually draw some pretty accurate conclusions as to his expertness. If you like what you hear, and you are getting a good conscientious demonstration, the best thing then is to TRUST this person. His knowledge and reputation were not acquired overnight. It takes time to master audio and the very worst thing you can do is to ignore this fact. DO NOT listen to your friends, no matter how well-meaning they may seem. The bitter truth is that on acquiring some hi-fi equipment and reading a few hi-fi mags and books, your friends have become "self-appointed audio experts" and paying them heed most usually results in all sorts of agonizing indecision on your part. Above all else, DON'T bring your "expert" to the store where in his noble desire to "protect" you, he can only succeed in lousing up the whole deal and in rousing the ire of the salesman. The ultimate loser is you—you'll be up in the air, more confused than ever—and most important of all, you still won't be enjoying the fruits of hi-fi in your home. I have digressed slightly, but with the growth of hi-fi the "expert" problem becomes ever greater and I thought you might like to have my views on the matter.

To return to the show—in addition to less than satisfactory sound from a technical viewpoint, one of the things I found particularly distressing was the musical aspect. If in former years the show was noisy, at least the material being demonstrated was halfway towards being decent music. This show was notable for the addiction of most of the exhibitors for certain "gimmick" records. Now Gadfrey, I'm not a hide-bound music snob—I can get as big a charge out of a well recorded gimmick as anyone—but once is about enough. In a day when there are fabulously good recordings of practically any kind of repertoire, the affront to good taste at the Fair was astounding. Over and over, the ear was subjected to the same thing. These "gimmick" records are all phonied-up with equalization to emphasize certain frequencies and any relation of these records to normal musical balance is strictly accidental. In all fairness, I must point out that most of the manufacturers of the better quality equipment used these records with discretion and, in a number of cases, not at all. It is the very nature of these "gimmick" records that they found their principal champions among the manufacturers whose products are deficient in the frequencies which are abnormally emphasized on the record. The discerning people who attended the show know what I mean, and I'll say no more. Surely, in our quest for audio perfection, we must not lose sight of the ultimate goal of all hi-fi—the better reproduction of the *music* that people enjoy. It is to be hoped that the next Fair will see the "gimmick" record give way to more substantial musical fare.

From an equipment standpoint, the Fair was both disappointing and interesting. Disappointing in that a number of significant new developments did not make their promised appearance, and interesting in some unexpected equipment from unexpected sources. No product exhibited was so new and world-shaking that it dominated the Fair. Rather, it was the fruition of several products previously in the experimental stage and the refining of existing products which found major interest with the serious audiophile. For years now, binaural or stereophonic sound has been the room-filling attractions at the Fair, but for the most part people could only "ooh and ah" at the magnificent sound. The prohibitively high price of the necessary equipment, plus the dearth of prerecorded material, deterred all but the brave and the wealthy. Last year, the situation was more or less the same and the discerning observer could see that binaural was assuming somewhat of an Olympian and, for the most part, an unobtainable ideal. Because of this, there was the beginning of a decline in interest and had the situation continued to this year, binaural sound would have been in sad shape indeed.

Happily, *Ampex* has come to the rescue with its Model 612 tape playback unit, on which I reported to you a few months ago. At $379.00, this unit will furnish the greatest impetus to those people who have longed for a reasonably priced stereo unit. Sure, as I said before, $379 isn't exactly beer money, but it does bring stereophonic sound within the reach of many. This is a fairly safe prediction after observing the reception the *Ampex* demonstration was given at the Fair. People flocked to the room and the demonstration was very well done, with a minimum of gimmickry and a maximum of thrilling music. The knowledge of this comparatively inexpensive stereo machine, coupled with the release of *RCA Victor* pre-recorded stereo tapes and the announced release of other material by *Westminster, Haydn Society, Urania* and others, has changed the buying viewpoint of quite a number of people I spoke to. Some went so far as to say they would not now purchase any disc playback equipment; others figured in the tape as a purchase to be made earlier than anticipated. A word of caution to those who would delete discs from their plans—the time is not yet. It will be a long time before there are sufficient tapes available to make even a sizable dent in the various repertoire. Use tape as an adjunct, yes, but don't deprive yourself of the vast musical treasury that has been built up in the LP records. I think all of you who are long time readers of this column know that I am one of the most ardent of tape enthusiasts, so when I caution about the tapes, it isn't sour grapes.

Electrostatic speakers are something else which has been kicking around the show for the past few years. The reception afforded them has been, up to now, lukewarm. The principal reason for this is that the units available have been tiny tweeters, no bigger generally than 4 inches, which crossed over at the high point of 5000 cycles. Their efficiency was very low, a characteristic of most electrostatic speakers, and no balance controls were provided, so that to the average person the addition of one of these units seemed to make very little difference. What was needed was a unit with a crossover point at least as low as a thousand cycles, and preferably even lower, so that the all-important mid-range . . . the so-called "presence" frequencies, could be produced electrostatically.

(*Continued on page* 132)

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.

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With DIAGRAM for Easy Conversion to CITIZENS' BAND!

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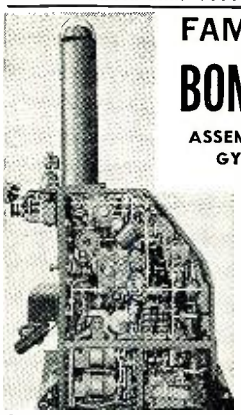

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Comes in three units—the main body and two attachable periscopes, 22 and 68 inches high, alternate parts of an intricate optical system made by Eastman-Kodak Co. Main body is 35x25x14 inches. Contains at least 8 27 VDC motors, electric heater and temp. 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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Comprises 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.

BRAND NEW, export packed, including tubes, all yours for only **$89.50**

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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:

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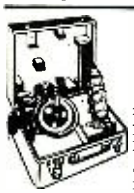

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BRAND NEW (worth $750)

OUR LOW PRICE **$34.50**

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 12½" 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**

ID-60/APA-10 SIGNAL INDICATOR, for 115 V AC, complete with all tubes including scope tube—NEW, demilitarized **$16.95**

BC-929 INDICATOR With tubes, excellent. . **$14.75**

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53.3 to 95 Mc. OUR PRICE

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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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Type	Input	Output	Excellent Used	BRAND NEW
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DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-34D	12V 2.8A	220V .080A	4.25	5.50
DM-35D	12.5V 18.7A	625V .225A	8.95	10.95
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		
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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

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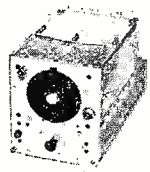
BC-946-B BROADCAST RECEIVER



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.

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ALL COMPLETE WITH TUBES

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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	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
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ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes $16.95

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal $12.45

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FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE** **$129.50**

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2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Louvred alum, cabinet 7⅜ x 4⅞ x 14". Complete with 10 tubes and 4 xtals. Excel. Cond. **$14.95**

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Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105. 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7⅜". Inside rear; 2" deep. Shock-mounted.

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Original Crystal for BC-221, NEW **$8.45**

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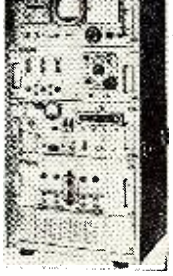
. . . now buy it for a tiny fraction of cost! Easily converted for Television. Complete assembly consists of Control unit with 5" C.R. Tube, transmitter and receiver assembly (157 to 185 Mc). Indicator unit, and Power Supply (450 watts), operating on 110 volts, 60 cycles AC. All assembled, ready to operate. 62 Tubes included: 8—6V6GT, 9—6SL7GT, 14—6SN7GT, 1—5CP1, 2—9006, 1—6Y6G, 2—6E5, 1—100TH, 2—6J5, 2—2C26, 1—3E29, 1—6H6, 7—6AG5, 3—6AK5, 1—6C4, 3—2X2, 1—6X5GT, 35U4GT. Overall size 55" high, 28" wide, 20½" deep. Shpg. weight 855 lbs. Your cost, complete, BRAND NEW, in original packing **$169.50**



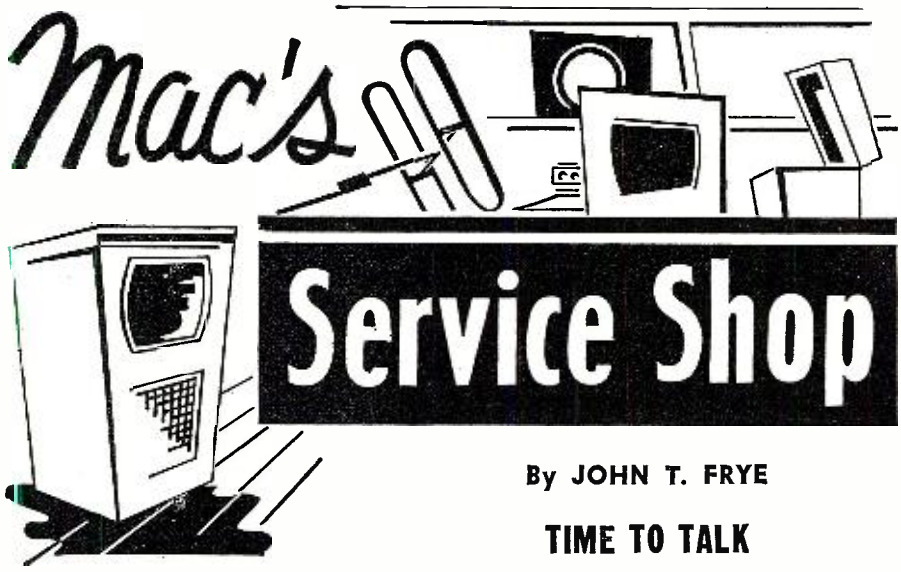
SCR-522 FINEST 2-METER RIG!

Terrific buy! VHF Transmitter-Receiver, complete with all components. 100-156 Mc. 4 channels. Xtal-controlled, Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes. COMBINATION ..... Special **$39.50**

Receiver only, with all tubes **$21.25**

Transmitter only. with all tubes **$24.50**



Mac's Service Shop

By JOHN T. FRYE

TIME TO TALK

BUSINESS was a little slow in Mac's Service Shop. People were still recovering from their Christmas spending, and it would take a payday or so to make them "well" again.

Barney was working away on a portable set, while Mac, his employer, was busy at the other end of the bench doing some testing with the oscilloscope purchased a couple of months back. A probe connected to the horizontal input terminals of the scope went to the output terminals of the square-wave generator. Mac carefully studied a book spread out in front of him on the bench and then inserted an insulated screwdriver into the rear one of two small holes in the probe body and turned the screw inside first one way and then the other. As he did so, the square wave displayed on the face of the tube grew taller and shorter and the top portion tilted first one way and then the other. When he was satisfied with this adjustment, Mac shifted his screwdriver to the other opening and started turning the screw inside. This time the leading corner of the square wave rounded off or developed a sharp spike in accordance with the setting of the adjustment.

"Hey!" Barney exclaimed, "what are *you* doing reading a book? I thought you knew all the answers. What are you trying to do, anyway?"

"You never heard me claim I knew all the answers," Mac said emphatically as his face wrinkled in a tolerant grin. "That's about the last thing I should be likely to say as long as I'm working in this ego-humbling racket. This book is called simply *'Probes,'* and it is written by Bruno Zucconi and Martin Clifford. It contains about all there is to say on probes that are used with v.t.v.m.'s, oscilloscopes, or other instruments to increase their range and usefulness. Every kind of probe from the simple direct type to the chromatic probe used in color TV work is discussed. The circuits of various probes, how they are constructed, how and where each is used, how they are adjusted, the limitations of each type, how you can make your own—these are some of the subjects covered. While many of these subjects have been written up over the years in various magazine articles, it is mighty handy to have everything you are likely to want to know about probes all in one book so you can refer to it as the need arises—as I have just been doing."

"What were you doing?"

"This new scope has a much lower input capacity and higher impedance than did our old job for which the 10-to-1 low-capacity probe and the 100-to-1 high-voltage probe were adjusted. It was necessary to adjust both probes so that their voltage-dividing function would be accurately matched to the impedance of the new scope and provide the proper specified attenuation. In addition, the low-capacity probe had to have its frequency-compensating adjustment matched to the new horizontal input impedance so that it would pass all frequencies without discrimination."

"Well, while you have been playing around with that interesting but nonproductive stuff, I've been paying the rent," Barney announced importantly. "The last set in the shop is now ready to go."

"What was wrong with it?" Mac asked casually.

"Strictly routine," Barney said with a yawn. "It was a three-way portable in which the oscillator cut out when the line voltage fell below 110 volts. I put in a new 1R5, and now the oscillator holds in right down to 100 volts. And oh yes, just as I was tagging it with the bill, I noticed the dial lamp was out and I replaced it. It's very unusual to find a dial lamp on these jobs; so that's why I didn't spot it before. The lamp is one of those 50 ma. jobs, a #49 if I recall correctly."

"It seemed to me the set played a lot louder after you put in that lamp," Mac observed, still with great casualness.

"Yeah," Barney admitted, "how about that? That's the first time I ever remember that a new pilot lamp helped the volume."

"Just for kicks, suppose you put the

old 1R5 back in and use the isolation transformer to run the line voltage down again until the oscillator cuts out," Mac suggested as he went over to the steel cabinets holding the service data.

"Well, all right, if you say so; but I don't see the sense of it," Barney grumbled. "I told you I did that the very first thing."

With the old 1R5 in the socket, the line voltage had to be dropped below 90 volts before the oscillator quit.

"Well, how do you like that!" Barney marvelled. "Now the old tube works at a lower voltage than the new one did. What's going on here?"

Mac heaved a great sigh of sorely tried patience before he answered.

"If I have told you once, I've told you two dozen times: whenever you notice any deviation at all from normal operation, find out *why* this strange behavior is going on. When you noticed that the new pilot lamp increased the volume, you should have headed for those data file cabinets at once to study the diagram of the set and see if you could find a reason for this phenomenon. Now take a look at the diagram: the dial lamp is shunted across a 270-ohm resistor that is right in the high-voltage lead coming out of the selenium rectifier. Both the 'B-plus' current and the filament current for the tubes must flow through the pilot lamp and the resistor in parallel. When the pilot lamp is burned out, the resistor must carry the whole load; and the voltage drop across this portion of the circuit increases while the current passed through it decreases. The voltage drop, as far as the plate voltage on the tubes is concerned is of little consequence; but the decrease in the current that flows through the series filament string is sufficient to drop those filaments below their proper temperature, even at 117 line volts. When the line voltage drops a little, there is not enough emission from the 1R5 filament to keep it oscillating."

"How come a new 1R5 worked down to 100 volts?"

"A new tube always has a little 'extra' emission that soon disappears. If you had let this set go out, it would have been back in a few days with the same complaint as the initial surplus emission of the new 1R5 disappeared."

"When I replaced the pilot lamp, I brought the current of the whole filament string back to normal, and that accounted for the increase in volume; right?"

"Right. Low emission produces more spectacular results in an oscillator tube than it does in an amplifying tube; but all the tubes in the string were running with below-normal current through their filaments when the pilot lamp was out."

Barney tore up the bill on the set and started to make out a new one.

"Write out a little note to the effect that it is highly important to replace the pilot lamp in this receiver as soon as it burns out and pin that to the

(*Continued on page* 90)

BETTER RECORDS — A RESULT OF BETTER PROCESS

A rather simple method—yet it will produce better records at less cost to the consumer.

A NEW process for commercial production of high quality phonograph records was recently announced by *Custom Records, Inc.*, 41 E. 42nd St., New York 17, N. Y. The equipment required in this new process is rather simple, consisting of two machines; a processing machine weighing less than 80 lbs. used for both heating and cooling cycles, and a very simple edge trimmer. Pressure required is approximately 500 lbs. per square inch (it may even go as low as 165 psi) as compared to 2000 psi in present day processes.

The actual operation takes about 10 to 15 seconds for heating at a temperature of 300 degrees F. and a similar period of time for cooling. Up to four records can be produced per minute.

The key to this new technique is in the use of Vinylite in its earliest stage of processing. The raw material is in near powdered form—just heated to the point of cohering. In this state it is more malleable and therefore requires less effort on the part of the machine to process.

This is considerably different than present techniques. The process practiced today uses the same Vinylite, but after it has been formed into a homogeneous mass. This makes of it a relatively hard substance requiring high pressures and heat for pressing the record. During the pressing process, there is considerable pressure from the center of the disc toward its outer diameter. This results in a granular "flow" of the Vinylite from the center towards the outer area. The results are eventual wear and tear on the record master and all in all a poorer quality reproduction. Since the new method uses Vinylite in a powdery form, these pitfalls are not confronted.

The advantages of this new system are of considerable interest to all individuals who enjoy better quality reproductions. As pointed out by R. I. Mendels, newly-elected president of the company, the advantages are a recording that is superior to any produced today—has less background noise and better high-frequency response. In addition, the cost of processing is considerably lower which eventually will be passed along to the consumer. —30—

K. R. Smith (left) and James A. Miller, who developed the new process, demonstrate the recording process. Shown at the right is the small, compact electrically heated hydraulic press. After automatic heating and cooling in the press, the record is punched and trimmed in a separate operation.

Heathkits

FOR THE ENTIRE ELECTRONICS INDUSTRY

AMATEUR RADIO

RADIO & TV SERVICEMEN

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

INDUSTRIAL LABORATORIES

TRAINING SCHOOLS

HI-FI ENTHUSIASTS

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

V-7A VACUUM TUBE VOLTMETER: Easily the world's largest selling VTVM. Features peak-to-peak scales—etched metal circuit board—1% precision resistors—full wave rectifier and AC input circuit—reads rms and peak-to-peak AC, DC, and ohms.

O-10 LABORATORY TYPE OSCILLOSCOPE: The world's largest selling oscilloscope kit, and the most successful oscilloscope in history. Designed especially for color and black-and-white TV service work. Its 5 megacycle bandwidth and new 500 Kc sweep generator readily qualify it for laboratory applications. Features easy-to-assemble etched metal circuit board construction.

WA-P2 HIGH FIDELITY PREAMPLIFIER: This is the world's largest selling hi fi preamplifier kit. Features complete equalization, 5 separate switch-selected inputs with individual pre-set level controls, beautiful modern appearance, high-quality components.

HIGH FIDELITY AMPLIFIERS: Five Heathkit Models to choose from at prices ranging from $16.95 to $59.75. Power output range from 7 to 25 watts.

DX-100 TRANSMITTER: A 100 watt phone and CW ham transmitter, offering the greatest dollar value available in the ham radio field today.

Greatest Dollar Value Through Factory-To-You Selling!

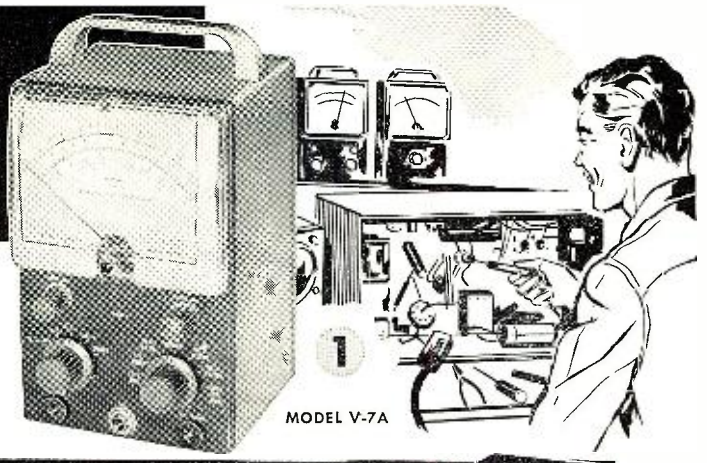
ONLY Heathkits CAN GIVE YOU ALL OF THESE DISTINCTIVE ADVANTAGES!

- *The Most Complete Construction Manuals for Easy Assembly.*
- *Originality of Design—Developed Through Pioneering in the Kit Instrument Field.*
- *Greatest Dollar Value—Finest Quality with Real Economy.*
- *Direct Contact with Manufacturer—Lower Price, Guaranteed Performance.*
- *Etched Metal, Prewired Circuit Boards—Save Construction Time, Improve Performance.*
- *High Quality Standard Components for Long-Life Service.*

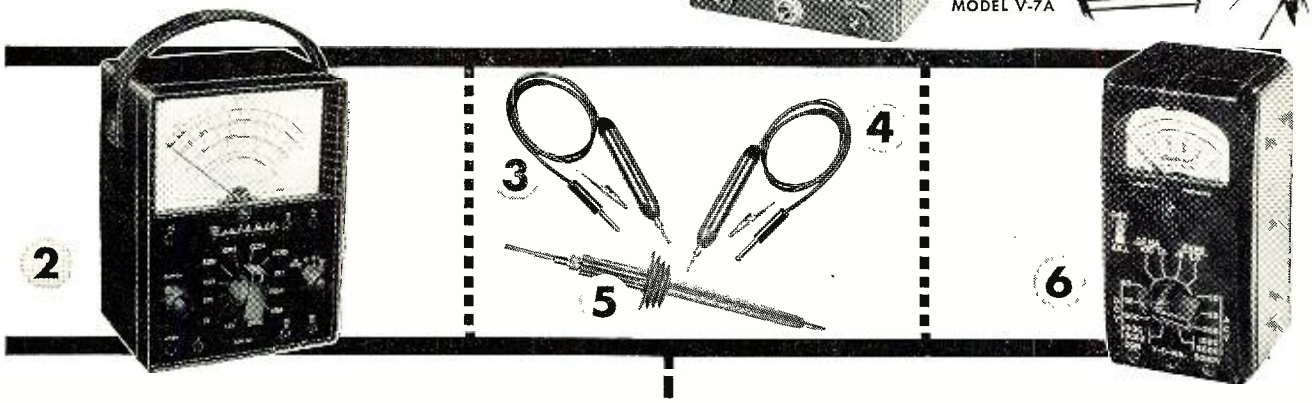
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

fill your test requirements

WITH HEATHKITS



DESIGNED FOR YOU: *Heath Company test equipment is designed for the maximum in convenience. Besides being functional, Heathkits represent the very latest in modern physical appearance, and incorporate all the latest circuit design features for comprehensive test coverage.*



1 *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A
$24.50
Shpg. Wt. 7 Lbs.

2 *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

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

3 *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C
$3.50
Shpg. Wt. 1 Lb.

4 *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C
$5.50
Shpg. Wt. 2 Lbs.

5 *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336
$4.50
Shpg. Wt. 2 Lbs.

6 *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 μa. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1
$14.50
Shpg. Wt. 3 Lbs.

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

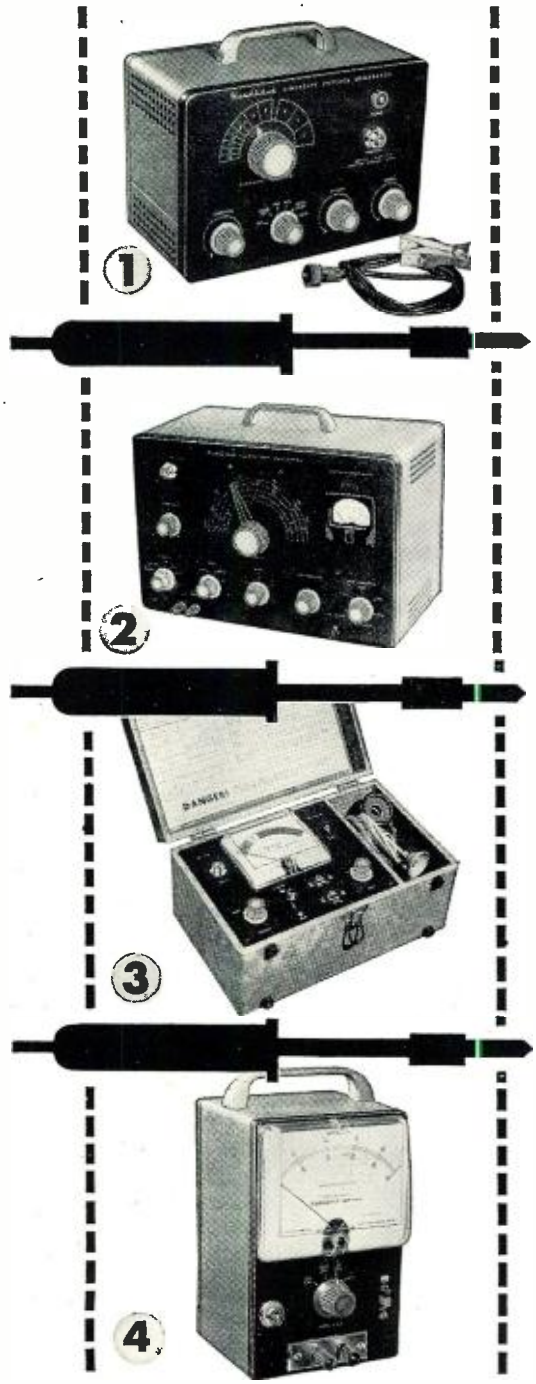
Heathkit TV ALIGNMENT GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4
$49.50
Shpg. Wt. 16 Lbs.



1 Heathkit LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1
$22.50
Shpg. Wt. 7 Lbs.

2 Heathkit LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 μv. to 1 μv. 200 μa. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1
$39.50
Shpg. Wt. 16 Lbs.

3 Heathkit CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight – ideal for outside service calls.

MODEL CC-1
$22.50
Shpg. Wt. 10 Lbs.

4 Heathkit DIRECT READING CAPACITY METER KIT

Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1
$29.50
Shpg. Wt. 7 Lbs.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

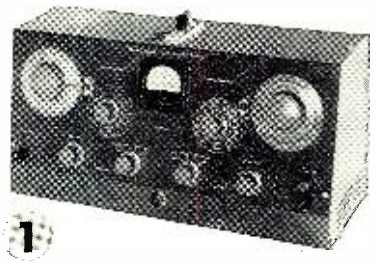
BENTON HARBOR 15, MICHIGAN

MODEL SG-8 **$19.50**
Shpg. Wt. 8 Lbs.

Heathkit SIGNAL GENERATOR KIT

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

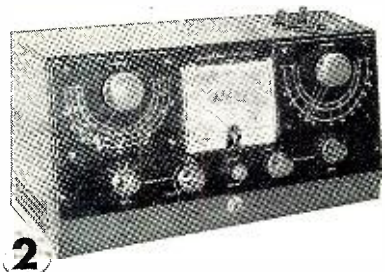


1 Heathkit . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

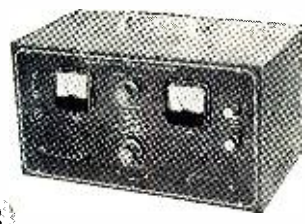
MODEL IB-2 **$59.50**
Shpg. Wt. 12 Lbs.



2 Heathkit "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

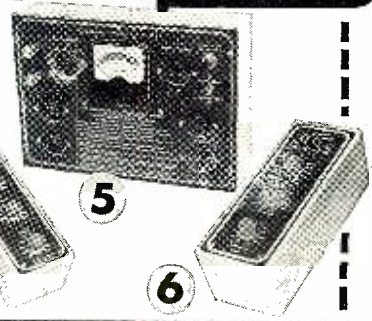
MODEL QM-1 **$44.50**
Shpg. Wt. 14 Lbs.



3 Heathkit 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4 **$31.50**
Shpg. Wt. 17 Lbs.



4 Heathkit DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1 **$19.50**
Shpg. Wt. 4 Lbs.

5 Heathkit VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1 **$14.50**
Shpg. Wt. 6 Lbs.

6 Heathkit DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1 **$16.50**
Shpg. Wt. 3 Lbs.

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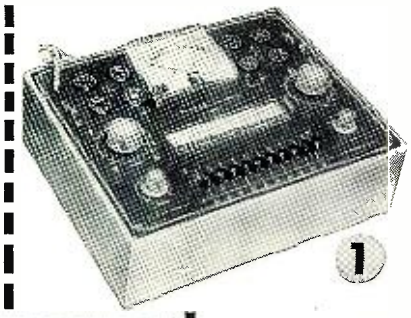
Heathkit TUBE CHECKER KIT



1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

2 Heathkit PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

3 Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

4 Heathkit . . . CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

5 Heathkit VISUAL-AURAL SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

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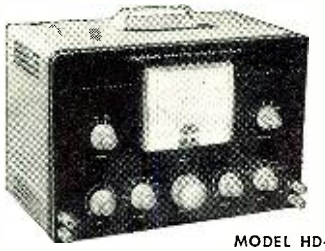


MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT

1 Heathkit AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1
$59.50
Shpg. Wt. 13 Lbs.

2 Heathkit AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

MODEL AG-9
$34.50
Shpg. Wt. 8 Lbs.

3 Heathkit AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

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

4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1
$5.50
Shpg. Wt. 2 Lbs.

5 Heathkit AC VACUUM TUBE VOLTMETER KIT...

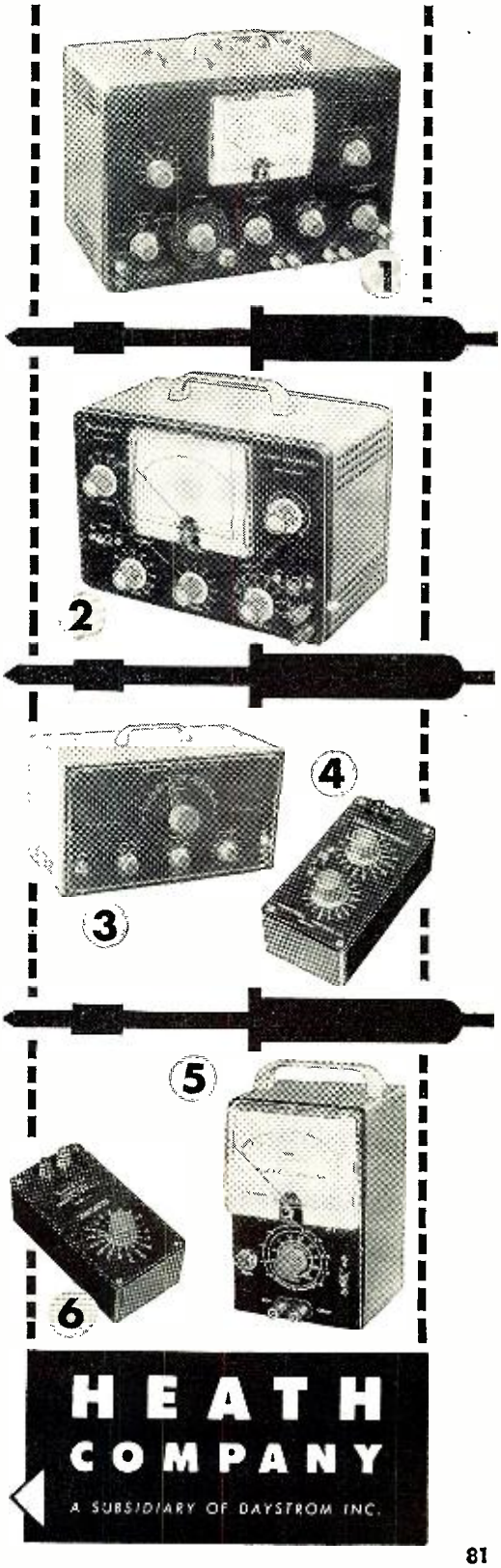
The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2
$29.50
Shpg. Wt. 5 Lbs.

