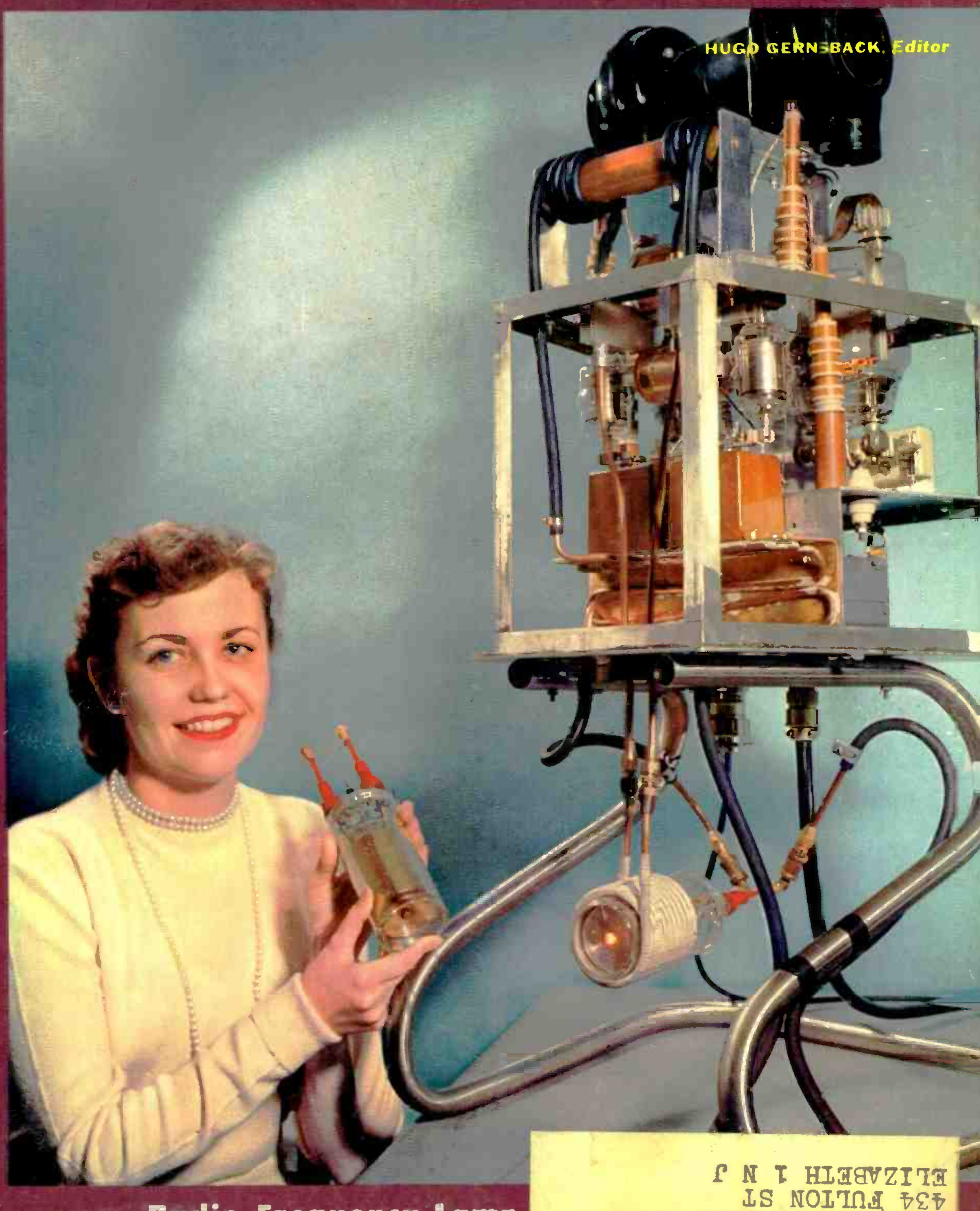
HIGH-FIDELITY OUTPUT CIRCUITS

RADIO-ELECTRONICS

MAY 1956

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor



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ON THE COVER

The world's brightest incandescent lamp, with the rf equipment that powers it. The lamp is mounted in the rf coil under the oscillator. A second lamp is held by Miss Jean Phillips of Sylvania Electric Products, Salem, Mass.

Color original by Larry Ankersen.

MAY 1956 **Vol. XXVII, No. 5**

Editorial

Test Instruments

Television

Audio—High Fidelity

Electronics

Radio

DEPARTMENTS

Average Paid Circulation over 175,000

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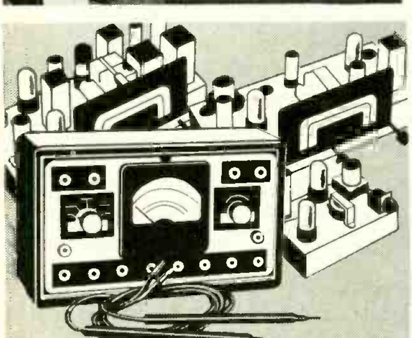

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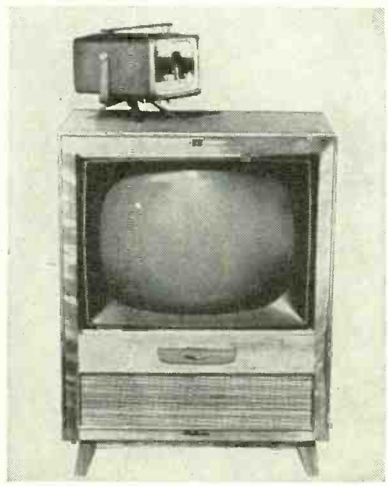
the Radio month

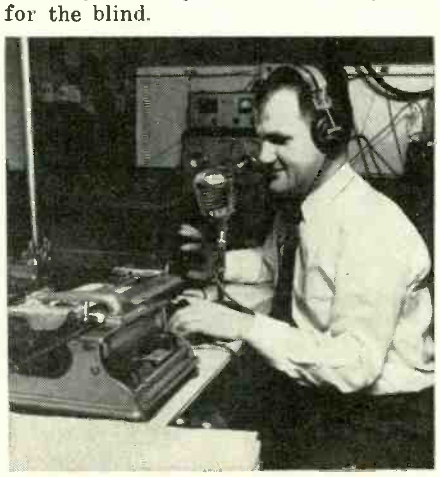
PORTABLE TV RECEIVER has been placed on the market by RCA. Only slightly larger than a table-model radio, the television set uses an 8½-inch picture tube having a 90° deflection angle. The cabinet measures 10¼ inches high, 9¼ inches wide and 12⅞ inches deep. It weighs approximately 22 pounds, making it a true portable.

The portable (shown in the photo



atop a 24-inch model) provides 36 square inches of viewing area. Although the chassis contains only 10 tubes plus the picture tube, 4 crystals, a tube rectifier and a selenium rectifier, it performs 24 tube functions, making it comparable to many larger sets.

BLIND RADIO AMATEUR has received G-E's 1955 Edison Radio Amateur Award. Sightless since birth, Robert W. Gunderson (see photo) operates amateur radio station W2JIO and is editor of the Braille Technical Press, the only monthly electronics magazine for the blind.



Gunderson has invented more than 30 types of special test instruments that open the electronics field to the blind as an occupation. A number of these were described by him in an article written for this magazine (March 1951). His work has been directly responsible for many of the 600 radio operator licenses that have been issued to the blind. The Edison Award, carrying with it a check for $500, is granted for outstanding ingenuity and sacrifice in using amateur radio in the public interest.

NEW COMMUNITY TV SERVICE has been outlined to the Senate Interstate and Foreign Commerce Committee by Milton J. Shapp, president of Jerrold. Seeking FCC permission to try the plan, Shapp stated that a very large antenna, similar to those used in many community television systems, would be placed on a mountaintop in the Ellensburg, Wash., area. It would receive uhf signals, amplify them and then retransmit through a directional horn type antenna to a receiving point in the valley. The transmitter would operate on 1/10 watt. The received signal is converted to vhf before it is fed into the coaxial cable for home receiver use.

COLOR TELEVISION, computer advances, space electronics, scatter propagation and medical electronics keynoted the 1956 IRE convention held in New York City March 19–23. Attendance was over 40,000, a startling figure for a convention that opened in the midst of the worst blizzard the northeast section of the country has seen for many years.

Some 275 technical papers were read at 55 sessions. Color picture tubes received great attention. Several types, including Philco's mysterious *Apple*, were the subject of papers. Tape recording of color was the subject of five papers. The session on the Earth satellite program attracted more than 2,000 people, jamming the meeting hall and necessitating two overflow meetings. Zworykin, of television fame, told the delegates how computer techniques could improve medical diagnosis.

Exhibitors occupied 714 booths, showing everything from a ½-ton radar antenna to a 3-transistor amplifier with a gain of 70 db, yet occupying a space of only 5/16 x 3/16 x ⅛ inch, smaller than many single transistors. Philco M-1's were the units used in this particular amplifier.

PORTABLE TV TRANSMITTER has been unveiled by the U.S. Signal Corps. Weighing only 8 pounds, the camera can be easily held in the hands like a home movie camera. The transmitter, complete with built-in power supply, weighs 47 pounds.

Freed for the first time from cumbersome cable connections that harnessed him to a source of power, the Signal Corps cameraman (see photo) can now reach previously inaccessible

spots—through forests and hedgerows, over ditches, etc. The camera can also be left unattended in dangerous areas. The voice accompanying the picture is handled by handy-talkie radio. In recent tests pictures a mile away were picked up by the camera and transmitted ½ mile to a television receiver mounted in a jeep, the jeep's electrical system supplying power for the receiver.

The transmitter can operate continuously and unattended for 2 hours from a five-cell rechargeable silver-zinc battery about one-third the size and weight of a car battery. Push-button controls at the jeep permit monitoring several cameras in the field.

TOLL-TV TRIAL has been urged by Federal Communications Commissioner Robert E. Lee. Writing in *Look* magazine, he said he was convinced that endless legal procedures, hearings and studies will never answer the questions of whether the public wants pay-as-you-see TV and will support it.

Lee proposed that the FCC adopt the following program: Approve subscription TV on a broad basis, leaving it up to the individual to choose the system he wishes to use; apply some temporary restrictions to toll TV, such as limiting it initially to uhf stations; permit the trial period for toll TV to continue long enough to test public reaction truly; permit stations to drop toll TV if they find it does not fill a market need in their own area.

He stated further that these views are strictly his own and do not reflect the opinion of the commission, which presently has the subject under consideration.

Calendar of Events

79th Convention of Society of Motion Picture & Television Engineers, April 29–May 4, Hotel Statler, New York City.

1956 Electronic Components Symposium, May 1–3, Department of Interior Auditorium, Washington, D. C.

1956 Electronic Parts Distributors Show, May 21–24, Conrad Hilton Hotel, Chicago. (A closed show for distributors, manufacturers and their representatives. RADIO-ELECTRONICS will exhibit in Room 632.

RETMA Symposium on Reliable Applications of Electron Tubes, May 21–22, Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa.

GIANT RADIO TELESCOPE capable of detecting celestial objects at distances close to the limits of the observable universe will be constructed near Delaware, Ohio. Work on the super radio telescope is scheduled to start late this spring with a grant of $48,000 from the National Science Foundation, Washington, D.C., to the Ohio State University electrical engineering department. The site is near Perkins Observatory, operated jointly by Ohio Wesleyan and Ohio State universities.

The reflecting type radio telescope will be about 700 feet long and 75 feet high, making it the largest of its kind in the world. Actually, the telescope is a giant radio antenna which receives radio emanations from the heavens much as an optical telescope receives light waves.

The antenna system will include a parabolic reflector and a flat, tiltable reflector to deflect radio waves from the sky into the curved portion, which in turn will focus the waves into a large metal horn. The horn will funnel the waves into an ultrasensitive receiver to be housed in a small building.

THREE NEW TV STATIONS have gone on the air since our last report:

KINY-TV Juneau, Alaska 8
WDMJ-TV Marquette, Mich. 6
WAST Hagaman, N. Y. 29

WIRK-TV West Palm Beach, Fla., channel 21, and WTAO-TV Cambridge, Mass., channel 56 have gone off the air.

KULA-TV, Honolulu, T. H., channel 5, will change its call letters to KTCA, effective June 1.

COSMIC RAY BOMBARDMENT, the greatest ever recorded on earth, began pouring on the earth around Feb. 22, following a tremendous flare on the surface of the sun which scientists estimated was equal in force to 1,000,000 hydrogen bombs.

They said it was the first clear evidence that radio waves were somehow associated with the production of cosmic radiations. The bombardment interrupted network radio communications between Rome and London and New New York and crippled shortwave communications throughout the world. END *your source of finest TV and Radio Tubes is*

first in transistors... RAYTHEON

Raytheon's pioneering in the research, development and production of Transistors has resulted in many important "firsts" — firsts that give Raytheon an unchallenged lead in the field. Here are some of these firsts:

FIRST in commercial production. Raytheon was the first company to commercially produce and sell junction transistors. These first transistors set high performance standards as they revolutionized the hearing aid industry.

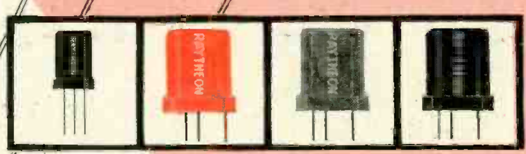
FIRST in RF Transistors. Raytheon scored another important first by leading the way in RF Transistors, too. The first commercially produced RF Transistors — Raytheons — are revolutionizing the portable radio industry, and are being used in computers and communication equipment. Many major manufacturers of portable radios use these Raytheon RF Transistors and all "hybrid" portables use either Raytheon Transistors, Raytheon Subminiature Tubes or a combination of both.

FIRST in PNP Silicon Transistors. Raytheon alone makes a line of PNP Silicon Transistors that fills the need for transistors that will operate at high temperatures.

FIRST Major Manufacturer to Break the Dollar Barrier. A most important first to you — Raytheon is the first major supplier to achieve such high production and product acceptance of their transistors that one of the line could be priced at less than a dollar — Raytheon quality transistors range in price from 99¢.

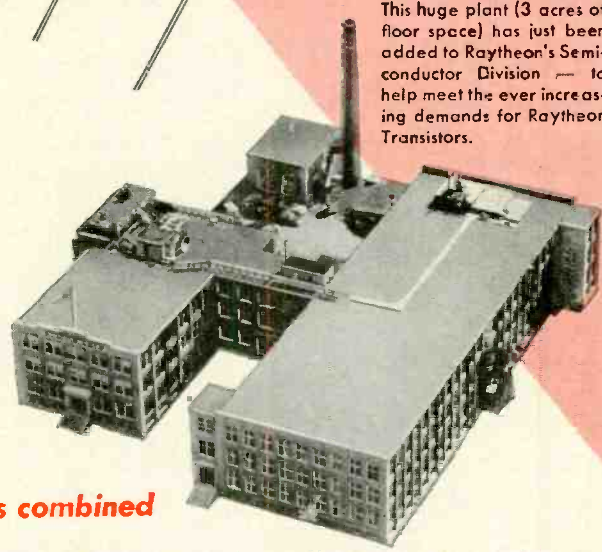
At Raytheon more than 100 engineers and scientists, plus nearly 1400 other employees are devoted to a single task — the design, development and production of the finest and best in transistors and diodes. To help them work more efficiently, and to meet increasing production schedules Raytheon recently added facilities totaling three acres of engineering and manufacturing space to its Semiconductor Division.

Raytheon Tube Distributors from coast to coast stock and recommend Raytheon Transistors.



ACTUAL SIZE

This huge plant (3 acres of floor space) has just been added to Raytheon's Semiconductor Division — to help meet the ever increasing demands for Raytheon Transistors.



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Raytheon makes all these: Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

Visit Raytheon Booth No. 4 at the ELECTRONICS PARTS DISTRIBUTORS SHOW May 21-24—Badges issued only in advance—No registration at the show

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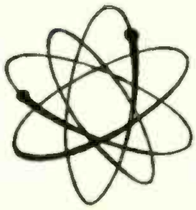

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If you have had any practical experience—Amateur, Army, Navy, Air Force Radio repair, experimenting, etc.

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

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Then use our amazingly effective JOB FINDING SERVICE

Employers make job offers like these to our trainees every month...

Transcontinental Airline: "American Airlines is very much interested in receiving applications from CIRE trainees. We have immediate need for technicians in many cities."

West Coast Manufacturer: "We are currenty in need of men with electronics training or experience in radar maintenance, and we would appreciate if you will refer interested persons to us."

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	*License*	*Time*
A/1C Ronald H. Person, St. Louis 20, Mo.	1st Class	25 weeks
Milton L. Geisler, ET3, FPO, San Francisco, Calif.	1st Class	26 weeks
Marvin F. Kimball, Lafayette, Ind.	2nd Class	21 weeks
L. M. Bonino, Harlington AFB, Tex.	2nd Class	16 weeks
John E. Hutchison, Bluefield, W. Va.	1st Class	27 weeks

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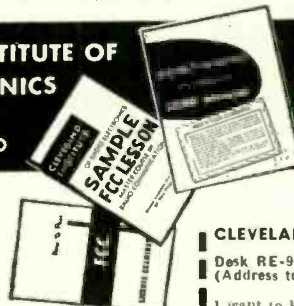

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Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Trainees Get Better Jobs

Here are a few recent examples of Job-Finding results:

ELECTRONICS TECHNICIAN

"I am now employed by the Collins Radio Company as a Lab Technician. (This job was listed in your bulletin.) I have used the information gathered from your course in so many ways and I know that my training with CIRE helped me a great deal to obtain the job."

Charles D. Sindelar, Cedar Rapids, Iowa

AIRLINES

"I replied to the Job Opportunities you sent me and I am now a radio operator with American Airlines. You have my hearty recommendation for your training and your Job-Finding Service."

James A. Wright, Beltsville, Md.

INDUSTRIAL ELECTRONICS

"Upon my discharge from the Navy I used your Job-Finding Service and as a result I was employed by North American Aviation in electronic assembly (final checkout)."

Glen A. Furlong, Fresno, Calif.

MOBILE SERVICING

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

Robert W. Cook, Odessa, Texas

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SYNTHETIC MUSIC

Dear Editor:

On receiving the March issue of RADIO-ELECTRONICS my attention was, naturally, captured by the article "Synthetic Music via Electronics," by Sol Heller.

I have for some months now, had the RCA Victor LP record *L.M. 1922 Experimental* which demonstrates many of the capabilities of this electronic music synthesizer. This, however, is unfortunately not mentioned in Mr. Heller's article. Anyone interested in this subject should by all means get the record for it demonstrates clearly the advantages and at least the present limitations of this method for production of music without performing artists. No doubt many improvements will be made so that most if not all of the subtle artistry of performing artists will be well simulated. The practical aspects of this development may, however, be impeded from unexpected quarters—for example, Mr. Petrillo!

My own interest might best be expressed by a prophetic quotation of the two concluding paragraphs of my 1936 paper "Electronic Music and Instruments," published in *Proceedings of the IRE*, Vol. 24, No. 11, pp. 1427–63:

"The ideal instrument is one which can make any sound known, unknown or conceivable; to do this we must provide a generator for periodic vibrations embracing the whole audio spectrum of frequencies. We must be able to select from this generator at will any desired single frequency or many single frequencies simultaneously, whether harmonically or inharmonically related or whether in narrow or wide continuous bands. We must further be able to emit these frequencies in any desired sound amplitudes and envelope shapes, even though, in a given sound, all the components require different shapes of envelope. We must be able to control the emission of these sounds by some suitable playing technique and apparatus.

"With such an apparatus we shall be able to synthesize any possible sound, continuous, damped, transient, musical or nonmusical, for we have all the elements of sound and means for putting together any desired combination of these elements in any desired time–amplitude relationship."

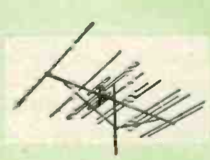
BENJAMIN FRANKLIN MIESSNER
Miessner Inventions, Inc.
Morristown, N. J.

damaged, weather-worn, obsolete!

6 out of 10 need replacement now!

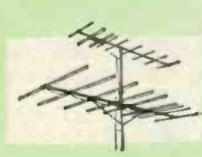
replace them with CHANNEL MASTER TV ANTENNAS

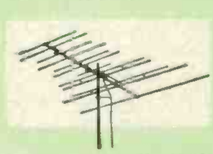
FIVE ALL-CHANNEL FAVORITES — TOPS FOR REPLACEMENT!



SUPER RAINBOW *model no. 331*
Still the most sensitive all-channel antenna made! Other popular Rainbow models also available.

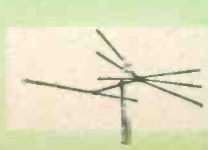
"K.O." *model no. 1023* (broad band)
Knocks out "venetian blinds" with the highest front-to-back ratios ever recorded!





TRAILBLAZER *model no. 335*
Extra elements provide extra performance at no extra cost!

New LANCER *model no. 337*
Popular fringe-area installation — new rugged powerful design. Also available: Super Lancer, and new economy "Challenger" model.



SUPER FAN *model no. 313A*
The finest of Fan-antennas — superior both electrically and mechanically!

Here's the greatest profit opportunity in TV today!

The "Golden Age" of antenna replacement is here! Time has finally caught up with millions of older TV antennas that no longer provide good reception.

A national survey shows that 65% of all TV set-owners in established areas are not getting the picture quality they *should* be getting. THEY NEED NEW ANTENNAS! And you can profit in a big way by replacing now with a powerful, new CHANNEL MASTER installation!

YOUR BEST REPLACEMENT BUY is Channel Master, America's most widely advertised and merchandised antenna line. Channel Master provides you with the most advanced electrical designs, the soundest construction, the easiest, fastest installation.

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CHANNEL MASTER CORP.
ELLENVILLE, N. Y.
WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS AND ACCESSORIES

LIKES OUR ARTICLES

Dear Editor:

"Those Deadly Intermittents," on page 98 of RADIO-ELECTRONICS, December, 1955, made very refreshing reading on this side of the Atlantic. It is indeed encouraging to learn that dealers and service technicians on your side experience the impatience and irritation of viewers when their TV gives out on them. *Televitis* is a terrible modern complaint which calls on all one's resources to combat. It is a boost to self-confidence to learn that a similar technique to what we have developed here is successful in dealing with service complaints. Some unenlightened people look askance on practices which start with "bottle-tapping" and customer interrogation, but surely this seems to be the quickest and surest way of getting at the trouble.

F. E. DYER

Sheffield, England

A CASE AGAINST LICENSING

Dear Editor:

May I answer John Wheaton's article titled, "Licensing—Bad or Good," which appeared in your January issue? I am opposed to licensing in any form! This subject has occupied my attention the past 4 years and all the statutes which Mr. Wheaton mentions are in my file and have been read by me carefully. What he failed to mention—and most certainly it should be highlighted—is one thing all these laws have in common—punitive and vindictive features. They hold the threat of heavy fines and imprisonment over those who come under their control and contain license-revoking powers.

As a small, independent shop owner, it has always been my belief that "He governs best who governs least." There are of course those vocations like law, dentistry and medicine whose complexity and impact on our daily life require that those who follow them need to give proof of their fitness and training. (It would make interesting reading indeed if some people could tell of their experiences at the hands of these licensed gentry.)

But why, why, this insistent demand for licensing radio and TV men? Is it really to exclude the part-time operator, the incompetent; to shackle and get rid of the chiseler and the cheat? Or because of so-called excessive charges?

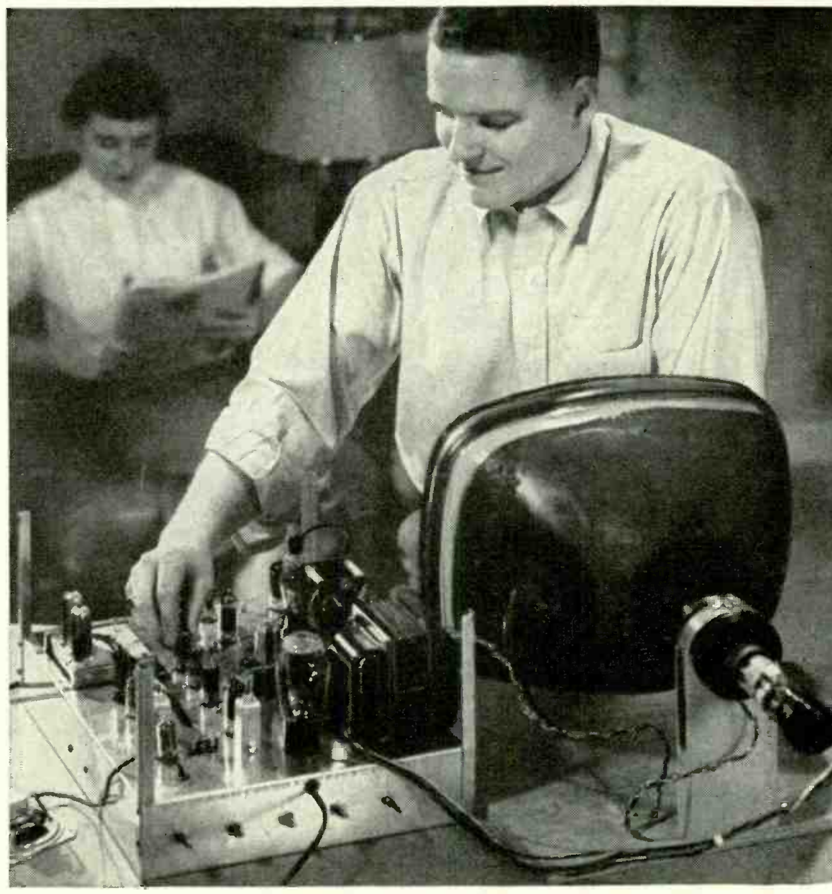
In the spring of 1953, when the art was newer and I was gathering material to fight a licensing attempt in Illinois, I wrote to Better Business Bureaus in representative cities asking their experience about television complaints against service technicians. As a comparison I wrote in the spring of 1955 to these same BBB offices and received the information that complaints generally had diminished sharply; that the public was pleased with the technical abilities of service technicians, and that charges generally were not excessive. You may also re-

(*Continued on page* 18)

An Invitation...

To men who want to *"go places"* in TV SERVICING

Find out about this NEW, ALL-PRACTICE WAY of becoming a Professional TV SERVICEMAN



Train at home easily, quickly, for TV's top servicing jobs. NRI's Professional Television Servicing course includes a 17-inch picture tube and all other tubes and components to build a complete TV Receiver, Oscilloscope, Signal Generator, H.F. Probe. Complete training, including all equipment, available now for a low introductory price—under $200 on easy terms.

If you have some Radio or Television experience, or if you know basic Radio-Television principles but lack experience—NRI's new Professional Television Servicing course can train you to *go places* in TV servicing. This advertisement is your personal invitation to get a free copy of our booklet describing this training in detail.

Learn-by-Doing "All the Way"

This is 100% learn-by-doing, practical training. We supply *all* components, *all* tubes, *including* a 17-inch picture tube, and comprehensive manuals covering a thorough program of practice. You learn how experts diagnose TV defects quickly. You see how various defects affect receiver performance—picture and sound; learn causes of defects, accurately, easily, and how to fix them. You do more than just build circuits. You get practice recognizing, isolating, and fixing innumerable troubles.

You get actual experience aligning TV receivers, diagnosing the causes of complaints from scope patterns, eliminating interference, using germanium crystals to rectify the TV picture signal, obtaining maximum brightness and definition by properly adjusting the ion trap and centering magnets, etc. There isn't room on this or even several pages of this magazine to list all the servicing experience you get.

UHF & COLOR TV Making New Boom

Installing front-end channel selector strips in modern UHF-VHF Television receivers and learning UHF servicing problems and their solution is part of the practice you get. To cash in on the coming color TV boom you'll need the kind of foundation in knowledge and experience this training gives.

Get Details of New Course Free

Once again—if you want to go places in TV servicing, we invite you to find out what you get, what you practice, what you learn from NRI's new course in Professional Television Servicing. See pictures of equipment supplied, read what you practice. Judge for yourself whether this training will further your ambition to reach the top in TV servicing. We believe it will. We believe many of tomorrow's top TV servicemen will be graduates of this training. Mailing the coupon involves no obligation.

National Radio Institute, Dept. 6EFT
16th and U Sts., N.W., Washington 9, D. C.

Please send my FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

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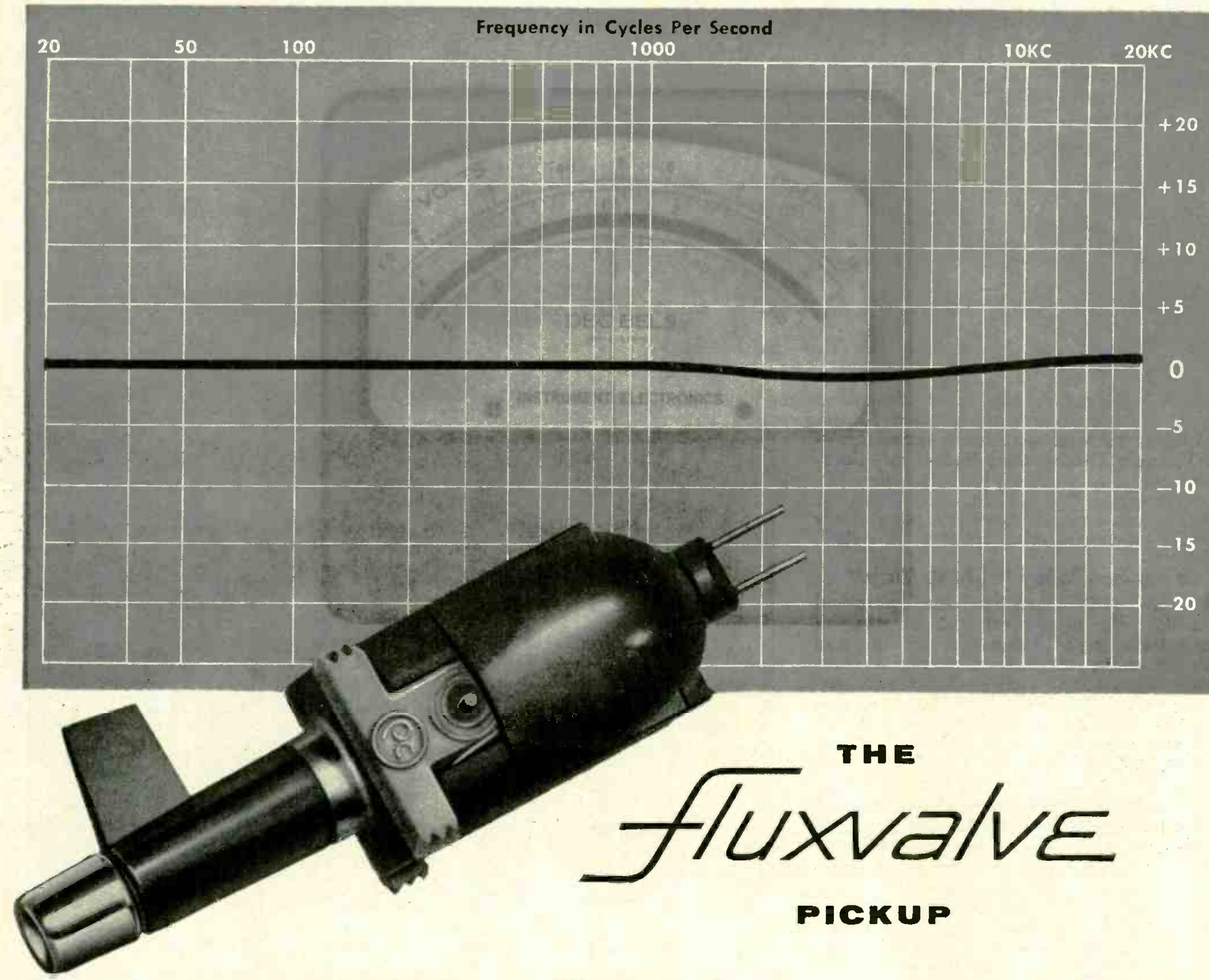
Address..

City..........................Zone....State......

APPROVED MEMBER NATIONAL HOME STUDY COUNCIL

At Last... and for the first time!

A PICKUP FOR CALIBRATING RECORDS!



THE *fluxvalve* PICKUP

Important as it is to the recording industry, the FLUXVALVE offers values never before available to thousands of record playing enthusiasts!

- *Very Wide Range (VWR)*
- *Unequalled transient response*
- *Long record and stylus life*
- *Low overall distortion*
- *Hermetically sealed*
- *Easily replaceable styli* ✲

✲ **Less than 1 mil stylus on special order**

THE FLUXVALVE PICKUP was originally developed for professional applications, particularly recording studios where accurate correlation between lacquer, master and pressings is essential, and has always been difficult. Now with the FLUXVALVE magnetic turnover pickup with which to make precise and *reproducible* record-measurements, a vital control step is simplified.

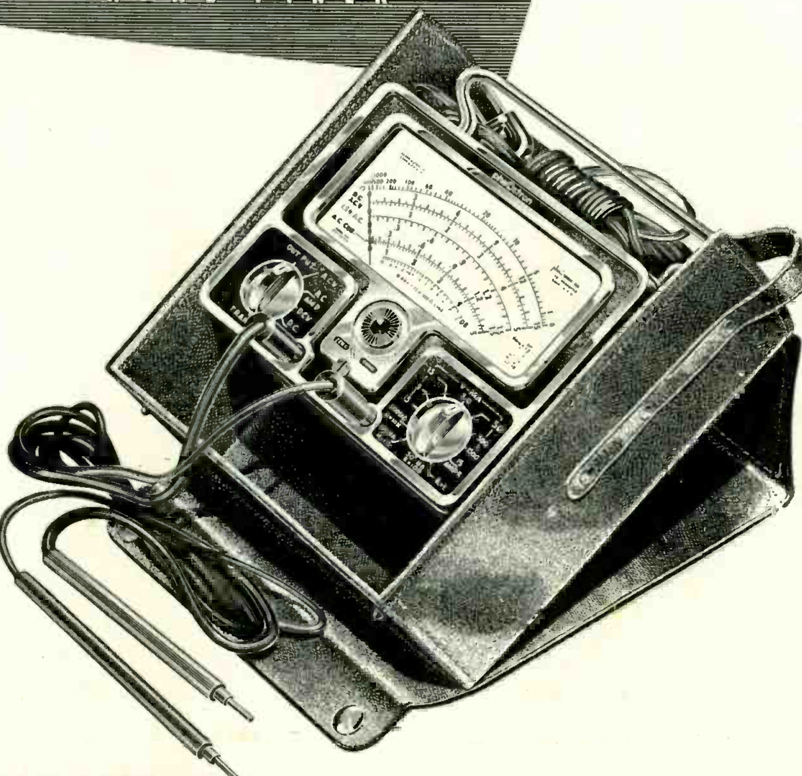
For a new listening experience, ask your dealer to demonstrate the new FLUXVALVE . . . *words cannot describe the difference . . . but you will hear it!*

PICKERING & CO., INC. OCEANSIDE, N.Y.

Professional Audio Components *"For those who can hear the difference"*

. . . Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature: write Dept. P-10

EXPORT: AD. AURIEMA, INC., 89 BROAD ST., NEW YORK / CANADA: CHARLES W. POINTON LTD., 6 ALCINA AVE., TORONTO



call that RCA conducted a Roper poll and found the same answer.

What then lies in back of this clamor to license you and me? The sad fact is that smart and capable technicians are being swayed into aiding and abetting this legislative stupidity for which there is no real need. They are selling themselves a bill of goods. They think that by putting a legislative straitjacket on their competitors, their own troubles will disappear like mist in the morning sun. The chiseler can never be eradicated by legislation; he is a disease that you have to learn to live with. Licensing yourself may well put you out of business however.

Let me point out how a license law can be a constant threat to your livelihood. Making a living in one's chosen field in this country should be a *right* and *not* a privilege granted by statute.

In that great body known as *the public* move all kinds of people including the chiseler, the hater, the troublemaker, the "there ought to be a law" type of individual. These particular people are always looking for a chance to throw their weight around. A licensing law is made to their order. You can plate your service work with the golden sweat of honest effort and knowledge of a job well done but these people give you the rap every time.

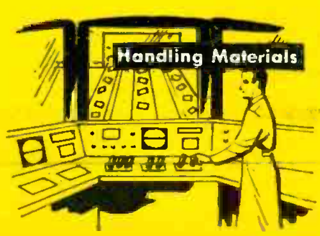
Then you will have the commission, or jury, or whatever you will choose to call the public body appointed to oversee the law and hear the complaints brought against you. You are a small shop operator and a member of the *public* complains to this group that you have done him wrong. You have to close your shop and come before this group to answer that complaint. It is dismissed. But there will be others. In time you come to live in fear of such injustified accusations for which you must answer to a jury.

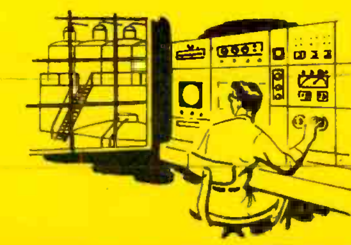
The time can come when the license body will say to you, "Mr. Service Technician, we have had numerous complaints about you. True, they have all been dismissed, but we feel that there must be some basis for these accusations and we are compelled to put you on probation. Many more such complaints and of necessity we will have to revoke your license in the *public* interest." From then on, brother, *you* are on *borrowed* time!

These public commissions must have a record of positive accomplishment. At the start they may bend over backward to be impartial but as time goes on they simply sink into the slough where all such agencies land—bureaucratic indifference. They are out to show the public how well its interest is defended, and you are the goat. If the continued attrition and pressure of needless complaints and appearances to defend yourself won't force you to throw in the towel, they will.

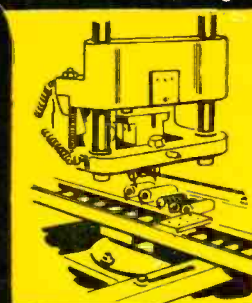
HOWARD WOLFSON
Chairman, Associated Radio & TV Servicemen
Chicago, Ill.

MEN 17-55!
HERE'S A NEW OPPORTUNITY FOR YOU!





PREPARE AT HOME FOR A PROFITABLE CAREER IN AUTOMATION ELECTRONICS*



Get in on the Ground Floor of this Fast-Moving Field

Want a better job? . . . more money? . . . better working conditions? These are the things that can come to a man when he has a *skill* to offer . . . especially when that skill is in a newer field where ground floor opportunities often lead to well-paying positions. Such a field is the Electronic applications to AUTOMATION — and *what a field!*

Many plants, large and small, in various parts of the country are looking for ways of using automatic electronic control equipment to help turn out a better product and at lower cost. This equipment must be designed, installed and maintained — calling for well trained men. That's where YOU may come in!

You need no special technical experience . . . no previous knowledge of Automation Electronics . . . to prepare for a future that can be bright and more secure. For now there is a proved way to get this important know-how. Mail coupon for complete details. Men 17 to 55 preferred.

*WHAT IS AUTOMATION ELECTRONICS?

Simply stated, this refers to the marvelous electronic controls that will help regulate the much talked about "automatic factory"—as well as other amazing automatic equipment in plants, offices and elsewhere. It is a gateway to some of the most desirable opportunities in the amazing, newer field of Automation.

A New Training Program!

As one of the leading organizations of its kind, the DeVry Technical Institute has years of experience in teaching Electronics, Television and Radio. So it is only natural for this training institute to develop a new program to prepare men for good jobs in instrumentation — as well as in the design, installation and maintenance of Electronic controls — as applied to Automation.

EMPLOYMENT SERVICE

Following the same proved method used to train thousands of other men, you get valuable practical experience from actual electronic equipment. You also receive well-illustrated texts and effective moving pictures to show important basic principles—a wonderful home training advantage! To top that off, D T I provides actual employment help when you have completed the training—all of which can open the way to many new and exciting opportunities.

Member of National Home Study Council

ONE OF AMERICA'S FOREMOST ELECTRONICS TRAINING CENTERS

DEVRY TECHNICAL INSTITUTE
CHICAGO 41, ILLINOIS
FORMERLY
DEFOREST'S TRAINING, INC.

MAIL THIS COUPON TODAY!

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I would like further information about the newer Electronic opportunities in AUTOMATION, also facts on how you may help me to prepare.

Name________________________ Age____
Please Print
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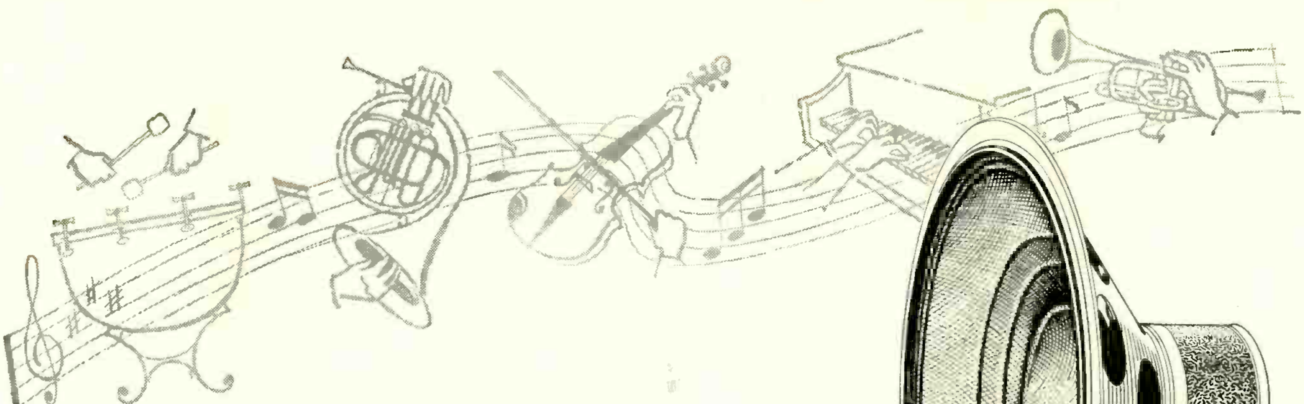
City________________ Zone____ State____

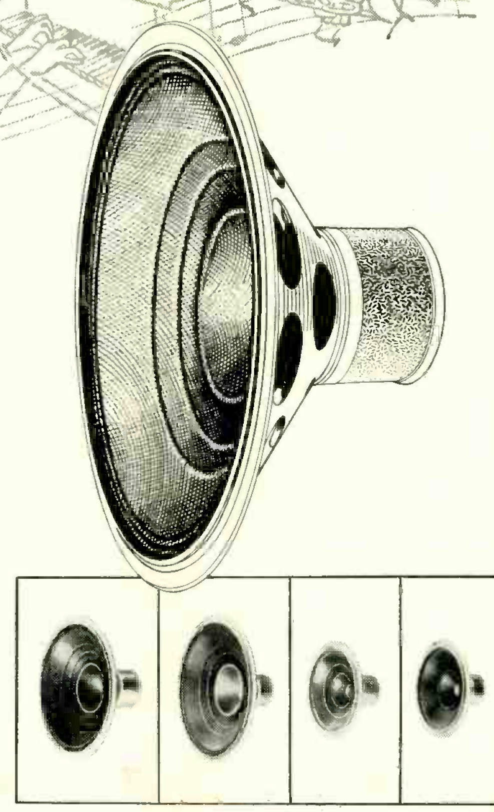
1012 DTI's training is available in Canada

Excitingly new

"LIVING SOUND" IS YOURS TO ENJOY WITH NORELCO *F.R.S.*

FULL RESONANCE TWIN-CONE SPEAKERS





High fidelity and tonal qualities associated with expensive multi-unit speaker systems—are similarly produced with new Norelco FRS Twin-Cone Speakers.

Norelco's exclusive Twin Cones are made from specially selected and matched materials—operated from the same magnet and voice coil—some covering an extremely wide range up to 20,000 c/s. Norelco's twin-cones are always in phase and operate in harmony—providing the same degree of efficiency under all conditions.

Unequalled manufacturing precision and quality is inherent in all Norelco speakers. All component materials—including magnets, wire and even cone materials—are manufactured and assembled by Philips to suit a specific speaker design.

Many sizes in standard impedances are available from your dealer or send to Dept. D-5 today for more details. Norelco FRS speakers are priced from $59.98 to $9.90 audiophile net.

Add to... and improve any sound system with *Norelco*

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In theory many centuries have gone into the development of the Univac.® Only recently, at Remington Rand Univac, has it achieved product perfection. The tremendous strides forward in the past few years are due to the imagination and creative genius of the scientists and engineers of Univac. Recognized leaders in the field of electronic computer systems, they are the men *who set the standards for others to follow.* You can become a member of this team . . . where ambition and professional skill find their reward in limitless opportunities in an expanding organization.

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in RADIO-TV-ELECTRONICS

What would a $10 or $20 a week raise mean to you?

Think of it! Only one $10-a-week raise will repay your investment in CREI training, and leave you a profit of $200 or more the very first year! Your increases in pay thereafter are all pure profit, and you'll be prepared for many more promotions and pay raises in the future years of your life!

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Why let opportunity to make more money pass you by because of lack of training? This booklet describes in detail how CREI training equips you quickly at home to forge ahead into a good paying job—in TV (color, too)—industrial communications—research—aeronautics and scores of other fields in this mushrooming industry.

CREI Training Means Promotion, Pay Increases Within a Short Time

Here are just a few letters received from CREI students:

"In this time of less than two years, I have almost doubled my salary and have gone from wireman to engineering assistant and now to junior engineer. I have CREI to thank."—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

"I chose CREI training upon recommendation of two top engineers. Before I completed the course I became transmitter chief of a 5KW station. I am now employed as a technician at a 100 KW TV station and in spare time have a good TV sales and service business."—Arlie D. Patton, 203 Burke Ave., San Antonio, Tex.

CREI TEACHES YOU WHAT INDUSTRY WANTS

Industry recognizes this, by choosing CREI to train their own technical staffs. Among them: United Air Lines, Canadian Broadcasting Corporation, Sears, Roebuck & Co., Bendix Products Division, All America Cable and Radio, Inc., Radio Corporation of America.

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CREI Residence School in Washington offers instruction at same high technical level. Classes start frequently. Qualified residence school graduates earn degree: Associate in Applied Science. Check coupon if you prefer residence study.

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CHECK FIELD OF GREATEST INTEREST

- ☐ Practical Radio Electronics Engineering
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To help us answer your request intelligently, please give the following information:

EMPLOYED BY ....

TYPE OF PRESENT WORK ....

SCHOOL BACKGROUND ....

ELECTRONICS EXPERIENCE ....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?

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PRODUCTION TECHNIQUES:

for the manufacturing of High Reliability Capacitors

To produce capacitors free from any possibility of latent defects, for use in the most critical applications, the Sangamo Electric Company has recently intensified its high reliability program of fabrication and inspection methods.

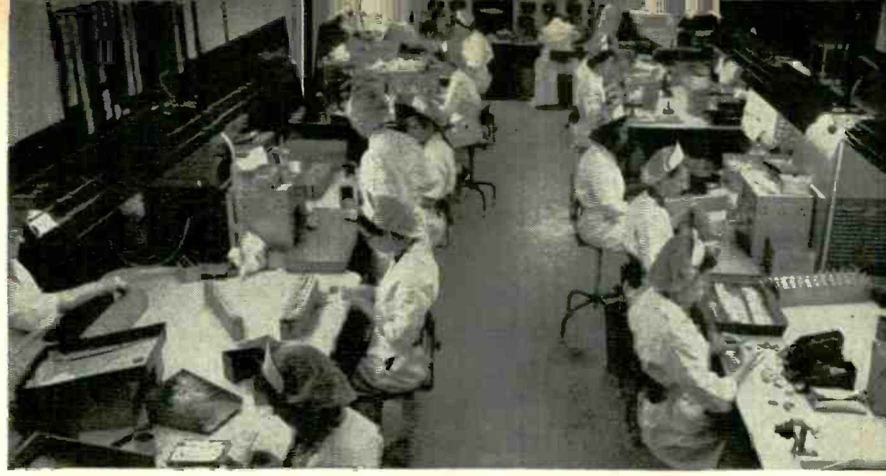
Incoming materials are rigidly inspected to meet stringent high reliability standards and are stored in areas where temperature, humidity and dust are controlled at all times.

Complete production histories are kept on the basis of small capacitor lots. X-raying of individual units, heat tests, vibration tests, altitude tests, and total destruction tests of a given percentage of all finished units assure components with an extremely low AQL. Testing facilities and resultant performance characteristics are far in excess of military specifications. Specify these high reliability capacitors for your critical applications.

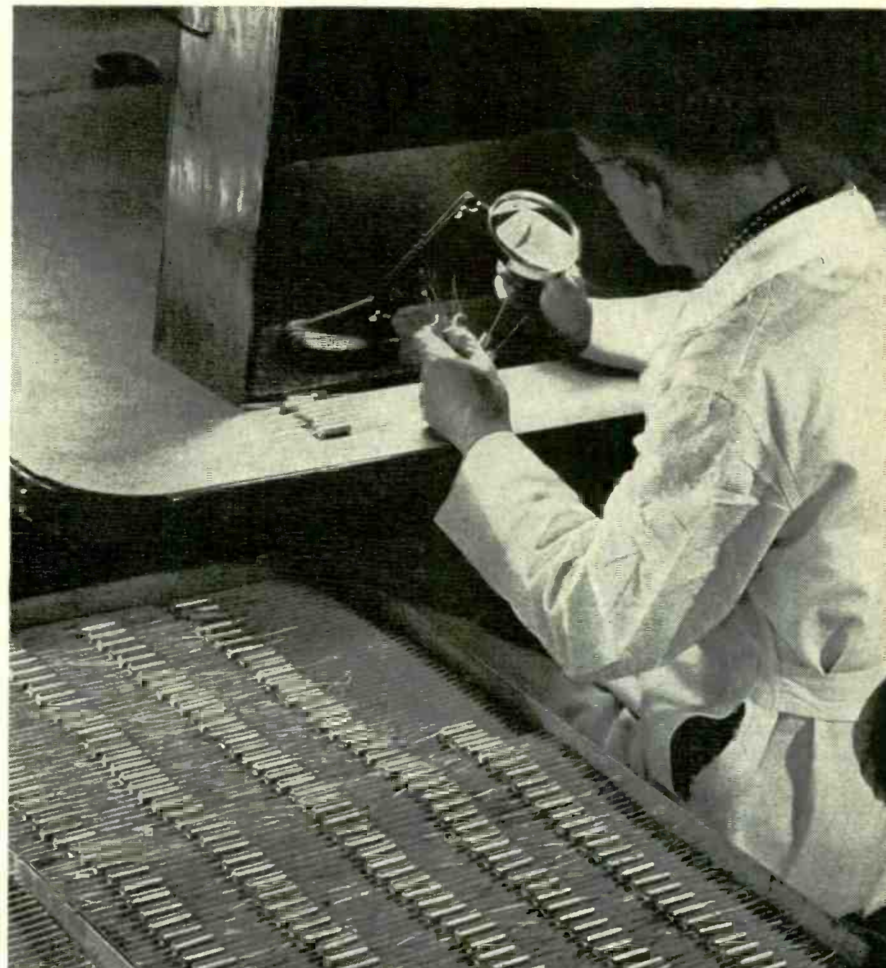
SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

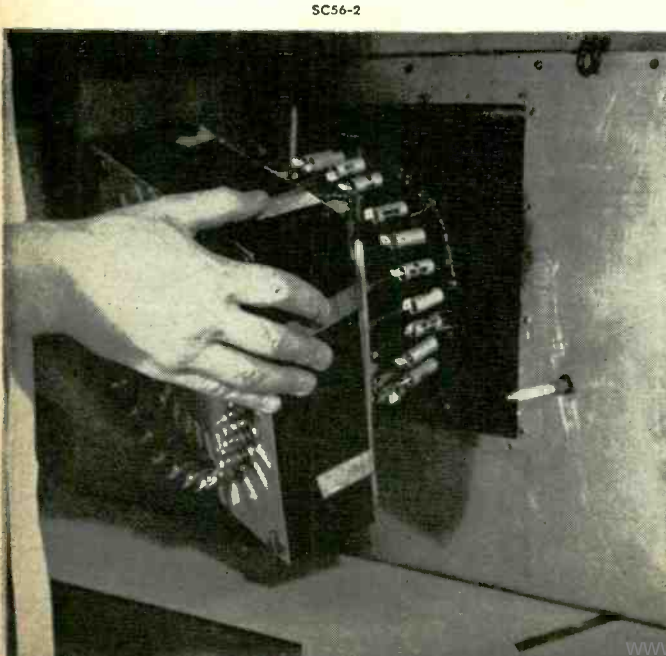
SC56-2



Separate facilities are maintained for the exclusive processing and manufacture of high reliability capacitors. Only specially trained, highly skilled operators, who wear special clothing to prevent any possible source contamination, work here.



Oil-filled capacitors are subject to vacuum under elevated temperatures, then are individually examined to insure complete hermetic seal.



High temperature test ovens are used to check insulation resistance of Sangamo high reliability capacitors under sustained temperatures of 125° C.

This vibration testing machine brutally punishes Sangamo high reliability capacitors at accelerations up to 10 G's to determine their ability to resist vibration without damage to leads or elements.

TOP performance for TV anywhere!

Federal's "ALL-STAR" LEAD-IN TEAM

Urban, fringe or distribution system... heat, rain, dust, snow, ice, salt spray, polluted air... whatever the conditions you'll find a winner in these dependable Quality-Controlled Cables by "FTR"

North, East, South, West... wherever there are TV customers... Federal's "All-Star" Lead-in Team can be depended upon to deliver *championship performance*...!

These six popular types are outstanding examples of the quality, ruggedness, efficiency and long life built into every foot of Federal Cable. Whatever the run requirements or local weather conditions the Federal "All-Stars" will score high in satisfaction... with you and your TV customers.

Federal lead-ins can be installed with utmost confidence, because they are engineered and manufactured by a *pioneer* cable maker... and "Certified by a World of Research"... through the International Telephone and Telegraph Corporation.

Check the high points of Federal's "All-Star" Team ...check your stock of TV lead-ins...get in touch with Federal now for prompt shipment of your needs!

"America's leading producer of solid dielectric cables"

Federal

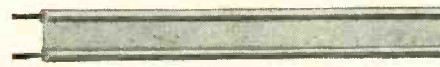
FEDERAL TELEPHONE & RADIO FTR A DIVISION OF IT&T

High Volume-Low Price TV Lead-in

TV-1190

Economical and Efficient

TV-1190—300-ohm heavy-duty lead-in with 90 mil. web. Has 7/#28 copper strands. Economical and highly efficient. Insulated with Federal-developed "silver" polyethylene for long life. Also available in brown.

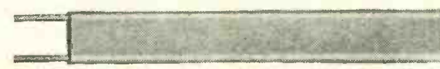


TV-2000

Another Low-cost Leader

TV-2000—300-ohm dumbbell-shaped lead-in with 55 mil. web. Has 7/#30 copper strands. A high-value, low-cost type for the average installation. Cinnamon-brown color is protection against ultra-violet.

"Quality-Controlled" TV Lead-in & Cable



TV-1182

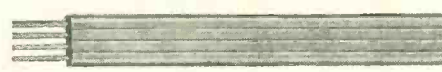
Heavy-duty Type

TV-1182—300-ohm deluxe type heavy-duty long life lead-in with 7/#28 copper strands, 100 mil. web. Available in "silver" or brown polyethylene. Resists weather, heat, sun. Very low line loss in fringe areas.

TV-1184

Quality *plus* Economy

TV-1184—300-ohm dumbbell-shaped, standard, economy type lead-in with 7/#28 copper strands, 70 mil. web, for urban areas with no unusual conditions. Cinnamon-brown color is highly effective in resisting ultra-violet.



TV-1188

Rotor Lead-in

TV-1188—Rugged, dependable, long-life rotor lead-in. Weather-resistant. Insulated with "silver" vinyl. Three 7-strand conductors of .0121 AWG soft bare and one conductor of .0121 AWG tinned soft bare.

Community TV Lead-in

59/U Type

Secondary Lead-in

59/U Type—73-ohm coaxial lead-in Highly efficient as a Community TV pole-to-house tap-off. Meets all needs wherever a high-grade installation is a must. Ideal for use with unbalanced input TV receivers.

For data on other types, write Dept. D-463A

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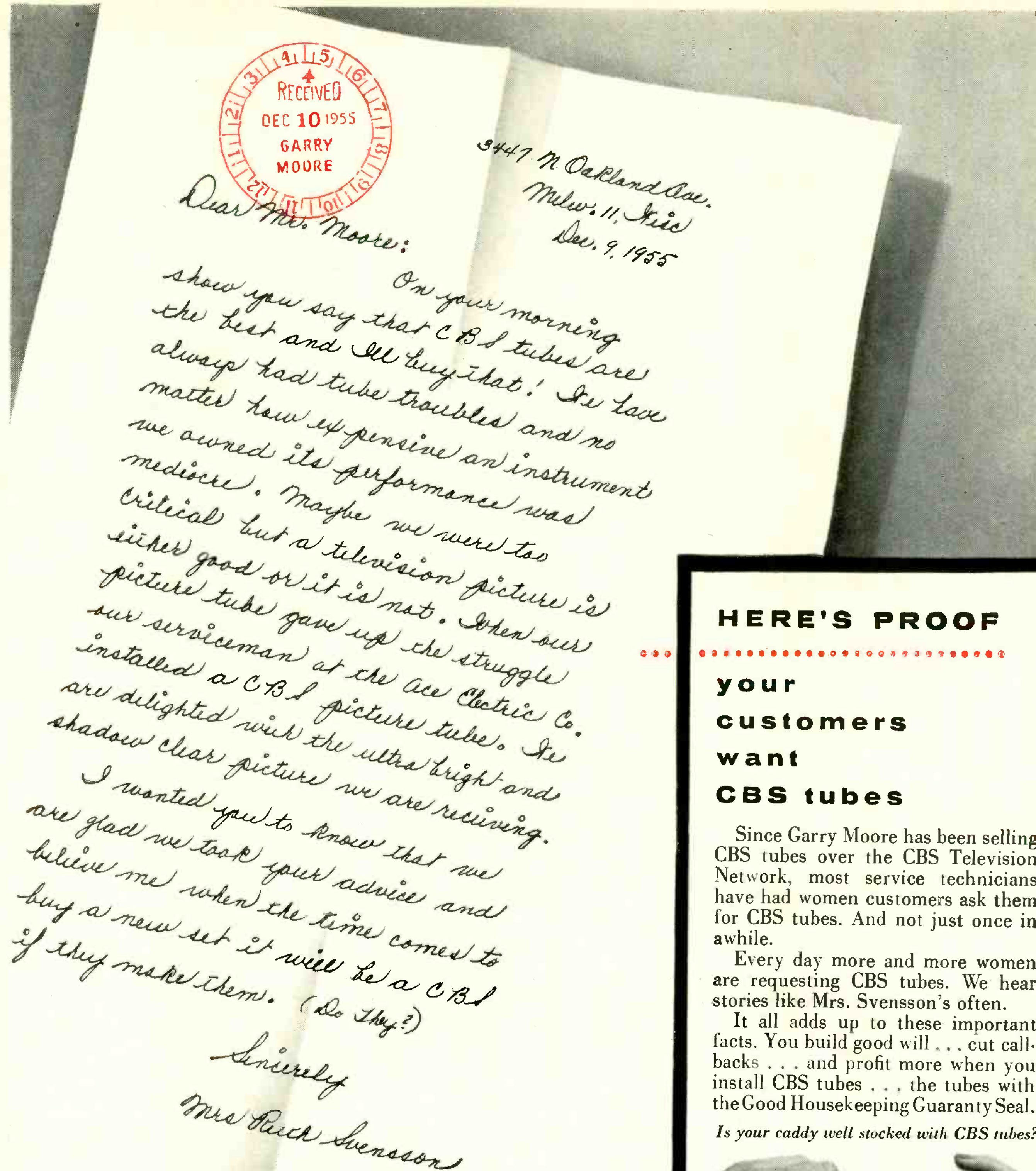

RECEIVED DEC 10 1955 GARRY MOORE

3447 N. Oakland Ave.
Milw. 11, Wisc
Dec. 9, 1955

Dear Mr. Moore:

On your morning show you say that CBS tubes are the best and I'll buy that! We have always had tube troubles and no matter how expensive an instrument we owned its performance was mediocre. Maybe we were too critical but a television picture is either good or it is not. When our picture tube gave up the struggle our serviceman at the Ace Electric Co. installed a CBS picture tube. We are delighted with the ultra bright and shadow clear picture we are receiving.

I wanted you to know that we are glad we took your advice and believe me when the time comes to buy a new set it will be a CBS if they make them. (Do they?)

Sincerely
Mrs Ruth Svensson

HERE'S PROOF your customers want CBS tubes

Since Garry Moore has been selling CBS tubes over the CBS Television Network, most service technicians have had women customers ask them for CBS tubes. And not just once in awhile.

Every day more and more women are requesting CBS tubes. We hear stories like Mrs. Svensson's often.

It all adds up to these important facts. You build good will . . . cut call-backs . . . and profit more when you install CBS tubes . . . the tubes with the Good Housekeeping Guaranty Seal.

Is your caddy well stocked with CBS tubes?

Guaranteed by Good Housekeeping

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

See Garry Moore sell your expert service over the CBS Television Network.

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

TENS OF THOUSANDS
OF ELECTRONICS TECHNICIANS NEEDED BY INDUSTRY!

