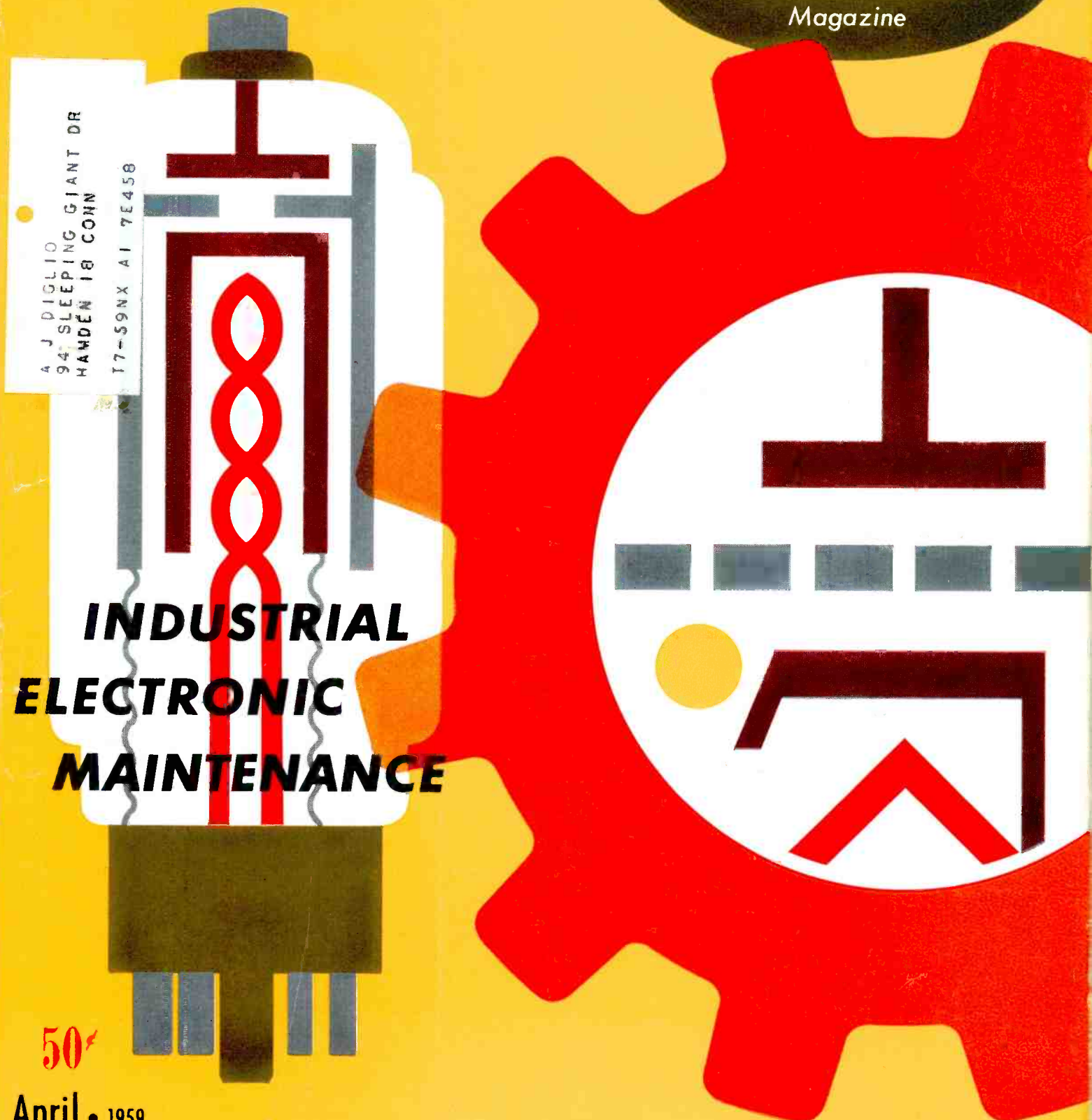
ELECTRONIC TECHNICIAN

Now Including
SERVICE
Magazine



INDUSTRIAL ELECTRONIC MAINTENANCE

50¢

April • 1959

the case of the stereo

HUMMMMMINGBIRD

or MAGNETIC *vs* CERAMIC

You may have been reading many controversial advertisements as to the merits of various stereo cartridges . . . namely, the magnetic version vs. the ceramic version. Qualified claims are made by their manufacturers . . . and most are accurate. But how a specific cartridge *sounds* in your stereo system is really the criterion. Let's consider the real facts:

IT'S A FACT! Audio Engineers agree that magnetic stereo cartridges are excellent, costly . . . but burdened with *hum*. Tests prove that the new Electro-Voice Magneramic cartridge is completely hum-free. No motor or line hum can possibly be introduced to mar soft record passages, because the Magneramic is *non-inductive*.

IT'S AN ENGINEERING AXIOM! The simpler the design of a precision product, the less chance there is of manufacturing defect. Magnetic stereo cartridges are far more complicated than the comparable Electro-Voice Magneramic stereo cartridge. With E-V, you are assured years of trouble-free, high fidelity stereo performance.