6 Heathkit CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1
$5.50
Shpg. Wt. 2 Lbs.



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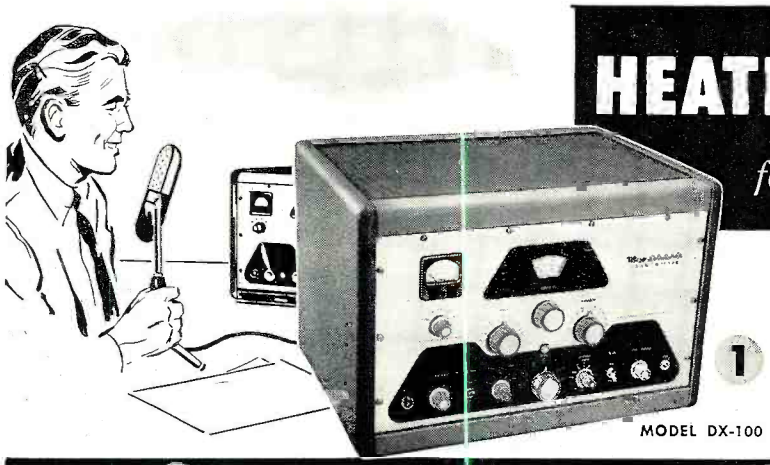
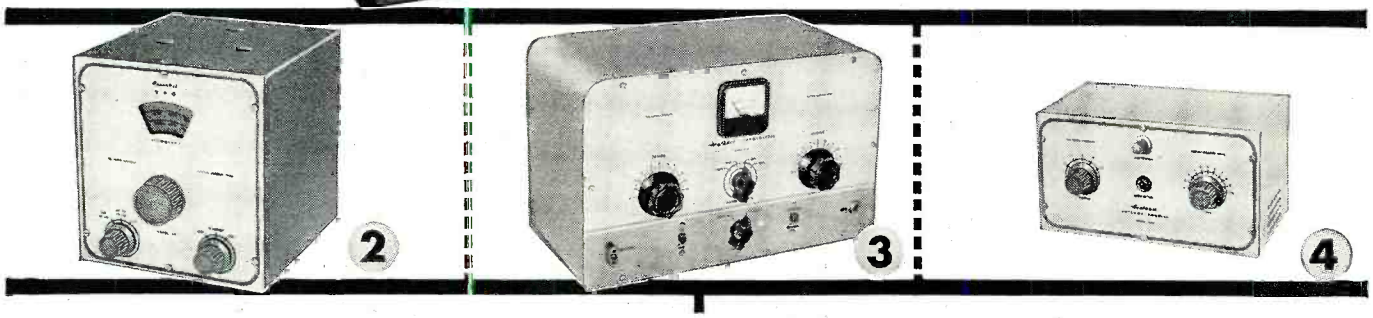
HEATHKIT HAM GEAR

for high quality at moderate cost



MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*



1 *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 Lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

2 *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

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

3 *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

4 *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

MODEL AC-1
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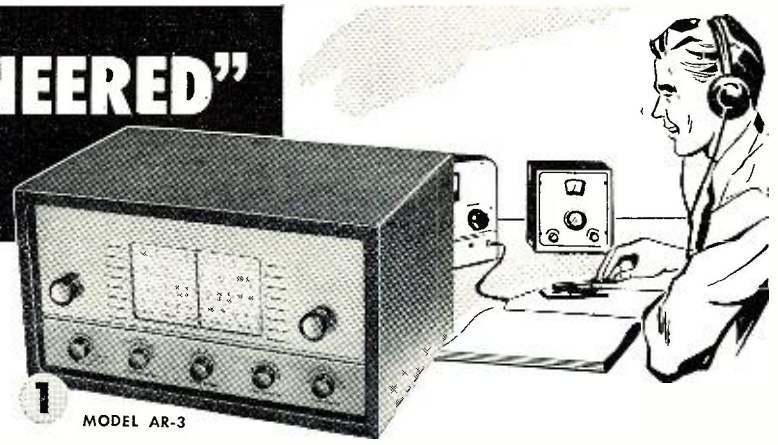

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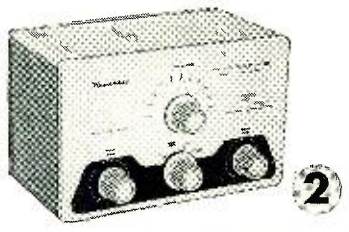

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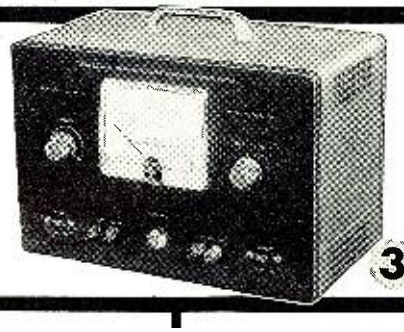

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1 *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply—electrical bandspread—separate RF and AF gain controls—antenna trimmer—noise limiter—AGC—BFO—headphone jacks—5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91- shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95
Shpg. Wt. 12 Lbs.
(Less Cabinet)

2 *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

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Shpg. Wt. 3 Lbs.

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MODEL PS-3
$35.50
Shpg. Wt. 17 lbs.

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MODEL AM-1
$14.50
Shpg. Wt. 2 lb.

5 *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B
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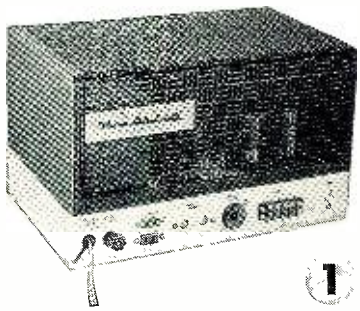

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The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

KIT COMBINATIONS:

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**

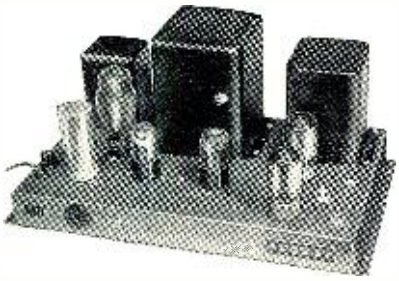
2 Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**



3 Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

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ATTRACTIVELY STYLED: *Heathkit high fidelity instruments are not only functional, but are most attractive in physical design. Such units as the preamplifier and the W-5 main amplifier are designed for beauty as well as performance. They blend with any room decor and are the kind of instruments you will be proud to own.*

enjoy.... THE VERY BEST IN AUDIO WITH "BUILD-IT-YOURSELF" HEATHKITS

1 *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

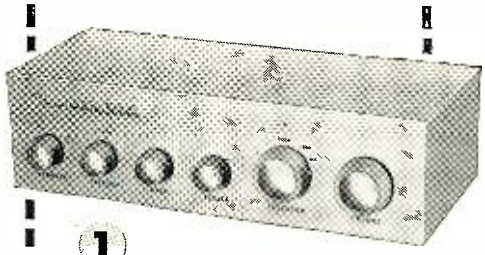
This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

Features five separate switch-selected input channels (2 low level and 3 high level), each with its own input control. Full record equalization with four-position turnover control and four-position rolloff control.

Output jack for tape recorder — separate bass control with 18 db boost and 12 db cut at 50 cps. — treble control offering 15 db boost and 20 db cut at 15,000 cps — special hum control to insure minimum hum level — and many other desirable features. Overall frequency response (with controls set to "flat" position) is within 1 db from 25 cps to 30,000 cps. Will do justice to the finest available program sources. Beautiful satin-gold finish.

Power requirements from the Heathkit Williamson type high fidelity amplifier — 6.3 VAC at 1 amp., and 300 VDC at 10 Ma. Uses two 12AX7's and one 12AU7.

MODEL WA-P2
$19.75
Shpg. Wt. 7 Lbs.



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2 *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

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3 *Heathkit* 7-WATT AMPLIFIER KIT

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

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are ± 1½ db from 20 to 20,000 cps. Potted output and power transformers employed. Push-pull output — detailed construction manual — top quality parts — high quality audio without great expense. Output transformer tapped at 4, 8, and 16 ohms. Bass and treble tone controls provided on the front chassis apron.

MODEL A-7D
$16.95
Shpg. Wt. 10 Lbs.

3

Model A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for variable reluctance or low level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. $18.50.

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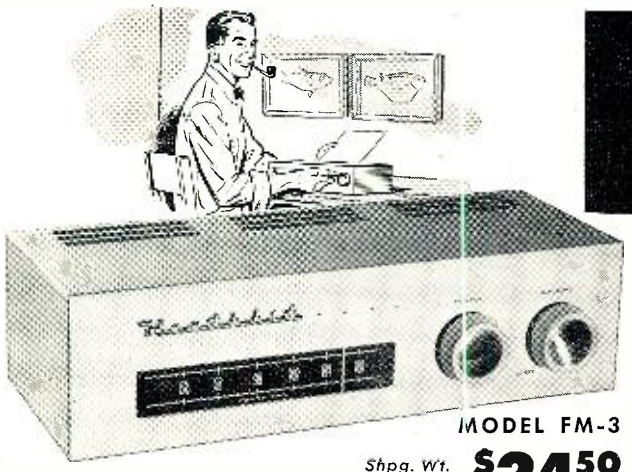

MODEL FM-3

Shpg. Wt. 7 lbs.

$24.50

(with cabinet)

Brand New HEATHKIT HIGH-FIDELITY FM TUNER KIT

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 μv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *prealigned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

Features

- *Brand New, Modern FM Circuit Using Latest Type Miniature Tubes.*
- *Low-Noise Cascode RF Stage—Two IF's—Ratio Detector —Stage of Audio.*
- *Extremely Good Sensitivity and Band-Pass for Outstanding Performance.*
- *Strikingly Attractive Satin-Gold Finish to Match Heathkit Model WA-P2 Preamplifier.*
- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

HEATHKIT BROADCAST-BAND RECEIVER KIT

Build your own radio receiver with confidence, even if you are a beginner. Complete instructions supplied.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, 5½" speaker, and planetary tuning from 550 Kc to 1500 Kc. Adaptable for use as AM Tuner and phono amplifier. Educational treatment of the construction manual helps the beginner learn about radio circuits and parts as he builds.

CABINET: Fabric covered plywood cabinet with aluminum panel as shown. Part 91-9, Shpg. Wt. 5 lbs., $4.50.

MODEL BR-2

$17.50 *Less Cabinet*

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Transistorized Audio Amplifier

A COMPACT, transistorized audio amplifier designed to operate a speaker in class B push-pull, transformer-coupled, ¼ watt power output is easy to build and relatively inexpensive.

Transformer coupling between the transistor amplifier stages provides impedance matching and allows the use of fewer stages for the same over-all gain than RC interstage coupling.

The circuit itself is built around three of the General Electric 2N107 junction transistors of the "p-n-p" type. The amplifier is powered by four 1½ volt penlite cells and operates in push-pull class B. Frequency response is from 100 to 8000 cps with an over-all power gain in excess of 50 db.

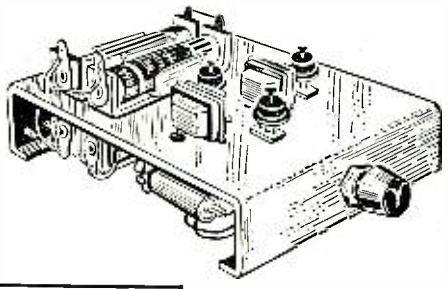
The three transistors are connected in a grounded-emitter type circuit which provides sufficient power to operate a good quality 4" to 6" PM speaker with a 3.2 ohm voice coil.

The transformers required for this construction are of the type especially designed for transistor circuitry. An important feature of such components is their high inductance and low d.c. resistance. Input impedance of this circuit is 1000 ohms. For high impedance inputs a matching transformer is required. For magnetic inputs a preamplifier is needed.

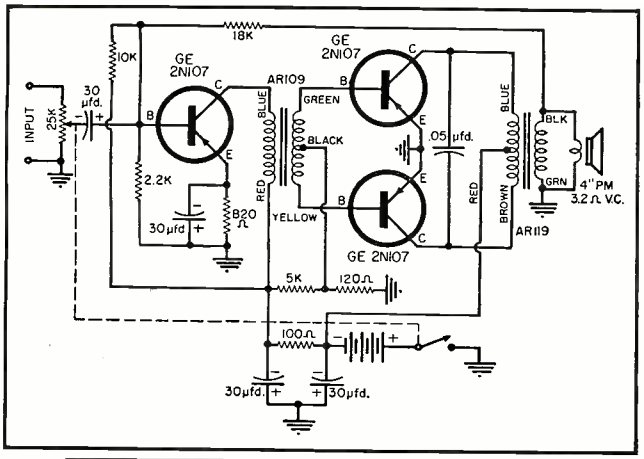
Since a feedback loop is employed, the necessary precautions in regard to phasing must be employed. Follow the color coding of the transformers carefully. Should oscillation occur after completion, reverse the black and green wires of the output transformer. The transformers, which are the only special components required to build this amplifier, are manufactured by Argonne Electronics Mfg. Co.

For those who wish to avoid the trouble of shopping for individual components, Lafayette Radio, 100 Sixth Avenue, New York 13, New York has a kit, Model KT-69, available for $17.95.

The primary purpose of this kit is for the experimenter, student, or anyone who wants to obtain some working knowledge of transistor operation. For all practical purposes, considering the price, a vacuum tube-type power amplifier would be more advisable. —30—



↑ Over-all view of the transistorized audio amplifier. Here, it is built breadboard style on a chassis measuring 3" x 4" x 1", although any arrangement of parts will do.



← Complete schematic diagram of audio amplifier. It uses three of the new G-E 2N107 transistors and two specially-designed transistor type transformers.

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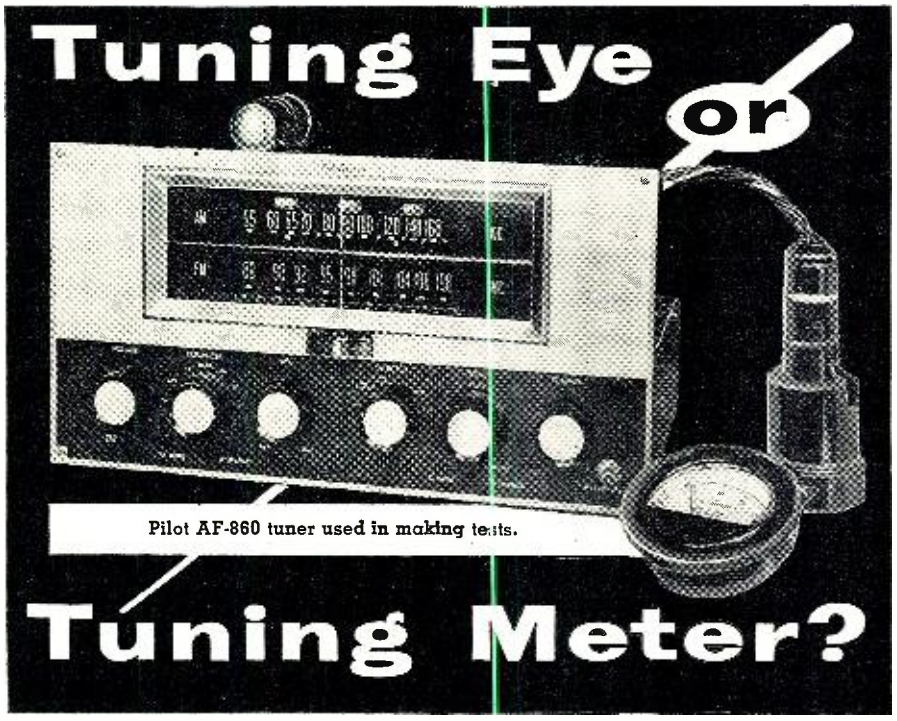
Tuning Eye or Tuning Meter?



Pilot AF-860 tuner used in making tests.

By **JAN SYRJALA**

An engineering evaluation of resonance indicators for FM and AM receivers and some conclusions regarding their use.

WITH the steady increase in the interest in high-quality audio systems that has developed during the past few years, the author is frequently asked to evaluate and compare equipment for the benefit of confused music lovers.

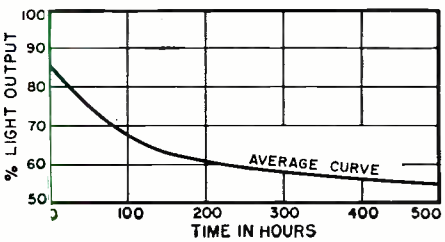
One commonly-asked question concerns the relative merits of the various types of tuning indicators. It is difficult to obtain maximum FM performance from an FM receiver if there is no adequate method of determining whether or not the set is tuned in "on the nose." It must be understood that the lack of a tuning indicator does not mean that a tuner is of poor quality or cheap, it merely means that it is more difficult to insure consistent top performance from such a system.

Two general classes of tuning indicators are available: electron-ray tubes and meters. This article will describe and evaluate the two types in the hopes that the reader will obtain a fuller appreciation of the necessity for exact tuning and an understanding of how it can be achieved.

Although the author, like many others in the field, had many theories based on casual observations of tuning indicators, it was felt that some experimentation was necessary in order to gather quantitative data with which to evaluate such devices. In order to gather the desired information, a representative tuner had to be selected. A *Pilot* Model AF-860 was selected as the "guinea pig." It was chosen since it is equipped with an effective tuning meter and is in the medium price class. Just as important are its circuit features which make it possible to acquire a great variety of performance data: FM reception, wideband and conventional AM reception, automatic frequency control on FM, continuously variable by means of a front panel knob, low oscillator drift, and a sensitivity of 2 microvolts for 20 db of quieting.

In order to make comparisons under identical signal conditions, it was necessary, of course, that all the indicators be connected to the same receiver and operated simultaneously. To accomplish this, two sockets on flexible leads were installed for the operation of two electron-ray indicators and the power supply was augmented slightly. The two tuning "eyes" which were considered were the 6E5 and the 6AL7. There was no problem with the 6E5; however, the 6AL7 required higher voltage than that available from the receiver's power supply so an additional rectifier tube and filter capacitor were installed. The meter-type tuning indicator is an integral part of the tuner and was left "as is."

Phosphor decay rate for tuning eye tubes.



Indicator Types

The 6E5, one of the most common types of electron-ray indicators, is found in many AM and some FM receivers. When operating, its screen or "target" glows, showing a disc of green light with a dark center. The latter is caused by an internal shield that blocks off the light from the heater element of the tube. A pie-shaped wedge of darkness or shadow area on the green disc varies in width with the strength of the incoming signal.

The 6AL7 is very different in construction, appearance, and use. It was developed by *General Electric Company* in 1945 out of the realization that if electron-ray indicators were to be used in FM receivers a more suitable type would be required. First of all, the 6AL7 is actually a double indicator, whereas the 6E5 indicates only one signal voltage, usually the a.v.c voltage in AM receivers or the first limiter grid voltage in FM sets. The 6AL7 indicates not only either of these signals but, in addition, the voltage at the discriminator output in FM receivers. This latter information is rather important for tuning FM sets correctly.

The 6AL7 displays two side-by-side rectangular fluorescent patterns. These function in such a manner that the entire upper half of the pattern moves according to the voltage at the discriminator output; the other side is fixed by being at ground potential and serves for comparison with the adjacent pattern. The principle behind the comparison of the two patterns lies in the fact that when the receiver is properly tuned to a station the d.c. voltage at the discriminator is zero. Therefore, when the movable pattern is aligned with the fixed pattern (which is at zero potential) we know that the set is properly tuned.

The third form of tuning indicator, the meter, employs minute FM discriminator or AM a.v.c. currents from the discriminator output in FM or the a.v.c. circuit in AM, which may vary in magnitude and polarity with tuning. These currents deflect a highly sensitive pointer which indicates relative or absolute changes in the circuit currents. In FM receivers it is advantageous to use a meter with its zero indication in the center of the scale, because the discriminator output current is zero with correct tuning and changes polarity as the set is tuned through the proper setting. The meter is thus capable of indicating these changes. It is possible to use an ordinary meter that has the zero mark

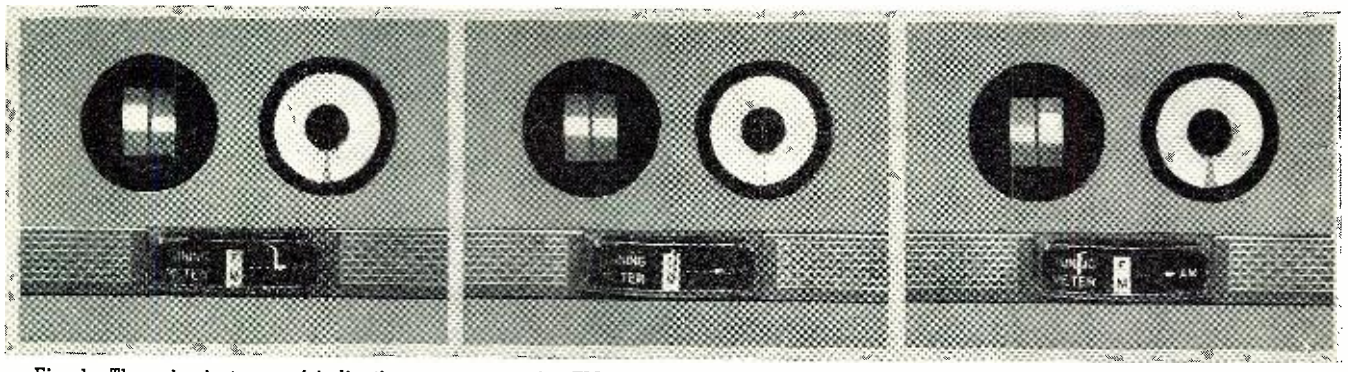


Fig. 1. Three basic types of indications over an entire FM tuning process during which station is off, "on-the-nose," then off again.

at either end of the scale, but this obviously tells only half the tuning story.

Fig. 1 will provide the reader with an insight into the operation of the three basic types of tuning indicators. These photographs show the entire FM tuning process of the indicators when "off-station," "on-station," and "off-station" once more.

Fig. 2 shows a similar tuning sequence but for AM reception. In this case the photos show (from left to right) a severe case of mistuning, a slight case of "off-station," and finally, "on-station" reading. Here the reader should observe that the meter varies or is deflected to one side of its scale only. This is because AM tuning indications are taken from the a.v.c. voltage which is always negative. In the case of the 6AL7, note that the height of the image indicates the state of tuning.

The most serious problem encountered with tuning "eyes" is the decay of the fluorescent screen material. This phosphor de-activation is due to heating effects. There are two sources of heat. The first is the thermal radiation emanating directly from the heater-cathode. The second and more destructive heat is generated by the impact of the electron stream on the phosphor surface. This is quite unavoidable since it is this very bombardment of electrons which produces the visible indicating pattern.

The brilliance and sensitivity of tuning "eyes" vary with the target voltage. In the case of the 6E5, reducing the target voltage by one-half roughly doubles the sensitivity, while with the 6AL7 tube the sensitivity remains relatively constant through a rather wide range of applied target voltages.

At this point one might well ask what are the advantages of using a tuning eye of some form in lieu of a meter. The advantage of the tuning eye lies in its high input resistance which permits the eye tube to be connected almost anywhere in a circuit without disturbing that circuit. In addition, the initial cost of an eye tube is low when compared with a meter.

Like a small child eating his vegetables first and saving the meat for last, we shall now embark on the matter of the tuning meter. It has no filament or target to deterioriate. It does draw a small amount of power from the circuit, although it is too small to be of consequence. One decided advantage is its long-term stability. Once it is calibrated, nothing short of a hammer blow disturbs its accuracy.

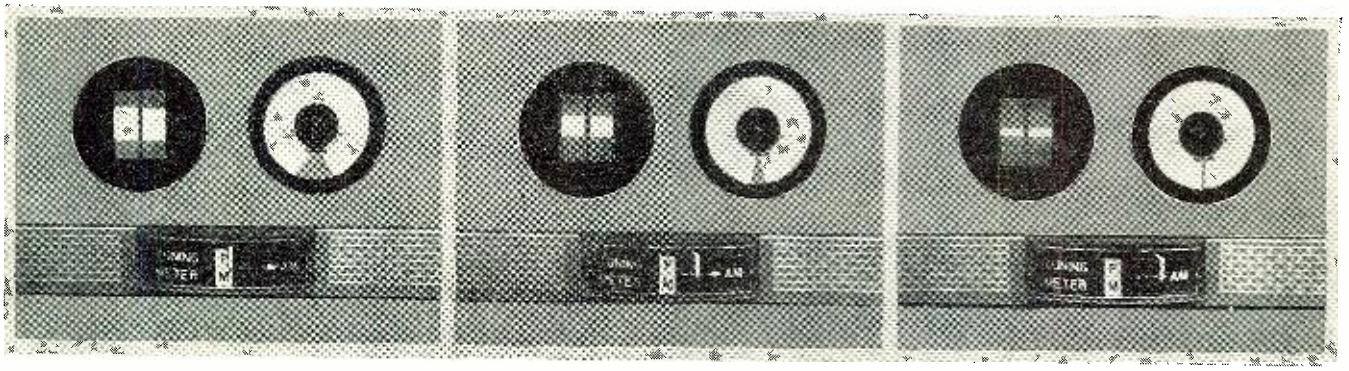
The aural tuning of AM receivers is fairly easy because the listener can compare the intensity of the background noise with that of the signal. FM background noise is generally present only when the receiver is excessively out of tune, unless the signal strength is such that the receiver is not limiting properly. Furthermore, the change of tone quality in an out-of-tune FM receiver is not quite as noticeable as it is on an AM set. When tuning an FM set by ear, one must listen very carefully to the extreme ends of the audio spectrum for signs of degradation, usually in the form of poor transients and intermodulation distortion. If the program has distorted highs or lacks lows, as in the case of many remote transmissions or poor recordings, it is very difficult to tune the station by ear alone.

When an FM tuner drifts appreciably during the initial warm-up period, distortion of the program material sets in. The onset of this distortion can be so slow that the listener is not immediately conscious of it, although it will grow on him. Drift is easily observed on a tuning meter and with the aid of the latter is easily corrected. Indeed, it becomes possible, with a little experience, to "off-tune" the set with the meter in such a direction that the tuner drifts into perfect tuning after the warm-up period, instead of out of it. The signals will sound fuzzy at the start, but will soon clear up.

In the course of experimenting with the AF-860 tuner, we found that there is a surprising difference in the facility with which FM stations can be tuned in, using the indicators mentioned. For example, in order to locate center frequency with a 6E5, one oscillates the tuning knob in gradually decreasing increments until the eye shows itself to be most completely closed. Receiver drift will cause the eye to open but will not indicate the direction in which the tuning knob must be turned to compensate for the error. The 6AL7 is more helpful in this regard. When tuning with a meter, adjustment is simpler and more positive in that one can see immediately both the direction and the degree of the drift. There is no need to wiggle the tuning knob or to try to align the ragged edges in an "eye."

To summarize the advantages of the meter type tuning indicator: the meter indicates direction and amount of mistuning by a relatively large deflection, the meter has a specific calibrated point for indicating correct tuning, and the life of the meter is well in excess of the life of the tuner itself. —30—

Fig. 2. Tuning sequence for an AM receiver as discussed in text. From left to right, badly mistuned, "off-station," and "on-station."



Mac's Service Shop

(*Continued from page 73*)

bill," Mac suggested. "Quite likely the original instructions accompanying the set mentioned this, but the first thing any good red-blooded American does with instructions is to throw them away; so a reminder may help."

"Say, Mac," Barney commented as he placed the corrected bill and the note on the set, "I was just wondering if we shouldn't build up a variable-voltage transformer that would allow us to go 'way on down below the 90 volts minimum we can get out of our isolation transformer. Every now and then I wish I could start with a very low line voltage and come up a little step at a time to the full 117 volts."

"When would you need something such as that?" Mac asked with interest.

"Well, for instance, the other day I got a set which the owner said burned out new tubes as fast as he could plug them in. A resistance check across the heater string with good tubes in the sockets revealed nothing wrong; but sure enough when I plugged it in, two tubes went out before I could unplug it. As I suspected and later proved, one of the tubes developed a cathode-to-heater short very shortly after the heater started to warm up; and this allowed the full line voltage to appear across two of the tubes and burned them out. Unfortunately, neither of the tubes burned out was the one with the trouble-causing short; so it just stayed in there all ready to take care of the heaters of the next pair of tubes put into those empty sockets. Now I feel sure that if I could have started with a very low voltage, say twenty or thirty volts, and gradually raised that voltage a few volts at a time, I could have triggered this condition at a voltage level that still would not have been sufficient to burn out the heaters."

"I'm convinced you could, and I'm delighted to see you using the old noggin," Mac applauded. "However, I believe we can satisfy your needs without going to the expense of a new transformer."

"Yeah?" Barney doubted.

"As I see it, all we have to do is take an old tube base and run a couple of leads from its heater prongs to an ordinary a.c. receptacle," Mac explained. "Then, whenever we need a very low a.c. voltage to power a receiver, we simply plug the tube base into a socket on the tube checker and plug the receiver into the a.c. receptacle. With the heater voltage selector on the tube tester, we can have practically any voltage we want from 1 volt right on up to the full line voltage. The fuse on the tube tester will prevent our damaging it with any unexpected overload. Since the tube checker uses a variable resistor in series with the transformer primary to serve as a line-voltage adjustment, the drop across this resistor provides our

lash-up with rather poor voltage regulation. This will serve as an advantage in that any sudden increase in current demand will produce a voltage drop that will tend to prevent serious damage."

"Nothing brings out the inventive genius of a Scotsman like the alarming prospect of having to put out some money," Barney said admiringly. "That will work fine, and I'll build up that little adapter right now while we have time. Incidentally, while I realize a breathing spell like this is bad for business, I must admit I rather enjoy seeing the shop all caught up for once. Seeing the bench all cleaned off this way makes me feel kind of free and easy and relaxed, and I get a kick out of your having time to do some serious talking."

"You know something?" Mac confessed with a twinkle in his eye. "This probably convicts me of being a very low-pressure businessman and a worse Scotsman, but I enjoy it too!" —30—

SIMPLE SIGNAL TRACER

By VICTOR SCHNEIDER

THE signal tracer described here is a reliable, inexpensive, and handy device for the radio service technician or the hobbyist who does not want to have to rely on one of the larger, more elaborate test instruments for the job.

The original model was built into a soft plastic cigarette case because it was easy to obtain and holes in the case could be made with a pair of scissors. Most of the parts required were found lying around in the spare parts box. For the rectifier, almost any kind of germanium diode will do. However, for best results, the use of a high-efficiency type such as the 1N34, 1N56, or at a lower price, the CK706, is recommended.

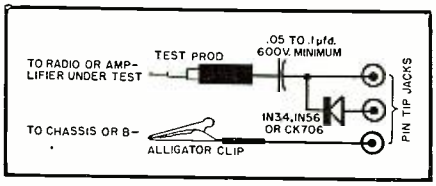
This tracer has one novel feature that makes it different from others of its type, which usually have no provision for tracing a demodulated radio signal. An extra jack is provided which is used to bypass the crystal. All parts shown on the circuit diagram are standard and easily obtainable.