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FUNDAMENTALS OF TRANSISTORS
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Explains the BIG thing in electronics, today—the transistor! Written by one of the pioneers in transistor development, this book tells you all you need to know about this electronic miracle: basic operation, characteristics, performance, and application. Soft Cover, 144 pp., 5½ x 8½", illus.
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A completely rewritten, up-to-the-minute edition of an authoritative and informative book. It is the newest and most comprehensive text on the subject, and follows the progress of the received signal from the antenna to the picture tube and loudspeaker. Leather Finish MARCO Cover, 352 pp., 5½ x 8½", illus.
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Prepared by experts, this book covers every major aspect of color TV receivers, including the latest 21" picture tube and its required circuitry. For anyone who wishes a solid grounding in color television, this volume is ideal. Destined to become a standard reference work on the subject. Soft Cover, 208 pp., 5½ x 8½", illus.
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by John F. Rider
Explains oscilloscope screen traces in clear, non-mathematical language. Contains over 800 scope traces, and complete instructions on the use of scopes and interpretation of traces. Soft Cover, 190 pp., 5½ x 8½", illus.
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Basic information relating to vacuum tubes, with a minimum of mathematics, from the behavior of the elementary electron to the specialized types of tubes. A must book for technicians, engineers, students. 208 pp., 5½ x 8½", illus.
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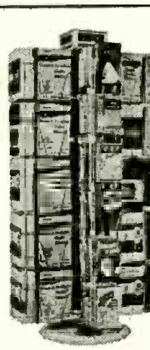

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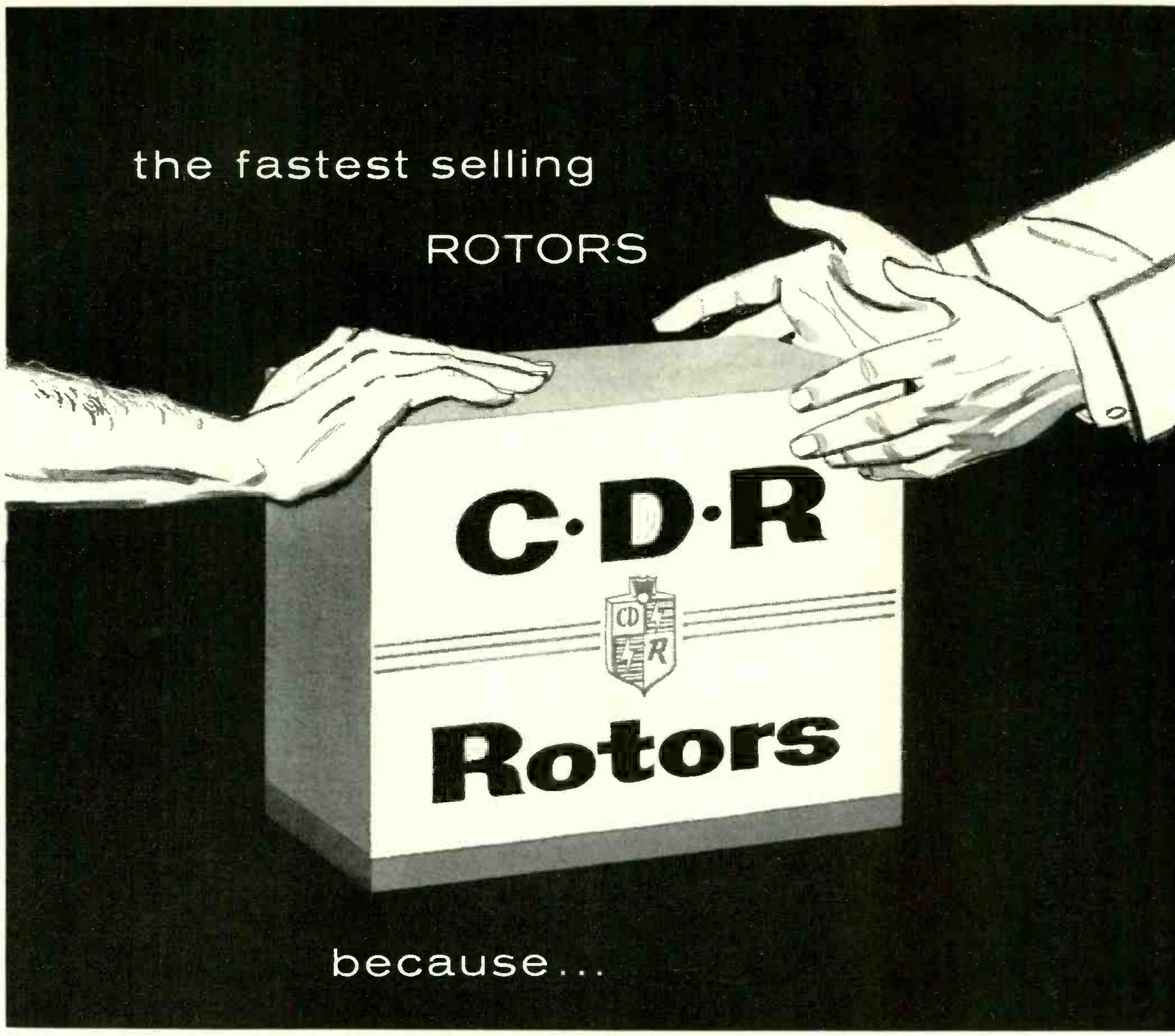

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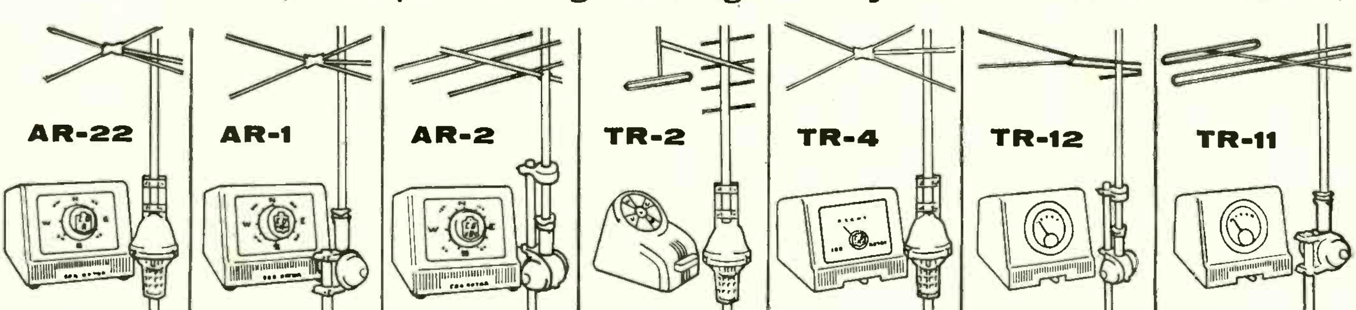

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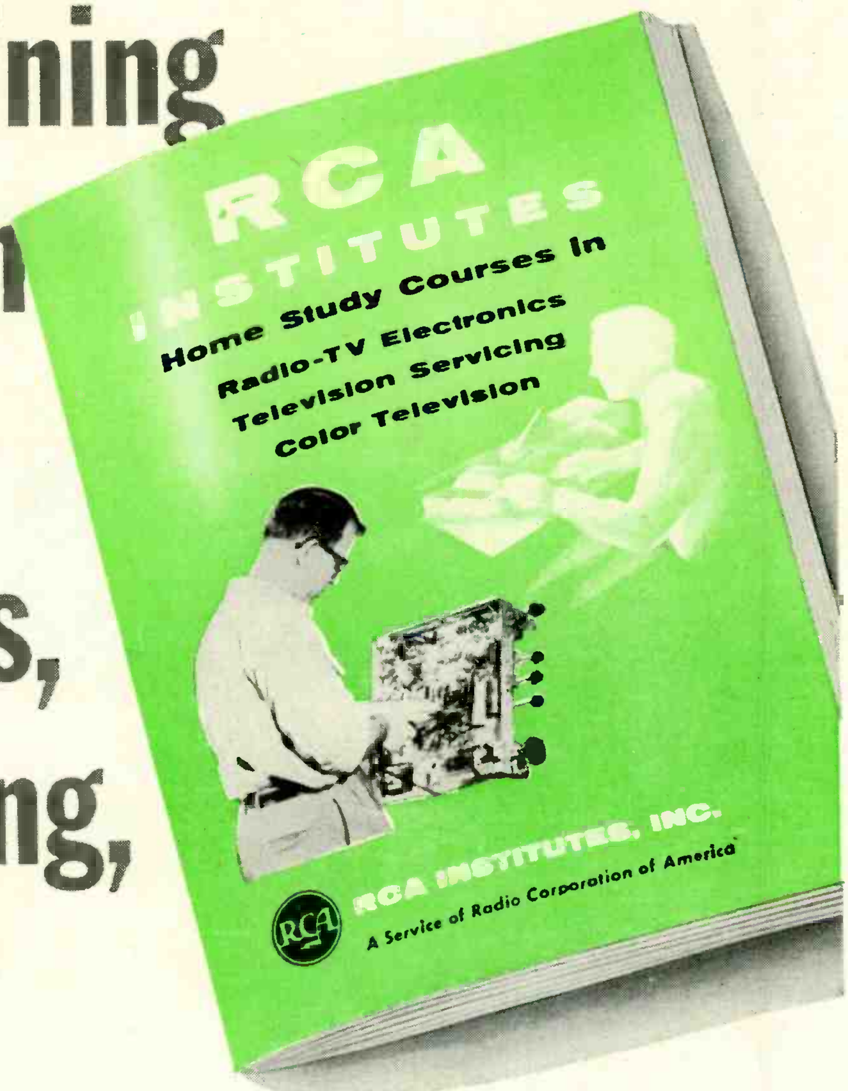

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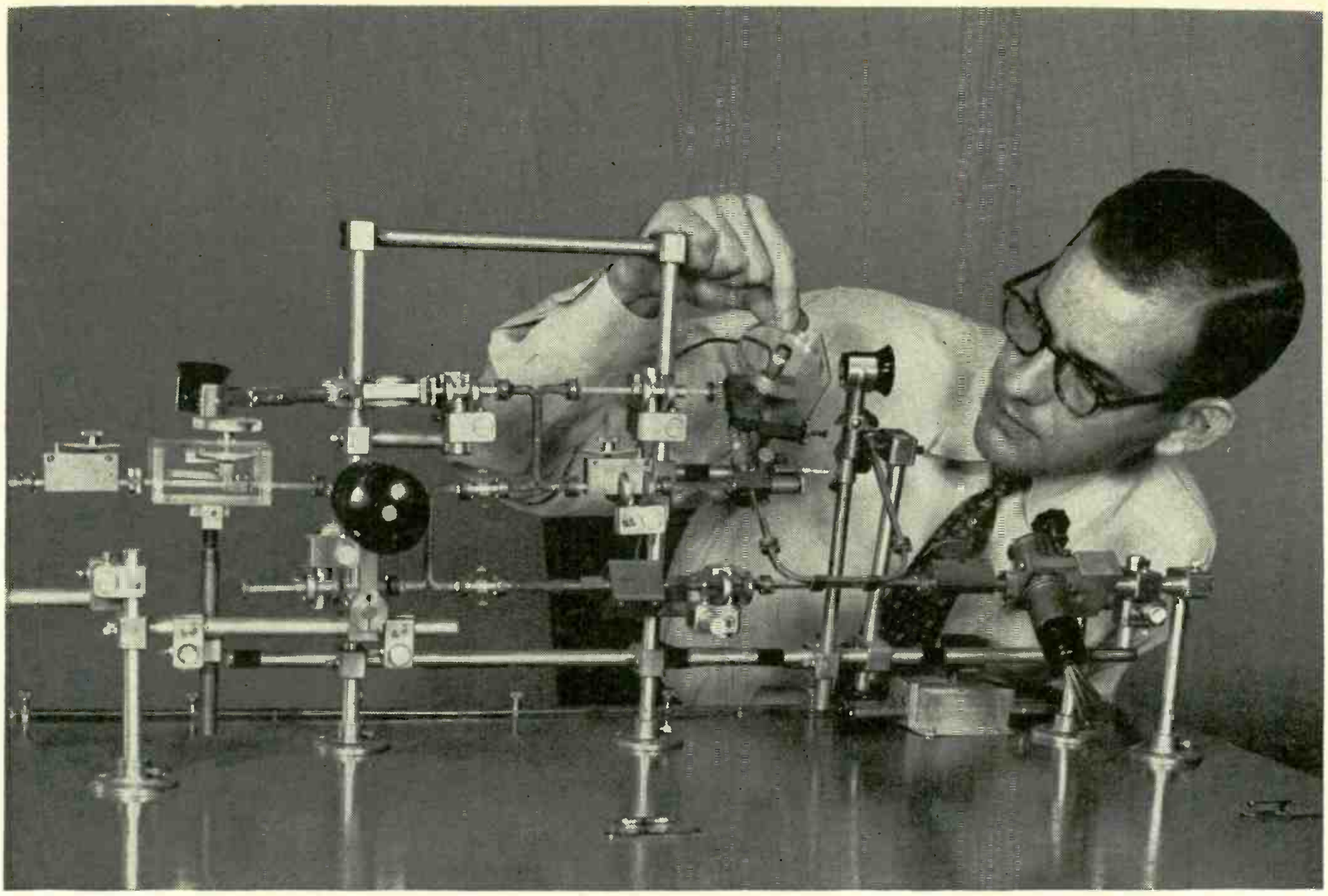

Physicist G. K. Farney checks the frequency of Bell's new klystron, which is located at far right. Tube's output is about 20 milliwatts.

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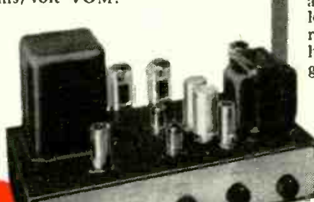

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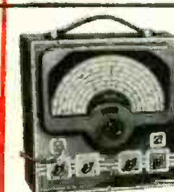

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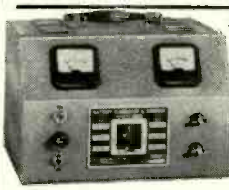

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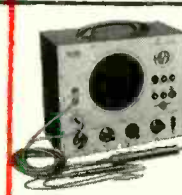

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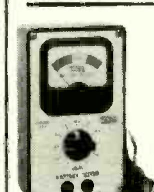

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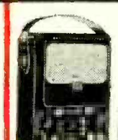

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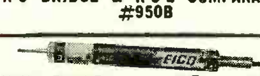

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RADIO-ELECTRONICS

Hugo Gernsback, Editor

THE ELEMENTS OF TELEDUCATION

. . . The threat to our future can be met . . .

THE economy of the United States now rests squarely upon technical progress. For decades our know-how was second to none in all technical endeavors. We are no longer in this fortunate position. Indeed, we are now running in second place, having already surrendered our rank to the Soviet Union. In the graduation of technicians and engineers, particularly in electronics, we are threatened with a further decisive setback. Not only is our economy thus threatened seriously, but our defense and our very existence are challenged.

Unfortunately we cannot now quickly reverse this disastrous trend by supplying the nation with nonexistent and competent teachers, the supply of which is constantly shrinking. Only one other means is left open to us to ameliorate the condition—technical education via television—*teleducation*. The present teacher shortage need *not* be an insurmountable obstacle. We have sufficient good teachers to reverse the downward trend in a few short years.

The writer has spoken of this situation often* and feels it necessary, due to the present emergency, to bring it up once more. Here is the plan briefly outlined:

1. Russia has now definitely overtaken the United States in teaching and graduating of future technicians. They turn out far more vital technicians than we do.

2. We have a disastrously low supply of technically competent teachers, who, due to inadequate pay, constantly defect to higher salaried industrial or other positions.

3. The number of technical students has declined constantly and will continue to until our shortsighted teaching methods are reversed.

4. Paradoxically, *we have* more good teachers than we actually need *IF* we only will use their talents intelligently to fit present-day technical growth. Why use an outstanding teacher to teach 100 students in a single institution IF THE SAME TEACHER CAN INSTRUCT 500,000 OR MORE SIMULTANEOUSLY?

5. We HAVE the technical facilities today to achieve this via closed-circuit television.

6. In short, without going into details, this is the way the proposed system, outlined by the writer in 1945, works: From a central point or points the best technical and science teachers in the land instruct via large wall projection color television ALL the classes in the land. If the instructor of the moment is at Yale, the rest of the country is connected to that point. The next lecture may come from MIT in Massachusetts, from Caltech in California or from any other point *because all institutions of learning are tied in to the national teleducation closed-circuit hookup*. Such lectures will not be merely talk. The teacher—be he a physics, chemical, electrical or electronics professor—will instruct directly from the laboratory all important experiments and make clear any technical point by actual physical demonstration.

7. Technicians and engineers, however, are not created overnight. We must implant the seed of scientific adventure into the very young mind—before age 10. Country-wide teleducation MUST start in grade schools and be followed up with more intensity in high school.

8. During the present educational emergency, only the Federal Government has the means to finance a National Teleducation Network. The Government would build the network just as it has built roads in the past, the cost to be pro-rated to the states over a span of years. The Government would NOT be in the teaching business, however, and would have no voice in any educational program. To guard against abuse, the teleducational closed-circuit network could be supervised through a special commission or similar agency.

9. Teleducation via the national closed-circuit network does NOT do away with the teacher in the classroom—supervision will still be needed. But why waste an Einstein type of educator on a 50-pupil class when a secondary teacher or qualified supervisor can do the paper work and all other necessary classroom routine?

The writer is fully aware that such a revolutionary teaching system will meet some resistance from orthodox pedagogues as well as the heads of many of our institutions of learning. Communications to us relating to universal country-wide teleducation seem roughly equally divided for and against. We have space for only two here:

> "I was very much interested in reading your article 'Tec-Teleducation.' We are at the present time teaching a large class located in three different rooms by television. We have gone one more step by teaching by discussion method. We have a talk-back system so that students remote from the studio can ask questions and enter into discussion. This is at present an experiment and we have selected a course that we feel is most challenging to this type of teaching, Comparative European Government.
>
> "I doubt if our nontechnical people can see as far into the future of this thing as the technical people can. Our educators are usually too complacent once they have made a small gain. They are not inclined to expand the scope of what they have accomplished.
>
> "C. D. PHILLIPS
> "*Technical Supervisor*
> "*State University of Iowa*"

* * *

> "Thank you for sending me a copy of the letter you received recently from Mr. Phillips of the State University of Iowa. Certainly the arrangement he describes is a very interesting one. Such an arrangement is, I fear, a luxury in which only an institution supported by public funds can indulge.
>
> "However, as I indicated to you last week, our plans for the future include the development of a lecture hall designed for the use of television, and we look forward to an opportunity to experiment with this valuable adjunct to established educational methods.
>
> "HAROLD TORGERSEN
> "*Assistant Dean, College of Engineering*
> "*New York University*"

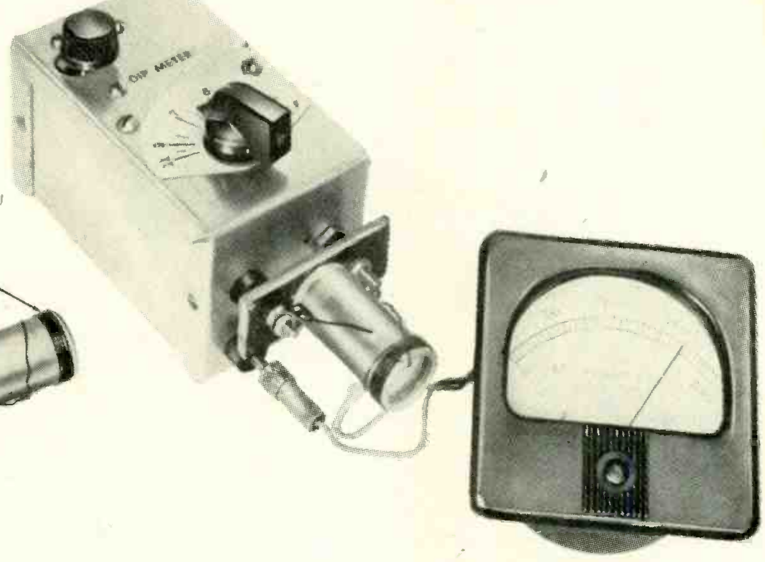
10. As the safety of the nation depends more and more on advanced technicians, engineers and scientists, such men should not be drafted for military service, but should be placed only in technical defense work. —*H. G.*

**Time*, December 1945; *Newsweek*, December, 1950; RADIO-ELECTRONICS, September, 1951. Also Tec-Teleducation, *Forecast*, December, 1954, and RADIO-ELECTRONICS, February, 1955.

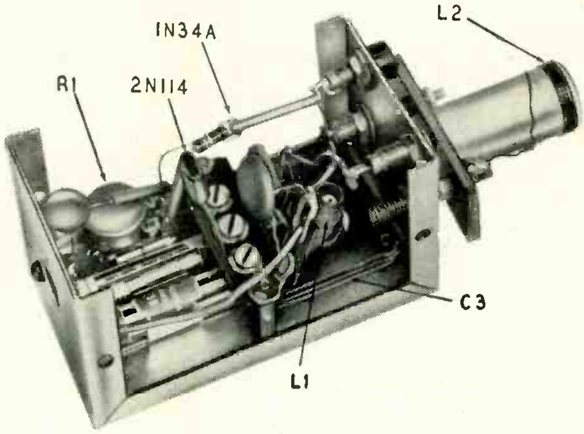
TRANSISTORIZING THE DIP METER

Compact junction device tunes from 2.5–11 mc

By I. QUEEN
Editorial Associate



Above—Meter is external to instrument.



Left—Internal view shows parts layout.

A GRID-DIP meter is, generally, a tube oscillator with a meter to measure grid current. When the dip meter is coupled to a nearby tank coil or other resonant circuit, energy is absorbed by the coil. As a result, there is a *dip* in the reading of the dip meter. When the meter is tuned for *maximum* dip, the external and dip circuits are in resonance. The unknown frequency of the tank may then be read on a calibrated scale on the grid-dip meter. The meter is also useful as a signal generator (it is essentially an oscillator), to check coil Q (by sharpness of dip tuning) and other related applications.

To transistorize the dip meter it is important to consider the difference between a tube and a transistor. In a tube oscillator the grid acts as a diode to rectify the rf oscillations. Therefore, it is easy to measure the rf level with a meter in the grid circuit. It may seem that the same principle applies to a transistor . . . perhaps all we need is a meter in series with the collector (or other transistor element). Unfortunately, this doesn't work. The reason is that *each* element of a transistor passes current at all times. Whether the transistor is oscillating or not, the current is essentially constant. For example, in a typical point-contact transistor oscillator, I measured 2 ma during oscillation; nonoscillating current was 1.6 ma. These may be called the O and N values, respectively. These values, therefore, vary only about 20%. Similar values hold for a junction transistor. In a typical circuit (RADIO-ELECTRONICS, August, 1954, page 87) N is 650 μa, O is 500 μa.

In each case the N–O difference is relatively small, representing at best a dip of about 20% on a meter scale. Yet this is not the whole story. This difference, small as it is, does not indicate the *true* dip available during a measurement. No coil can be coupled so tightly that it will absorb *all* the energy from a grid-dip meter. Under normal conditions all we can expect is a dip of about 10–15% of the N–O difference. This comes out to only about 2% of full scale as experiments have shown. For example, in a typical case, a coil was coupled 1 inch from the grid-dip meter. The dip was only one small division on the meter. Evidently the grid-dip principle cannot be used with transistors unless you want to use a magnifying glass, too.

The problem may be solved easily. After attempting various complicated balancing and bucking networks, the following idea was adopted: A diode is added to rectify rf across the grid-dip meter tank and the current is fed to a dc meter. This approximates the operation of a *tube* grid-dip meter! The diode rectifies just like a grid so we now have the *entire* meter scale to indicate oscillation level. With normal oscillation the meter is set to full scale. When oscillations cease (as from shorting out the coil), the needle deflects back to zero.

Now the N–O difference is the whole meter scale! In one test, a coil was coupled to the grid-dip meter at a distance of 1 inch. The dip amounted to about 15% of full scale (to which the meter had originally been set). With tighter coupling (about ½-inch separation) the dip was to mid-scale. These are healthy dips for which no apology need be offered to tube instruments.

This principle has been applied to a junction-transistor grid-dip meter and results have been most successful. A two-band device was constructed and has been tested under many conditions; a separate plug-in coil is used for each band. One covers from 2.5–5.5 mc; the other from 5.0 to over 11 mc. These ranges were chosen because they represent the most useful portion of the frequency spectrum. For example, there is full coverage and overlap for any experiments and tests in or near the 40- and 80-meter bands.

The oscillator (see diagram) is a Raytheon 2N114, a high-frequency type. It has a frequency cutoff of 20 mc, one of the highest values available. While this article concerns itself only with a coverage up to 11 mc, there is no reason why this cannot be extended considerably higher if desired.

The oscillator is tuned by C3 which shunts plug-in coil L2. Coil L2 is wound on an Amphenol polystyrene form ¾ inch in diameter, 1½ inches long. This form has a base which is to be screwed down to a Bakelite strip (see photo) 2 inches by ¾ inch. The strip is drilled for a pair of banana plugs so the coil may be removed. This device has no on–off switch. This is not an oversight! The instrument is automatically shut off when the coil is removed from the banana jacks since this opens the negative side of the battery (when the external meter is disconnected). No matter how often you use this dip meter, the battery will last many, many months for the drain is very low.

Capacitor C3 is a special unit recently introduced to transistor experimenters. It is only 3/16 inch thick, 1½ inches square. Yet it is a 365-μμf variable capacitor effective over a 180° rotation! The secret is that this unit has a mica dielectric between the metal movable "plates." It is obtainable from Lafayette Radio Co. as part number MS-215.

Regeneration (and oscillation) is produced by C2 which connects the emitter and collector of the 2N114. The value of 100 μμf was found just right for the two bands covered by this instrument. If you are experimenting with much higher or lower frequencies, try other values for this capacitor.

Coil L1 is a loopstick with the core entirely removed and all excess form cut off. Ceramic capacitor C1 shunts it. This value was chosen after many experiments to obtain a nearly constant output over each band. A higher or lower capacitance here may cause a droop in output at either the high or low end of each band. I suggest you try a variable for C1 at the start, then choose the optimum value. For convenience, C1 was placed *inside* the loopstick and the capacitor leads were used for making connections. The coil leads are very thin and cannot offer much support for the coil. So wrap the coil leads around the capacitor leads and let the latter do the supporting.

The transistor leads are not clipped (see photo) as is usually done. Instead of a transistor mounting block, a three-terminal strip is used. The screw terminals hold the transistor leads tightly. This is only a matter of preference—the usual five-pin subminiature socket may be used if desired.

The rf across L2 is rectified by a crystal diode and filtered by a disc capacitor before being fed to the dc meter. Potentiometer R1 controls the current to the meter to obtain full-scale deflection or any reading close to it. Another unusual component, R1, is a "dime-size" pot only ¾ inch in diameter with a shaft only ⅛ inch in diameter! This tiny part is also available from Lafayette, their part number VC-34.

The meter is a 200-μa instrument. You may use a more sensitive unit if you wish by using a larger resistance at R1 to prevent overloading. On the high band, average current is about 230 μa; on the low band it averages about 300 μa. As constructed here, the grid-dip meter does not have an internal meter. Thus, you can use your meter for other applications and not tie it down. Useful as the dip meter is, few technicians or experimenters need it for more than a few hours a week at most. It does not seem practical to incorporate the meter into the dip instrument.

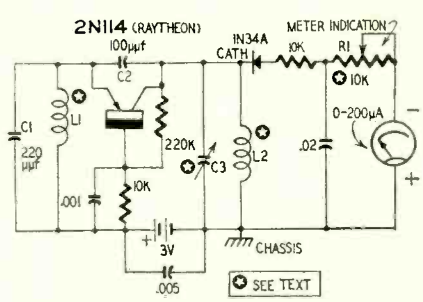
To calibrate the scale, insert the high-frequency coil and place it near an all-wave receiver. You can increase pickup by connecting the antenna lead of the receiver to the dip-meter chassis. Tune the receiver to various frequencies: 5, 5.5, 6 mc, etc. This will calibrate the high range up to about 11 mc or beyond.

As a bright idea I attempted to wind the low-frequency coil so that its calibration would be *exactly half* that of the high-frequency unit. Perhaps I was only lucky but the result was sensational. One coil covers frequencies exactly half that of the other, so only one calibration is needed. Only at the very low end is there a discrepancy. For example, 11 mc on the high-frequency coil corresponds exactly (to within the width of a line) to 5.5 mc on the low-frequency coil. They match all the way down so that 6 mc on the high-frequency coil corresponds to 3 mc on the lower unit. However, 5 and 2.5 mc do not quite come in at the same spot on the respective coils, so a special calibration is made at this point.

Here are dimensions for the coils which produced the above calibrations: The low-frequency coil has 23 turns occupying about ¾ inch; the high-frequency coil has 8 turns closely spaced. Both are wound with No. 22 enameled wire. To produce the desired correspondence between coil calibrations, separate or push turns together as required.

Parts for the dip meter

2—10,000-, 1—220,000-ohm, ½-watt resistors; 1—10,000-ohm potentiometer (see text); 1—100, 1—220 μμf; 1—.001-, 1—.005-, 1—02-μf disc capacitors; 1—365-μμf miniature tuning capacitor (see text); 1—2N114 transistor; 1—1N34A crystal diode; 2—1.5-volt penlight cells; 1—0-200-μa dc meter; 1—3-terminal mounting strip; 1—loopstick; 2—tuning coils, high and low frequency (see text); 2—banana jacks; 2—pin jacks; 2—Bakelite strips with banana plugs mounted; 2—polystyrene coil forms, ¾-inch diameter, 1½ inches long; 1—cabinet, aluminum, approximately 2¼ x 2¼ x 4 inches.



Schematic of the grid-dip meter.

Using the instrument

To make a measurement, plug in the desired coil and also the external microammeter. Adjust R1 for meter indication near full scale. The reading should remain nearly constant over most of the dial, but there may be a slight drop-off at either end. As an example, using the high-frequency coil, the meter may be set to full scale (200 μa) at 11 mc. There is a variation of only one or two small divisions all the way down to 5 mc and below.

Uniformity of scale indication is controlled to some extent by C1 and L1. The original reading (before looking for a dip) does not necessarily *have* to be full scale. However, this is a convenient starting point and provides maximum sensitivity.

Having set the meter, couple the plug-in coil to the tank circuit under test. Either the grid-dip meter or the tank may be tuned for the dip. At first the coupling may be made very close, perhaps a ½ inch or closer. Coupling may be reduced once a dip is detected.

When coupling is fairly close, it is better to tune the dip-meter dial from the low-frequency end. Otherwise the changes in meter reading may be jumpy. With relatively weak coupling, it is better to approach resonance from the high-frequency end of the dial. Remember that highest accuracy results from weak coupling. Often a dip may be observed with as much as a 2-inch separation between dip-meter and tank circuit.

The dip principle described may be used with any transistor oscillator. The 2N114 was chosen because of its extraordinary high-frequency cutoff. This particular unit will oscillate at even higher frequencies than the 11-mc limit of the present unit. The battery voltage should be increased to 6 volts for this purpose. Also, experiment with C2, C1 and L1 for optimum results at very high frequencies. Note that the power input to the transistor is largely determined by the base resistor.

This dip meter is also very satisfactory for use as a calibrated signal generator. Besides, it provides information for estimating circuit Q. If the dip is broad, the tank being tested has low Q.

The dip meter is housed in an aluminum Flexi-mount case, 2¼ x 2¼ x 4 inches. The two penlight cells which power it are mounted in a battery holder, available from Lafayette. Four jacks are mounted on the front end of the box. Two are banana jacks for the plug-in coil. The others are pin jacks for the external meter. When coil and meter are removed, we have a very compact instrument. By the way, remember to remove these units before storing the dip meter. When you do, you automatically open the battery circuit. END

Simplified TV ALIGNMENT

Weston model 985 v.h.f. calibrator.

Unusual v.h.f. calibrator provides accurate, easy-to-read markers

By ROBERT F. SCOTT
TECHNICAL EDITOR

SERVICE technicians often shy away from realigning or checking alignment of TV receiver circuits because they are not sufficiently familiar with their equipment and alignment procedures or feel that the improvement in performance will probably not be great enough to compensate for the time required to set up the equipment.

Fig. 1 shows a typical setup for realigning a TV receiver with a scope and sweep and marker generators. But it does not show the maze of leads draped across the chassis and bench or the spurious responses caused by improper grounds, stray coupling and out-of-tolerance components. Nor does it provide a remedy for the headaches that result when the marker signal is so strong that the set oscillates or when the marker pip disappears along the base line or close to an important trap frequency.

Fig. 2 shows a simplified alignment setup recommended by Weston for use with their new model 984 sweep generator and model 985 TV calibrator. This setup minimizes overloading in the TV receiver and provides a plainly visible marker at all times—even when set exactly at an important trap frequency.

The r.f. circuits of the 984 sweep generator are conventional. A portion of the r.f. or i.f. output signal is tapped off and fed to the marker generator (model 985 TV calibrator) where it is mixed with the calibrator signal to develop a pulse type marker. This pulse is shaped, clamped and fed to the Z-axis input of the scope to modulate the scope trace. The marker (Fig. 3) then appears as a double spot or a double hole in the response pattern, depending on whether the calibrator's function switch is set to blank or brighten the trace at the marker points.

The display at *a* is a type likely to be obtained with conventional alignment procedures and equipment. The marker in the center of the passband is too strong and causes distortion. Markers at vital trap frequencies are attenuated too much to be visible.

The displays at *b* and *c* result when markers are injected into the scope's Z-axis circuit. Marker visibility is constant regardless of its position on the trace. With positive-intensity markers at *b* the marker frequencies are centered between two close-spaced dots. When negative-intensity markers are used, marker frequencies are indicated by the short line centered between two blanked portions of the trace as at *c*.

Model 985 calibrator

The variable marker-frequency signal is developed by a capacitance-tuned oscillator covering 4 to 110 and 160 to 265 mc in 10 fundamental ranges. A drum type dial with an effective length of 8¼ feet provides easy-to-read frequency indications — including TV sound and video carrier settings. The dial drum is coupled to the range switch so only the scale in use is visible.

Rectangular markers are placed at 4.5-mc intervals (see photo) and round markers are 1.5 mc apart on each scale. These points correspond to harmonic frequencies of the built-in 4.5- and 1.5-mc crystal oscillators. A neon lamp indicates zero beat between the variable-frequency oscillator and the harmonics of the 4.5- or 1.5-mc crystal oscillators. A mechanical scale-shift control permits the operator to move the drum laterally so the pointer lines up accurately with the crystal calibration points.

The crystal-controlled frequencies may be used to modulate the v.f.o. and provide additional markers on each side of the v.f.o. marker. The 985 can be used as a modulated or unmodulated crystal-controlled signal source for adjusting traps, aligning FM circuits, as a heterodyne type frequency meter for calibrating signal generators and small transmitters and identifying the frequency of unknown signals. It also provides bar patterns for linearity adjustments.

The circuit of the 985 is shown in Fig. 4. The v.f.o. signal developed by the 6T4 Colpitts oscillator is taken from the plate circuit and fed to the RF OUT terminal through a CK705 crystal diode modulator and the r.f. attenuator. The diode permits the v.f.o. output to be amplitude-modulated by 4.5 mc, 300 kc or 400 cycles.

The function control is set to CALIB & HET for calibrating the v.f.o. against the built-in crystals or identifying unknown signals. A part of the signal from the 6T4 is fed to the cathode of the 6BA7 mixer. Throwing the CRYSTAL switch to 1.5 MC or 4.5 MC turns on the crystal oscillator (V2-a) and injects its signal into grid 3 of the 6BA7. The v.f.o. and crystal oscillator signals heterodyne in the untuned mixer plate circuit that responds to low audio frequencies. This heterodyne signal is amplified by V2-b and fed to the 6CL6. A neon lamp beat indicator and 47,000-ohm resistor are in series across half of the tapped primary of output transformer T1. When the difference between the v.f.o. and crystal fundamental or harmonic is around 1,000 cycles, the neon indicator lights. Exact zero beat is indicated when the light is sharply extinguished.

To calibrate the v.f.o., the dial pointer is set to the calibration point nearest the desired frequency and the crystal oscillator is turned on with the crystal providing a harmonic at the calibration point. The tuning dial is then rocked about the calibration point

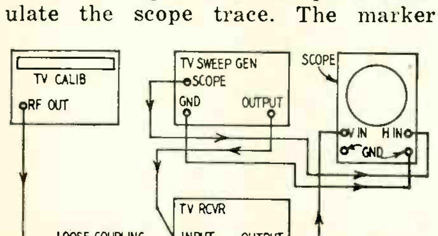


Fig. 1—Typical TV alignment setup.

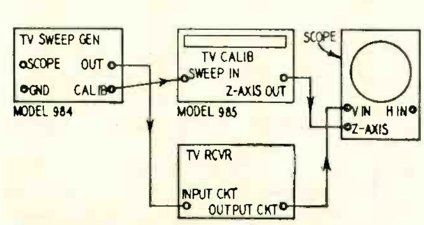


Fig. 2—Simplified alignment setup.

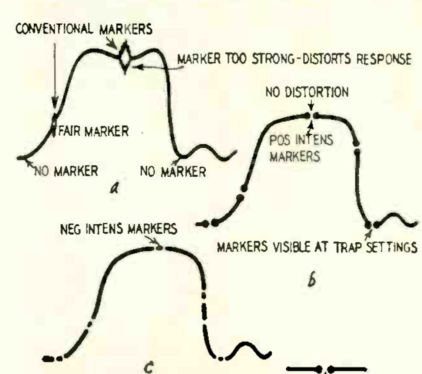


Fig. 3—TV receiver response patterns.

and carefully adjusted to the position where the indicator light goes out. If the pointer is not now exactly on the calibration point, the operator shifts the dial right or left until the pointer and calibration point coincide. Dial calibration accuracy is now the same as that of the crystal—.01%.

A signal whose frequency is unknown is checked by feeding it into grid 1 of the 6BA7 mixer and tuning the v.f.o. until zero beat is indicated. The frequency of the unknown signal is the same as the dial reading.

Marker circuit

When the Z-axis circuit is operated, signals from the v.f.o., crystal oscillator and sweep generator are fed to the 6BA7 mixer where they produce a large number of beat frequencies. The mixer plate load is now a 75-kc tuned circuit. The swept signal starts at a low frequency and rises to a frequency above that of the v.f.o. in the calibrator. A voltage is developed across L1 – C4 in the mixer plate circuit when the sweep frequency is 75 kc below the v.f.o. and again when it is 75 kc above. This 75-kc signal is amplified by V2-b and then rectified by one of two CK705 germanium diodes to produce either a positive or negative pulse.

This pulse is amplified in the 6CL6, clamped by the 6AL5 and then fed to the Z-AXIS OUT terminal where it is taken off and used to brighten or blank the scope trace. (See Fig. 3.) When positive-intensity marking (trace brightening) is used, the calibrator frequency is midway between the two bright spots. With negative-intensity marking (blanking) the 75-kc points are marked by narrow gaps on each side of the calibrator frequency.

When the crystal oscillator is turned on, its signal is fed into the mixer and appears as sidebands on the v.f.o. signal. As the sweep signal passes over these sidebands additional markers are produced simultaneously at the sideband frequencies. For example, if the v.f.o. is set to a picture r.f. or i.f. carrier frequency and the 4.5-mc crystal is switched on, a second marker will appear 4.5 mc away at the sound carrier frequency. The other 4.5-mc sideband will normally be outside the passband of the receiver's circuits and will not produce a marker on the scope pattern. When the 1.5-mc crystal is used, several markers will appear 1.5 mc apart on the pattern.

Offset markers

When a set is far out of alignment or interstage shielding is poor, oscillations may occur when a marker signal is applied. In this case, oscillations or overloading caused by strong markers can be eliminated by setting the v.f.o. to a frequency 4.5, 9, 13.5 or 18 mc above or below the desired frequency and switching on the 4.5-mc oscillator. The sidebands of the v.f.o. will then fall exactly on the desired marker point. Thus, by using successively higher sidebands it is possible to attenuate the marker to the desired degree. END

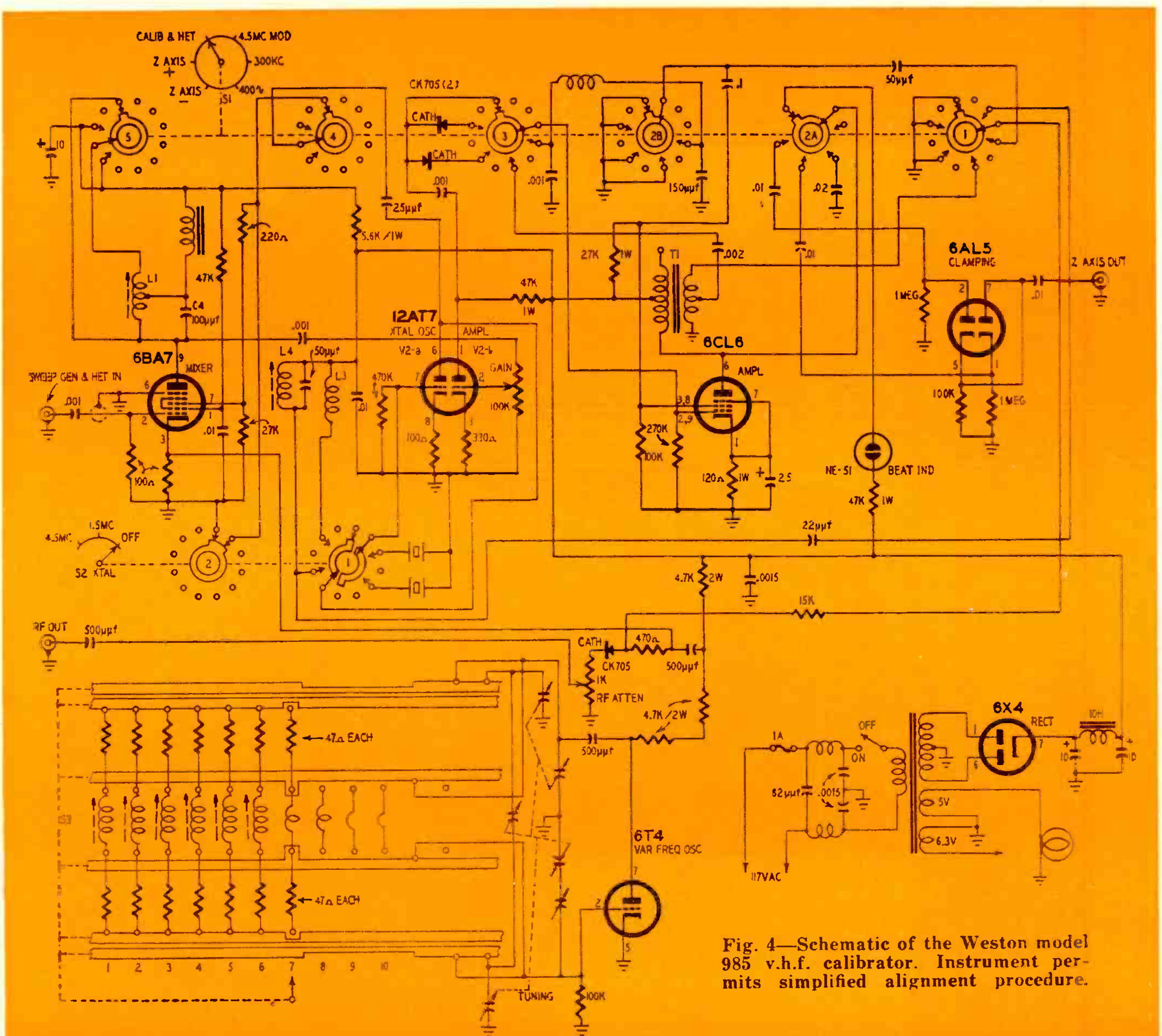
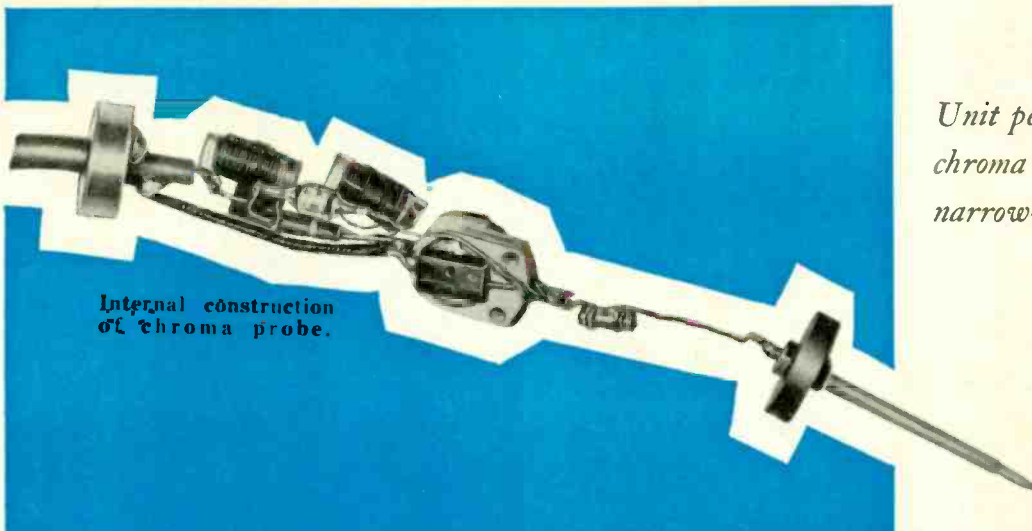


Fig. 4—Schematic of the Weston model 985 v.h.f. calibrator. Instrument permits simplified alignment procedure.



Unit permits checking chroma circuits with a narrow-band scope

CHROMA PROBE

By FRED W. RODEY

MOST oscilloscopes used in service shops are of the narrow-band type and cannot do a thorough job of color TV servicing. The probe described in this article (see photos) is made for just such scopes and permits viewing the chrominance portion of a color TV signal; it can be used to measure burst amplitude or chroma.

The probe (Fig. 1) consists of a high-pass filter which removes the color information from the composite signal and passes this on to a 3.58-mc trap. The subcarrier trap is broad enough to pass the color information sidebands, approximately plus and minus 500 kc. This band of frequencies is then rectified and filtered in a low-pass network so as to apply only the low-frequency component to the scope.

The output of the chroma probe is proportional to the chrominance amplitude and is not affected by the luminance component. Its input impedance is high enough so that the probe can be used across the low plate and cathode resistors found in most video amplifiers without introducing distortion.

Construction and adjustment

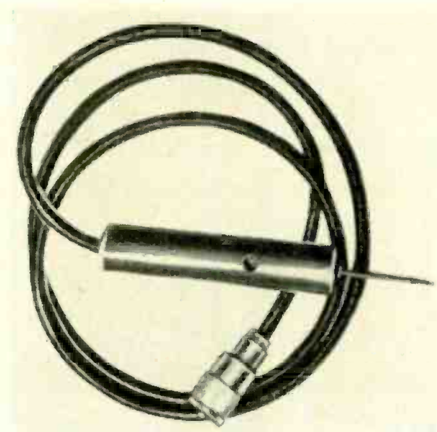
The chroma probe layout is shown in Fig. 2. The ¾-inch brass end piece is drilled out to ¼ inch for the coaxial cable. The cable shield is soldered to a solder lug by drilling and tapping the end piece for a 4-40 screw and fastening the lug to the screw.

The parts may then be assembled (except for the Bakelite end piece) as in the photo. Drill the Bakelite end piece for the probe tip made from a piece of brass rod 2 inches long and ⅛ inch in diameter. The rod should be threaded for a 6-32 screw with ½ inch of thread; it is held in place with two 6-32 nuts.

Both end pieces are force-fit so no screws are necessary. With the parts completely assembled, drill a hole in the probe housing (see photo) so that C2 can be adjusted for tuning the 3.58-mc trap.

Finally, the open end of C1 is soldered to the tip and the Bakelite end piece put into place. To keep parts from shorting after assembly, insert a sleeve of empire cloth or similar material inside the tubing.

To tune the trap it will be necessary to use a television receiver tuned to a channel transmitting a color bar signal or program with a stripe signal. Place the probe at the output of the video detector. Set the scope sweep for 7,875 cycles. Adjust the trap for maximum indication on the scope. It is a good practice when using this probe or when doing any video checking with a scope to synchronize the scope externally with a capacitance pickoff from the yoke or flyback transformer. This can be done by clipping a lead from the scope external-sync binding post to a yoke lead. It is not necessary to puncture the yoke lead insulation. External synchronization allows the scope pattern to remain locked in regardless of amplitude or polarity of the signal being viewed.



Probe complete with the coax connector.

The scope ground must be connected to the chassis ground.

Using the probe

The probe can be used to measure the relative amount of chroma a receiver will pass. It is not intended for use in rf or if alignment; this job is for a sweeper. After this is done the probe can be put at the output of the video detector to check for antenna mismatch, which can account for loss of color information although the black-and-white picture may appear normal.

The probe can be used at the output of the burst-gate tube to check for the presence of the color burst after keying. The output of the bandpass amplifier can be observed to check for proper operation of the color killer circuits. The final check point at which the probe may be used is at the grid of the I and Q or R − Y and B − Y demodulators. Beyond this point the video color information has frequencies up to only 500 kc, or 1500 kc in the case of the I channel, so normal scope tracing may be used.

A vtvm may be used to check the CW

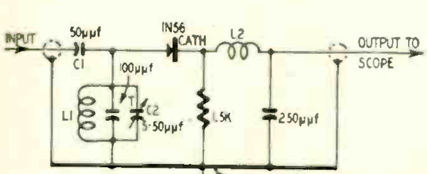


Fig. 1—Schematic of the chroma probe.

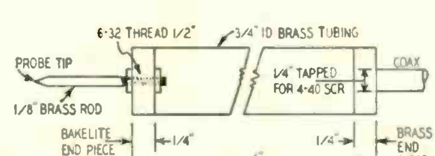


Fig. 2—Mechanical layout of the probe.

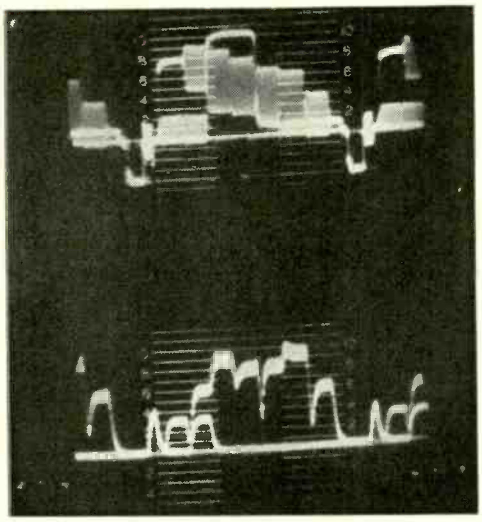


Fig. 3—Standard horizontal waveform of NTSC color bar pattern: above, video detector output as seen with wide-band oscilloscope; below, the same output using the probe and narrow-band oscilloscope.

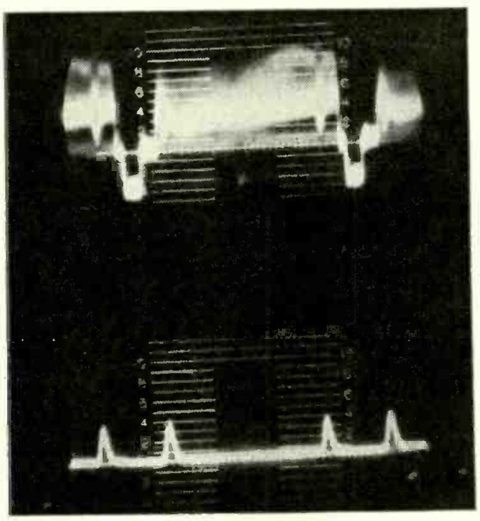


Fig. 4—Color stripe signal in monochrome transmission: above, with wide-band scope; below, with probe and narrow-band scope.

operation of a receiver's local 3.58-mc oscillator up to the demodulator grids to complete the checking of the chroma portions of a color receiver.

Fig. 3 shows the standard horizontal waveform of the NTSC color bar pattern. The colors are arranged in their descending order of luminance: white, yellow, cyan, green, magenta, red and blue. The relative amplitudes of chroma, as displayed by this probe, are not so regular. They are as follows:

Yellow	69%	Magenta	88%
Cyan	94%	Red	94%
Green	88%	Blue	68%

The input pattern was taken at the output of a receiver video detector with a wide-band oscilloscope. The output picture was taken with the probe at the same point using a narrow-band scope.

Fig. 4 was made under the same conditions. Most television stations transmitting color programs will insert a stripe signal on their black-and-white programs to aid in adjusting and checking color-receiver operation during installations. The stripe signal consists of two bursts of 3.58 mc of approximately 2 microseconds' duration just preceding the front porch and just following the back porch of the horizontal sync. The stripe following the back porch locks in the receiver's 3.58-mc oscillator and the stripe preceding the front porch appears as a greenish yellow bar on the right edge of the color-television screen.

Parts list for chroma probe

1—1,500-ohm resistor; 1—50-μμf capacitor (Centralab TCN tubular ceramic or equivalent); 1—100-μμf capacitor, silvered mica, 5%; 1—250-μμf capacitor, silvered mica, 5%; 1—5-50-μμf, trimmer capacitor (Centralab 822-AN or equivalent); 1—1N56; 1—L1, 50 turns of No. 26 wire wound in 2 layers on ¼-inch Lucite rod over ⅝ inch, 15 μh; 1—L2, 40 turns of No. 26 wire wound in 2 layers on ¼-inch Lucite rod over ⅝ inch, 10 μh; 1—4-foot length RG59/U coaxial cable; 1—connector or jack, depending on scope input connection; 1—4-inch length brass tubing, ¾-inch inside diameter; 1—brass end piece, ¾-inch round stock, ¼-inch long; 1—Bakelite end piece, ¾-inch round stock, ¼ inch long; 1—2-inch length ⅛-inch brass rod threaded for 6-32, ½ inch, on one end.

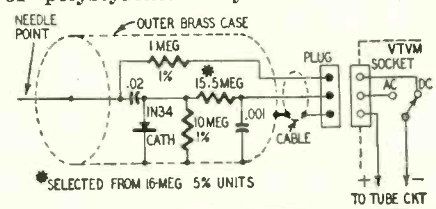
When the probe is used on a video signal containing a 3.58-mc stripe, the output will appear as two pips on either side of the video blanking interval. These pips can be used in tracing the color information just like a color-bar pattern. However, only the burst following the horizontal sync pulse will appear at the output of the burst keyer and the burst preceding horizontal sync will appear in the bandpass amplifier channel. END

A.C.-D.C. PROBE

If you do a lot of testing with a v.t.v.m., you probably have occasion to measure d.c. or a.c. voltages at about the same time. With separate d.c. and a.c. probes you will have to keep changing probes or group your d.c. and then your a.c. measurements.

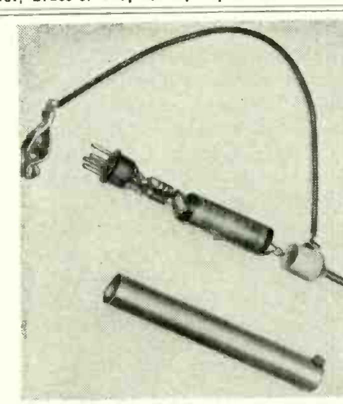
In a combined probe you simply include both probe circuits within the same shielded cable. The common lead is the same for both. The hot a.c. lead includes an isolating capacitor (see diagram) and filter network. The corresponding d.c. lead needs only the usual isolating resistor. The capacitor used was chosen because it fitted snugly.

The probe is enclosed in a brass cylinder, 4⅜ inches long and ⅝ inches in diameter. The business end is a needle prod set into a rounded piece of polystyrene. Poly cement is used



Materials for a.c.–d.c. probe

1—1, 1—10, 1—15.5-megohm, 1% resistors (the latter may be a selected 16-megohm 5% unit or 15 megohms and 500,000 ohms 1% in series); 1—.001, 1—.02-μf capacitor; 2—4-prong cable type plug, 1—4-prong cable type socket, 1—4-prong chassis type socket, brass sleeve, cable, clip as indicated in text.



to hold the prod firmly in place. The other end of the probe is a four-pin miniature plug, of which only three pins are used.

A three-conductor extension cable ties the probe to its v.t.v.m. This permits the probe to be detached from its cable so it may be kept safely in a desk drawer while the cable is hung up somewhere. Also, it allows the cable to be used for other purposes.

The far end of the cable is a male unit which plugs into a female socket on the front panel of the v.t.v.m. A toggle switch must be added on the voltmeter panel to switch from d.c. to a.c. as required, without need for changing probes.

The component values shown in the schematic are for a v.t.v.m. with an input resistance of 10 megohms, a common value. With these values, the meter calibration will be correct for both a.c. and d.c.—*Nathaniel Rhita.*

The Knight model F 119 capacitor checker.

INEXPENSIVE CAPACITOR CHECKER

The Knight in-circuit tester kit makes for rapid servicing

By NORMAN KRAMER*

CAPACITORS are made to a great many specifications. However, regardless of the manufacturing technique or the voltage–capacitance rating, there are two basic properties all capacitors have in common—the ability to block dc and to pass ac.

To determine the condition of a capacitor in a given circuit, with ordinary equipment, one lead must be unsoldered to isolate it from the rest of the circuit. This method is time-consuming because many good capacitors may have to be unsoldered before the faulty one is found. Perhaps more important, the trend in modern receivers and other electronic equipment is definitely toward printed-circuit wiring. Here, with the short component terminals and the ever present danger to foil pattern, phenolic and bonding of the foil to the phenolic, unsoldering and resoldering capacitors can be costly.

The new in-circuit capacitor checkers permit service technicians to check capacitors quickly while they are still soldered into their associated circuits. The test leads from the instrument are placed across the capacitor and the test switch depressed. Observing the condition of the tuning eye, one can determine if the capacitor is open. Pressing another switch and again observing the condition of the eye provides a short test. Thus, both the open and short tests are made without disturbing the leads or the circuit.

An example of this type of instrument is the recently released Knight capacitor checker kit. This instrument has two separate test circuits to show whether capacitors are open or shorted.

Fig. 1 is a simplified diagram of the open-circuit test. Hartley oscillator V1 operates at a frequency of approximately 20 mc, with L1–C1 forming the tuned circuit. Pickup coil L2 is close-coupled to the tank circuit and feeds network Z1, consisting of C2, L3 and C3. This network and the 48-inch coaxial cable to the test clips make up a quarter-wave transmission line at approximately 20 mc. Without Z1, which serves as an artificial line, the test leads would have to be over 12 feet in length to be a quarter wavelength at 20 mc.

An interesting property of a quarter-wave line is that any impendance connected at the output is reflected to the sending end as a *reciprocal*. That is, if the output end is open, the input end "sees" a short circuit and *vice versa*. Thus, if the test clips are open or connected to an open capacitor, the sending end of L2 sees a short circuit, or zero voltage. The voltage across L2 is rectified by the diode and applied to the grid of V2, keeping the eye normally open.

If L2 sees a short circuit (an open capacitor), no voltage is impressed on the grid and the eye remains open. If, however, a normal capacitor is connected across the test leads, a voltage appears across the test leads, is applied across L2, rectified and fed to the grid of the eye tube. This causes it to close in proportion to the magnitude of the voltage. A capacitor of 20 $\mu\mu f$ will cause practically complete closing; any capacitance larger than this will definitely close the eye. Capacitors smaller than 20 $\mu\mu f$ will cause partial closing. Shunting resistances of 50 ohms or less across the capacitor under test will cause the eye to close, indicating a good capacitor even though the capacitor may be open. (A description of a similar circuit appeared in the July, 1954, issue on page 53.—*Editor*)

Fig. 2 is a simplified schematic of the short-circuit test. With the test

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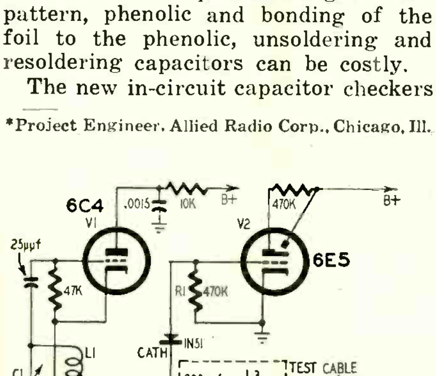


Fig. 1—Diagram for open-circuit test.

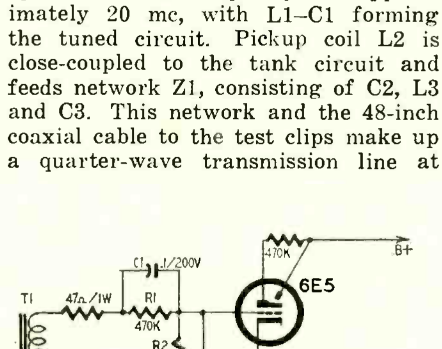
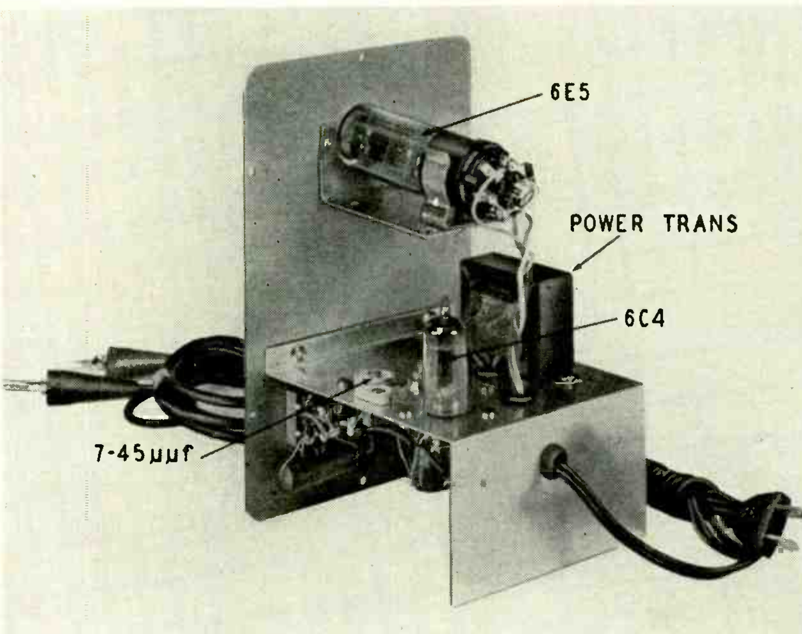
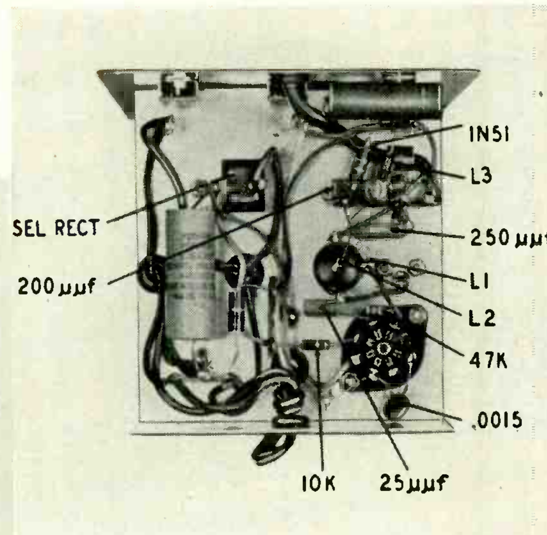


Fig. 2—Diagram for short-circuit test.