IT'S POSITIVE! When the Electro-Voice corps of 60 engineers began intensive scientific stereo studies, they had the choice of either designing a magnetic or a ceramic cartridge. Knowing that two of the most vital factors for true audio reproduction were lack-of-hum and trouble-free performance, they took the positive approach and produced a stereo cartridge incorporating simple elements permitting positive, stable control for uniform output.

And so, with the advent of stereo, Electro-Voice introduced an entirely new concept in ceramic cartridges . . . a true high-fidelity series . . .

THE E-V MAGNERAMIC

which will consistently outperform the best magnetics and do away with the "hummingbird" in your stereo system.

Choose the Magneramic . . . a new improved E-V stereo cartridge which plugs directly into magnetic inputs. See why it's the choice of so many FM stations for critical stereo broadcasts:

- NO HUM
- BEST CHANNEL SEPARATION
  Over 25 db isolation between channels
- HIGHEST COMPLIANCE
  Horizontal and vertical compliance equal to or surpasses the best magnetic cartridges
- WIDEST RANGE FREQUENCY RESPONSE
  Far in excess of any monaural (monophonic) or stereo record
- FLATTEST RESPONSE TO WESTREX 1A VELOCITY CURVE
  From 20 cps to beyond audibility
- HIGH 20 MILLIVOLTS OUTPUT
  All the voltage you need . . . and then some
- PROVEN SUPERIOR
  for conventional monophonic records as well as stereo records
- SOLD ON MONEY-BACK GUARANTEE
  We invite you to try an E-V Magneramic, with E-V's unqualified guarantee backed by over 30 years as a manufacturer.

Give the Magneramic a thorough listening test. If for any reason you aren't completely convinced of its superiority, your FRANCHISED Electro-Voice dealer is authorized to give you a full refund.

Step up to the excitement of stereo . . . step up to Electro-Voice Stereo . . . the industry's standard. Over a half-million in use, more than the total of all other stereo cartridges combined, attest to its acceptance as stereo's standard. Choose either the E-V *Magneramic* for magnetic inputs or the E-V *Standard* Stereo Cartridge for non-magnetic inputs.

21 MD with 0.7 Mil Diamond Stylus, net $19.50; 26 MDST Turnunder with 0.7 Mil Diamond Stylus, and 3-Mil Sapphire Stylus for 78 R.P.M.'s, net $22.50; 21 MS with 0.7 Mil Sapphire Stylus, net $9.90; 26 MST Turnunder with 0.7 Mil Sapphire Stylus, and 3-Mil Sapphire Stylus for 78 R.P.M.'s, net $12.90.

GOOD STEREO DEPENDS ON THESE VITAL FEATURES: FREQUENCY RESPONSE, 20-16,000 cps flat (Westrex 1A); ELEMENTS, 2 PZT Ceramic; OUTPUT VOLTS, 20 mv. Nominal; COMPLIANCE, 2 x 10^{-6} cm/dyne; WEIGHT, 3.4 Grams; TRACKING FORCE, 4-6 Grams; CHANNEL SEPARATION, 25 db at 1 KC; MOUNTING, EIA (RETMA) Standard 1/2"-7/16" Center; STYLUS, .7 Mil (Diamond or Sapphire); OUTPUT TERMINALS, Standard .050 Connectors; IMPEDANCE OR LOAD, 22,000 ohm or higher magnetic input.

See your High Fidelity Specialist or write Dept. ET-4

STEREO STANDARD

Electro-Voice®

INC., BUCHANAN, MICHIGAN

Over ½ Million In Use . . .
MORE THAN ALL OTHERS COMBINED

ELECTRONIC TECHNICIAN

Now Including SERVICE Magazine

World's Largest Electronic Trade Circulation

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Telephone YUkon 6-4242

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Printed in U.S.A. by Hildreth Press.