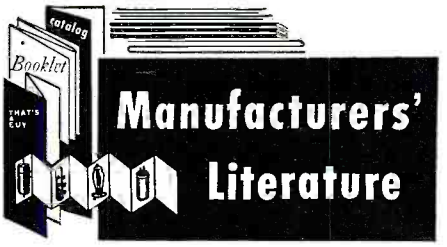
The testing points for a radio using octal tubes with grid caps are: the grid cap on the converter tube, r.f. amplifier, and sometimes the preamplifier, and pin 3, which is generally connected to the plate. For sets using octal tubes without caps, the points are: pin 3 or 8 to the plate circuit, and pin 2, 4, or 5 for the input circuit.

For a set using miniature tubes, the test points are: pin 2, 3, or 6 for battery portables, and pin 1, 5, 6, or 7 for table models.

Considering the small amount of time and money involved in building this compact unit, it performs amazingly well and is a valuable test bench accessory. —30—

Schematic diagram of the inexpensive signal-tracing probe described here.





Manufacturers' Literature

SENSITIVE RELAYS

A comprehensive catalogue on high-speed and sensitive relays is now available on request from the Electronics Division of *Iron Fireman Mfg. Co.*, 2838 S. E. 9th Ave., Portland 2, Ore.

The 12-page catalogue describes relays especially designed for precision aircraft electronic equipment conforming to highest military ratings in quality control.

Operational charts and instructions for their use are included. The charts provide a means of predicting the behavior of special values of coil resistance and other operating characteristics. Dimensional and wiring diagrams are also shown in this publication.

TUBES FOR INDUSTRY

The Tube Division of *Radio Corporation of America*, Harrison, N. J., has just released a new technical booklet covering the subject of receiving-type tubes for industry and communications.

The 20-page booklet contains technical data on 130 small industrial tubes including "Special Red" tubes, premium-tubes, pencil-type tubes, computer tubes, glow-discharge tubes, small thyratrons, low-microphonic amplifier tubes, and other special types. In addition, a chart is included listing *RCA* types intended for government end use only.

The booklet is priced at 20 cents a copy and is available from local tube distributors or from the Commercial Engineering Dept. of the Tube Division.

GROUND ANCHOR DATA

Laconia Malleable Iron Company, Laconia, N. H., is in production on a new ground anchor which has been developed by *Clevett Engineering Laboratory* of 34 Harwood Road, Natick, Mass.

Details on this new device are included in a four-page booklet which lists the outstanding features of the anchors, specification and installation data, and illustrated applications for the devices. An insert data sheet illustrates, by means of cartoon characters, how the anchor grounds should be installed.

Write the manufacturer for a copy of this data sheet.

TEST EQUIPMENT FLYER

Moss Electronic Distributing Co., Inc., 3849 Tenth Ave., New York 34, N. Y., is currently offering copies of its four-page brochure covering a line of test instruments for the service technician.

This two-color flyer lists v.o.m's, "super meters," tube testers, CRT tube

checkers, "Genometers", etc. Copies of this publication are available from the company on request.

SOLAR CAPACITORS

Solar Mfg. Corp., E. 46th St. and Seville Ave., Los Angeles, Calif., has recently released a new 24-page catalogue which gives application data, capacity-per-size designations, specifications, and curves for a complete line of ceramic capacitors.

The line includes disc types in bypass, high voltage, temperature-compensating and special styles, feedthrough and trimmer types, and tubular types in bypass and temperature-compensating styles. An extensive line of printed networks is also catalogued, together with data on piezoelectric elements.

Requests for copies of this catalogue must be made on company letterhead.

MICROMINIATURE RELAYS

General Electric Company, Schenectady 5, N. Y., is offering a four-page bulletin describing its recently-developed microminiature relay for electronic applications which demand minimum size and weight.

The publication, designated GEA-6346, describes the relay and lists specifications for both the standard and the current-sensitive models. The hermetically-sealed relay weighs .35 ounce in the standard model and .4 ounce in the current-sensitive model.

AN CONNECTORS

In order to assist engineers to quickly specify AN connectors for a wide range of applications, *The Deutsch Company* of 7000 Avalon Blvd., Los Angeles 3, California is currently offering a new wall chart which measures 22" x 27".

Items shown for ready reference on the chart include selection of the right connector, data on number of contacts, contact size, voltage rating, creepage distance, and particularly spacing information.

The section on specifying complete connector assemblies includes data on insert insulation materials and shell finishes.

Address requests for the chart direct to Mr. R. H. Cumins of the company.

VIBRATION MEASUREMENT

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass. has just issued a new 64-page booklet entitled "Measurement of Vibration."

The text covers the meaning of vibration terms, description of vibration-measuring instruments, procedures, typical examples, and interpretation of results. A short section is devoted to the human response to mechanical vibration.

Since unwanted vibration is a plague but since there are also desirable and useful types of vibration, the first step in understanding the phenomenon lies in the measurement of vibration. Copies of the booklet are free. -30-

Those Tough Dogs

(*Continued from page 53*)

another heater-to-cathode leak was replaced. The sound and picture came on, but the picture was weak and shrunken and the sound noisy. The 12AU7 video amplifier tube, selenium rectifiers, 6S8 audio detector, and 19BG6 horizontal amplifier were changed and the set began to play like new.

To repair this set, six tubes, two selenium rectifiers, one capacitor, and one resistor were changed and it took hours of labor and checking. Our company took a beating on the job.

Fixing "dogs" has its compensations. If you fix a receiver that other companies couldn't, the word will get around. Your reputation will grow which, in turn, brings more customers. These "dogs" are perhaps the best experience a TV service technician can have to make a better technician out of him; they impart a backlog of knowledge that can't be gotten any other way. —30—

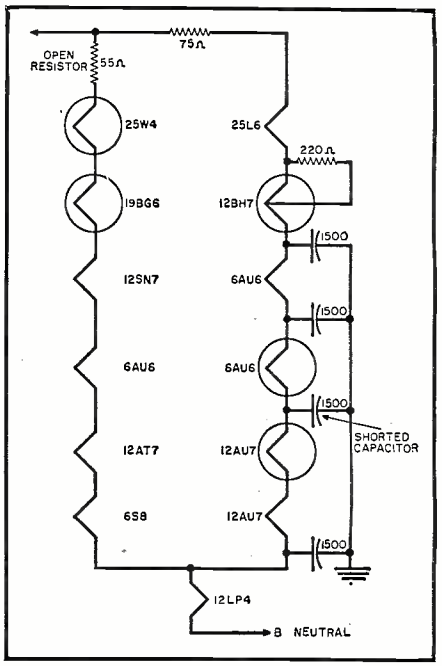


Fig. 4. All the circled components in this heater circuit of a 12" Emerson were bad.

INEXPENSIVE COAXIAL ANTENNA FOR 10 AND 15

By W. H. B. COWAN, W5BDK

DESCRIBED herewith is a simple, efficient, and inexpensive (about $2) antenna for ten or fifteen meters. It requires no complicated masts, mounts, or rotators.

Using the dimensions given in the drawing, it will be resonant at 29.0 mc. All the grid dipping, micro-matching and antenna-scoping has been done. The drawing shows a section of RG-11/U coax cable which has been transversely expanded for clarity.

There is no problem of matching the feedline to the antenna, as it is all one unit.

Excellent signals have been reported locally as well as short skip with about 120 watts, with the top of the antenna some 30 feet above ground level.

Maritime mobile contacts have been made over short skip (about 1500 miles) from the edge of a pine forest, using this antenna hung from the limb of a tall pine and fed directly from the output of an AF67 mobile transmitter.

The feeder length can be anything over about six feet or the antenna can be connected directly to the transmitter.

To construct a ten-meter antenna, first remove nine feet of the outer vinyl covering. Then work the shielding braid downward and over the vinyl covering until it is 8 feet, four inches long. Tape the end firmly in place. Then bend the length of wire (inner conductor) back until the length from where it leaves the cable to the end of the eye thus formed is 8 feet, 4 inches. Pass the "eye" through an insulator, solder a connector on the end of the feedline and the job is finished.

Hang the antenna in the nearest tree, to a corner of your house or garage, or run it up a wooden flagpole. The higher the better. On a boat, it may be run up a signal halyard, a topping lift, or a gantline. If it gets in the way, lower it. If you move, roll it up and take it with you.

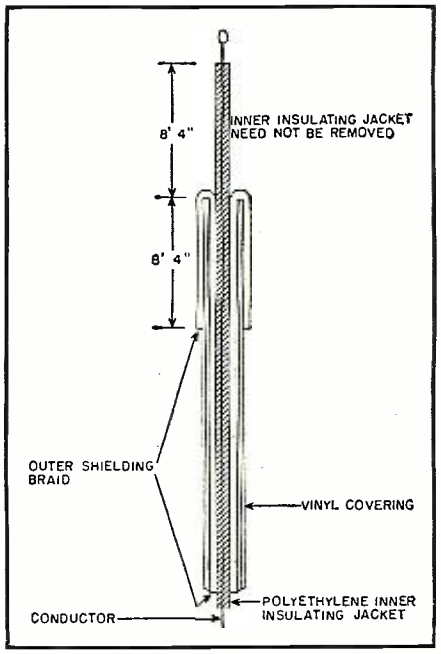
This type of antenna has no feeder radiation. Using RG-11/U the feedline is non-resonant, the impedance of the line is the same as the half-wave impedance of the half-wave antenna formed by the "folded" braid and the exposed conductor.

It provides low radiation angle and is omnidirectional.

It does not have the gain of, for example, a six-element beam; but neither does it take up as much space, attract as much attention, or remotely approach the beam in cost.

For fifteen meters, make each element ten feet, eleven inches long. —30—

Details on the antenna for 10 meters. See text for dimensions used for 15 meters.



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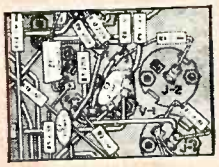

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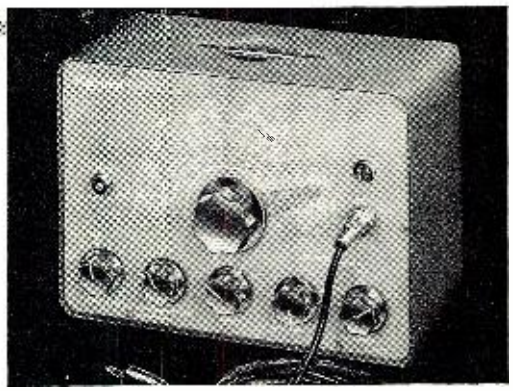

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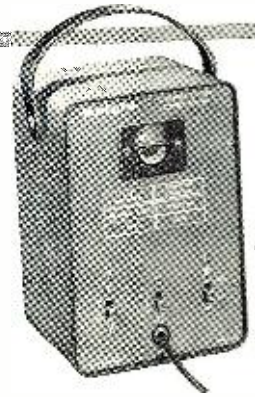

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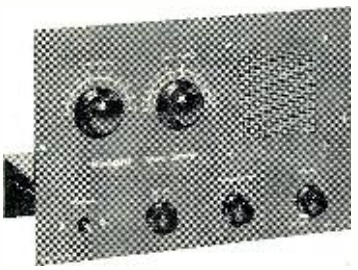

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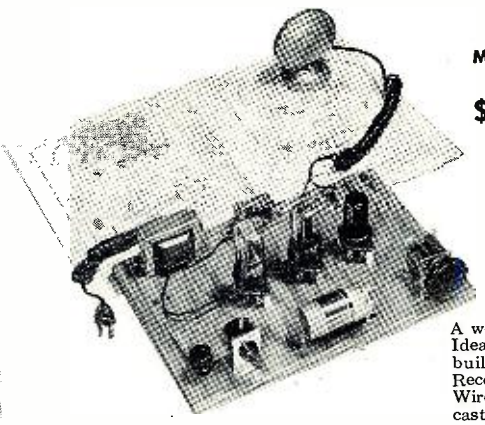

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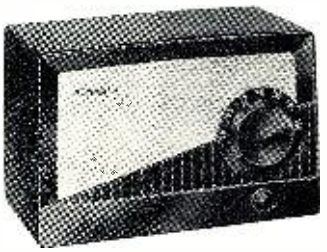

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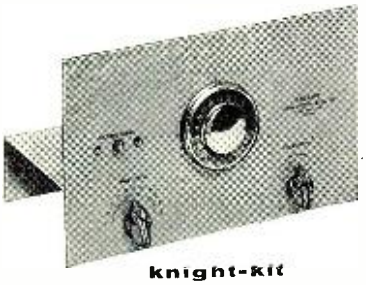

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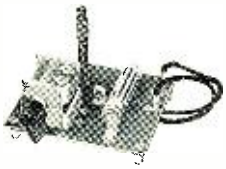

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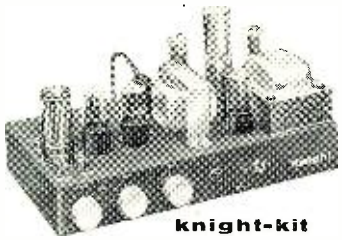

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Model S-235. Preamp Kit for above. Net..... **$2.75**

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20 WATT HI-FI AMPLIFIER KIT

Model S-750

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True hi-fi for less! Frequency response, ± 1 db, 20 to 20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono, 72 db below 20 watts. Sensitivity: tuner input, 0.6 volt for 20 watts output; magnetic phono, .007 volts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records, controlled from front panel. 23 lbs.

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Sylvania Test Points

(*Continued from page* 51)

of the horizontal frequency coil (L_{100}, Fig. 4) and set the horizontal hold control to mid-range.

4. Adjust the horizontal range control until the picture moves back and forth across the screen with the blanking bar vertical.

5. Remove the jumper from L_{100}, then adjust the coil until the picture again behaves as in step 4.

6. Remove the short from pin 8 of V_{13}.

With an oscilloscope sweeping at 30 cycles, test point 8 (pin 3 of the 6W6) should indicate 400 volts peak-to-peak. The observed waveform is voltage from the vertical output stage and should be checked for linearity. Nonlinearity may be due, among other causes, to low emission of the vertical oscillator tube, a leaky decoupling capacitor in the plate circuit of the oscillator, a defective vertical output transformer, or a defective cathode resistor and its bypass capacitor.

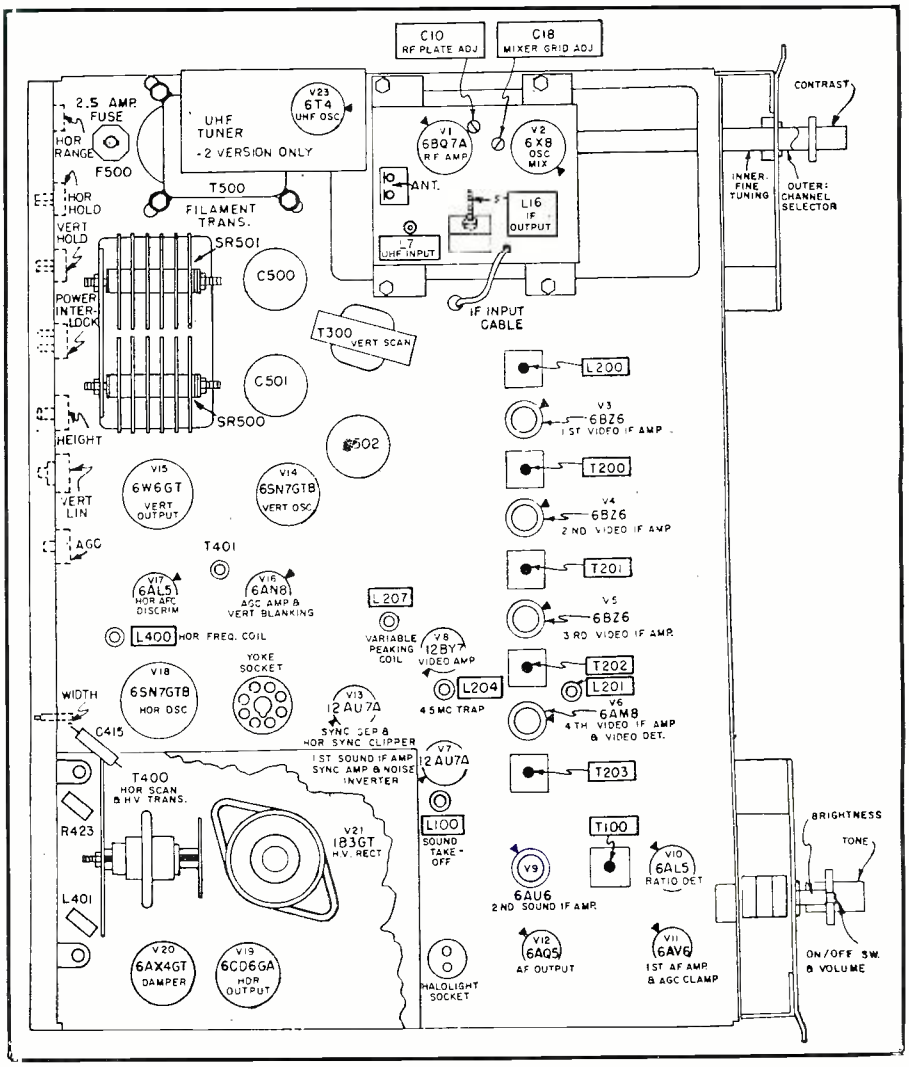
Pickup from leads not properly dressed may cause poor vertical sync. For instance, the hot lead from the horizontal deflection coil may have shifted too close to the vertical oscillator, or hum may be induced into its grid from the heater wiring.

Sometimes, vertical foldover occurs when the line voltage falls below 100. However, if the a.c. potential hasn't dropped, measure the "B+" at test point 9. A reading of less than 250 volts at normal line voltage denotes trouble in the power supply. Probable causes are a weak selenium rectifier or a leaky charging capacitor in the doubler circuit. An open low-capacity output filter will have slight effect on the "B+" potential, although this condition would put hum into the picture. An oscilloscope connected to this test point should show a ripple of no more than 1.3 volts peak-to-peak.

If a complete failure of "B+" voltage occurs, look for an open fuse or surge resistor. Rarely, of course, does a filter choke open up in any chassis—although the possibility of such an occurrence should not be overlooked.

The test points discussed in this article are found in the 1956 *Sylvania* horizontal chassis only. Circuitry in the vertical model is quite dissimilar, although the general approach to troubleshooting would be substantially the same. —30—

Fig. 4. Top of chassis diagram of the Sylvania model 533 showing location of tubes.



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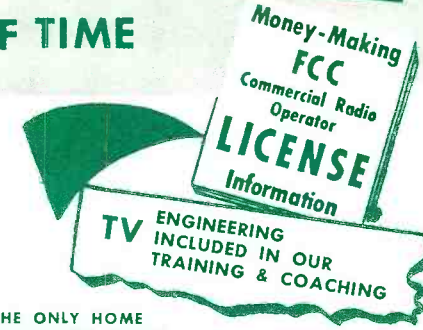

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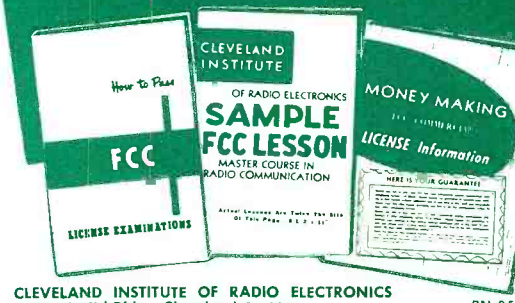

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Frequency Meter

(*Continued from page 69*)

quency meter, and a number of check points obtained for different points on the frequency meter tuning dial.

These points may then be plotted on a standard calibration curve. A different curve will be required for each coil used.

To use the frequency meter, turn the "power" switch "on." Since no tubes are used, no warm-up time is required. Turn the "meter sensitivity" control all the way "up" (for maximum sensitivity).

With the proper coil plugged into the coil socket (to cover the desired band of frequencies), hold the instrument near the source of r.f. energy to be checked and *gradually* adjust the "tuning" control. As the frequency of the signal source is approached, an upscale meter reading should be obtained. Should the meter pointer tend to go off-scale, either reduce the coupling or turn the "meter sensitivity" control back.

Continue to adjust the "tuning" control until a peak meter reading is obtained. Note the dial setting at this point and check this value against the previously prepared calibration curve to obtain the frequency of the unknown signal source.

The relative strength of the signal source may be determined by the amount of coupling required to obtain a good meter reading, or by how far back the "meter sensitivity" control must be adjusted to avoid an off-scale meter reading.

If strong harmonic signals are present, these may sometimes be detected by plugging in the proper coil and using the frequency meter at maximum sensitivity.

Applications

In the ham shack, the frequency meter is quite useful for preliminary checks of a new "rig" and for determining that the "rig" is within the band. The ease of operation of the unit makes it practicable to check station frequency at any time.

The frequency meter is quite valuable in schools, particularly when setting up and working with experimental r.f. circuits. Quite a number of experiments have been based on the use of the r.f. frequency meter.

In the laboratory, the frequency meter is especially handy for checking the operation of experimental transmitter and oscillator set-ups. Because of the good sensitivity of the unit described, it may also be used to check for changes in r.f. output as experimental changes are made in a particular piece of equipment. When used in this application, the coupling between the frequency meter and the r.f. source should be kept fixed, and changes in signal level noted as differences in the peak reading of the meter.

-30-

New G-E Color Picture Tube

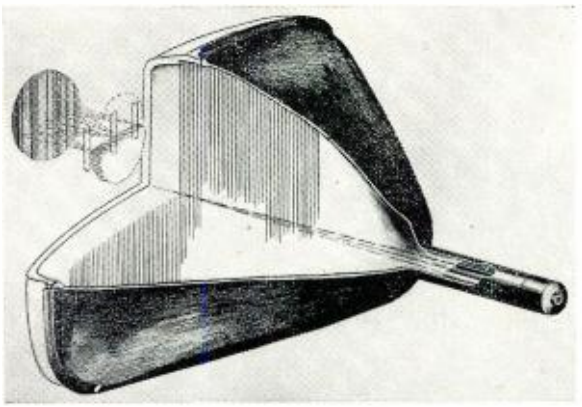


Fig. 1. Shown here is a drawing of the G-E post acceleration P.O.F. color TV tube, still in the development stage.

Using a grille instead of a shadow mask, and vertical phosphor stripes instead of dots, yields high brightness.

A COLOR TV picture tube that gives many times more brightness than the tubes in color sets now on the market was recently demonstrated by the *General Electric* Tube Department. Developmental models of this tube were demonstrated in various degrees of room lighting and produced a bright picture in light comparable to a brightly lighted store.

The new tube, which may not be ready for the production lines until 1957, has a 22-inch rectangular face and uses three guns. However, it is of the post acceleration type, meaning that the electron beams directed at the phosphor screen inside the face of the tube are accelerated after passing through a grille located in close proximity to the phosphor screen. The screen itself consists of *vertical* color phosphor stripes rather than color phosphor dots.

Fig. 1 is a drawing of the *G-E* tube, which is known as the P.O.F. tube (phosphor on the envelope face). Considering first the neck end, three electrostatic guns are shown lying in a plane instead of in a triangular array as in the shadow-mask tube. This type of gun structure allows each gun to be more or less independent of the other two insofar as convergence adjustments are concerned.

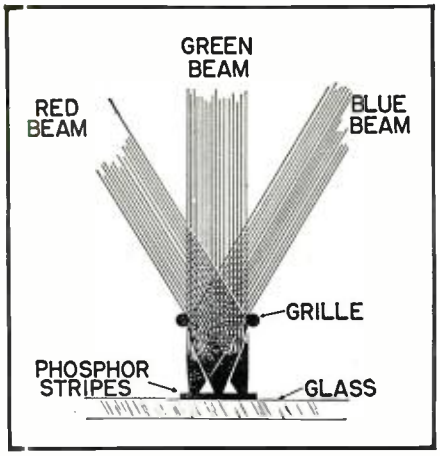
On the other end of the tube is the grille (or color selective electrode), which consists of a parallel array of wires fastened to the envelope itself. In front of this is the tube envelope surface on which the red, green, and blue vertical phosphor stripes are printed. In normal operation, the final gun electrode and cone potential are held at about 6½ kilovolts, and the grille is held at a potential of about 200 volts less. The phosphor screen is run at approximately 25 kilovolts.

Fig. 2 shows in simplified terms the operation of the front end of the tube. The electron beams are shown entering the grille with a relatively large angular separation. Actually the angular separation is less than 1 degree. As the electron beam from one of the guns enters the grille region two effects occur; first, the central ray of this beam no longer travels in a straight line, but instead assumes a parabolic path exactly as occurs when one throws a ball which is then acted upon by the earth's gravitational field. In this case the strong electrostatic field between the screen and the grille accelerates the electrons to the high screen potential.

A second action which occurs as the beam enters the grille region is focusing. With properly applied potentials, each pair of grille wires forms an electron optical cylindrical lens which reduces the size of the beam in the horizontal dimension from its initial diameter of about 35 mils to only 5 mils. This makes the beam width small in comparison with the phosphor stripe width, and allows a guard band to form on either side of the beam landing area. Thus, the beam can move about on a particular stripe without striking an adjacent stripe allowing for good color purity.

One strict requirement of this tube is that the ratio of screen-to-grille voltage must be regulated since the electron trajectories between grille and

Fig. 2. Detail drawing showing how the electron beams enter the grille of the G-E tube and are deflected to the screen.



screen and also the properties of the cylindrical lenses are dependent on this ratio.

As claimed by engineers at *G-E*, the advantages of this tube over the shadow-mask type are that the P.O.F. tube yields higher brightness and uses less deflection power, simplified convergence circuitry, and simplified components on the neck of the tube. The higher brightness results from the fact that, because of the grille-type structure of the color selective electrode, 90 per-cent or more of the electrons ejected from the guns strike the phosphor screen in contrast to about 14 per-cent for the shadow-mask type tube. Less power is used because the beam is operated at a voltage of 6½ kilovolts versus the 27 kilovolts used in the shadow-mask type tube.

Because of the increased brightness of the P.O.F. tube, color selective safety glass can be used resulting in more saturated colors and better contrast in an illuminated room. —30—

VOICE-POWERED RADIO

THE Army Signal Corps Engineering Laboratories at Fort Monmouth, N. J. has developed a sound-powered radio transmitter that is small enough to fit inside a telephone mouthpiece. As long as the sender speaks, the radio works, and his voice is broadcast.

A unique technique using a single transistor and matched circuit makes it possible for the new transmitter to harness the tiny voice power. In this device, the voice operates the transmitter and runs it. After the speech strikes the microphone, part of its power is filtered to operate the radio, while the rest puts intelligence into the signal put out.

Although still in the experimental stage, this particular transmitter has broadcast more than 600 feet. With higher radio frequencies and a matched antenna, the Signal Corps expects to be able to increase this distance up to a mile.

Further development is also expected to lead to a companion radio receiver weighing only three ounces and powered by the same voice energy. This energy would be built up and stored in the set when sending, and later used for receiving. —30—

Signal Corps' tiny voice-power radio set.

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FOR { **The Experimenter or Part-time Serviceman,** who has delayed purchasing a higher priced Tube Tester.
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The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

SPECIFICATIONS

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types. • Tests for quality by the well established emission method. All readings on "Good-Bad" scale. • Tests for inter-element shorts and leakages up to 5 megohms. • Test for open elements.

Model TV-40 comes absolutely complete — nothing else to buy. Housed in round cornered, molded bakelite case. Only . . .

$15.85 NET

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★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

TRANS-CONDUCTANCE TUBE TESTER

The new Model TV-12

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

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A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Model TV-12 housed in handsome rugged portable cabinet sells for only

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ALSO TESTS TRANSISTORS!

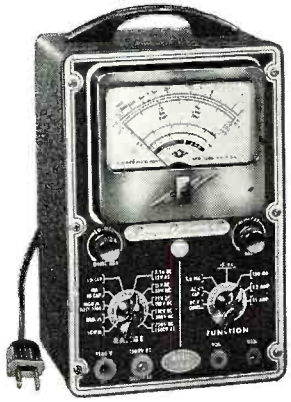
EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

New! SIGO SUPER-METER

The new Model 670-A

SUPER-METER



SPECIFICATIONS

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
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ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

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A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions

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Preamp-Control Unit?

(*Continued from page 49*)

curves in Fig. 1, which attain a maximum boost of about 17 db at 50 cycles.

The original loudness of music generally ranges between 40 and 90 db.[3] In reducing gain, the lowest intensity sounds should not be brought below the level of audibility if it is desired to prevent part of the music from dropping out. At 1000 cycles the absolute audibility level in a quiet residence is 15 db.[2] Considering that this is the very threshold of audibility, and that one ordinarily desires music at least slightly higher than the threshold, it may be said that music should not be reduced below an absolute level of 20 db at 1000 cycles.

If none of the music is to be lost, the maximum extent of reduction at 1000 cycles is therefore 20 db, that is, a reduction from 40 db absolute to 20 db absolute. If for the sake of peace in the household one is willing to lose part of the music, an additional reduction of, say, 10 db may be introduced. This would convert orchestral peaks of 90 db to 60 db, which is in the range of conversational speech (peaks).

According to the Fletcher-Munson curves, a 20 db reduction requires in the neighborhood of 12 db boost at 50 cycles. If the reduction is from 90 to 70 db, the actual required boost is 11 db; if from 40 to 20 db, the actual boost is 12 db. This amount of boost is well within the 17 db maximum bass boost of the response curves in Fig. 1.

If gain at 1000 cycles is attenuated 30 db, then about 16-18 db of boost is required according to the Fletcher-Munson curves. The maximum bass response curve of Fig. 1 just about meets this requirement.

If gain at 1000 cycles is attenuated more than 30 db, the boost available from most bass controls would be insufficient. However, such a degree of attenuation borders on the extreme. Let us assume that at 1000 cycles gain is reduced by 40 db. This means a portion of the music would be lost. The percentage lost would of course vary with the nature of the music. Less would be lost of the "Age of Gold Polka" than of the "Afternoon of a Faun." Nonetheless, considering that the lowest level sounds of an orchestral selection would be placed 15 db below audibility, it may be inferred that the loss would be substantial in all cases. A 40 db reduction at 1000 cycles would require 24 db of bass boost at 50 cycles. Thus the response curve in Fig. 1 would fall 7 db short of providing complete loudness compensation. This deficiency of 7 db seems far less serious than the loss of a substantial portion of the music when gain is reduced 40 db.

Some loudness compensation controls have been designed to provide bass boost far in excess of that required by the Fletcher-Munson curves. For example, a control with as much

as 41 db boost at 50 cycles has been described and commented upon as follows: ". . . listening tests proved that the control does a very good job."[4]

However, such super bass boosters do not belong in the category of loudness compensators, whose purpose is to make reproduced music sound as much like the original as possible at a reduced level. Instead, they should be classified with echo chambers, low cut-off filters, and other special devices which may impart to music a pleasing quality, but one that was not there to begin with.

It has been shown here that a good bass control can be used as an adjunct to record equalization and as the means of loudness compensation in all but extreme cases. The question arises whether these two uses are mutually exclusive. For a bass control with as much as 17 db boost the answer appears to be essentially "no."