Left—Rear view of the tester, showing the 6E5 assembly and oscillator adjustment. Above —Underchassis view of capacitor checker.

selector switch in this position, the heater winding of the transformer furnishes, through R1 and C1, a proper bias voltage which is impressed across R2, closing the 6E5 eye tube. The test clips in this test shunt R2. If the test clips are shorted, bias voltage is lost and the eye opens. Thus, any shorted capacitor will open the eye. Capacitors which are merely leaky will only shunt R2, reducing the bias voltage but not eliminating it. Actually, a leaky capacitor must be almost completely shorted to open the eye completely.

The bias voltage is chosen to make the test insensitive to high resistance. Therefore, good capacitors larger than 2,000 µf whose reactance is extremely low, or good capacitors which are across resistors of less than approximately 20 ohms, will show partial eye opening.

The 7–45-µµf ceramic trimmer capacitor is the only variable element in the entire circuit. So when the instrument is assembled and the coaxial test lead is left hanging free, a simple screwdriver adjustment will tune the oscillator to approximately 20 mc, making the test lead and the load line exactly a quarter wavelength long.

Parts for capacitor checker

Resistors: 1—10,000, 1—47,000, 3—470,000 ohms, ½ watt, 10%; 1—47 ohms, 1 watt.

Capacitors: 1—25, 1—200 (5%), 1—250 µµf, mica; 1—.0015, 1—0.1 µf; 1—20-µf electrolytic, 150 volts; 1—7—45-µµf trimmer.

Coils: 1—oscillator type (L1), 12 turns of No. 22 enameled wire wound on a ⅝-inch diameter coil form, tapped at 6 turns; 2—coils (L2 and L3) 0.4 µh, 12 turns of No. 28 enameled wire closewound on ⅛-inch diameter form.

Miscellaneous: 1—50-ma selenium rectifier; 1—1N51 crystal diode; 2—spst slide switches; 1—dpdt slide switch; 1—transformer, 140 volts at 20 ma, 6.3 volts at 1 amp; 1—6E5 and 6-pin socket; 1—6C4 and miniature 7-pin socket; 1—mounting bracket for 6E5; 1—chassis; 1—48-inch length of coaxial cable; 2—alligator clips.

Fig. 3 is a complete schematic of the Knight capacitor checker kit. The power supply consists of a half-wave rectifier using a single 20-µf filter capacitor. Further filtering is unnecessary as it will not affect operation. The 6.3-volt secondary winding of the power transformer supplies the heater voltages and the bias voltage to the 6E5 when the instrument is in the short-test position. Switch S1 must be closed before each test is performed; S2 selects either the open- or short-circuit capacitor test.

In some cases a short may be intermittent. Therefore, it is a good idea to tap or jar the capacitor under test and note any flicker of the indicator. By so doing a very troublesome intermittent short may be discovered.

Shorted capacitors may be somewhat obvious, especially where they cause complete loss of tube voltages. Open capacitors may have a far more subtle effect and, hence, be more difficult to detect. Such capacitors could cause signal loss, serious change of waveform or instability.

In view of the time-saving features alone, an in-circuit capacitor checker can be a welcome addition to any service shop. END

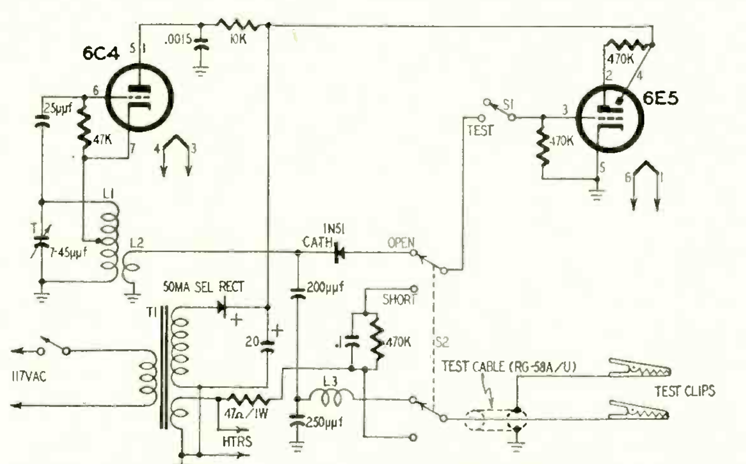
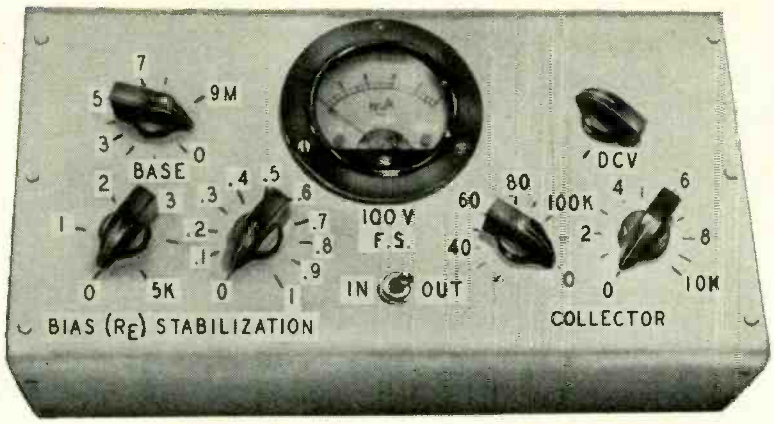


Fig. 3—Schematic diagram of the Knight in-circuit capacitor checker.

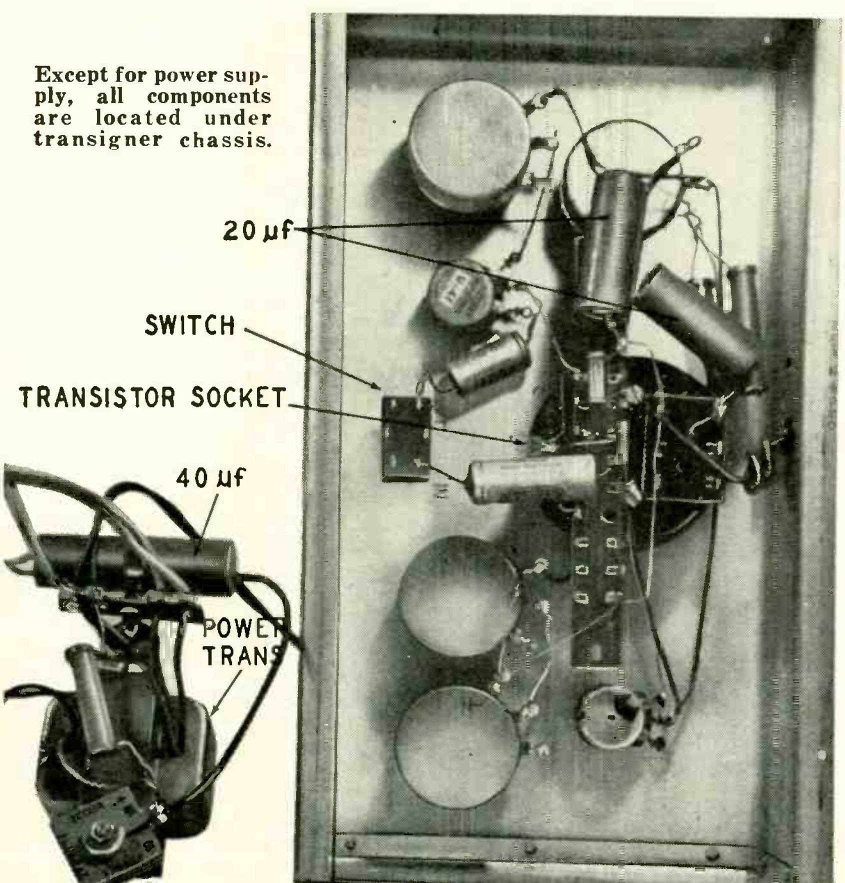
Test unit permits rapid design of transistor circuitry

the transigner

By FORREST H. FRANTZ, SR.*



A front view of the transigner.



Except for power supply, all components are located under transigner chassis.

SINCE the appearance of the transistor, considerable emphasis has been placed on the wide variations between transistors of a given type. This has been so well publicized that I was convinced that attempts at graphical and analytical amplifier design would be futile. The prospect of having to change resistors in a miniature transistor amplifier was not at all pleasant. This wastes time, usually messes up the looks of an amplifier and occasionally leads to ruined parts.

This little unit was created to overcome these difficulties. The transigner method of amplifier design is fast and accurate. Many experimenters do not like to become entangled with calculations. For those, the big advantage in the transigner approach is that calculations may be dispensed with, optimum operating values predicted and transistors with abnormal characteristics may be easily detected.

What is the transigner? It is simply a grounded-emitter amplifier circuit and variable power supply equipped with variable bias resistances. To change the operating voltage, you turn a potentiometer; to change the value of any resistance, you turn another (Fig. 1). The dc voltage applied to the transistor circuit may be varied with the 7,500-ohm voltage divider in the power supply circuit. The collector bias resistance may be adjusted by varying the 100,000- and 10,000-ohm potentiometers connected in series in the collector circuit. A 10-megohm pot in the base circuit controls base bias resistance and 5,000- and 1,000-ohm units in series with the emitter permit varying the emitter bias resistance. With these controls you can design a transistor audio amplifier in minutes.

The original transigner was a cheap and dirty arrangement constructed in 3 hours. Stress was placed on ease of operation, versatility and ease of interpretation rather than elegance. The bottom view of the transigner reveals that a large number of blank tie-down points are available. These were provided so that changes could easily be made in the circuit later if desired. The transistor socket and the terminal strips were fastened to the meter with

* Physics Dept., Mississippi State College

Duco cement. The meter is not essential since a bench instrument may be used to adjust the applied dc voltage.

The switch permits speedy measurement of input and output voltages and waveforms. The leads from an oscilloscope and an audio vtvm clip to the ground bus and the center switch terminal. The signal leads from an audio generator connect to the input terminals. The power transformer and several associated components are wired separately to avoid hum pickup. They should be placed in an enclosure (I use a cardboard power-transformer box) for safety. The power supply in the transigner circuit was designed for p-n-p type transistors such as the Raytheon CK722. For n-p-n transistors such as the 2N35, a negative ground is required and a conventional utility power supply can be used.

The markings on the front panel may be made with India ink. They should be made prior to wiring, using an ohmmeter to determine calibration points. The builder who does not include a voltmeter in his transigner may calibrate his dc voltage control with an external voltmeter and be assured of reasonable accuracy.

Using the transigner

To design a grounded-emitter transistor amplifier stage, place the transistor to be used in the socket (be sure to make proper connections). Connect an audio signal generator to the input of the transigner and an audio voltmeter and oscilloscope to the center switch terminal and ground. Set the resistance controls to approximately correct values. For example, if a CK722 is to be used with a 6-volt supply, set the base bias to 250,000 ohms and the collector bias to 20,000 ohms if a high-impedance output load is to be used. The approximate settings are not critical. The power may then be applied and the voltage control advanced to supply 6 volts. The base and collector bias controls are then

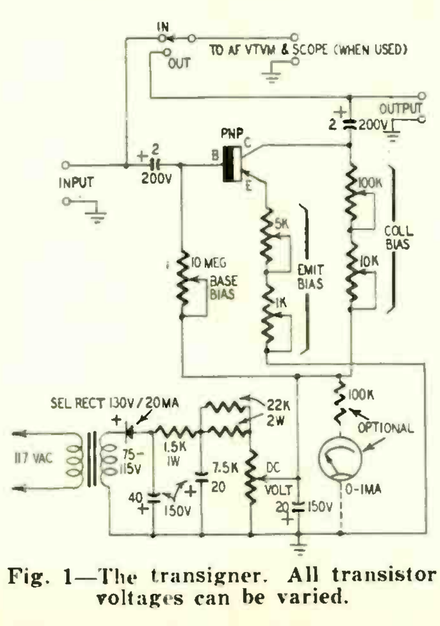
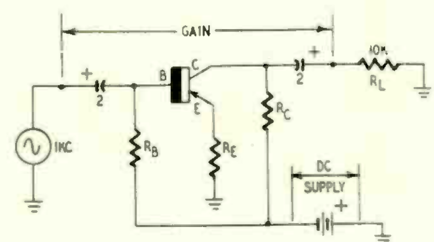


Fig. 1—The transigner. All transistor voltages can be varied.

manipulated for maximum gain and best output waveform.

Although the audio generator output control is kept at a constant setting, the input voltage to the amplifier may vary with changes in the transigner control settings. Therefore, to be sure about the gain of the amplifier stage, you must always divide the output audio voltage by the input audio voltage.

The emitter bias resistance plays an important role in grounded-emitter amplifiers. An unbypassed emitter bias resistance stabilizes the amplifier by minimizing shifts in the dc operating point with temperature changes. It also increases the input impedance of the amplifier. Since it is often desirable to cascade amplifier stages or use high-impedance input devices, the latter feature is particularly important. A further effect of the emitter bias resistance is to improve low-frequency response. Of course, a price must be paid for these improvements and the cost is a reduction in amplifier gain.



GROUNDED-EMITTER AMPLIFIER

Dc volts	R_C (ohms)	R_B (ohms)	R_E (ohms)	Voltage Gain	Input Impedance
3	10,000	200,000	0	59	2,300
			500	14.1	9,300
6	10,000	250,000	0	112	1,800
			500	15.6	10,400
			1,000	8.6	18,800
22.5	40,000	900,000	0	500	1,280
			500	64	10,200
			1,000	33.3	19,200

Fig. 2—Diagram of test circuit and data obtained using CK722 transistor.

Fig. 2 contains some experimental results for various circuit values for a grounded-emitter amplifier using a CK722 transistor. It indicates performance with various circuit values. Note that for the particular transistor used for this data, an emitter bias resistance of 500 ohms increased the input impedance to approximately 10,000 ohms and a resistance of 1,000 ohms increased it to approximately 20,000 ohms.

If the amplifier you're designing is to drive a load of less than 100,000 ohms, the load should be connected at the output terminals of the transigner. This is necessary because the output load has considerable influence on the operation of a transistor amplifier. For example, if you intend to use the amplifier stage you're designing to drive a second transistor amplifier stage, the second stage will present a load of approximately 1,500 ohms to the collector circuit of the first amplifier (assuming zero emitter bias resistance for the second stage). In such a case you should connect a 1,500-ohm resistance to the output of the transigner to simulate the actual load. If the second amplifier stage has an emitter bias resistance of approximately 1,000 ohms, the input impedance (and consequently the load on the first stage) will be approximately 20,000 ohms and a similar resistor should be connected to the output of the transigner.

You might say, "That's fine and dandy, but how can I find the input impedance of a given transistor amplifier?" This can be done by using the arrangement shown in Fig. 3. Measure voltages V1 and V2 with an audio volt-

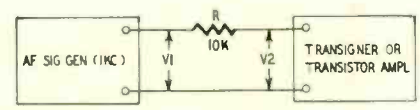


Fig. 3—Method for determining transistor amplifier input impedance.

meter. Then substitute the measured values in the equation:

$$Z_{in} = \frac{V2R}{(V1 - V2)}$$

to calculate the input impedance.

To design a multistage transistor amplifier, you must start with the last stage and work toward the input end of the amplifier. As each stage is designed, record the component values. When optimum component values have been determined for all stages, you're ready to proceed with the construction of the miniature amplifier. The coupling capacitors can be 5-μf miniature electrolytics. A safe rule of thumb for determining the voltage rating is to make it equal or greater than the dc power supply voltage to be used in the miniature transistor amplifier.

Parts for the transigner

Resistors: 1—1,500 ohms, 1 watt; 2—22,000 ohms, 2 watts; 1—1,000, 1—5,000, 1—7,500 (3-watt wirewound), 1—10,000, 1—100,000 ohms, 1—10 megohms (logarithmic taper), potentiometers.

Capacitors: 2—2-μf 200 volts; 2—20 μf, 1—40 μf 150 volts, electrolytics.

Miscellaneous: 1—selenium rectifier, 20 ma; 1—power transformer, secondary 75–110 volts; 1—spdt switch; 1—transistor socket; 1—chassis; 1—container for power-supply components.

Optional: 1—0-1-ma meter; 1—100,000-ohm ½-watt resistor.

In addition to being valuable in design work, the transigner can perform other jobs. For example, the quality of a transistor may be checked by recording the gain for several transistors, known to be good, in the transigner with a chosen value of dc supply voltage, collector bias resistance, base bias resistance and input signal voltage at 1,000 cycles. These gain figures may be used as standards and a transistor of unknown quality may be checked against them. The high-frequency capabilities of the transistor may be checked by using an rf signal generator as the signal input source and a standard vtvm with rf probe for the measuring function. END

the Y signal in MATRIX OPERATION

When excessive signals are applied to the picture tube, the Y voltages may also affect the picture hue

By ROBERT G. MIDDLETON *

MATRIX response changes greatly when the Y signal level is varied. It is possible, for example, to *cut off* or *energize* the green gun in the picture tube merely by varying the Y voltage while the chrominance signal voltage is held constant.

Fig. 1 shows a familiar matrix arrangement used in many present-day color TV receivers. We will observe how this matrix responds to various levels of Y voltage while an R−Y signal is applied to the color detectors. Fig. 2 shows the output from the R−Y detector when applying the R−Y signal. For illustration, the output from the R−Y detector is 7 volts; the output from the B−Y detector is zero because a B−Y detector cannot respond to an R−Y signal voltage.

However, as shown in Fig. 2, the R−Y signal causes the G−Y matrix to develop an output voltage, equal in this case to −3.6. Readers will recall that the G−Y matrix responds to a color signal voltage by adding −0.51 (R−Y) to −0.19(B−Y), *a G−Y output is obtained when an R−Y signal is applied to the color circuits.*

*Chief field engineer, Simpson Electric Co.

The output voltages from the R−Y detector and the G−Y matrix are applied to the grids of the color picture tube. In a low-level demodulation system the output voltages are amplified before application to the picture tube; in a high-level demodulation system the detectors operate at a sufficiently high voltage so that the output voltages from the detectors can drive the grids of the color picture tube directly.

Figs. 3, 4 and 5 show how the response of the picture tube to an R−Y signal varies in accordance with the voltage of the Y signal, applied to the cathodes of the picture tube. When the Y voltage is zero (Fig. 3) and the R−Y detector output is 7 volts, the result is 7 volts drive to the red gun, zero to the blue gun and −3.6 to the green gun. The red gun develops output because the signal is positive; the blue gun develops no output because no drive is applied; the green gun develops no output because the signal is negative. Thus we will see a saturated red hue of low brightness when the color picture tube is driven by the signal voltages in Fig. 3.

Fig. 4 shows the result of raising the Y signal from 0 to 3 volts, keeping the output from the R−Y detector at 7 volts. (In discussing matrix operation, a positive signal voltage *increases* the beam current from the gun, a negative signal voltage *decreases* it. Thus, the signal voltages at the red gun are now additive and a total of 10 volts drive is applied to the red gun. The signal voltages at the blue gun provide 3 volts of drive, the blue gun now producing beam current. The signal voltages at the green gun subtract, resulting in −0.6 volt drive to the green gun. Thus, the green gun is still cut off. Since there is output from the red and blue guns, the red hue is no longer pure. It is mixed with blue and a magneta hue is produced.

In Fig. 5, we see the result of further raising the Y signal voltage—to 5. As a result, the green gun is no longer cut off, developing beam current corresponding to 1.4 volts of signal drive. A greenish hue is now mixed with the red and blue hues.

Y voltage in rainbow generators

Let us apply the above to the display of rainbow patterns and see how hue may depend upon the value of Y signal voltage selected by the technician. A rainbow signal is a simple sine-wave voltage, usually set at 3.58 mc ±15,750 cycles—the color subcarrier frequency plus or minus one horizontal scan. The color TV receiver then displays one rainbow spectrum, with a small portion lost on retrace. When the rainbow signal operates *below* 3.58 mc the colors are reversed in their order as compared with the order when the rainbow signal is operating *above* this frequency.

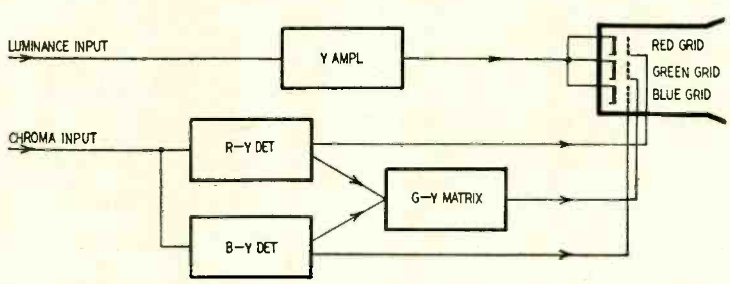


Fig. 1—A common matrix arrangement used in color TV receivers.

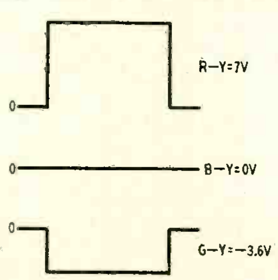


Fig. 2—Output of color detectors and matrix when R − Y signal is applied.

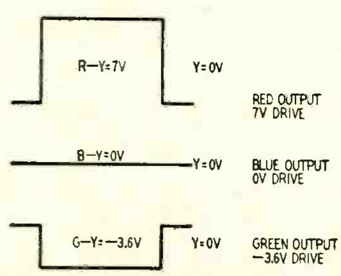


Fig. 3—Tube drive when Y = 0 volt.

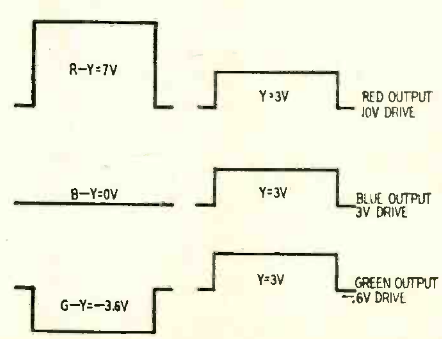


Fig. 4—Tube drive when Y = 3 volts.

A rainbow signal can be displayed on the screen of a wide-band scope having a triggered horizontal sweep or a conventional horizontal sweep capable of operating at 300 or 400 kc. The rainbow signal then appears as shown in Fig. 6. The signal has the shape of a simple sine wave. Since the frequency of this rainbow signal differs slightly from the color subcarrier, it is often referred to as an *offset color subcarrier.*

The rainbow signal has a constant voltage, depicted in Fig. 7 by representing the signal voltage in the form of a circular sweep (constant radius). The rainbow signal rotates in phase with respect to the color-subcarrier oscillator in the receiver because it has an offset frequency. (An ac voltage represented as an arrow—or vector—necessarily rotates with respect to another ac voltage having a different frequency.) And because the rainbow-signal vector rotates with respect to the color-subcarrier oscillator vector, it sweeps through the various hues indicated in Fig. 7. For this reason, a rainbow signal is sometimes called a *linear phase sweep.* It is a *linear* sweep because it has a constant rotating speed; it is a *phase* sweep because its only variation consists of a change in phase with respect to the color-subcarrier oscillator voltage.

When the rainbow signal is applied to a color TV receiver, it is picked up only by the color detectors (see Fig. 1); no part of the rainbow signal passes through the Y amplifier since the color subcarrier frequency is trapped out in the Y amplifier.

Since the rainbow signal is incomplete (no Y-signal component), how is it possible to obtain visible patterns on the screen of the picture tube? *This is done by introducing an artificial Y component via the brightness control.* The master brightness control applies a dc bias voltage to the signal electrodes of the color picture tube. Thus the technician simply advances the brightness control to a point where the rainbow colors appear satisfactorily on the screen of the picture tube. This is equivalent to having a Y signal of constant value.

Returning to Figs. 3, 4 and 5, we can see that when the rainbow signal is sweeping through the R−Y phase, we can obtain any one of the three conditions by adusting the master brightness control. That is, we can make the R−Y signal phase energize the red gun alone, the red and blue guns together or the red, blue and green guns together.

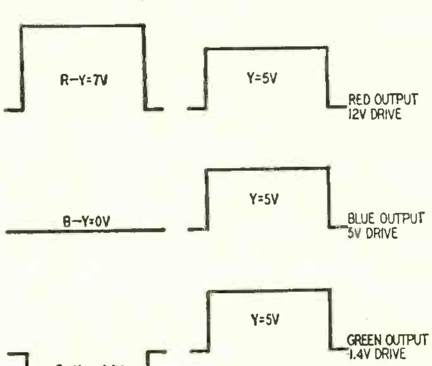


Fig. 5—Tube drive when Y = 5 volts.

Thus, the hue displayed on the screen of the color picture tube can be made to vary by adusting the value of the Y signal. However, it must not be supposed that this is *always* the case—the value of the Y signal in other (and more conventional) situations controls only the *brightness* and *saturation* of a color, without changing its *hue.*

A standard NTSC color-bar signal for 100% saturated colors is shown in Fig. 8. This color signal has a luminance and a chrominance component, as shown in Fig. 9. The three characteristics of a color, which concern matrix and picture-tube operation, are brightness, hue and saturation, which the matrix processes in terms of Y, R−Y, B−Y and G−Y. R−Y and B−Y are distinguished by phase, being in phase quadrature (90°) to each other. The chrominance signal in Fig. 9-a is a mixture of R−Y and B−Y.

As a simple illustration of the effect of the Y component in controlling brightness and saturation, consider the following three red color signals:

1. *Signal for 100% saturated red at full brightness:*

$$\begin{aligned} Y &= 0.30 \\ R - Y &= 0.70 \\ B - Y &= -0.30 \\ G + Y &= -0.30 \end{aligned}$$

2. *Signal for 50% saturated red at full brightness:*

$$\begin{aligned} Y &= 0.65 \\ R - Y &= 0.35 \\ B - Y &= -0.15 \\ G - Y &= -0.15 \end{aligned}$$

3. *Signal for 100% saturated red at half brightness:*

$$\begin{aligned} Y &= 0.15 \\ R - Y &= 0.35 \\ B - Y &= -0.15 \\ G - Y &= -0.15 \end{aligned}$$

The voltages in these three red signals show that the only difference between 100% saturated red at half brightness and 50% saturated red at full brightness in the Y component.

This, then, leads to the question, "Why do we observe cases of matrix operation in which the value of the Y component affects hue, while in other cases the value of the Y component affects only brightness and saturation?" The answer to this is that the value of the Y component can change the hue only when the relative values of luminance and chrominance voltages are such that the dynamic operating range of the color picture tube is exceeded.

Thus, it can be stated: **The role of the Y signal in matrix operation is controlling the brightness and saturation with no control of hue, during normal operation of the picture tube.** END

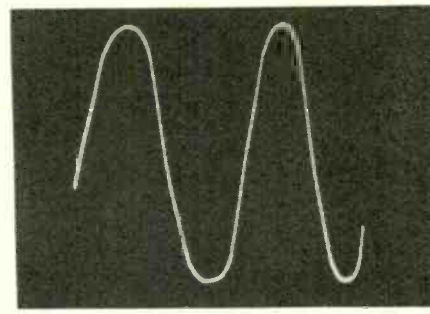


Fig. 6—Waveform of rainbow signal.

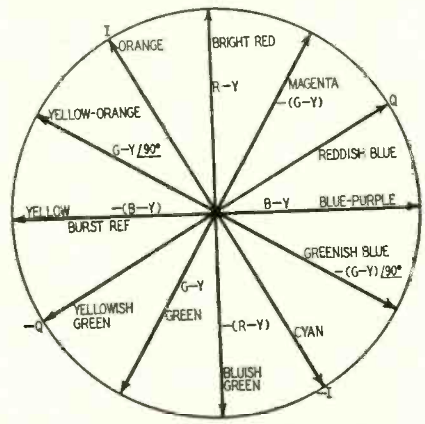


Fig. 7—Color phase relationships.

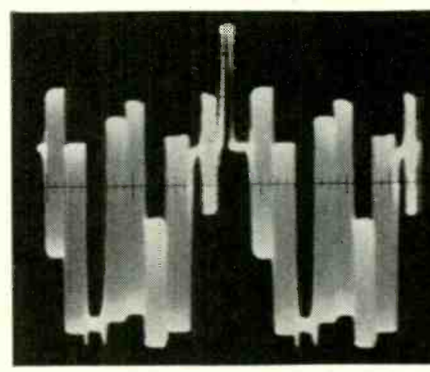


Fig. 8—Standard NTSC color-bar signal.

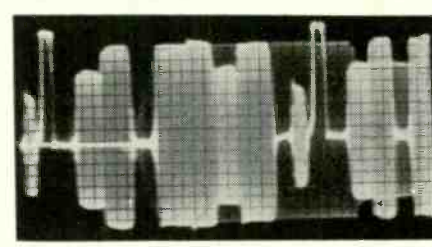
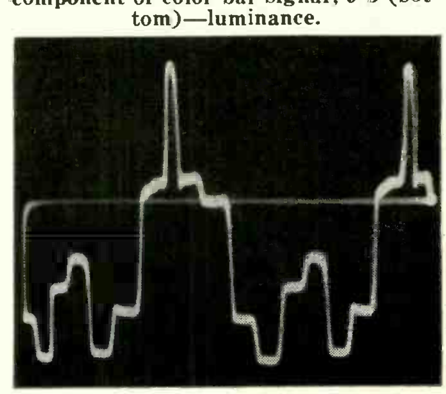
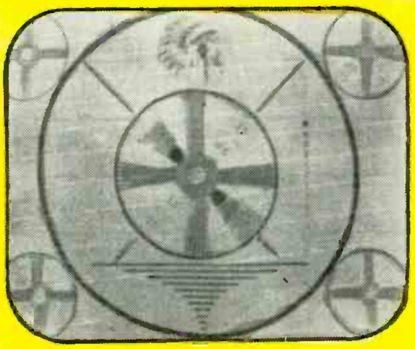


Fig. 9-a (top)—5.58-mc chrominance component of color-bar signal; 9-b (bottom)—luminance.

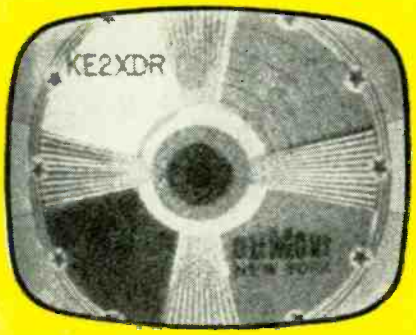


TROUBLESHOOTING A.G.C. CIRCUITS

Part I—Types and operation of a.g.c. systems



Weak picture due to defective a.g.c.



Snow caused by excessive a.g.c. voltage.

By CYRUS GLICKSTEIN

A.G.C. (automatic gain control) troubles in TV receivers are often tough to find. This is not because a.g.c. circuits are more complex than most other TV circuits—the a.g.c. system is usually one of the *simpler* circuits. The difficulty arises because most of the symptoms resulting from a.g.c. faults are exactly the same as those produced by familiar troubles in other sections of the receiver.

In some cases, the defect may immediately point to possible trouble in the a.g.c. circuit:

Normal signal input at the antenna produces video overload (too much contrast), with the contrast control having less than the usual range of control, while sound is normal;

Sound is O.K. but the screen is blank (no picture or raster) on active channels at normal brightness settings—on inactive channels a normal raster is visible. (This indicates the picture tube is blanked out with normal signal input as a result of video overload.)

The following symptoms may be caused either by a.g.c. troubles or faults, as indicated in parentheses, in other sections of the receiver:

1. Tearing, bending, erratic horizontal hold action or other horizontal instability (front end, video strip, sync section, horizontal a.f.c., horizontal sweep circuit).
2. Defective vertical and horizontal sync (front end, video strip, sync section).
3. No sound, no pix, raster O.K.

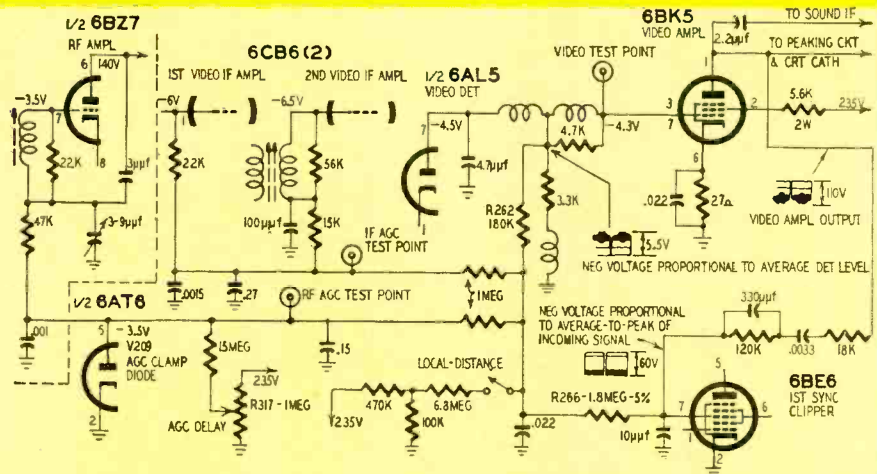


Fig. 1—Schematic diagram of the a.g.c. circuit in the Du Mont RA-312 chassis.

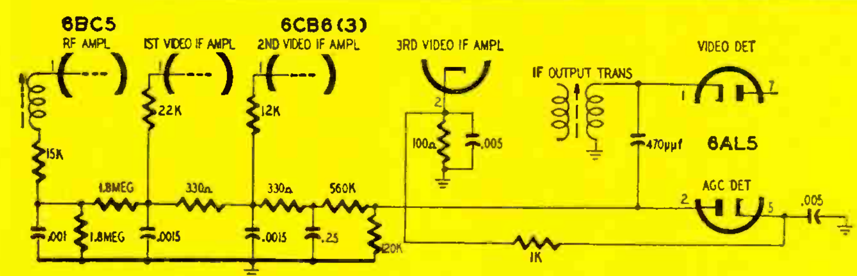


Fig. 2—Simple a.g.c. with separate a.g.c. rectifier in Silvertone 478.380.

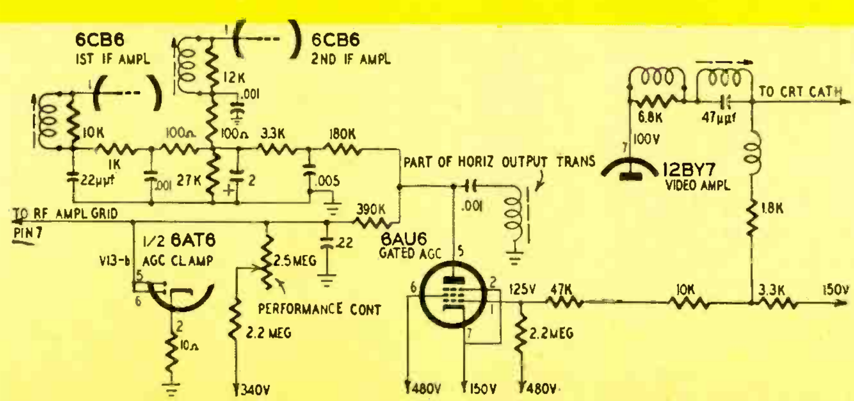


Fig. 3—Gated a.g.c. with threshold control in a.g.c. bus—Sparton 23U214.

(front end, common i.f. stage, video detector and possibly video amplifier in intercarrier sets).

4. No pix, sound normal, raster O.K. (video strip in split-sound receivers, video amplifier in intercarrier sets when sound is taken off at the video detector).
5. Weak (snowy) pix (see photo), weak sound (front end, common i.f., video detector and possibly video amplifier in intercarrier sets).
6. Weak video (see photo), loss of horizontal and vertical sync, sound O.K. (video strip).
7. A change of sensitivity in both video and sound as the set is operating (front end, common i.f., video detector and possibly video amplifier in intercarrier sets).
8. Video hum pickup (front end, video strip).

The a.g.c. circuit is usually considered part of the video strip which also includes the video (or common) i.f. stages, the video detector, the video amplifier and the picture tube. Thus, the a.g.c. circuit must be kept in mind as a possible source of trouble when symptoms point to a defect in the

Front end or common portion of the video strip (no sound, no pix, raster O.K.);

Video strip (weak or contrasty video or no video, sound and raster O.K.);

Sync section, horizontal a.f.c. or sweep circuits (poor horizontal or vertical sync).

Therefore an a.g.c. circuit check should be made a part of normal troubleshooting when these symptoms are noticed.

A.g.c. systems

Two basic types of a.g.c. systems are commonly used: simple and keyed (gated). A third type, found in several recent models, can be considered a combination of the two (Fig. 1). A similar circuit in a current Zenith model is labeled *noise-gated amplified a.g.c.* A fourth variety—amplified a.g.c.—was used in a number of models before the keyed a.g.c. system became so popular. There are of course many variations of each of these major types. Fig. 2 shows a simple a.g.c. circuit, using an a.g.c. diode rectifier.

Simple a.g.c. is similar to a.v.c. in radio receivers. The rectified and filtered video i.f. signal produces a negative d.c. output voltage based on the peak value of the i.f. input. In simple a.g.c. systems noise bursts and high noise levels tend to add to the normal a.g.c. voltage. This increases the adverse effect on the signal unless noise cancellation circuits are used.

A keyed a.g.c. system is shown in Fig. 3 and is used in many recent models. The keyer tube, which is biased to cutoff by a high cathode voltage, conducts only during the period when the positive peaks of the video signal (horizontal sync pulses) are applied to the grid. At the same time, a narrow, positive square wave derived from the horizontal sawtooth retrace is applied to the plate from the horizontal output circuit. Plate current, therefore, flows only during the sync pulse interval. The plate circuit has an a.g.c. filter network that charges to a negative voltage in accordance with the signal strength. Noise pulses between sync pulses have no effect in developing a.g.c. bias since the tube is cut off during these intervals.

In the noise-gated amplified a.g.c. circuit shown in Fig. 1, the video signal from the plate of the video amplifier is applied to grid 3 of the 6BE6 first sync clipper. Grid rectification occurs, developing a negative voltage at this point which is applied to the a.g.c. line. At the same time, a negative voltage is developed at the video detector

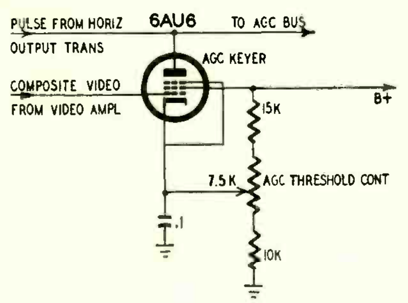


Fig. 4—The a.g.c. threshold control is in cathode circuit of keyer tube.

output which is also applied to the a.g.c. line. The resulting a.g.c. bias at the junction of R266 and R262 is a function of the peak signal input at the antenna terminals of the receiver. (The 6BE6 also functions as a noise-cancellation stage. Video signals of opposite polarity are applied to grids 1 and 3. The normal amplitude of each allows sync pulse output to appear at the plate. However, large noise pulses in the video signal act to cancel each other in the output of the stage.)

A.g.c. action

The primary function of a.g.c. is to keep the output picture level relatively constant with changes in signal strength (peak signal level) at the antenna terminals. Like a.v.c. in radio, this is done by making a strong signal develop more a.g.c. bias, applied through the a.g.c. bus to the grids of the r.f. and video (or common) i.f. amplifier stages, to reduce amplification. A weak signal produces less a.g.c. bias. Therefore, r.f. and video (common) i.f. amplification is greater.

However, if a comparatively weak signal were allowed to develop *any* a.g.c. bias, the result would be a still weaker signal. This is undesirable, especially in fringe areas where the signal-to-noise ratio is low. For this reason many receivers with a.g.c. have controls or switches in the a.g.c. system for selecting the level of signal strength at which the a.g.c. becomes operative.

Manual a.g.c. controls fall into two main groups: local–distance switches and a.g.c. threshold controls. Automatic a.g.c. delay networks generally use either a clamping diode or a bias applied to the a.g.c. diode rectifier. Some models use one or more of these devices in the a.g.c. system (Figs. 1–4). Other receivers with a.g.c. may use none. The local–distance switch shorts out part or all of the a.g.c. voltage to the r.f. amplifier (and in some receivers, the other controlled stages) in the distance position. This allows the r.f. amplifier (and in some receivers, the other controlled stages) to operate with little or no a.g.c., permitting greater amplification of weak signals with a resultant improvement in the signal-to-noise ratio.

The threshold control is generally a potentiometer connected in a voltage-divider network. In some models, this control (Fig. 4) varies the bias to the a.g.c. keyer tube so that the stage does not operate until a given level of video signal is present. Above that level, the tube operates and applies a.g.c.

In other models the threshold control varies the voltage applied to the a.g.c. bus—usually to that section of the bus connected to the r.f. amplifier (R317, Fig. 1; PERFORMANCE CONTROL, Fig. 3). In this type of circuit it is generally used together with a clamping diode. In the circuit of Fig. 4 no negative voltage appears on the entire a.g.c. bus until the video signal is above the level selected by the threshold control setting. In Figs. 1 and 3, some a.g.c. voltage is developed even at low signal levels but no a.g.c. bias is applied to the r.f. amplifier stage until the video signal is above the threshold setting.

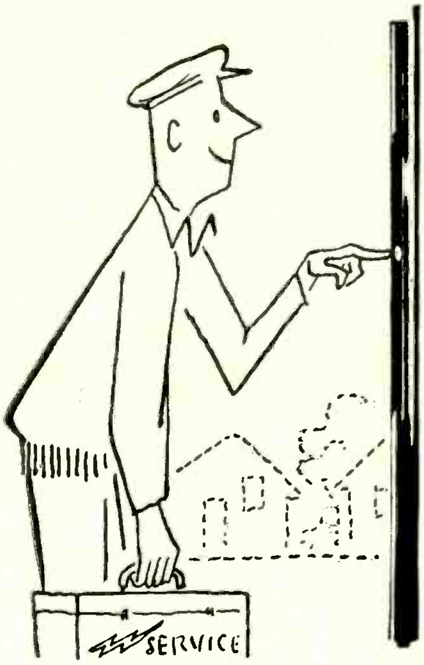
A clamping diode is connected from the a.g.c. bus to ground (V209, Fig. 1; V13-b, Fig. 3). At low signal levels, the diode conducts and clamps the point where the diode plate is connected to ground potential. No a.g.c. voltage is developed at this point. When the video signal rises above a given level, the voltage at the clamping diode plate becomes negative and the diode no longer conducts. A.g.c. voltage is then developed.

When a threshold or delay control is used with a clamping diode as in Figs. 1 and 3, the level at which a.g.c. bias begins to be developed can be varied. If the control is rotated so the voltage at the center tap is more positive, a stronger video signal is necessary to bring the voltage at the diode plate below ground potential and so cause the clamper to cut off.

Fig. 2 shows a simple a.g.c. delay network which makes use of a bias voltage applied to the a.g.c. rectifier. The cathode of the a.g.c. diode is connected to the cathode of the last video i.f. amplifier. The small positive voltage applied to the a.g.c. rectifier cathode keeps the tube cut off until the signal level at the diode plate is large enough to overcome this biasing voltage. A.g.c. voltage is then developed in the usual way. TO BE CONTINUED

Field Service Experiences with COLOR TV

A review of common troubles the service technician may expect to find



By CHARLES W. RHODES*

ASIDE from the routine component breakdowns in color receivers, which have their counterparts in monochrome chassis, a few new problems have developed to challenge the service technician who has turned his attention to color.

One common trouble is intermittent color reception. I have seen cases where slight changes in antenna orientation or lead-in placement caused loss of color. At first the trouble appeared to be in the antenna system. However, the color didn't grow weaker gradually; it disappeared abruptly and in each case varying the hue control also caused loss of color, often just as the correct setting of the control was approached.

Actually the trouble had nothing to do with either the antenna or hue control. The clue is the abrupt loss of color. It is caused by the color killer circuit which biases the chrominance amplifier beyond cutoff during monochrome reception to prevent noise pulses from passing through the chrominance circuits and causing color specks on the screen.

Fig. 1 shows a widely used color killer circuit. During color reception the burst signal is rectified by V4 which develops a high negative bias at the plate of V4-b. This is applied to color killer V1 and cuts off plate current. The plate voltage of V1 then rises to B plus, 150 volts.

Chrominance amplifier V2 is direct-coupled to V1, its cathode being returned to B plus. Plate current flow through V1 lowers the grid voltage of V2, cutting it off whenever the burst signal is not present — during monochrome transmission. It is not possible for both V1 and V2 to conduct at the same time, and for color reception V1 must be cut off to allow the chrominance signals to reach the color demodulators via V2.

Frequently, the rectified burst signal is not strong enough to completely cut off V1 although it can synchronize the color oscillator. This is the real cause of many cases of intermittent color reception. When this trouble is suspected, the V1 cathode lead to ground should be opened, disabling the killer circuitry. Many technicians have installed a switch between the killer cathode and ground. If the receiver must operate on marginal signals, it is best to open the switch.

Another frequent cause of intermittent color reception, where monochrome pictures are received properly, is an intermittent color subcarrier oscillator. Fig. 2 shows a widely used crystal-controlled oscillator circuit. Here the tube may check perfect but will refuse to oscillate — several tubes should be tried.

Tuning cathode coil L4 is very critical. As this coil is tuned toward resonance from one side, output rises until resonance is reached and the oscillations cease.

Tuning L4 too close to resonance will cause intermittent operation. A convenient way to adjust L4 properly is to connect a v.t.v.m. to the plate pin of V4-b (Fig. 1), setting the meter to read on a –30-volt scale. Remove V3 so that the voltage read at the plate is only the oscillator output fed from V7, the subcarrier buffer amplifier. Tune L3 first for maximum output. Then back off the slug to start oscillations again. Finally tune it to give exactly 2 volts less output than the maximum you obtained. This is sufficient output for the demodulators and yet is far enough from resonance that drift will not cause it to stop oscillating.

In this circuit, feedback to sustain oscillations is through the grid-cathode capacitance of the oscillator tube and a 2.2-$\mu\mu$f capacitor, generally a 5% NPO unit. In some cases where L4 was properly tuned, and several oscillator tubes have been tried without success, an erratic oscillator has been cured by increasing this capacitance to 4.7 or even 6.8 $\mu\mu$f, using only 5% NPO units. This will require retuning L4. The crystal itself has given us very little trouble.

Defects in the reactance control tube (V5) and its circuit may stop the oscillator (V6). V5 behaves like a variable tuning capacitor shunting L3 and the crystal, thereby controlling the oscillator frequency. Its shunting capacitance depends upon its transconductance which varies with electrode voltages and the values of C3 and R2. Leakage in C3 would cause the grid to go positive, increasing the capacitance beyond limits. If either C3 or R2 increases in value, excessive capacitance will shunt the crystal and it won't oscillate. If

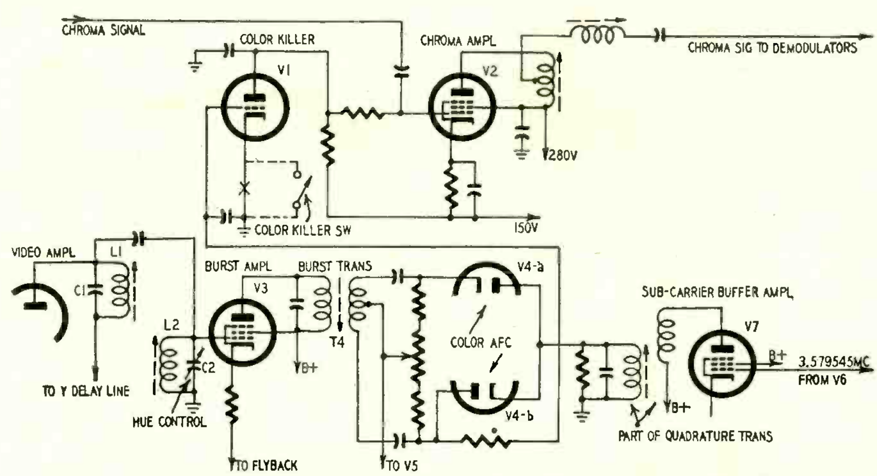


Fig. 1—Schematic shows simplified color killer and a.f.c. circuitry.

*Northwestern district service manager, CBS-Columbia.

either is too low in value, there may be very little a.f.c. action and color sync will be poor.

Many cases of erratic shifts in hue in the color picture, notably with camera changes, have been traced to horizontal oscillator alignment. The burst signal is transmitted during part of the horizontal blanking or retrace time. A pulse from the flyback transformer forces the burst amplifier to conduct for its brief duration and then cuts it off during the active scanning period so that chrominance signals cannot enter the burst circuits which would be analogous to letting raw video pass through the sync circuits. This would cause the hues to change with picture content. Chrominance signals may enter the burst circuits if the horizontal keying pulse (retrace) is delayed too long and part of it occurs during active scanning time. In monochrome receivers we refer to this as a left-hand horizontal foldover. The cure is to align the horizontal oscillator very accurately. Synchroguide circuits commonly give this trouble.

Tinting of monochrome pictures, causing some areas to be greenish or magenta, is a frequent shortcoming of color picture tubes. This is a special case of impurity which can exist even though perfectly pure individual fields of red, green and blue are obtained. It is a defect for which there is no remedy. Individual fields may be checked for purity by turning down the screen controls for the other two guns in sequence. The contrast control must be turned fully off for checking purity. With the green and blue screens off, the resulting red raster should be pure red. If not, the usual purity adjustments should be made. Generally, when the red field is pure, the green field will also be and the blue field is almost sure to be pure, but they should be checked as well, in any case.

Where the three individual fields are found to be pure and tinting exists in the white raster, the trouble is either a hum or a low-purity picture tube. Hum may be isolated by bypassing the cathodes and grids of the picture tube with a suitable capacitor or by removing the video tubes which drive the picture tube. Hum will form one or two horizontal bands. As tube manufacturing techniques improve, this problem will diminish.

The extremely high anode voltage of color picture tubes may produce some freak breakdowns of components. Occasionally the high voltage can momentarily break down the insulation of the picture-tube glass envelope and arc through to a nearby component such as the purity coil, convergence assembly or yoke. This has explained some mysterious failures of these parts or associated controls. The energy stored in the high-voltage supply is far greater than in monochrome receivers and consequently more lethal.

A few color receivers have been made using the Standard Coil turret tuner which uses R strips. In some u.h.f. areas, these strips produce a picture i.f. of about 42.0 mc and a sound i.f. of 46.5 mc. Monochrome reception is satisfactory. However, the sound i.f. is not trapped out and very heavy interference on color programs occurs as a result.

In cases where the hue control is not centered in its range but tunes at the extremes of its rotation, it may be possible to center it. But considerable caution is required.

Fig. 1 shows how the burst signal is taken off the plate of a video amplifier in many color receivers and fed to the keyed burst amplifier. The chrominance signals are taken off earlier in the video amplifier. Components L1–C1 form a trap tuned to 3.579 mc to prevent the burst signal from reaching the color tube. It is capacitively coupled to L2–C2 in the grid of the burst amplifier. Capacitor C2 is a small variable unit which can tune the circuit slightly above or below 3.579 mc and is the hue control. When it is tuned to resonance, there is no phase shift and the burst signal is passed at maximum amplitude to the burst amplifier. If the hue control is tuned lower than 3.579 mc, the burst signal is reduced in amplitude and shifted in phase. Tuning above 3.579 mc also produces attenuation and a phase shift opposite to that produced before. This phase shift determines the hue of reproduced colors and is a customer control.

While the slug in L2 could be adjusted to center the range of the hue control, it may result in further detuning which results in additional and unwanted attenuation of the burst signal. Should 3.579-mc trap L1–C1 or the burst transformer be slightly out of alignment, they can produce phase shifts which the customer may counteract by detuning the hue control in the opposite direction.

The safer plan is to follow the manufacturer's instructions and realign all these coils together. END

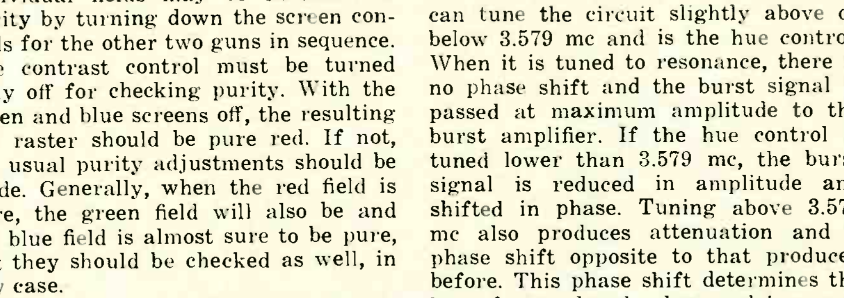
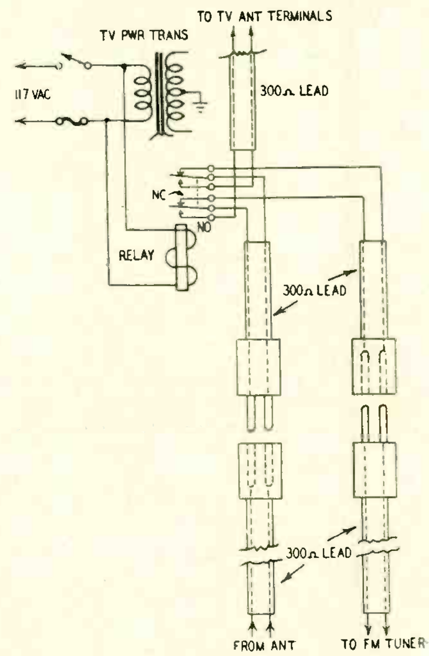


Fig. 2—Typical color subcarrier oscillator circuit.

FM–TV ANTENNA SWITCH

WHEN a single antenna is used for both FM and TV, it is seldom satisfactory to connect both receivers directly to the lead-in because this usually causes mismatch and losses. A d.p.d.t. switch is one answer to the problem, but it is easy to forget to switch from one set to the other.

A relay in the antenna circuit provides a simple, automatic and foolproof method of switching the antenna. A d.p.d.t. relay with a 115-volt a.c. coil should be connected as shown in the diagram. This relay may be a Potter & Brumfield KR11A, Leach 327, Advance AM/2C/115VA or equivalent.



Mount the relay on the TV chassis as close to both the power supply and tuner input as is convenient. Tie the relay coil directly across the primary of the power transformer. Use a short section of 300-ohm ribbon type transmission line to connect the normally open contacts of the relay directly to the antenna terminals on the TV set. Connect the armature contacts to the antenna lead-in through a plug-and-socket type of TV antenna connector. The normally closed (back) relay contacts are connected to the FM antenna terminals through a section of transmission line and a connector. Polarize the connectors as shown in the diagram.

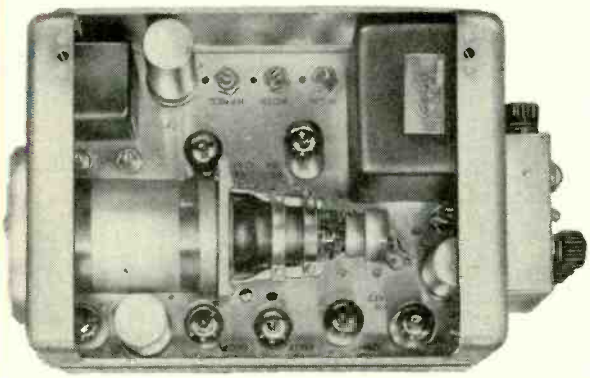
This arrangement leaves the antenna connected to the FM receiver whenever the TV set is turned off. But, when the TV receiver is in use, the relay coil is energized and transfers the antenna from the FM to the TV set. When pulling the TV chassis for inspection or repairs, simply separate the connectors to the antenna and FM tuner and plug the antenna lead into the FM connector. The TV receiver and relay may then be removed without interrupting the use of the FM set.—*R. D. Herlocker* END

Methods and techniques used in closed-circuit operation

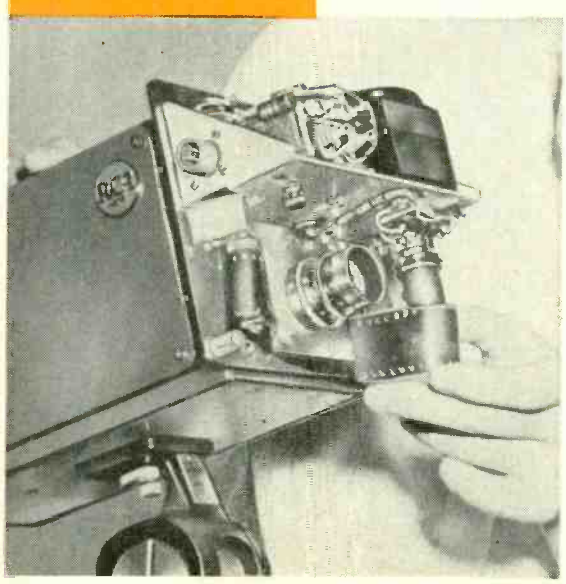
INDUSTRIAL TV is simple

By EDWARD M. NOLL*

Vidicon camera tube —the RCA 6198.



The Dage model 60 video camera.



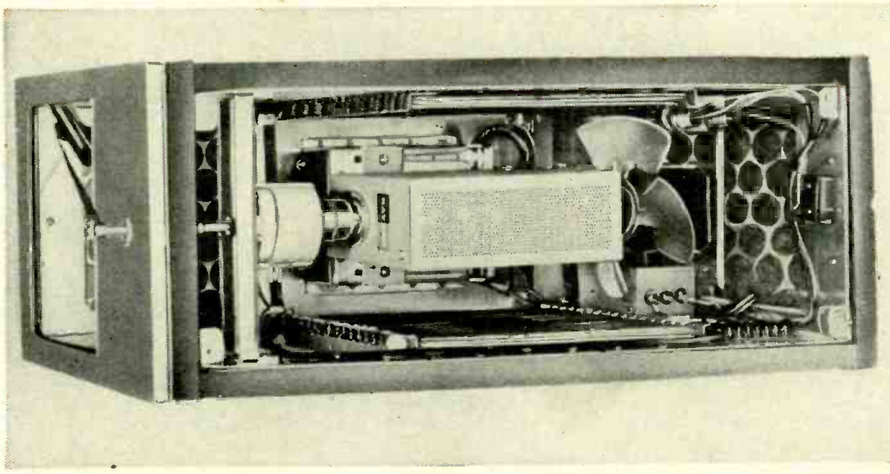
Installing the RCA automatic iris.

TELEVISION camera tubes and circuits are no more complex or difficult to learn than receiver techniques. In closed-circuit industrial TV the simplicity of the composite television signal makes the system much less complex. Compared to the elaborate signal construction for commercial telecasting, the closed-circuit composite is less exacting and has fewer pulse components.

The first hurdle is to understand that circuit functions at the camera tube are almost identical to those at the picture tube (Fig. 1). For example, there must be a source of electrons in the form of a cathode-ray gun. The beam of electrons must be set in motion horizontally and vertically to form a raster on the target image. Thus horizontal and vertical deflection waveforms must be generated to deflect the camera-tube beam. Just as at the picture tube, the camera-tube beam must be made inactive during retrace intervals. Therefore horizontal and vertical blanking pulses are needed at the camera tube. The basic difference between camera and picture tubes is that the scanning beam at the camera tube produces a video signal as it scans a phototarget surface; at the picture tube the scanning beam causes a fluorescent screen to glow as a function of the video information.

There must be synchronized motion of the picture-tube beams; the synchronizing pulses perform this service. They insure that the image on the picture tube is reproduced in the same sequence the image video information was released at the camera tube. Synchronizing pulses are formed by the pulse generator section of the camera and supplied to the deflection systems of both camera and picture

*Author *Closed Circuit and Industrial Television,* Macmillan, 1956.



The Kay Lab industrial TV camera.

tubes. Consequently the motion of the two scanning beams is synchronized.

Simultaneously timed blanking pulses also go out from the pulse generator to the camera and picture tubes to prevent release and display of spurious retrace signals.

Interconnection plans

There are a number of methods of sending the video and synchronizing information between camera and viewer. For many installations (Fig. 2-a) a standard television receiver functions as a viewer. The synchronizing and video signals are used to modulate a low-power r.f. oscillator tuned to a frequency of one of the v.h.f. television channels. Therefore the television signal can be carried by a transmission line (300-ohm or coaxial) between camera and antenna input terminals of the television receiver.