Table 2 shows that at 50 cycles the maximum bass boost required for record equalization is 7 db or less, leaving 10 db or more for loudness compensation. In the unusual combination of events where 1000 cycles is attenuated as much as 30 db and where a recording with the old *RCA* characteristics is played, there would be a 7 db deficiency at 50 cycles. On the other hand, at 30 db attenuation of 1000 cycles there would be no deficiency for the *London*, *Columbia* LP, and *Columbia* 78 recordings, and only a relatively minor deficiency of 3 db at 50 cycles for old AES recordings. Furthermore, it must be remembered that the hypothetical simple control unit is assumed to provide only RIAA equalization. Provision for one more phono equalization setting with greater bass boost would make it possible to supply sufficient bass in all cases.

To summarize, a simple control unit with one or two record equalization curves and without a loudness compensator, but with a good set of bass and treble controls, can handle the majority of situations in which the average home listener is apt to find himself. True, the complex type of control unit can take care of some situations where the simple unit is not completely adequate, but these situations can usually be tolerated when the added cost of a complex control unit is taken into account. In audio the last ounce of satisfaction costs considerably more than the first ounce. It seems sensible, where dollars are limited, to forget the last ounce of satisfaction in a control unit and to concentrate on improvement elsewhere, such as the speaker end, which usually leaves more to be desired.

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2. *O'Leary, M. G.: "Loudness Controls," Radio-Electronics, August 1953*
3. *Schjelderup, John R.: "A Proposed Solution to the Loudness Control Problem," Audio Engineering, September 1952*
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—30—

Scope Calibrator

(*Continued from page 63*)

with pliers. The end of the diode that corresponds to the cathode of a vacuum-tube rectifier is marked with the letter "K."

The exact value of R_1 is not too important. A fifty per-cent variation is possible without much change in waveshape. As was mentioned previously, resistors R_2 and R_3 are regular 5% units and are accurate enough for most applications.

Output connections from the calibrator can be made to jacks or binding posts on the scope front panel, or a push-button may be installed to connect the scope vertical input to the calibrator when the button is depressed. The 2.7 volt output from terminal "A" (see Fig. 2) is more accurate than the one-volt signal, so, it is advantageous to have both these signals available for calibration purposes.

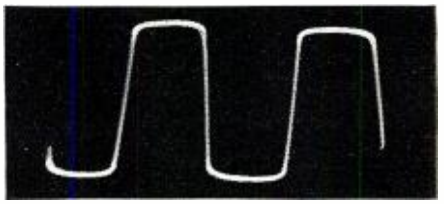


Fig. 3. Output waveform of the calibrator, fed to scope's vertical input.

Operation

Connect the calibrator to the vertical input terminals of the scope. A square wave like the one in Fig. 3 will appear on the screen. The height of the wave represents 2.7 or 1 volt peak-to-peak depending upon which is used, output "A" or "B." If the gain is adjusted, for example, until the one-volt square wave spans ten divisions of the scope grid, the calibration is .1 volt per division. —30—

AN INEXPENSIVE PULSE GENERATOR

By ALVIN G. SYDNOR

OFTEN a need arises in the home laboratory for pulse equipment which normally can only be found in large electronic laboratories. The author, faced with this problem, constructed the pulse generator described here which serves as a useful piece of equipment and is inexpensive.

The pulse generator to be described is a simple blocking oscillator in which the trigger is an electron-coupled oscillator. The complete circuit is shown in Fig. 1. A wide range of pulse repetition rates may be obtained with the values of C_X and R_X shown in the table.

The author's unit was built in a small general purpose 4" x 4" x 2" utility cabinet. The heater and plate voltages were taken from an external source; there is no limitation on building the power supply and pulse generator on a chassis large enough to accommodate the required parts.

Tubes and resistors alone cannot produce all of the waveforms required when pulsing or starting other electronic circuits. Multivibrators can produce a nearly rectangular pulse of any adjustable or fixed duration, but they differ from many other pulse circuits in that a multivibrator determines its own cycle of operation because it uses a feedback path.

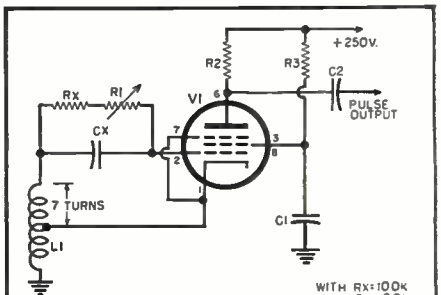
Trigger pulses are widely used for controlling the operation of various types of circuits. Most cases call for a trigger pulse of very short duration and very sharp leading edge. The trigger generator of Fig. 1 is a simple blocking oscillator which cuts itself off after a few cycles because a negative charge accumulates on the grid capacitor. Let's look at Fig. 1. Say electrons have accumulated on the capacitor C_X. They must return through the grid to the cathode coil. If the resistance is high enough to permit the grid capacitor to stay charged, we can bias the tube well into the cut-off region. Now the tube is cut off, thus the capacitor will slowly discharge through the resistance until a point is reached when the tube will start to conduct again, and this repeats over and over again.

Pulse duration of a self pulsed oscillator such as this one is controlled by the grid capacitor. The value of R_X has little effect on pulse length. Changing the value of C_X will vary both repetition rate and duration.

Remember that pulse duration is the time from the leading edge to trailing edge, usually expressed in microseconds (μsec.) and that pulse repetition rate is the time from the leading edge of one pulse to the leading edge of the following pulse.

An excellent article on pulses and how to work with them appears in the "Oscillographer" Vol. 14, No. 2, April—June, 1953 under the title "Techniques in Pulse Measurements" by Melvin B. Kline. Those interested in the general field of pulses should investigate this article for further information. —30—

Fig. 1. Complete schematic diagram and parts list covering a simple pulse generator.



CX	RX	FREQ.(PPS.)
.1	10MEG.	1
.01	10MEG.	10
.003	10MEG.	30
.003	1.2MEG.	250
.001	1.2MEG.	750
.001	100K	7000
.0001	100K	70,000

R_1—25,000 ohm pot
R_2—10,000 ohm, 1 w. res.
R_3—56,000 ohm, 1 w. res.
R_X—See chart above
C_1—.1 μfd., 500 v. capacitor
C_2—.01 μfd., 400 v. capacitor
C_X—See chart above
L_1—24 t. #22 en. closewound on ½" dia. form, tap at 7 t.
V_1—6CL6 tube

Horizons Unlimited

(*Continued from page 35*)

than $4 billion annually ten years hence.

Industrial Electronics

Although now relatively small, the field of industrial electronics promises to become another giant in the electronics family. A figure of about $600 million gives a fair estimate of the present size of this business. Since it is still in its initial stage, the substantial sales already achieved suggest an enormous potential. Already the list of products for electronic devices is becoming encyclopedic. Some of the more familiar applications would include the control of motors and machines, automatic elevator controls, electronic cooking, testing, sorting, closed circuit television, etc. Also significant here (although much broader in application) is the development of the transistor.

There is a strong likelihood that industrial electronics will become a billion dollar business by 1960.

Components and Service

Because of its magnitude, the electronics industry is able to support a sizable parts and servicing business. The value of component parts which include tubes, capacitors, transformers, speakers, resistors, etc., was in the area of $600 million during 1954.

Broadcasting

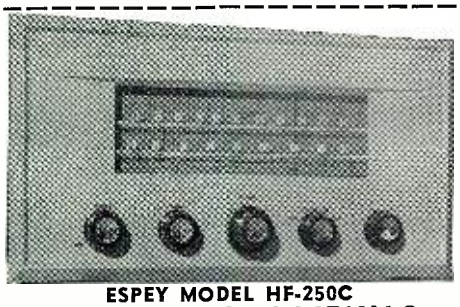
Today, TV ranks third among all advertising media, exceeded only by newspaper and direct mail. In 1954, it obtained 9.9% of national advertising budgets, equal to $809,100,000. During the current year, it is estimated that expenditures on TV advertising will surpass $1 billion. That the industry has not yet achieved its pinnacle may be seen by looking at authoritative projections of future revenues which envision billings of $3.5 to $4.5 billions ten years hence.

Of course, the rapid growth of TV has displaced radio as the star medium of home entertainment. Considering that it will be able to generate revenues in the area of $500 million annually, however, radio's contribution to the total sales picture of the electronics industry should not be underestimated.

Judging from the success it has already achieved, it appears virtually certain that the electronics industry will go on to fulfill its tremendous potential. Well out of the cradle stage now, it has exhibited an enormous vigor. Its capacity for additional growth has already been proven by its ability to rejuvenate itself through the frequent development of new facets. Perhaps of no other industry might it be said with so much certainty that it promises to maintain and strengthen its position as one of our brightest industrial diamonds. —30—

14 TUBE ESPEY HI-FI CUSTOM FM-AM CHASSIS $84.95

LATEST 1956 MODEL WITH RESPONSE FROM 10 TO 22,000 CPS



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 "Norelco" 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, $54.95 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 MODEL HF-250C. A FULL HIGH FIDELITY AUDIO AMPLIFIER AND FM-AM TUNER—ALL ON ONE CHASSIS

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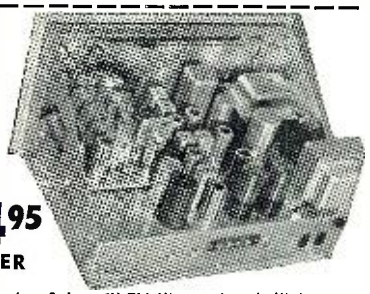
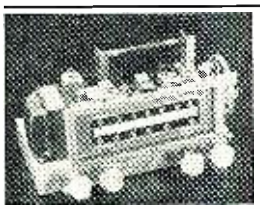
SALE PRICE **$84.95** LESS SPEAKER



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. Beautiful edge lighted flywheel inertia slide rule dial. Size: 7¾"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable) Model HF-250C. Sale price, $84.95. With heavy duty Utah 15" coaxial PM speaker, both for only $99.95.



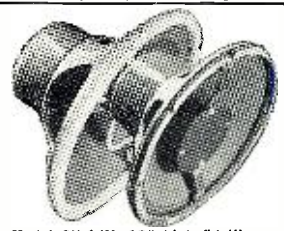
HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER

10 W. AMP.

BOTH FOR **$44.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 3 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased, we will include the necessary pre-amp, no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 2—6BA6, 6AT6, 6AL5 and 6X4 rectifier. Amp has 2—6V6's, 6SN7 and rectifier. Full superhet circuit with AVC, 3 position tone control, 9" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone control, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. FA9-2CR tuner and amplifier complete. Ship. wt. 22 lbs. Sale price, $44.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

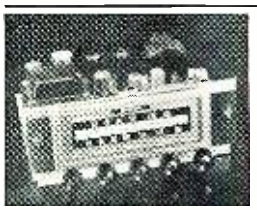


McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.



JACKSON AM9A

9-TUBE HI-FIDELITY

12 Watts Audio
Dual Tone Controls

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9½" x 6" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 19 lbs. Sale price, $39.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

WEBCOR 3 SPEED CHANGER

MODEL 140-16 WITH 2 NEEDLE FLIPOVER CARTRIDGE **$24.95**

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. 13⅜" x 12" wide. 7½" high overall. 2½" below motor board and 4½" above. Model 140-16. Ship. wt. 12 lbs. Sales price, $24.95.
Model 114-43 Webster-Chicago 3 speed changer with G.E. RPX-050 variable reluctance cartridge, otherwise similar to above. Sale price, $29.95.
EG-2, self-powered preamplifier for use with a variable reluctance cartridge when your radio or amplifier only has input for crystal cartridge. Just plug V.R. pickup into pre-amp and pre-amp into regular phono input. Model EG-2 preamplifier with tube, $5.95.

NEW—SMALL VOLT-OHM METER

2000 OHMS PER VOLT AC-DC WITH TEST LEADS

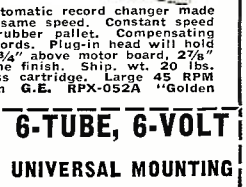
McGEE SCOOP SALE PRICE **$9.95**

2 FOR $19.50—4 FOR $37.00

New, small Volt-Ohm meter 5¼" tall, 3⅝" wide and 1½" thick. 3¼" meter. Sensitivity 2000 ohms per volt. DC volts 0 to 1000 in 5 ranges; AC volts 0 to 1000 in 5 ranges; DC current 0 to 500 ma. in 3 ranges; Resistance 2 ohms to 1.5 megohms in 3 ranges; Decibels minus 20 to plus 16 (0db .774 volts). A thin, compact instrument small enough to fit in your service kit. A fine imported meter specially priced at $9.95 for this Radio & TV News ad. Never before have we offered an instrument value like this. Model TP-5, complete with test leads. Sale price, only $9.95. Ship. wt. 2 lbs. Special quantity price, 2 for $19.50, or buy 4 for only $37.00.

REGULAR $65.00 LIST COLLARO 3 SPEED HI-FI CHANGER

Imported from England — Sale Price **$38.95** Less Cartridge



Regular $65.00 list Collaro Model 3/532, 3 speed automatic record changer made in England. Intermixes 10" and 12" records of the same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and Std. records. Plug-in head will hold any popular cartridge. 14¾" long, 12¼" wide and 4¾" above motor board, 2⅞" below. Available in grey, cream and gold hammertone finish. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95, less cartridge. Large 45 RPM spindle $3.30 extra. 3/352 Collaro changer with G.E. RPX-052A "Golden Treasure" cartridge, $58.95.

MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE

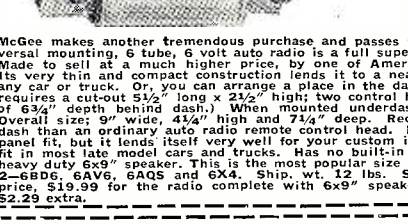
SALE PRICE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

6-TUBE, 2-BAND RADIO KIT $14.95

6-18 MC 550-1650 KC

6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receivers broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model ME6-2, Net $14.95.



6-TUBE, 6-VOLT UNIVERSAL MOUNTING AUTO RADIO

$19.99 WITH 6" x 9" SPEAKER

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 5½" long x 2½" high; two control holes on 7" centers. A minimum of 6¾" depth behind dash.) When mounted underdash it extends only 2⅛" below. Overall size; 9" wide, 4¼" high and 7¼" deep. Requires no more room under your dash than an ordinary auto radio remote control head. Not intended for an exact custom panel fit, but it lends itself very well for your custom installation ideas. Can be custom fit in most late model cars and trucks. Has no built-in speaker, but is furnished with a heavy duty 6x9" speaker. This is the most popular size auto radio speaker. Tubes: 6BE6, 2—6BD6, 6AV6, 6AQ5 and 6X4. Ship. wt. 12 lbs. Stock No. AH-759. McGee's sale price, $19.99 for the radio complete with 6x9" speaker. 3 section top cowl antenna, $2.29 extra.

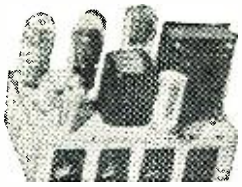
McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20 WATT AMPLIFIER $22.95



NEW 1956 MODEL

Push-Pull 6L6 Output Tubes
Response 30—15,000 CPS
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V.R. Phono

With CU-14Y, 12" Coax Speaker . . . $32.95
With P15-CR, 15" Coax Speaker . . . $42.95
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. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, $22.95.

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. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE, Sale price, $49.95.
Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)
Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

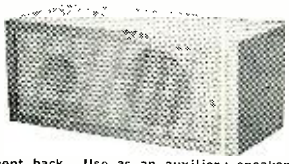
DELUXE CONSOLE SPEAKER SYSTEM $89.50

15" UTAH WOOFER—8" GE—2 - 5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity console speaker system. Has 15" Utah woofer with 21 oz. Alnico V magnet, 8" model 850 G.E. mid-range speaker and two Utah 5" tweeters. This is the finest console speaker system that we offer. Available in blond oak or natural mahogany finish. Cabinet size, 43" high, 31" wide and 23" deep. Has ¾" 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-15CR-1, deluxe quality Hi-Fi console speaker system. Ship. wt. 100 lbs. (Specify cabinet finish desired.) Sale price, $89.50.

NEW IMPERIAL IV with General Electric

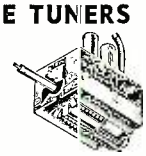
8 in. HIGH FIDELITY SPEAKER $19.95



New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

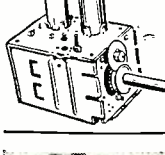
FAMOUS STANDARD COIL CASCODE TUNERS

SALE PRICE **$12.95**



TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.
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.

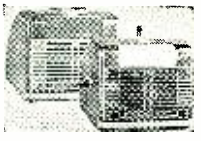
2 FOR $25.00



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 too. Has 6J6 and 6BC5 tubes. Used in CBS, Arvin, Crosley, etc. Makes a good replacement for one tube tuners. 3⅛" shaft. Takes SCK-2 knob set described above. Sale price, $7.95 each, 2 for $15.00 with tubes.



3-STATION MASTER SUB-STATIONS $3.95 EACH $16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MPM-3, Ship. wt. 10 lbs., $16.95. Matching sub-station PM-A5, with 5" PM and call-back switch, $3.95 ea.; 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft.; 500 ft. for $8.95.

TELEVISION BOOSTER CLEARANCE SALE

Clearance sale on VHF television boosters for channels 2 through 13. RMS Model SP-5, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascode front end. Sale price **$4.95**
RMS Model SP-6, brown plastic case. Same as SP-5 except has variable gain control. (Pictured.) Sale price **$4.95**
McMurdo-Silver GB-6B continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price **$5.95**
Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price **$6.95**

IMPERIAL 30 WATT AMPLIFIER $29.95

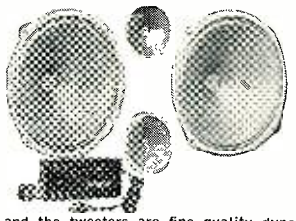
NEW 1956 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-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 $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12¼" x 7¾" x 7¼" high. Complete with tubes: 6AT6, 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.

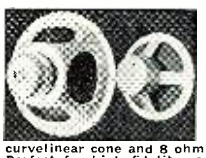
25 WATT HI-FI SPEAKER SYSTEM



2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE **$24.95**

25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply for only $24.95. Frequency response 20 to 18,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 2000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.
No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.95. Ideal for use with HF-20 and 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 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,500 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt. 6 lbs. Model HF-8J. Sale price, $6.95.
Model HF-15WF, new 15" "Blue Streak" HiFi woofer. Has 21½ oz. Alnico V magnet with one piece cone and 1¼", 8 ohm voice coil. Will give excellent response from 50 to 9500 cps. Takes 18 to 25 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.

NEW—LOW COST HIGH FIDELITY MICROPHONES

M28—$3.99 M14—$7.95 M20—$4.95

Special Sale! Model M28-KT, high quality imported crystal lapel microphone. Very trim and neat in appearance. Polished chrome case 1½" x ⅝" 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 is a 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 ⅝" mike stand.

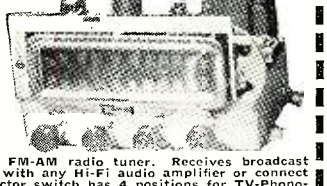
Model M20-KT, all purpose crystal microphone. Hi-Fi response. A terrific imported value. Comparable or better than microphones selling for $10 to $12 net. Fits standard ⅝" mike stand. Shipped with pin plug, phone plug and screw-on connector. Stock No. M20-KT, Sale price, $4.95.

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. 3 other controls are volume-off-on, tone and tuning. With tubes: 12AT7, 2—6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11½" x 7½" x 6¼" high. Illuminated slide rule dial 7½" x 2½", with escutcheon plate and knobs. Self-powered with its own power transformer. Air King FM-AM tuner chassis No. 703 as used in Air 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.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
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TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

New Hi-Fi-Audio Equipment

10-WATT AMPLIFIER

Challenger Amplifier Co. is now offering a 10-watt amplifier, the Model HF8A, which has a frequency response of 30 to 20,000 cps ± 1 db.

The HF8A features a three-position phono equalizer for RIAA, 78, and POP equalization curves. A bass tone control provides an 8 db boost at 50 cps while a treble control provides for 18 db attenuation at 10,000 cps.

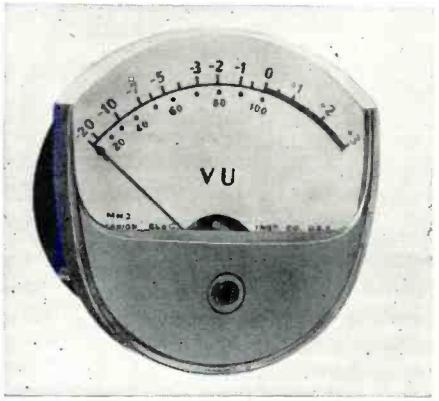
The amplifier may be used with low-level magnetic cartridges as well as crystals and ceramics. It is adaptable to both open shelf and custom cabinet installations since it is supplied with a removable etched-brass front panel.

Write the company at 29 Ninth Ave., New York 14, N. Y., for additional specifications on this unit.

MARION VU METER

Marion Electrical Instrument Company has developed a new vu meter which has joined the firm's line of "Medalist" panel instruments.

The new unit has the characteristic "medallion" shape which provides increased readability and legibility. The clear Plexiglas case construction results in virtually shadow-free dial illumination by admitting light from the top and sides as well as from the front.



The Model MM2VU meets the latest ASA specification C16.5-1954 for volume measurements of electrical speech and program waves and is designed to

be used where the precise indication and measurement of a.f. voltages is required in broadcast, monitoring, recording, and hi-fi applications.

The company will supply full details on this instrument if you will write them at Manchester, N. H.

FM ANTENNA LINE

Technical Appliance Corporation is offering a new series of FM antennas in its "Taco" line.

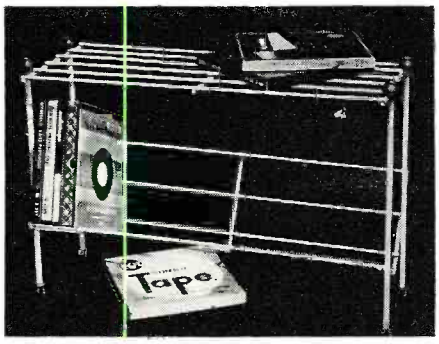
One of the units is the "Omni-directional S-type" antenna which provides a nearly perfect circular directivity pattern. This antenna has a broadband folded dipole tuned to cover the entire FM band. Matching the conventional 300-ohm transmission line, the antenna delivers maximum signal to the receiver terminals. By having the driven element at ground potential, a simple and effective lightning protection feature is provided automatically. The Model 624L is a single antenna and the two-stacked version which provides added gain has been designated as the Model 624ST-L.

The Models 644 and 645 are single- and two-bay units designed for fringe reception of FM signals.

The firm, located in Sherburne, N. Y., will supply additional data on this line upon request.

RECORD AND TAPE RACK

Leslie Creations has come out with a "Stack-a-Rack" unit which is designed to accommodate 45 rpm records and recorded tape packages.



The "Stack-a-Rack" features a unique "expansion" principle in that the top corner supports are fitted with sockets that accommodate the legs of another rack. Several racks may be stacked in this manner to become an inexpensive room divider. Legs are rubber tipped.

Measuring 22" x 14" x 9" over-all, the rack will hold either 225 single 45 rpm records, more than 160 LP albums, or over 30 recorded tape or 45 rpm album boxes.

Write the company at P.O. Box 9516, Dept. 308, Philadelphia 49, Pa., for prices on these racks.

GRANCO CONSOLETTE

Granco Products Inc., 36-07 20th Ave., Long Island City, N. Y., has recently expanded its radio line to include a radio-phono consolette, the Model RP-1000.

The new instrument is cabineted in a wood veneer housing and includes an

(*Continued on page* 116)

FM-AM tuner, the company's coaxial-tuning unit, and amplifier. The set uses

two speakers and incorporates a three-speed automatic record changer.

At present the Model RP-1000 is available in either mahogany or limed oak finishes.

AMPRO "CONSOLETTES"

Ampro Corporation, 2835 North Western Ave., Chicago 18, Illinois, has two new model "Consolettes" tape recorders in its line.

Designed to fit into any home decor, the Models 757M and 757B are offered in either Honduras red mahogany or "primavera" blonde wood finished cabinets. Space is provided in the cabinet for over 45 hours of tape programming.

The recorders include electronically-balanced, two-speaker systems; amplifier bypasses for high-fidelity hookups; extended frequency response from 40 to 12,500 cps; two speeds for both record and playback (7½ ips and 3¾ ips);

electromagnetic piano-key controls; automatic selection locators; and electron eye level indicators.

"BIFIEX" SPEAKERS

Altec Lansing Corporation, 161 Sixth Avenue, New York 13, N.Y. is now offering three new loudspeakers which have been designated as "Bifiex" units.

The most interesting feature of the new speakers is their use of multiple concentric compliances. The speaker not only has compliance at the outer edge, but an additional compliance approximately midway down the slope of the cone.

Presently available are the 8" Model 408A with a guaranteed frequency range of 60 to 13,000 cps; the 12" Model 412A which covers from 40 to 13,000 cps; and the 15" Model 415A which offers coverage from 30 to 13,000 cps. Write the company for full details on this new line.

SPINET-TYPE ORGAN

Electronic Organ Arts, 4878 Eagle Rock Blvd., Los Angeles 41, California, has added another build-it-yourself kit to its line of electronic organs.

The new spinet type features modern styling, compactness and portability. The organ kit includes a full-size 61-note organ manual and a 13-note pedal keyboard with a master volume control pedal.

The nineteen stops include several couplers plus a variety of solo and ensemble voices. The electronic components feature the latest in printed cir-

cuitry. Although there is space in the console for loudspeakers, if desired, the organ is designed to operate through the owner's audio system.

Write for full details on this "Artisan Spinet Electronic Organ" kit direct to the manufacturer.

"SELF-CABINETED" UNITS

Bell Sound Systems, 555 Marion Rd., Columbus 7, Ohio has announced that its Model 2122-C, 2199-B, and 2200-C amplifiers are now being offered with an optional satin-finish gold cover for those who wish a "cabineted" unit.

The cover houses the entire deck area of the amplifier, presenting a neat, modern appearance. The entire front face of the cover is a grille of perforated metal, while the back is entirely open for maximum ventilation. A pilot light is provided on all three models. The company will supply complete data on this "Series G" line of amplifiers, on request.

4-SPEAKER SYSTEM

Sight and Sound Electronics Co., 167 Depot Road, Huntington Station, L.I., New York is now offering a new 4-speaker system which is being marketed as the "Fidelio."

The four speakers are mounted in a hand-crafted enclosure finished in mahogany, natural birch, or walnut. The infinite baffle type enclosure requires no tuning or adjusting of any kind.

Response from 37 to 17,000 cps is

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Long Shaft, 41 C, complete with 6J6, BQ7, 12 channel (2 to 13). Long shaft can be cut. ..... ea. **$13.95**

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For 90% of 6 volt auto sets. $1.39 ea. ..... Lots of 10, ea. **$1.29**

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12" PM—Jumbo Alnico 5 magnet. $5.50 ea. ..... Lots of 8, ea. **$4.50**

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1L6	.51	6BK7A	.78	12AT6	.41
1LA4	.57	6BN6	.59	12AT7	.68
1LB4	.68	6BL7GT	.77	12AU6	.46
1LC6	.66	6BQ6GT	.80	12AU7	.68
1LD5	.37	6BQ7A	.80	12AV6	.42
1LE3	.57	6BZ7	.90	12AX7	.82
1LN5	.57	6BY5G	.60	12AY7	.60
1LH4	.66	6C4	.38	12BA6	.46
1LN5	.47	6C5	.38	12BE6	.70
1N3GT	.55	6C6	.50	12BE8	.48
1R4	.66	6CB6	.51	12BH7	.60
1R5	.51	6CD6G	1.18	12BY7	.64
1S4	.59	6D6	.50	12SA7	.52
1S5	.51	6E5	.46	12SH7	.47
1T4	.51	6F6	.40	12SJ7GT	.50
1U5	.50	6H6GT	.40	12SK7	.50
1V	.57	6J4	2.00	12SL7GT	.60
1X2A	.62	6J5GT	.40	12SN7GT	.57
2D21	1.00	6J6	.49	12SQ7GT	.40
2V3G	.80	6J7	.45	14A5	.59
2X2A	.90	6K6GT	.39	14A7	.45
3D6	.45	6K7	.40	14B6	.40
3LF4	.69	6L7	.44	14Q7	.52
3Q4	.55	6N7	.61	19BG6G	1.18
3Q5GT	.63	6Q7	.45	19J6	.66
3V4	.58	6S4	.48	19T8	.70
5T4	.70	6S7G	.47	25A7GT	1.50
5U4G	.49	6SA7GT	.50	25AV6GT	.80
5V4G	.71	6SC7	.50	25L6GT	.48
5Y3GT	.39	6SG7	.43	25BQ6GT	.82
5Y4G	.43	6SH7	.45	25Y5	.45
5Z3	.45	6SJ7GT	.45	25Z5	.42
5Z4	.54	6SK7	.50	25Z6GT	.42
6A7	.59	6SL7GT	.70	35A5	.48
6A8	.59	6SN7GT	.57	35B5	.48
6AB4	.45	6SQ7GT	.44	35C5	.48
6AF4	.80	6V6GT	.48	35L6GT	.48
6AG5	.52	6W4GT	.40	35W4	.39
6AH6	.80	6W6GT	.53	35Y4	.40
6AK5	.80	6X4	.35	35Z3	.41
6AL5	.42	6X5	.39	35Z5GT	.39
6AL7GT	.70	6X5GT	.35	50B5	.48
6AS5	.50	6X8	.75	50C5	.48
6AS6	2.00	6Y6G	.60	50L6GT	.48
6AS7G	2.25	7A4	.47	75	.44
6AT6	.40	7A5	.55	77	.39
6AU5GT	.70	7A6	.47	78	.39
6AU6	.43	7A7	.45	80	.35
6AV5GT	.75	7A8	.46	83V	.60
6AX5GT	.59	7B5	.41	117L7GT	2.00
6B4G	.90	7B7	.43	117N7GT	2.00
6BA6	.49	7B8	.47	117P7GT	2.00
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6BE6	.46	7C5	.44	117Z6GT	.65
6BG6G	1.18				

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GRegory 1-2498

assured. Each speaker is a full-range 9" unit and requires no crossover network for complete audio coverage.

CRESTWOOD RECORDER

Daystrom Electric Corp., 753 Main Street, Poughkeepsie, New York, is currently marketing a new magnetic tape recorder, the *Crestwood* "Concerto Model 360".

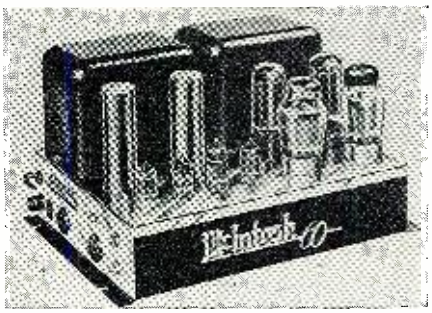
Basically a table model unit, it is unique in that accessory legs screw in the base to convert it to an armchair-height consolette. Decorator-styled wood cabinets are offered in mahogany and blonde finishes. The woofer and tweeter speaker system is properly baffled to reproduce the full music range.

Push-button control, a printed circuit preamp, and a 10-watt power amplifier are additional features of the unit.

The company will supply complete specifications on request.

McINTOSH 60-WATT UNIT

McIntosh Laboratory, Inc., 320 Water Street, Binghamton, New York, has



added a 60-watt amplifier to its line of audio equipment.

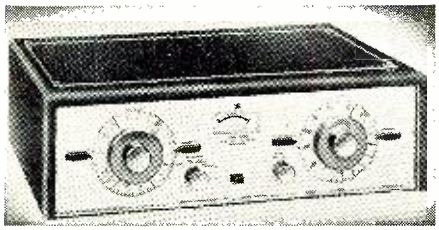
The Model MC-60 incorporates a new patented circuit which delivers 60 watts of power with less than ½ of 1 per-cent distortion from 20 to 20,000 cps. Frequency coverage is from 20 to 30,000 cps. Output impedances of 4, 8, 16, and 600 ohms are provided. The amplifier measures 14¼" x 10" x 8" and is of chassis-type construction.

The amplifier is designed to be used with the company's C-4, C-8, or other preamplifiers.

SCOTT AM-FM TUNER

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass. is marketing a new AM-FM tuner, the Type 330-A.

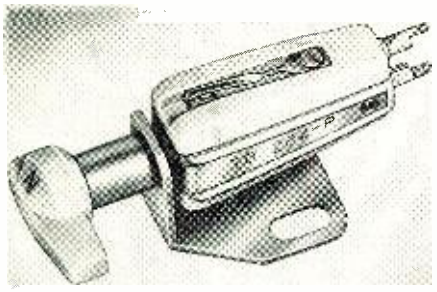
The new unit features wide-range, distortion-free AM, and highly selective, sensitive, drift-free FM performance. The new AM design permits the full 10 kc. frequency range broadcast by better AM stations to be received. The 3-position i.f. bandwidth switch allows wide range, normal, or distant reception. The wide-band design provides extra sensitivity on FM and eliminates drift. Full 80 db rejection of spurious cross-modulation response by strong local signals is also offered.



A free bulletin on this new tuner is available on request.

RONETTE CARTRIDGE

Not new, but still of considerable interest to hi-fi fans, is the 284 series of cartridges imported from Holland by *Ronette Acoustical Corp.*, 135 Front St., New York 5, N. Y. Model TO-284P is particularly designed for high quality reproduction. According to the company, this cartridge will equal, if not outperform in many cases, present-day magnetic units. It is a low-priced crystal type with turnover operation for both LP and 78 rpm recordings.



Its greatest feature is in the fact that it has a very low value (less than 1% according to the company) of intermodulation distortion even at high stylus velocities. In addition, the extremely small mass and high compliance of the moving system contribute to its ability to track even at the extreme stylus velocities. It has a constant velocity response and will drive a power amplifier with a sensitivity of .75 volt to full output.

Write direct to *Ronette Acoustical Corp.* for information on this and on other cartridges in the line.

"PLUG-IN" ADAPTER

The Audak Co., 500 Fifth Ave., New York 36, N.Y. is in production on a new instant "Plug-In" adapter that permits any of its cartridges to be connected to any *Garrard* record player.

The connecter was designed specifically for the *Garrard* RC-80M and RC-

90 changers and for the Model "T" turntable. Provision is made for maintaining the all-important stylus-to-groove alignment. No soldering or wire handling is required.

Additional details on this adapter are available from the manufacturer.

NEW RCA PICKUP

The Tube Department, *Radio Corporation of America,* Harrison, N.J. has unveiled its new developmental wide-range, dynamic-type phonograph pickup which offers several features of interest to the audiophile.

Among the unique properties of the device are the elimination of the need for external damping material in the suspension and the use of a new-type coil which produces a more uniform magnetic field for smooth signal output. The pickup has a frequency response extending to 20,000 cps.

NEW LITERATURE

E-V MIKE CATALOGUE

Electro-Voice, Inc., Buchanan, Michigan is now offering a colorful, illustrated catalogue covering its line of microphones.

Detailed application information, features, and specifications on each of the firm's microphones used in telecasting and broadcasting is included in this 32-page publication. The booklet also shows how these microphones work, and includes polar patterns, frequency response curves, and wiring diagrams.

Please specify Catalogue No. 120 when writing for this publication.

MAGNETIC TAPE

ORRadio Industries, Inc., Opelika, Alabama, maker of "Irish" brand recording tape, is offering an interesting new folder which completely describes and illustrates every step in the manufacture of magnetic recording tape.

Entitled "How Magnetic Tape is Made," this booklet will be sent to interested persons without charge. Address all requests for this booklet to Department 120 of the firm. —30—

"BUILD YOUR OWN" COMPUTER AVAILABLE

THE scope of "do-it-yourself" projects is a continual source of amazement to those who have been keeping track of the trend for the past few years.

Today's prospective home owner is positively casual about whipping up his own roof and installing the necessary wiring and plumbing.

This same trend toward handling the more complex "do-it-yourself" projects has now extended into the field of electronics. The Heath Company has just introduced a relatively inexpensive electronic analog computer in kit form which will provide a real challenge to the electronic hobbyist.

The unit was not designed simply as a challenge to the home technician but serves a real purpose in universities and industries where the cost of an elaborate commercial instrument is not justified but where an accurate instrument is required.

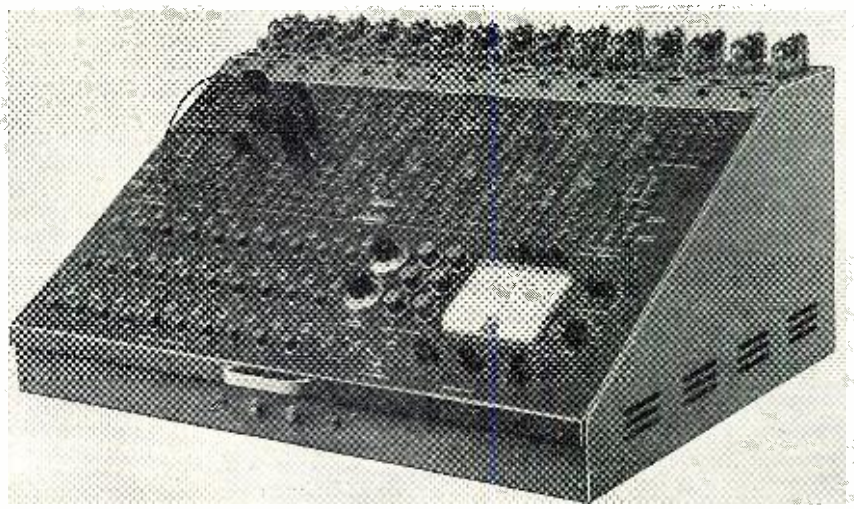
This table-model unit incorporates 30 coefficient potentiometers, each of which is capable of being set to an accuracy of better than 1/10th of 1 per-cent; a standard reference supply for all d.c. voltages; a nulling meter for accurate setting of computer voltages; and a patchboard layout which enables the operator to "see" his computer block layout.

The computer cabinet, shown in the photo below, houses all of the electronic components comprising the computer. It will handle 15 amplifiers; 30 coefficient potentiometers, 2 auxiliary 10-turn potentiometers; 6 floating initial conditions; and 4 dual bias diodes. The amplifier, power supply, and initial conditions circuits come as individual chassis to be assembled into the cabinet. The function generator is housed in a separate self-contained cabinet.

While the company doesn't recommend that this unit be built as a "first project" by the beginner, the student engineer or more advanced technician can assemble this unit by following the step-by-step instructions and pictorial diagrams which accompany the project.

Although the price of this kit has not been finally determined as yet, according to the company, it will sell for under $700. Distribution is scheduled for some time prior to March 31st of 1956. —30—

Over-all view of the Heath electronic analog computer now available in kit form.



CLIFF DWELLER'S ANTENNA

By K. E. HUGHES, W6CIS

THE accompanying diagram of the author's "Four-Band Cliff Dweller's Antenna" is self explanatory and might be of interest to other readers.

Let me say at the outset that such an antenna will not replace a good three-element beam on 20 or a 60-foot high doublet on 80; however, considering the space, cost, and ease of adjustment, it gives a very good account of itself.

Basically, the antenna functions as an ⅛ wave on 80, ¼ wave on 40, ½ wave on 20, and ¾ wave on 15, being base loaded on all except 20 meters where it is voltage-fed from the parallel resonant tank. The vertical radiator is made up of five six-foot lengths of ½" diameter surplus whip. In the author's case, the whip is guyed with two sets of three guys each (light sash line, spring loaded at the lower ends to allow for shrinkage) at 12 and 24 foot levels. The antenna can be used at ground level (if well clear of buildings, trees, etc.) or well off the ground, using ground plane wires as an effective ground.

In the author's installation, the tuning unit is 8½ feet off the ground, at the same height as the aluminum patio roof. This roof, plus a heavy copper ribbon running to a good ground rod, makes up the "ground system."

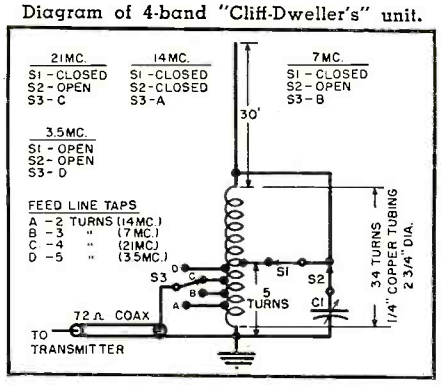
The cold end of the coil is truly cold on all bands. The switches, S_1, S_2, and S_3 are actually heavy copper clips, although relays or knife switches could be used if available. The capacitor can be any variable type with a maximum capacity in the neighborhood of 100 $\mu\mu$fd. A National TMS-100 would be suitable.

Adjustment of the tuning unit was extremely simple. A grid dipper should be used in determining the proper setting for the S_1 tap, as well as getting the correct number of turns in the complete coil for resonance at 3.5 mc. The next step is to determine the correct feedpoint for the coax. If a SWR bridge is available, it amounts to finding the point which gives the lowest SWR on the feedline. If no bridge is available, the feedpoint can be found by observing reflected reactance in the final amplifier tank. With correct tap points at the antenna, the PA tuning will be very nearly the same with or without the feedline coupled to the transmitter.

Results have been excellent, considering the size of the system. The transmitter was free from TVI and no change was noted when switching to this vertical radiator.

As an example of its possibilities, only Europe is needed for a WAC on 3.5 mc. while running 450 watts input. It is hoped that this idea may be of some help to those amateurs living in so-called "impossible locations." —30—

Diagram of 4-band "Cliff-Dweller's" unit.



A Low-Cost Crystal Marker

By CHARLES H. WOOD, JR., K4CKO

Build this handy ham shack unit for a buck and a half!

THIS crystal marker generator is a virtual "do-all" piece of equipment that the author has found indispensable in the ham shack. Even if you buy all new parts, this marker can be constructed for approximately one dollar and a half, excluding the crystal. A little later in the article a few of its many uses will be covered.

The circuit of this crystal marker is not critical. Any triode may be used or a pentode may be triode-connected and similarly used. The only changes that are necessary when using other than a 6J5 are the socket pin connections. The construction of this marker generator is straightforward in that lead length and placement are non-critical.

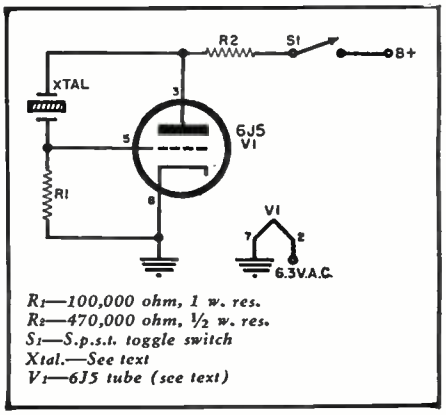
A power supply capable of delivering 6.3 volts at 0.3 amp. and 75 to 250 volts at 2 ma. is all that is needed. Any available power supply should easily handle these requirements.

It should be noted at this point that only fundamental type crystals are applicable in this circuit. Overtone type crystals should definitely not be used or damage to the crystal will result.

The uses of the crystal marker are limitless and after you have used this one for a while, you will agree that it was a very worthwhile addition to your equipment. This marker can be used as a spot frequency generator for servicing radios and television sets. For AM broadcast receivers, three crystals are needed: 456 kc., 600 kc., and 1400 kc. If you're working with color television, a 3.579 mc. crystal could be used. Similarly, crystals can be selected for alignment of FM and TV i.f.'s, etc.

Crystals may be selected for spotting the net frequency, spotting your

Schematic of the crystal marker unit.



R1—100,000 ohm, 1 w. res.
R2—470,000 ohm, ½ w. res.
S1—S.p.s.t. toggle switch
Xtal.—See text
V1—6J5 tube (see text)

favorite short-wave station, or any other frequently-tuned-in frequency. If a 3.500 mc. crystal is chosen, this generator will mark the lower edge of the 80, 40, 20, and 10 meter amateur bands, insuring "within the band operation" if you like to operate near the lower edge of the band. It can even be used as a code practice oscillator with any receiver that incorporates a b.f.o. Just shunt the key across the "B-plus" switch, select a crystal within the tuning range of the receiver, and you're all set to go.

How about a receiver that you can instantly tune to Conelrad? Just install a crystal-controlled oscillator in your receiver, flip a switch, and you will be tuned precisely to 640 or 1240 kc. By picking a crystal one kilocycle higher or lower than the i.f. of your receiver, this marker may be used as a b.f.o. in receivers which do not already enjoy this feature, producing a 1000 cycle beat note. If you prefer a 2000 cycle beat note, choose a crystal which differs from the i.f. frequency by 2 kc. If you have a tunable converter, this generator will be handy for marking on your receiver the exact i.f. of your converter.

Many other ideas will suggest themselves once you have built this low-cost crystal marker. —30—

PHONE PLUG ADAPTER

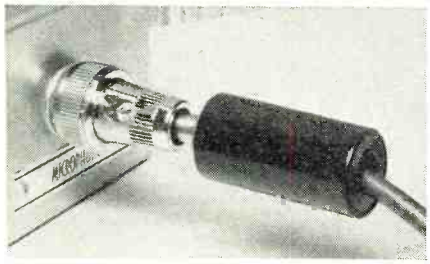
BY ARTHUR TRAUFFER

IN THE course of some experiments, I wanted to connect a phone plug to a male mike chassis unit, but I had no adapter on hand and I didn't want to take time out to build one. I solved the problem by removing the spring on the end of a female mike connector. Then the phone plug was inserted into the connector so that the pointed bead on the end of the plug fitted into the eye in the center of the connector, then the set-screw in the connector was tightened to hold the assembly fast. The connector was then screwed onto the chassis unit, as shown in the photo. The result was a good solid connection that didn't give a bit of trouble!

This trick also gives pretty good shielding, as can be seen by studying the assembly, especially if you use a phone plug with a metal shell instead of the Bakelite one used by the writer. The set-screw in the female mike connector will not damage the phone plug if you don't tighten the screw too hard.

If your phone plug doesn't have a pointed bead, just be sure that the rounded bead centers in the eye in the connector. Then press the two units together tightly and tighten the set-screw in the connector. —30—

One method for connecting a phone plug to a male mike chassis unit. Details in text.



Pulse Generator

(*Continued from page* 65)

the "Polarity" and "Power" switches in the author's model. If preferred, a volume control type switch could be used for the "Power" switch, permitting this unit to be combined with either the "Pulse Rate" or "Output" controls.

Although binding post output connectors were employed by the author, tip jacks, banana jacks, or even a coaxial connector may be used instead.

An *Eveready* type 411 battery may be used in place of the battery specified in the parts list. This unit is about the same size physically and supplies the same voltage as the battery used by the author.

Capacitor C_4 is not critical, since it is used only for bypass purposes and a smaller or larger unit may be substituted here without difficulty.

The size of the output blocking capacitor, C_3, is non-critical, and either a larger or smaller capacity may be used here if desired. The larger capacities are suggested, however, to prevent possible distortion of the output signal waveform.

Circuit Modifications

The basic transistorized pulse generator may be easily modified to suit the specialized needs or requirements of the individual builder. Let us discuss the more important modifications in order:

Changing Pulse Width: As mentioned earlier, the pulse width depends primarily on the characteristics of the transformer used in the blocking oscillator circuit. The author used a standard "universal" audio output transformer in the model shown in the photographs. Where the prospective builder has access to special transformers, it should be practicable to substitute another unit to obtain either a narrower or a wider pulse.

Changing the "Pulse Rate" Range: The author's model covers a range from approximately 100 to 6000 pulses-per-second. Where a different range is desired, it is only necessary to change the value of C_1.

Using a larger capacity here will reduce the operating frequency, while a smaller capacity will increase the frequency. If desired, several "ranges" might easily be provided by using a selector switch to choose different values of C_1.

The pulse rate range covered by the "Pulse Rate" control may be extended to provide wider coverage or reduced to provide more accurate adjustment. To extend the range covered by the control, use a potentiometer having a larger maximum resistance (a 5 megohm or 10 megohm pot, for example). To reduce the range covered by the control, use a pot of lower maximum resistance (1 megohm, 500,000, or even a 100,000 ohm unit).

Where pulses at only a few fixed rep-

etition rates are desired, a selector switch may be substituted for the "Pulse Rate" potentiometer, and fixed resistance values chosen as the switch is rotated.

Changing the Output Impedance: Where a lower or slightly higher output impedance is desired, it is only necessary to substitute a potentiometer of the desired impedance (resistance) for R_5. When this is done, care should be taken that the output transistor cannot be accidentally overloaded. Do not use a pot of less than 3000 ohms with a 15-volt supply.

Obtaining Pulses of Fixed Amplitude: Where the user will not need an adjustable output amplitude, a fixed resistor may well be substituted for R_5. The output pulse amplitude should approximate the battery supply voltage and should remain fairly constant, even at different repetition rates.

A fixed amplitude signal with a lower value may be obtained by using two fixed resistors in series in place of R_5 to form a simple voltage divider. The output signal is obtained at the junction of the two resistors.

Obtaining Pulses of Fixed Polarity: Should the user not require both positive- and negative-going pulses, the pulse "Polarity" switch may well be omitted and the circuit permanently wired to deliver whichever type of signal the user requires.

The possible applications of a pulse generator are too numerous to more than briefly indicate. New applications are constantly being worked out, and the individual worker often finds that the only limitation on his use of the instrument is his ingenuity and skill in applying it.

The pulse generator is particularly valuable for operating many types of "slave" sweep circuits or for syncing "recurrent" sweeps and multivibrators.

A simple linear sweep (saw-tooth signal) generator may be formed by using the positive-going pulse from a pulse generator to operate a "discharge" tube connected across the capacitor in a simple *RC* series network. The capacitor is charged slowly through the resistor from a d.c. source, then discharged rapidly by the tube when a positive pulse is applied to its grid.

Pulse generators are widely used for checking and testing delay lines, for checking the transient response of amplifiers, for testing counter circuits, and for calibrating and testing radiation instruments.

The pulse signals obtained from a pulse generator are also useful for oscilloscope retrace blanking and for use as a "marker" to divide a scope trace into segments of known duration. In both of these applications, the pulse signal is applied to the "Z-Axis" or "Intensity Modulation" terminal of the scope.

Considering the small amount of time and money required to build this compact unit, it makes a worthwhile project. —30—

Spot Radio News

(*Continued from page* 18)

shelters are constructed of aluminum sheeting and insulated with a foamed-in-place plastic. Included among the equipment are a control tower unit, a low-frequency beacon, a direction-finder, radio receiver and transmitter, facsimile apparatus for weather reports, and a complete mobile electronics shop for maintenance work.

The most important element in the system is the control tower. During transport, the glass-walled astrodome of the control tower telescopes into the control tower housing, but can be elevated during operation for complete visibility. Since the tower operator is confined to a relatively small area for long periods, the equipment has been planned for his comfort. Meteorological instruments are in plain view; there is adequate lighting and the tower has been air-conditioned for both tropical and arctic climates.

When the control tower is in operation, it can be used to assist in landing aircraft carrying the remainder of the communications-navigation gear, or begin the task of directing other aircraft to take off or land at the forward airstrip.

With a homing beacon and a direction-finding unit to aid landings of lost or strayed aircraft, and with the necessary transmitters and receivers, the new system was described as a near duplicate of any permanent air traffic control system.

ALTHOUGH ELECTRONIC BUILDING blocks have become widely accepted for their general function and circuit arrangement, no attempt has been made by industry to standardize their exact circuit configurations or the resistance or capacitance values of their components. Everyone has recognized that one of the great advantages of electronic techniques is the flexibility of the circuits, both during design and production, since an electronic assembly consists of many parts that may be rather easily replaced by others. Electronic engineers have been naturally reluctant to surrender this flexibility except for great compensating advantages.

It has been found, though, that standardization of circuits used in aeronautical electronic equipment could result in worthwhile advantages to both the military user and the industrial producer.

For example, most aeronautical electronic equipment includes rectifier circuits, and many include amplifier, timing and other circuits. Some of the circuits in a complete piece of equipment are unique and especially designed for that particular equipment, but the majority of circuits in any device are of widely-used types.

To the military, standardization means lower purchase prices, shorter delivery time, greater operating reliability, fewer spare parts at field installations, and simpler maintenance procedures. For the producers, there is the prospect of economies in design and production engineering. Junior engineers, usually assigned the routine work of designing or selecting such well-known circuits, would have their work facilitated and this, in turn, would reduce the supervisory burdens of the senior engineers. Production would benefit from fewer designs and reduced inventories.

Several years ago, the Navy Bureau of Aeronautics and the Bureau of Standards decided to undertake a study of a plan that would result in a circuit standardization program. To initiate the investigation, experts made a detailed examination of twenty-two pieces of aeronautical-electronic equipment including radar sets, indicator assemblies, radios, and similar gear. Sources of information included instruction manuals, specifications, and the experience and advice of equipment engineers and maintenance personnel. The over-all circuits were divided into functional subcircuits and then subjected to systematic analysis of the detailed circuit differences and of design parameters. Considerable attention was paid to the establishment of common terminology, as different equipment designers may use widely different names for essentially the same circuit.

The results showed that the over-all circuits of the twenty-two equipments were essentially made up of sixty circuit types. Although the circuits falling within a given type were

NEW TV STATIONS ON THE AIR

(As of December 25, 1955)

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

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Arkansas					
El Dorado	KRBB	10	192-198	5.08	24
South Dakota					
Florence	KDLO-TV	3	60-66	16.06	27
Texas					
Big Spring	KBST-TV	4	66-72	14.61	12.75
Laredo	KHAD-TV	8	180-186	5.43	2.27
Territories					
Wailuku, Hawaii	KMVI-TV	12	204-210	4.79	30
Canadian Stations					
North Bay, Ont.	CKGN-TV	10	192-198	5.08	51.5
Mexico					
Nuevo Laredo	XEFE-TV	11	198-204	4.93	

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 473 (116 of which are u. h. f.).

not identical, in many cases examination showed that these circuits were sufficiently similar in their more important aspects so that standardization would be feasible. For example, it was found that certain range marker generator circuits could be identical for many of the radars and for other time-scale indicators.

Even the various elements in tubes were considered. To illustrate, it has become the practice to use the ratio of the number of cathodes in standardizable portions of the circuit to the number of cathodes in the over-all circuit. Cathodes are counted instead of entire vacuum tubes to avoid ambiguity resulting from such items as double triodes. On this basis, the feasibility study showed that 50 to 75% of the cathodes were standardizable.

It was found that the most promising field of standardization was in the power supply circuits. One of the first steps that became evident here was the reduction possible in the number of power-supply voltages. It was found that the voltages used in the twenty items under study showed twenty different nominal values, which appeared readily reducible to four.

As a result of the favorable outcome of the feasibility study, work was started on a preferred circuits program. Priority was given to the most widely used and readily standardizable items. The work on any given circuit required both theoretical and experimental studies of the known versions, so that a *least-common denominator* circuit could be established. Thus far a number of standardizable factors have been well established.

The investigation, which is now in high gear, is expected to result in major economies in critical engineering man hours, lead time, and by accelerating production. It should also provide the military with means for simplifying maintenance training, designing simple *throw-away* units, achieving improved operational reliability, and establishing design standard levels.

The engineering electronics laboratories of the Bureau of Standards, directly involved in the standards study, is cooperating with industrial groups engaged in similar programs.

THE CAREFULLY-DEVELOPED MILLION-DOLLAR CONELRAD plan, adopted by nearly 1300 commercial

broadcasters to shift to 640 or 1240 kc. in an air-raid target area and subsequent intermittent transmission, has run into civil defense trouble in California.

The state's CD director has taken the whole warning plan to task and tagged it obsolete and a . . . "highly dangerous panic-producing potential . . ." because too much time is consumed before the plan begins to function, and in addition the cluster signals fade and do not cover sufficient distances reliably.

The technique developed for cluster broadcasting, as a means of circumventing the use of standard broadcast signals for homing by alien aircraft, was described as unsound.

It was charged that the . . . "concept of a potential enemy's dependence upon our commercial broadcast stations for navigational purposes is, in itself, exaggerated, unrealistic and outmoded."

In defense of the warning system, a FCC expert said that Conelrad is basically a counter measure against enemy planes who might use broadcast signals for guidance. This, it was said, was still a key factor and would become more so with the stepped-up use of guided missiles. It was agreed that a warm-up-time situation did exist but this was called minor because some stations could shift from normal to emergency operations in about five minutes. Probably the most difficult problem to overcome is the twenty-five mile transmission limit of the cluster stations; under present evacuation plans, those sent outside of the city limits would be deprived of over-the-air information.

NOTWITHSTANDING THE SQUABBLE over u.h.f. effectiveness, some still have faith in the band and are buying expensive transmitting equipment.

Recently WGBI-TV, Scranton, Pa., purchased a 45-kilowatt transmitter and a 50-gain helical antenna combination that will provide an output of 2 megawatts, and also feed signals to two associate stations in Williamsport (WRAK-TV) and Sunbury (WKOK-TV). These allied telecasters dug into their bank balance and bought 1 and 12 kw. stations and 25-gain antennas. The channels involved are 22, 36, and 38.

Station-grant activity was also a bit livelier during the early winter months, and produced approvals for some high and low-band stations as noted on page 16 of this issue.

THE FATHER OF INFORMATION THEORY, Claude E. Shannon, was honored recently at the *Franklin Institute* with the Stuart Ballantine medal award for his outstanding contributions, which have made it possible to establish an index that accurately describes the size and complexity of communication facilities required to handle messages; a major concept that has revolutionized transmission and reception design and application techniques.....L. W.

A Method of Measuring High Resistance

By **J. P. C. McMATH**
Assoc. Prof., Electrical Engr.
University of Manitoba, Winnipeg

A simple technique which requires no special, hard to get test instruments.

THE writer has found the following method of measuring high resistances most useful. It is particularly advantageous for measuring the insulation resistance of capacitors and the inter-element leakage in vacuum tubes. It is capable of a sensitivity and accuracy otherwise attainable only by the use of expensive special-purpose measuring equipment which is seldom available to the amateur. Any desired test voltage, of either polarity, may be applied.

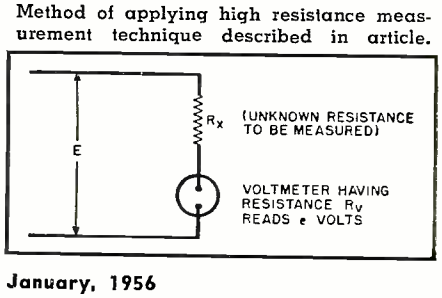
The basic principle, the so-called series voltmeter method, is given in many textbooks but does not appear to be in very general use. To apply the method, the resistance to be measured is connected in series with a vacuum-tube voltmeter having a known input resistance, as indicated in the diagram. A suitable known direct voltage is applied to the series circuit. Solution of this simple circuit gives:

$$Rx = [(E/e) - 1]Rv$$

An example will illustrate the sensitivity of the method. Suppose E to be 300 volts (a reasonable value for testing most ordinary capacitors), the vacuum-tube voltmeter to have an input resistance of 11 megohms (a common value, including the usual 1-megohm isolating resistor in the probe) and a 1-volt full-scale sensitivity on its most sensitive range. Then, for full-scale deflection on the 1-volt range, we would have $Rx = [(300/1) - 1]11 = 3289$ or approximately 3300 megohms, measable essentially to the accuracy of the vacuum-tube voltmeter. If we are merely interested in *detecting* rather than *measuring* leakage, we can readily detect 0.1 volt or less on the 1 volt range, thus making the "reasonably detectable" limit in our example 33,000 megohms.

If instead of a vacuum-tube voltmeter (which normally has constant input resistance on all ranges) an ordi-

Method of applying high resistance measurement technique described in article.



nary multimeter is used, the method is, in general, much less sensitive, primarily because such instruments are usually designed to have constant "ohms-per-volt" so that their input resistance varies with the range in use. For example, assume a meter of 20,000 ohms-per-volt sensitivity, with 300 volts applied to the series circuit as before. If we use the 1-volt range, then for 0.1-volt reading we would have:

$$Rx = [(300/0.1) - 1]\ 20{,}000 \times 10^{-6} = 60 \text{ megohms}$$

If we use the 100-volt range, then for a 10-volt reading (same percentage indication) we would have

$$Rx = [(300/10) - 1]\ 20{,}000 \times 100 \times 10^{-6} = 58 \text{ megohms}$$

Actually, of course, for such instruments used in this manner, the sensitivity is essentially independent of the range used, provided the unknown resistance is large in comparison with that of the meter. It is not advisable to use the low ranges on such instruments if there is any possibility of the test specimen (as in the case of capacitors or vacuum-tube leakage paths) breaking down and subjecting the meter to full circuit voltage. However, well-designed vacuum-tube voltmeters will not be harmed by such an occurrence when working at ordinary voltages since tube current in such instruments is limited to values which will not damage the meter, and there will normally be a sufficiently large isolating resistor in series with the input grid to prevent damage to the tube. In any case an inspection of the meter circuit will determine whether it is safe for this usage.

Where very high supply voltages (of the order of several thousand) are used, as for testing insulation on high-voltage apparatus, the meter can be adequately protected by using a high-voltage supply designed for a maximum current output on the order of 10 milliamperes or less, and by shunting the meter input circuit with a neon lamp or VR tube which will break down harmlessly if the voltage across the meter exceeds a safe value. Further consideration of such specialized high-voltage methods is beyond the scope of this article.

For most purposes, a few hundred volts will be adequate for the detection of leakage in even good quality capacitors. In the writer's opinion, capacitors intended for coupling service should be considered unsuitable if their insulation resistance, when measured at maximum operating voltage, is less than 1000 megohms. Tests of surface leakage may be expected to give widely varying results, since values are greatly influenced by humidity, temperature, and surface contamination. Tests for leakage between vacuum-tube elements should be made with normal heater voltage applied and after normal warm-up time. Care should ordinarily be taken not to apply voltages in excess of tube ratings. In testing capacitors, and insulation generally,

it must be remembered that "insulation resistance" is greatly affected by a number of factors such as the magnitude, polarity, and duration of application of the test voltage, the temperature, and in precise work, on the immediate previous dielectric history of the test specimen.

In using this method with applied voltages greater than perhaps 50 volts, the usual safety precautions should be observed. It is good practice to work with one hand only, at one time, and to stand on an insulating floor, which may well consist of a dry wooden platform supported an inch or two above floor level on wood cleats, if work is done on a concrete or basement floor.