With this method there is no need to modify any existing television receiver as the signal input contains the conventional r.f. and video components and the horizontal and vertical syncronizing pulses. Of course, the disadvantage here is the relative complexity of the signal.

A second common system (Fig. 2-b) is to send the composite video and synchronizing signal over a coaxial cable to the video amplifier input of the viewer. For this method an r.f. carrier is not required. However, sync separator circuits are needed at the viewer to break down the composite television signal into its basic components of video blanking, horizontal and vertical sync.

A final arrangement (Fig. 2-c) is one that sends each basic signal component separately to the viewer. The first two methods require but one line to link camera and viewer. When signal components are sent separately, three lines (multiconductor cable) carry signals between camera and viewer. In this plan the sync signals are applied directly to the horizontal and vertical deflection generators. Sync separators are not required.

The first method is convenient when standard television receivers are used as viewers since chassis need not be worked upon. The second method does not use any r.f. carrier and bypasses the r.f. and i.f. processes. The third arrangement eliminates the sync separator circuits but requires a multiconductor cable.

Signal makeup

The simplicity of the composite television signal for an industrial system is amazing. Such complex waveforms as equalizing pulses, serrated vertical sync pulses, etc., are not necessary in a closed-circuit system. In fact, as shown in Fig. 3, the front and back porches of the combined horizontal sync and blanking pulses need not be present. As a result one pulse serves both the sync and blanking functions. Thus, two pulses can meet the requirements of a small closed-circuit system—vertical and horizontal sync-blanking pulses. If the horizontal pulse rate is set near the line frequency of 15,750 cycles and vertical pulse rate at 60 cycles this simple signal construction is able to lock in a standard television receiver. In fact if the horizontal oscillator is stable, and its frequency set critically, an interlaced pattern can be attained.

Even an interlace system for use in a more elaborate industrial installation can be established with a less complex composite synchronizing signal than is used in commercial telecasting. Instead of equalizing and serrated vertical pulses, a short-duration carefully timed vertical sync pulse (Fig. 4) is used. This pulse is inserted so that its leading edge coincides with the leading edge of one of the horizontal sync pulses during one vertical retrace interval. The very next vertical sync pulse occurs halfway between two horizontal pulses. Thus the second vertical retrace is timed to occur at

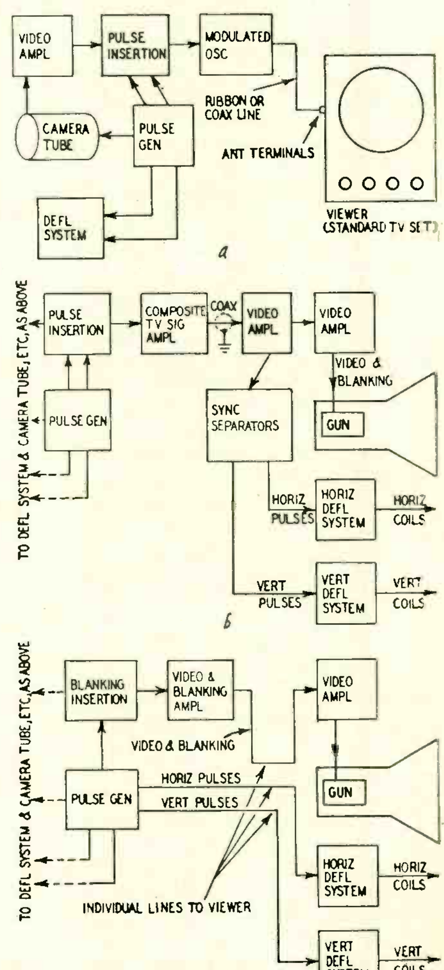


Fig. 2—Diagrams show systems used in industrial television transmission.

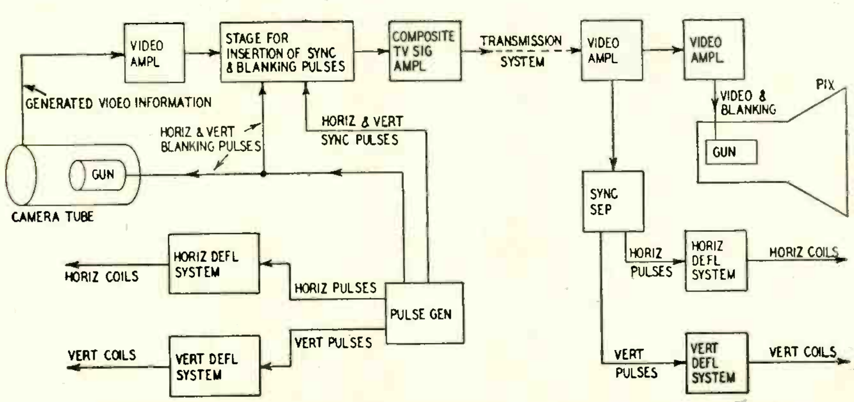


Fig. 1—Block diagram shows basic plan.

a half-line position—a necessary relation for interlace.

Television camera

The RCA vidicon camera tube (see photo) has been responsible for initial successes in industrial television. It has high sensitivity, minimizes lighting problems, is very small and permits design of lightweight and compact television cameras. Equally important is that its associated circuits need not be elaborate. For example, the top anode voltage is only about 300. Thus a separate high-voltage supply is not required. As the vidicon has a low-

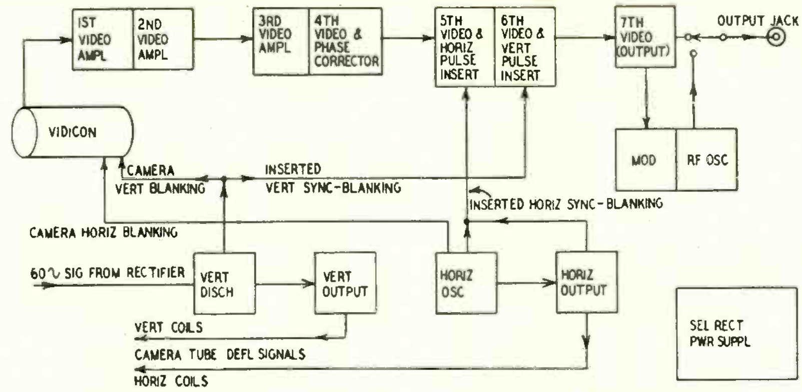


Fig. 5—Block diagram shows circuits in the Dage 60 industrial TV camera.

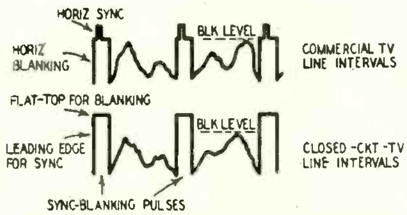


Fig. 3—Signals for standard television and closed-circuit systems.

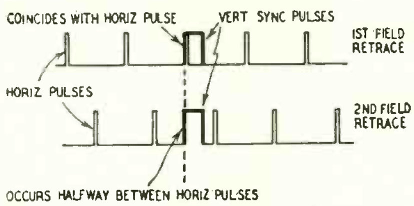


Fig. 4—Producing vertical interlace.

velocity scanning beam the deflection-circuit power requirements are relatively low.

All the factors mentioned—wired connection to receiver or viewer, simplicity of signal construction and the vidicon—permit construction of an almost unbelievably small television camera. For example, the Dage camera (see photo) uses only eight tubes including camera tube. The camera measures only 10 x 6½ x 4½ inches. It can supply a video-modulated r.f. signal directly to the antenna terminals of a receiver or a straight video signal for application to the video amplifier input of a viewer.

The circuit functions within the camera are shown in Fig. 5. Video signal output of the camera tube is amplified by a seven-stage video amplifier consisting of four tubes. Three of these tubes have dual functions. The fourth stage is a phase corrector or so-called "high peaker" which corrects for the high-frequency de-emphasis that occurs at the output circuit of the camera tube.

In the fifth stage horizontal blanking and sync are inserted in the video signal; vertical sync blanking is added in the sixth stage. The final amplifier is a video output stage supplying composite video to an output jack and succeeding video modulator. One dual triode functions as video modulator and r.f. oscillator. It supplies a video-modulated television signal to the output jack.

The pulse generator is a four-stage segment of the camera containing vertical discharge and output stages and horizontal oscillator and output stages. The vertical discharge tube forms a vertical sawtooth, being excited by a 60-cycle waveform from the power supply. The vertical sawtooth drives the vertical output stage which develops the camera-tube deflection current in the vertical coils. A pulse is removed from the discharge tube cathode to be used as video-inserted sync blanking and as vertical blanking for the camera tube. The horizontal oscillator and output stages perform similar functions in the formation of the horizontal pulses and horizontal deflection energy.

Many special accessories are being developed for use with industrial television cameras. They improve the versatility and reliability of industrial installations. For example, RCA now has a number of accessories such as remote optical focusing of camera from monitor viewer, weatherproof housing, explosion-proof housing, extension video amplifier to increase spacing between camera and viewer, underwater units and automatic iris.

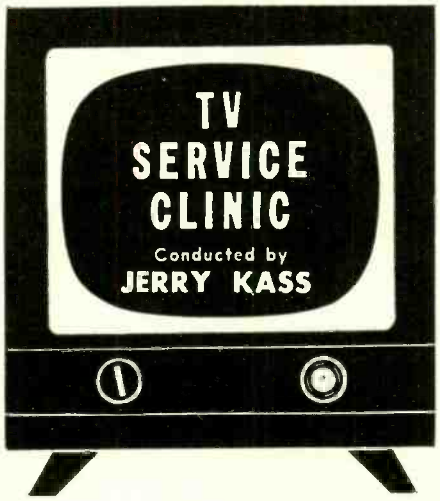
The automatic iris (see photo) compensates for changing light levels to assure TV pictures of constant brightness and contrast. Thus the television system functions without readjustment as the brightness levels change.

The actual iris, which resembles a roll of 35-mm film, is mounted with motor-driven regulators. The film serves as a filter and is continuously graded in density. As external light levels change, the film automatically unreels between camera lens and vidicon until a filter of proper density for the light condition moves into place.

Weatherproof housing for the Kay Lab industrial camera is shown in another photo. The unit contains a heater for cool-weather, fan for hot-weather operation, plus a windshield wiper for mist and rain. All accessories can be made to operate automatically. The Kay Lab camera is also excellent for picking up slides or film directly from a projector — the projector is focused on the sensitive surface of the vidicon. Thus film can be run and presented simultaneously on a number of viewers in different locations. This is an excellent educational tool.

The field of closed-circuit and industrial television is new and exciting. There are many applications and techniques to be explored. It is important that the television technician pay close attention to the field and keep abreast of its development. END

"Now then, how long have you been a half-wave rectifier?"



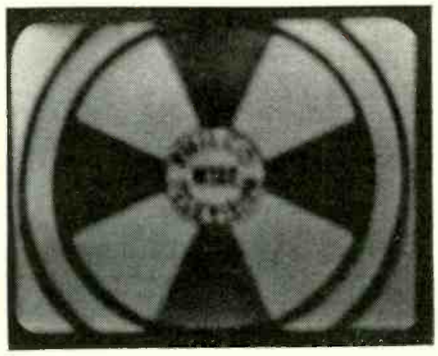


Photo shows poor picture focusing.

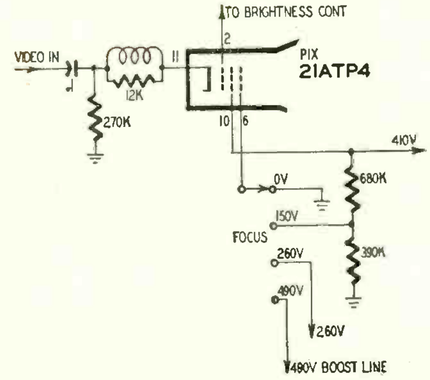


Fig. 1—Semi-adjustable electrostatic focus circuit in Crosley 472 chassis.

FOR maximum screen brightness and picture detail, the electron beam of a cathode-ray tube must be brought to the sharpest possible focus at its point of contact with the screen. Should the beam be too wide at this point the individual scanning lines overlap, producing a blurred and poorly focused picture (see photo).

When electrons leave a heated cathode, they tend to spread out in a broad beam because they are like (negative) charges and thus repel each other. Through a system of lenses these electrons are accelerated and when they reach a high velocity are focused on the picture-tube screen—their momentum preventing them from spreading out. Higher anode voltages provide better focus; however, they must be limited because they increase the deflection power necessary for scanning.

The problem of focusing has been attacked two ways—by the construction of the picture-tube electron gun and by using external magnetic devices placed over the neck of the tube. The early television receivers containing 10- to 16-inch picture tubes such as the popular 10BP4, 12LP4, 14BP4, 14CP4, 16AP4, 16GP4 and 16KP4 used magnetic focusing in which the electron-beam concentration was controlled by the magnetic field of a focus coil or permanent magnetic focus device.

In recent years the low-voltage electrostatic-focus tube has been developed and is growing increasingly popular. This type — the 17HP4, 20HP4-A, 21ALP4-A, 24DP4-A, etc.—requires no external magnet. Its beam is focused by an electrostatic field set up by a potential applied to a focusing electrode (pin 6). Another relatively new development is the automatic-focus type tube, such as the 20JP4, that needs no magnetic focus field or focus voltage. While holding much promise, this type has not been widely used.

The early focus coils were pretty much standardized. They were generally 247-ohm 200-ma, 470-ohm 140-ma or 360-ohm 150-ma coils. Despite the increased use of permanent-magnet focusing devices, many manufacturers still use focus coils whose resistance, depending upon circuitry, may be as high as 2,000 ohms.

Focus control circuits

Good focus is often a critical adjustment varying considerably among the same tube types. Changes in second-anode voltage will often necessitate focus readjustment. Interaction between the magnetic fields of the focus magnet and the deflection coil will also affect focus. Thus most sets provide for a wide range of focus control.

A typical electrostatic focus control is shown in Fig. 1. It is used in the Crosley chassis 472. The focus electrode of the 21ATP4 low-voltage electrostatic picture tube may be connected to ground or to a potential of 150, 260 or 490 volts. In installing or repairing this set each of the four connections should be tried to obtain the sharpest picture or sharpest horizontal lines. Whenever the picture tube is replaced, all connections should again be tried.

Fig. 2 shows the focus arrangement in the Admiral 23B1AZ chassis. Here the 24TP4 or a 24CP4-A picture tube

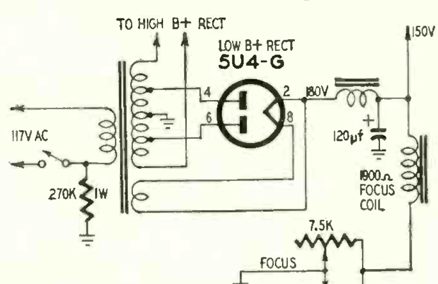


Fig. 2—Continuously variable magnetic focus control in Admiral 23B1AZ sets.

used requires magnetic focusing. A 1,900-ohm focus coil is connected in series with parallel 7,500-ohm potentiometers between a B-plus voltage of approximately 150 and ground. Here again a wide range of focus is evident with the potentiometers ranging from zero resistance to approximately twice that of the focus coil.

Fig. 3 shows the focus circuit of the Westinghouse V-2314 and V-2324 chassis. A 24DP4 or –A electrostatic-focus picture tube is used in which the focus-electrode voltage is controlled by a potentiometer connected between 480 volts and ground. The 2-megohm unit thus provides a continuously variable focus voltage, permitting a more precise adjustment than in Fig. 1.

One last circuit (Fig. 4) lest we become too complacent about focusing systems. This is found in the G-E model

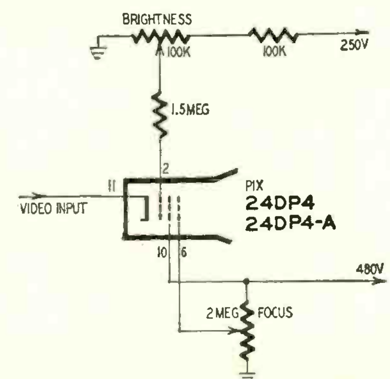


Fig. 3—Westinghouse focus circuit.

17C110 where the focus coil is in the cathode circuit of the 6W6-GT audio output tube. Here, a portion of the tube's plate and screen current passes through the focus coil, the amount determined by the setting of the 10,000-ohm focus control.

Focus defects and adjustments

The edges of a picture are usually not in perfect focus when the center is

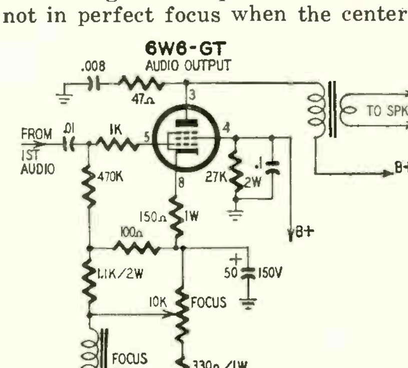


Fig. 4—Magnetic focus circuit used in several General Electric TV sets.

sharpest. This is a normal condition, provided the defocusing (astigmatism) is not excessive; it is common when the focus coil is used for centering or correcting corner shadows.

Focus circuits are relatively simple and easy to check. Where focus is poor and the control has little or no effect, check the focus coil for an open circuit or shorted turns. Also check the focus potentiometer and associated circuitry.

The location of the focus coil or magnet on the neck of the tube affects picture centering. It should generally be placed about ⅜ inch behind the deflection yoke—bringing it closer will produce interaction between the magnetic fields of the two and cause poor focus. The coil provides a limited centering control and should be adjusted in conjunction with the ion-trap margnet, with the latter being used *only* to obtain maximum brightness—leave centering and shadow correction to the focus coil and centering magnet (after carefully adjusting the yoke).

In cases of poor focus where the coil and control circuits have been checked out, replace the picture tube or check it for gas.

The PM focus magnet (Focalizer) must be adjusted with a nonmagnetic screwdriver. It consists essentially of three or four small bar magnets in a frame encircling the neck of the tube. Magnet strength is controlled by a shorting screw that shunts the magnetic field of the focus magnet that would ordinarily pass through the neck of the tube. Where a magnet is too strong, the technician can improvise a shunt to bring the unit to a point where it will provide optimum focus.

When replacing a tube using a focus coil with an electrostatic-focus type, remove the coil from the neck of the tube and place it as far from the tube as the cabinet permits. Do not remove the coil from the circuit unless you replace it with a resistor of equivalent value and wattage.

Changing Focalizer strength

A customer complained her picture had a slight blur. The set couldn't be focused properly in the home so it was brought to the shop. We have tried a few Focalizers made by a well-known manufacturer and in each case, with the screw all the way in, the picture comes close to looking acceptable, but not quite. We have tried moving the magnet around slightly but that did not help. Since there is no other focusing control, we are at a loss as to the trouble. Does this set use some special focus magnet? And if so, why should the regular magnet suddenly become too strong? I can understand a magnet becoming weak.—S. C., Trenton, N. J.

It is most improbable that the Focalizer has increased in strength. More likely a change has taken place in the physical characteristics of the picture tube. If you have not already done so, try replacing the tube—the old one may be slightly gassy. Also try readjusting the deflection yoke firmly against the flare of the tube and adjust the ion-trap magnet for maximum brightness.

If these do not help, the strength of the Focalizer can be reduced by the following: Take a piece of 1/16-inch steel, approximately 1¼ inches square. Round it so that it matches the curvature of the focus magnet and place it anywhere on the circumference of the magnet so that it covers a portion of the air gap. The steel shunt will be held firmly in place by the magnetic attraction of the Focalizer and will reduce the strength of the unit to a point where optimum focus can be obtained.

Vertical nonlinearity

A Crosley model H-17TOBH has come in with a very bad case of vertical nonlinearity at the top of the picture. Adjusting the vertical linearity and height controls does not improve the picture. Every component related to the vertical oscillator and output stages has been checked and appears O.K. In replacing the 12BH7 I noted some improvement, but nowhere near what the picture should look like.

I have a schematic of the set and all connections are as they should be. The picture is very clear and steady, but just not linear. What next?—I. S., Cranston, R. I.

You omitted an important piece of information—is the top of the picture spread or compressed? They have different solutions. This trouble goes beyond your set and is fairly common in most of the Super V series. Try several 12BH7's. If this does not help, replace the vertical output transformer and again try a few 12BH7's. Very often some particular combination of these components will produce nonlinearity and changing them will cure the trouble.

If the above does not help, spreading can usually be corrected by inserting a peaking circuit consisting of an .01-μf 600-volt capacitor in series with a 150,000-ohm 1-watt resistor, connected from plate to ground of the vertical output stage (Fig. 5). In some

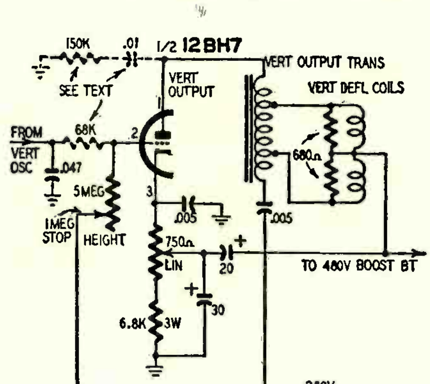


Fig. 5—Crosley vertical output circuit with components added to correct nonlinearity at top of the picture.

cases the fixed cathode resistor should be increased in value slightly to about 7,500 ohms, also 3 watts. These components affect the current waveshape in the yoke so as to add a slight amount of compensating spread.

If the top of the picture is compressed, add a resistor of about 68,000 ohms between the grid of the vertical output tube and the .047-μf capacitor. This resistance will spread the input waveshape fed to the output stage so as to compensate for the compression.

Make a record in the cabinet of what you have done—changing the 12BH7 or vertical output transformer in the future may require that the compensating networks be altered or eliminated.

Tracking

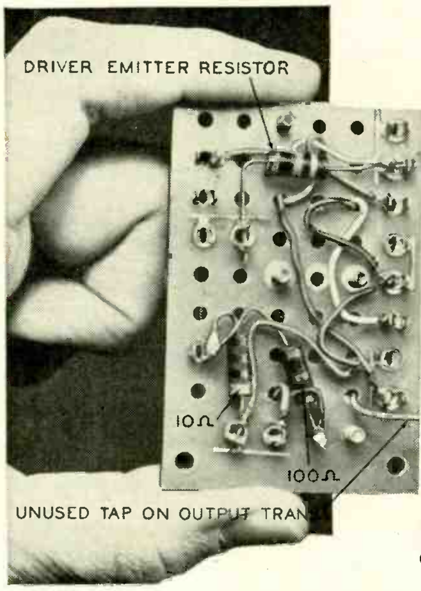
An RCA set with a KRK-7 tuner has come in with a complaint of poor picture and sound. It could be cleared by fine tuning but the set would drift considerably. The rf oscillator was replaced and this took care of the drifting. However, the tracking was very bad. I tried to align the set but this did not help. Is there any special alignment procedure so that the set will track properly? All rf and if tubes have been replaced and all voltages appear normal. I made a thorough check of all connections in the tuner and have cleaned all contacts.—J. W., Ogden, Utah

Oscillator-tube characteristics vary considerably and you should try several of them before doing anything else. If this does not help and you are reasonably certain that the set is in good operating condition otherwise, there is a solution that is fairly popular.

Run a continuous length of tinned copper bus wire from eyelet to eyelet of the high-channel inductance strap on the rear section of the oscillator wafer switch. The wire between the eyelets should be in the form of small semicircles having a length of about 7/16 inch and laid flat against the inductance strap. Solder each contact with the eyelet and make sure it is mechanically firm. Some time ago RCA made a recommendation similar to this and suggested No. 20 wire be used. However, good results could also be obtained with No. 22 wire.

In making the tracking adjustment, the semicircular loop should be moved slightly away from the inductance strap and the oscillator channel adjustment screw turned until the screw is in the center of its tuning range. When the wire is against the strap, there is practically no change from the original tracking. If necessary, the method may be applied to the high-channel rf and converter circuits. END

All queries to the TV Service Clinic should be accompanied by a stamped, self-addressed envelope. This will insure a more rapid answer. Be especially careful to state the *model* or *chassis* number. In many cases these have been confused with the serial number which, in most cases, is meaningless. An unidentified receiver can be analyzed in general terms only.



Resistors and wiring on underside.

CLASS B for TRANSISTORS

An excellent low-distortion audio output stage

By EDWIN BOHR

WOULD you like to build a transistorized intercom, phono amplifier or power output stage? The class-B circuit to be described is ideal for any of these purposes. It is exceedingly easy to construct and the performance, as will be explained in detail, excels most commercial circuits. Important, too—all components are readily available!

For audio operation class B offers all the advantages. The power-handling capabilities of the transistor are used to the fullest, efficiency is amazingly high and distortion can be kept below 2%. This distortion figure, incidentally, is better than most battery-operated vacuum-tube circuits can obtain.

Dollar-variety transistors operate successfully in this circuit to 100 milliwatts. If it is really necessary they can be pushed to ¼ watt.

The class-B circuit

Using push-pull operation, this bridge circuit (Fig. 1) is a refinement meeting wide acceptance in the design of all types of new audio equipment. It is particularly advantageous, however, for class-B operation.

Ordinarily much of the distortion in a class-B stage results from an imperfect output transformer. Since the bridge circuit can either drive a voice coil directly or use a single-primary output transformer, these troubles are largely eliminated.

That is why most commercial transistor output stages use the bridge circuit. However, virtually all these circuits employ a special split-secondary driver transformer not commercially available. A few people with transformer-winding facilities have built and used such a circuit but, for the individual with no special facilities, it has been out of reach.

The circuit presented here can be built by anyone. After much searching, a nationally advertised transformer has been found that is just about ideal as a driver for the bridge type of push-pull output stage. The transformer does require a slight modification, but this is very simple and requires only peeling back the outer paper wrap from one side.

Distortion

Before going further into the actual circuit let's look at a peculiar, but very interesting, aspect of transistor class-B operation.

Curve A of Fig. 2 shows the distortion of a typical class-B transistor stage increases at near maximum output and at very low output levels. But, the distortion is *most severe* at *low output*.

Distortion at high output is common. But why does it increase so drastically at low levels? The answer is simple.

For very small driving signals the transistor input resistance is very nonlinear. In fact, below a certain threshold voltage the transistor does not respond appreciably to any input signal. Commercial circuits overcome this difficulty with a bias current to lift the transistor out of its nonlinear region. The bias reduces the low-level distortion (curve B, Fig. 2) but it also increases medium-power distortion, places a fixed bleeder current on the power supply and lowers the maximum power capacity of the transistors since the bias causes transistor heating.

Fig. 1 does not use bias to reduce low-level distortion; negative feedback is used instead. Feedback does not have the power-wasting and other undesirable effects of the bias system. Furthermore, feedback reduces distortion at *all* power levels and smooths out the frequency response curve.

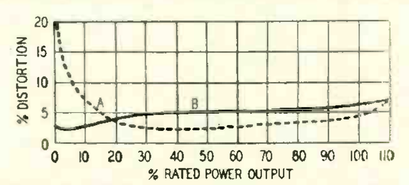


Fig. 2—Diagram shows typical distortion curves for class-B stage.

Fig. 3-a indicates the no-bias, low-output distortion of a sine wave. Fig. 3-b shows the improvement when feedback is added. Both photos present the distortion at its worst. The slight gap in the photograph with feedback is a result of high-frequency ringing at the zero-crossing point. This effect is completely eliminated in the finished circuit and there is no perceptible distortion up to the rated output.

Fig. 4 shows the overall response of the driver and class-B output stage. Low-frequency response is limited by transformer overloading. The high-frequency response is deliberately rolled off to prevent the ringing just mentioned. Considering that two small transformers are used in the circuit, the response is very good.

Efficiency is so high that in some

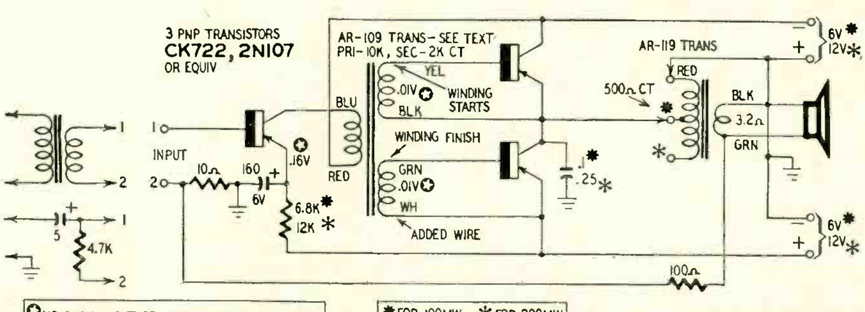
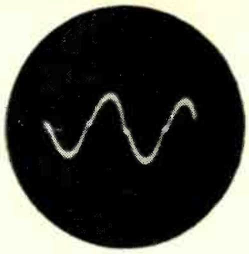


Fig. 1—Schematic of class-B output stage for 100- or 200-mw operation.



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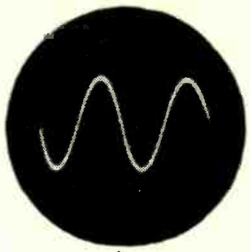

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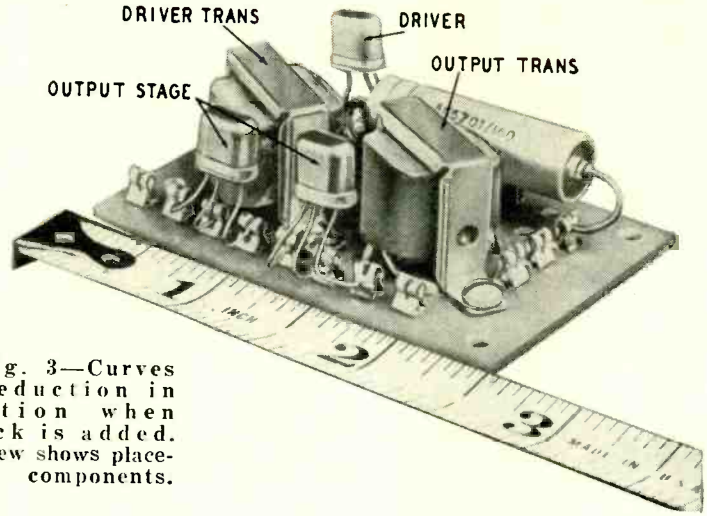


Left—Fig. 3—Curves show reduction in distortion when feedback is added. Right—View shows placement of components.

applications it may be unnecessary to include an on-off switch. With no audio input the amplifier draws an idling current of only 1 ma. And most of this is consumed by the class-A driver.

When an audio signal is applied, the amount of current drawn depends on the signal amplitude. With loud signals the current may climb to 20 ma.

For these reasons the circuit is very attractive for intercoms or other applications where the amplifier sits idle for long periods.

Construction

Terminal cards (see photo) are the ideal medium for transistor circuit construction. The three major components are the two transformers and the 160-μf electrolytic capacitor. The electrolytic need not be so large; any 5-μf, or higher, capacitor rated for 3 volts or more should be satisfactory.

The output transformer has a tap for either 100- or 200-mw operation. The battery voltage, emitter resistor and shunt capacitor across the output transformer are changed when operation is switched from one power to the other. The shunt capacitor is essential for proper operation; it is not gingerbread work.

The transistors are soldered directly to terminal lugs. Possible transistor damage from soldering may have been somewhat exaggerated. Transistors can even be dip-soldered into place. If the transistor is soldered *quickly* (this is the really important thing), no pliers or other heat sink is necessary. But, if you are in doubt, use the pliers.

Feedback is supplied to the driver through the 100- and 10-ohm resistor combination. For this reason the driver input must be applied between terminals 1 and 2. Typical inputs for both transformer and R-C coupling are shown on the diagram.

The driver transformer modification is really very simple but it requires a little thought and common sense. The transformer is an Argonne AR-109 sold by Lafayette Radio. A data sheet supplied with it indicates the start and finish of the windings along with the color coding of the wires. This same nomenclature is followed in Fig. 1. Not all transformers have the same color wire for the secondary center tap. On this unit it was black.

The modification separates the center-tapped secondary so the two halves become independent windings. To do this, slit open the outer paper wrap, exposing the center tap and its connection to the external lead wire. Cut apart the center tap. An external lead wire is then soldered to the free end produced by the cut. I used a white lead as labeled on the diagram.

This wire must be small and flexible. If none is available, excess lead from the same transformer can be used.

The leads can be pressed into place and held with a few drops of hot wax. Also, the wrap can be pushed into the warm wax and resealed. When this is done, check off and pair the secondary wires with an ohmmeter. A pair goes to each transistor—one wire to the base, the other to the emitter. They must be connected exactly as the diagram shows. Before connecting, check to see that there is no continuity between the two secondary halves.

Circuit operation

This is a basic output circuit. It can be driven by either a preceding transistor stage or matching transformer. The input impedance is in the neighborhood of 3,000 ohms. And, if a low-gain transistor is used for the driver, 200 mv of signal produces full output. High-gain transistors, of course, require less signal. The circuit can be pushed to 0.25-watt output by increasing the batteries to 16.5 volts while retaining the 200-mw circuit values.

Check voltages are shown on the diagram. These are based on 100-mw operation with no signal. Operation is normal if the meter readings are within one-half to twice these values.

Because the AR-109 has low winding resistance, the base-to-emitter resistance is low enough to obviate the usual stabilization resistors.

To read the current with the signal applied, place a milliammeter in either of the battery leads. A milliammeter placed in the common lead indicates how well the output transistors are matched. A current here of more than 3 ma at full signal indicates poor matching. They should be as nearly alike in characteristics as possible.

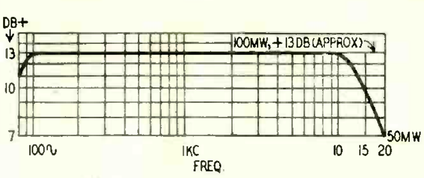


Fig. 4—Response of the class-B stage.

Most p-n-p transistors are suitable—for example, the CK722. Do not use types that have low power and collector-voltage ratings. Several companies offer matched pairs of transistors for class B. I certainly recommend these be used if the pocketbook can take the extra pinch.

Occasionally, this amplifier will oscillate at near-ultrasonic frequencies, producing distortion. This can be cured by spacing the input and output wires, grounding the circuit or placing 10,000-ohm resistors between collector and base of the output transistors. END

(There is some feeling among authorities in this field that it may be extremely difficult to obtain an output of 200 mw using CK722's or 2N107's in this circuit. High-current transistors are needed for appreciable output. Perhaps the added cost of matched 2N109's or Amperex OC72's will be justified by the large increase in power output.—*Editor*)

Parts for class-B circuit

1—10, 1—100, 1—6,800 (or 12,000) ohms, 1/2-watt resistors; 1—0.1- (or 0.25-) μf capacitor, 200 volts, miniature; 1—160-μf 6-volt electrolytic capacitor; 3—p-n-p transistors (CK722, 2N107, etc.); 1—driver transformer, primary impedance 10,000 ohms, secondary 2,000 ohms ct; primary resistance 500 ohms, secondary 50 ohms (Argonne AR-109 or equivalent); 1—output transformer, primary impedance 500 ohms ct, secondary 3.2 ohms; primary resistance 20 ohms, secondary 0.3 ohms (Argonne AR-119 or equivalent); 2—6-volt batteries; 1—insulated mounting board; mounting pins.

THE Fluxvalve PICKUP

Higher compliance and lower vibratory mass make for superior performance

By W. O. STANTON*

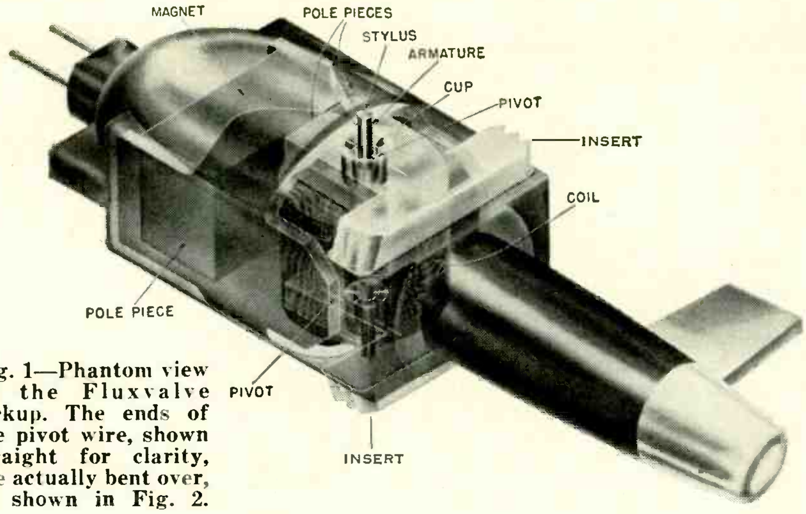


Fig. 1—Phantom view of the Fluxvalve pickup. The ends of the pivot wire, shown straight for clarity, are actually bent over, as shown in Fig. 2.

FOR pickup performance on contemporary records approaching closely to the ideal, we need a considerably higher level of mechanical refinement than has been standard in the past and, in particular, a much higher compliance and lower vibratory mass. But the desirable compliance and the mass values have always been extremely difficult to combine with the ruggedness and ease of stylus replacement that pickup users today rightfully expect in a high-quality instrument.

I will describe in this article a new pickup in which all of these mechanical characteristics have been combined to open up a radically higher level of reproduction from disc recordings. The tough mechanical design problems have been licked by putting the whole vibratory system, including the stylus, in a small plastic-encased insert, which the user can put into or remove from the pickup without using tools of any kind.

Magnetic circuit

The way the pickup operates can be made clear by a description of the magnetic circuit. When the insert is in place, the stylus projects parallel to a lip in the plastic pickup housing, as can be seen in Fig. 1 and the photo. The magnetic flux—produced by the permanent magnet enclosed in the pickup housing—is carried by a metallic member out through the housing to a point directly above the top or butt end of the stylus. There an exposed metal button contacts a similar button on the insert.

The button on the insert is the top end of an inverted metal cup, which surrounds the upper end of the stylus, leaving it free to move. This cup can be seen in dotted lines at the butt end of the stylus in Fig. 2. It carries the magnetic flux to the stylus tube itself. In the lip of the pickup housing directly in back of the *lower* end of the stylus are the ends of two metallic members, side by side, centered on the line through the resting position of the stylus. These carry the magnetic flux back into the housing and through the coil.

The magnetic circuit is so arranged that when the stylus is in its center position, not moving, flux flows from it equally to the two members behind its tip and the two lines of flux balance each other out so that no voltage is produced in the coil. When the stylus moves to right or left, one side gets more flux than the other, the magnetic circuit is unbalanced and flux flows through the coil, producing a signal voltage.

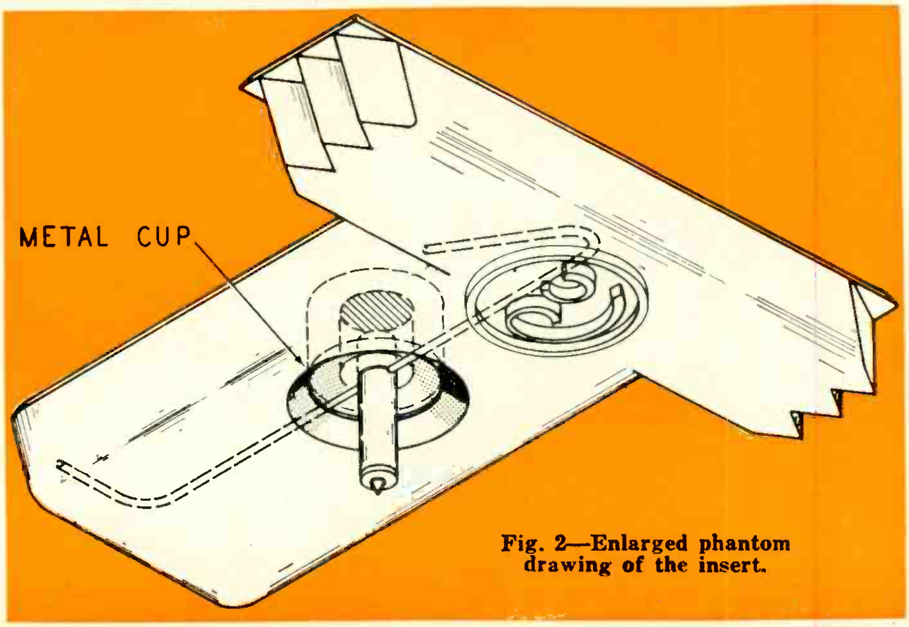


Fig. 2—Enlarged phantom drawing of the insert.

* President, Pickering & Co., Inc.

Mechanical vibratory system

As shown in Fig. 2 and the photo of the insert, the stylus projects through a hole in the center leg of the insert. The stylus is attached to a wire that runs along the longitudinal axis of the insert and moves to follow the record modulation by bending this wire. The wire is held mainly at its two ends, which are bent to hold it firmly in the insert.

The lateral compliance of the stylus with this suspension system can be made extremely high by proper choice of the wire material and thickness. In the present pickup the compliance has been raised as high as it can be without leading to off-center motion, even in the most refined pickup arms. The compliance of this pickup is too high for use with some record changers and the pickup is not recommended for all such applications. A manually operated arm of very low friction and highest quality is desirable.

The proper amount of vertical compliance is included to allow stylus motion through "pinch" effects and record irregularities such as may occur in normal record pressings. The value of vertical compliance chosen is such that the stylus can respond to vertical forces without losing contact with the record groove even under conditions of high transient groove modulation.

Vibratory mass

The stylus and its tube comprise the whole vibratory mass, so that this mass is unprecedentedly low. As a consequence, the armature resonance of the pickup is far above the audible frequency spectrum, in the neighborhood of 30 kc. This greatly improves the performance of the pickup at high frequencies and gives it excellent ability to handle transient signals, which are highly sensitive to any abrupt change in the mechanical response characteristics in or near the operating frequency band. The lack of a peak in the operating range also eliminates the distortion that such a peak can produce in subharmonics of the resonant frequency. A strong peak at 10,000 cycles, for instance, will increase the distortion at 5,000 and 2,500 cycles.

Nothing contributes so much to clarity, snap, smoothness, listening ease and low surface noise as low moving mass and the absence of peaks within the operating frequency range.

The entire pickup, including the magnet, coil and magnetic gap, is completely encapsulated in a tough plastic which practically guarantees it an endless life. The encapsulated parts cannot be damaged in any way, short of a coil burnout by application of a heavy dc voltage to the pickup terminals (a theoretical disaster which is extremely improbable). The only parts which move and wear are in the insert and so, when the user puts in a new insert, he is getting in effect a whole new pickup.

Electrical characteristics

The output of the pickup is about 25 millivolts at the normal recording level of about 10–15 centimeters per second. The frequency response is absolutely flat well beyond both ends of the audible frequency spectrum. The value of this superaudible response at the high end has already been noted. It insures smoothness and excellent handling of transients. Intermodulation distortion has been reduced to a negligible level by careful arrangement of the magnetic circuit. The impedance of the pickup is medium high. It should work into a load of about 27,000 ohms.

Effect on record wear

The very high lateral compliance, the small mass and the lack of any mechanical resonance in the operating range combine to produce an additional benefit. With a stylus in good condition and in a well-designed arm which lacks strong arm resonances, the pickup does *not* tend to wipe off the record the microscopic groove modulations representing the highest frequencies, which is the fixed habit of pickups with heavy moving systems and mechanical resonances in the mid-high frequency range. Record wear, in other words, has been reduced to a new, much lower level. Records played with the pickup will keep their top "sheen" indefinitely and exhibit no increase in the level of surface noise.

Mounting system, stylus force

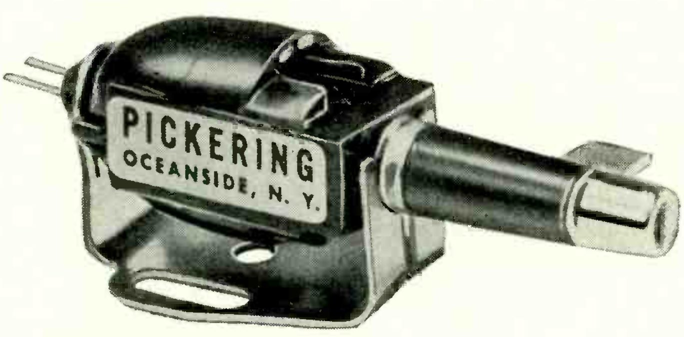
The pickup is supplied with a mounting clip which also forms the bearing for pickup rotation. The clip has mounting holes on standard (RETMA) ½-inch centers and can be attached to almost any of the high-quality arms available on the market.

Because of the extremely high lateral compliance and low mass, the pickup will track with a vertical stylus force as low as 3 to 5 grams, depending somewhat on the character of the record modulation. With reasonably flat records, not modulated at an abnormally high level, and with a well-leveled turntable (see below), the lower figure of 3 grams is enough for perfect tracking.

Turntable leveling

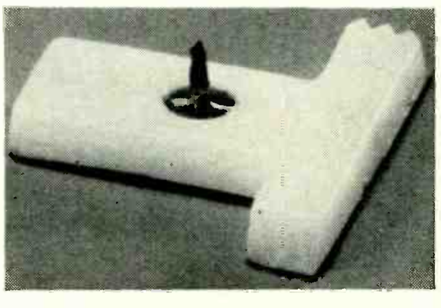
To get the full benefit of the high lateral compliance of the pickup, it should be used on a turntable that has been dynamically leveled. This means that, under operating conditions, with the record exerting a dragging force on the stylus, the arm has no tendency to push toward either the inside or outside of the record.

To find the turntable position which produces this neutral condition of the arm, put on the table a blank record, such as an unused recording blank. Start the motor and put the pickup down on the moving record surface. Then level the turntable so the stylus does not move toward either the outside or the inside of the record. In this position, the arm will be climbing very slightly "uphill" in its travel from outside to inside of the record, and the force of gravity tending to slide it back toward the outside will closely offset the pull of the groove friction, which tends to pull the arm toward the inside. With a neutral arm, the high compliance of the pickup will produce the maximum of faithfulness to the groove and thus the maximum clarity of reproduction. END



The Pickering Flux-valve pickup, with the plastic inserts removed.

The insert, enlarged about four times.



HIGH-FIDELITY POWER AMPLIFIERS*

One of a series of articles on modern audio equipment. Power output and driver circuits are discussed here

By JOSEPH MARSHALL

THE high quality of performance of modern high-fidelity equipment is due in large part to highly specialized and sometimes unique circuitry. The service technician who looks for the first time at the wiring diagrams of modern commercial hi-fi equipment is very likely to be puzzled and perhaps even shocked by some highly unorthodox and unfamiliar circuits. High-fidelity circuits can be divided into two general categories: those applying to power amplifiers; those applying to control units, preamplifiers and accessories.

Power amplifiers consist of three sections: the power output stage whose function is to deliver to the speakers anywhere from 10 to 50 watts of power with minimum distortion; the driver which must supply sufficient driving voltage to the output stage to drive it to maximum output; a phase inverter to convert a single-ended input signal to a push-pull signal, since almost all power amplifiers in high-fidelity equipment use push-pull parameters or an equivalent.

The classic power output circuit is shown in Fig. 1. Two triodes or pentodes are arranged with plates loaded and grids driven in push-pull. (Beam-power tetrodes are classed as pentodes in this article.) In older, inexpensive high-fidelity amplifiers, the circuit usually has 6V6 tubes as pentodes.

It is not easy to obtain high-power outputs with receiving type tubes. One of the first steps in the rapid progress of high-fidelity design in the past decade was the use of transmitting types in the output stages. There were two reasons for this:

First, these transmitting tubes require very little driving voltage even when used as triodes. Thus, where the 6B4 family requires 60 volts peak per grid of drive, transmitting pentodes of the 807 family used as triodes require only 40 volts.

Theoretically it should easily be possible to design drivers capable of delivering 60 volts peak with low distortion. In practice it is difficult to do so without increasing distortion to high levels. But 40 volts is easily supplied and at a distortion level very much lower.

Second, where receiving type tubes have to be driven into nonlinear operation to deliver 10 or 15 watts of output, transmitting tubes deliver this output over the most linear portion of their

* From the book *Maintaining Hi-Fi Equipment*, Gernsback Library.

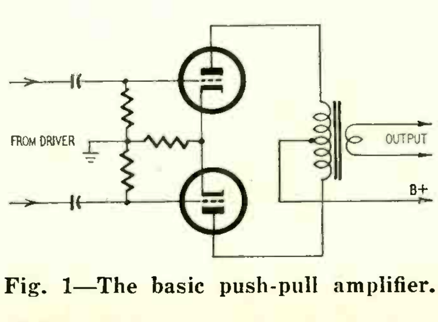


Fig. 1—The basic push-pull amplifier.

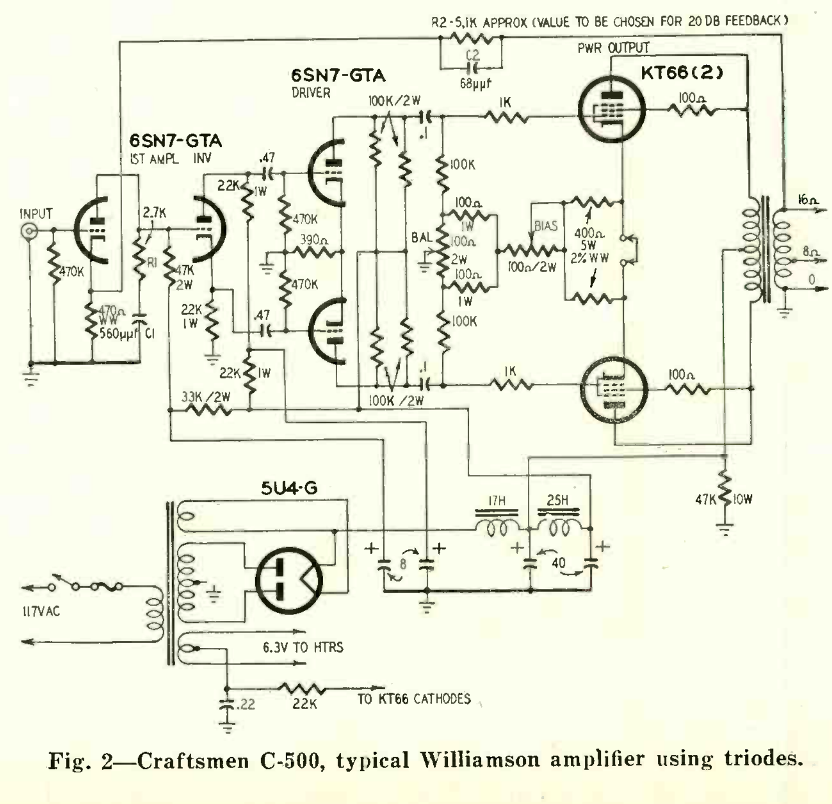


Fig. 2—Craftsmen C-500, typical Williamson amplifier using triodes.

curves, operating at only a small fraction of their maximum capabilities and strictly class A. Thus, distortion can be reduced to a small fraction of that with receiving type tubes. By this time it had become very clear that low distortion was the primary consideration and that a wide bandwidth was tolerable only when distortion was reduced to insignificant levels. The use of transmitting tubes provided a simple means of obtaining the desired low distortion.

The Williamson amplifier

This trend found its most notable expression in the amplifier named after D. T. N. Williamson, engineer of the British firm, Ferranti. The Williamson circuit not only used transmitting type tubes, but used them with highly refined circuitry for drivers and inverters. It was one of the most successful audio designs in electronic history. Even now, most commercial amplifiers use either some modification of the Williamson circuit or portions of it.

There is nothing very remarkable about the circuit. The original used two transmitting pentodes connected as triodes and loaded with an output transformer of hitherto unprecedented bandwidth, low distortion and very large size. The biasing arrangement was complex but permitted excellent balance and precise bias adjustment. The first amplifier–inverter used direct coupling to minimize phase shift at the low-frequency end. (See Fig. 2.)

A number of improvements were made as the circuit was applied to commercial equipment. One modification is that of splitting the self-bias resistors of the output tubes. About half the bias for each tube is developed in an independent unbypassed cathode resistor. This provides some current feedback to reduce distortion further.

As output transformers were improved and bandwidth extended to 100,000 cycles and beyond, it became more difficult to maintain stability in the feedback loop at the extremes, particularly at the resonant peak of the output transformer which fell usually in the region around 100 kc. One expedient was to include within the loop, a bypass network affecting only the frequencies around and above 100 kc. This took the form of a resistor and a capacitor in series (R1 and C1, Fig. 2) in the plate circuit of the input tube which bypassed the unwanted ringing frequency. To minimize these troubles further, a phase-shifting capacitor (C2) was added in parallel with the feedback resistor. This network had a time constant which produced a phase shift opposite to that of the output transformer at the ringing frequency, or in that region.

Ultra-Linear operation

About 1952 David Hafler and Herb Keroes revived an unusual output tube circuit which had been patented some years before and which provided operation combining the best features of triode and tetrode or pentode operation. This Ultra-Linear configuration made only a very slight change in the normal push-pull circuit; the screen grids were connected to taps on the primary of the output transformer. There is some controversy about how this circuit actually operates but the general consensus is that connecting the screens in this way applies a certain amount of negative feedback.

In any event, the connection has some very great virtues. First, the operating curve is more linear than that of either triode or pentode operation. Second, the power output capabilities are about one-half those of pentode connection and about double those of the triode connection. Thus, with the same plate supply voltage and drive, the Ultra-Linear configuration doubles the output power over that of the triode Williamson. More important than this is the fact that distortion is decreased at low output levels. Finally, the tube capacitances are the same as in pentode operation. This eliminates, or at least greatly minimizes, the Miller effect at high frequencies. It not only makes possible an upward extension of the bandwidth, but—more important—reduces the phase shift in the region of 100 kc. It therefore permits the use of larger feedback factors for an equal degree of ringing.

The Ultra-Linear circuit was immediately applied to the Williamson design and a high proportion of today's commercial amplifiers are Ultra-Linear versions of the Williamson. A typical circuit is shown in Fig. 3.

Cathode loading

Meanwhile, considerable work was being done on cathode loading of power-output tubes. It was known that such loading produced high power with very low distortion, since cathode loading results in current feedback. Cathode loading also improves the high-frequency response greatly. This permits higher feedback with less risk of ringing or instability at the transformer resonant frequency. Unfortunately, cathode followers have no voltage gain; hence the drivers have to supply somewhere between 150 and 200 volts of drive per side. This is a serious problem

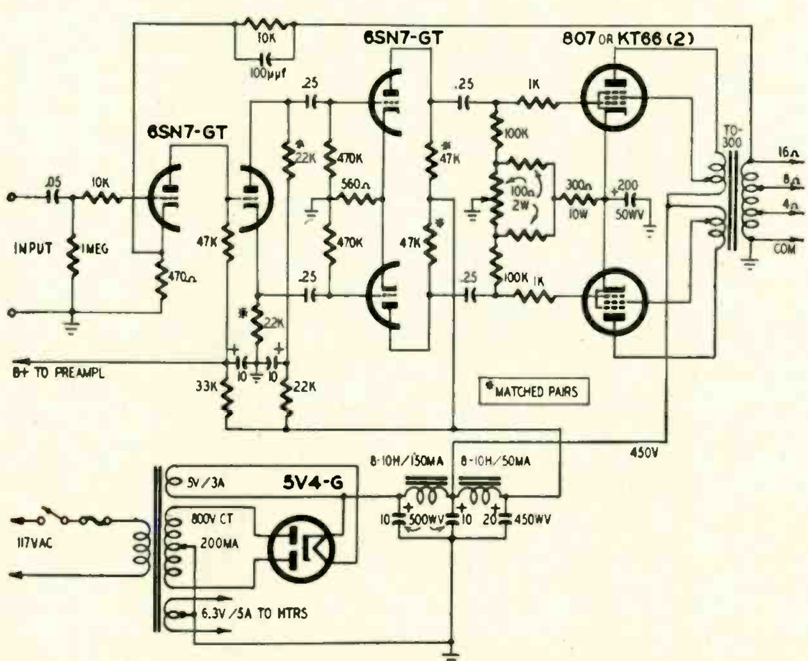


Fig. 3—Typical Williamson amplifier designed for Ultra-Linear operation.

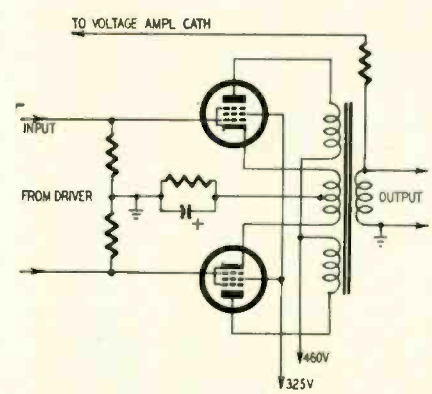


Fig. 4—Cathode-loaded output circuit.

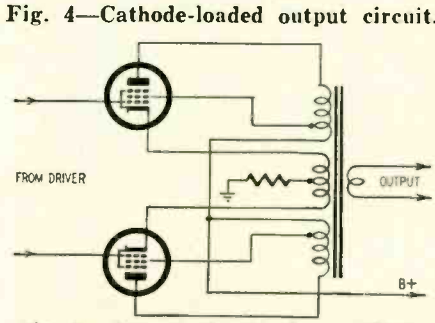


Fig. 5—Output circuit shows Ultra-Linear design with cathode loading.

since, as mentioned before, it is difficult enough to supply 60 volts of drive with low distortion.

Though complete cathode loading poses too many problems, it was quickly perceived that partial cathode loading would provide a good degree of current feedback without raising the driving requirements out of practical reach. Several circuits of this type were developed, differing in the ratio of plate-to-cathode loading. Typical examples are the British Quad amplifier and the American Bogen DB15G. (A simplified circuit is shown in Fig. 4.)

Both of these use pentode operation, obtaining a low output impedance by combining current feedback via the partial cathode loading and voltage feedback of an overall loop. Since pentodes are far more sensitive than triodes, a simpler driver can be used. The Bogen uses merely the first two stages of the Williamson front end; the Quad uses a pair of pentodes in the paraphase phase-inverting circuit.

It is possible to combine the Ultra-Linear configuration with partial cathode loading and this was done in the Fisher 70A (Fig. 5) amplifier.

An arrangement which looks rather similar is that of the McIntosh amplifiers. (See "Circuit Features of High-Fidelity Power Amplifiers," August, 1955.) In this, bifilar windings are used for the plate and cathode portions of the transformer primary and the screens are cross-coupled to the opposite plates. This arrangement permits class-B operation with very low distortion and without the switching transients normally produced by such operation. Thus a pair of 6V6's can deliver outputs in excess of 20 watts. Fig. 6 shows a simplified version of the output of the McIntosh amplifier.

I mentioned switching transients in the preceding paragraph. These occur when output tubes are driven to and beyond cutoff. The transient is produced by leakage reactance of the output transformer which results in collapsing currents at the cutoff point and produces parasitic oscillation, audible in the output as a very annoying thump, which tears up the signal. Because these transients occur at cutoff or beyond, high-fidelity power stages avoided such operation. That meant, in practice, they were limited to class-A or -AB$_1$ operation. Unfortunately, this operation is inefficient and it is difficult to obtain high-power output with it. Much design thought has therefore been expended on means of obtaining class-AB$_2$ or -B operation without switching transients.

Before going into that we might mention two expedients for obtaining high-power outputs with class-A operation. One is a style of operation called A$_2$. In this the tubes are never cut off but they are driven into the grid-current region. This produces higher distortion, but its effects can be minimized by careful balancing and high feedback factors.

The first commercial amplifier to employ this mode of operation was the Brook unit designed by Lincoln Walsh which was the first great postwar high-fidelity amplifier. It has since been used also in the Fisher Laboratory model 50A. In this type of operation the grids draw considerable current, consequently the grid impedance must be very low. The driver is therefore a cathode follower with transformer coupling to the output tubes; even the low resistance of a cathode follower with resistor loads would be too great for A$_2$ operation. The transformer also has capacitor coupling to extend the low-frequency response. This results in something intermediate between transformer and double-impedance coupling (Fig. 7).

Another possible arrangement (Fig. 8), not used at present in a commercial amplifier, is *extended* class-A operation. Here four identical tubes are used, one pair operating as triodes, the other as pentodes. At low levels the pentodes are cut off and do not contribute anything. At a certain point in the dynamic range, however, as the driving voltage increases and reduces the effective bias,

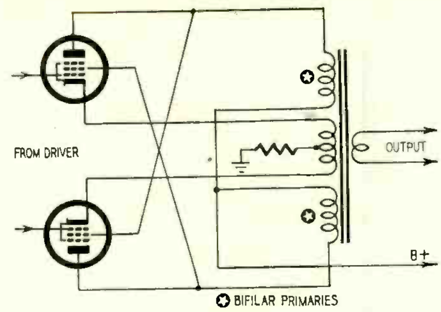


Fig. 6—McIntosh output circuit.

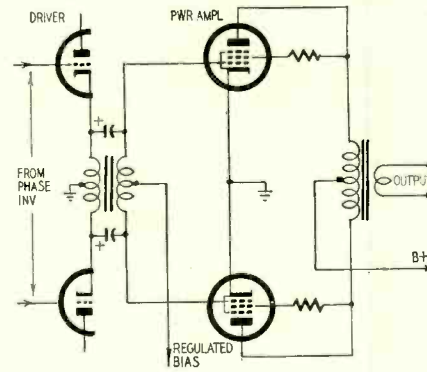


Fig. 7—Circuit for class-A$_2$ operation.