It is generally desirable to use power supplies having a maximum current output of 8 or 10 milliamperes, however, if larger supplies are used, a suitable series resistor can be used to limit the current. Fluctuations in supply voltage will cause erratic readings when testing large capacitors, so that for capacitor testing, batteries or else electronically-regulated supplies are desirable. —30—

RECORD FLOAT

By ARTHUR TRAUFFER

LESS surface-noise and longer record and stylus life are the rewards when you float your records about ⅛" off the surface of the turntable, as shown in the photograph. The record grooves never touch the turntable so the grooves cannot pick up dust, lint, flock hairs, etc., from the turntable. Since this float is made of sponge rubber ⅛" thick and only 4" wide, there is less chance of turntable rumble being transmitted to the phono pickup through the record.

Get a small amount of ⅛" green U.S. "Non-Slip" under-the-rug material from your rug and furniture dealer; they often have scraps and small leftovers so it isn't necessary to buy a large amount. Cut a disc 4" in diameter or about the same diameter as the record label. To do this easily, find a tin can 4" in diameter, lay the can on the sponge rubber and then cut around the edge of the can with a sharp razor blade. Now punch a hole about 9/32" in diameter in the exact center of the disc; this is for the turntable spindle. To do this, find the exact center of the disc using a compass or dividers, file a sharp edge on one end of a thin-wall metal tube of the required diameter, and simply twist the tube through the sponge rubber. This cuts out a neat hole. —30—

Use of a 4" diameter rubber float protects records against wear, cushions turntable.

Certified Record Revue

(*Continued from page 70*)

The *Janzen Company* of Cambridge, Mass., exhibited two models of electrostatic speakers at the Show, one with a crossover at 1000 cycles and one with a 500 cycle crossover. These are fairly small, compact units about 18" by 6" in attractive wooden cabinets, and contain the speaker units and the necessary power supply and amplifier. The whole reasoning behind electrostatic speakers is that they can be made virtually distortionless, albeit with low efficiency. This lack of distortion results in a fabulously "pure" sound. The smoothness is quite indescribable when compared with the conventional type of tweeter, and possibly the most alluring aspect of all is the miraculous way in which string tone is smoothed, with all the wiry "edge" that so many people dislike in hi-fi systems absent to the point where it can truthfully be compared to tape. When properly adjusted with a good woofer, these *Janzen* units have all the characteristics mentioned above. The kicker is that the *Janzen* units are somewhat difficult to balance with the more efficient woofers. I understand this situation is being corrected in the assembly-line run on the production models.

Quite unexpected was the electrostatic speaker from *Pickering*. This is an entirely different concept than the *Janzen*, being much larger in radiating area. There are two models here, the 1000 cycle and 400 cycle crossover units. The 1000 cycle is about 12 by 18 inches, but only about 2½ inches thick and slightly curved. The 400 cycle model, which I find the most exciting speaker development to come along in some time, is roughly 2 by 3 feet by 2½ inches thick and also slightly curved. This is a tremendous radiating area when compared with conventional speakers and the effect is sensational. It is almost impossible to get out of the range of the high frequencies and it is even quite difficult to pinpoint the source of the sound if it is heard alongside several other speakers. A crossover network and power supply comes with each unit and has a high-low switch with an attenuator which makes the job of balancing very easy. I have one of the 400 cycle units working in perfect balance with a *Jim Lansing* D130, a notably efficient woofer. With the crossover this low, the woofer has a very easy job and the lows benefit in cleanness and articulation. When properly balanced (the *Pickering* units are on short stands that can be placed atop any speaker cabinet) there is no sensation that two separate speakers are operating. When first heard, one is inclined to think that the units are a little deficient in highs, but closer listening reveals the highs are there all right (both the *Janzen* and the *Pickering* units are flat almost to 30,000 cycles!). What fools one is the incredible smoothness and after listening to these electrostatic jobs for awhile other speakers seem strident. There is no doubt that the future of speaker development lies with these electrostatics. Response below 400 cycles is difficult to achieve at present, but indications are that within a few years we will have all-electrostatic speakers with response below thirty cycles!

I have already mentioned *Pickering's* new "Fluxvalve" pickup, which was very widely used at the show in various exhibitor's rooms. *Electrosonic* had their professional model arm and cartridge in wide use and much comment was made of its clean sound. *Weathers* showed a new viscous-damped arm for his new ruggedized cartridge and also an induction-tuned oscillator which eliminates any problems of drift. Also new is the *Weathers* speaker, which is a unit that can easily be fitted into apartments and other places where size is of primary consideration. In spite of its modest size, it puts out a remarkable bass from a specially horn-loaded driver and the over-all sound is very smooth and brought much favorable comment.

H. H. Scott showed his new line, nicely integrated as to styling and with several remarkable buys in amplifiers. Incidentally, because of their low internal impedance, *Scott* amplifiers work particularly well with the *Pickering* electrostatic speaker, as a few listenings revealed. The prize in the *Scott* line is their cute little 311 FM tuner. An attractive unit, it has shown remarkable performance as a wide-banded type at a moderate price. *Marantz* showed an unusually well-designed amplifier as a companion unit to his superb audio consolette. A novel feature is the ability to satisfy both schools of thought on amplifier design. Connected one way the unit is a 20 watt triode; a few reconnections and it's a 40 watt beam type amp. It looks and sounds good, with typical *Marantz* attention to quality details. *Fairchild* showed a new turntable which I am most eager to try. A sort of modification of the *Components Corp.* table, it has certain features which would make for greater ease of mounting and operation. Speaking of *Components Corp.*, they were showing their fine table in a new chairside model and according to reports had made improvements in bearings and drive system. *Jim Lansing* followed up their highly successful D123 speaker with a new design tweeter and crossover for same. Of course, their handsome "Hartsfield" was much in evidence in display rooms around the show.

Electro-Voice exhibited several new speakers, the most interesting of which was the "Centurion," a sort of scaled-down version

of the "Georgian." Whopping bottom end for a moderate-sized speaker, and good and solid to about 35 cycles. Speaking of bass, the most fantastic unit at the show was the gargantuan *Stan White* 4-D speaker. Stan was guilty of some outrageous levels of sound, but at least he can be partially excused as he was busy showing people how his speaker handled the full output of a 200 watt *McIntosh!* This 4-D is really loaded—the first speaker I've heard that can actually get close to the long-sought-after 16 cycles. A cute trick—Stan balances a nickel on its edge and then plays huge volumes of organ music, which doesn't bother the nickel a bit since there are virtually no cabinet resonances with the new 4-D system!

Speaking of friend *McIntosh*, he was there with his fabulous new 60 watter and they were much in demand by various exhibitors for demonstrating their speakers, etc. Also shown at Mac's room was the new *Microlab* turntable, which is evidently some tie-in with *McIntosh*. Good design, straightforward and business-like, these are attractive buys and I hope to have the opportunity of testing one before too long. *Rek-O-Kut* showed its "Rondine" line of tables and a remarkably balanced new arm, which should enjoy a terrific sale since it is quite low-priced and is small enough to fit with a small table in an average changer drawer. *Jensen* gladdened the heart of the do-it-yourself-crowd by making available a kit for their splendid "Imperial" speaker. There are just the "inner works" in this case . . . the three speakers and associated crossover networks and balance controls. Also available were complete constructional plans for the "Imperial" enclosure. Speaking of kits, I should have mentioned that *Electro-Voice* has set the market on its ear with kits for their various speaker enclosures up to and including the "Patrician." These are reportedly the complete deal—all parts precut, fastenings, glue, furniture finishing material, etc. Not for a lazy guy like me, but at the low prices involved a boon for those who want to get good horn-loaded enclosures at a very moderate price. *Fisher* showed a new 30 watt amplifier which should enjoy a brisk sale at the price involved, but the new preamp is, I think, the gem of his new line. It is attractive, very quiet in operation, and with a high enough gain to operate many of the low-output cartridges directly without recourse to transformer boost. Real selling feature for many tape recorder and home movie fan is the ability to mix two or more channels of the *Fisher* simultaneously—a genuine boon!

There were many other items of interest, but space will not permit going into them at present. In a future column, I will tell you about *Jim Miller's* revolutionary new record press, where discs are turned out by a high frequency induction heating process literally "instantaneously."

Equipment Used This Month: *Pickering* "Fluxvalve" cartridge and 190 arm, *Marantz* preamp, *H. H. Scott* "Strobe" turntable, *McIntosh* 60 watt amp, *Stan White* 4-D speaker system.

Reviews will necessarily be limited this month due to the annual Audio Fair report. Next month will be 99 per-cent records and literally slews of them!

BEETHOVEN
SYMPHONY #3 (EROICA)

Chicago Symphony Orchestra conducted by Fritz Reiner. Victor LM1899. RIAA curve. Price $3.98.

There is no doubt that this is the best sounding version now available. In fact, whether you care for the performance or not, this disc fills a long felt need for a really hi-fi "Eroica." The rich acoustics of Orches-

tra Hall are admirably suited to this work and the sonorities generated are truly splendid. The strings are clean-lined, brass is weighty and full-blown, all other elements are reproduced with fine definition. Reiner has a few eccentricities in his reading, but they are not serious and this is a very satisfying performance. No, it hasn't the blaze and drive of the Toscanini disc, but taken all together the elements of good performance, superb orchestra, and the wide-range low distortion sound make this the most desirable "Eroica" in the catalogue.

TCHAIKOVSKY
SYMPHONY #6 (PATHETIQUE)

Boston Symphony Orchestra conducted by Pierre Monteux. Victor LM1901. RIAA curve. Price $3.98.

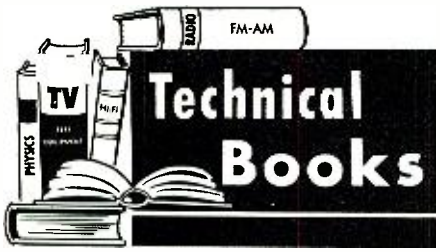
The same remarks as applied to the "Eroica" could well apply here, with slight modification. The indefatigable Monteux seems to get better as the years go by. This reading must certainly be reckoned as one of his finest achievements. His tempi, his phrasing and dynamics, and the fine orchestral balance leave little to be desired and combined with the best Boston Symphony sound to be heard on a disc, this is a richly rewarding "Pathetique." Competition-wise, only the Kubelik Chicago Symphony version stands comparison. I think that the *Mercury* disc, in spite of it being a good deal older than this, still has a slight edge in over-all sound quality, but performance-wise the honors must be shared about evenly. Perhaps what will decide many in favor of this version is the superb Boston strings, sounding better here than anything since the Koussevitsky days. Highly recommended.

RICHARD PURVIS ORGAN RECITAL (VOL. 1)
HI-FI R-704. RIAA curve. Price $5.95.

This small West Coast label got off to a rousing start a few months ago with a fabulously good "pop" organ recording entitled, "George Wright Plays the Mighty Wurlitzer." It captured the essence of the mammoth theater organ as few recordings ever have and was an instant best seller. Now they follow up their "pop" effort with this excursion into the classical realm. The results are, to put it mildly, sensational! This Richard Purvis is not only a highly regarded organist, but a composer and arranger as well. This fact is attested to on this disc by his virtuosity on the organ, his arrangements of several orchestral works, and some of his own compositions. In such standards of the organ repertoire as the Purcell "Trumpet Voluntary" and the "Toccata" from Widor's "5th Organ Symphony," as well as the other material, Purvis shows his mastery of his instrument.

The most sensational thing about this disc, however, is the incredible sound. This is huge-organ-sound that a few years ago would have been impossible to cut on a disc. Using both *Telefunken* and the *AKG* microphones, the engineers of this disc have done the best job ever of capturing the roar of huge 32 foot contra-bombarde pipes. Of course, the organ itself is highly contributory to this success—a great *Aeolian-Skinner* installed in the Grace Episcopal Cathedral in San Francisco. Just to give you a rough idea of the pedal power available, there are *32* of the 32 ft. contra-bombarde pipes, *32* of the 32 ft. open diapasons and many more pedal stops with many pipes to each stop! I'll admit I listened to this recording through the fabulous *Stan White* 4-D, which is capable of reproducing the 16 cycles of these huge pipes, and I was literally blown off my feet with the tremendous shuddering realism of these pipes.

—30—



"AUTOMATIC RECORD CHANGER SERVICE MANUAL WITH TAPE RECORDER SERVICE DATA" by Sams Staff. Published by *Howard W. Sams & Co.*, Indianapolis. 288 pages. Price $3.00. Paper bound.

This is the sixth in the current changer manual series and covers twenty different basic changers and recorders. As with the previous volumes, complete data is presented on the operation, adjustment, troubleshooting, and servicing of each unit. "Exploded views" of each unit are included along with photographs, parts lists, and a description of service procedures.

The changers or tape recorders of nineteen manufacturers, released during 1953-54, are covered in this volume.

* * *

"PROCEEDINGS OF THE SYMPOSIUM ON PRINTED CIRCUITS." Published by *Engineering Publishers*, New York. 122 pages. Price $5.00.

This is a compilation of the papers presented by leading engineers at the recent symposium on printed circuits sponsored by the Engineering Department of the Radio-Electronics-Television Manufacturers Association and the Professional Group on Production Techniques of the IRE.

The papers cover both the theoretical and practical aspects of printed circuitry along with materials and components, design and production testing and evaluation, and reliability and management problems.

* * *

"AUDEL'S RADIOMAN'S GUIDE" by E. P. Anderson. Published by *Theo. Audel & Co.*, New York. 1040 pages. Price $4.00.

This compact, hard-hitting reference manual covers radio, television, industrial electronics, and p.a. systems in a single volume. Since so much material is discussed in such relatively few pages, the presentation is, of necessity, concise. This in no way detracts from the value of the text but requires a little extra in the way of concentration on the part of the user.

A comprehensive index makes it possible for the user to locate information on any specific subject covered by the text. The material, as presented, can be used for self-instruction, as a classroom textbook, or as a reference manual for the practicing technician.

* * *

"TRANSISTOR ELECTRONICS" by Lo, Endres, Zawels, Waldhauer, & Cheng. Published by *Prentice-Hall, Inc.*, New York. 508 pages. Price $12.00.

This team of *RCA Laboratories'* engineers has provided an integrated

approach to both theory and practice of transistors and transistor circuits in this monumental work which includes, for the first time, some of the results of its original research.

The text material covers physical concepts; the characteristics, parameters, equivalent circuits; basic amplifier configurations; d.c. bias circuits; low-frequency amplifiers; power amplifiers; high-frequency operation; transistor parameters; high-frequency amplifiers; oscillators; modulation and demodulation; and pulse circuits. For a comprehensive coverage of transistor circuitry, this book would be hard to beat.

* * *

"ELEMENTS OF TELEVISION SERVICING" by Abraham Marcus & Samuel E. Gerdler. Published by *Prentice-Hall, Inc*, New York. 570 pages. Price $6.95.

This book has been designed as an instruction manual for the radio technician who wants to enter the TV field, the student of radio and TV either at home or school, and the practicing technician who wants to brush up on television theory and practice.

The text is divided into four sections dealing with TV theory, field servicing, theory and practice of bench servicing, and color television. The material is presented in a thoroughly usable style with many diagrams and photographs being used to amplify the text material.

* * *

"RADIO SERVICING COURSE" compiled by M. N. Beitman. Published by *Supreme Publications,* Chicago. 192 pages. Price $2.50. Paper bound.

This book offers basic instruction in the servicing techniques required to repair and troubleshoot radio receivers. Since it is designed for beginners, the material is presented in as simple a manner as possible. Each part of the circuit is described in detail, its schematic symbol given, and an explanation of its function included.

Since self-testing questions are given at the end of each chapter, this text is entirely suitable for self-instruction and home study.

* * *

"TELEVISION RECEIVER SERVICING, RECEIVER AND POWER SUPPLY CIRCUITS," by E. A. W. Spreadbury. Distributed by *Illife and Sons, Ltd.,* London. 308 pages. Vol. 2. Price 21s.

Although concerned with servicing British TV receivers, this volume contains a great deal of material of interest and value to experienced American TV service technicians. It is a companion to Vol 1, which covered sweep circuits and circuits associated with the picture tube.

* * *

"FUNDAMENTAL FORMULAS OF PHYSICS" edited by Donald H. Menzel. Published by *Prentice-Hall, Inc.,* New York. 765 pages. Price $13.50.

A practical handbook and reference of physical formulas, carefully integrated to make the volume indispensable to researchers in all of the physical sciences. Typical sections, of which there are 26, include basic mathematical formulas, electromagnetic theory, electronics, sound and acoustics, and nuclear theory.

* * *

"STATIC AND DYNAMIC ELECTRON OPTICS" by P. A. Sturrock. Published by *Cambridge University Press,* New York. 240 pages. Price $5.50.

An account of focusing in lens, deflector, and accelerator, this book first develops the theory of "geometrical" electron optics from clearly stated physical assumptions, and then proceeds with the focusing of particle accelerators.

* * *

"CIRCUIT ANALYSIS BY LABORATORY METHODS" by Carl E. Sproder & M. Stanley Helm. Published by *Prentice-Hall, Inc.,* New York. 376 pages. Price $5.75.

This is the second edition of a book designed as a guide and text in conjunction with a college laboratory course in electrical circuits. Experiments are presented in the form of problems rather than experiments in the usual sense of the word.

* * *

"NETWORKS, LINES AND FIELDS" by John D. Ryder. Published by *Prentice-Hall, Inc.,* New York. 593 pages. Price $7.65. Second edition.

This book provides a basic coverage of the theory of transmission of electric energy in lumped-constant circuits, on distributed-constant lines, through wave guides, and into space. It serves as an introduction to the field of communication circuit engineering and electrical network theory from the standpoint of both currents and fields.

* * *

"LAPLACE TRANSFORMS FOR ELECTRICAL ENGINEERS" by B. J. Starkey. Published by *Philosophical Library,* New York. 279 pages. Price $10.00.

The method of solving linear differential equations as described by Laplace over a century ago has been adapted to the solution of electrical engineering problems. A physical rather than a purely mathematical vocabulary is used, and a language and method of explaining problems is employed which is particularly familiar to electrical engineers.

* * *

"INTRODUCTION TO ELECTRONIC ANALOGUE COMPUTERS" by C. A. A. Wass. Published by *McGraw-Hill Book Company, Inc.,* New York. 227 pages. Price $6.50.

This basic work provides an excellent introduction to the subject of analogue differential analyzers and their components. Both theory and design are covered in the text, along with detailed descriptions on setting up computers for solving specific problems.

Standard computer components and the newer non-linear varieties are covered in some detail for the benefit of the engineering fraternity. —30—

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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	14Q7	.50
1H5GT	.47	6A7	.57	6CD6G	1.15	7B5	.39	19BG6G	1.15
1J6GT	.47	6A8	.45	6D6	.48	7B6	.42	19T8	.65
1L4	.45	6AB4	.43	6E5	.44	7B7	.41	24A	.39
1L6	.55	6AC7	.67	6F5	.37	7B8	.45	25AV5GT	.78
1LA4	.57	6AF4	.79	6F6	.38	7C4	.39	25BQ6GT	.78
1LA6	.47	6AG5	.50	6G6	.40	7C5	.42	25L6GT	.47
1LB4	.57	6AG7	.69	6H6	.38	7C6	.43	25W4GT	.43
1LC5	.49	6AH6	.69	6J4	1.79	7C7	.45	25Z5	.37
1LC6	.47	6AJ5	.70	6J5	.39	7E5	.45	25Z6	.37
1LD5	.57	6AK5	.54	6J6	.47	7E6	.55	27	.25
1LE3	.57	6AL5	.39	6J7	.43	7E7	.70	35A5	.46
1LG5	.57	6AQ5	.46	6J8G	.85	7F7	.59	35B5	.50
1LH4	.64	6AR5	.46	6K6GT	.37	7F8	.70	35C5	.50
1LN5	.47	6AS5	.48	6K7	.39	7G7	.75	35L6GT	.47
1N5GT	.50	6AS6	1.70	6K8	.65	7H7	.50	35W4	.34
1R5	.50	6AS7G	2.19	6L6	.68	7J7	.75	35Y4	.34
1S5	.42	6AT6	.39	6L7	.42	7K7	.75	35Z3	.39
1T4	.50	6AU4GT	.65	6N7	.60	7L7	.75	35Z5GT	.34
1U4	.47	6AU5GT	.59	6Q7	.40	7N7	.50	37	.29
1U5	.42	6AU6	.42	6S4	.40	12AT6	.37	50A5	.46
2A3	.65	6AV5GT	.65	6SA7	.45	12AT7	.66	50B5	.50
1X2	.61	6AV6	.39	6SC7	.48	12AZ7	.63	50C5	.50
2A3	.55	6AX4GT	.60	6SG7	.41	12AU6	.41	50L6GT	.43
2A5	.57	6AX5GT	.57	6SH7	.43	12AU7	.53	75	.42
2A7	.55	6B4G	.52	6SJ7	.43	12AV6	.35	76	.42
3A4	.51	6B8	.69	6SK7	.45	12AV7	.67	77	.38
3A5	.50	6BA6	.47	6SL7GT	.55	12AX4GT	.65	78	.38
3AL5	.45	6BA7	.58	6SN7GT	.55	12AX7	.58	80	.34
3AU6	.46	6BC5	.47	6SQ7	.39	12B4	.68	84/6Z4	.44
3BC5	.54	6BC7	.80	6SR7	.42	12BA6	.46	117L7GT	1.09
3BN6	.70	6BE6	.45	6SS7	.41	12BD6	.48	117N7GT	1.09
3CB6	.52	6BF5	.40	6T4	.95	12BE6	.46	117P7GT	
3Q4	.46	6BF6	.50	6T8	.68	12BH7	.60		
3Q5GT	.57	5BG6G	1.15	6U8	.75	12BY7	.65		
3S4	.47	6BH6	.50	6V3	.80	12BZ7	.61		
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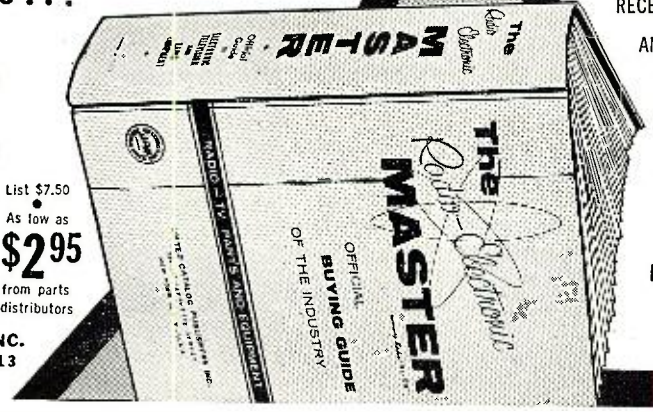

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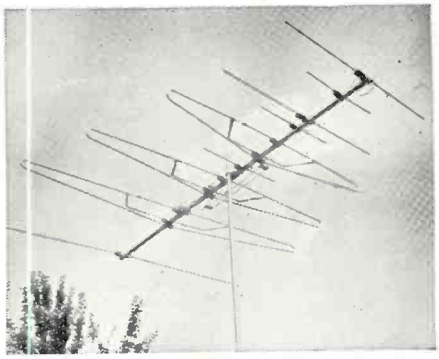
Antenna News

NEW ELEMENT DESIGN

Trio Manufacturing Co., Griggsville, Illinois, recently introduced the "Zephyr Royal" TV antenna using a "wing" dipole to obtain wide-band operation over the v.h.f. range. These elements are stagger-tuned to six predetermined frequencies so as to obtain good performance throughout the v.h.f. band. On the low band, the "Zephyr



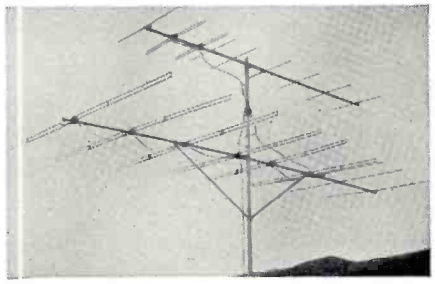
Royal" has three driven elements stagger-tuned to channels 2, 4, and 6, together with two directors and one reflector. Other than the "wing" dipoles, there are eight parasitic high-band elements. The three "wing" dipoles add a total of nine driven elements pretuned to channels 7, 10, and 13, together with three directors.

Additional information as well as price lists may be obtained by writing the company.

HIGH GAIN ANTENNA

Channel Master Corp., Ellenville, N. Y., has announced a new v.h.f. yagi-type TV antenna, the "K.O.," which the company claims has the highest front-to-back ratios ever recorded for any TV antenna. There is a low-band model, No. 1026, for channels 2 through 6; a high-band model, No. 1073, for channels 7 through 13; and a broad-band model, No. 1023, consisting of the other two models stacked and connected with a "Tenna-Tie" coupling network.

A combination of element spacing and phasing is used to obtain for this



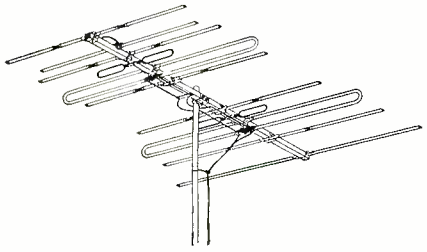
antenna its high front-to-back voltage ratios which range from 20:1 to 50:1 on the low band, and up to 13:1 on the high band. In addition, the an-

tenna has a 7 to 9 db gain on the low band, and from 8.5 to 10.5 db on the high band. These figures are for the single bay.

The "K.O." is preassembled and features "Snap-Lock" action. It is of 100% aluminum construction, and the low band model is boombraced with high temper seamless aluminum tubing.

BROADBAND ANTENNA

Finney Company, 4612 St. Clair Avenue, Cleveland 3, Ohio, is marketing a new v.h.f. TV antenna which features high gain and excellent front-to-back ratio for the elimination of the vene-



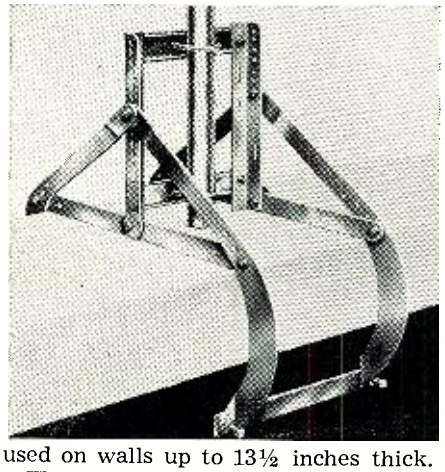
tian blind effect. This broadband antenna, specified as the Model B-8, uses a combination of reflectors, directors, and phasing elements in a colinear array giving sharp directivity. Broadband operation results from the use of elements cut to different sizes.

Self-locking and self-aligning aluminum alloy element brackets, and the "Lock-tite" saddle bracket are used for element and boom mounting.

Two stacking kits are available for use with this antenna. The Model No. S-830 is for maximum high-band gain, and the Model No. S-860 is for maximum low-band gain.

PARAPET MOUNT

Kenwood Engineering Co., Inc., Kenilworth, New Jersey, was recently issued Patent No. 2717751 on the Kenco parapet mount Model No. 106. Designed to take antenna masts up to 1½ inches in diameter, this mount can be



used on walls up to 13½ inches thick.

The mount itself employs a sturdy frame with four clawlike members. At the end of each claw is a hardened cone-point set screw which assures positive anchorage to the wall. At each side of the frame is a cam that can be adjusted to prevent the mount from sliding sideways on tile or stone copings. —30—

losses that occur in the tape recorder in question when bias is set to obtain maximum output at 1 kc. These losses, it will be remembered, are caused largely by demagnetization and bias erase.

Curve 2 shows the recorded magnetic induction implied by the NARTB playback standard. It corresponds to curve *AE* in Fig. 3. Curve 2, it should be noted, attains a 6 db-per-octave slope at the high end. This slope is specified because the playback head characteristic has a 6 db-per-octave slope in the opposite direction, which is used to compensate the drop in recorded induction. Curve 2 represents an approximation of the maximum amount of induction that can be recorded at 15 ips consistent with low distortion and high signal-to-noise ratio. If the speed were 30 ips, the specified induction characteristic would begin to drop at a frequency twice as high as in the case of the 15 ips speed. In some recorders, flat induction is recorded at 30 ips.

Curve 3 shows the treble boost required in the record preamplifier in order to bring Curve 1 up to the level of Curve 2. Thus Curve 3 equals Curve 2 minus Curve 1. It may be noted that Curve 1 is slightly higher than Curve 2 in the area of 600 to 1600 cps, but this results in less than ½ db departure above flat response. The amount of treble boost required is 10 db at maximum. As will be made clear in the following section, such boost appears well within the limit for achieving low distortion and high signal-to-noise ratio.

Curve 2 has a turnover point (3 db down) at 3180 cps. Therefore the bass boost characteristic, shown by Curve 4, must have the same turnover point. Curve 4 eventually attains a slope of 6 db-per-octave, but then levels off as it reaches the lower limit of the audio range. The second turnover point, where bass boost is 3 db below the maximum, occurs at 50 cps. To compensate the resulting decline in bass playback response, Curve 5, there must be a corresponding bass boost in the record preamplifier, shown by Curve 6.

Curve 7 shows the playback response to the NARTB recorded induction if there were no bass boost in playback. It may be compared with the general curve *CB* in Fig. 3.

Curve 8 is the unequalized record-playback response of the 15 ips tape recorder in question. It can be obtained by adding Curve 1 (record losses) to Curve 9, which is the 6 db-per-octave playback characteristic for the head, assuming no treble losses.

Next month, the final article of this series will cover the problems of maximum permissible record boost, optimum magnetic induction, and the need for standard equalization.

(*Concluded Next Month*)

Phonograph Evolution

(*Continued from page* 59)

matter of fact, its action was identical. A typewriter under development by Edison is also shown in the illustration.

In this model the governor has been added to the conventional Edison mechanism and may be seen directly in back of the feedscrew. This particular model was primarily intended for business use and it was during this period that Edison was keenly interested in his invention as an office dictating device. The accessories included are practically the same as for the earlier models, with the exception that the hearing tubes which terminated in small rubber inserts were now designed to be inserted into the ear. These were self-supporting. They later became standard equipment on the early Edison machines and were used for many years.

Another foot-powered phonograph of improved design is shown in Fig. 8. The major improvement was in the stabilization of rotation due to an improved governor. Note the pull-out drawer in the center of the treadle stand. This was required for the gathering of shavings when wax cylinders were prepared for re-use. Practically all of the early Edison models employed a shaving knife. This adjustable device could be moved into the rotating wax cylinder to remove previously recorded sound from the cylinder. The knife was made of sapphire.

A radical change in the design of Edison's phonographs is seen in Fig. 9. This particular model was known as the Model "M", "spectacle-type." It was powered by four electric batteries seen in the accessory box at the rear of the stand. Of particular interest is a new governor assembly seen at the top left of the mechanism which has a governor control and an electric switch used in combination to compensate for the varying current supplied by the cells as well as to provide means for adjusting the speed of the machine. The action of this device was described briefly in Part 1 of this series. Accessories included the spectacle recorder-reproducer, the speaking tube, and the hearing tube. It was sold during the year 1889 by the *North American Phonograph Company* of New York, sales agents for Edison.

One of the most interesting of all of Edison's phonographs is the one shown in Fig. 10, which was operated by water power. It was made in 1889 on an experimental basis and was sold the following year in small quantities. Two major changes are observed in addition to the unique method of driving power. One is the change to a single mounting for either a recorder or for a reproducer. The second development was the elimination of a separate feedscrew by threading the drive shaft supporting the mandrel which eliminated the necessity for additional parts. Two

"half nuts" are mounted to a flat spring which engages the feedscrew now cut by a lathe on the drive shaft.

The turbine-like water wheel is seen to the left in the illustration. A hose connected the device with a water faucet. The water wheel was coupled to a governor and could be adjusted to compensate for speed. It was during this period of Edison developments that the main assembly of his phonographs took on some form of standardization. It will be noted in models that followed that an attempt was made to simplify as well as to standardize his phonograph.

The same year, 1889, saw the development of his "Cylinder Phonograph," Model "E", Fig. 11. This was powered directly from 117 volt direct current house circuits. A crude rheostat seen at the left in the illustration reduced the line voltage to approximately two volts, which was the requirement of the motor. It operated at approximately three amperes. This model apparently had been in development for several years or was simply a modification of the early Model "M," originally designed for storage battery power. It did not contain the later improvements mentioned in the previous paragraph.

The model shown in Fig. 12, was designed principally for business. It was first produced in 1890 and was driven by means of an electric motor which was powered from a special primary cell like the one shown in Fig. 12. This model, as well as the one shown in Fig. 11, were simply modifications of the old Model "M". This one still used the "spectacle-type" recorder and reproducer and was provided with an accessory drawer and a removable box to contain the shavings.

The Model "M" phonograph using a single housing for a recorder or a reproducer is shown in Fig. 13. This model never attained any great success on the market and very few, if any, will be found in existence today. It has been included solely for its peculiar appearance, especially with respect to the modification of the box or cabinet upon which the machine rests.

History records the development of the Edison phonographs in the following order: 1. hand-powered, 2. electric-powered, 3. foot-powered, 4. water-powered, 5. spring motor-powered, and 6. clock-work (abandoned). Subsequent chapters in this series will continue with the many spring-driven phonographs of Edison which became standard and were produced in great quantity from 1895 to 1912. Other chapters will include the developments of Eldridge Johnston and others.

The authors will appreciate any "leads" as to owners of the above models. They are needed for a permanent collection.

(To be continued)

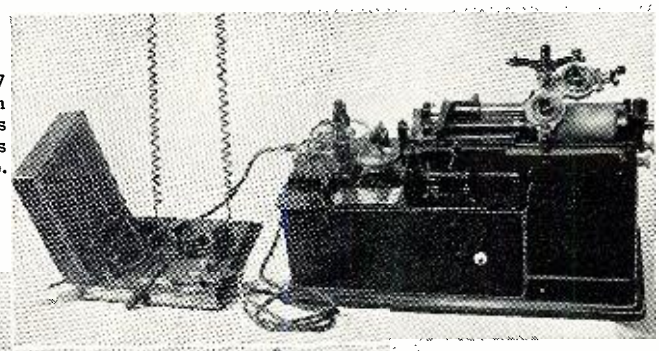


Fig. 11. Standard 117 volt d.c. power (which was stepped down) was used to operate this Edison Model E phono.

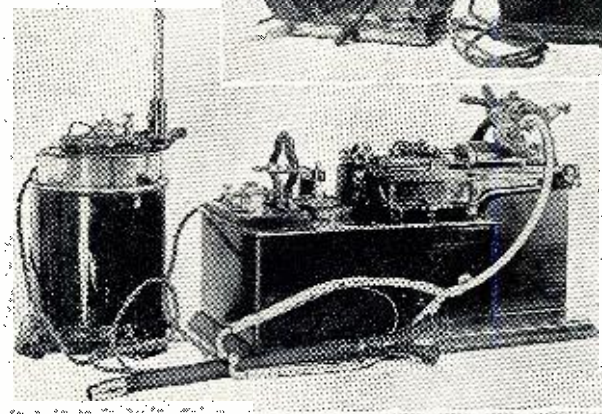


Fig. 12. Same phonograph as the Model E but this was powered by primary battery.

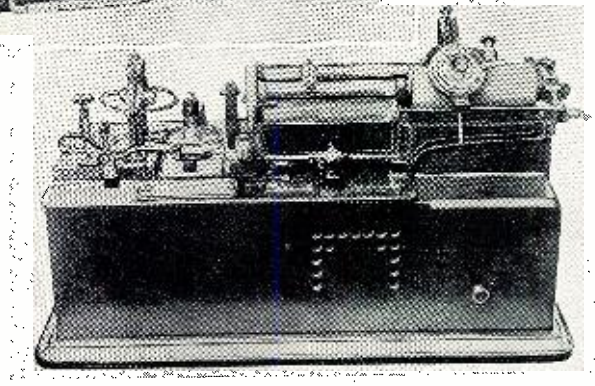
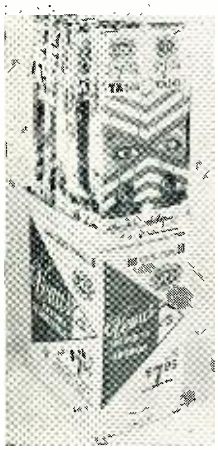


Fig. 13. First Edison model which used the dual sapphire styli or single reproducer.

Sales Aids

PACKAGE-DISPLAY UNIT

JFD Manufacturing Company, Inc., 6101 —16th Ave., Brooklyn 4, N. Y., has developed an arresting new package for its "Venus Indoor Antenna" line, Models TA141 and TA144.



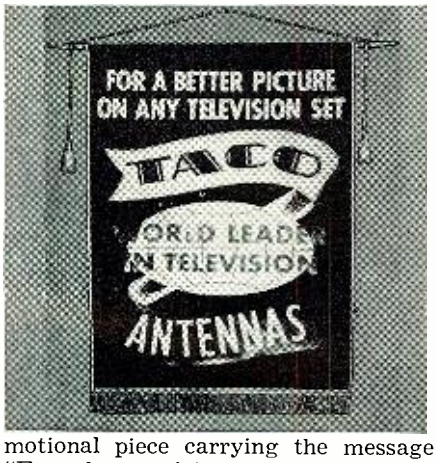
The package embodies a fashion model's eye against a colorful striped pattern alternating on a silver or gold foil. The carton houses ten of these separate packages and can be opened by means of a tear tape and then converted into a display stand which will hold the "Venus" packages on top.

The antenna itself is available in mahogany, ebony, or ivory.

* * *

TACO WALL BANNER

Technical Appliance Corporation of Sherburne, N. Y. is making it possible for its dealers to tie-in with the firm's national advertising campaign by offering colorful wall banners measuring 2 feet by 3 feet. Carrying out the same design which appears in *Taco* advertising, the banner is an attractive promotional piece carrying the message "For a better picture on any television set—*Taco* (World Leader in Television) Antennas."



* * *

SYLVANIA AD CAMPAIGN

A double-barreled outdoor advertising program for the company's TV dealers has been announced by the Radio and Television Division of *Sylvania Electric Products Inc.*

The program has two parts. To a large-size permanent highway "spectacular" display program now under-

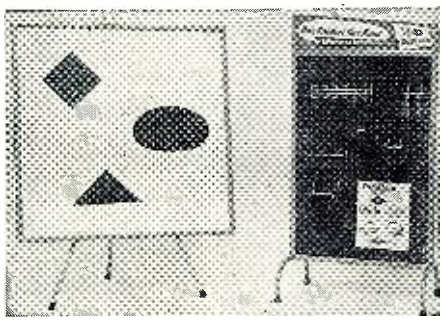
way in many states, the division has added a low-cost program of smaller signs. Both utilize reflectorized material for maximum visibility in automobile headlights at night. Both types avoid the common rectangular shape of most billboards.

Although the program is designed specifically for the suburban and small town dealer, it will benefit all dealers in the territory. Distributors and dealers may select the type of signs, location, and message. The displays are available to dealers on a cooperating basis.

* * *

FRAMED DISPLAY UNITS

Woodall Industries Inc. of California, 1970 Carroll Ave., San Francisco, Calif., is now offering a new line of



portable displays which are available in a choice of types and sizes.

Identified as the "3-D Display," units are made of perforated hardboard framed with lightweight steel tubing. Panels are of regular 3/16" "Perforall" stock, drilled on 1" centers, which can be used in their natural dark finish or painted any desired color. A variety of standard hooks and holders suitable for literature and product display are available.

Information on the sizes and types of displays currently stocked is available from the manufacturer.

* * *

PILOT BANNER

Pilot Radio Corporation, 37-06 Thirty-Sixth Street, Long Island City 1, N. Y., is now offering a handsome royal blue satin banner with gold letters, fringe, and tassels which measures 31" x 21".

The banner copy reads: "High Fidelity by Pilot. Designed to Professional Standards for the Home".

Each banner is individually packaged and is available to *Pilot* dealers upon request.

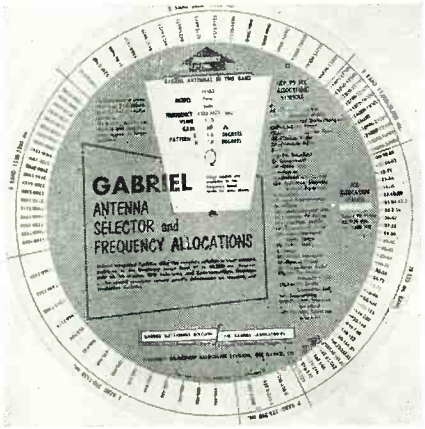
* * *

ANTENNA CALCULATOR

A compact, rotary slide chart which facilitates the computations involved in antenna design and application is now available from the Electronics Division of *The Gabriel Company,* Needham Heights, Mass.

One calculator scale provides for quick conversion between frequency and wavelength in both centimeters and inches. Another shows relation of power gain and db gain. Other scales give the relationship of wavelength, gain, and beam width to reflector diameter for parabolic reflectors from 4 inches to 100 feet in diameter.

The reverse side of the calculator is designed to aid in the selection of an-



tennas for use in various microwave bands. The calculator is printed in three colors on heavy card stock that will withstand repeated usage. Requests for the calculator should be addressed to Mr. A. Murphy of the company.

* * *

G-C-STACKPOLE DISPLAY

G-C Electronics Mfg. Co., a division of *General Cement Mfg. Co.*, 400 S. Wyman St., Rockford, Ill., and *Stackpole Carbon Co.* are now offering a comprehensive line of carbon resistors in color-coded hinged cover plastic boxes.

Designed to make it easy for service technicians to select the resistors they need on a self-service basis, the new "*G-C* 60 Line" is uniformly priced with

six, four, or three resistors to the box. The large self-service display rack holds 77 different RETMA values of resistors.

* * *

JENSEN PROMOTION PACKAGE

Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago, Ill., has teed off with a hard-hitting promotional campaign to market its line of "TV Duette" speaker systems for improving sound from television receivers.

The campaign includes newspaper advertising mats, spot announcements for radio and television, consumer flyers and brochures, mailing pieces, window banners, and point-of-sale displays.

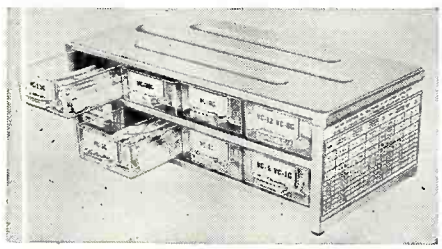
The entire campaign is offered as a package to dealers who should contact

their local distributors or write the company direct.

* * *

PISTON CAPACITOR KITS

JFD Electronics, a division of *JFD Manufacturing Company, Inc.*, 6101 16th Ave., Brooklyn 4, N. Y., is now offering a new piston capacitor kit, PK85, which provides a comprehensive selection of the units for electronic experimental purposes. The kit houses



an assortment of 85 quartz and glass piston capacitors of the 10 basic types now in use.

All of the capacitors in the kit are individually packaged, affording positive protection and easy selection. A rugged, compact metal cabinet, with a double row of compartment drawers, holds the assortment.

* * *

SOLDERING TIP ASSORTMENT

Electric Soldering Iron Co., Inc. of Deep River, Conn., is now offering a complete assortment of its new gun-type soldering tips mounted on an attractive counter card.

The varied sizes and shapes, including long and short, narrow and broad, straight and curved, are included in this new assortment. Included are tips for soldering connections to small prongs and for thin channel-type lug connections to make the technician's job simpler and faster.

Write the manufacturer for full details on the line and its display card.

* * *

BATTERY MERCHANDISER

Franklin Manufacturing Company of Minneapolis, Minn., has recently introduced a new battery merchandiser which is designed to increase the dealer's battery sales.

The Model 154A "Speed-O-Matic" tester-charger, for both 6 and 12 volt batteries, provides five different bat-

tery tests to positively identify battery trouble. A built-in "battery protector" makes fast recharging safe. —30—

Choosing a Phono Pickup

(*Continued from page* 39)

and will be discussed in another article.

If the stylus point tends to ride up the walls of the groove at any modulation frequency in the audio band, it is said to be failing to track at that frequency. This means that a greater pressure is required on the stylus to force it down into the groove and avoid this cause of distortion.

The principal way in which a pickup can be made to follow the groove more readily with less stylus force is by increasing the compliance in the stylus movement. Compliance is that quality which is opposed to the quality known as stiffness, thus, as the movement becomes less stiff it becomes more compliant. Obviously compliance is a matter that must be considered in conjunction with the ruggedness of the pickup, because the stylus has to maintain its correct operating position in the middle of its travel, otherwise it will run into distortion troubles.

This means that every part of a pickup, including the arm in which it is mounted, must have extremely free movement if the best use is to be made of a high compliance. Thus we might say that the higher the stylus compliance, the less will be the record wear that the pickup produces. While this is true in principle, there are other factors that go along with compliance, which we will discuss in a moment.

Undoubtedly the best pickup for minimizing record wear is the *Weathers* which was mentioned earlier. It has a lateral compliance of 14×10^{-6} centimeters per dyne, which is much higher than for any other pickup on the market, and it will track with an effective stylus force of 1 gram, which is not more than half that required for the next best type of pickup.

Its disadvantage, as already mentioned, is that performance depends on accurate maintenance of the oscillator/FM part of the equipment. Most people prefer a pickup which gives an audio output direct, so that, if the pickup is mechanically sound, there is nothing else to worry about. However, if you are a perfectionist, and are prepared to go to some trouble with maintenance to keep your record wear to an absolute minimum and distortion low, you may well choose this pickup.

Design Features

A few words here about the general principles in the mechanical design of pickup movements. The best design is a compact one, in which the whole moving mechanism is of the simplest and most "streamlined" shape possible. Try to think of the moving mechanism vibrating in as many different modes as you can imagine. The more complicated its shape, the more complicated the possible modes in which the mechanism could vibrate, and each of these will produce variations in the frequency response in the form of resonances.

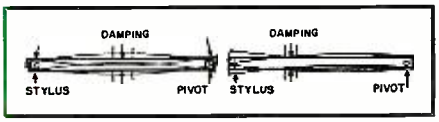
The stylus must be rigidly mounted to the armature, or moving coil, or whatever element forms the transducer and any damping, using blocks of rubber or other special material, must be mounted in such a manner that the damping controls the resonance of the system and does not encourage it to vibrate in some more complicated mode. For instance, damping applied half way back along the stylus arm, in a concentrated lump between the stylus point and the pivot, will tend to hold the point still where the damping is applied, and make the stylus vibrate at its tip and again at the pivot. As output from the pickup is dependent upon the moving mechanism *rotating* about the pivot, rather than vibrating there, this kind of movement will not result in output and will cause a hole in the response. This is illustrated at Fig. 5. Other kinds of undesired vibration can produce peaks in the response.

A sudden change in the cross-section can also result in undesirable characteristics in the response curve. The cross-section from the stylus tip back to the pivot should increase gradually, and not in any sudden step, and similarly the junction of the stylus with the transducer element should maintain a smooth change in shape and not one that gives sudden steps to the cross-section. All these things can add irregularities to the frequency response.

Assuming that these irregularities are reasonably well eliminated, there are two basic mass components and two compliance components that contribute to the over-all performance: the mass of the tone arm, and the mass of the stylus with its arm, the compliance of the stylus movements, and the compliance of the disc material. Three of these elements are under the control of the pickup and tone arm designers, while the fourth is liable to vary from disc to disc.

The mass of the tone arm in conjunction with the compliance of the cartridge tends to produce a low-frequency resonance. This should be adequately damped, either by damping in the tone arm movement itself, or by care in its construction, or the mass should be adjusted so that the resonance is beyond the low frequency end of the range and not at some frequency where it will emphasize rumble, and other undesirable effects. This

Fig. 5. Effects of poor damping distribution along stylus arm. At (A) damping concentrated midway between the stylus and pivot, accentuates a resonance in the mode shown. The pivot vibrates more than it rotates at this frequency, so the effect will cause a dip in the frequency response. At (B) damping concentrated about one-third of the distance from stylus to pivot will accentuate resonance in a different mode, giving rise to a peak at this frequency, because the damping does not have to move with the stylus arm.



will be more fully discussed when we come to the question of choosing a tone arm.

The mass of the stylus and its arm referred to the stylus point, in conjunction with the compliance of the stylus and the compliance of the disc material, should produce a resonant frequency at least up at the top end of the audio spectrum and preferably beyond it. The damping of the compliance should also prevent the resonance from producing a peak, that is, it should be critically damped, so as to produce a smooth roll-off.

There is the problem of selecting a suitable damping material for a pickup cartridge. Most manufacturers have solved it by using a material that suits their particular design, but the qualities of the material have a time limitation, which means the cartridge has a limited life before its performance begins to deteriorate.

Of course the final judgment of performance will be based on the frequency response of the cartridge and a listening test of the whole equipment. But a general look at the construction provides a good performance criterion.

Matching Problems

After considering the various pickups on their basic merits, we are still left with the problem as to whether we can match it successfully to our preamplifier.

All ribbon-type pickups and many moving-coil types require a transformer to step the output voltage up to something suitable for amplifying at the grid of the preamplifier input stage, because the impedance of the pickup is so low and its output voltage would be down in the noise unless a transformer were used. In most instances the manufacturer either supplies or recommends a suitable tansformer which will serve this purpose. It is essential to consider where the transformer may be placed, as failure to pay careful attention to this can result in serious hum pickup. The transformer must be placed well away from any supply transformers or motor in the equipment and will probably need careful orientation to get a minimum of hum pickup from these components.

All pickups using a transformer will need careful attention to the loading on the secondary of the transformer to avoid a high-frequency resonance due to the transformer itself. This means that the grid resistance of the input stage will need adjusting to get the best over-all response.

The magnetic, or variable reluctance, or moving-iron type cartridge—whichever you prefer to call it—comes in an impedance suitable for the input of the average preamplifier and requires attention only to the necessary loading resistance. If the preamplifier has a resistance across the input of higher value than that specified for the cartridge used, there will be a rise in high frequency. If the value is lower the high frequencies will roll off somewhat. Maybe this can be corrected in

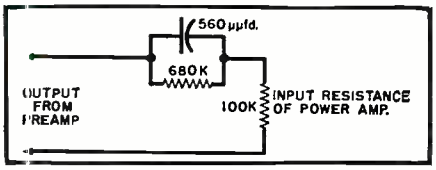


Fig. 6. A simple equalizer circuit for amplitude-sensitive types of pickup that can be placed between preamplifier and the power amplifier. It is calculated on the basis of the power amplifier having an input resistance of 100,000 ohms. For other values, the resistance should be multiplied and the capacitor divided by the factor by which the input resistance differs. For example, with an input resistance of 500,000 ohms, the resistance should be 3.3 megohm and the capacitor 120 μμfd. (nearest value). The arrangement should be carefully shielded, because of high impedance.

the equalization of the preamplifier or maybe the resistor should be changed to suit the cartridge.

All of the foregoing cartridges require a low-level or high-gain input at the preamplifier to get sufficient gain to supply the power amplifier.

The piezoelectric pickups and the *Weathers* FM pickup each provide a high-level output that does not need a low-level input on the preamplifier. On the contrary, a high-level input, such as that normally used for input from a tuner, is adequate for this purpose.

The input should be high impedance. This is essential for the piezoelectric type, otherwise there will be a low-frequency loss due to the fact that the pickup has a capacitance source impedance instead of a resistance.

Quite pleasing results can be obtained with these pickups without any equalization, but this really assumes that the discs have a constant-amplitude instead of constant-velocity recording characteristic. A little equalization, using the response shown in Fig. 4C, produces an over-all flat response from this type of cartridge. If this is not provided in the preamplifier, a useful circuit for adding it between the preamplifier and power amplifier, assuming that the input resistance of the power amplifier is 100,000 ohms, is shown in Fig. 6. Take care to shield the entire circuit to avoid hum pickup.

The life of any pickup being limited, and it being a vital link in phono reproduction, if you have any perfectionist leanings, you will probably end up trying at least one of each type in the course of time.

To summarize then: for a low-cost system, requiring a pickup with reasonable fidelity and a large output, the ceramic and crystal types are ideal; but if you want to get absolutely the best from your records, in terms of both reproduction and number of playings before wear begins to show up, you need a type that will reduce stylus force necessary and give you the lowest distortion. Suitable types are: the higher quality variable reluctance, the moving coil, and the ribbon. Taken in this order, however, they will require progressively more gain from your pre-

amplifier. Another high-quality possibility is the *Weathers* FM pickup, which needs the FM demodulator that comes with it, but has a high-level output.

EDITOR'S NOTE: The general comments with regard to the crystal cartridges are, of course, the opinions of the author and are generally well-known. However, we would like to call to the reader's attention that there are crystal cartridges on the market today that, according to the manufacturers, are extremely good to a point where they compare favorably with magnetic units. These reports have not been verified as yet.

One of the most important things about the performance of a pickup is its frequency response. But published responses are of rather limited meaning, particularly at the high end; this is because the record material compliance contributes toward the response measured and different test records use different pressing compositions, and so do not give consistent results with different pickups. This means that pickups will not give consistently different performance either, when compared on program records using different pressing composition. For this reason, published characteristics can best be assessed by listening to the differences they represent, which means the ear should be the final arbiter in making a choice. After making your preliminary choice from the published data, it is advisable to listen to the pickup played through your own equipment, or one as similar to it as possible, to judge whether or not it will give satisfaction.

Happy hunting! —30—

REPAIR NOISY CONTROLS

BY PAUL FALK

ALTHOUGH it is a general practice to replace noisy controls, it is sometimes impossible to obtain an exact or even suitable replacement.

There is one type of control that can be repaired satisfactorily if a little care is taken. On this type of control the carbon element is sprayed onto a flat C-shaped washer made of cardboard or porous fiber. Noise in these units is almost always due to a slight warping or moving of this element as the contact moves over its surface. If the element can be cemented securely to the fiber base of the control, the noise will disappear.

For the repair of such units, remove the control from the chassis and take off its rear cover and switch section (if any). Remove the shaft and contact assembly. Notice that the C-element is riveted onto the fiber base at the ends and at the tap, if it is a tapped control. Pry the element away from the base and apply radio cement to its under surface. If any cement gets on the top surface of the element, remove it immediately with solvent. Clamp the element in position for about 20 minutes with spring-type clothespins or alligator clips. Clean all moving contacts with carbon tetrachloride and reassemble the control.

This repair will not work with controls which have badly pitted or worn elements. —30—

Within the Industry

(*Continued from page 32*)

Annual Industrial Show, Wednesday and Thursday, Jan. 25th and 26th, at the Penn Sherwood Hotel in Philadelphia. According to reports, some ninety to one hundred of the leading industrial manufacturers of the electronic industry will participate. In addition, about twenty-eight radio amateur clubs will be represented.

This show, which is sponsored exclusively by *Almo Radio,* should be of considerable interest to all radio amateurs and anyone who desires first-hand information on industrial electronics in all its aspects.

For additional information, write direct to the company, 509 Arch St., Philadelphia, Penna.

* * *

ROBERT G. DAILEY is the new vice-president of *Vokar Corporation,* Dexter, Michigan manufacturer of auto radio vibrators and a line of subminiature electronic components.

He joined the firm in 1954 as general sales manager and will continue to direct all sales activities in his new post.

A 1937 engineering graduate of the University of Michigan, Mr. Dailey was formerly sales promotion manager of the *General Motors'* truck and coach division and prior to that was sales manager of the *Reid Division* of *Standard Products Company* of Cleveland.

* * *

WESTINGHOUSE ELECTRONIC TUBE DIVISION is initiating a tooling-up program of over $1,000,000 to implement production of its new all-glass color television picture tube in the Elmira plant.

Orders have already been placed for approximately $500,000 worth of new equipment — primarily exhaust machines. Plans are to have the new *Westinghouse* rectangular shadow-mask color picture tube ready for commercial production by the early part of 1956. —30—

NEW TV SERVICE GROUP

THE organization of a new TV service mutual aid group for the purpose of "educating the public to good service practice at fair prices," has just been announced in Oklahoma City, Oklahoma. Called the Television Service Association of Oklahoma, membership is open to those service technicians who can conform to the ethical standards established by the association. The association, in turn, will impress upon the public the advantages of dealing with their members.

Additional information regarding the TSA of Oklahoma may be obtained by writing to Mr. Bob Armstrong, executive secretary, P.O. Box 9664 Shartel Station, Oklahoma City 18, Oklahoma.

—30—

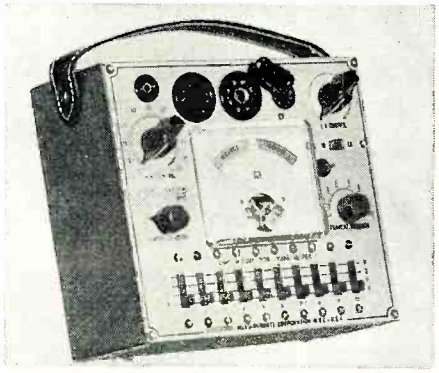
What's New in Radio

TUBE TESTER-REJUVENATOR

Electronic Measurements Corporation, 280 Lafayette Street, New York 12, N. Y. is now offering a low cost tube tester and rejuvenator as its Model 209.

This combination instrument permits the checking of all types of vacuum tubes in addition to effecting repairs on monochrome picture tubes. It is available in three different forms; wired and tested in a hammertone case, wired and tested in an oak carrying case, and in easy-to-assemble kit form.

The instrument tests tubes by using the standard, total emission method. All octal, loctal, miniature, and noval base tubes can be evaluated with this unit. Rapid checks can be made for tube quality, shorts, leakages, continuity, and opens occurring between any



two tube elements. A plastic meter with a 3½" easy-to-read scale reads "Reject-?-Good."

With an accessory picture tube adapter the Model 209 can be used as a CR tube rejuvenator.

REPLACEMENT FLYBACKS

Triad Transformer Corporation, 4055 Redwood Ave., Venice, California has added five new flyback transformers to its line of TV replacement components.

Designed for use in *RCA, Trav-ler,* and *Zenith* television receivers, these new items are electrically and mechanically interchangeable with the manufacturer's original equipment. Wherever possible they are composite replacements to fill a number of requirements where mechanical and electrical specifications are identical.

A copy of Catalogue TV-155 giving specifications on the entire line of replacement transformers is available from the firm's distributors or from the company direct.

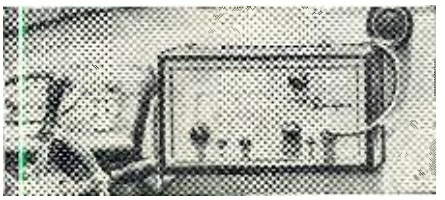
MARINE RADIO EQUIPMENT

Sonar Radio Corporation, 3050 West 21st Street, Brooklyn 24, New York

has added the "Snap-On, M35WS" to its line of marine radio equipment.

The new unit is a 35-watt radio with five marine channels, plus a broadcast band, designed for permanent installation on any vessel. It has an effective range of 50 to 200 miles.

The installation consists of a power supply which is located remotely, a tray that is permanently connected and mounted to the bulkhead in the binnacle area, through which the power cable of the power supply is fed, and the receiver-transmitter which is snapped on or off from the tray and



connected by means of a polarized plug. The unit comes complete with power supply, two pairs of crystals, a push-to-talk carbon mike, and a 17-watt p.a. system.

PC VARNISH

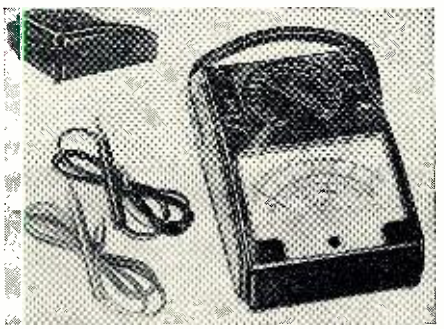
A new varnish designed especially as a protective insulating coating for modular assemblies, printed circuits, and printed circuit components has been developed by the *Schenectady Varnish Company* and is being marketed by *The Insl-X Sales Company,* 26 Rittenhouse Place, Ardmore, Pa.

More flexible than conventional coatings, the #642 printed circuit varnish can be baked or air-dried to a tough, resilient coating that completely seals the laminate and component leads against arc-producing moisture. A 2½ mil coating will withstand 1250 volts even after 72 hours exposure at 100% relative humidity. This highly arc-resistant varnish will not support tracking, nor will it char.

HICKOK V.O.M.

Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio has developed a portable v.o.m. which features a new technique that protects both meter and the entire internal circuit against accidental burnouts.

In the event of dangerous overload, the instrument disconnects itself and



raises a reset button on the case. Thus any high voltage may be applied directly across any function without

danger to the meter movement or associated components.

The new v.o.m. is currently available in two models, the Industrial Model 455 which has a sensitivity of 20,000 ohms per volt a.c. or d.c. and the Audio Model 456 with a sensitivity of 20,000 ohms per volt d.c. and 1000 ohms per volt a.c. It also includes db ranges and has provisions for output measurements.

4½" AND 5½" METERS

Two new lines of rectangular panel instruments, 4½" and 5½" in size, have been announced by *Simpson Electric Company,* 5200 W. Kinzie St., Chicago 44, Illinois.

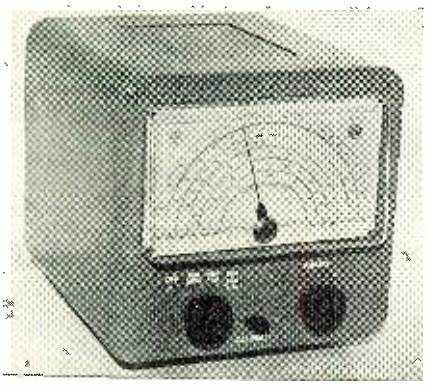
The 5½" instruments are available in three types: d.c. meters, r.f. meters, and a.c. rectifier-type units. Each of the three types can be supplied with external magnet meter movements or shallow or deep core magnet meter movements.

The 4½" size is available in the same three meter types and can be supplied with either the shallow or deep core magnet meter movement. Both sizes are available in standard black Bakelite cases or in the firm's new modernistic black Bakelite cases with chrome trim. All practical ranges can be supplied.