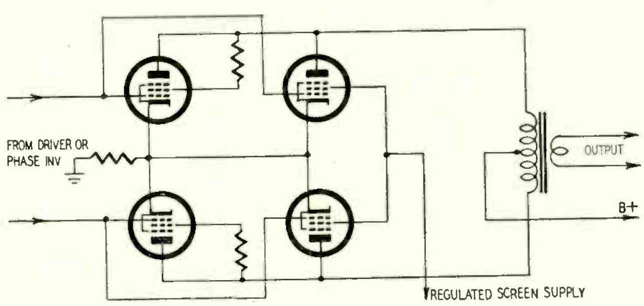
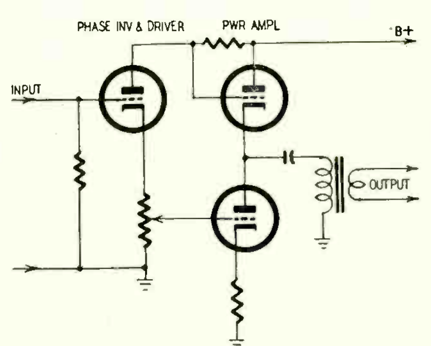
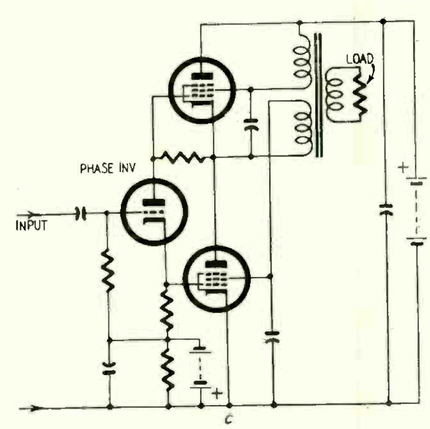


Fig. 8—Circuit for extended class A.





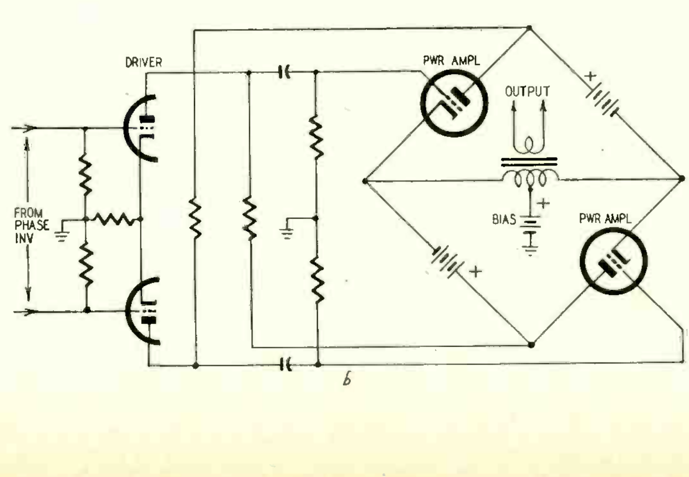


Fig. 9—Output circuit with plate of one tube and cathode of other loaded.

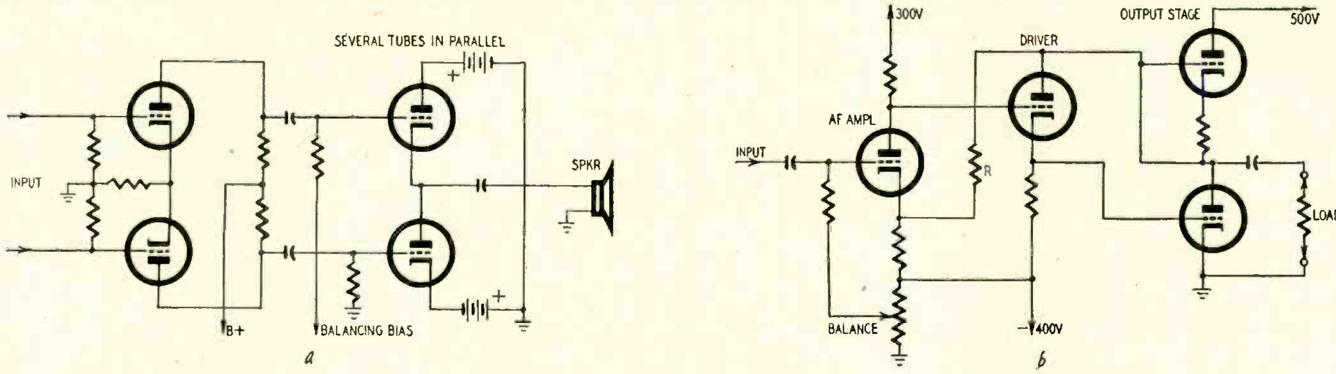


Fig. 10—Single-ended push-pull output.

they begin to contribute and at maximum output are the dominant developers of power. Operation is class A, but the amplifier output power is much higher.

One of the possible ways of using two tubes in a power stage is to load the cathode of one and the plate of the other tube. This appears in different forms in two commercial amplifiers: the National Unity-Coupled Horizon and the Electro-Voice Circlotron.

Since the circuit diagrams of these amplifiers do not make the operation clear, let us examine the circuit in simplified form. The general idea is expressed in the simple diagram of Fig. 9-a. Here we have, in effect, two tubes whose outputs are in series but whose inputs are in push-pull. The transformer is connected in the middle of the circuit at the point where the two tubes are connected in series. It is in the plate circuit of the lower tube, in the cathode circuit of the upper one. Push-pull operation results because the two grids are fed by out-of-phase voltages and therefore, as the plate current of one tube rises, the current of the other falls. The load for both sections is common, so all the distortion products cancel.

National and Electro-Voice have traveled two different paths to obtain a practical amplifier with this configuration. Electro-Voice turns the circuit into a bridge as indicated in Fig. 9-b. This requires two power supplies (indicated by batteries), but as long as the bridge is well balanced no dc can flow through the output transformer. This simplifies the design of a good output transformer; it also makes possible class-AB_2 operation approaching class B without switching transients. This in turn makes it possible to develop high power outputs with high efficiency. Triodes or pentodes can be used and, since the output impedance is very low, pentode operation in this mode produces as good or better damping factors than triode operation in conventional push-pull stages. Furthermore, the load resistance required is only one-fourth that required in plate loading. This makes the problem of producing a high-quality transformer considerably simpler.

Since the output stage has no gain, high driving voltages are required. To obtain them a "bootstrap" driver circuit has been developed. In this circuit (Fig. 9-b) the plate loads of the drivers are returned to the plates of the opposite output tubes. Their signal voltages add to the dc potential applied to the driver plates, effectively raising their plate supply voltage.

National avoids the need for two high-current power supplies by arranging the circuit as in Fig. 9-c. The output transformer has two primaries with unity coupling. One is connected in the plate circuit of one tube and the other in the cathode circuit of the other tube. The output tubes' screen grid and power-supply filter capacitor improve the coupling between plate and cathode windings. Not as much drive is required in this circuit and the preceding amplifier is simplified, consisting of a single twin-triode. For a more detailed discussion of this circuit, see "Circuit Features in Hi-Fi Power Amplifiers," September, 1955.

Another form of this so-called "single-ended push-pull" style has been used in one commercial amplifier (the Stephens OTL) and may be used in the future because it permits coupling 500-ohm speakers directly to the amplifier without an output transformer. Fig. 10-a gives a very simplified diagram of one form of this circuit. The two grids receive out-of-phase signals. Two power supplies are used and balance is achieved by returning one grid to an appropriate negative voltage. The output is taken off the junction of plate and cathode and the impedance can be made low enough by paralleling a number of tubes to match the low impedance of a 500- or even a 16-ohm speaker.

Various methods of driving and of supplying the various voltages can be used. Fig. 10-b is a simplification of the output and driver stages of the Stephens amplifier. This configuration permits class-B operation but has two serious disadvantages: It is extremely inefficient even in class-B operation, the power output ranging from 1 to 10% of the input power; there is no common load in which distortion can be canceled. However, the absence of an output transformer permits the use of 40 db or more of feedback, which compensates for the higher initial distortion. It is probable that this circuit will appear in additional amplifiers in the future.

The driver is a cathode follower direct-coupled to the grid of the lower output tube. The output tubes are in series across the 500-volt supply and they feed the load in parallel. Current flows from ground through the cathode-plate circuit of the lower triode and then through the plate and cathode circuits of the upper tube. Signal voltage for the upper tube is taken off the plate of the lower and grid bias is developed by the drop across the cathode resistor.

The upper tube sees the lower as a cathode resistance shunted by the load and the lower sees the upper one as a plate load resistor. In each case, the load is capacitance-coupled to the source. Resistor R between the driver plate and the voltage-amplifier cathode provides inverse feedback to stabilize the amplifier against possible voltage drift.

The internal resistance of the lower triode varies as the signal applied to its grid. This varies the current through the upper triode and develops a signal voltage across the load. At the same time, the change in current through the tubes develops a signal voltage on the upper triode grid that is equal to and in phase with that applied to the lower triode grid. The blocking capacitor prevents dc from flowing through the load. END

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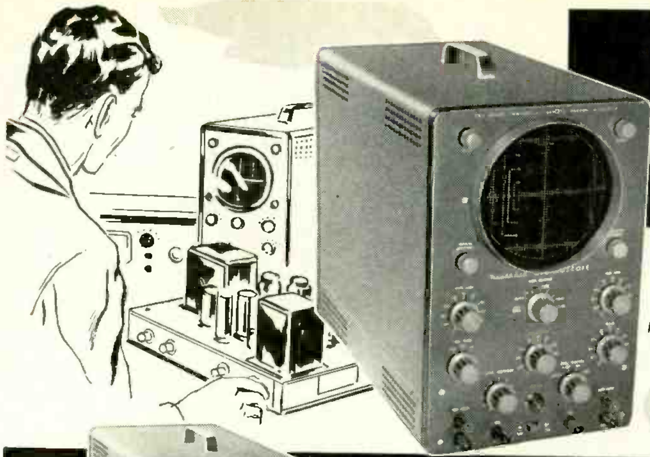

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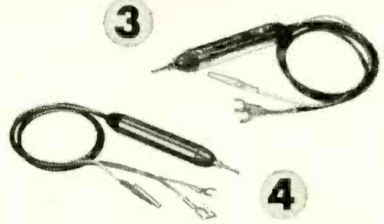

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❹ *Heathkit* ETCHED CIRCUIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

NO. 337-C
$3.50
Shpg. Wt. 1 Lb.

❺ *Heathkit* ETCHED CIRCUIT 3″ OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½″ H. x 6½″ W. x 11¾″ D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

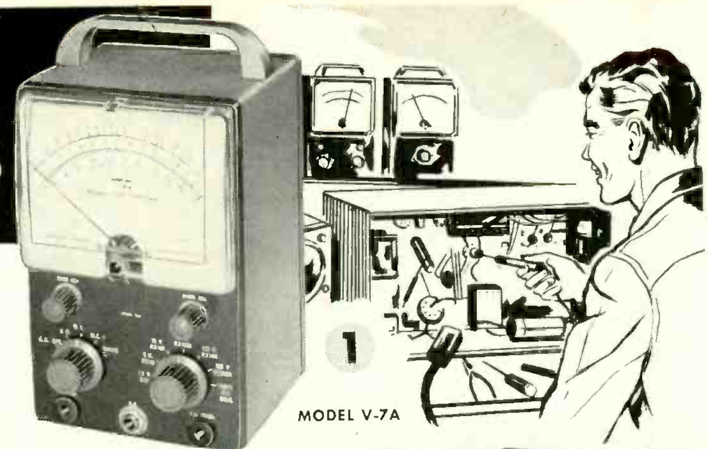
Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

MODEL OL-1
$29.50
Shpg. Wt. 14 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, 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.*

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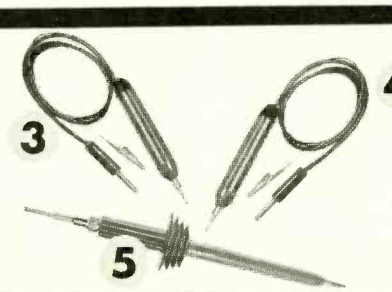


6

❶ *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.

❷ *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.

❸ *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.

❹ *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.

❺ *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.

❻ *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 20, 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

❶ *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

❷ *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

❸ *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

❹ *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 20, 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.

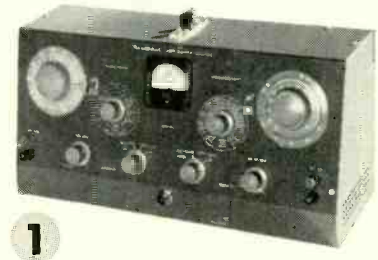
The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio 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.

❶ *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.



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❷ *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.

2

❸ *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.

3

❹ *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.

❺ *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.

❻ *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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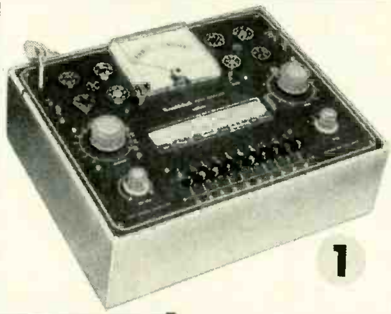
HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 20, MICHIGAN

Heathkit

TUBE CHECKER KIT



1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

2 *Heathkit* PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

3 *Heathkit* TV PICTURE TUBE TEST ADAPTER

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

4 *Heathkit* . . . CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

5 *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 20, MICHIGAN

MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT

❶ *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.

❷ *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.

❸ *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.

❹ *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.

❺ *Heathkit* AC VACUUM TUBE VOLTMETER KIT...

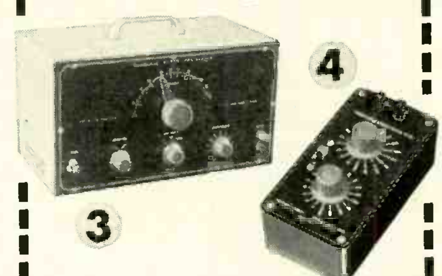
The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency 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.

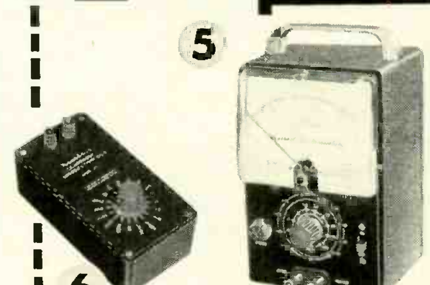
MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.

❻ *Heathkit* CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.





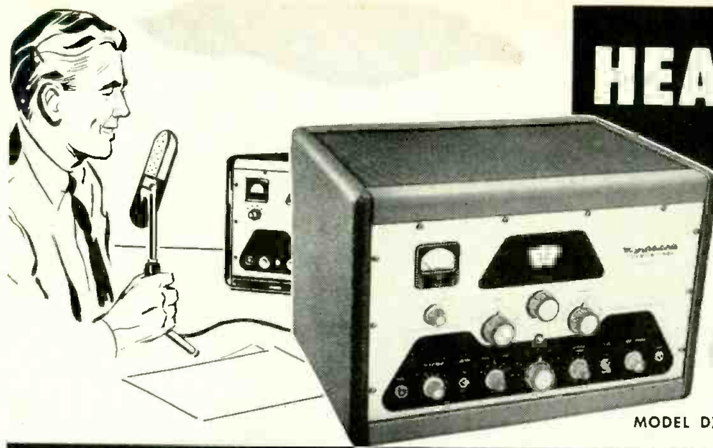
HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 20, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost



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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.*

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❶ *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

❷ *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.

❸ *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.

❹ *Heathkit* ... ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

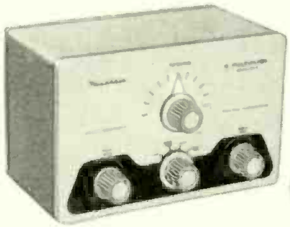
HEATH COMPANY *A Subsidiary of Daystrom, Inc.*, **BENTON HARBOR 20, MICHIGAN**

"AMATEUR-ENGINEERED"

Equipment For The Ham

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

1 MODEL AR-3



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❶ *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. 91-15, shipping weight 5 lbs. $4.50.

MODEL AR-3 **$27.95** Shpg. Wt. 12 Lbs. (Less Cabinet)

❷ *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1 **$9.95** Shpg. Wt. 3 Lbs.

❸ *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

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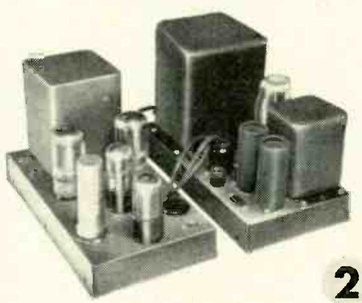

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This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output 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

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Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

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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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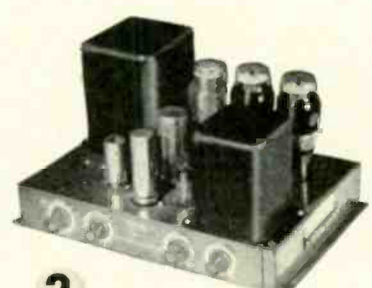
MODEL WA-P2
$19.75
Shpg. Wt. 7 Lbs.

❷ *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT



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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.

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MODEL A-9B
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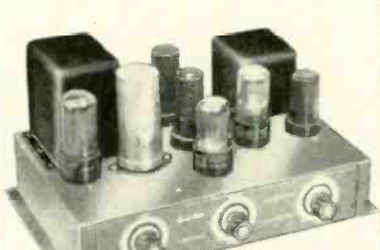

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MODEL A-7D
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Servicing Home Tape Recorders

Part I—Correcting poor frequency response and insufficient erase

By HERMAN BURSTEIN

TAPE recorder troubles may be divided into two kinds: mechanical, involving the transport mechanism; electronic, involving the audio preamplifiers, equalization circuits, bias oscillator and record level indicator. Principally the electronic problems are discussed in this article.

Except for minor repairs and adjustments, such as replacing a belt or aligning a head, it is too often a losing proposition for the service technician to repair an unfamiliar device that has developed serious mechanical difficulty. As with record changers, servicing the transport mechanism is frequently a matter for the factory or specialist, found in large cities, primarily engaged in the repair of phonographs and tape recorders.

Because of the large number of recorders on the market and the great variation in their mechanical design, servicing these units requires a stock of many special parts and extensive know-how. Large volume enables the specialist to meet these requirements. However, with minor exceptions, the electronic portion of tape recorders can be serviced with standard components—tubes, resistors, capacitors—that the service technician normally has on hand.

Familiarity with the principles of tape recording should enable the technician already adept at radio, TV and high-fidelity troubleshooting to cope with electronic troubles in tape recorders. These may be classed as: poor frequency response, insufficient erase, weak or no sound, distortion, hum and noise.

This article is concerned with restoring tape-recorder performance to original quality rather than with improving upon the manufacturer's product. However, for some problems, such as hum and noise, there are measures which can be tried to improve on original performance—if the customer desires and at reasonable cost.

Frequency response

The setup in Fig. 1 can be used to check frequency response. Note that response is measured at the output of

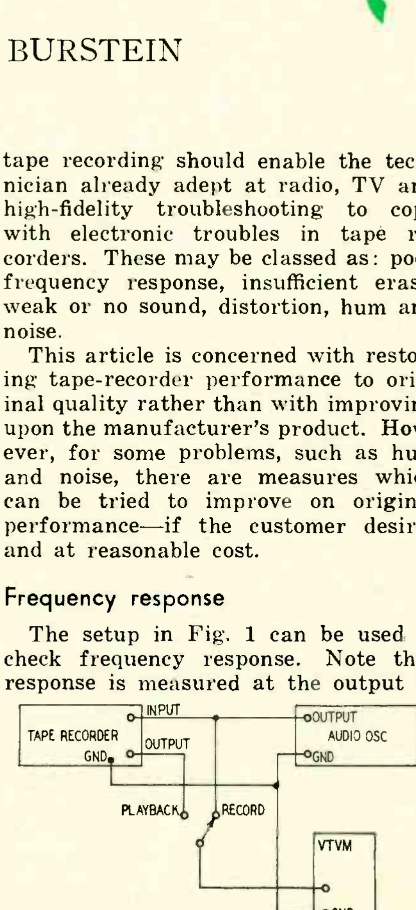

Fig. 1—Checking frequency response.

the playback preamplifier, that is, before the power amplifier and speaker which are built into many home tape recorders. Response should be measured before the tone control, if any. If the tone control is used to obtain flat response, it may also be desirable to check response for extreme and mid-settings of the control.

Make a tape with an audio generator supplying various frequencies at a constant voltage, say 1 volt, into the recorder, and measure the recorder's output during playback. Through a switch, the same vtvm can be used to measure input and output voltages. Record at a level substantially (about 20 db) below maximum permissible recording level as shown by the recorder's level indicator—neon lamp, electron-eye tube or VU meter. Otherwise a false indication of poor high-frequency response may be obtained.

For a quick check at the commonly used 7.5-ips speed, frequencies of 50, 100, 200, 500, 1,000, 2,000, 4,000, 6,000, 8,000, 10,000, 12,000 and 15,000 cycles should be sufficient to obtain a curve. On a three-head machine where immediate playback is available, the playback output may be measured while a given frequency is recorded. For machines using a single record–playback head, all the desired frequencies must first be recorded and then played back into the vtvm. To recognize frequencies during playback, they may be monitored on an oscilloscope. Or, use brief increases in signal level during recording to mark off several guidepost frequencies, say 500, 1,000 and 10,000 cycles.

In home type recorders, ±3-db response over the range claimed for the particular recorder may be considered acceptable. The response of professional and semiprofessional machines should be ±2 db or less over the stated range. Be on the lookout for peaks in excess of 3 db which sometimes appear in the range of 3–8 kc as the result of equalization circuits designed to maintain response out to 10 kc and beyond. Such peaks, though as low as 3 db, are evident to the ear as treble coloration.

Should frequency response at the output of the playback preamplifier be within specifications, then the cause of poor response lies in later stages. It may be in the power amplifier or speaker contained in the tape recorder or possibly in a tone control circuit following the playback preamplifier.

A frequency response test of stages following the playback preamplifier may be run by feeding audio frequencies to the first of these stages and measuring output at the speaker voice coil with a sensitive vtvm or oscilloscope. However, if the internal tone control, amplifier and speaker perform normally and the customer is feeding the tape recorder into a separate amplifier and speaker system, apparently his sound system is at fault and he should be advised to check it by a radio tuner or phonograph.

If the tape recorder proper (before the internal power amplifier and speaker) has poor low-frequency response, the fault is apt to be in a defective capacitor or resistor. The capacitor may be one used in the bass-boost circuit or it may be a coupling or screen bypass unit. Most commonly, all or most of the bass boost is provided in the playback circuit. However, in some home tape recorders an equal amount is provided in the record and playback circuits, as these recorders generally use the same preamplifier for record and playback. A typical playback bass-boost circuit, which operates on the principle of shunting high frequencies to ground, is shown in Fig. 2. If capacitor C1 is open, shorted or substantially lower than design value, low-frequency response suffers. Similarly, an increase in the value of R1 can adversely affect the bass end. A feedback type of R-C bass-boost circuit is shown in Fig. 3.

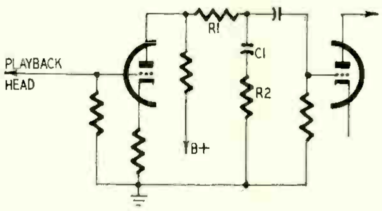

Fig. 2—Playback bass-boost circuit.

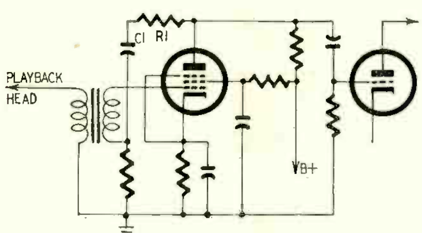

Fig. 3—Feedback bass-boost circuit.

If high-frequency response is poor, look into the following for the source of trouble:

1. Dirt on heads. As the distance between the head and tape, measured in 1/1,000's of an inch, is increased, response drops. The higher the frequency, the greater the drop. The minute separation caused by tape oxide deposited on the heads due to friction can greatly attenuate high-frequency response. Cleaning the head with alcohol, using a Q-Tip, is sometimes all that is necessary to end the customer's complaint. Do not use carbon tetrachloride, it is poisonous and may act as a solvent for the head material.

2. Defective high-frequency equalization. All or most of the treble boost is usually provided in the record preamplifier. A variety of circuits is used, most of them relying upon R-C networks although the use of inductors is not uncommon. Fig. 4 shows two typical treble-boost circuits, one employing an inductor. As in the case of bass boost, a defective resistor or capacitor can be responsible for incorrect high-frequency response.

3. Improper azimuth alignment. This fault is most prominent in a machine with separate heads for record and playback. It is vital that the orientation of the record-head gap with respect to the tape be exactly the same as that of the playback-head gap. Each gap should be perpendicular to the direction of tape travel. Although all frequencies are attenuated by improper azimuth alignment, the effect increases as frequency goes up. In a machine which uses the same head for record and playback, azimuth misalignment in record is compensated by the same error in playback. However high-frequency response results when playing back tapes made on other machines, for example prerecorded tapes.

Test tapes are available which permit rapid azimuth alignment. First the playback head is aligned to produce maximum output of the high-frequency alignment signal on the tape. No further steps are necessary for a machine using a single record–playback head. If a recorder uses separate heads, the record head is then aligned so that in recording the same high-frequency signal the output obtained from the aligned playback head is maximum.

4. Worn heads. High-frequency response depends upon the gap width (often called gap length) of the playback head. At 7.5 ips response out to 10 kc or better requires a gap of .0005 inch or less. With use, the head may wear so as to widen the gap, reducing high-frequency response. Because of the microscopically small gap, visual inspection is of no help and another head must be substituted. However, before substituting another head, try recording a tape on the machine in question and playing it back on another machine of the same brand or with similar performance characteristics. (Satisfactory recording can be achieved with a gap considerably greater in length than used for playback.) If high-frequency response is still poor and it cannot be corrected by azimuth adjustment of the head on the machine used for playback, then the fault would appear to be in the treble emphasis circuit.

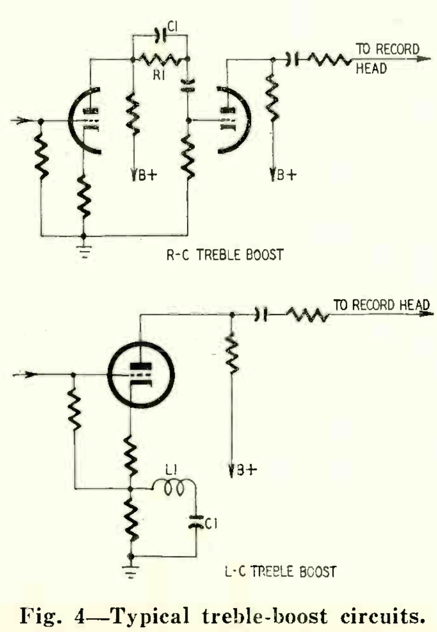

Fig. 4—Typical treble-boost circuits.

5. Excess bias current. A high-frequency bias current between 30 and 150 kc is applied to the record head simultaneously with the audio signal, its principal purpose being to reduce distortion to a satisfactorily low level. Up to a point, the greater the bias current, the less the distortion for a given amount of audio current applied to the tape. Beyond this point, an increase in bias current fails to reduce distortion and may even increase it. Unfortunately, long before bias current fails to lower distortion, it begins to attenuate the signals recorded on the tape. The greater the bias current, the greater the attenuation of high frequencies as compared to low ones. If through failure or change in value of a component the amount of bias applied to the record head increases substantially over the amount prescribed by the tape-recorder manufacturer, high-frequency response suffers.

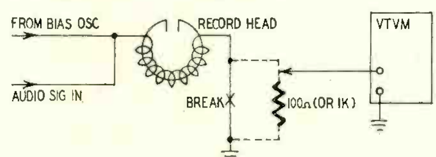

Fig. 5—Measuring the bias current.

It is difficult to state the correct value of bias current since this differs considerably among various machines. Roughly, in home tape recorders, it may range from less than one to several milliamperes. The correct value or means of determining it should be obtained from the manufacturer. Fig. 5 shows how it may be measured. A 100-ohm resistor is inserted between ground and the ground lead of the record head. A vtvm is placed across the resistor and the ac voltage is measured with the machine in record position but with no signal input and the volume control at minimum.

The bias current is calculated by Ohm's law; that is, the measured voltage is divided by 100. If the vtvm does not have sufficient sensitivity, a 1,000-ohm resistor may be used in place of the 100-ohm unit. This results in a higher voltage reading. The impedance of the record head at the bias frequency is usually high enough so that the impedance of the 1,000-ohm resistor is still low enough to have negligible effect upon current through the head.

6. Slow tape movement. The customer's complaint may be based on the fact that old recordings or prerecorded tapes sound low-pitched on playback. If the tape transport is running below rated speed, this reduces pitch. A test for speed accuracy can be made by determining the time required for a tape of known length to run out. Or on a machine of known accuracy the service technician can make a tape with signals at stated intervals, such as 1 or 5 minutes, and then use this

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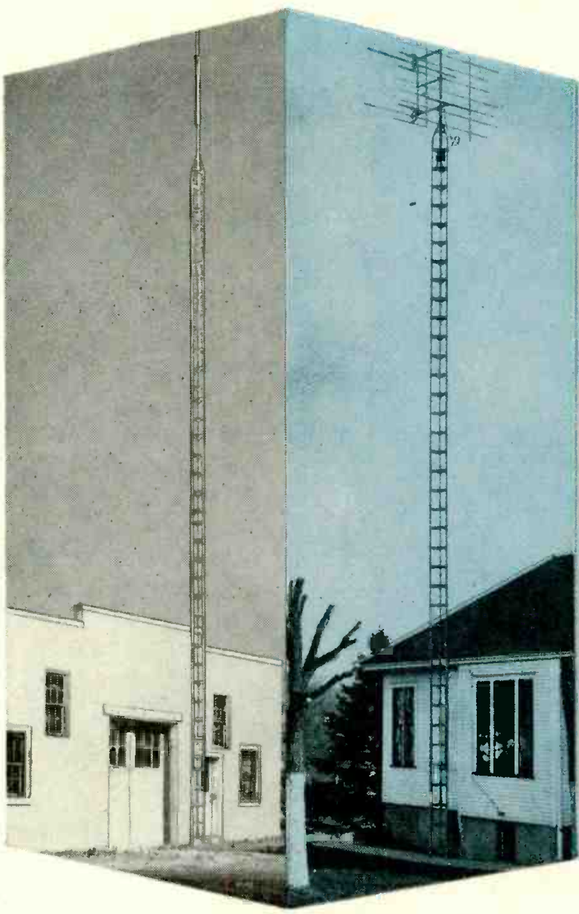

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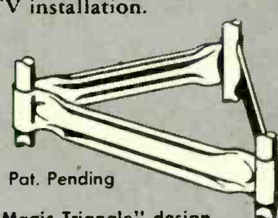

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as a timing tape. Or he can purchase one of the Dubbings test tapes which have 5-minute signals as well as other useful test material—azimuth alignment, frequency response, maximum recording level and signal-to-noise ratio.

7. Pressure-pad misadjustment. Most home tape recorders use pressure pads for maintaining good contact between the tape and the heads and generally provision is made for adjusting the amount of pressure. Insufficient pressure results in reduced high-frequency response. However, in adjusting the pad, guard against excessive pressure which will increase the deposit of tape oxide on the heads, increase head wear and possibly decrease the tape speed.

Complete failure to erase may be due to the coil in the erase head being open or shorted. With the machine set for record, check the record head for open and short circuits. Erase current is often coupled to the record head through a resistor or capacitor, and a defect or change in value of such a component would affect erase.

Insufficient erase may be caused by a dead or weak oscillator. Erase-head current in different home recorders varies from less than 15 ma to amounts several times as great. The actual current can be found by connecting a vtvm across a 100-ohm resistor inserted between ground and the ground lead of the erase head and then calculating current by Ohm's law. The value so determined should be compared with that specified by the manufacturer. If erase current is more than 20% below the required value, oscillator and coupling components to the erase head should be checked.

Another possible cause of inadequate erase is improper vertical positioning of the gaps of the record and erase heads with respect to each other and to the tape. This may occur in some machines where the mechanical arrangement for attaching the heads to the transport mechanism permits them to be moved slightly up or down. If the erase head gap does not fully cover the path on the tape covered by the record head gap, complete erasure obviously cannot take place. On a two-track machine, which uses slightly less than half the width of the tape for recording each channel, it is important that the gaps be confined to either the lower or upper half of the tape and do not extend across the center of the tape. Otherwise a portion of each track would be reproduced in playback.

The erase heads on home machines often do less than a complete job. On tape reuse, the previous recording is therefore slightly audible during quiet passages. If the owner desires complete erasure, he should purchase a magnetic eraser or one can be economically constructed. (See "Improving Inexpensive Tape Recorders," Part II, RADIO-ELECTRONICS, May, 1955, by the author.) TO BE CONTINUED

FOR GOLDEN EARS ONLY

The Heathkit AG-9 audio generator; Knight SX702 AM-FM-TV tuner; Cabinart accessories; Ortho-Sonic tone arm

By MONITOR

ONE of the most tedious laboratory and servicing procedures is making a series of frequency runs with an audio generator. Those who have to do this frequently will find the Heathkit AG-9 an extremely clever new instrument.

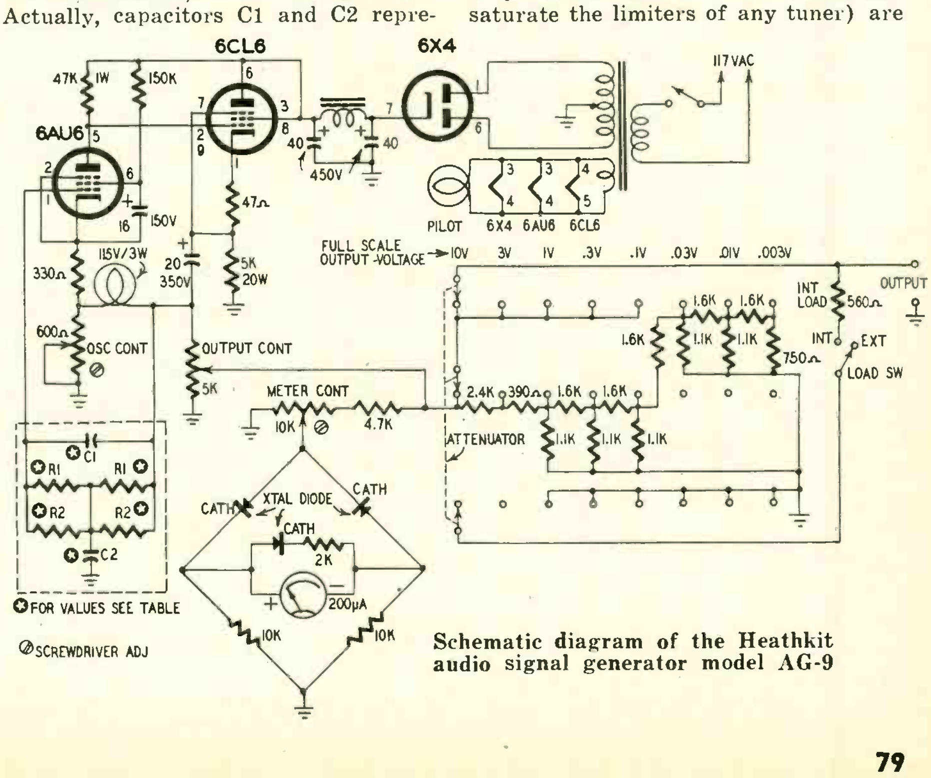
The innovation is the tuning method. Instead of continuous tuning, the AG-9 uses three switches which provide two significant figures and a multiplier. The combination covers the range from 10 to 100 in units of 1 cycle, from 100 to 1,000 in units of 10, from 1,000 to 10,000 in units of 100 and from 10 to 100 kc in units of 1,000 cycles. Superficially it might seem that this would be more complicated than using a single continuous-tuning dial and a range switch. But when one has become accustomed to it, it is possible to make a run in a fraction of the usual time and with considerably greater accuracy because it takes a fraction of a second to flip a switch but several seconds to readjust a dial accurately to a new frequency. It is possible that there are some applications in which the ability to cover a range continuously and without any skips or steps is desirable. But the steps here are in terms of 1% of the frequency and in audio it is practically impossible to obtain resonant peaks or nulls that sharp.

The usefulness and accuracy of the generator (see diagram) are further improved by the output meter which monitors the output in terms of volts or db. Most service type generators have an amplitude error of 1 or 2 db from one decade to another or from one end to the other of the same decade. One either has to remember the error and correct for it or use an external meter if greater accuracy is necessary. With the AG-9 it is possible to keep the output constant. The overall accuracy over the full range from 10 to 100,000 cycles appears to be well within 1 db, and within the 20–20,000-cycle range it is better than that.

The output is controlled by a combination of a potentiometer and a decading attenuator in eight voltage ranges with a maximum of 3 millivolts on the lowest range and 10 volts on the highest. The leakage is very small and the minimum voltage on the lowest range is less than 100 μv. Thus, the generator can be fed into the most sensitive preamplifiers without overloading. On the 3- and 10-volt ranges the source impedance is around 1,000 ohms; the lower ranges can either work into a 600-ohm external load or a 290-ohm internal load is available through a switch.

The AG-9 uses the now well known Bureau of Standards circuit with resonance controlled by a T network in a feedback loop. Critical component tolerances are 1% for resistors and 2% for capacitors. The construction is simple and the adjustment even simpler. Only the meter requires calibration and for normal useage the heater voltage is sufficiently accurate for a standard.

Fig. 1 shows the T network (within the dashed lines) with a set of codes. Actually, capacitors C1 and C2 represent four pairs that are switched into the circuit by turning the multiplier to its four positions. Resistors R1 and R2 represent 10 sets of resistors that are switched into the circuit.



Schematic diagram of the Heathkit audio signal generator model AG-9

Knight SX702 AM-FM-TV tuner

The Knight line of high-fidelity equipment has always provided high quality per dollar and the SX702 tuner is an example of more of the same. The usable FM sensitivity is surpassed only by two or three of the highest-priced tuners, but the difference may be entirely academic unless in your location a 3–6-db increase in gain is just what is needed to shove a station over the noise threshold. In my location the sensitivity was adequate to provide acceptable reception of all but the very weakest of the stations regularly receivable with the best receiver tried so far. The biggest difference is that very weak stations (which will not saturate the limiters of any tuner) are

AUDIO—HIGH FIDELITY

less readable in the noise. One or two of the new wide-band-detector tuners have lowered distortion but whether this makes a practical difference in overall distortion will depend on how careful the broadcast stations are in holding down their own distortion. There is a choice of tuning with or without afc. A meter and a good dial ratio result in uncritical tuning.

The AM characteristics with the built-in ferro-loopstick antenna are very good and in most locations no additional antenna is needed. The band width appears to be about 10 kc and provides excellent reception with low interference in secondary and fringe areas; for local use the frequency response is narrower than desirable.

The unique feature of the Knight (shared also by the Rauland line) is the availability of a TV-sound tuner which can be plugged in as an accessory. This will provide TV sound almost infinitely superior to that of the best available TV receiver and greatly superior to that possible when the sound output of a TV receiver is fed into a high-fidelity outfit. The fine reception is possible because there is no difficulty with interference from the sync frequencies and the if channel of the Knight tuner provides very wide bandwidth compared with that of a good TV receiver, reducing distortion to about the same degree as the wide-band FM tuners reduce it on the FM band. TV sound is beginning to improve and some of it qualifies for high-fidelity standards; in any case, the improved sound quality greatly improves the illusion of presence and versimilitude.

Moreover, I have found that many TV programs are just as enjoyable with sound alone and this way provide far less distraction for other activities. Finally, those in the extreme TV fringe areas can improve their overall TV reception by using this separate TV sound tuner; the TV receiver can be tuned for peak picture reception and the sound tuner for best sound. The TV tuner consists of a Standard Coil tuner remodeled to provide a 10.7-mc if output.

The audio output of the Knight tuner is very good indeed. Two outputs are provided from a cathode follower for amplifier and tape recorder. An unusual feature of the Knight is that there is no volume control on the panel. The level of the amplifier channel can be set by a potentiometer on the rear of the chassis. The idea is that the volume will be controlled by the control unit.

Phono accessories by Cabinart

It has been well said that some of the best things come in very small packages. A case of hi-fi point is the Levelor kit introduced by Cabinart. Why nobody thought of putting something like this out before I do not know. Certainly Cabinart deserves a medal for making it available. The Levelor is simplicity itself. It contains a bubble

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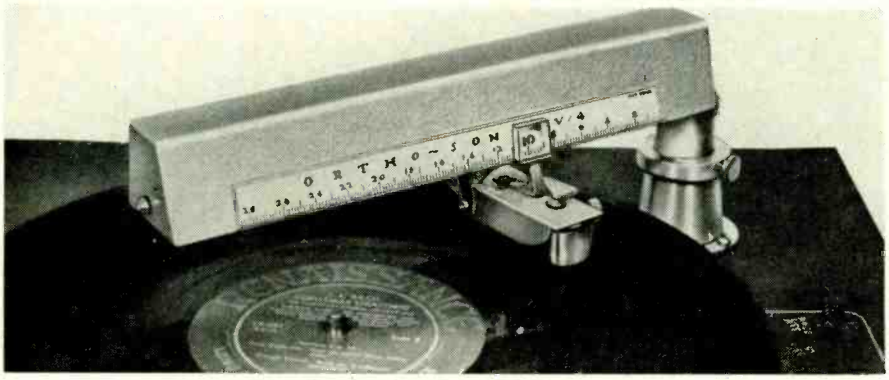


The Bard Ortho-Sonic pickup arm.

level which can be mounted on top of a changer or turntable base and which indicates precise leveling in both dimensions at a glance. Having determined, as you are certain to, that the base is out of level and the pickup arm compliance is being fouled up by gravity, the next problem is to correct matters. Therefore, the kit contains four rubber feet to fasten to the bottom of the turntable or changer base. But these are not ordinary feet—each has a screw which permits an adjustment in length (and therefore in height of base) of a little over ¼ inch. With one on each corner of the base, it should be possible to make a turntable level even aboard a yacht. In the average installation you'll recapture the $2 cost of the kit in a mere week, in the form of less damage to your prized records through groove jumping, skipping and skating, as well as in more satisfactory sound.

To make putting a hi-fi together easier, Cabinart also has several other items. The ACC-1 record changer or turntable base is a tray made of birch plywood with a top precut for any of the popular changers or turntables; the whole is mounted on excellent quality ball-bearing slides. The slides can be mounted on a shelf or in a cabinet in a jiffy and you have a professional slide-out changer for a minimum of labor and a cash outlay of just $10.

The ACC-2 is a handsome base (without slides) for professional type turntables. It is made of heavy plywood with genuine mahogany, walnut, korina or ebony black lacquer finish. The top is available either precut for any of the standard turntables or in one solid piece for cutting by the customer. An interesting and very helpful design feature is that the top floats on a sponge-rubber gasket to minimize the bad effects of vibration and shock. The base is large enough for any turntable I know of including the D & R and still leaves plenty of room for a transcription type arm.

In addition Cabinart has a series of partitioned lightweight record storage units ranging from 1 to 3 feet long and in price from $9 to $25, and a series of wrought iron bases for each.

Ortho-Sonic tone arm

Ever since the cylinder record was abandoned in favor of the disc, playback has suffered from the tracking error which results because the cutting stylus moves in a straight line across the radius of a disc, whereas a playback needle—on its arm pivoted outside the diameter of the disc—moves in an arc. So the playback needle can reproduce the exact movement of the cutting needle at only one point (at best) and at all others departs from the ideal alignment by up to 25°. For years engineers have been trying to produce a playback mechanism which would reproduce accurately the movement of the recording equipment.

The Ortho-Sonic V/4 has some minor faults but does solve the essential problem of eliminating tracking error. Since the needle now follows the same straight line path as the cutting needle there is no tracking error at all. The benefit from this should be lower distortion, and my measurements—though not of laboratory conclusiveness—indicate that the benefit is achieved. With ordinary arms there is some variation in IM distortion as the arm moves from outside to inside of the record; in the Ortho-Sonic the variation is considerably less. (Unfortunately, variations in distortion from outer to inner diameter can be due to other causes, even in the recording process, and it is not possible completely to isolate the portion due to tracking error only. But so far as I can determine the aberrations due to tracking error are at least greatly minimized and possibly eliminated.)

Granting this, the real test comes in that other type of tracking—the ability to follow high-amplitude modulation of the groove without skipping, jumping, groove locking or loading the needle. To distinguish it from tracking error I will refer to it as arm compliance for in essence it represents the ability of an arm to permit the needle to comply with the motion imparted to it by the grooves without loading that motion with its own friction or mass. The trouble with past attempts at solving the tracking-error problem has been that the suspension has had so much friction that the loading of the needle produced effects far worse than the tracking error did. In this respect the Ortho-Sonic seems to be superior to most conventional arms. It will pass the McProud test which consists of placing a big-hole 45-rpm disc on a table so that one edge of the hole is against the center pin. This imparts an eccentric motion to the arm with a swing of more than 1 inch. The Ortho-Sonic will track this way without skipping, jumping or locking about as well as any other arm I know of. Since the eccentricity of the McProud test is a gentle one resembling a sine wave, it is not as severe as that produced by extremely sharp high-amplitude transients recorded in a normally revolving groove because the sharp transients "throw" the arm more sharply and impart higher velocity. Many arms which meet the McProud test will nevertheless fail on such recorded transients, as those on Cook's *Earthquake* or Audiophiles *Thunderstorm*. So far as I can determine the Ortho-Sonic is just below the Ferranti, which in this respect is the best of all arms tested. At any rate, in some months of use it has not been guilty of skipping or locking once.

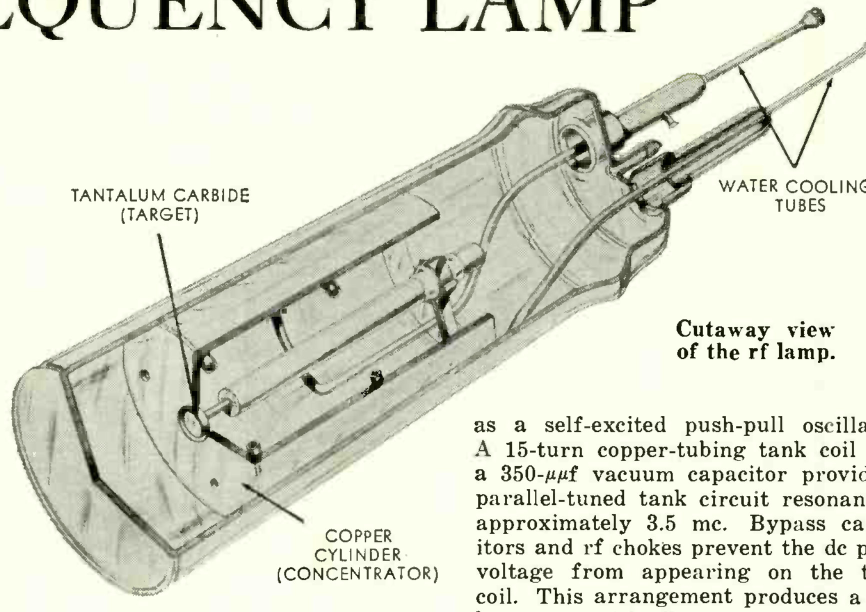
It seems to be at least as free of resonances as conventional arms. This, I guess, is the result of the fact that the cartridge mount is isolated from the large superstructure of the arm through friction-free bearings. It is easy to install and equally easy to adjust for height, needle pressure and parallelism to the disc, and no more sensitive to leveling. It has features conventional cartridges do not possess. There is an indexing scale with a magnifier which enables one to index records and place the needle quite accurately in the desired groove. Cueing is even more accurate. The record can be precued with the needle in the groove and stopped exactly in the desired spot; when the arm is lifted with only reasonable care and then returned to the groove, the exact same spot can be found very accurately. Radio stations should find this a worth-while feature.

There are some disadvantages, the most serious of which could be corrected by refining the design. The cartridge mount is of the slide-in type with a knurled knob to fasten the cartridge in place. Unfortunately, this design will not accept all available cartridges by any means; in fact, the cartridges it will take without providing special mounts constitute a minority of those on the market. It will take the G-E (either turnover or single) Fairchild, the original Pickering and the individual units of the 240 series. But most of the others will require some additional mount which I presume the manufacturer will soon make available. The arm is a little more awkward to use initially, but once a habit is formed, this disadvantage disappears. I have not tried all possible mounting positions but I judge that for accuracy in letting down the needle and using the indexing scale, it will have to be put somewhere on the right of the turntable, whereas conventional arms permit a greater choice of position. But, assuming you can mount your favorite cartridge in the Ortho-Sonic, the minor faults are petty in relation to the virtues. END

New Records Review is on page 102.

RADIO-FREQUENCY LAMP

By S. C. PEEK*



Cutaway view of the rf lamp.

THE high-frequency oscillator shown on the cover is designed to power the brightest incandescent lamp ever sold commercially. The light source is a solid disc of tantalum carbide heated inductively by the output from the 3.5-mc oscillator.

Early incandescent lamps had carbon filaments, but these lamps could be run at relatively low brightness only, because of the rapid rate of carbon evaporation. Tungsten provided a means of obtaining much greater brightness and has been used ever since. The past 50 years have seen no radical change in incandescent filament structure but recent developments, in color TV, widescreen movies and fast-thinking computers have emphasized the need for an even brighter incandescent lamp. These applications also demand more uniformity in the light source than can be obtained from a coiled filament. Radio-frequency heating of a tantalum carbide disc provided the answer. The oscillator and lamp were developed by Sylvania Electric Products Inc.

The light source is a 5/16-inch-diameter disc of tantalum carbide surrounded by a silver-plated copper cylinder which concentrates the magnetic field right at the disc. The oscillator tank coil is placed around the lamp, closely coupled to the copper cylinder (Fig. 1). Therefore, in effect, the tantalum carbide disc becomes the final sink for most of the radio-frequency power generated by the oscillator. Since the eddy currents developed by the alternating magnetic field produce circular currents in the disc, heating is uniform and symmetrical. Therefore, the light produced by the incandescence of the disc is uniform across its entire surface. Furthermore, tantalum carbide has such a high melting point and its rate of evaporation is so low that it can be heated to a very high temperature (3,400°C). This produces twice the light per square millimeter of surface area than in any known incandescent lamp and lasts five times longer as well. Water-cooling tubes are inserted through glass-to-metal seals in the base of the lamp. The tubes are attached to the copper cylinder and keep it cool. Were it not for water cooling, the tremendous currents would melt the copper.

The radio-frequency source consists of two 833-A triodes (Fig. 2) operated as a self-excited push-pull oscillator. A 15-turn copper-tubing tank coil and a 350-$\mu\mu f$ vacuum capacitor provide a parallel-tuned tank circuit resonant at approximately 3.5 mc. Bypass capacitors and rf chokes prevent the dc plate voltage from appearing on the tank coil. This arrangement produces a 1.5-kw output with all components operated well within their ratings.

A separate dc supply powers the oscillator. It operates from a 230-volt 60-cycle 3-phase line and uses six 866-A's in a bridge rectifying circuit. The use of a 3-phase power supply makes filtering unnecessary and provides 4,000 volts at 1 ampere for plate power. Varying the voltage with a variable-voltage transformer provides control of the lamp brightness.

Both power supply and oscillator are completely shielded and rf filters are placed in the power-line connections, keeping the radiation well under 10 microvolts at ½ mile from the installation, to prevent interference with radio or TV reception.

Although the lamp was originally designed for motion-picture printing, it has found its way into some interesting electronic applications—color pic-

*Sylvania Electric Products Inc., Salem, Mass.

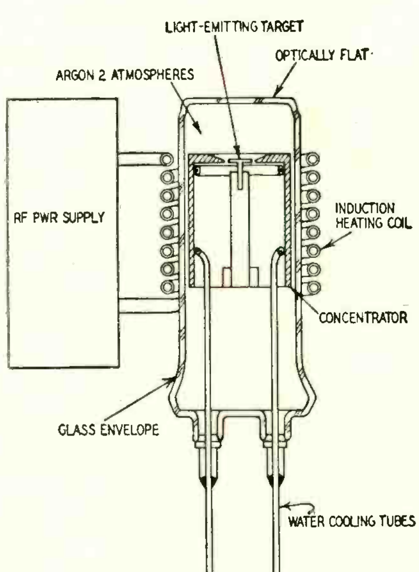


Fig. 1—Diagram of rf lamp system.

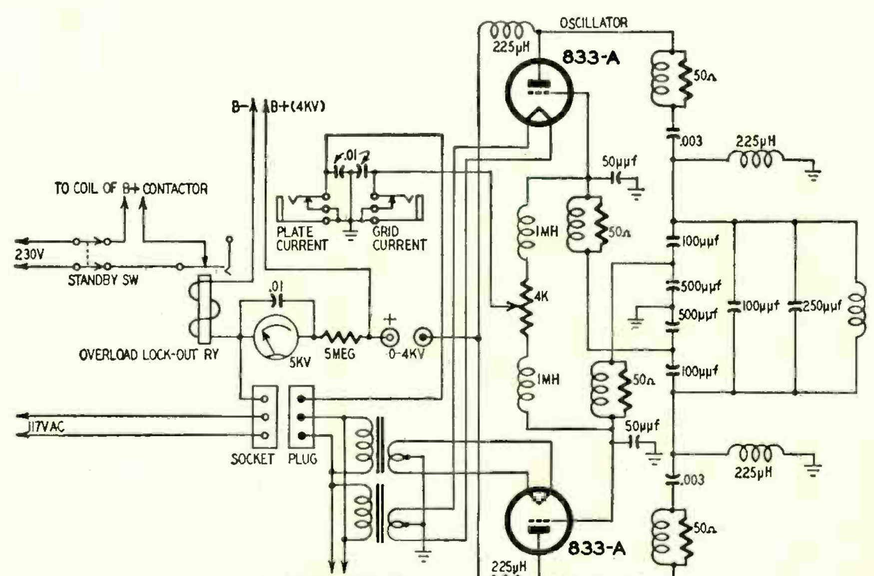
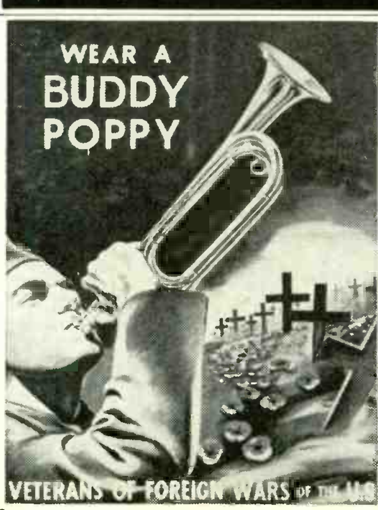


Fig. 2—Schematic diagram of power supply and oscillator for rf lamp.



ture-tube processing, computor readouts and instrument landing system beam checkers.

Color picture tubes depend upon a photographic process to produce the three-color dot clusters which make up the light-emitting surface. In the finished tube an electron beam will pass through small holes in the aperture mask and excite one of the three colors. It is essential for good color reproduction to have the proper color phosphor dot precisely aligned with respect to the aperture mask holes and the electron gun. The light beam which exposes the photo-resist phosphor and also determines its position must follow the same path as will the electron beam in the finished tube. The light beam must therefore come from a concentrated source approximating the dimensions of the electron beam at its origin. The rf lamp not only provides the necessary concentrated source but also greatly speeds up the process because of its high brightness. Although there are still other costly processes in the manufacture of color tubes, the rf lamp has a good chance of significantly reducing the cost of an important one.

The rapid advances in electronic computers have resulted in a peculiar dilemma. They can think faster than they can talk! Computation and reference to data in their memory is limited only by the speed of an electron in a vacuum tube or the migration of a hole in a transistor, but communication of the results to the outside world has generally depended upon some slower mechanical device. Recent developments in the readout or communicating section have made use of a combination of light beam, electron beam and photographic emulsion. All these phenomena are fast especially if the light beam is bright. The rf lamp looks very promising for this application and speeds of 10,000 digits or letters per second may soon be realized.

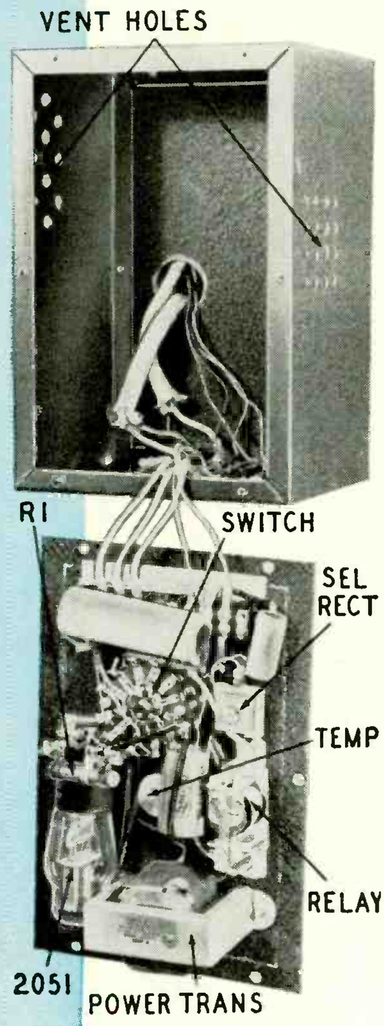
Still another use may be connected with electronics in aviation. The high-frequency ILS beam used to guide aircraft in for a landing sometimes drifts from its desired position, a very serious situation. Present methods for checking the position of these beams is time-consuming and costly. A light beam does not stray from the path upon which it is directed and, therefore, might be used as a reference beam which a pilot could use in good weather to check the radio beam. The problem was to get a sufficiently narrow light beam, bright enough for good visual tracking. The rf lamp has characteristics which seem to solve this.

Thus, one more industry—illumination—is being advanced through electronics. Communications and the entertainment fields have blossomed because of electronics. Aviation would be lost without it and now even lighting is feeling the impact of this powerful, ever-expanding conglomeration of tubes, wires, capacitors, coils, transistors and heaven knows what else. END

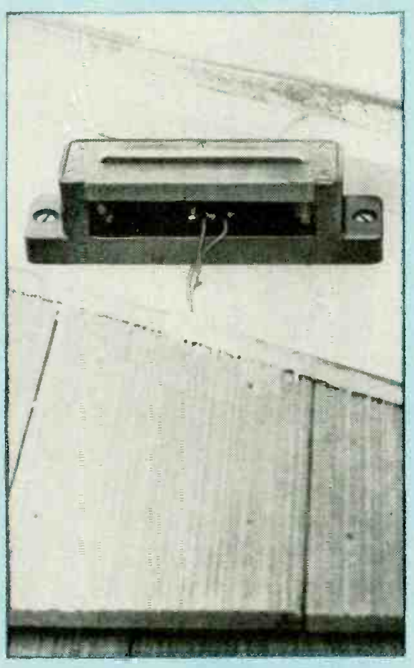
CONTROL UNIT FOR VENTILATING FANS

By ELLIOTT A. McCREADY

Panel view of the control unit.



Right — Internal view shows layout of parts.



Above — The outside temperature-sensing element is in ventilated, weatherproof case.

THE attic ventilating fan is becoming almost standard equipment in many new (and older) homes. On warm summer evenings it approaches air conditioning by exhausting the hot air from the house and replacing it with much cooler outside air—a process which might take all night without such a fan, depending on the amount of breeze.

The ventilating fan has one major disadvantage: it must be switched off in the morning as the sun rises. Failure to do so will defeat the purpose of the fan by filling the house with warm air. This disadvantage can be overcome by any of several methods. You can set the alarm clock and risk a fractured toe stumbling out to switch the fan off or you can buy an electric timer to do the job for you. The alarm-clock method is obviously a pain in the neck. The timer isn't too good either because it must be properly set each night and a sudden rise in outside temperature will raise the temperature of an already cool house.

The ideal method of controlling the ventilating fan would be by temperature differential—as long as the inside temperature is the same as, or a preset amount above, the outside temperature, the fan should be off. When either the inside temperature rises or the outside temperature falls, the fan should switch on. If the outside temperature should start to rise, the fan should remain off. This type of control sounds like a pretty large order but it's really simple and relatively inexpensive to build.

Two temperature-sensitive elements THERM1 and 2 form the heart of the control unit. These are two Carboloy type R111 thermistors with a resistance of about 100,000 ohms at room temperature and a very large negative temperature coefficient. These thermistors are available and information regarding prices may be obtained by writing Carboloy Dept., General Electric Co., Detroit 32, Mich.

The thermistors act as a voltage divider across a variable dc supply. The grid of the 2051 thyraton is connected to the midpoint of this voltage divider and any change in temperature at either the inside or outside sensing element will raise or lower the bias on the tube, opening or closing the relay. Using an ac plate supply enables the grid of the thyratron to regain plate control on the negative half-cycles of plate voltage. Resistor R2 limits thyratron grid current to an optimum value. The large resistance in the grid circuit stabilizes the unit against changes in grid current produced by widely varying outside and inside temperatures (and subsequent changes in the total resistance of the voltage divider).

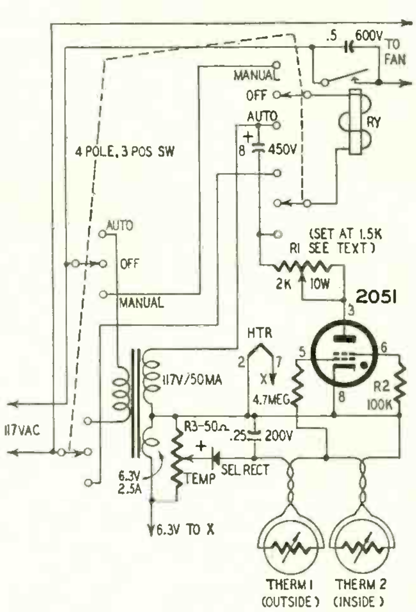
A relay with an ac coil permits manual operation of the fan without using a hefty switch. Current-limiting resistor R3 was made adjustable to minimize relay stuttering. The value shown in the schematic was found best for smooth relay operation and maximum temperature sensitivity.

Construction and operation

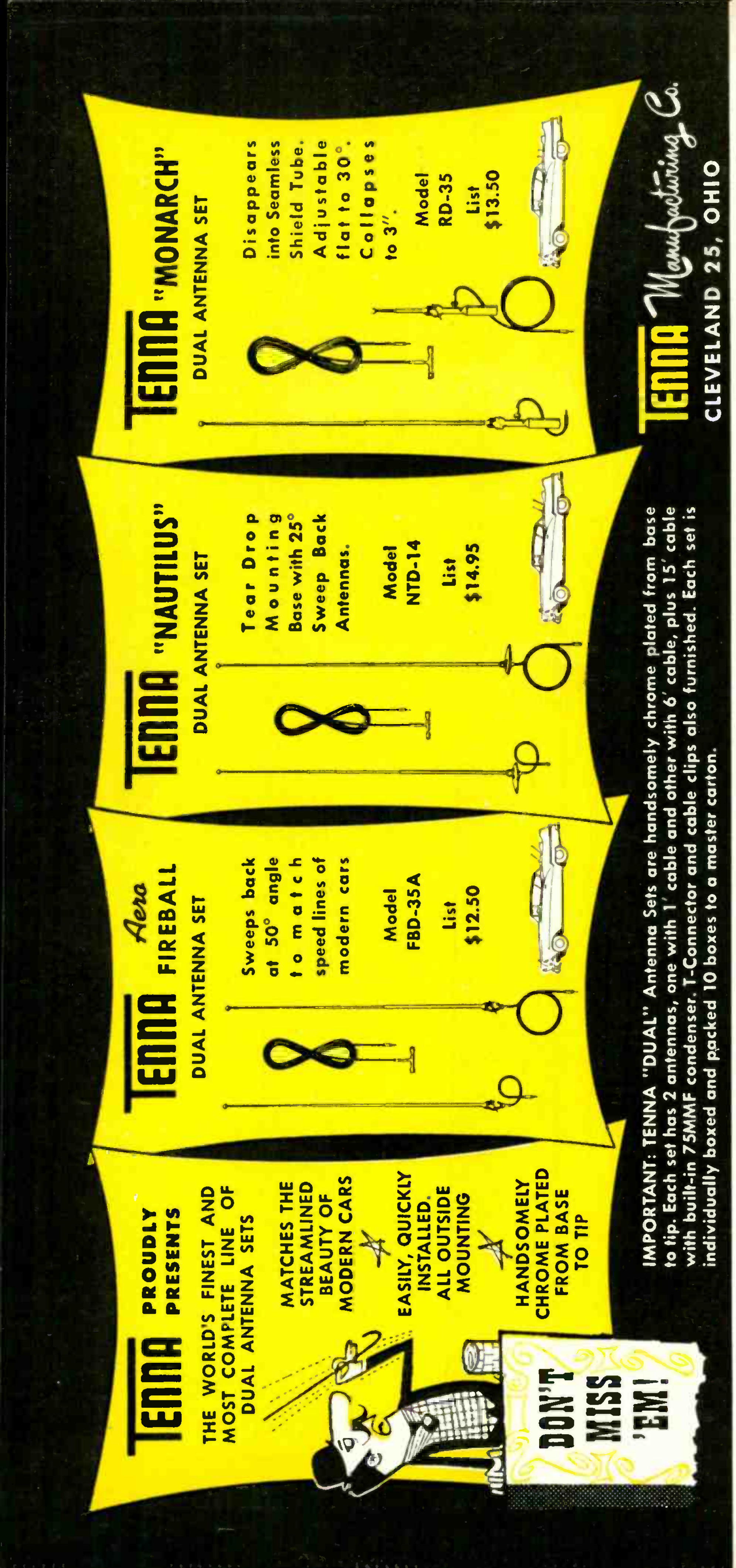
The unit was built in a 6 x 9 x 5-inch utility cabinet. All components were mounted on the front panel as shown in the photo, and two Cinch-Jones terminal strips and spade lugs make it easy to remove the unit. The cabinet was fastened to the wall and the power, fan and thermistor lines run through the wall and into the rear of the cabinet. Ventilating holes were drilled on either side of the cabinet, but the unit runs very cool and only a few holes are necessary. Parts placement isn't critical.

The temperature-sensitive elements are mounted one inside and one outside the house (don't get the leads mixed). The outside element is best situated on the north side of the house in a ventilated, weatherproof case (see photo). I found a surplus generator shunt case which proved ideal. The inside element is mounted in a room which is in the air path between the fan and an open window.

When the unit is connected, turn the



Schematic diagram of control unit. Two thermistors make up voltage divider.



selector switch to AUTO and set R3 for minimum bias for the 2051. After the unit warms up, the fan will switch on. Let the fan run for a couple of hours until the temperature in the vicinity of the inside sensing element stabilizes. Then *slowly* back off R3 until the fan switches off. The unit is now set. Slight additional adjustments may be necessary but once the unit is set it is very stable. Future use of the unit requires about a half-hour for the circuit to stabilize, but no adjustment of the temperature control is necessary.

If the relay tends to stutter slightly before making, increase the value of R1 slightly. If the unit seems insensitive to temperature variations, decrease R1. When the unit is properly adjusted, room temperature should be constant within 1 or 2 degrees (decreasing as the outside temperature decreases).

An advantage in using this control unit that may not be immediately obvious is the fact that the fan doesn't run continuously. The saving in electricity and wear and tear on the fan motor should help pay for the unit.

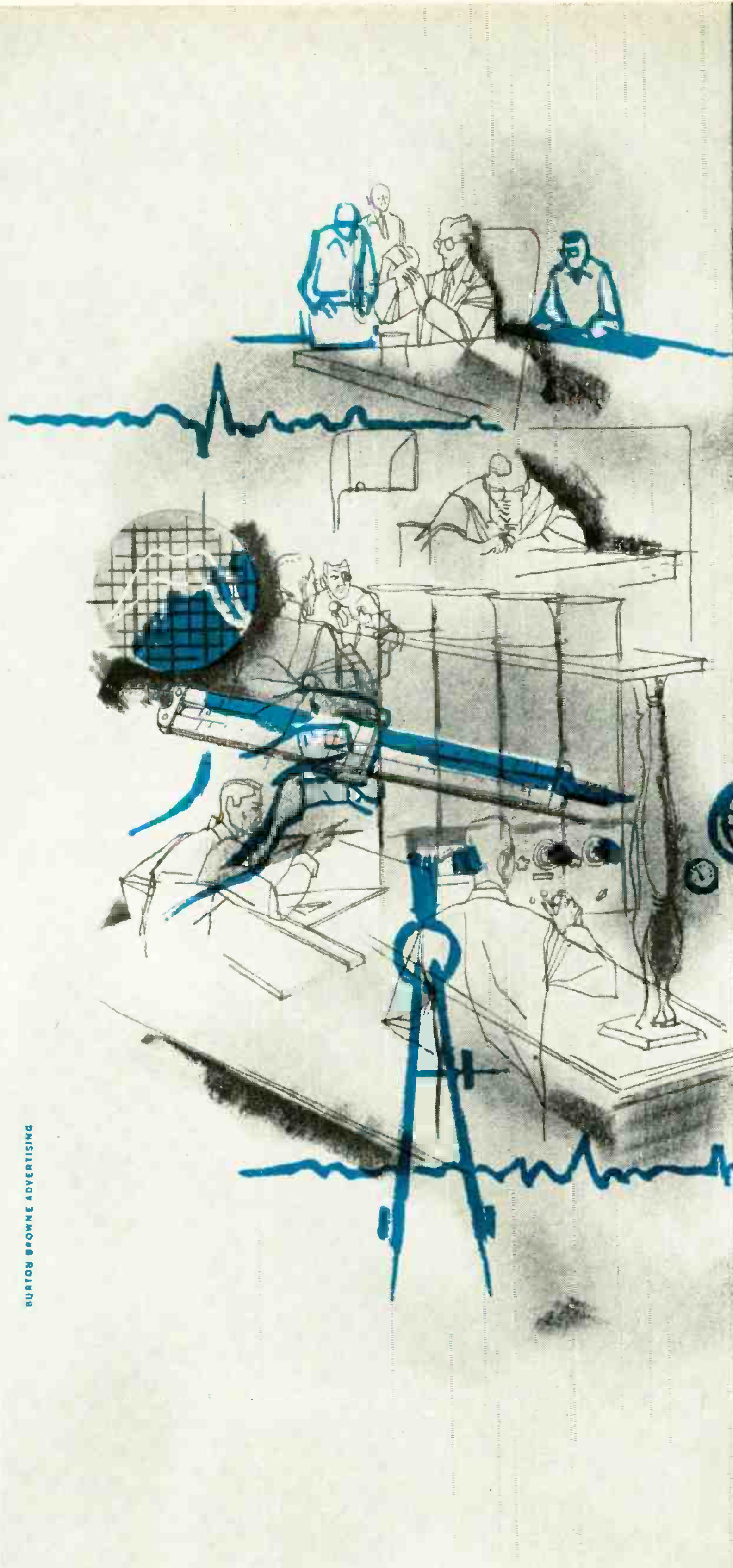
After reading this far, a few questions may have come to mind: For instance, what happens if the control unit switches the fan on when all the windows and doors are closed or a sudden shower at night lowers the outside air temperature and switches the fan on, sucking in all kinds of water?

Parts for control unit

1—100,000 ohms, 1—4.7 megohms, ½-watt resistors; 1—50-ohm wirewound potentiometer; 1—2,000-ohm 10-watt adjustable resistor; 1—0.25 µf (200 volts), 1—0.5 µf (600 volts), 8 µf (450 volts), capacitors; 1—power transformer, secondary 117 volts at 50 ma, 6.3 volts at 2 amps (Merit P-3045 or equivalent); 1—power relay, 115-volt coil, spdt (Potter & Brumfield MR5A, 115 volts, or equivalent); 1—2051 thyratron and socket; 1—65-ma selenium rectifier; 1—4-pole 3-position rotary switch; 2—thermistors, Carboloy type R111 or equivalent; 1—9 x 6 x 5-inch utility cabinet; 2—Cinch-Jones type 6-140 barrier strips; 2—containers for thermistors (see text); 1—knob.

Obviously, even with the control unit added, the ventilating fan is not an air conditioner and its use is confined to those evenings when there is insufficient breeze to cool the house or when the breeze is coming from the wrong direction. Most people like to have the windows and doors open on a warm summer day. I switch the control unit off altogether when I get up in the mornings and thus the chance of the unit switching on with the windows and doors closed is remote.

Now for the rain problem. Since most summer showers are accompanied by a westerly breeze, I use east windows as an air inlet. I have found that very little rain is sucked in by the fan if the open window is on the downwind side of the house. Incidentally, I have never yet failed to waken when it started to rain at night—fan operating or not. I think that if one of the open windows is located in the master bedroom, very little trouble should be encountered with showers. A moisture-actuated switch connected to the control unit and located near the window would remove this problem. END



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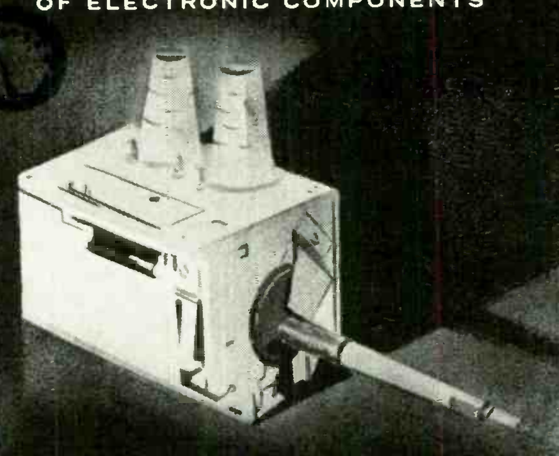

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SERVICING THE WATCHMASTER

By JACK DARR

FOR the benefit of those service technicians who have never run into one, the Watchmaster is an electronic device used for accurately testing and adjusting watches. It enables a watch repairman to listen to amplified sounds of a watch movement and make a permanent record (Fig. 1) of the actual gain or loss of time. With this machine, variations as little as 1 second per day can be detected. The line of dots traveling straight across the paper indicate a watch that is keeping perfect time; the upward-sloping line a watch that gained; the downward-sloping line a watch that lost. Each fine line indicates 1 second, each heavy one 5 seconds.

Driving power for the motor is supplied by a 240-cycle tuning-fork oscillator, a 4-to-1 frequency divider and a power amplifier. (See Fig. 2.) V1 is the amplifier–oscillator. The fork vibrates and induces a voltage in the output coil. This voltage is amplified by V1-a and V1-b. A part of the output of V1-b is fed back to the driving coil of the fork to sustain its vibrations. The output of the amplifier circuit is held constant by the Varistor in the negative feedback loop. The resistance of the Varistor varies inversely as the voltage applied to it. Thus, when the fork's output is low, the feedback voltage reaching V1-a's cathode is low and the stage gain is high. As the fork's vibrations increase in amplitude, the input and output of V1 tends to rise accordingly. However, the Varistor acts as a variable resistor in the feedback path to keep the output of V1 and the fork constant.

The output of V1-b is also fed to V2, a multivibrator that divides by 4 to reduce the signal frequency to 60 cycles. The 60-cycle signal is amplified by V3 and applied to the motor through an output transformer. Motor voltage is around 110 but can drop to 100 without serious loss of speed.

The resistors marked with asterisks are especially selected values that determine the amount of feedback and the multivibrator's frequency. These values vary between individual units.

Beneath the recording drum is an electrically driven stylus coupled to a half-nut drive. This moves the stylus along the drum, taking 30 seconds for the full length. A snap-action switch disconnects the motor at the end of travel. The sound of the watch-ticks is picked up by a small crystal microphone (Fig. 3) mounted in the watch-holder on the right side of the machine (see photo). The output of this pickup is fed to a two-stage amplifier using 6SJ7's. Amplifier gain is controlled by a 50,000-ohm potentiometer connected across the pickup.

The amplifier feeds a 2050 thryratron which drives the coil of the recording stylus. Each impulse causes the stylus to snap upward, making a dot on the chart, through a tape similar to a typewriter ribbon although wider. In the grid circuit of the 2050, a dpdt RECORD–LISTEN switch connects the output of the amplifier either to the grid of the thyratron and the recorder or to a single earphone.

Servicing these machines should not be difficult for any radioman. All tubes used are standard receiving types with the exception of the 2050 and VR150, and these are readily obtainable. Most of the troubles found will be in weak or dead tubes.

The ac type power supply uses a 5U4-G with a simple choke-input pi filter. The first capacitor, an 8-μf, 600-volt unit, is visible immediately behind

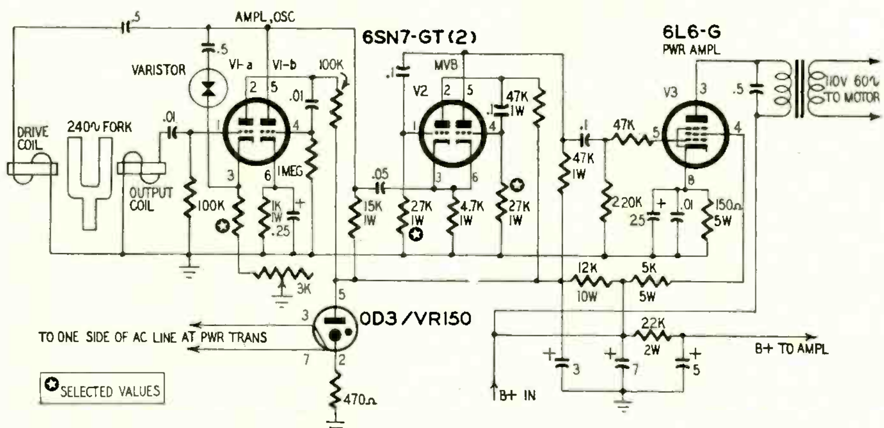


Fig. 2—Schematic shows circuitry of fork, frequency divider and amplifier.

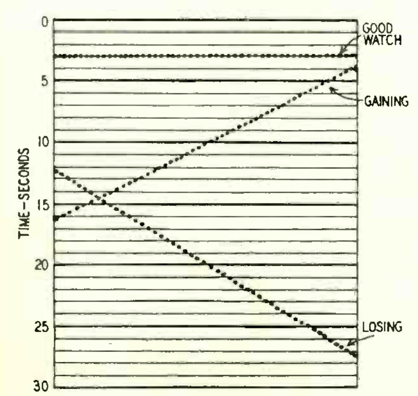


Fig. 1—Diagram shows typical chart made on rotating drum of Watchmaster.

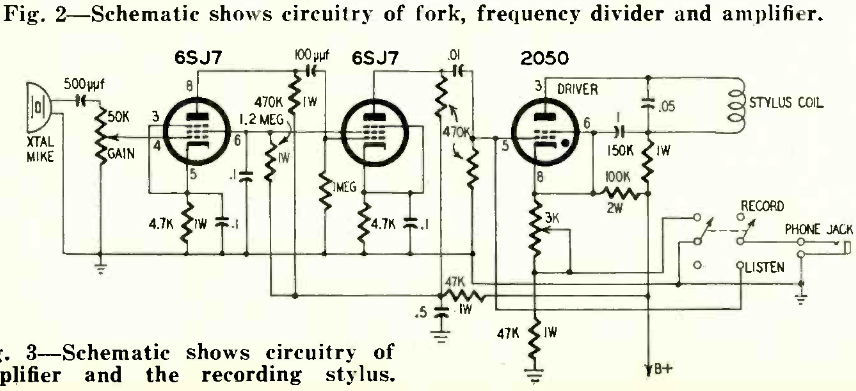
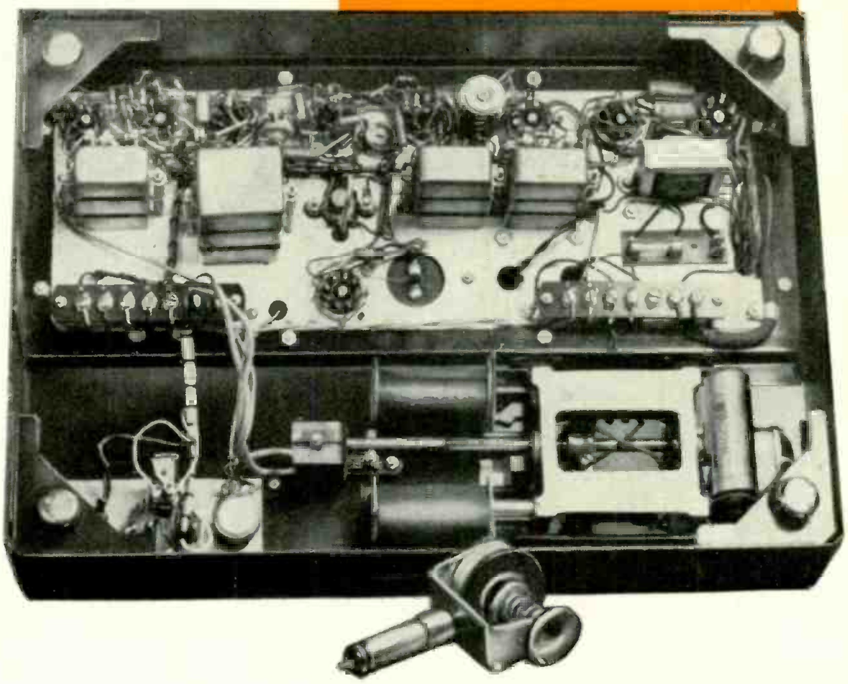


Fig. 3—Schematic shows circuitry of amplifier and the recording stylus.



Underchassis view of the Watchmaster.

the recording drum. The other filters are plug-in types.

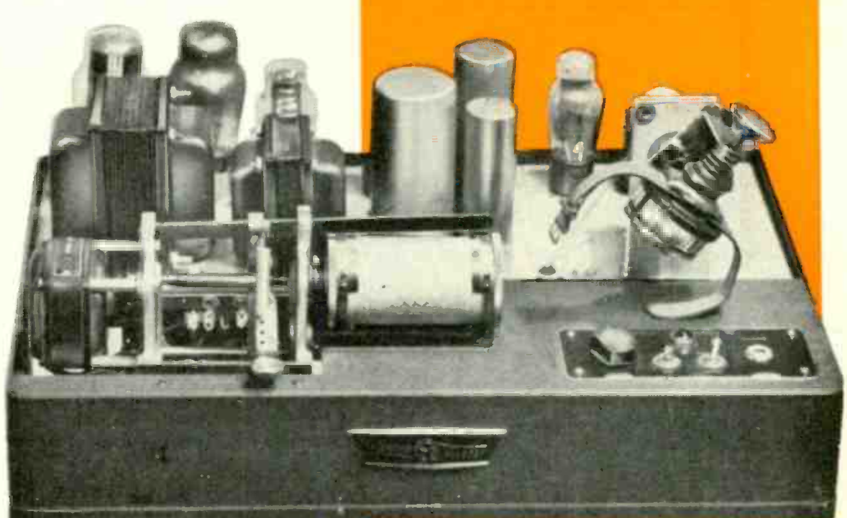
If the motor will not run, check the fuse, rectifier, voltages, the two 6SN7's and the 6L6. If the tuning fork is running, the vibration may be felt on the housing. If it is not running, check the leads at the bottom of the case for breakage. The case is shock-mounted and movement sometimes breaks these wires. The snap-action switch actuating lever sometimes becomes damaged, as does the switch itself.

If the unit runs but does not record, turn the switch to LISTEN and check the amplifier. If the sound is coming through the amplifier, check the stylus coil for continuity. This unit has two long and very flexible leads to enable the stylus to travel; these have been found open.

The RECORD–LISTEN switch is a toggle type and subject to trouble from dirty contacts. It closes the cathode circuit of the 2050 in the record position and may not be making good contact, causing erratic operation of the recorder. It is a good idea to wash this switch with contact cleaner each time the machine is brought in for service.

The gain control is a 50,000-ohm unit and may cause noise or erratic operation if it becomes dirty. Wash with cleaner or replace if too noisy. If this unit opens entirely, it will cause the amplifier to hum and become unstable, making very peculiar recordings. Sometimes the amplifier will sound as if it were motorboating. If bridging filter capacitors does not help, check to see if the driving-current impulses from the fork and oscillator circuits are being picked up by the amplifier. This pickup generally occurs in the first stage and gain-control circuit.

Although all these leads are shielded, check the grounding carefully. Adding an extra ground lug at the gain control usually aids in eliminating this pickup. If some noise remains, try adding an extra 0.1-μf 600-volt bypass capacitor across the input 6SJ7's screen grid. Check the plug and socket of the crystal pickup; a bad ground here will cause noise pickup and hum. Clean with a service cleaner and a very fine polish; do not use sandpaper or any harsh abrasive. Check the hot wire of this device for contact. It is made



Top view of Watchmaster — watch is in holder, recording drum in the center.

ELECTRONICS

through a small spring and can give considerable trouble, if not perfectly clean.

The amplifier is very sensitive and it may be necessary to ground the chassis to prevent pickup of high-level electrical interference. A small line filter may be helpful in eliminating this type of trouble.

The motor and moving parts of this instrument are mounted on rubber to prevent mechanical vibrations from affecting the pickup. If these are defective, extra noises will be fed into the recorder circuit. See that all the mounts are good and the chassis is floating freely.

For a test of machine accuracy it should be possible to use a single earphone and a sensitive shortwave receiver tuned to the loudest WWV frequency. Place the earphone in the pickup and advance the gain until the 1-second ticks are heard. Now make a record and see if the dots are in a straight line. As the drum turns five times per second, they will not be as close as when recording a watch but they will give you an accurate test. (The standard American watch makes 18,000 beats per hour—5 per second. This will produce a dot each drum revolution.)

The Watchmaster can be serviced with ease by any radio or TV shop, using nothing but everyday tools and equipment. There is good money in this work and it can be had for the asking, as the jeweler usually does not know that you can repair this kind of machinery. Let him know that you can repair his pet instrument just as well as, and much quicker than, it can be done by sending it out of town, and you'll have a friend and customer for life! Keep 'em ticking! END

Reference

Henry O. Maxwell, "*Modern Watch Rate Recording*," RADIO-ELECTRONICS; August, 1953, page 26.

CORRECTION

The cuts for Figs. 2-d and 5-b of the article "Time Constants . . . What they do" on page 37 of the March issue are upside down. This causes the capacitor charging rates to increase rather than decrease with the passing of time.

It was also pointed out that the values of the blocking capacitor and the resistor in series with the battery must be carefully selected. If they are not, this network may differentiate the incoming square wave and ruin the experiment. Too, a discussion of time constants is incomplete without mention of the R-L time constant. This acts exactly like the R-C circuit except that it equals L/R in seconds and it affects the current through the inductor instead of the voltage across the capacitor.

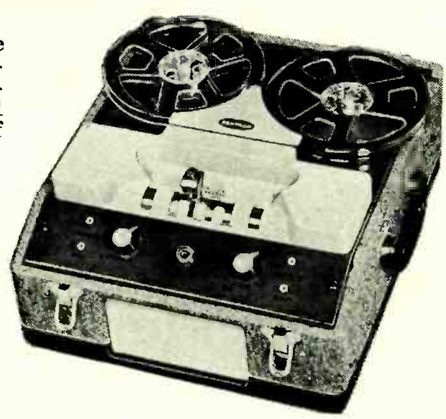
We thank Joseph R. Mensch, of Redwood City, Calif., for these corrections and comments.

SERVICE THE SCHOOLS

Expanding audio-visual programs offer opportunities to the electronic technician

By YVON O. JOHNSON*

Author makes backstage check of Stromberg-Carlson public address system.



Tape recorders are becoming increasingly popular in education. Pentron CT-1 right is typical of units in use.

Record players used in schools must be rugged. Usually, the top of case becomes detachable speaker which can be located for better coverage than built-in unit.

HOW would you like to find customers more interested in quality work than cheap prices and not likely to try to escape paying their bills? Certainly you would!

I am one of those customers. We are located in every part of this country. Some of my fellow customers are having just as much trouble finding a competent repair service as you are having in finding the perfect customer.

These prospects are the schools, colleges and universities in your area. If you were to visit me in my school, you would be pleased at the quantity of electronic equipment in use; most of it in our audio-visual program. At James Lick Junior High School, San Francisco, Calif., we use the following electronic items for approximately 1,000 pupils:

3 16-mm sound motion picture projectors
3 record players with amplifiers
1 public address system
3 radio receivers
1 tape recorder

I've listed only equipment using electronic tubes and have not included purely optical items. This equipment that I look after and send out for repairs has about 75 tubes—plus microphones, connectors, cables and plugs. Our school is not heavy with electronic equipment either. Some schools and colleges have TV sets, elaborate paging and intercom systems, disc recorders, multiple earphone systems for use with disc or tape players, and sound-filmstrip projectors.

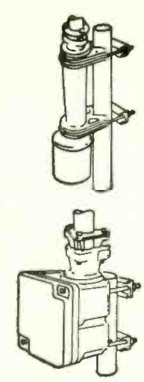
Let's see what advantages there are to you, the technician, in addition to just "more business." This type of business is equally good for you whether you have a large or small shop; shop size is important only to the extent that you can handle the work within a reasonable time limit. I want my school's equipment serviced as soon as possible, but I hope I'm not as demanding as the customer who fears missing his favorite comedian.

School systems and colleges are usually good pay. You may have to wait a little while for your payment while the paperwork goes through channels, but you don't have the problem of the customer moving away. And you'll find that I and other audio-visual men will not be looking as much for bargains as

*Audio-visual building coordinator, James Lick Junior High School, San Francisco, Calif.

Thompson Products

Automatic ELECTRONIC **Superotor**



For accuracy, dependability, and ease of control, the new Electronic *Automatic* Superotor is years ahead of any other antenna rotator on the market. Electronic VP* Tuning, completely silent operation, and smooth, even rotation combine to bring you instantly, automatically, the finest TV picture you've ever enjoyed.

* *Vernier Precision*

INTERCHANGEABLE ROTATORS

Famous Superotor models "100" and "500" have both been designed for automatic operation.

OTHER THOMPSON PRODUCTS ELECTRONIC AFFILIATES

• Bell Sound Systems • Dage Television • Ramo-Wooldridge Corp. • Pacific Semi-Conductors, Inc.

ELECTRONICS DIVISION

Thompson Products, Inc.

2196 CLARKWOOD ROAD • CLEVELAND 3, OHIO

Available in Canada thru Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto do so many home service customers.

An advantage to you in the long run is the indirect advertising you receive when servicing schools. School personnel cannot help noticing and remembering that you are maintaining the school's equipment. They may then think of you when their own and friends' radio and TV sets need repairs.

Don't overlook the prestige value you receive. Should a new customer come into your shop to inquire if you know how to service tape recorders, think of the effect of your being able to mention casually, "Oh, yes. We take care of all tape recorders belonging to the school district."

How this business differs

From my professional experience I can give you some pointers about the differences in this type of work as compared to TV servicing in the home.

Be thorough. You have probably found that most TV servicing customers are willing to have just the tube that is causing the immediate trouble replaced if additional repairs for less bothersome faults will cost them more money. They rightly feel that they can call you back whenever the trouble becomes worse or when they can afford the extra service work.

Not so with audio-visual equipment! Inspect it to locate other defects than the main trouble and, if necessary, obtain authorization to repair all the defects. Preventive maintenance is the thought to keep in mind; you will certainly please the school if you do. Put yourself in my place in the following cases to see which one would leave you more favorably disposed to the service shop.

Case A: I had sent in a 16-mm sound motion picture projector to have a belt replaced. Not listed for repair, but just as obvious as "no picture" in a TV set, was a broken clamp on the cable running from the photoelectric cell to the audio amplifier. The belt was replaced but the cable clamp wasn't. A few days later, the same projector had to be sent back for repair of broken connections at the end of that cable. That time, the clamp was replaced.

Sure, I had forgotten to list the broken clamp the first time, but don't you agree that the service shop should have replaced it (and charged for it) rather than take the chance that resulted in customer displeasure?

Case B: I had sent in another 16-mm sound projector for belt replacement. It came back with the belt replaced and with missing rubber feet on the case put back on. Minor? Yes, but wouldn't it show you, as an audio-visual coordinator, that the service technician had you in mind?

Your thoroughness is extremely important to the school because each repair job means that the school will be losing the use of that equipment for several days while the equipment is being transported to the audio-visual center, to the service shop, repaired, back to the center and finally to the school.

Also, as an audio-visual building coordinator, I have to produce results in the form of equipment ready for use, not excuses that the equipment has been sent back to the service shop again!

Learn the paperwork. You will probably find it necessary to have written requisitions authorizing the repair work; oral requests to have work performed are usually backed up by a confirming requisition. You may have to submit several copies of your bill to the school system or college. Once you find out how to do these things, you should not have any particular problem if you observe the rules faithfully. In dealing with any large organization — business, governmental or school — you lose the personal relationship that exists in dealing with an individual. The clerks, accountants and auditors involved in the transaction do not know you. Their only contacts with you are through the many pieces of paper they see. Their concern cannot be with the actual equipment, but only that the paperwork has been done according to their procedures. However, the director of the audio-visual department for the school system will be alert to the quality of your servicing.

Watch for mechanical troubles. In servicing for schools you will find a higher ratio of mechanical to electrical troubles than in home servicing, because the school equipment receives more handling than similar things would in the home. A record player in the average home is moved little and is used by the same few people. In schools, a record player might be moved among several rooms in one day and be used by many people. This transportation exposes the equipment to mechanical damage. If someone doesn't fasten the record player's arm each time it is transported, you will have a service job.

Although I spend a good part of my time training teachers and students, many of them are not as familiar with the equipment as they should be. I have had cones pushed out of speakers, plugs and sockets broken, wires ripped out, arms broken off projectors and other damage inflicted by intellectual, well-intentioned people.

If you mentally picture two elephants trying to pull a microphone connector apart, you'll have a good idea of the handling it will get!

More audio equipment. In general, you'll find relatively more audio than radio equipment in school servicing as compared to home servicing—public address systems, record players, tape recorders and motion picture projectors with optical and magnetic sound.

Most of the troubles in the audio amplifier section of 16-mm motion picture projectors and many obvious mechanical breakdowns can be handled

Superior's New Model TC-55

TUBE TESTER

FOR
The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap".

Checks for shorts and leakages between all elements
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

Superior's new Model TV-11

TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

ALSO TESTS TRANSISTORS!

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

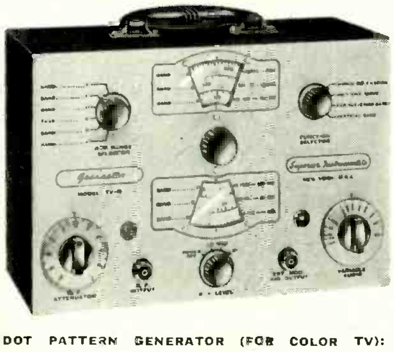
TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50 NET



Superior's New Model TV-50

GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio • F. M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV 50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only ....

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

easily by a competent radio–TV technician. But the optical section, along with the optical parts and adjustments associated with the sound section, had better be left until you are experienced in that type of work. However, there is nothing so mysterious about it that a good service technician could not master with proper study of the optics and mechanics involved.

Do only safe work. I am responsible for the safety of my students so I make certain that the equipment in my care cannot injure a person through electrical or mechanical hazards. I expect any service technician working on this equipment to be positive that the ac line is not shorting or leaking to a metal case, exposed metal parts, the microphone or a speaker.

Think ahead. A Bakelite ac plug may be satisfactory in the home but it would be hazardous in the school where a pupil could step on it, break it and then try to insert it in the wall outlet. (Don't think they haven't tried it!) You have to anticipate unintelligent action on the part of the user to protect him from himself.

How to get business

If you are interested in this type of servicing, let's take a look at some steps Steve Jones, an imaginary service technician, took to get this work for his shop. Maybe his method can help you.

He contacted his local school's principal. Steve found out from the principal how the school was supplied with audio-visual equipment and how the principal went about getting it repaired. Steve was told that there was a district audio-visual department to which he sent defective equipment and was given the name of the audio-visual director in charge of that central agency.

He contacted the director. It surprised Steve when he found that even large school systems often do not do their own repair work. They may, perhaps, employ a man to perform minor repairs only. The audio-visual director (coordinator, supervisor or whatever he may be called) told Steve the policy that was followed. Steve stated his qualifications and offered the services of his shop. He also invited the director to visit his shop to see the test equipment and facilities. Steve and the director were soon discussing recent developments in high fidelity, tape recording and film projection. The director enjoyed finding someone who talked his language!

Steve was not able to get the business of repairing 16-mm sound motion picture projectors that were under guarantee—the director preferred having a factory-authorized service station perform that work rather than possibly voiding the guarantee. Steve is now checking with the manufacturers to see if he can qualify and have his shop become an authorized service station. END

UNUSUAL SERVICING EXPERIENCE

ONE afternoon, a pleasant-appearing man brought in an expensive Philco 116X chassis and speaker. As I was quite busy at the time, I jotted down the usual complaint, serial and model number information on a repair tag and gave him his half of it as a receipt.

The second section of the repair tag was the itemized bill that he would receive when the work was finished. It indicated the parts used, the tubes supplied, the labor charges and the serial number of the radio.

A third section was for my record file and showed exactly what I had done to the radio in question and the serial number of the radio.

The radio in question had two low-reading tubes, a shorted screen-bypass capacitor and the usual burned voltage-dropping resistor.

I replaced these parts, put in two new tubes, checked the alignment of the radio and was finished with it. Several days later, the customer called for the radio, paid and left pleased.

About three weeks later, he returned, the chassis and speaker in his arms. He put it on the counter, grinned and remarked, "Well, here it is again. I hope that that guarantee of yours means what you said."

Tests quickly indicated that the output transformer was open and further testing showed me that the mid-tap had opened. As this left no voltage on the output tube plates, this meant a completely inoperative radio.

As this was a fairly common fault in those days, I had a new universal type on hand, and it did not take too long to install. I then checked for the possible cause. The coupling capacitors were OK and grid bias was normal, so I supposed that the transformer had opened. It was.

All this time, something seemed to be telling me that things were not according to Hoyle. Just before I put the set on the counter for the customer, I went to my record file and took out the card that I had filled out on the previous repair. I noted the serial number on both the second section of the tag and the record card. They matched on the cards, but they did *not* match the serial number of the radio!

I slowly counted 10 to keep my temper and then said softly, "My friend, something is wrong here. This is not the radio that I fixed for you 3 weeks ago."

He colored and then blustered, "Sure it is! What are you trying to do? Welsh on your guarantee?"

I laughed grimly and replied, "Not a bit. However, I guarantee only what I do. This set does not have the serial number of the one I repaired. You can look yourself . . ."

Seeing I was wise, he then replied weakly, "Well, you can't blame a guy for trying . . ."—*W. H. Raring*

For Your Protection

RADIO-ELECTRONICS is continually alert to maintain a high level of integrity in our advertising columns. In the case of tube advertising—which has suffered special abuses—we insist that all advertisers must warrant that their tubes are:

New and unused
Not mechanical or electrical rejects
Not washed or rebranded
(See page 57 of the January, 1956, issue)

We investigate carefully when we have grounds to suspect that any advertiser is not living strictly up to these rules.

new Records MONITOR

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

High-Fidelity Test Record
Written commentary by John M. Conly
Westminister TRC

Because high fidelity is so subjective an art it is not likely that anyone will ever issue a test record that will test everything in a way to suit everybody. But this Westminister contribution comes closer than any preceding disc I can recall and will do a better job in the hands of most audiophiles, particularly the less experienced ones dependent entirely on listening tests, than any other single recording I could recommend.

John Conly, in the accompanying brochure, does an exceptionally good job of explaining what qualities need testing and why. From the extensive Westminister library the editors have chosen well and with discrimination brief selections which provide clear demonstrations or tests of these qualities. Conly's band-by-band commentary explains succinctly what to listen for and there is very little reason for any confusion on the part of any listener.

The disc starts with a 440-cycle tone for checking turntable speed and wow. This is followed by a frequency sweep from 15,000 to 30 cycles in discreet frequencies and then a continuous sweep over the same range. The test tones are very clean and free of distortion, particularly the very low bass. Finally, there is a 1,000-cycle tone in five amplitudes from 0 to —40 db.

The musical selections demonstrate dynamic range, frequency range, transient response, definition and 10 varieties of tonal and acoustic balance. The opening of Dvorak's *Symphony No. 5* is said to demonstrate a range of 60 db from softest to loudest passage. The peak is very clean and most spectacular played back at concert-hall level. There are several passages with a good 36-cycle bass to shake out rattles. The drums from *Peter and the Wolf* are most awesome, though I don't consider them as good a test of transient response, stability and hangover as those in Westminister's old *Scheherezade*. Still they are a very stringent test, being very fortissimo as well as staccato and are not as likely to produce locked grooves. To cap a very good job, the music is very interesting and well assorted so that there is little likelihood of boring anybody. All the selections—about half come from the Lals series—are clean, well defined and well recorded.

GOULD: *Fall River Legend*
BERNSTEIN: *Facsimile*
Ballet Theatre orchestra conducted by Joseph Levine
Capitol P-8320

Two of our brightest contemporary American composers get here a very fine recording of recent ballets. *Fall River Legend* is based on the Lizzie Borden ax-murder case and the music is properly frightening in spots. There are some very sharp attacks and several big peaks excellently recorded. The drum on both sides is very fine. Only a moderate degree of triangles and tinklers but plenty of sharp brasses. *Facsimile*, a more subtle and quiet work, is a sort of psychological study of frustration. There are some fine examples of instrumental leads and solos, a pretty big string bass in spots, nice highs but not many high highs of any kind. The tonal balance of both sides sounded very good to me, the liveness is moderate. Those who can take modern ballet music should find this good listening on a fine hi-fi.

NEW RECORDS (Continued)

Guitar Music of Latin America
Laurindo Almeida, solo guitar
Capitol P-8321

You may recall that I liked the previous Almeida recording very much as a demonstration and test record. This disc, more sophisticated and serious, includes *Etudes* and *Preludes* by Villa-Lobos. two dance-inspired studies by Barroso, a prelude and *Choro* by Barrias, a waltz by Ponce and three short pieces by Almeida himself. This does not require the virtuosity demanded by the classic Spanish guitar music. Nevertheless, if you like guitar music at all you'll like this. The middle bass is very fine indeed. The presence is superb. And there are traces of the finger squeaks and fingering and plucking transients. etc., which make such good test material.

Italy After Dark
Cyril Stapleton orchestra
MGM E-3302

Add this to the small library of popular or semipop music suitable for demonstration. Exceptionally clean for a pop, it has sharp and clean brushed drum high highs and a good assortment of other percussion instruments. There are good pizzicato strings, a mandolin with nice transients. an accordion playing with a variety of stops. The bass is only fair but the liveness and presence are excellent.

RIMSKY-KORSAKOV: *Scheherazade*
Steinberg conducting Pittsburgh Symphony
Capitol P-8305

Scheherazade is one of the best of all hi-fi show horses and popular with most people as music. As demonstration material this version is by no means up to Westminister's WL-5234. From a strictly musical point of view I imagine it is acceptable. But possibly because of the excessive liveness of the Mosque in which it was played the definition is inferior. Also, neither the drums nor the percussion "cutlery" are prominent. The drums in the final movement, which in the Westminister are like Death knocking at the door, are here just barely audible. The contrast, however, provides a special demonstration and test value and I for one am happy to have both versions. The Capitol version reproduced exactly as recorded sounds the way the Westminster would sound on a poor system. So, if both versions sound rather similar, there is something seriously wrong with the system. However, the two can be used together to demonstrate the difference between a really fine hi-fi system and a poor one — a thing which is sometimes hard to do if one doesn't have a poor system on hand.

In His Shadow
Fisk Choir, Dinah Shore, Snooky Lanson, Sylvia Stahlman, James Melton, Joseph MacPherson and others.
Dot Records No. 227

This recording is a memorial dedicated to preserve the architecturally strange and historic Downtown Church of Nashville. It presents the entire gamut of religious songs from country hymns sung in the *Grand Ole Opry Style*, through spirituals (and a satire of one by Phil Harris), Protestant and Catholic hymns sung by popular singers like Dinah Shore and Snooky Lanson up to *Alleluja* in the grand opera manner. It all sounds excellent. The acoustics of the old church are interesting; the voices are fine, especially Dinah Shore, Lanson and Morgan. The organ bass is especially good behind Dinah Shore. The recording technique falls down in a spot or two, but the overall quality is good. Those who like religious music, or would like to have something in their collection to satisfy listeners who do, should like this.

Proceeds from sales will go to the church. Records are available from Vance Memorial Music, 154 Fifth Ave., No. Nashville, Tenn., for $5.

DVORAK: *String Quartet in G Major*
Barchet Quartet **Vox PL-9250**

One way to enhance the presence of a recording is to bring into the playback room the resonances and acoustical character of the room in which the music was played originally. The playback room should be "neutral" or dead for its own resonances would confound and obscure the recorded ones. Here is a rather unique record for testing the acoustics of a playback room. It is recorded in a "live" studio whose reverberation period can actually be measured by the decaying echo, especially at the end of the first movement. The playback room should make it possible to hear the difference between this and other recordings very plainly and, indeed, to measure the echo. Aside from this special test value, this is capable of producing a high degree of pseudo-stereophonic presence which is very impressive and "real." The definition of the individual instruments is always good.

GLUCK: ***Flute Concerto in G Major***
BOCHERINI: ***Flute Concerto in D Major***
PERGOLESI: ***Flute Concerto in G Major***
Camillo Wanausek, Flute
Pro Musica Orchestra of Vienna
Vox PL-9440

Another lovely peace offering for the family suffering from too much loud demonstration. The music is most pleasant, the flute beautifully clean and naturally "windy" although rather out of scale because so closely miked. No instrument makes a lovelier sound on a really fine hi-fi system than the flute.

SCHUBERT: ***Symphony No. 4 (Tragic), Symphony No. 8 (Unfinished)***
Bamberg Symphony conducted by Hollreiser **Vox PL-9370**
DVORAK: ***New World Symphony***
New Symphony of London conducted by Rudolph Schwarz
Capitol P-8308

Two of the most popular of all symphonies are played with what seems to me adequate competence to produce a stunning sound. The Dvorak has fine kettledrums and beautiful sharp clean strings. The definition is excellent and the solo instruments outstanding. Soft passages require a low noise and rumble level. The two Schubert symphonies have the outstanding Vox bass, the *Unfinished* especially should be most prepossessing with good speaker systems.

DE FALLA: ***Concerto for Harpsichord and Chamber Orchestra***
RIETI: ***Partita for Harpsichord, Oboe, Flute and String Quartet***
SURINACH: ***Tientos***
Sylvia Marlowe, Harpsichord and Concert Arts Players
Capitol P-8309

A real tidbit for lovers of chamber music. All modern music but with a greater variety of melody than usual. All are beautifully recorded with an awe-inspiring presence. The harpsichord receives, for my money, its most accurate and felicitous recording. The definition throughout is exceedingly good—you can hear the faintest harpsichord tinkle even in crescendos and over the drums. Not recommended to those who haven't learned the special charm of modern chamber music, but I'm sure that those who have acquired the taste will enjoy it.

TCHAIKOVSKY: ***Piano Concerto No. 2***
SCRIABIN: ***Piano Concerto in F Sharp Minor***
Friedrich Wuehrer and Pro Musica Orchestra of Vienna **Vox PL-9200**
SCHUBERT: ***Impromptus Op. 90 and 142***
Ingrid Haebler, pianist **Vox PL-8940**
MOZART: ***Piano Concerto No. 6, Piano Concerto No. 8***
Ingrid Haebler and Pro Musica Orchestra of Vienna **Vox PL-9290**
Favorite Piano Classics
Leonard Pennario, Pianist
Capitol P-8312
Echoes of Budapest
George Feyer, Piano and Rhythm
Vox VX-850 (10-inch LP)

Four pianists, four (or possibly five) pianos, four styles—high fidelity makes their differences obvious to the most unskilled ear. Pennario's piano has a strident, almost barrel-house, treble; Haebler's is sweet and mellow, Feyer's sharp and round and Wuehrer's very resonant. The Vox bass is fuller and more resonant than Capitol's but any of these will serve as a good example of how well today's high fidelity does by the piano.

Many will prefer the standard repertoire (*Second Hungarian Rhapsody, Prelude in C Sharp Major, Clair de Lune, Polonaise in A Flat,* etc.) on the Pennario record although I found his playing very dispirited as if (and I don't blame him too much) he were more than a little weary of the old warhorses. Wuehrer delivers a really old-fashioned bravura, no-muscle-spared performance which I imagine suits the Tchaikovsky and Scriabin works nicely. Personally I liked Haebler's restraint and delicacy best and I thought her piano sounded best. However, I believe most people will find Feyer's clever improvisations on various Hungarian themes most interesting though, like most pop recordings, the bass is a little too heavy and the treble by no means as clean as it should be. But the piano is good and the music is fun.

SCHUMANN: *Quintet in E flat*
HUMMEL: *Quartet in G*
Victor Aller, piano and Hollywood String Quartet
Capitol P-8316

Charming chamber music in an excellent performance and recording; a fine piano, sharp but not strident strings. The presence is excellent and with just about the right liveness for maximum realism in a moderately dead living room. Just a touch of overcut distortion in the finale. The Schumann quintet was the first coupling of the piano with string quartet and is still one of the finest; the second movement is one of the most moving funeral marches. The Hummel quartet is also musically engaging and its Mozartian counterpart provides an excellent demonstration of definition and the differing qualities of the four strings. One of the best chamber demonstration records.

BLOCK, Ernest: *Quintet for Piano and Strings*
Johana Harris, piano, and Walden String Quartet
MGM E-3239

This is a quintet of another color entirely. Both the piano and the strings get a more thorough workout in music in which form and rhythm are more important than melody. The cello is asked to get down in double-bass range and sometimes to pretend it is a pair of tympani; the pianist must find portions of this sweat-producing work. And while the music is definitely for those capable of the "domestic but good" type of judgment about music, the sound is very impressive on a good system and provides good measures of definition, IM distortion, and even dynamic range. The low range of the cello is outstanding for its genuine stringy tone, indeed one of the best on records. Excellent for advanced chamber-music hi-fi fans.

HARRIS, Roy: *Fantasy for Piano and Orchestra*
MGM Symphony Orchestra conducted by Izler Solomon

Abraham Lincoln Walks at Midnight
Nell Tengeman, soprano, plus piano, violin and cello
MGM E-3210

Two of Roy Harris' latest works (first played in 1954) given a pretty brilliant recording under the supervision of the composer and presumably authentically expressing his ideas. The music is strictly for the congoscenti of modern America although the *Fantasy* is thoroughly listenable and indeed pleasant, being based on obscure American folk motifs. Not hard to take by anyone who has the patience to listen to it a few times. I found little interest in the cantata *Abraham Lincoln Walks at Midnight* either as music or demonstration material.

END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14th St., New York 11, N. Y.*

Technicians' News

SELF-LICENSING PLANNED

The Associated Radio–Television Servicemen of New York City and the Long Island Radio Guild have added themselves to the number of organizations who plan to do their own licensing. The New York City plan proposes giving examinations to applicants and licensing them as technicians or apprentices. Permits will also be issued to shops who employ ARTSNY-licensed technicians and who abide by the association's Code of Ethics. The association will guarantee all work done by licensed technicians. If a customer does not receive satisfactory service, the association will have the work done by another member and reimburse the member. Then a decision will be made as to whether action should be taken against the first technician.

The Long Island Guild plan is to license shops. Nine requirements must be met. These include adherence to the Guild Code of Ethics, possession of adequate test equipment, and employment of recognized technicians.

(Qualifications of techincians are to be decided by guild license examiners.) The shop must be located in a business zone, be open during hours specified on the application, have a registered business name and carry adequate liability insurance for its customers' and its own protection. A 90-day guarantee must be issued on all parts installed and service done. The license is to be displayed prominently in the place of business.

A tentative license fee of $15 per shop plus $5 per employe is suggested.

KING COUNTY ELECTS

At the March meeting of the King County Television Service Association, Seattle, Wash., officers elected for the coming year were: Bob Kelly, president; Harold Hart, vice president; Clayton Faller, secretary-treasurer.

PROTEST NEDA STATEMENT

Both Forest Baker, of the new Electronic Service Council, and Frank Moch, president of NATESA, found themselves fully in accord with each other in condemning and criticizing an editorial in the January *NEDA Journal.* The feature most vigorously attacked by both was the statement that licensing was usually advocated by a handful of service technicians whose local reputation was poor. "If this article reflects the opinion of the members of the National Electronic Distributors Association," stated Baker, "it is extremely unfortunate that electronics parts distributors are so poorly informed about the current situation in the TV service industry." He went on to point out that the TV service industry is in a critical state, and that further difficulties might lead to the dominance of manufacturer-controlled service, a development which would most hurt the independent parts distributor.

Moch did not confine himself to this point but made it the last of four numbered paragraphs, each of which refuted a statement made in the editorial. He objected in turn to the inference that there was no record of legitimate complaints on the TV user level, that elected officials or civic leaders were uninterested in licensing and that TV service technicians in general were not interested in a licensing law nor fully able to realize "its harmful consequences."

SERVICE GROUPS CONTACTED

More than 300 letters have been sent to radio-TV service associations asking their opinions in regard to unity of the service industry, according to Forest Baker, chairman of the Electronics Service Council. This action was taken in accordance with decisions made at the council's Chicago meeting January 15 (RADIO-ELECTRONICS, March 1956, page 124). The next meeting is planned for Kansas City, possibly for May 18–20, Mr. Baker stated.

DOLLAR CONVERSIONS?

Speaking before a Senate commission, Robert Lee of the Federal Communications Commission suggested that some of TV's allocation problems could possibly be solved if it were possible to add to the present vhf spectrum some channels now controlled by the military. "The conversion problem," said Mr. Lee, "would not be as difficult as the uhf problem." He went on to say that the tuners might be adjusted by the individual set owner for "maybe a dollar plus a service call." (The optimistic estimate was apparently based on strip type tuners.)

Mr. Lee made it quite clear that there was no immediate probability that new vhf channels would be opened to commercial TV and pointed out that an act of Congress would be required to allot to the broadcaster frequencies now held by the defense forces.

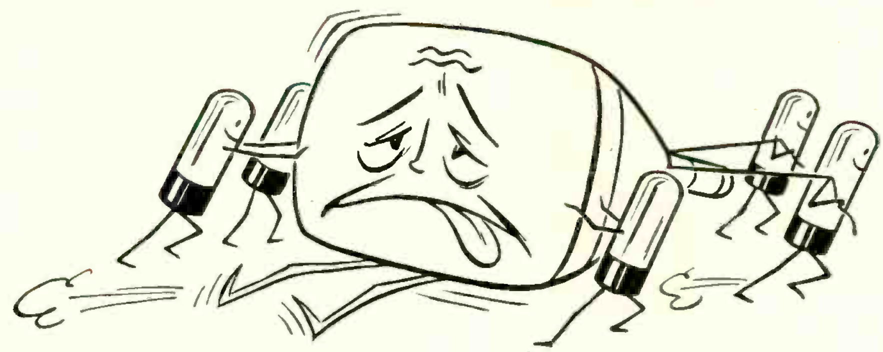
NEW COLOR SCHOOL IDEA

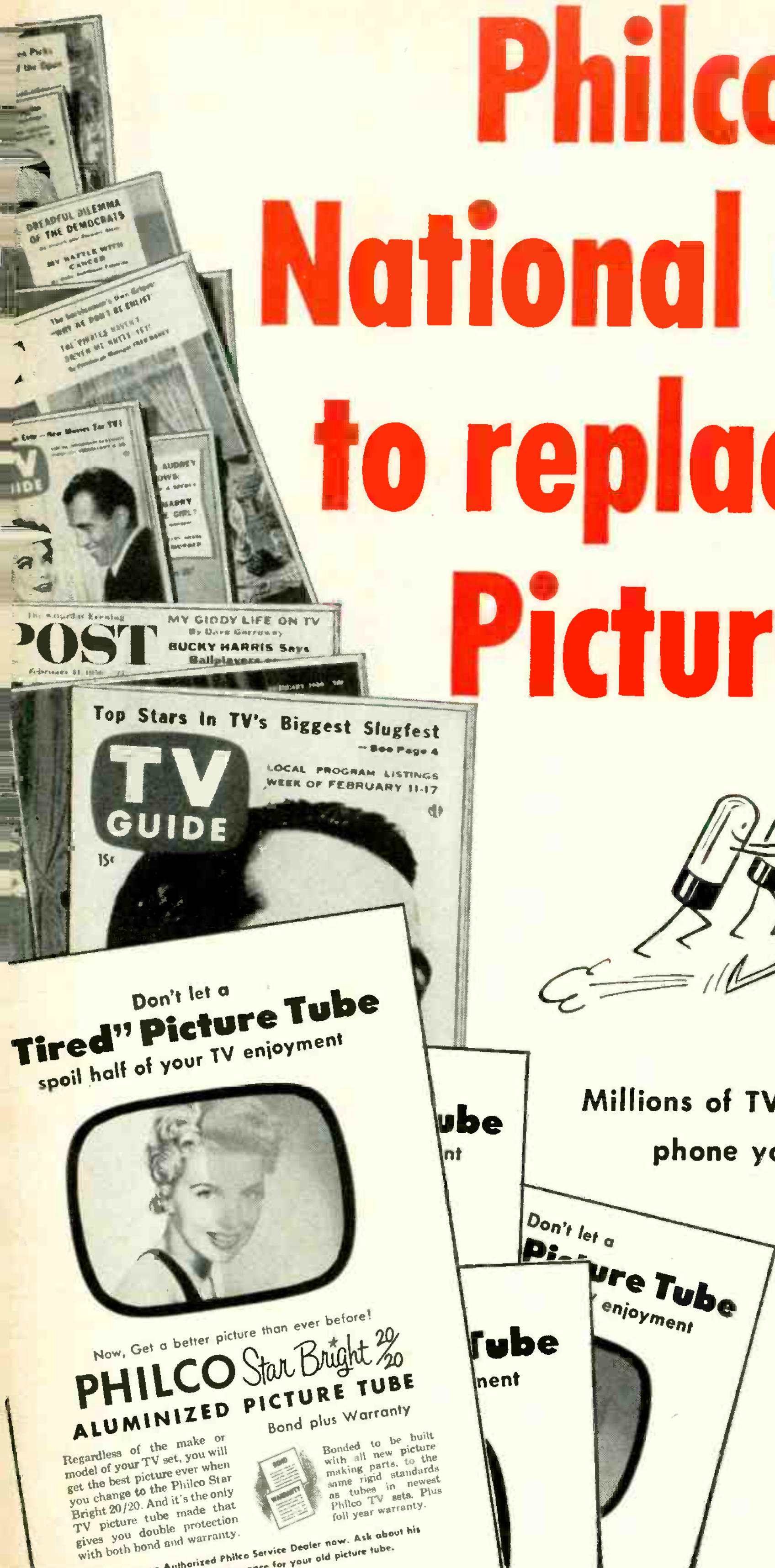
More than 175 service technicians out of 200 invited came to Dallas to hear a plan for a new type of color TV course outlined by E. P. Miles of Adleta Co., electronic distributors of Dallas.

The new plan consists of combining a correspondence course—in this case the nine-lesson course offered by RCA Institutes—with in-person review periods at the end of each three lessons. At least 50% of the review periods were to be devoted to shop techniques—at which time the technicians would have access to color TV sets to work on.

(*Continued on page* 110)

Philco breaks National Campaign to replace "Tired" Picture Tubes





Millions of TV Set owners get the call to action—to phone you immediately for a new picture tube

TV Guide, Saturday Evening Post, newspapers and TV commercials are ready to break the big replacement story and sell the Philco Star Bright 20/20 Aluminized Picture Tube for you. Be sure to have stock on hand when your phone starts ringing. Then you'll be ready to move into the homes of television owners and cash in on the greatest campaign of its kind ever to hit the public.

Invest in your future in Color TV Service and equip your shop FREE during the fabulous

PHILCO SHARE AND PROFIT

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That's right, you can earn FREE color and B/W Test Equipment and Parts and Accessories by concentrating your radio and TV parts on Philco. With each purchase you get SHARE and PROFIT stamps, redeemable for the dividends of your choice at your Philco Distributor. They build EXTRA 100% PROFITS because they cost you nothing. See your Philco Distributor now for full details.

Now, an Exclusive Double Edged Selling Tool . . .

Bond plus Warranty

ON EVERY

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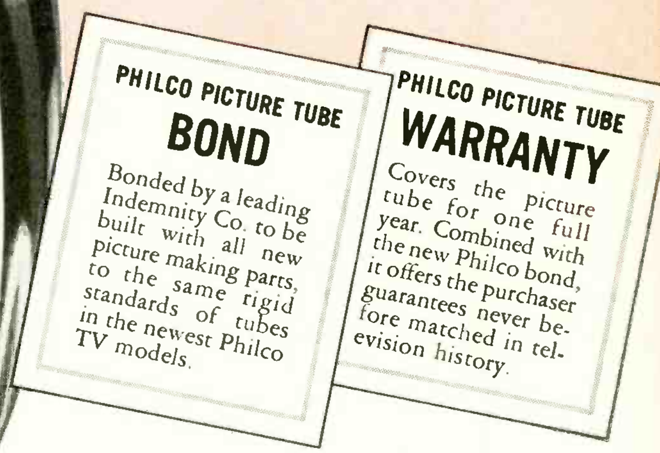
Star Bright 20/20

Sharon Kay Ritchie
Miss America 1956



SUPER ALUMINIZED! CLEAREST, MOST LIFELIKE PICTURE POSSIBLE

Regardless of the make or model of a TV set, a Philco Star Bright 20/20 Aluminized Picture Tube gives your customers a clearer, brighter, more lifelike picture than ever before . . . and builds confidence in you.

Yes, Philco gives you a double-edged selling exclusive to boost your replacement tube business. In addition to the one year warranty, the Philco Star Bright 20/20 Aluminized Picture Tube is BONDED to have all new picture making components. This bond protects your customers against counterfeit tubes and assures a picture tube that's built to the same rigid standards as those in original TV receiving equipment. The Philco Star Bright 20/20 is the only picture tube made that is backed by such a bond.

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Model 7100

Philco puts you in the color service business with this one compact instrument

PHILCO Universal COLOR BAR and DOT BAR Generator

It's new . . . highly efficient . . . designed to provide the widest possible variety of functions in the minimum amount of space. PHILCO MODEL 7100 is used to completely trouble-shoot circuits associated with color reproduction and make accurate convergence adjustments in any color television receiver on the market, The course is open to all qualifying technicians, whether affiliated with Adleta or not. Approximately 95% of those attending the meeting passed the qualifying test. In addition to the lessons, technicians taking the course were offered a color TV set at considerably less than key dealer price—the only condition being that the technician must agree to retain the set for the whole term of the course.

NATESA CONVENTION

The National Alliance of Television & Electronic Service Associations announces that the date of the 1956 annual convention is finalized at Sept. 14–16. The convention will be held in Chicago. A special enlarged edition of the association's paper, the *NATESA Scope,* will be published concurrently with the convention. The exhibition which formed a part of previous conventions will be omitted to give the delegates and visitors more opportunity to concentrate on the business meetings and technical sessions.

DEATH THREAT

Efforts of the Radio and Television Association of Santa Clara Valley, Calif., to clean up the service industry have resulted in what was described as a "death threat" over the phone. President Larry Schmitt told members at a recent meeting that he received a phone call from a husky-voiced man who said, "You're looking for a hole in the head if you don't keep your nose out of other people's television business."