WRL'S NEW V.F.O.

World Radio Laboratories, 3415 W. Broadway, Council Bluffs, Iowa is now offering its Model 755 v.f.o. in both kit and wired form.

This newly-developed circuit is easy to operate and comes complete with a built-in power supply. The unit is calibrated on 160, 80, 40, 20, 15, 11, and



10 meters. It also incorporates a calibrated switch for zero-beating the signal frequency.

The instrument is housed in a streamlined case which measures 7" x 6⅝" x 7½". It comes complete with four feet of RG-59/U output cable and plug for a ½" crystal socket.

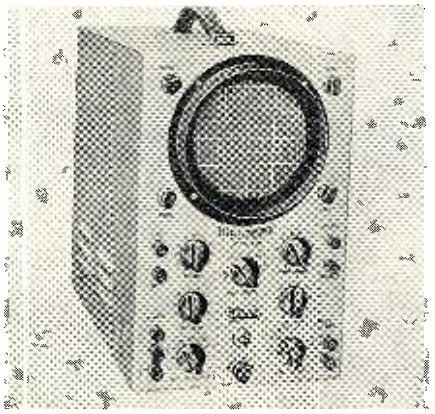
The company will supply a data sheet on this new unit upon request.

EICO SCOPE

Electronic Instrument Company, 84 Withers Street, Brooklyn 11, New York has added a 5 mc. bandwidth d.c. oscilloscope to its line of test equipment.

The Model 460 is especially designed for laboratory, production line, black

ard white, and color television servicing. It provides reproduction of the 3.58 mc. sync burst and 3.58 mc. oscil-



lator signals in color TV sets. Coverage is flat from d.c. to 4.5 mc., usable to above 5 mc.

The unit is supplied with a satin-finished aluminum panel and grey wrinkle steel cabinet. To facilitate calibration, the Plexiglas scale of the #460 is edge illuminated, with a dimmer control provided on the front panel. The illuminated scale is especially convenient for photographing a trace with the scale superimposed.

In kit form, the #460 is supplied with complete step-by-step instructions for assembly and operation.

JUNCTION POWER TRANSISTOR

To meet the need for a transistor with greater power than those currently available, *Amperex Electronic Corporation*, 230 Duffy Ave., Hicksville, Long Island, N. Y. has just introduced the Type 2N115 *p-n-p* junction power transistor that delivers 5 watts push-pull output with a 6-volt supply.

The transistor has a very high current rating at a low drop across the unit itself, the relationship between the base current and collector current is extremely linear and the gain is exceptionally high for the power level. It is internally insulated from its metal case, so that no external mica insulation is needed when mounting the unit on a chassis. The output impedance is low enough for a 5-ohm speaker voice coil to be used directly as the collector load in the audio output stage, thus eliminating the need for output transformers.

Complete specifications on the Type 2N115 are available from the manufacturer on request.

LOW-COST POTENTIOMETERS

Clarostat Mfg. Co., Inc. of Dover, N. H. has redesigned its "Humdinger," Series MB control, a low-cost potentiometer, to provide an increased range of resistance values from 2 ohms to 15,000 ohms, a gain of 14,000 ohms over earlier models.

In addition, the new version features insulated construction, with the wiper arm insulated from shaft mounting and bushing. An optional feature is the hollow-shaft construction which allows the mounting of a switch at the rear,

with the switch shaft passing through the center of the controls.

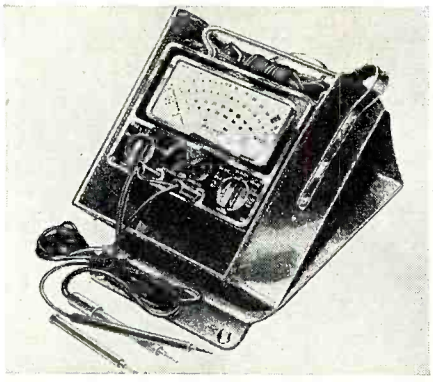
These units are especially useful in auto radio, dashlight dimmer, auto speaker, and various test meter applications.

PHAOSTRON V.T.V.M.

Phaostron Company, 151 Pasadena Ave., South Pasadena, California has announced the development of a new vacuum-tube voltmeter, the Model "777."

The new unit is a completely self-contained, ready-to-use instrument with all its accessories fitting easily into its genuine leather carrying case. Accessories include a high-frequency coaxial cable, d.c. probe, and a.c. line cord. A 28-page illustrated instruction manual accompanies the instrument.

The Model "777" has illuminated scales, a double-shielded 200 microampere movement, 42 unduplicated ranges, separate range and function



switches, unbreakable metal case, and two jacks which handle all of the measurement functions.

Write the company for full specifications on this new service instrument.

TEST SOCKET ADAPTERS

A complete set of test socket adapters, designed to make quick electronic measurements on any TV set chassis has been developed by *General Cement Mfg. Co.,* 400 S. Wyman Street, Rockford, Ill.

Four adapters are included in this kit, which is packaged in a convenient form for use in a technician's kit as well as on his bench. The kit facilitates the measurement of voltage and resistance, audio and video from the top of the chassis or the base of the picture tube. Besides the adapter for use with the CR tube, there is also included a 7-pin and 9-pin miniature test socket adapter and an 8-pin octal socket adapter. Each has extended test tabs, making it possible to use either alligator clips or test prods.

AMPLITUDE MODULATOR

Measurements Corporation, Boonton, New Jersey has just released an amplitude modulator which has been designated as the Model 115.

Operating over a frequency range of .1 to 50 mc. with external modulation frequencies of 30 cycles to 15 kc., it provides 100% amplitude modulation with low envelope distortion and negli-

gible incidental frequency modulation.

This instrument is designed for making measurements on systems requiring up to 100% modulation and on

narrow-band receivers where incidental FM cannot be tolerated. It may be used with any conventional AM or FM signal generator and an audio oscillator capable of producing approximately 10 volts across 100,000 ohms. The instrument is housed in a case of modern design and weighs only 15 pounds.

PORTABLE WORKBENCH

Argos Products Co., 6514 W. Higgins Road, Chicago 31, Illinois has developed a portable workbench for service technicians which has been tradenamed the "Quickie Bench."

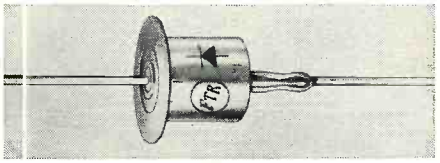
When folded for carrying, the bench resembles a small, low-height suitcase only 26" x 11" x 6¼" thick. It can be set up in less than 35 seconds to give a work surface 26" by 22" by about 25" high. In addition there is a small extension shelf, 9" x 12" on one end for a service meter or tube checker.

The work surface is of hard Masonite. Its wedge-type legs afford great strength and assure wobble-free support throughout the life of the bench.

POWER RECTIFIERS

A new series of germanium diffused junction power rectifiers is now available in production quantities from *Federal Telephone and Radio Company*, 100 Kingsland Road, Clifton, N. J.

The rectifiers, 1N91, 1N92, and 1N93, have a reverse current of at least 20



per-cent lower than RETMA specifications for the type. These units are particularly recommended for blocking, magnetic amplifier, and magnetic control applications. They can replace thermionic diodes in computers and, in addition, their low capacitance permits the passage of frequencies up to 50 kc., making them suitable for such uses as carrier-type servo amplifier rectifiers.

PORTABLE MEGOHMMETER

Freed Transformer Company, 1715 Weirfield St., Brooklyn 27, N. Y. has introduced a battery-operated version of its 1020B megohmmeter for measuring leakage of transformers, motors,

cables, capacitors, and insulating materials wherever a power line is inaccessible or where battery operation is more desirable.

The Model 2030 portable megohmmeter measures leakage resistance from 5 megohms to 10,000,000 meghoms in 5 ranges with an accuracy of ±3%. A regulated 500 volt supply is incorporated in the instrument.

TRANSISTORIZED VOLTMETER

A new portable voltmeter covering frequencies from 20 cps to 1 mc. has been developed by *Alto Scientific Company*, 855 Commercial Street, Palo Alto, California.

The Model D-21 is battery powered, is housed in a 5" high plastic case, and

weighs only 30 ounces complete. The instrument is transistorized and uses printed circuits for maximum ruggedness, dependability, and uniformity. Peak sensitivity is 0 to 1 millivolt and any of 12 decade (10 db) ranges may be switched on the front panel. A 10 megohm input impedance on all ranges prevents disturbances to circuits under test.

IMPROVED FILAMENT CHECKER

Service Instruments Company, 171 Official Road, Addison Industrial District, Addison, Illinois has announced a new version of its *Senco* filament

checker for locating the open filament in the new series filament TV sets.

The Model FC 4 is pocket sized and automatically checks all octals, loctals, 7- and 9-pin miniature tubes and picture tubes. The unit can also be used as a continuity checker and neon voltage indicator by merely inserting standard test leads in pins 1 and 12 of the picture tube socket. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

RECENTLY, the second meeting of the Electronic Service Council for National Unity was held in Indianapolis, Ind. The Council was formed early in August by association delegates meeting in Pittsburgh, Pa., for the purpose of bringing together all of the factions of the electronic service industry to determine whether the differences between the several groups could be resolved and a single national association created that would embrace all of them. It was decided at the Pittsburgh meeting that, to be successful and effective, a single national association must be representative of all elements of the electronic service industry. This would include shop owners, servicing dealers, and technicians. It was also the opinion of the delegates to the Pittsburgh meeting that an "umbrella" type of organization would be necessary to handle the integration of the several national and state groups into a single national association.

Prior to the Indianapolis meeting, most of the delegates felt that it would provide an opportunity for an open-minded exchange of ideas. Many looked forward to discussions of association programs that are currently successful as a means of appraising the changes that should occur in the direction of association affairs to take advantage of the best elements of the successful plans.

Following the procedure recommended by the Pittsburgh conference, the second meeting was opened by Bert Bregenzer of Pittsburgh, president of the Federation of Radio-TV Service Associations of Pensylvania. After the reading of the minutes of the Pittsburgh meeting by Gordon Vrooman of Syracuse, N. Y., secretary pro tem of the conference, the chairman invited nominations for a new chairman to preside at the Indianapolis meeting. In a skillfully executed maneuver, Joseph A. Barg, a professional trade association executive from Cincinnati, executive director of ATSCO, the NATESA affiliate in that city, was elected chairman of the meeting. Mr. Barg had been presented to the delegates as an attorney and a competent parliamentarian who would follow the basic principles of parliamentary law.

Shortly after the Indianapolis meeting started, the chairman of the meeting threw parliamentary law and procedure out the window. After brief presentations of the Texas Electronics Association plan of organization by Forrest Baker, president of the T. E. A.; the new NATESA plan for national organization by Frank Moch, president of that association; the United Nations plan by Max Liebowitz, president of ARTSNY and ESFETA; and the MINTSE plan by John Hemak, president of the Minnesota State Association, Mr. Barg led the meeting into a discussion of how the various associations could join NATESA, freely injecting his own opinions and, at times, confining the proceedings to two-way discussions between himself and Mr. Moch. A motion by Max Liebowitz of New York to form an entirely new national association was tabled by the chairman. The confusion of the proceedings led Murray Barlowe, president of the RTG of Long Island, to tell the chairman, 'There is something going on here that I do not understand."

Late in the afternoon the chairman called for a meeting between Mr. Moch and a delegate from each state. This meeting led to the development of a resolution to the effect that delegates would present to their constituents a proposal that they join NATESA and make any desired changes in the organization at the Spring meeting of NATESA in Omaha, Nebraska. This motion was later adopted unanimously by voice vote of the entire delegation.

State Associations

On the heels of their third and most successful annual electronics fair and clinic, the Texas Electronics Association is formulating a plan to encourage the formation of local associations in all sections of the Lone Star State. At the third annual clinic, held in San Antonio, Texas, outstanding authorities in the technical and business operating aspects of service passed along a wealth of information in the carefully-planned and skillfully-managed clinic sessions.

With three years of successful experience behind them, the officers of the Texas Electronics Association are already working on the details of the 1956 Electronic Clinic and Fair which will be held in Houston, Texas. The keen rivalry between the host cities,

Fort Worth, Dallas, San Antonio, and Houston, which rotate the meetings, will spur the Texas Electronic Technician's Association of Houston, host organization for the 1956 affair, to surpass the records established in the other three cities.

A number of associations met recently in San Francisco, Cal., to form the Television Service Betterment Committee of California. The aims of this committee are to educate the public, to present a stronger front to distributors, to promote an adequate State Licensing bill, and to put the "illegitimate" service shops out of business.

The following associations banded together to form the Television Service Betterment Committee of California: Radio & TV Association of Santa Clara; TV-Electronics Association of Marin; San Francisco TV & Radio Service Guild; Central Valley TV Service Association; Sonoma Radio & TV Association of Contra Costa; Tri-County Radio & TV Association; Radio & TV Dealers Association of Sacramento; San Joaquin Radio & TV Association; and the Bureau of Home Appliances of San Diego. Associations are being formed in Vallejo, Napa, Eureka, and Bakersfield.

The Indianapolis Television Technicians Association has taken the lead in inviting other associations in the State to meet in Indianapolis for the purpose of discussing the formation and organizational structure for a State-wide association. Invitations were sent to associations in Anderson, Muncie, Fort Wayne, South Bend, Elkhart, Gary, Logansport, Lafayette, Columbus, and Evansville. Other Indiana associations interested in a State-wide association have been invited to contact Robert M. Sickels, president, ITTA, 1859 South East Street, Indianapolis, Indiana.

The several active local associations in the State of Missouri met in Jefferson City during October to form the Television Electronic Service Association of Missouri. Jack Mulford of Springfield, Missouri, was named chairman of the new group; Howard Sieggen of Kansas City was elected treasurer, and William Pryor of Mountain Grove was given the post of secretary.

The group voted to become an affiliate of NATESA and appointed committees to draw up its constitution and bylaws. The next meeting of the forming association is scheduled to take place January 25 in Jefferson City.

The Television Service Association of Oklahoma, a State-wide group, was recently formed with H. O. Eales as president; Floyd E. Banks, Ed Cones, and Raymond Selby, vice-presidents; William S. Jones, secretary-treasurer; and Bob Armstrong, executive secretary.

Oklahoma service operators who are interested in this new development may get information by writing to the executive secretary at P. O. Box 9664, Shartel Station, Oklahoma City 18, Oklahoma.

The several Ohio associations represented at the national unity meeting discussed the project of calling a State-

wide meeting in Columbus to explore the possibility of forming a State group. In a previous meeting, members of the Associated Radio-Television Service Dealers of Columbus and the Television Service Guild of Dayton had agreed to work together to bring about such a meeting.

Ohio associations interested in discussing a State association should contact Fred Colton, Graham & Colton, 2552 North High Street, Columbus.

The Associated Radio Television Servicemen of Chicago have been encouraging the formation of local associations in other cities in downstate Illinois. Several new groups have been formed with the cooperation of ARTS officials. Illinois service technicians who are interested in assistance in forming local associations should write to Howard J. Wolfson, chairman, ARTS, 433 South Wabash Avenue, Chicago, Ill., for information.

The Minnesota Television Service Engineers, Inc., has developed some excellent basic material for association use that can be studied with profit by all groups working on the formation of State associations. One very important factor in the orderly development of electronic service into a recognized professional activity, is the development of nomenclature and standards for the classification of individual technicians on the basis of their knowledge, training, experience, and skills.

Details of the MINTSE program of technician classification and identification can be obtained from John W. Hemak, president, MINTSE, P. O. Box 42, Minneapolis 21, Minnesota.

Price Fixing

Many service associations do not seem to be aware of the illegality of standard schedules of labor pricing developed by associations for the use of their members. The following news item from the "Yardstick," house organ for the Kansas Appliance Dealers Association, is indicative of the attitude that may be taken by federal judges in interpreting violations of the Sherman Act:

'Many times we are asked why the association does not do this or that. Most recent of these questions has been: 'Why doesn't the association issue a chart of suggested prices for television service?' The following article from the 'American Trade Association Executive News Letter' will throw considerable light on the dangers involved in recommending, suggesting, or publishing standard charges as an association project:

'Preparation by a trade association of a 'suggested' price list can constitute unlawful price fixing *even in the absence of evidence* that members of the association agreed to follow the price list, or did so, a federal district court in Kansas has ruled.

'The association, composed of companies renting trailers for attachment to automobiles for one-way, single-trip use, prepared a schedule of suggested rental rates. The court's opinion de-

scribes the evidence as to this rental schedule as follows:

"As regards to the above referred-to price list, the evidence was and it is specifically found as a fact that the members of the NRTS did not strictly adhere to the price list. Nor was there any punishment ever inflicted for deviation. In fact, no evidence of any agreement to adhere to the price list was introduced. The price schedule was adopted by the association. The schedule itself was referred to by the defendants as a 'suggested' price schedule. The extent of the agreement concerning the price list was that it be circulated to all members. Several witnesses characterized the price list as a guide, 'something to go by.' The Court is unable to find that the price list was circulated for no purpose at all. . . . The Court concludes that the publication, adoption, and circulation of the schedule, while not fixing a rigid price, *was such tampering with prices as is forbidden by the Sherman Act.*

"Not directly mentioned by the Court is the fact that the restraint on competition is even harder to find because the members of the association did not compete with each other, there being only one at each locality." —30—

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ERRATA

On page 67 in the October, 1955 issue, rectifier filaments (5Y3) in the article, "The 'Minipack' #1" should be 2 and 8 instead of 2 and 7. Also, the sixth line, third column, "pin #7" should be "pin #8".

Also on page 67, column 1, the paragraph above "Construction Details," there are three references to 0.3 ampere. These should all refer to 0.15 ampere instead.

* * *

In the article, "A 13-Watt All Triode 'Infinite Feedback' Amplifier," page 69 in the November, 1955 issue, the vertical lead connecting the left end of R_{15} to the lead running up to the junction of R_3 and R_1 should be deleted.

* * *

On page 71 of the November, 1955 issue (the third line from the bottom, first column, "The 'Minipack' #2"), the correct reading should be "half-wave" rather than "full-wave."

* * *

The 15th line from the bottom of page 191, (November, 1955 issue, "Making Use of Load Lines"), $(R_2 \times R_4)/(R_2 \times R_4)$ should be $(R_2 \times R_4)/(R_2 + R_4)$.

INDEX OF Advertisers

JANUARY 1956

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

Classified

RATE: 50¢ per word. Minimum 10 words. March issue closes January 11th. Send order and remittance to: RADIO & TELEVISION NEWS, 366 Madison Ave., N. Y. C. 17.

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 18 or 21 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

CODE Oscillators Guaranteed. $4.00 Postpaid, or C.O.D. Details Free. Stout, 2241 E. Broadway, Muskegon, Michigan.

TRADE-IN Television Sets $14. Jones Radio, 1115 Rambler, Pottstown, Pa.

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 Southern Blvd., Bronx, N. Y.

NEW stock of Tung-Sol 6550 Audio Tubes $4.35 each, plus postage. Spera Electronic Supply, 37-10 33rd Street, L. I. C., N. Y.

SURPLUS Radios, Receivers, Electronic Equipment—Buy Direct from Government, Bulletin $1.00. Box 1842U, Hartford 1, Conn.

FOR Sale—Complete T.V. Laboratory and library, tubes and books. Send for complete inventory. F. J. Stephens, Hollister, Mo.

HI-FIDELITY Specials: Collaro RC-54, Ronette 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.

TUBE Bargains—865—$1.00, 615 (vt 235)—35¢, 7193—35¢. All Tubes Guaranteed New. Send Money order, Postage Free. Stern & Kaufman, 718 New Market Street, Philadelphia 23, Pa.

SCINTILLATION Crystals. NE-101 Plastic-Phosphors at new low cost, with instructions for use. Scintillation counter circuit $1. Uranium Yearbook $2. Geiger tubes only $5. Geiger counters $37.50 to $545. Scintillation counters $289 to $3500. Ultraviolet lamps. Metal detectors. Western Radiation Laboratory, 1107 West 24th Street, Los Angeles 7, California.

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.

MANUFACTURERS Surplus. Build your own Electronic Organ from these basic units: 60 note triple stacked shunt keying mechanisms, octave wired isolating resistor to each palladium contact. Three types available: Great 16', 8', 4' dimensions 5" wide, 2½" high, 36" long; Swell 8', 4' 2⅔" dimensions 3½" wide, 3¼" high, 36" long; Single Manual 16', 8', 4' including 12 pedal bass notes dimensions 4" wide, 3" high, 36" long; keying mechanisms—$10.00 each. Tone generator subassemblies consisting of 21, 400V and 600V capacitors and 15 resistors. $.50 each. Box 549, % RADIO & TELEVISION NEWS.

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 want all types airborne electronic equipment: ART-13; BC-788; I-152; ARC-1; ARN/7, etc. Top dollar paid! Bob Sunett, W6REX, 1524 S. Edris Dr., Los Angeles 35, California.

CYLINDER and old disc phonographs. Edison Concert, Balmoral, Conqueror, Opera, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia disc and cylinder Graphophones, Bettini micro-reproducer. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % RADIO & TELEVISION NEWS.

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-2, 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, parts, and components, DY-12 and DY-17 dynamotors, CU-25, etc. Also ARC-1 and ARN-7 material. Advise price condition first letter. Florida Aircraft Radio & Marine, Inc., P. O. Box 205, International Airport Branch, Miami 48, Florida.

WANTED Receiver R5/ARN-7, Transceiver RT18/ARC-1, MN-62-A, AN/ARC-3, Dynamotors, Test Equipment, Receivers, Transmitters. We Pay The Very Highest Prices. Send full information including quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 40th St., New York City, Telephone Lexington 2-6254.

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HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y. Ba. 7-2580.

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RADAR—Correspondence course, including Loran, Sonar and Microwave, now being offered. Inquire Progressive Electronics Institute, P. O. Box 27764, Los Feliz Station, Los Angeles 27, Calif.

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PHONOGRAPH Records Cheap. Catalogue. Paramount, NA—313 East Market, Wilkes-Barre, Penna.

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15 WATT HIGH FIDELITY AMPLIFIER

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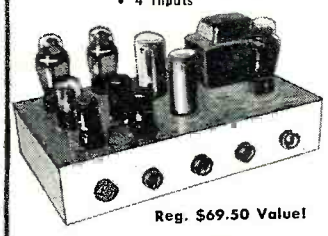

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Will outperform any Auto Radio on the market today!

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Complete with 9 section 82" solid brass whip antenna. Measures only 14" collapsed. Worth $9.20

Here's the auto radio with all the excellent features every car owner wants in his auto. Covers full broadcast range with powerful 10 watt push-pull output. Has 5 push-buttons and a sensitivity control in addition to manual tuning! Selective 8 tube circuit includes 2-6SK7's, 2-6V6's, 1-6SQ7, 1-6SA7, and 1-0Z4. Large 6"x9" speaker, push-pull output, and wide range tone control guarantee that this radio will outperform any competitive model on the market. It's ideal for tractors, trucks, boats and vacation camps as well as your automobile . . . truly the finest money can buy. Size: 9" nigh x 10" wide x 7¼" deep. Control shaft centers are 6-11/16" apart and require ½" diameter holes. Shpg. wt. 19 lbs. Complete with owners' installation manual, all necessary hardware, brackets and knobs. With tubes, less escutcheon.

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SPECIAL BUY—8" and 10" PHILCO SPEAKERS

Complete With 50L6 Output Transformer and AC-DC Choke Mounted on Frame! Extra Heavy Alnico V Magnets.

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Made for Philco, individually boxed. Excellent frequency response and power output. Ideal for replacement use or for original equipment design.

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4x6	450 Ohm	98c	10"	1700 Ohm	$1.49
6"	1700 Ohm	$1.05	10"	2500 Ohm	$1.49

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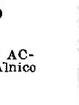

Famous Brand Diamond Styli designed to fit into new GE Reluctance Cartridge RPX-050A or old RPX-050. Replacement for GE #RPJ-013A. Has individually replaceable slide-in styli. Diamond and Sapphire.

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New Slide-in type diamond styli for RPX-041A or RPX-040. Complete assembly. List $27.50....$10.95 ea.

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Unmatched Value! Expertly designed indoor TV antennas attach in seconds. Mount invisibly on back of TV set. No unsightly rabbit ears or wings to spoil the appearance of the room. And what's more, they work! Buy them by the dozen and solve many of your TV antenna problems.

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REG. $12.50 **Only $1.98 ea.**

One of the most sensational Whip Antennas ever offered. 9 section solid brass construction. 82" fully extended, only 14" collapsed. Can be adapted to a hundred different uses. Designed originally for bumper mounting with a removable base clamp. Can be used on 2, 6, 10 or 11 meters. Removable mast makes it possible to base load this antenna for 20, 40 or 75 meters. Simplified construction makes it possible to use 6 of the whips as a low priced beam antenna, or 4 as a ground plane.

Stock No. R-AN75D .....3 for $5.45

BUILD YOUR OWN SNOOPERSCOPE

INFRA-RED SNOOPERSCOPE TUBE AND FILTER Reg. $39.50 **Only $7.95**

Now you can see in the dark with this ingenious infra-red viewing device. Made famous by Armed Forces during World War II. Simple to construct with parts easily obtained. Snooperscope tube and filter supplied are the only specialized parts required. Complete with instructions schematic and information sheet. **Stock No. SCR124**

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10 for $3.45 Worth $12.50

Here's a sensational kit value that has never been offered before. An assortment of 10 of the most modern and widely used germanium diodes. Complete with their specifications and interchangeability chart. Included are such currently used TV numbers as 1N34A, 1N57A, 1N54A, 1N56A, 1N38A and the latest GoldBond diodes TS6, TS3, and TS1. The retail value of these brand new, famous brand diodes is over $12.50. Order several kits to be sure of an adequate supply.

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TV REPLACEMENT CHOKE—2.5 henry at 150 MA. 60 ohms DC Res. Size 2¼" x 3¼" x 2". Mtg. Ctrs. 2¾" apart. Stock No. R-25H6.
59c ea.—3 for $1.59

250 MA SWINGING CHOKE—Rated at 4.5 henrys at 250 MA to 8.5 henrys at 50 MA. DC res. 150 ohms. Open frame mounting—2" H. x 2" W. Mtg. Ctrs. 3-5/15" apart. Stock No. R-SWK45
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JEFFERSON DUAL CHOKE—Two separate 8 henry 80 MA chokes in one case. JAN specs. Hermetically sealed. 6" H. x 2¾" x 3" Worth $10.00. Stock No. R-004105
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6.3 V @ 1 Amp. Worth $2.95 JAN SPECS **$1.19 Ea.** **3 for $2.95**

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304TH—$3.95 ea. 304TL—$7.95 ea.
6J6's—6 for $3.00 6SN7—5 for $3.00

Send for Bargain Tube Sheet No. 114—Thousand of Fabulous Tube Values!

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LATEST SARKES TARZIAN CASCODE VHF TUNER

Another exceptional tuner value from Concord. Latest 3 tube Sarkes Tarzian Cascode tuners for less than manufacturer's cost! Covers all 13 VHF channels with unusually high sensitivity and low co-channel interference. Designed to last a lifetime and give terrific fringe area reception. Ideal low cost replacement unit. Guaranteed Brand New and in excellent operating condition. Available for either 21 or 41 megacycle use. Please specify.

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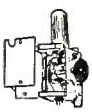
WESTINGHOUSE UHF RECEPTOR

Complete with 6AF4 Tube, Crystal Diode, Schematic and Instructions



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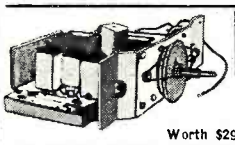

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Quickly locating the bad tubes
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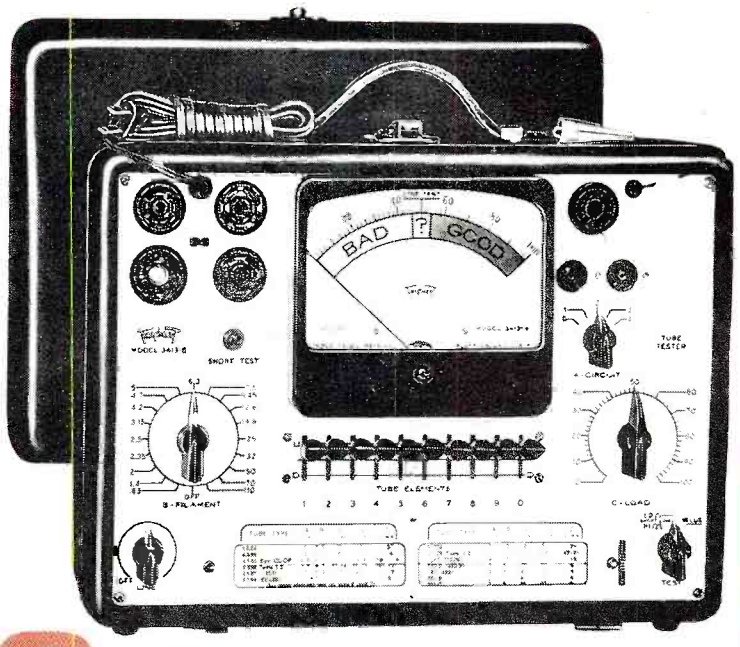

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SHORT TEST

Triplett model 3413-B combines provision for conventional short test (0.25 megohms) with high sensitivity leakage test (2.0 megohms)—will test series string tubes without adapter.

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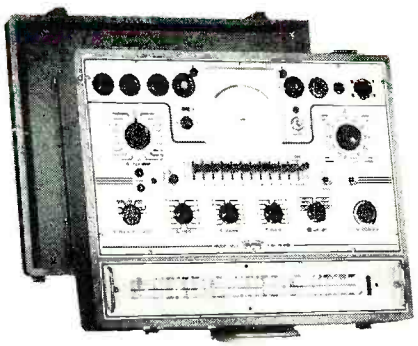

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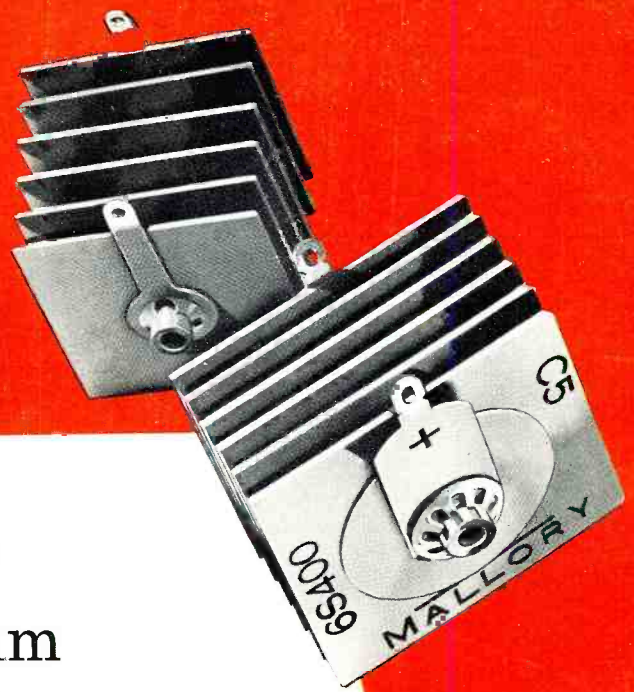

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