Schmitt believed that the threat may have come from a crackpot—"probably someone whose toes were stepped on in association cleanup work."

In view of the fact that another service company was threatened, the RTA magazine urged all members who receive such calls to call the police, crackpot or no crackpot.

ARTSD LISTS GRIPERS

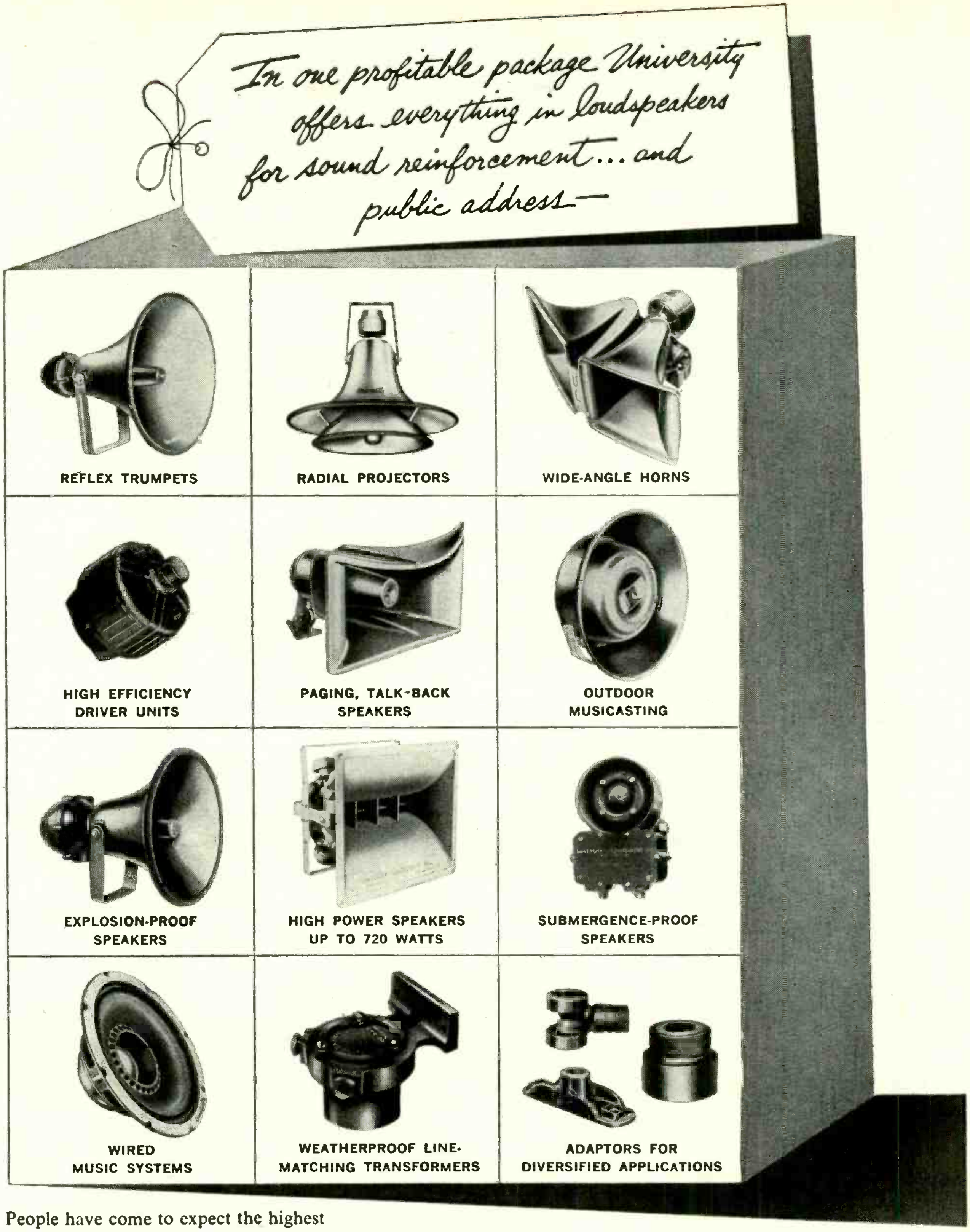
An interesting experiment has been tried by the Associated Radio-Television Service Dealers of Columbus, Ohio. Forms have been given to the members, to be filled in with the names of griping and slow-paying customers (in two separate lists). These will be consolidated and complete lists of these two unpleasant types of fauna distributed to the members, so that they can orient themselves correctly toward customers who fall into the two categories. END

WHAT A SIGHT

By Jeanne DeGood

We've learned to service black-
and-white
And studied grayish hues,
But now we must adjust our sight
To reds and greens and blues.

And now we'll earn our daily
bread
(It's hard to realize)
Adjusting sets by seeing red—
And spots before our eyes.



People have come to expect the highest standard of quality in a product bearing the University label.

This kind of public acceptance is something that University has consistently worked to achieve. *First*—by backing you up with an advertising campaign that's making University a "buy-word." *Second*—by building the kind of quality into all our products that ensures your customers' satisfaction.

Yes, everyone is finding out, to his profit, that *"University sells on sound!"*

For information regarding products or technical data, write to Desk B7.

For an exciting preview of new products visit us at the **May Parts Show**, Conrad Hilton Hotel, Chicago, Rooms **502 & 509 & Booth 874**, May 21-24.

University LOUDSPEAKERS, INC. 80 South Kensico Avenue, White Plains, N. Y.

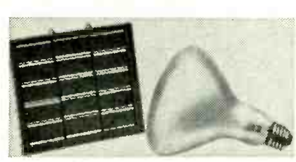
new Devices

MOBILE TELESCOPIC TOWER, *E-Z Way*, travels anywhere on trailer. 60 and 85 feet. Operated by two men. Tower with microwave transmitter attached can be up and on the air in less than 45 minutes. Orientation controls are located at base of tower.

Tower height adjustable by winch-cable mechanism. Plate

at top of each tower for mounting microwave transmitter that can be rotated 360° and tilted from 15° below horizontal to 30° above while standing on ground.—**E-Z Way Towers, Inc.**, Tampa, Fla.

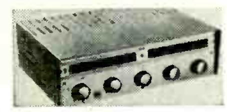
SELENIUM SUN BATTERY converts solar into electrical power. Designed as power supply for transistorized devices such as portable radio receivers and transmitters. May be used with miniature storage batteries to supply continuous power to load. Supplies electrical power in milliwatt range when exposed to sunlight or artificial light. When exposed to very bright incident sunlight, approximately 10,000 foot candles, can supply maximum output power of 5,000,000 watts



per active square inch at output voltage of 0.26 volt per sensitive element.

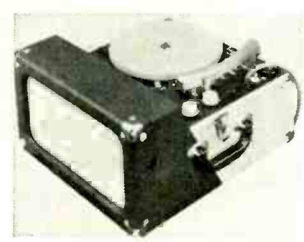
Sun battery illustrated has 15 photosensitive elements connected in series. Output voltage approximately 4 at maximum power transfer, and 8 under open-circuit condition. Maximum operating temperature of battery 85° continuous duty and 100°C in intermittent use. Unlimited life expectancy.—**International Rectifier Corp.**, 1521 E. Grand Ave., El Segundo, Calif.

TUNER-AMPLIFIER, *Knight Uni-Fi*, combines FM–AM tuner, magnetic preamp and 10-watt hi-fi amplifier on single chassis. Housed in cork-grained metal cabinet with brushed brass panel. Input for record player using either crystal or magnetic cartridge; auxiliary input for TV set or tape recorder. AM loopstick and FM loop antennas; 10 tubes plus rectifier



and germanium diode detector. Requires 8-μv FM signal for 30-db quieting. Amplifier response ±0.5 db 20–20,000 cycles.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

PORTABLE PHONOGRAPH, *Ballerina, model C-12V*. Variable speed for control of tempo and pitch of 33⅓-, 45- and 78-rpm records. Extended-range 11-inch oval speaker and 5-watt inverse feedback amplifier. Heat-resistant ceramic pickup cartridge



with double-jeweled needle. Washable Fabricoid of maroon and gray covers case. — **Newcomb Audio Products Co.**, 6824 Lexington Ave., Hollywood 38, Calif.

PORTABLE HI-FI TAPE RECORDERS, series 3A Ferrographs, 3 motors, one a specially designed Octaquad synchronous hysteresis capstan motor for long-term speed stability, eliminating pitch errors on playback. 2 portable models of dual-track magnetic recorder in 3¾ and 7½ ips, 7½ and 15 ips, respectively. Both accommodate 1,750-foot reels of standard tape, have one-knob selector control, auto-stop

TEST 5 TUBES in 4 SECONDS EACH...ACCURATELY!

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Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER

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PRECISE MODEL 116K in kit form. **$69.95**

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Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately . . . by rotating the FUNCTION SWITCH . . . each triode of a dual triode is checked individually . . . each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the PRECISE Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

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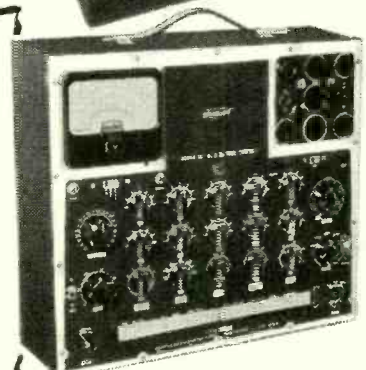
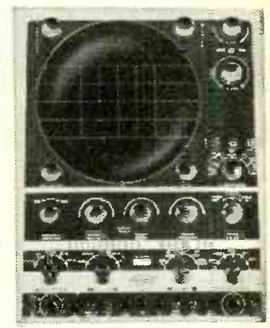
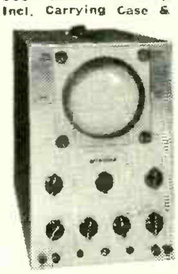
SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER — OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.



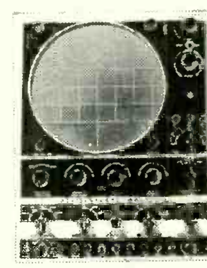
THE FAMOUS MODEL #111
111K $79.95
111W $139.95
Incl. Carrying Case & Cover



THE FIRST LOW PRICED 7" COLOR SCOPE
300K $99.95
300W $199.50



LOW PRICED 5" SCOPE
315K $49.95
315W $84.95



THE FIRST AND ONLY 8½" COLOR SCOPE
308K $129.50
308W $229.50

LOWEST PRICED WIRED 4½" VTVM
909K $25.98
909W $37.50

RF—AF—BAR GENERATOR with pre-assembled* head
630K $33.95
630KA* $38.95
630W $53.95

THE FINEST VOLT, REG, 7" VTVM KIT
9071K $35.95
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LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
610K $23.95
610KA pre-assembled head........ $28.95
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UNIV. AF, SINE, SQ, & PULSE GEN.
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PTAK .. $2.95
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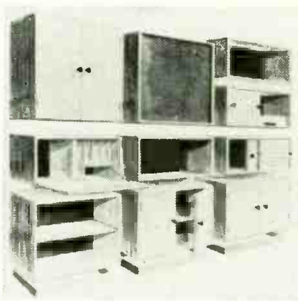
precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

switch, 60-second rewind, separate bass and treble controls and output for 15-ohm extension speaker.

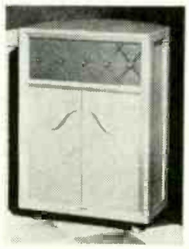
Frequency response within ±2 db between 50 and 10,000 cycles at 7½ ips, 40 and 15,000 cycles at 15 ips. Signal-to-noise ratio better than 50 db between 200 and 12,000 cycles. Output stage provides 2½ watts of low-distortion power into 15-ohm self-contained elliptical speaker. 18 x 17½ x 9¾ inches. 50 pounds. — **British Ferrograph Recorder Co., Ltd.**, London, England, available through **Ercona Corp.**, (Electronic Div.), 551 Fifth Ave., New York 17, N.Y.

HI-FI CABINETS, 10 units, 9 cabinets and 1 base in *ST series*. Modular and identical in width. 16-, 24- and 32-inch heights. 16-inch depth permits all-purpose



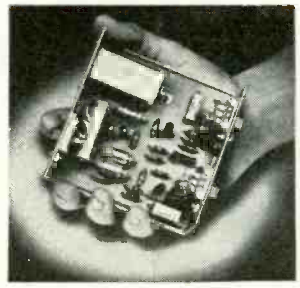
storage. Cabinet doors and moldings of birch. Cabinet shells constructed of heavy, ¾-inch white pine plywood.— —**Cabinart**, 99 North 11th St., Brooklyn 11, N.Y.

CORNER FOLDED-HORN ENCLOSURE and 4-way loudspeaker systems, *Centurion*, feature of E-V Georgian on smaller scale. Single-path indirect-radiator folded horn uses walls corner to extend bass reproduction below 35 cycles, improve transient response, lower distortion. Integrates with matched speaker system as 4-way repro-



ducer. 42 x 29 x 22½ inches. Factory-assembled 4-way speaker system or do-it-yourself kits, enclosure kit, 4-way package of driver components. — **Electro-Voice, Inc.**, Buchanan, Mich.

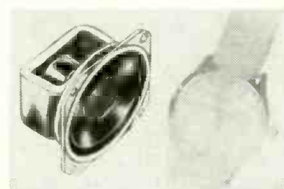
PREAMPLIFIER-EQUALIZER, *Model TR-1*, all transistor type. Hum level zero with no microphonism. Microphone selector allows use as phonograph or microphone preamp. .033-watt drawn from self-contained battery. 3 transistors; printed wiring throughout. Use with any amplifier, audio control or sound system. RIAA equalization. 3 controls on panel for flexibility of function. Cartridge impedance selector permits use of TR-1 with magnetic cartridges, including low-level types; does not require transformer. Vol-



ume control to be direct-connected to basic amplifier which has no level control. 12 ounces. Self-contained; fully shielded. —**Fisher Radio Corp.**, 21-21 44th Dr., Long Island City 1, N.Y..

CUSTOM-BUILT HI-FI SYSTEM flexible in size and layout. Adaptable to almost any demand. Consists of Gray viscous-damped tone arm, turntable, amplifier, preamp and speaker. Can be adapted for use in hotels, restaurants, schools, churches, concert halls, homes, etc.—**Gray Research & Development Co., Inc.**, 685 Hilliard St., Manchester, Conn.

SUBMINIATURE PM SPEAKER, for transistorized circuitry, 1½ inch in diameter and 15/16



inch deep. Alnico 5 magnet; voice-coil impedance 10 ohms. Weighs 1⅞ ounces. Mounting centers 1 9/32 x 1 9/32 inches. —**Lafayette Radio**, 100 Sixth Ave., New York 13, N.Y.

HI-FI MANUAL RECORD PLAYER, *Starlight*. Variable-speed motor drives precision-machined 12-inch aluminum turntable with center-drive action. Built-in illuminated stroboscope permits speed adjustment to perfect pitch over

range of 16⅔–85 rpm. Vernier type speed control. Wow and flutter held to 0.2 volt and rumble more than 40 db below average recording level.

Pickup arm has double-wrist-action arm movement; simple change of cartridges or cleaning. Ball bearing swivel mount. Turntable and pickup arm mounted on natural birch base. Overall base dimensions 16 x 17½ x 6½ inches.—**Metzner Engineering Corp.**, 1041 North Sycamore Ave., Hollywood 38, Calif.

MASTER TV CHANNEL CONVERTER, *model MVC*, high- to low-channel vhf converter. Oper-

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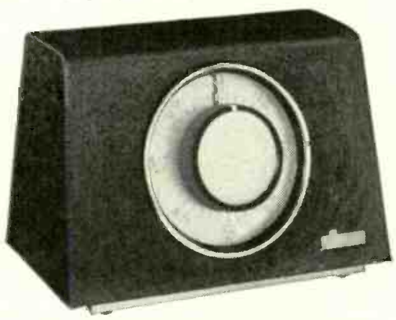
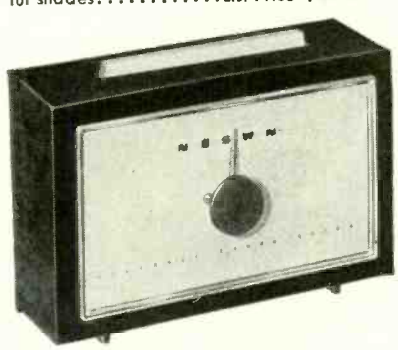
NEW COLORS! Forest Green and Ivory

Beautiful new decorator models U-98 and T-12 now available in both Forest Green and Ivory colors, as well as the standard, rich mahogany grain!

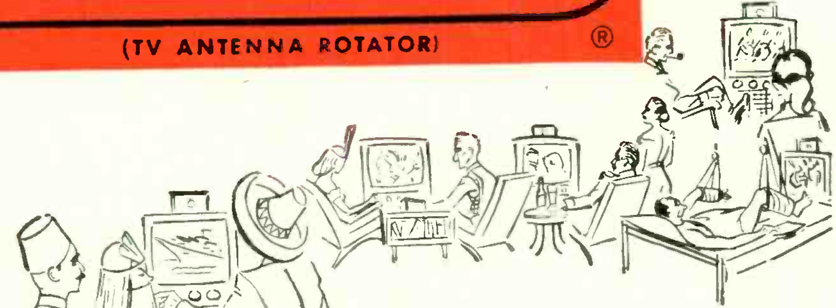


Model U-98—The first and finest fully automatic rotator—"just set it and forget it!" No swinging or drifting—points instantly to target station. Has 32 distinct improvements. The best rotator for *all* stations, *all* channels, VHF, UHF and Color! Available in 3 beautiful shades........... List Price **$39.95**



Model T-12—With exclusive Tenna-Teller pointer. Gives constant direction readings, wholly accurate, dependable. Striking design with finger-tip rocker control bar on top. Available in 3 colors...List Price **$29.95**

Model K-22—Lowest-priced quality rotator on the market. Has finger-tip control. Available in standard color only........ List Price **$19.95**



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EXPANDS THE NATION'S TV AUDIENCE!

In more than two million homes, from coast to coast, viewers get better TV . . . thanks to Alliance. And in fringe areas, Alliance Tenna-Rotor is often the difference between good television and *no* television! Turning the antenna . . . makes for clearer, interference free reception. Alliance Tenna-Rotor increases the effective signal range of stations everywhere!

USES TV TO TELL ITS OWN STORY!

For 7 years Alliance TV spots have run consistently to demonstrate and sell. By using television as its *principal medium,* Alliance has become nationally recognized among the biggest TV advertisers . . . has always been the largest national TV accessory advertiser.

AND WHEN COLOR TV COMES . . .

Color TV is highly critical, more sensitive to reflections. For full color definition Alliance Tenna-Rotor will be *indispensable in many markets!*

More Than 2,000,000 Now in Use!

See us at the Radio-TV Parts Show
Hilton Hotel—Booth 322

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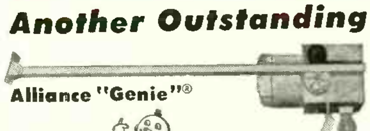


Alliance "Genie"®

LIFT-A-DOR
GARAGE DOOR OPERATOR

Radio-controlled (from car dash) automatic garage door operator—opens, closes, locks door, turns lights on and off. Factory-assembled for easy installation. Customers gleam when you tell them the *low* price!

THE ALLIANCE MFG. CO., INC.
ALLIANCE, OHIO

In Canada—**ALLIANCE MOTORS,** Schell Avenue, Toronto 10 ates at antenna site for community installations to reduce signal loss in long transmission lines. 33-db gain with low-noise grounded-grid amplifier. 1-volt

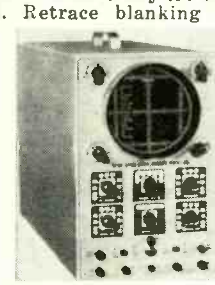
rms output at either 75-ohm outlet. Third 75-ohm fitting for input from high-channel Yagi.

All-channel vhf mixing network for other MVC converters or MCS channel amplifiers in system. Fused power supply and ac receptacle for power plug of next unit. Enclosable in *model MRH-A* weather and radiation-proof housing.—**Blonder-Tongue Labs.**, Inc., 526–36 North Ave., Westfield, N. J.

REPLACEMENT TRANSFORMERS for flybacks used in most

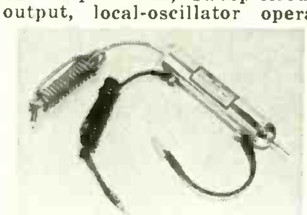
types of modern TV receivers. —**Raypar, Inc.**, 7800 W. Addison St., Chicago, Ill.

COLOR TV OSCILLOSCOPE, *model 601*, full 5-mc bandwidth for color TV servicing. Dc positioning prevents bounce or overshoot. Push-pull vertical amplifier sensitivity .02 volt per inch. Retrace blanking ampli-



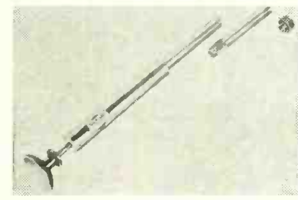
fier. 2-step compensated attenuator input. Positive or negative synchronization of input voltage or from external source. Built-in 60-cycle phasing control and blanking amplifier for TV servicing. Astigmatism control.—**Electronic Measurements Corp.**, 280 Lafayette St., New York, N.Y.

SIGNAL-TRACER PROBE, *model 262*, permits checking ac waveform voltages in horizontal and vertical oscillator circuits, drive voltage to horizontal output tube, sweep-circuit output, local-oscillator opera-



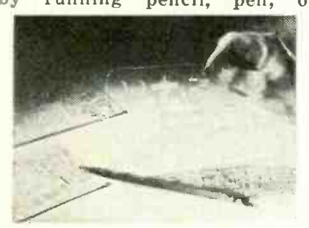
tion, sync-circuit signals, if output, audio signal, etc. Permits top-chassis checking of many ac waveform voltages in TV receiver. Plugs into any 20,000 ohms-per-volt VOM.—**Futuramic Co.**, 2500 W. 23 St., Chicago, Ill.

LONG-SHANK ADAPTER for TrolMaster, the tool for cleaning and lubricating TV and radio controls without removing chassis from set or taking back off cabinet. With 7-inch adapter which screws on, Trol-



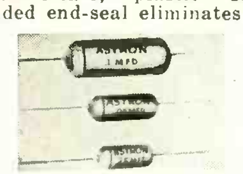
Master can be used on controls with shafts up to 7 inches long. Made of solid brass, will not corrode when used with any chemical normally used in electronics industry.—**R-Columbia Products Co., Inc.**, 305 Waukegan Ave., Highwood, Ill.

ELECTRONIC DIAGRAMMER. No drawing experience for professional-looking circuitry plans by running pencil, pen, or



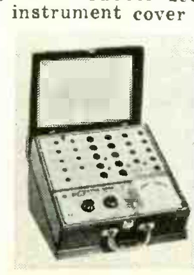
stylus through any combination of engraved electronics symbols. Rigid transparent Vinyl template includes commonly used electronics symbols; beveled for ease and accuracy. 4.25 x 6.5 x .040 inch. Symbols include usually tedious-to-draw pronged tube bases, cathode-ray tubes, resistors, elements and coils.—**A. Lawrence Karp**, 16 Putnam Park, Greenwich, Conn.

PAPER TUBULAR, *Comet*, molded-plastic metallized paper capacitor. Miniature, self-healing, lightweight, heat-resistant, moisture-safe, plastic shell. Bonded end-seal eliminates en-



vironmental effects. Reliable operation from −65°C to +125°C. Leads won't pull or melt out.—**Astron Corp.**, 255 Grant Ave., E. Newark, N. J.

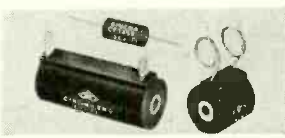
COUNTER STAND for *Dyna-Quick model 500* portable tube checker (page 52, March 1956, issue). Four rubber feet. Rail holds instrument cover in ver-



tical position. Weighs 6 pounds; 7 x 15½ x 14¼ inches.—**B & K Manufacturing Co.**, 3726 N. Southport Ave., Chicago 13, Ill.

RACK AND PANEL TYPE CONNECTORS, *DPE*, made up of 40 contacts. Narrow for crowded installations. Die-cast aluminum shell (3 15/16 inches) protects insert and contacts. Positive polarization by keystone design, construction feature of many connectors in smaller rack and panel series. Flashover rated at 1,700 volts, 60 cycles, ac rms at sea level. Mated connector 0.381 pound.—**Cannon Electric Co.**, 3209 Humboldt St., Los Angeles 31, Calif.

ENCAPSULATED RESISTORS, *CE 100, CE 200 series* and *PW types*, feature several improvements, including reduction of thermal hot spots through greater conductivity, increased tensile strength, resulting in greater mechanical strength when operating at higher ambi-



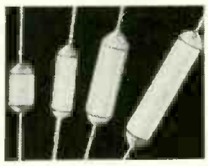
ent temperatures and 15% greater wattage dissipation through improved surface emissivity. Where accurate resistance is a requisite, Cinema-Alloy E resistance wire is used. Housing of black epoxy with circle of yellow epoxy at each end of resistor.—**Cinema Engineering Div., Aerovox Corp.**, Burbank, Calif.

SELENIUM TV RECTIFIER, *AirKore*. Open-paced 6-contact spring for large contact area and uniform temperature rise across surface of rectifier plate. Optimum air circulation around plates, through core and spring. Maximum air flow in vertical mounting positions. In all standard sizes, stud and eyelet construction.—**International Rectifier Corp.**, El Segundo, Calif.

PRECISION POTENTIOMETER, *Vari-Phase*, single-turn type with simplified phasing. Permits external independent phasing of each sectional cup without affecting phase relationships of others in group. Phasing may be applied after mounting in equipment to correct or cancel any mechanical or electrical errors that developed during or after assembly. Done by loosening clamping nut, moving terminal board in

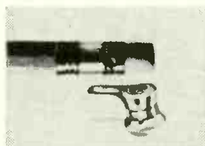
desired direction, then retightening. No clamping rings to hold cups. Available in 5 different sizes: ⅞-, 1 1/16-, 1⅝-, 2 and 3-inch diameters.—**Clarostat Mfg. Co., Inc.**, Dover, N. H.

SUBMINIATURE CAPACITORS, type NT tantalum polarized electrolytic. Ratings from 0.5–16 volts dc; capacitances from .08–30 μf; case sizes 3/32 or ⅛ inch in diameter and 5/32–½ inch long. For transistor circuits in hearing aids and miniature radio receivers, printed-circuit assemblies, sub-



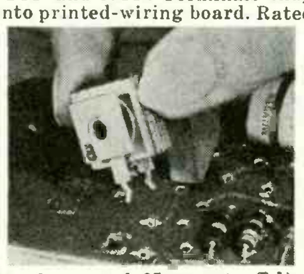
miniature controls and other very small low-voltage devices designed for −20 to 55°C operation.—**Cornell Dubilier Electric Corp.**, So. Plainfield, N. J.

MINIATURE GLASS TRIMMERS, *models VC 9G* and *10G*. *VC 9G's* capacitance range 0.5 to 8.5 μμf; temperature range −55° to +125°C; dielectric strength 1,000 volts dc; Q at 1 mc greater than 1,000; insula-



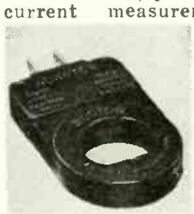
tion resistance greater than 2,000,000 megohms. *VC 10G* is the same as *VC 9G* except slightly smaller and has a capacitance range of 1 to 4.5 μμf.—**JFD Electronics Corp.**, 1462 62 St., Brooklyn, N.Y.

MINIATURE SELENIUM RECTIFIER, half-wave stack types *8Y1B* and *8J1B*. Terminals snap into printed-wiring board. Rated



at 30 ma and 65 ma at off-line voltages with capacitive load in 45°C ambient temperature. Mount in 3/32-inch diameter holes spaced on 27/64-inch centers.—**Radio Receptor Co., Inc.**, Semi-conductor Div., 251 W. 19th St., New York 11, N. Y.

PLUG-IN ADAPTER, for Weston *model 749* miniature ac clamp volt-ammeter. Plug receptacles on either side—one reduces scale range of model 749 by factor of 10, permitting low current measurements;



other for reading ampere scale directly. Adapter plugs into ac line, appliance connects to adapter and clamping jaws of instrument inserted through adapter opening.—**Weston Electrical Instruments Corp.**, 614 Frelinghuysen Ave., Newark 5, N. J. END

All specifications given on these pages are from manufacturers' data.

new Tubes Transistors

2N175

A new hermetically sealed, germanium-alloy junction transistor, the 2N175, has been announced by RCA. The p-n-p type is designed especially for use in the preamplifier or input stages of transistorized audio equipment operating from extremely small input signals.

Because of its exceptionally low noise factor of 6 db maximum and its freedom from microphonics and hum, the 2N175 can be operated from low-impedance low-level devices such as magnetic microphones and magnetic pickups without an input coupling transformer.

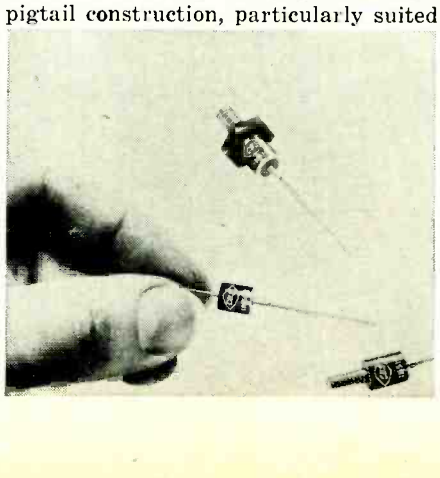
In a common-emitter type circuit, the 2N175 features an exceptionally low wide-band noise factor, a current amplification ratio of 65 and a matched-impedance power gain of approximately 43 db. The transistor is 0.026 inch in diameter, 0.495 inch in seated length.

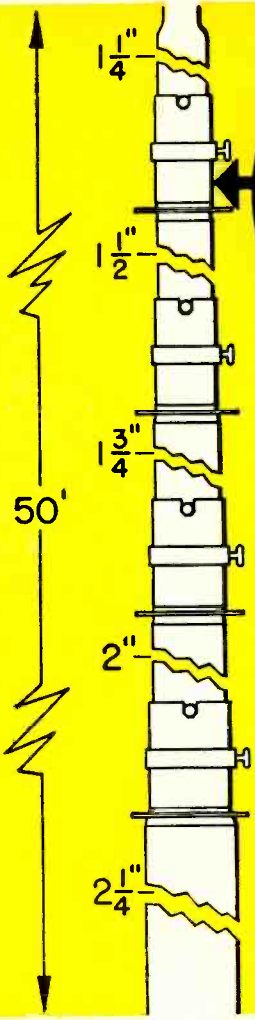
Maximum ratings for class-A audio-frequency service are: collector voltage, −10; collector current, −2 ma; collector dissipation, 20 mw; emitter voltage, 10; emitter current, 2 ma; ambient operating temperature, 50°C.

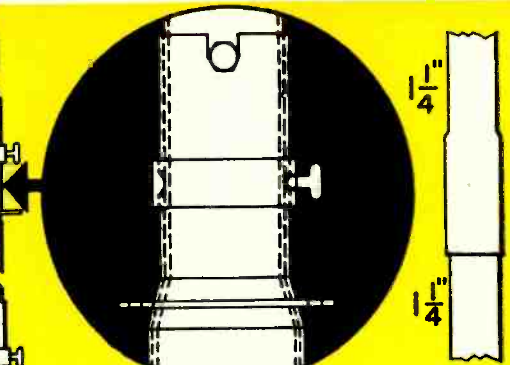
SILICON POWER RECTIFIERS

Developed by CBS-Hytron, the 1N503 through 1N526 feature exceptionally large power-handling capacity for their size. These silicon power rectifiers operate with extremely high reverse voltages and low reverse currents. This feature, together with a very low forward voltage drop, enables the rectifier to deliver large power to the load with relatively little dissipation. Because of their low thermal resistance the rectifiers operate in ambient temperatures up to 125°C.

The units are available in three shapes (see photo), depending on the heat dissipation required. The smallest unit can handle ⅓ ampere without an additional heat radiator and features pigtail construction, particularly suited







Same 1¼-inch piece of Perma-Tube can be used for telescoping masts or with another 1¼-inch piece to make smaller 2-piece masts.

Why buy assembled telescoping masts? Use J&L Perma-Tube in 10-foot lengths and easily make your own

Get flexibility in your stock SAVE MONEY—SAVE SPACE

Only J&L Perma-Tube offers:

- Joint design which provides instant field assembly.
- Machine-fitted joints that insure close tolerance for high strength and rigidity.
- Guy wire ring position that eliminates all binding and guy wire interference.

Buy only a carton each of five different sizes of Perma-Tube (1¼ to 2¼-inch) and make any telescoping TV mast up to 50 feet in height. Hardware —cotter keys or bolts, clamps and guy rings—may also be secured from your distributor.

You can now "tailor-make" your own TV masts up to 50 feet high by using standard 10-foot lengths of 16-gage Perma-Tube—and save money. Five diameters are available in easily-handled cartons from your local distributor. Largest base section OD is 2¼ inches and each telescoping section is ¼-inch smaller, the smallest section having an OD of 1¼ inches.

Corrosion-resistant Perma-Tube is treated with Vinsynite—then coated both inside and outside with a metallic vinyl resin base. It's made of a special, high-strength, J&L steel tubing. A 10-foot section of 1¼ inch diameter by 16 gage is capable of supporting a weight at its center point of 200 pounds with a minimum of deflection and permanent set.

J&L Perma-Tube—best for strength and rust protection

Jones & Laughlin
STEEL CORPORATION · PITTSBURGH

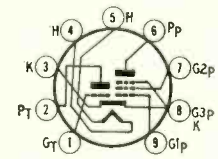
STEEL

for printed circuits. The second unit has a screw type mounting and can carry 1 ampere. The third has a hexagon base screwstud mounting and is capable of handling 1¼ amperes.

5CG8, 6CG8

Two new nine-pin miniature type receiving tubes, each containing a medium-mu triode and a sharp-cutoff pentode in one envelope, have been announced by RCA. The tubes, the 5CG8 and 6CG8, are designed especially for use as combined oscillator and mixers in television receivers using an intermediate frequency of approximately 40 mc.

A feature of these tubes is a cathode



5CG8, 6CG8

having two leads (see base diagram) connected to separate base-pin terminals. This arrangement reduces the effective cathode-lead inductance, thereby minimizing input loading effects of the pentode mixer unit. This also makes it possible to eliminate a common return for the input and output circuits of the pentode mixer and thus minimize interaction between the two circuits.

The low capacitance between grid 1 and plate minimizes feedback problems often found in mixer circuits operating at an if of 40 mc. Feedback problems are especially troublesome on channel 2 because of the small difference between the channel frequency (54–60 mc) and the if. The low value of output capacitance permits the tube to work into a high-impedance plate circuit with resultant increase in mixer gain.

The 5CG8 and 6CG8 are highly useful in the design of AM–FM receivers. The pentode unit may be used in the AM section as a pentode mixer to provide high gain and in the FM section either as a pentode mixer or as a triode-connected mixer, depending upon signal-to-noise considerations. The triode unit of these tubes makes a satisfactory oscillator for either the AM or the FM section.

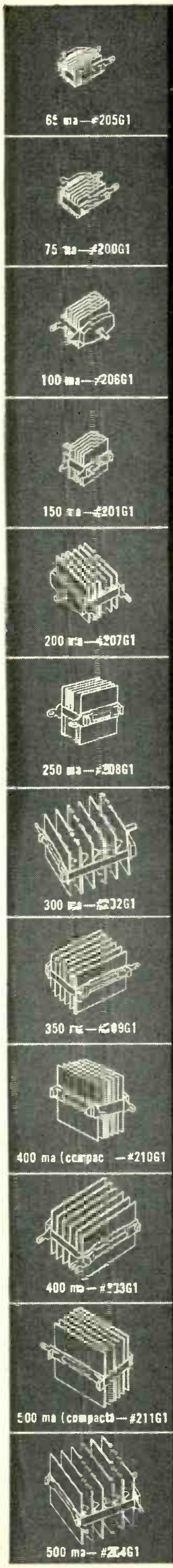
The 5CG8 is like the 6CG8 except that it is designed for series-string operation, having heater requirements of 4.7 volts at 600 milliamperes. The 6CG8 draws 450 ma at 6.3 volts.

2BN4, 6BN4

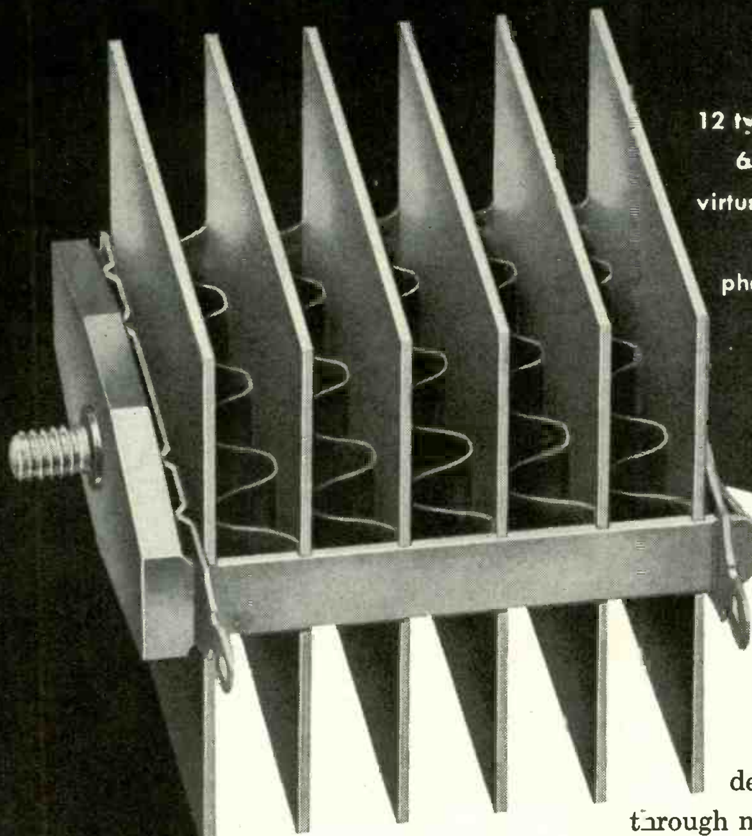
Medium-mu triodes of the seven-pin miniature type, the 2BN4 and 6BN4 are designed especially for use as rf amplifiers in grounded-cathode circuits of vhf television tuners.

The 2BN4 and 6BN4 each have a transconductance of 6,800 micromhos, permiting high gain and reduced equivalent noise resistance. The double base-pin connections (see base diagram) for both cathode and grid reduce the effec-

(Continued on page 124)



For dependable replacement



12 types—ratings from 65 ma to 500 ma—meet virtually all your replacement requirements in radio, phonograph, hi-fi, and TV sets.

RCA SELENIUM RECTIFIERS are manufactured to give long and dependable performance. This dependability is made possible through new, advanced design, careful selection of production material, and thorough quality control in manufacture. The new, open design permits greater heat dissipation . . . *no possibility of center "hot spots."*

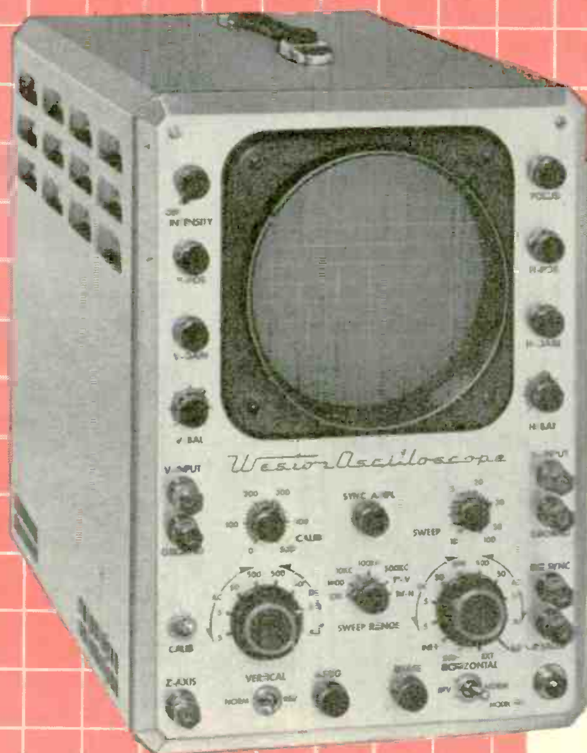
RCA SELENIUM RECTIFIERS are a dependable replacement line because they are . . . cool in operation . . . sturdy in mechanical construction . . . efficient in electrical operation . . . easy-to-install.

Now available through your RCA distributor!

RCA SELENIUM RECTIFIERS

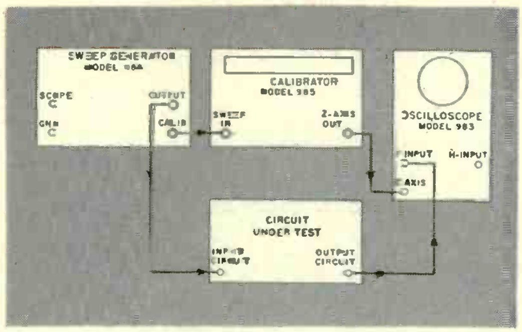
RCA® **RADIO CORPORATION of AMERICA**
ELECTRONIC COMPONENTS HARRISON, N.J.

Align in HALF

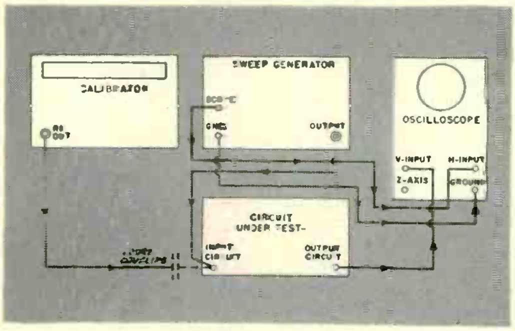


Model 983 WESTON Oscilloscope **$329.50** net

WESTON Simplified Method of Visual Alignment



Conventional Method of Alignment



Model 984 WESTON Sweep Generator **$199.50** net

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the usual time!

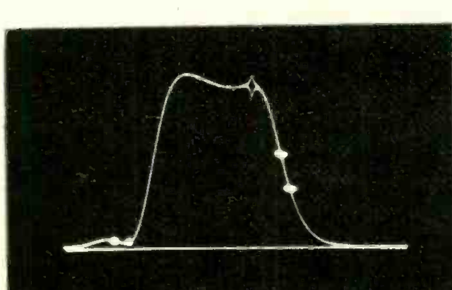
Simplified WESTON method makes aligning *quick-easy-profitable* for every serviceman!

There's real money in alignment . . . now that it's no longer necessary to use complicated, time-consuming methods. The Weston method is so *quick*, so *simple*, any serviceman can complete any alignment job in one hour maximum.

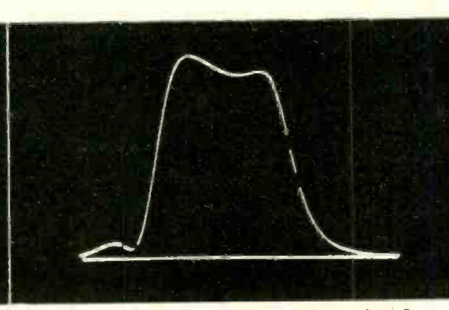
Note the simplicity of the hook-up illustrated at the left, in which the calibrator is *not* connected to the circuit under test. With only two simple connections to the receiver, oscillations encountered in conventional methods are entirely eliminated. Further, there is no disappearance of markers at trap frequencies. Z-axis modulation of the scope provides accurate intensity markers on the response curve under conditions where beat note markers would not be visible. Response curves are not disturbed. Annoying trimmer touch-up on trap circuits is minimized. (See marker presentations shown below.)

All you need to align simply, quickly, and get the big profits from this constantly increasing class of work are the WESTON Calibrator and Sweep Generator, and the Weston Oscilloscope or any scope with provisions for Z-axis intensity modulation.

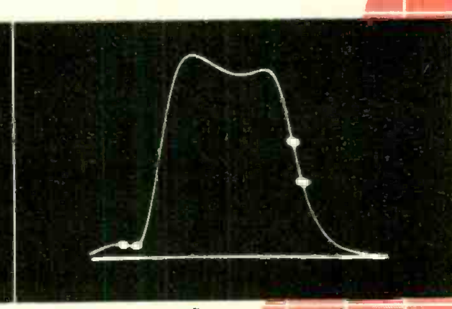
SEND for CATALOG NOW! A new catalog describing this simplified method and the instruments used, is available for the asking. Also included are descriptions of other Weston Test equipment including – Model 980 Volt-Ohm-Milliammeter $42.50 net – Model 982 VTVM at $69.50 net – Model 981 Tubechecker at $199.50 net. Send for your copy now.



Simultaneous marker presentation of video and sound carrier frequencies (positive intensity markers).



Simultaneous marker display of video and sound carriers (negative intensity markers).



Note that with intensity markers there is no possible misinterpretation with spurious responses.

WESTON *Electronic Testing Equipment*

WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.
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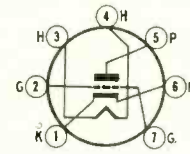
NEW TUBES AND TRANSISTORS *(Continued)*

tive lead inductance and resistance with a resulting reduction in input conductance. The special basing arrangement of these tubes permits excellent isolation of input and output circuits,



2BN4, 6BN4

neutralization and short, direct connections to the base-pin terminals.

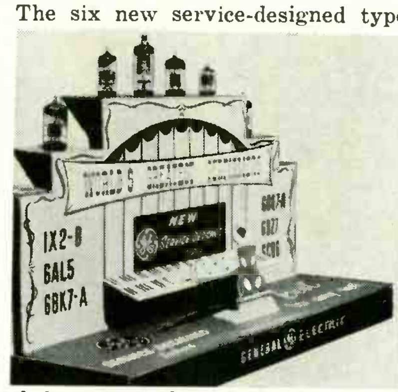
The 2BN4 is like the 6BN4, both announced by RCA, except that it is designed for series-string operation. Its heater requirements are 600 milliamps at 2.1 volts. The 6BN6 draws 200 ma at 6.3 volts.

Characteristics as a class-A amplifier are as follows: plate voltage, 150; cathode-bias resistor, 220 ohms; amplification factor, 43; plate resistance (approximately), 6,300 ohms; transconductance, 6,800 micromhos; plate current, 9 ma; grid voltage (approximately) for plate current of 100 microamperes, −6.

Service-designed tubes

G-E has added six more popular receiving tube types to its "service-designed" line (see photo). These tubes, G-E states, provide greater safety factors than called for in the standard product and thus perform well in most circuits.

The six new service-designed types,



and the improved features of each, are:

1X2-B—A tungsten shield post construction alleviates filament pullout. An improved filament coating gives better electron emission. A flyback operation life test insures quality.

6AL5—New heater construction prevents flash burnouts by initial surge current.

6BK7-A, 6BQ7-A and 6BZ7—Have construction features for greater heater reliability and freedom from heater-cathode shorts in cascode amplifiers. High zero-bias mutual conductance for improved fringe-area reception.

6CB6—A special alloy screen grid handles increased heat dissipation found in some video and if amplifier circuits and prevents control-to-screen grid shorts. Special mica spacers reduce interelement leakage and reduce agc troubles in some television circuits. This tube also has a high zero-bias mutual conductance. END

Patents

PULSE CALIBRATION

Patent No. 2,719,232

Robert W. Ehrlich, W. Orange, N. J. (Assigned to American Telephone & Telegraph Co.)

This describes an accurate method for calibrating a low-frequency pulse generator without using an oscilloscope.

To calibrate, the measuring circuit (including the galvanometer is plugged into connector J. (See Fig. 1.) When impulse relay RY is energized by the pulse generator (as shown), the negative battery terminal biases the cathode of meter rectifier D so it conducts and shorts out the meter. It is only during a "break" between pulses that the meter can deflect.

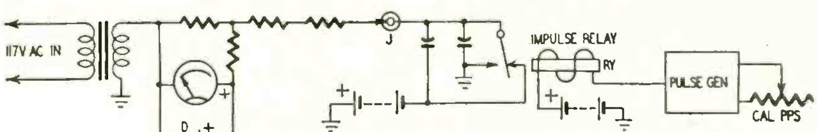


Fig.1

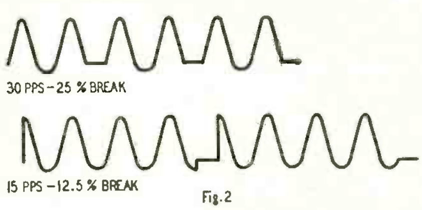


Fig.2

During a pulse the voltage across the meter will be a combination of ac from the line and dc from the battery. Now if the pulse rate (pps) is an exact submultiple of 60 cycles, the break will occur at an identical point on the voltage waveform across the meter. For example, assume a pps of 30. Then the break will occur *once* for each two cycles of line voltage (Fig. 2). Because of the submultiple relationship, the make and break of the relay will occur at identical points of every other sine wave, so the meter will show a steady deflection. If this relationship did not hold, the break would occur at different parts of the wave and the meter current would vary with time.

The pulse generator needs only a rough adjustment for frequency, that is, only an approximate calibration. Then the operator sets a control until the meter remains perfectly steady. This indicates that the pulse rate is some submultiple of 60, for example 30, 20, 15, etc.

CRYSTAL DISCRIMINATOR

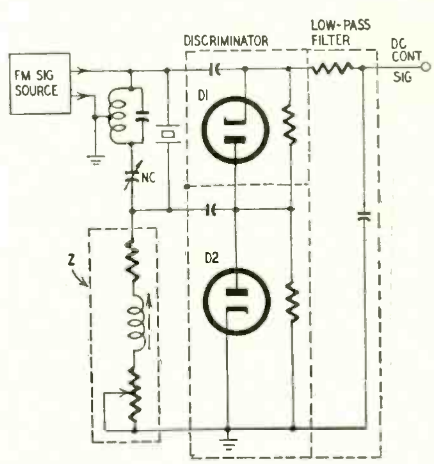
Patent No. 2,724,089

John Ruston, Fair Lawn, N. J., (Assigned to Allen B. DuMont Labs, Inc.)

A frequency discriminator measures or indicates frequency deviation. Ordinarily the discriminator puts out zero voltage at a standard or center-value frequency. When the frequency shifts in one direction, the output is positive; when it goes in the other, the output is negative. The output voltage may be used as a *control signal* to control an oscillator and prevent it from drifting from its assigned frequency.

In this discriminator circuit a crystal is in series with impedance Z (about 1,2000 ohms), to form a voltage divider. The voltage across each of these elements is rectified by a separate diode and combined and filtered to produce a dc control signal at the output terminals. The output of D1 is always positive while that of D2 is always negative. At the chosen center frequency f_o, the crystal and impedance Z have equal impedance, so the rectifier outputs combine and cancel. This frequency f_o, must be intermediate between the series-resonant frequency f_s of the crystal and its parallel-resonant frequency f_p. A crystal has minimum impedance at frequency f_s and maximum at f_p.

At frequencies above f_o, the crystal has the greater impedance and D1 has the greater output. Thus the control voltage must be positive. It will be *negative* at frequencies *below* f_o because D2 has greater output. This control voltage is fairly linear between f_s and f_p.



A trimmer neutralizing capacitor balances out the capacitance of the crystal holder to some extent and thus adjusts f_p as desired. For any crystal, series-resonant frequency f_s remains constant.

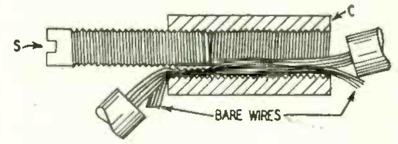
SOLDERLESS CONNECTOR

Patent No. 2,716,226

Walter Monroe Jonas, No. Bergen, N. J. (Assigned to Reiner Electronics Co., Inc., New York)

A good wire connection is ordinarily made by soldering. This is easy and convenient when suitable soldering iron is handy, but there are occasions when a substitute method is required. For example, a solderless connection has definite advantages from a military viewpoint or during civil emergency when no power is available.

The method shown here requires only a screwdriver. The diagram illustrates one form of solderless connector. Screw S is made of somewhat smaller diameter than the bore or threaded metal cylinder C into which it is to fit. The wires to be connected are pressed together and held tightly between the threads as the screw is driven into the bore. Actually the wires are bent into a corrugated pattern and make an excellent electrical and mechanical splice. Loose wire ends



are snipped off and the connection taped or provided with an insulating jacket.

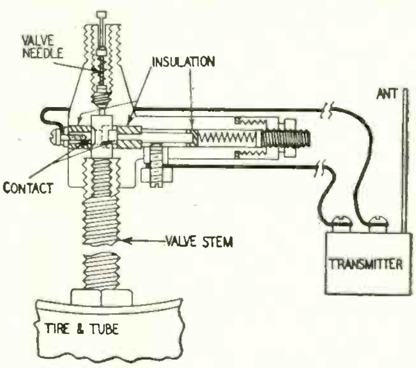
If necessary, these wires can be separated without damage.

TIRE PRESSURE ALARM

Patent No. 2,727,221
Edward A. Sprigg, E. Orange, N. J.
(Assigned to Breeze Corporations, Inc., Union, N. J.)

Tires on all types of vehicles—especially heavily laden trucks and trailers that travel at high speeds—must be inflated to a certain minimum pressure for safety and reduced wear. This is a radio warning system which notifies the driver when tire pressure falls too low. Tiny radio transmitters, located on each wheel, are actuated by a switch that closes whenever the pressure of a tire falls below the predetermined minimum. A receiver in the cab of the truck receives these impulses.

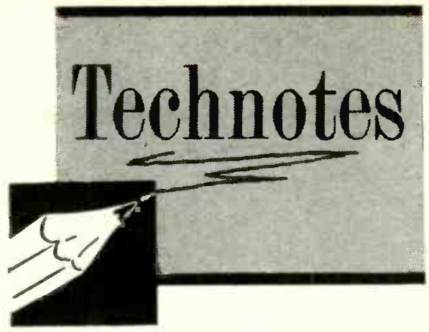
The switch that operates by the tire pressure is described in the patent notice. Briefly, when the tire loses air, a spring drives a plunger to



close switch contacts. Actual transmitter or receiver circuits are not described in the patent, but they must be tiny and may radiate very weak power. A transistorized printed-circuit network would seem practical.

As shown in the diagram, each tire is equipped with its own transmitter and antenna. A receiver in the cab picks up the signals. The inventor suggests a different frequency for each tire and perhaps colored lights on the dashboard to indicate which tire is at fault. END

"Well, you shouldn't have any more trouble with that .0001-µf bypass. I put in an overrated replacement."



Technotes

HORIZONTAL OSCILLATOR COIL

Recently I was stuck with a defective oscillator coil used in a conventional horizontal multivibrator circuit (Fig. 1). With no replacement on hand and faced with the customer wanting the set in a hurry, I made up a new unit using a width coil having an agc winding. The Merit MWC-1 was perfect.

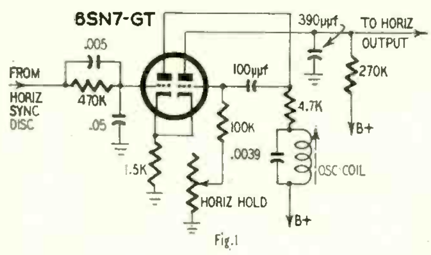


Fig. 1

With the several windings and taps available, there are many ways of connecting them to get the required amount of inductance. Fig. 2 shows how the width coil was connected with the best results as a replacement for the oscillator coil.

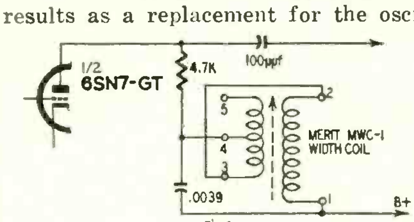


Fig. 2

This done, it was just a matter of adjusting the circuit on frequency, using the slug in the width coil. No other changes were necessary. There were no mechanical difficulties since the replacement is about the same size and mounts in the same manner as the original.—*Carl Lindfors*

MAJESTIC 7P420 RADIO

If the 50B5 in this receiver is gassy, the tubes will frequently burn out. When this appears to be the trouble, replace the 50B5. The heater voltages should be checked to see if they are normal after a good tube has been placed in the receiver.—*E. M. Breckenridge*

PHILCO C1908 RADIO

If a howl is heard after a defective output transformer has been replaced, reverse the plate connections of the transformer primary.

If full volume produces excessive distortion, with normal sound at average volume, the output transformer may be defective. This can be checked by measuring the voltage at the plates of the 7C5's. There will be equal voltages at

normal volume levels, slightly different at high volume levels.—*Lyle Briggs*

PICTURE FLUTTER

A common cathode lead impedance in a combined first audio and agc circuit often produces picture flutter. A typical circuit (Emerson 120166-D) is shown in Fig. 1; Fig. 2 shows the equivalent circuit containing resistance, inductance

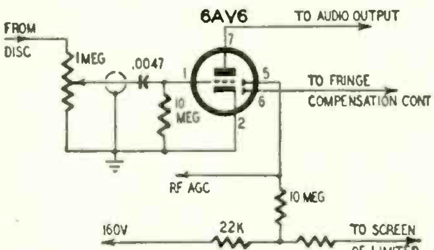


Fig. 1

and capacitance. A voltage is developed across this impedance and impressed on the agc line, regardless of the amount of agc filtering. Thus, the agc voltage will vary with sound volume, causing the gain of the rf amplifier to vary at the audio rate and the picture to flutter.

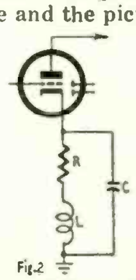


Fig. 2

The cause of this trouble is often a cold solder joint that creates a high-resistance path in the cathode circuit. Sometimes it is merely a very long lead that can easily be shortened or supplemented with a braid from the cathode terminal to ground. To check, turn the volume on full and watch for this effect. —*James A. McRoberts*

RCA TELEVISION SETS

To improve sound and picture gain in the early RCA split-sound receivers, change the first and second picture if cathode resistors from the original 120 ohms to 80 ohms. This modification is especially helpful in fringe areas. Also move the sound takeoff on trap T103 up two turns on the coil. This provides additional 21-mc sound signal for the if amplifier. Realign the set after this change.—*W. S. Ross*

RCA 21-INCH COLOR TV

In the 21-CT-661U and 21-CT-662U receivers color edges may be improved by a change in the 6AZ8 bandpass amplifier stage. Resistor R232 (Fig. 1) should be changed to a 2,700-ohm ½-watt unit. The bandpass and first video amplifiers should then be realigned to give the response curve in Fig. 2.

A further change was made in the bandpass amplifier to make its bias track better with changes in burst level. This is desirable in areas where both strong and weak signals are encountered. Disconnect pin 2, the screen grid of the bandpass amplifier, from terminal A of T113, the bandpass trans-

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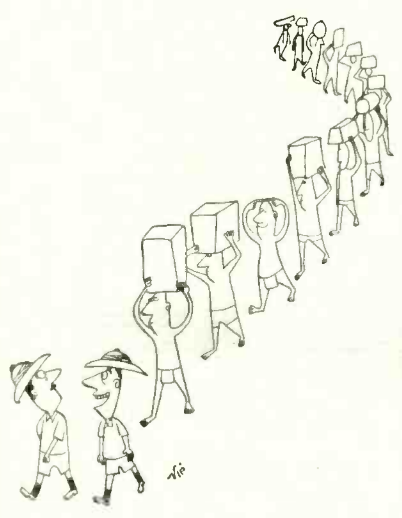
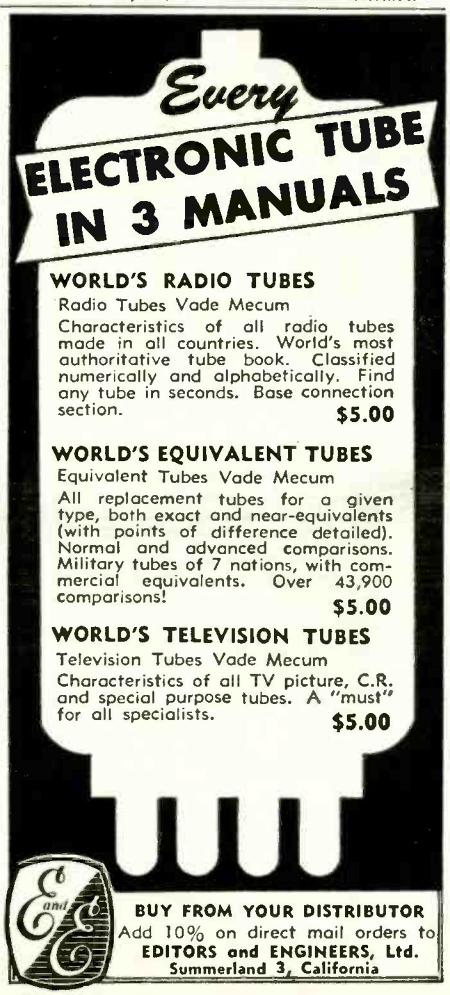


"That third guy? He's the serviceman carrying the JENSEN NEEDLE!"



former, and re-connect to the 140-volt bus at pin 7 of the agc amplifier. Connect an 18-megohm resistor from ter-

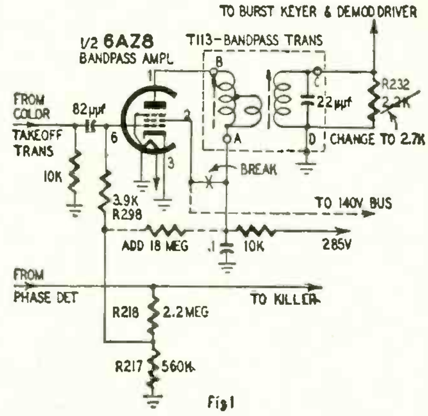


Fig 1

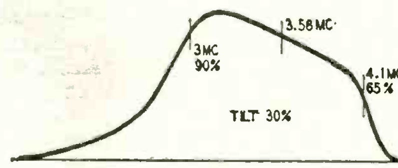


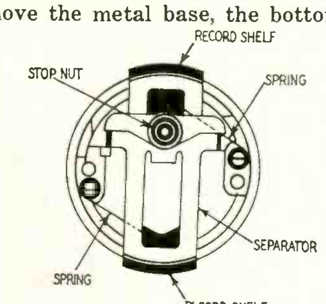
Fig 2

minal A of T113 to the junction of R298, R217 and R218.—*RCA Television Service Tips*

MAGNAVOX-COLLARO 45 RPM

If the 45-rpm adapter for the above changer fails to function, it can usually be repaired easily in the field. The procedure for checking is:

1. Remove the retaining ring on the bottom of the center shaft. You can now remove the metal base, the bottom sec-



tion of the adapter and the large coil spring (see diagram). *Caution:* Do not lose the brass shim on the hub of the center shaft.

2. Remove the two screws holding the top and center sections together. These are accessible from the bottom of the center section.

3. While holding the two sections vertically, lift the top section straight up so as not to disturb the springs holding the plastic shelves in position.

4. Loosen the elastic stop nut and clean the record separator parts with carbon tet so they are free of dirt and will slide easily. (Service cleaners other than carbon tet are safer and should be used.—*Editor*)

5. Make sure both springs are in place, tighten the elastic stop nut until there is no play in the record separators and then back off about ¼ turn.

6. Reassemble the adapter, following the reverse order of the disassembly instructions. — *Magnavox Service News Letter* END

try This one

VIDEO PEAKING

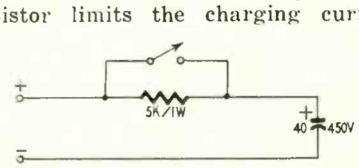
Some power resistors have just enough inductance for plate loads in video amplifiers and are simpler than noninductive resistors plus separate peaking coils. This is often true of 10- and 20-watt sizes from 2,000 to 6,000 ohms. I have used ordinary Ohmite Brown Devils as loads for 6AC7 preamplifiers and an 829 deflecting a 5CP1 in a 5-mc oscilloscope for fast transients. I now am using 3,000-ohm, 20-watt IRC type 2D resistors as loads for 1625's deflecting a 5CP1 or 5ABP1 in another wide-band scope. This instrument uses feedback and reproduces a 450-kc square wave well.

Power resistors below 2,000 ohms may have too much inductance. A 1,000-ohm, 20-watt resistor as load for parallel 807's to drive an rf bridge rang badly when hit by a square wave and would have caused oscillation in a feedback amplifier.—*A. H. Taylor*

FILTER CAPACITORS

A defective filter capacitor is suspected whenever a radio or TV receiver has loud hum. The usual method for locating the bad unit is to place a test filter capacitor across each unit in the set, one at a time. When the hum is eliminated, the bad capacitor has been found.

Instead of placing a test capacitor directly across each suspected unit, we use a testing aid that includes a 40-μf capacitor and 4,700- or 5,000-ohm resistor with a cutout switch as in diagram. The unit is placed across the suspected capacitor with the switch open. The resistor limits the charging current



into the test capacitor and eliminates costly burnouts of pilot light and rectifier tube in ac–dc receivers. After a second or two, when the capacitor is almost fully charged, the switch is closed. Another advantage of using this testing aid is that the suspected unit is usually not disturbed by the test. This avoids the annoying experience of temporarily healing an intermittent capacitor which then is difficult to locate until it becomes defective again.—*G. Sabin*

HANDY BENCH "TOOL"

A very handy item for the radio–TV service bench can be picked up for

TRY THIS ONE (Continued)

practically nothing from any iron works or dealer in structural steel materials. I have found that short lengths of steel I-beam are useful for many purposes in the shop. Mine are 4-inch lengths of material ¼ inch thick and 3 inches wide with 1½-inch leg channels. I use them for propping up awkward chassis, for weighting reglued speaker cones, as soldering-iron rests, as temporary bookends and as anvils for light riveting and hammering.

I picked mine off the scrap heap of a local iron works, filed the ends smooth and sprayed them with aluminum Krylon. I've used them almost every day for the past several years. The four units that I have are probably the only tools in the shop that will never wear out and cannot be broken.—*L. H. Wilson*

CHECKING 3-WAY SETS

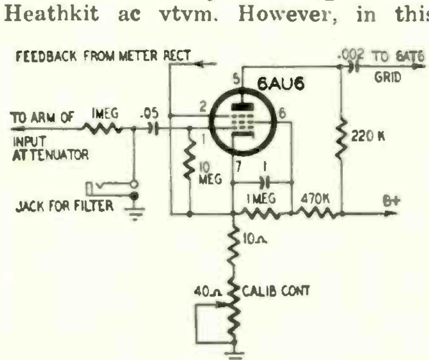
A variable voltage source is necessary to check three-way portables properly on ac line operation. Because of the low current drain of these sets a tube tester will serve the purpose while providing isolation from the line to prevent shock hazards.

Many tube testers have a blank socket that can be replaced by an ac type receptacle. The current is taken off the 100- to 117-volt tap of the filament transformer with a 1-ampere fuse in series with one side for protection against shorts. On other types of tube testers a simple adaptor using one of the tube sockets can be made up and the connections set up as for the 117-volt tube.

By adjusting the line set control the voltage can be raised or lowered. A set that has a bad oscillator tube, rectifier or other troubles is easily detected because it will usually cut out when the voltage is lowered.—*G. P. Oberto*

MODIFYING VTVM FILTER

In the December, 1955, issue James Fred described a 400- and 1,000-cycle filter, to be used with a vtvm when aligning AM equipment. The article suggests connecting the filter to the coupling network between the first and second audio amplifier stages of a Heathkit ac vtvm. However, in this

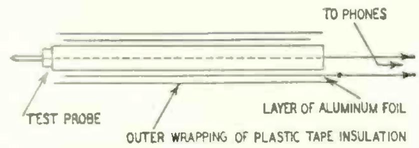


meter there is a feedback loop from the output of the second audio stage to the cathode of the first. Thus the filter will be inside the loop and its selectivity will be flattened. Hence the filter may not yield its designed performance.

In my opinion, the best place to connect such a filter in the Heathkit vtvm is in the grid circuit of the 6AU6 first audio stage, as shown in the diagram. Here the filter is out of the feedback loop and will show its full selectivity. The 1-megohm resistor in series with the grid circuit prevents shunting of the filter by the low resistances of the divider chain on the higher voltage ranges or by a low-impedance source on the higher voltage ranges. Due to the high input impedance of the 6AU6 stage, there will be but little change in calibration for normal operation. This can be easily compensated by the calibration pot.—*Charles Edwin Cohn*

VERTICAL SYNC TRACER

When it is inconvenient to use a scope for tracing vertical sync-pulse troubles, this handy little gadget, made from a pair of headphones and an extra test prod, can stand you in good stead. The sketch is self-explanatory: one lead of the headphone goes to the prod itself while the other side goes to a sheet of aluminum foil wrapped around the handle. The whole business can then be wrapped with a plastic insulating tape for safety in use. Only one direct connection is made to the circuit under test, thus avoiding load-



ing the circuit. The return is through "body capacitance."

When the probe is touched to an output portion of a functioning vertical oscillator, a distinctive 60-cycle click or thump will be heard, the frequency of which should vary as the hold control is manipulated.

In those sets which have a normal raster and picture, but will not stand still vertically, loss of sync is indicated. It is in these cases that we can use this tool to good advantage. Start at the point of sync take-off, whether it be the video detector or the last video if stage. At this point you should be able to hear a decided click or thump of the sync pulse so long as the blanking bar appears on the picture. Then touch the inputs and outputs of all tubes, capacitors, resistors down through the sync separator, the sync amplifiers, and clippers, even the integrator until you find the points between which the pulse disappears.

Just one word of caution. Often you will find a sync pulse on both sides of a blocking transformer when the fact is that the coupling coil is open. You can check to see if the click is sync or generated pulse by twiddling the hold control. If generated, the frequency will vary. Many times, as you follow the sync pulse through the chain, it does not disappear, but becomes weaker, due to a faulty tube or component.—*H. L. Matsinger* END

Question Box

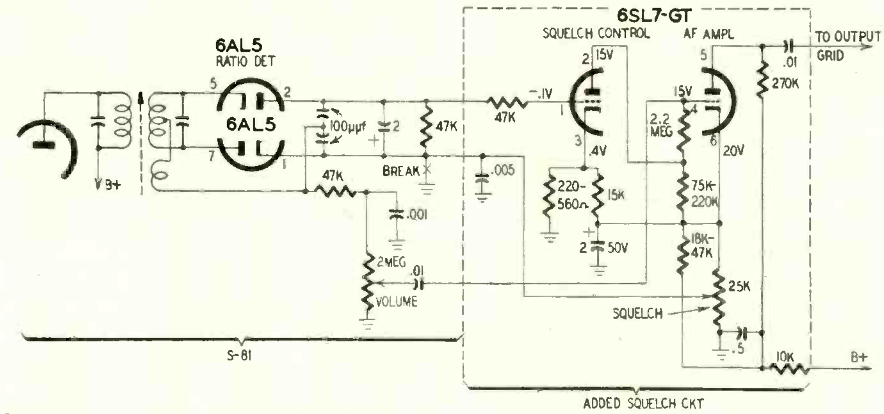
SQUELCH FOR S-81 RECEIVER

We use a Hallicrafters S-81 receiver as a radiation monitor for dielectric heaters in our plant. We would appreciate details on an audio squelch circuit that we can add to this receiver to control the background noise and hiss that are present when there is no signal on the antenna.—B. R., Boonton, N. J.

The drawing shows how the Hallicrafters S-81 can be modified to include a squelch circuit similar to that used in the Monitoradio MR-32 and to the system described on page 82 of our October, 1950, issue.

The 6SQ7 af amplifier is replaced by a 6SL7-GT. The added components are enclosed within dashed lines. The grounds on the 47,000-ohm detector load resistor, the 2-μf storage capacitor, one of the 100-μμf balancing capacitors and pin 1 of the 6AL5 are lifted and connected to the arm of the squelch control as shown.

The voltages and some resistance values may have to be determined empirically. Those resistors whose



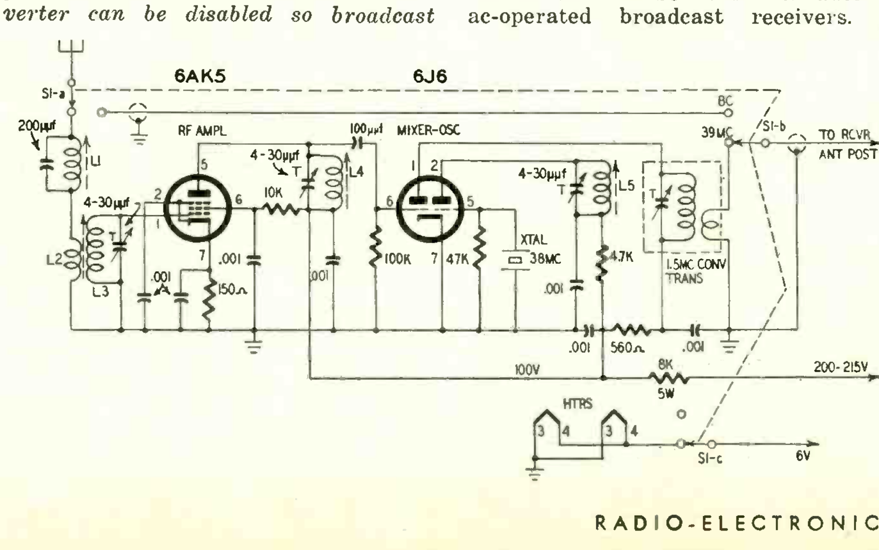
values are likely to be critical are shown with a range of values. Select the optimum value by experimenting.

The circuit is designed so that when no signal is applied to the set's antenna, the control tube conducts and develops a voltage drop across the resistor in its plate circuit. This increases the bias on the af amplifier and drives it to cutoff. When a signal comes in, a negative voltage appears on the grid of the control tube and cuts it off and permits the af amplifier to operate normally. The squelch control sets the operating point for the circuit.

39-MC CONVERTER

Is there a simple converter that can be used with AM radios to receive 39.5-mc forest-ranger signals? If so, please print the circuit and show how the converter can be disabled so broadcast stations can be received.—E. R. S., Centertown, Ky.

Here is the circuit of a 39-mc converter that can be used with auto or ac-operated broadcast receivers. A



crystal-controlled oscillator is used for stability. The oscillator may be operated on any frequency between 38,000 and 38,950 or 40,050 and 41,000 kc and still have the converter output come in on the receiver between 550 and 1500 kc.

In this circuit, the oscillator frequency is 1500 kc below the signal frequency so the receiver must be tuned to 1500 kc when the converter is being used. The crystal may be one of the James Knights series JK-H17, Bliley BH-6 type or equivalent.

Coils L3, L4 and L5 may be CTC (Cambridge Thermionic Corp.) type LS3 30-mc coils. L2 is a 3–5-turn winding of No. 28 enameled wire closewound over the ground end of L3. L1 is a trap tuned to the converter's output frequency to prevent broadcast stations from breaking through and causing interference. It may be a slug-tuned broadcast antenna coil or an adjustable rf choke with a range of around 60 to 120 μh. Its tuning capacitor may be a trimmer instead of a fixed unit.

With the 38-mc oscillator, signals between 38,550 and 39,600 kc can be received by tuning the receiver from 550 to 1600 kc and signals between 36,400 and 37,450 can be heard when tuning the receiver from 1600 to 550 kc. For fixed-frequency operation in these ranges, the tuning capacitors across L3 and L4 should be peaked to the desired frequency and the converter output transformer replaced by a broadcast antenna coil peaked to the converter's output frequency.

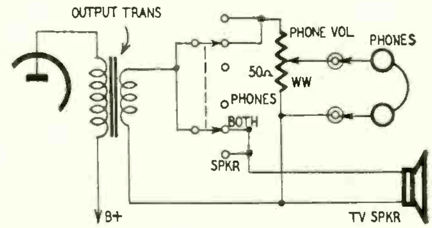
For continuous tuning in these ranges, the tuning capacitors across L3 and L4 should be ganged and fitted with a calibrated dial for peaking. The converter output transformer will have to be replaced with a self-resonant output circuit. You can use a J. W. Miller type 472-UA antenna coil or a 2.5-mh rf choke and use capacitance coupling from the mixer plate to the 39-mc contact of S1-b.

Regardless of the type of operation, the oscillator tuning slug and trimmer capacitor must be adjusted for minimum current on a 10-ma meter inserted between the 4,700-ohm resistor and the junction of L5 and the .001-μf bypass capacitor. Use a grid-dip meter to make sure that L5 is tuned to the crystal frequency.

TV HEADPHONE ADAPTER

One of our household has defective hearing. Even when using a hearing aid, he operates radio and TV sets at a level that is much too high for others. How can headphones be connected to the output of the receiver so they can be used alone or with the speaker. What type of phones are best for this application?—D. M., Bronx, N. Y.

Here is a simple switching circuit that can be used with any receiver. Headphones with impedance in the range of 6 to 75 ohms are recommended. Phones and adapters are available as easy-to-install kits that range from around $3.50 to $15, depending on the type and quality of the phones. A light-

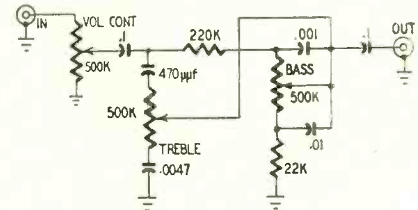


weight hearing-aid type of phone would probably be more comfortable when worn for hours at a time.

TONE AND VOLUME CONTROLS

Please print the circuit of a volume and tone control unit that I can insert in the line between my phonograph preamplifier and the input to a power amplifier. The output of the preamplifier is nearly 5 volts and the amplifier requires an input of only about 0.75 volt for full output. I'd like to use 500,000-ohm controls if possible and would like to be able to boost and cut the treble and bass.—R. E. D., Durham, N. C.

This circuit can be used as a remote-control panel for your audio system. The input and output leads should be shielded. If the connecting cables are long, insert a 1-megohm resistor in series with the output terminal of the preamp and another between the 0.1-μf capacitor and the output terminal of the control unit to minimize high-frequency losses due to the cable capacitance.



The losses are rather high in this tone-control circuit so it may be necessary to add another stage of amplification to the preamp or main amplifier to compensate. A 6J5, half of a 6SN7-GT or any similar tube will provide enough gain.

PHONO MOTOR CLICK FILTER

There is an annoying click in my amplifier each time that the phono motor is turned on or off. Is there any way to eliminate or reduce this click? —*J. M. F., West Islip, N. Y.*

A click filter can consist of a resistor and capacitor in series across the switch contacts. The capacitor may vary from about .02 to 0.1 μf and the resistor may be any convenient value between 50 and 100 ohms. END

Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*	
Modern Electric	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In May 1922 *Science and Invention* (formerly *Electrical Experimenter*)

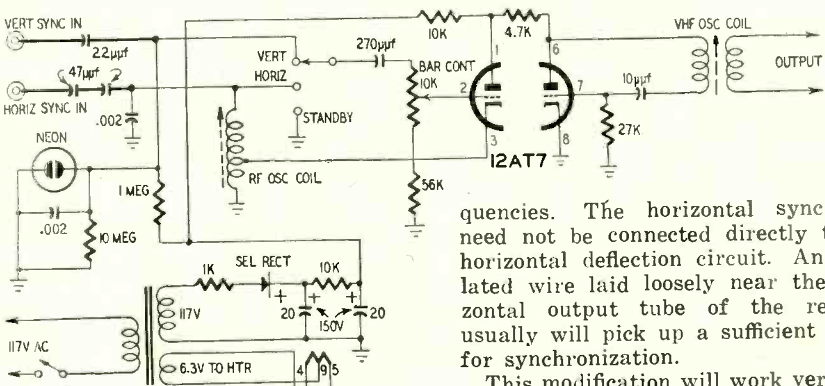
The Radio Explorers, by Robert R. Parker.
Radiophoning from Ship to Shore.
Thomas A. Edison Has Become a "Radio Fan."
Dancing to Radio Music on the Ocean.
Chicago Police Adopt Radiophone.
What Caused the Signals?, by John G. Merne.
Radio on Aircraft.
Continuous Radio Recorder, by Arthur H. Lynch.
Simplest Radiophone Receiver (Second Prize), by H. L. Jones.
Radio Receiver in Fountain Pen.
Radio Constructor Hints, by H. Winfield Secor.
Radio for the Beginner, by Armstrong Perry.

radio-electronic Circuits

SYNCING BAR GENERATOR

Many bar and dot generators used for TV linearity and convergence tests have no provision for synchronization. This usually results in a very critical horizontal frequency setting to obtain stationary vertical bars or dots. A minor modification of the generator will give excellent synchronization so that the receiver checks can be made without having to reset the horizontal hold control continuously.

This modification is shown in heavy lines on the diagram for the Heathkit bar generator BG-1. Adding the capacitors to the circuit allows a small signal from both the horizontal and vertical deflection circuits of the receiver to be fed into the generator, synchronizing the bars or dots to the receiver frequencies. The horizontal sync lead need not be connected directly to the horizontal deflection circuit. An insulated wire laid loosely near the horizontal output tube of the receiver usually will pick up a sufficient signal for synchronization.



This modification will work very well for other generators; however, different capacitors may be necessary. When the sync leads are connected directly to the deflection circuits, be sure that the voltage rating of the capacitors is sufficient to prevent breakdown by the high-voltage pulses which can be as high as 2,000 volts.—*Henry A. Kampf*

GROUNDED-GRID MODULATOR

Sometimes a simple wide-band modulator is needed for a signal generator or a low-powered transmitter. A grounded-grid amplifier may be easily converted into a high-frequency modulator that handles frequencies ranging from near dc to high in the video range. Although the circuit in Fig. 1 is not widely used, it will give satisfactory results. The grid is grounded for the carrier frequency by the series-tuned trap.

Fig. 2 shows a similar arrangement using a cathode follower driver direct-coupled to the grounded-grid modulator. In all cases, L and C are selected to tune to the rf carrier.—*I. F. Barditch*

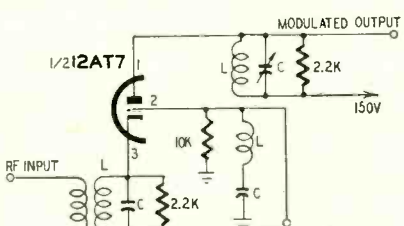


Fig.1

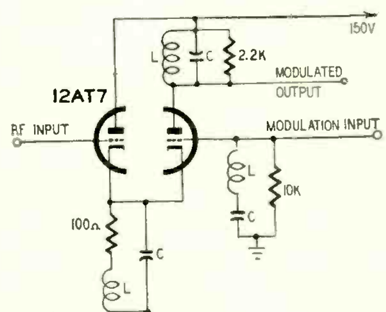


Fig.2

NOVEL VHF ANTENNA

The tri-delta (three-element delta-matched) 2-meter parasitic array is described here. See Fig. 1. It has a gain of nearly 8 db and may be fed either with 300-ohm ribbon or 50–75-ohm coax. Designed for portable operation with the Gonset Communicator II, it is used for reception and transmission of vertically polarized signals but can be turned on its side for horizontal polarization.

The delta provides an essentially flat

match between the radiator and the 300-ohm input terminals and a good means of bringing the lead-in out of the field around the active elements. The connection between the delta and the 300-ohm ribbon is made at an insu-

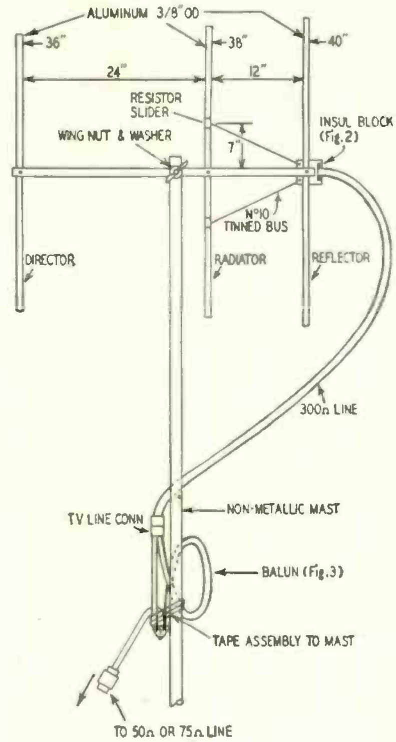


Fig.1

lating block constructed as in Fig. 2. The ribbon is clamped to the block to ease the strain on the connections.

The delta section is No. 10 tinned bus bar fanned out approximately 7 inches each side of the radiator's cen-

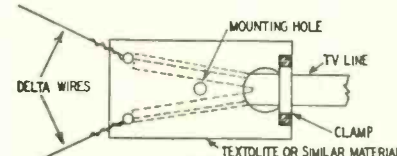


Fig.2

ter. Adjustable, it is fastened to the radiator with sliders from 10-watt adjustable resistors. For best results, the sliders should be adjusted for the best standing-wave ratio.

A length of 300-ohm ribbon is used

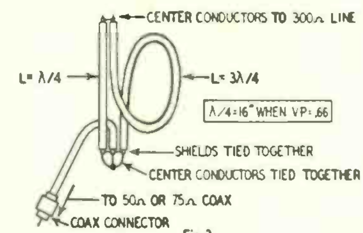


Fig.3

to maintain a balanced line close to the antenna. When coax is used, the impedances are matched with a balun (balanced-to-unbalanced) transformer constructed from RG/62-U 93-ohm coax as in Fig. 3. This type of cable tends to flatten out the overall standing-wave ratio somewhat more than most others.

(An antenna is matched to a transmission line when its input impedance equals the effective characteristic impedance of the transmission line. When the two are matched the voltage standing-wave ratio is unity. Thus, the match between antenna and transmission line can be determined by either measuring the SWR or the antenna's input impedance. Simple standing-wave and antenna impedance bridges are described in detail in recent editions of *The Radio Amateur's Handbook.* —*Editor*)

Some additional gain can be obtained by using additional directors, each being cut about 5% shorter than the nearest one between it and the radiator. However, when the directivity improvement is balanced against the increase in overall size, a three-element unit is about right for portable use.—*C. O. Field*

(The resonant frequency of this antenna is approximately 145.8 mc. For other frequencies, scale the dimensions up or down in proportion to the ratio of the frequencies.—*Editor*)

6AS7-G's IN POWER SUPPLIES

The 6AS7-G is an excellent regulator tube for power supplies whose output current is around 200 ma but has one serious drawback—there are variations in the triode sections of the tube. These sections are usually connected in parallel and controlled by a single biasing voltage as in Fig. 1. For a given control voltage the variations cause an uneven distribution of the currents in the two sections of the tube. This is not serious at low-current levels, but it

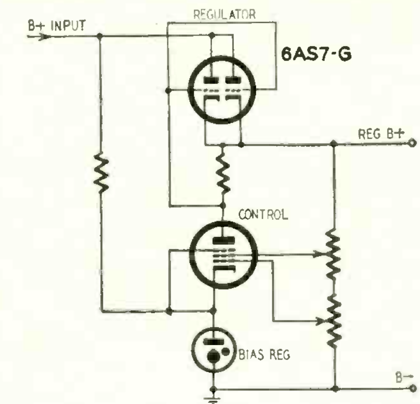


Fig. 1

is when current is high. If one triode draws considerable more current than the others, it will overheat. As it overheats, it tends to draw more current. This "regeneration" continues until the tube is destroyed.

Some attempts have been made to reduce this effect by inserting cathode resistors in the regulator circuit to develop cathode degeneration, but this is not too effective as the cathode degeneration is negligible compared to the thermal "regeneration."

Tube selection at the price of the tube is prohibitive for experimenters and expensive for manufacturers of equipment using the tube. Tubes are plugged in and, if one section gets red hot, it is unbalanced and the tube must be replaced. Fortunately, only a small percentage of them are prohibitively unbalanced.

When installing a 6AS7-G in a regulated power supply, the triode sections may be adjusted for optimum performance by using the simple circuit shown in Fig. 2. A potentiometer is installed

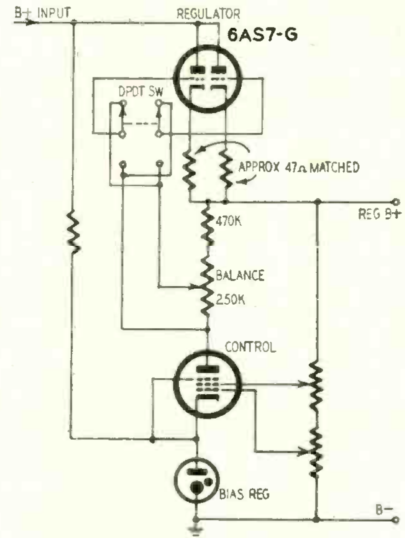


Fig. 2

and the control voltage adjusted to the grids of the tube until the current balances. This is done at about two thirds of the maximum current for which the supply is designed. Once set, the tubes remain fairly well balanced throughout the current range if the maximum plate voltage is not exceeded. If the supply is to be used in a fixed load circuit, the adjustment is made at the operating load.

My supply has a single tube. If more than one tube is required, it is not difficult to modify the circuit. The supply is adjusted as follows:

1. Set the balance control so its arm is at the plate of the control tube.
2. Connect an appropriate load to the output of the supply.
3. Measure the voltage across the cathode resistors of the triodes to find the section delivering the least current.
4. Turn off the power supply and then throw the d.p.d.t. switch to the position that connects the grid of that section to the arm of the balance control. (The power supply should be turned off when throwing the selector switch to avoid damaging it as the grids are momentarily opened.)
5. Connect a voltmeter across the cathodes of the triode sections and adjust the balance control until the cathode voltages (and therefore the currents) are equal.

The values shown have worked well for me, but variations may be made to suit the individual case. The cathodes of the triodes may be brought through the chassis with pin jacks for future adjustments. The balance control should be a screwdriver-adjusted type and should be placed behind the front panel.
—*R. P. Jamison* END

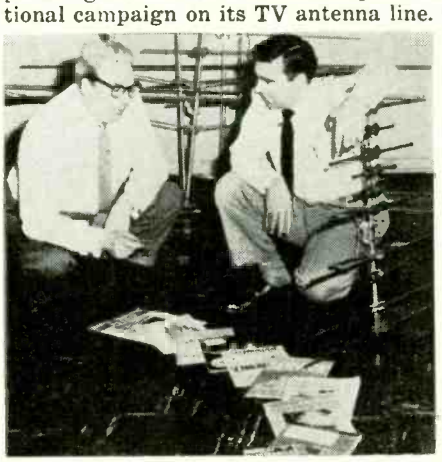
Business

¢ $

Merchandising and Production

RCA Tube Div., Harrison, N. J., is sponsoring an all-out sales promotion program on its batteries. The plan includes extended payment terms, buying benefits and technical selling tools. Counter merchandisers, window displays, advertising mats, etc. were prepared for dealers and distributors.

Winegard Co., Burlington, Iowa, is planning a trade and consumer promotional campaign on its TV antenna line.



The photo shows John R. Winegard (right), president of Winegard, discussing the campaign with Burton Browne, head of the company's advertising agency.

Service Instruments Co., Addison, Ill., designed a four-color display board for its small service units. The board is equipped with easels and hooks so that it may be hung or set on a counter.

Brach Manufacturing Co., Newark, N. J., was featured recently on Bob Considine's "Cavalcade of Progress" TV show over WABD channel 5, New York. Ira Kamen, Brach's vice president in charge of electronic research, and Jerome Berger, plant manager, were interviewed and several of the company's new products were introduced.

National Radio Week will be celebrated May 13 to 19. It is sponsored by the National Association of Radio & TV Broadcasters, the Radio Advertising Bureau, RETMA and the National Appliance & Radio-TV Dealers Association.

Production and Sales

RETMA reported that a record 7,421,-978 TV sets were shipped to dealers during 1955. The association also reported that manufacturers' sales of transistors reached a total of 3,646,802 units last year, nearly three times the previous year's total.

The Magnetic Recording Industry

Association, New York, reports that about 20% more recorders were sold in 1955 than 1954. Total production for 1955 was estimated at 360,000 units.

RETMA reported that 43,099,796 TV sets had been shipped to dealers during the past 10 years. It also reported TV picture-tube sales of 892,385 units for January, 1956, compared with 866,956 for January, 1955. Comparative sales of receiving tubes were 40,140,000 in January, 1956, as against 37,951,000 in 1955.

Mergers

Textron American Inc., Boston, Mass., acquired all outstanding stock of **General Cement Manufacturing Co.**, Rockford, Ill., manufacturer of TV antennas and technical aids. Stanley B. Valiulis, president of General Cement, will head the new Textron division.

P. R. Mallory & Co., Indianapolis, Ind., acquired **General Dry Batteries, Inc.**, Cleveland, Ohio, which it will operate as a division, subject to stockholders' approval.

Astron Corp., East Newark, N. J., bought all the outstanding stock of **Skottie Electronic Corp.**, Peckville, Pa., including buildings and production facilities. Skottie manufactures ceramic capacitors.

New Plants and Expansions

Sprague Electric Co., North Adams, Mass., is beginning construction on a new 20,000-square-foot plant in Concord, N. H., for the manufacture of surface-barrier transistors.

Merit Coil & Transformer Corp., Chicago, opened a new warehouse in San Francisco to improve service to its West Coast distributors.

International Rectifier Corp. relocated its New York office in larger quarters at 132 East 70th St.

Allen B. Du Mont Labs transferred its Missile Engineering Dept. from Clifton, N. J., to Los Angeles.

Westinghouse has begun work on a new 120,000-square-foot electronic-tube warehouse in Elmira, N. Y.

Business Briefs

. . . **1956 High-Fidelity Show and Music Festival** will be held in the Palmer House in Chicago Nov. 2–5. The show management announces that all display rooms will be air-conditioned and elevator service will be improved.

. . . **Westlab Electronics**, Yonkers, N. Y., formerly a partnership, has been incorporated. Officers include Ira B. Perelle, president; Lois A. Brook, vice president, and Louis Petta, secretary.

. . . **Ray-O-Vac Co.**, Madison, Wis., has adopted the NEDA numbering system for its complete line of radio batteries.

Correction

In the March issue an item stated that **Tescon TV Products Co., Inc.** was imprinting its distributors' names on its antenna cartridges. This should have read on its antenna cartons. END

People

Dr. Thomas T. Goldsmith, Jr., vice president research, of Allen B. Du Mont Labs., Clifton, N. J., was named vice president and general manager of the Government and Research Div. in a move to consolidate all government manufacturing, engineering and sales operations into one division. He will continue to direct the company's Research Div.

Merle W. Kremer was appointed assistant general manager of the Sylvania Parts Div., Warren, Pa. He will continue his present duties as general manufacturing manager, with plants at Cleveland and Nelsonville, Ohio, as well as at Warren.

Harold F. Cook (left), advertising manager of Tung-Sol Electric, Inc., Newark, N. J., was appointed to the newly created post of director of ad-

vertising and market research. **Robert M. Andrews** (right), former assistant advertising manager, was named manager of advertising and sales promotion for electronic products.

Edward G. Hazeltine was appointed manager of advertising and sales promotion for automotive products and will continue as manager of TBA sales. **Gerald A. Morgan**, former market analyst, was named manager of market research.

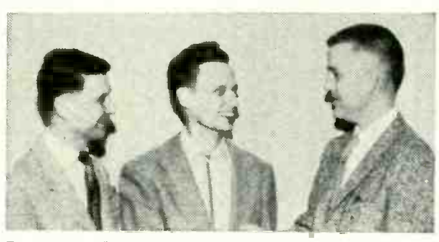
John D. McNamara joined Weston Electrical Instrument Corp., Newark, N. J., as field sales manager. He was formerly with Beckman Instruments, Inc., as that company's industrial sales manager.

Mal Parks, Jr. joined Howard W. Sams & Co., Indianapolis, Ind., in an executive capacity. He had been publisher of *Parts Jobber Magazine*.

Louis H. Niemann (left) was named equipment sales manager at CBS-Hytron. He was formerly Eastern district

sales manager. **Lee Ballengee, Jr.,** (right) formerly with General Instrument Corp., suceeds him as Eastern district sales manager. **Herbert L. Reichert,** formerly Central district manager for CBS-Hytron, was appointed Midwest regional manager for CBS-Hytron Sales Corp, with headquarters in Chicago.

W. Ropp Triplett, general manager of Triplett Electrical Instrument Co., Bluffton, Ohio, was named president of the company. **Ray L. Triplett,** founder and president, becomes chairman of the board. The photo shows W. Ropp Triplett (center), one of the two sons of the founder, being congratulated by Norman Triplett, vice president and sales manager, while M. Morris Triplett, the other son of the founder, and vice president, engineering, looks on.



Beg Pardon

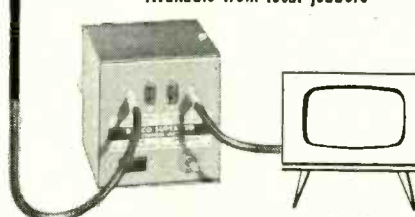
In the April issue, the photos of **Ken Hathaway**, who was elected treasurer of the Association of Electronic Parts and Equipment Manufacturers, and **Russel Schlegel**, who joined Weston Electrical Instrument Corp. as manager of Industrial Product Sales, were transposed.

Obituary

Robert Robins, a public relations counsel and radio pioneer, at his home in Forest Hills, N. Y. He was at one time president of Cath-Ray Electronics Corp. and the Duovac Radio Tube Corp.

Personnel Notes

. . . **James H. Carmine**, retired as president of Philco Corp., but will continue as a member of its board and Finance Committee. He is to be succeeded by **James M. Skinner, Jr.**, director and



vice president and general manager of the Television Div., pending approval by stockholders.

. . . **George J. Parker**, former president of the Daystrom Instrument Div., was appointed vice president of Daystrom Inc. in charge of its Washington office. **Walter W. Slocum**, vice president of operations for Daystrom Inc., will assume responsibility for the operation of the Instrument Div.

. . . **Andrews Ferguson** was placed in charge of New England distributor sales for Sprague Products Co., North Adams, Mass. He was formerly field representative for the company. **Albert Coumont**, who had been service coordinator and staff assistant to the RETMA Parts Div., joined the Sprague Electric Co. Distributor Sales Div.

. . . **Arthur I. Rabb**, advertising and sales promotion manager of United Catalog Publishers, Inc., New York, was promoted to general manager. **George Siegel**, former assistant advertising manager, succeeds him. **Herman Holstein** was named editor of *Radio-Electronic Master*. Other appointments include: **George M. Kerner**, manufacturer liaison, and **Robert J. Males**, administrative assistant.

. . . **Harold A. DeMooy** was appointed manager of manufacturing for RCA receiving tube activities at Harrison, and Woodbridge, N. J., Indianapolis, Ind., and Cincinnati, Ohio. He had been in charge of the tube plant in Cincinnati. **John B. Farese** was named manager, personnel, for the division. He had been manager of manufacturing for the concern . . . **William L. Eschwei**, manager of radio assembly inspection and test at the Clifton, N. J. plant of Federal Telephone & Radio Co., was named plant manager of the Pacific Div. **Joseph F. Rapone**, superintendent of radio assembly, succeeds him.

. . . **Peter L. Jensen**, chairman of the board of Jensen Industries, and **Edwin S. Pridham**, former vice president of Magnavox, were named honorary members of the Audio Engineering Society for their pioneer work on the electrodynamic loudspeaker in 1915.

. . . **Avery Fisher**, Fisher Radio Corp., was elected chairman of the Board of Directors of the Institute of High Fidelity Manufacturers.

. . . **Robert L. Ashley**, with the company since 1952, was appointed sales manager for germanium and silicon products by Radio Receptor Co., Inc., Brooklyn, N. Y.

. . . **Harry A. McDonald**, investment counselor, was elected to the Board of Directors of Sonotone Corp., Elmsford, N. Y.

. . . **John M. Palmer** was named manager of the new Spring City, Pa., plant of the Lansdale Tube Co., a division of Philco. He had been manager of receiving and cathode-ray tube operations.

. . . **Herbert C. Guterman**, who has had wide industrial operating experience in the electronics field, was elected chairman of the board of National Co., Malden, Mass. END

technical Literature

G-E BROCHURE

An 8-page brochure *ECG-95* contains condensed specification and rating data on transistors and rectifiers, critical parameters for absolute maximum ratings and design center ratings for G-E n-p-n and p-n-p transistors; critical specifications for germanium rectifiers including basic rectifier units; high-temperature, magnetic amplifier and 5-amp power rectifiers; rectifier stacks, including medium-power, in various applications.

Brochure or individual specification sheets from Semiconductor Products Section, General Electric Co., Electronics Park, Syracuse, N. Y.

BUD CATALOG

Catalog No. 156 describes sheet-metal products and electronic components. In addition, special fabrication facilities are outlined. Complete sizing information is given on each product and suggestions for uses and applications are also included.

Bud Radio, Inc., Dept. C8, 2118 E. 55 St., Cleveland 3, Ohio.

SPEAKER SYSTEMS

A comprehensive *Guide to High-Fidelity Loudspeaker Systems* stresses the importance of the loudspeaker in any home music center and provides basic facts on how to choose a loudspeaker system. It gives details about integrated, separate and completely assembled two-, three- and four-way systems as well as acoustically designed, furniture-styled enclosures to suit individual budgets, space, decor and musical tastes. It also includes information about Electro-Voice do-it-yourself high-fidelity enclosure kits and the availability of individual speaker system components.

Electro-Voice, Inc., Buchanan, Mich., 25c.

SELENIUM RECTIFIERS

Form HT1 describes the new Sarkes Tarzian line of selenium rectifiers designed to operate at full voltage and current without derating at temperatures as high as 150°C.

Sarkes Tarzian Inc., Rectifier Div., 415 No. College Ave., Bloomington, Ind.

AMPLIFIERS

RCA's *Catalogs S3027, S3026* and *S3023* give data on applications, descriptions, specifications and accessories of 30-watt amplifiers MI-12154, type SA-34A, MI-12155, type SA-32A and 15-watt sound amplifier MI-12156, type SA-15A.

Radio Corp. of America, Sound Products, Camden, N. J.

NEEDLE CATALOG

A 73-page catalog includes a cartridge-to-needle listing, illustrated cartridge index, illustrated needle listing with an index and needle installation data.

Permo, Inc., 6415 Ravenswood Ave., Chicago 26, Ill.

MAGNETS

Cast, sintered, ductile and formed permanent magnet materials are discussed in manual *No. 5, Permanent Magnets Materials and Their Selection.* A selector type chart summarizes the magnetic characteristics, application and design factors, material characteristics, manufacturing methods and shape limitations of each.

Other sections of the manual discuss the hysteresis loop and demagnetization curve, temperature limitations, directional properties, incremental permeability, hysteresis loss, etc.

A glossary of magnetic terms, listing of magnetic symbols and graphic illustration of material characteristics are also included.

Indiana Steel Products Co., Valparaiso, Ind. Use your letterhead.

BENCH TOOLS

A 40-page catalog describes insulated and noninsulated screwdrivers, nut drivers, pliers, service tool kits, alignment and specialty tools, etc. Heavily illustrated with photos, charts and tables.

Vaco Products Co., 317 E. Ontario St., Chicago 11, Ill. Requests must be on letterheads.

INSTRUMENT TYPE SWITCHES

An 8-page *Catalog 17-SE* describes instrument type switches. Illustrations, complete code system outline and specifications are included in the data.

Cinema Engineering Co., Aerovox Div., 1100 Chestnut St., Burbank, Calif.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

MULLARD AUDIO TUBES

This leaflet describes the EF86, EEC83, EL84 and EL34 tubes designed for audio equipment. The electrical characteristics of each are given together with tables on typical operating conditions. In addition, preliminary technical data are given for the EZ81 and GZ34 full-wave rectifiers.

International Electronics Corp., 81 Spring St., New York 12, N. Y.

PAPER CAPACITORS

Catalog 155 describes paper capacitors for ac and dc applications. Data on mineral-oil-impregnated paper-dielectric capacitors in a variety of containers, synthetic-oil-impregnated paper-dielectric capacitors, etc. are included. Charts and diagrams also given.

Plastic Capacitors, Inc., 2511 W. Moffat St., Chicago 47, Ill.

ELECTRONIC EQUIPMENT

Newark's 1956 catalog devotes more than 20% of their catalog to audio and high-fidelity equipment, as well as a large line of radio and TV repair equipment, components, radio hardware, etc.

Newark Electric Co., 223 W. Madison St., Chicago 6, Ill.

OUTPUT TRANSFORMERS

A 6-page folder contains complete data and three schematics of Dynaco output transformers. A chart on color coding of transformer leads is also included.

Dyna Co., 5142 Master St., Philadelphia 31, Pa.

AUDIO EQUIPMENT

Langevin's catalog describes transformers, reactors, amplifiers, power supplies and special equipment.

Langevin Mfg. Corp., Subsidiary of W. L. Maxson Corp., 47-37 Austell Pl., Long Island City 1, N. Y. END

OPPORTUNITY ADLETS

Rates—45c per word (including name, address and initials) Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for July issue must reach us before May 15, 1956.

RADIO-ELECTRONICS,
154 West 14 St., New York 11, N. Y.

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HIGH-FIDELITY SPEAKERS REPAIRED. Amprite Speaker Service, 70 Vesey St., New York 7, N.Y. BA 7-2580.

"NEW. Build $4.00 transistor radio. Illustrated plans, 50c, COOK. 4003-R Roosevelt, Midland, Texas."

SPEAKER RECONING: Guaranteed workmanship. C&M Recone Co., 255 Tioga St., Trenton 9, N.J.

TELEVISION Tuner Repairs. DAN'S Television Laboratory. 9 West 183rd St., N.Y. 53, N.Y.

DIAGRAMS FOR REPAIRING RADIOS $1.00. Television $2.00. Give Make, Model. Diagram Service, Box 672-RE, Hartford 1, Conn.

TUBES—TV, RADIO, TRANSMITTING, AND SPECIAL PURPOSE TYPES BOUGHT, SOLD AND EXCHANGED. Send details to R. E. Gensler W2LNI, 512 Broadway, N.Y. 12, N.Y.

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FT-243's: 3500 to 8700 KC. $2.00 each. HUNDLEY CRYSTAL CO., 2951 North 36th, Kansas City 4, Kansas.

TRADE IN TV SETS $14 up. JONES RADIO, 1115 Rambler, Pottstown, Pa.

TAPE RECORDERS, tapes; Wholesale prices. KARSTAN, 215 E. 88 St., New York 28, N.Y.

WANTED: AN/APR 4, other, "APR.", "TS-", "IE-", ARC-1, ARC-3, ART-13, BC-348, etc. Microwave Equipment. Everything Surplus. Special tubes. Tec Manuals, Lab Quality Equipment, Meters. Fast Action, Fair Treatment. Top Dollar! Littell, Fairhills Box 26, Dayton 9, Ohio.

JAPAN DIRECTORY. 100 Japan exporters, plus opportunity mail. Just $1.00 today. NIPPON ANNAI, 920-3rd Ave. Seattle 4, Wash.

DIAGRAMS: Professional Model Timers, Counters, Intercoms, Organs, etc. $1.00 each. List free. Parks, 101 S.E. 57th, Portland 15, Oregon.

Tenaclip anchors whip antenna firmly. $1.98 postpaid. PLASTICLES, 4207 Grand River, Detroit 8, Mich.

PRINTING—Letterheads, 6¾ envelopes, statements. 250 for $2.50. Postpaid. POOR BOY RE, Box 1055, Little Rock, Ark.

RADIO, RADAR, TELEVISION instruction leading to Licenses. Port Arthur (Texas) College.

FOREIGN jobs list. Technicians needed. $1. RATHE. Box 173, New Orleans 3, La.

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Notre Dame viewcards, 8 for $1.00. Remails 25c. SCHAUT, 619 Kamms, Mishawaka, Indiana.

HI-fidelity Specials — Limited Supply — Order Today — Collaro RC-54—Mounting Board—Ronette Cartridge—Diamond Stylus on LP—only $49.75 Prepaid—$39.50 without Diamond, prepaid. 1800' Guaranteed tape—New—on 7" reel—plastic base, 10 for $24.00 Prepaid—Full line of Hi-Fi equipment—write today . . . SOUND MART UNLIMITED, INC., 63-03 39th Ave., Woodside 77, New York.

RUBBER STAMPS: 1st line 65c, Add'nl lines 35c. Ink-Pad 60c. STAMP SHOP, Victoria, Kans.

Diagrams—Repair Information! Radios, Amplifiers, Recorders $1.00 Televisions $1.50. Send Make, Model, Chassis. (Air-Mail ? + 20c) TV MILTIE, Box 101-E, Hicksville, New York.

INTERNATIONAL TAPE-RESPONDENCE MEMBERS WANTED. U.R.C. Box 147, Chicago 50, Illinois.

TV FM ANTENNAS. ALL TYPES. Mounts, accessories. Lowest prices. Wholesale Supply Co., Lunenburg 2, Mass.

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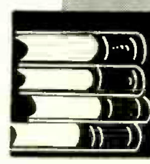
Books



THE LONG PLAYING RECORD GUIDE, by Warren De Motte. Dell Books, 200 Fifth Ave., New York, N. Y. 50c.

Even the connoisseur who knows both the music and the orchestras would have difficulty choosing between 20 recorded versions of the same work assuming he could even manage to hear them all. The typical listener who listens primarily because he loves music and pretends no expertness about it is usually completely at a loss. Warren De Motte in this inexpensive pocketbook offers guidance to both classes of listeners and in my view succeeds better than others in more pretentious and expensive guides.

In a work like this the author cannot avoid being colored by his personal likes and dislikes, tastes, preferences and even prejudices. I particularly like this work because Mr. DeMotte does less categorical judging and more describing of differences in performance, interpretation and recording than others. He does mark with an arrow the recording which in his view is the best of the available lot, but he also gives the highlights or deficiencies of all versions succinctly but clearly enough so those whose taste may differ are given more than a hint to guide them in their own choice.

Judging by the small percentage of works I have heard myself, Mr. De Motte compiles a very good batting average in his recommendations. And the complete layman does not run much risk of being displeased if he follows them. The audiophile and hi-fi fan will also be well served for Mr. De Motte invariably points out the best recordings, even if the recording is not musically first-class in his own judgment; and here too his batting average is very good.

The book does not even begin to pretend to be a catalogue of all LP recordings. It concentrates almost entirely on those most popular classics of which there are several recordings. The arrangement is alphabetical by the name of the composer.—*JM*

FUNDAMENTALS OF TELEVISION ENGINEERING, by Glenn M. Glasford. McGraw-Hill Book Co., Inc., New York, N. Y. 6 x 9 inches, 642 pages. $12.75.

This text is not for most service technicians but is suitable for engineers and advanced TV technicians. It covers the entire TV field from a theoretical viewpoint. Math is used extensively and there is considerable material on Laplace transforms and their applications.

Color TV is analyzed along with black-and-white.

Among important chapters are those on scanning, synchronizing, wideband amplifiers and restorers. The transmitting end of TV is covered in chapters which study problems relating to cameras, video transmitters and antennas.—*IQ*

A GUIDE TO GOOD BUSINESS, prepared by Merchandising Dept., Sylvania Electric Products, 1100 Main St., Buffalo, N. Y. 40 pages. 8½ x 11 inches.

Free from Sylvania Central Advertising Distribution Dept.

Published as an aid to present and future electronic service dealers, this booklet attempts to show the many things to be considered in opening and operating a radio and television sales and service shop. Among the subjects covered are original planning, surveying market conditions, choosing the right location, ideas and suggestions for window displays and arranging the work shop area.

The text is heavily supplemented with photos and drawings. Covering so many subjects in so few pages, the book is necessarily superficial in its treatment of each. However, several references are given to more detailed works on specific subjects.

Overall, the booklet is slanted toward sales and away from servicing, noticeably lacking in its treatment of test equipment and servicing supplies. For the prospective service dealer, *A Guide to Good Business* is just exactly that. —*JK*

PRACTICAL RADIO SERVICING, by William Marcus and Alex Levy. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 6 x 9 inches, 565 pages. $8.50.

This book should interest professional radio men as well as prospective technicians for members of the first group will want to recommend it to their friends in the second. Starting right from the beginning, nothing is taken for granted. The reader is told how to solder, shown how to remove a chassis and how to make simple tests. As he gains knowledge he proceeds to more complicated tests and troubleshooting.

The more common types of radios are discussed here: ac–dc, battery portable, phonograph. Diagrams show typical placement of components and tubes and where the set adjustments are located. Separate treatment is given to the power supply, if strip, audio and converter. Instruction is given on the use of an ohmmeter, multimeter and tube tester.

Valuable features are the assigned "jobs." The reader is asked to provide himself with an old set for experimental work and he is told how to take measurements and draw schematics. Deliberate defects may be introduced by the experimenter so he may learn to recognize faults and symptoms through experience.—*IQ*

School Directory

THE VTVM, by Rhys Samuel. Gernsback Library (No. 57), New York, N. Y. 5½ x 8½ inches, 224 pages, $2.50

This "workingman's book" is equally suitable for beginners because it is clearly written and avoids deep theory or calculations. It tells all about the vtvm and probes, and covers operation, use and maintenance. One chapter lists possible defects in the vtvm and how to correct them.

The basic idea behind this book is to explain the virtues (and also the faults—or limitations) of the vtvm—to show what you can reasonably expect the instrument to do.

Among the many applications described here are several that are eminently suited to a vtvm but sometimes not known or understood. Tests and measurements of impedance, ripple, stage gain, transformers are discussed. Other topics include scope calibration, receiver alignment and high-resistance measurements.

For the sake of completeness, the author even describes chores generally left for other types of equipment because the vtvm is considered too cumbersome or insensitive for the particular job. These include transmitter neutralization, kinescope tube test and bandpass curve plotting.

Useful data are provided in db charts, capacitor leakage values and schematics of receivers and various types of vtvm circuits.

INTRODUCTION TO TV SERVICING, by H. S. Swaluw and J. Van der Woerd. Philips Technical Library, 5¾ x 8 inches, 266 pages. Distributed in U. S. by Elsevier Press Inc., 2330 Holcombe Blvd., Houston 25, Tex. $5.50

For the radio technician who wants to learn television, this book describes European receivers with the 625-line picture system, but the same principles and service technique hold for our own system. Receivers are clearly described and illustrated and the theory is easy to understand.

The author emphasizes service procedure especially as applied to repairs in the customer's home. There are chapters on troubleshooting, test instruments suitable for home service, point-to-point measurement, etc. The author notes that most repairs do not require removing the chassis from the cabinet to the shop.

Two modern receivers are analyzed from front end to power supply, circuit by circuit. Schematics are printed on loose sheets of high-grade paper, folded into a pocket in the cover for convenient reference.

Approximately 100 pages are devoted to troubleshooting. Each listed defect occupies two pages. The left-hand page shows the result on a test pattern, while the right page shows how it looks on a cross-hatch generator. Pictorial effects, description and remedies are noted without page turning, greatly simplifying analysis.—*IQ*

R/C BIBLIOGRAPHY, by Paul F. Runge, Ace Radio Control, Higginsville, Mo. 5½ x 8½ inch looseleaf, 18 pages plus 20-page catalog. $1

An alphabetically arranged comprehensive bibliography of the most pertinent articles on radio control of models published between September, 1950, and July, 1955, in 10 of the leading model, hobby and radio magazines. Divided into sections on boats, planes, transmitters, control units and the like.

With the rapid growth of radio control, this bibliography should be a valuable asset to hobbyists.

SPECIALIZED HI-FI AM–FM TUNER MANUAL (Vol. 1), by John F. Rider Laboratory Staff. John F. Rider Publisher, New York. 208 pages. $3.50

A compilation of manufacturers' original specifications, circuit diagrams, photographs and troubleshooting and alignment data on AM, FM and AM–FM radios and tuners produced in 1950 through 1955 by 22 manufacturers.

RADIO AMATEUR QUESTION AND ANSWER LICENSE GUIDE (2d Edition), by Martin Schwartz. American Electronics Co., New York, 32 pages. 50c

A guide and aid in preparing for Novice, Technician, Conditional and General radio amateurs' license examinations. There are over 200 questions and answers — mostly multiple-choice type — similar in content and construction to those used by the FCC. One section is devoted to questions for prospective Novices and the other for would-be General, Conditional and Technician licenses.

REPAIRING RECORD CHANGERS, by E. Eugene Ecklund. McGraw-Hill Book Co., New York. 271 pages. $5.95

A practical manual on repairing record changers with a chapter on the mechanical aspects of magnetic tape recorders, it discusses in well-illustrated detail the operation of the various popular record changers and describes how defects are corrected. END

CORRECTIONS

There is an error in the 23rd line, second column, of the April editorial (page 33). Temperatures of hydrogen in the liquid and solid states should be Celsius (Centigrade) rather than Fahrenheit: −253° C and −260° C.

Our thanks to Chesley H. Johnson, of Massapequa, N. Y., for calling our attention to this error.

There is a discrepancy in the "Improved CRT Tester" diagram on page 171 of the January issue. The lead from the arm of S2's left-hand section should connect to the junction of the meter's positive terminal and the 500-ohm resistor, not the junction of the resistor and REJUVENATE contact S1.

This revision uses the 500-ohm resistor to limit cathode current as before. When wired as shown, the C-R tube is apt to be damaged when S1 is thrown to REJUVENATE.

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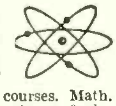

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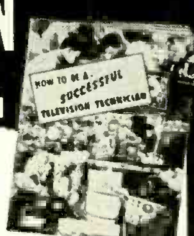

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MS-31

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RADIO-ELECTRONICS does not assume responsibility for any errors appearing in the index below.

SCHOOL DIRECTORY PAGE 150-151

FREE! LAFAYETTE CATALOG

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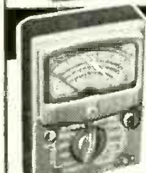

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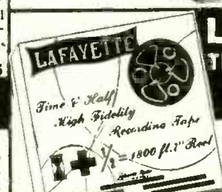

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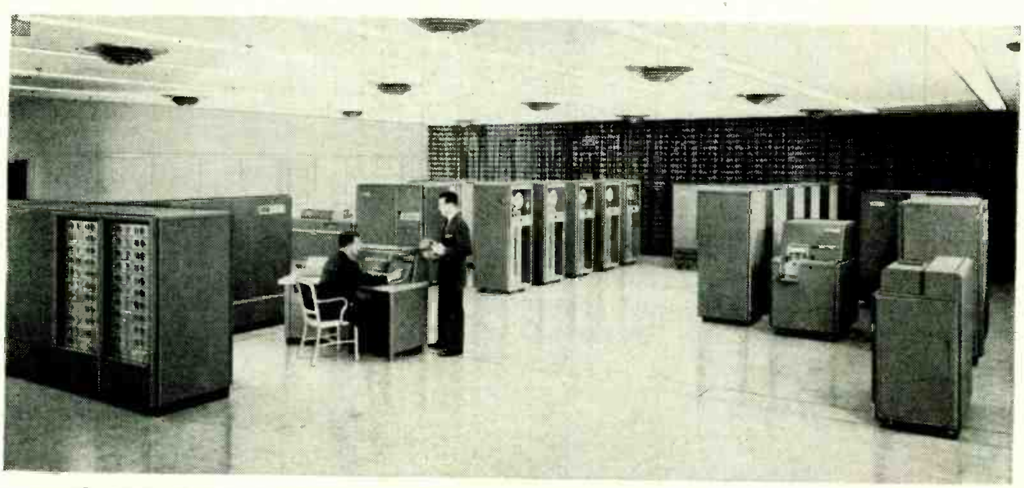

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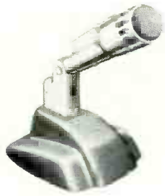

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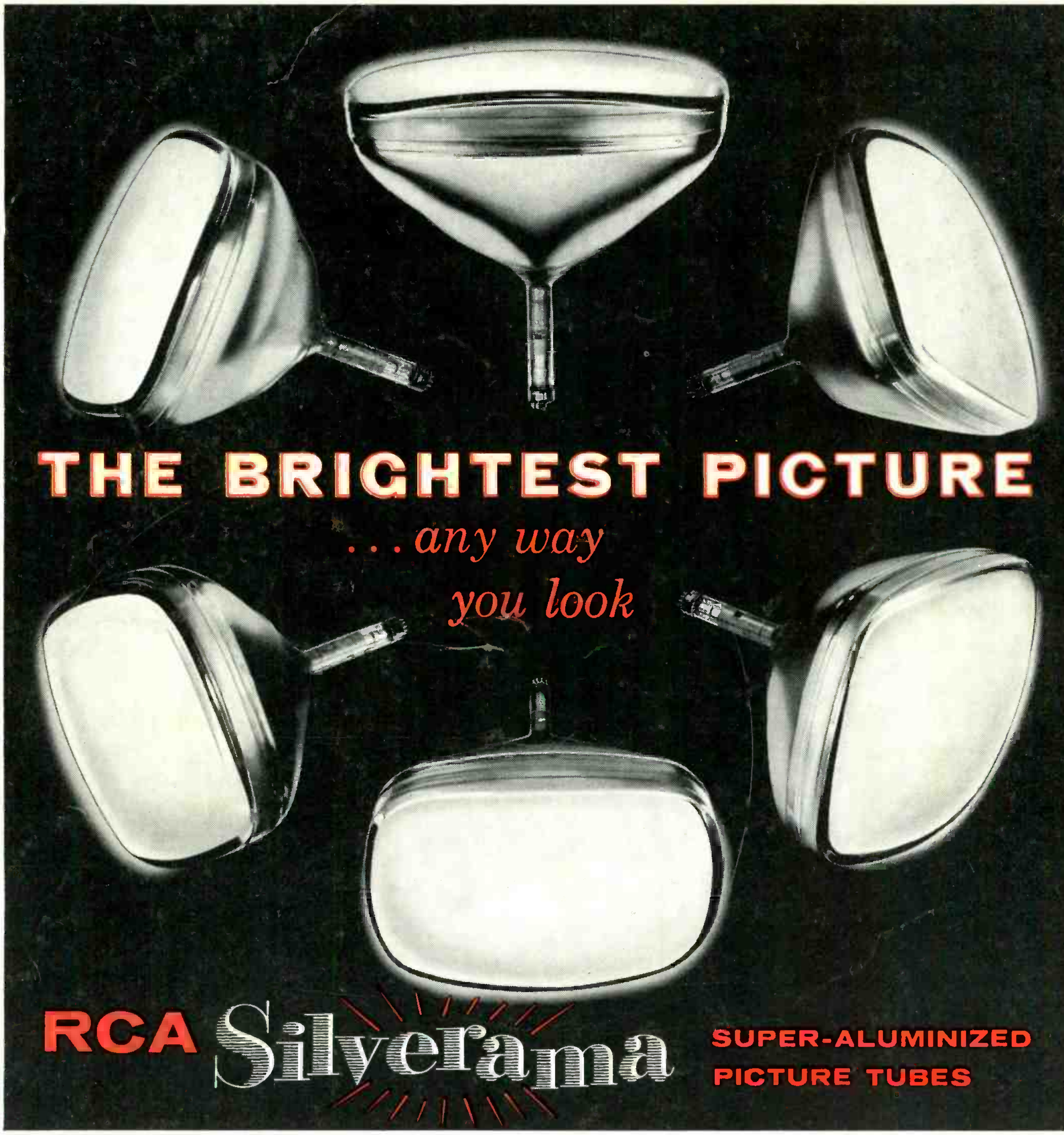

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