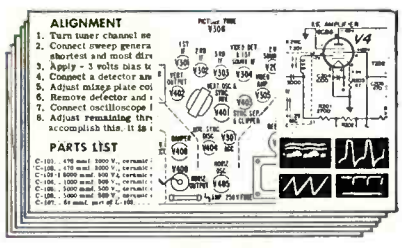
April 1959

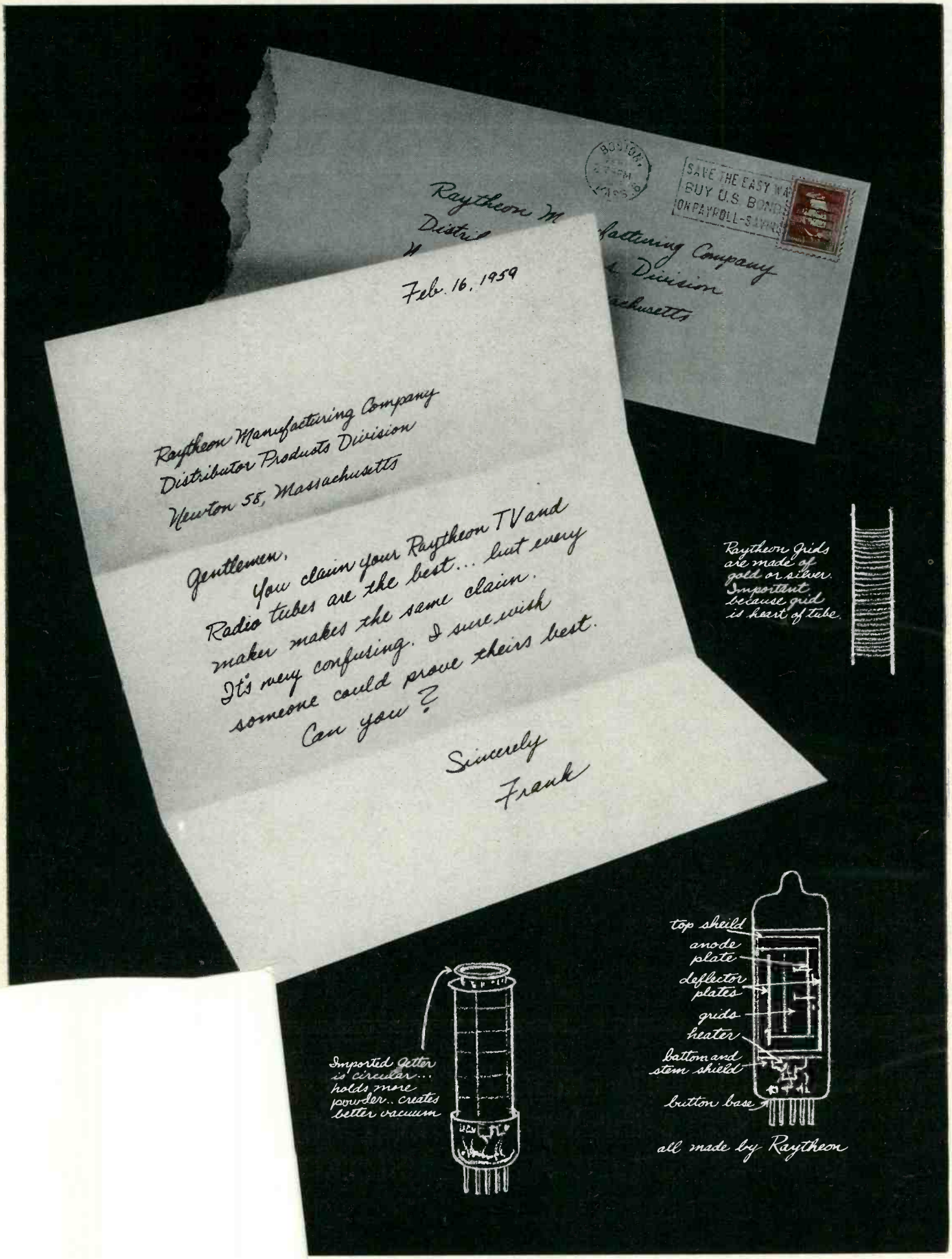
FRONT COVER Industrial control tube and gear symbolize the growing importance of industrial electronic maintenance work carried out by technicians. Business and industry are becoming increasingly dependent on electronic devices—and the specialists who repair them. See editorial on page 29, and industrial section on page 43.

FEATURES and ARTICLES

DEPARTMENTS

CIRCUIT DIGESTS .....




Raytheon M
Distri
Feb. 16, 1959
Raytheon Manufacturing Company
Distributor Products Division
Newton 58, Massachusetts
Gentlemen,
You claim your Raytheon TV and
Radio tubes are the best... but every
maker makes the same claim.
It's very confusing. I sure wish
someone could prove theirs best.
Can you?
Sincerely
Frank
Raytheon grids are made of gold or silver. Important because grid is heart of tube.
Imported getter is circular... holds more powder.. creates better vacuum
top shield
anode plate
deflector plates
grids
heater
bottom and stem shield
button base
all made by Raytheon

RAYTHEON MANUFACTURING COMPANY

DISTRIBUTOR PRODUCTS DIVISION

55 CHAPEL STREET • NEWTON 58, MASSACHUSETTS • BIGELOW 4-7500

Dear Frank:

How can I prove Raytheon Tubes are superior to all others? A good question and I'm going to try and give you an honest answer!

First, we believe that what we put in Raytheon TV and Radio Tubes . . . and the way we make them . . . are the real reasons why they are best. Pictures of quality control, manufacturing processes, might help convince you, but would they actually prove the end result is a quality product?

You still wouldn't be sure that the Raytheon replacement Tube you put in your customer's set was as good as or better than the original and would outlast it in saving you all those no-charge repeat calls.

To be sure, Frank, we could give you a long list of how we make all our own tube parts—use imported getters, special grids, ceramic insulated multiple fold heaters, and many, many others—but do you really care about these things?

You know, of course, that Raytheon is the world's largest exclusive manufacturer of Electronic Components. Raytheon Tubes and Components which go into 21 of our nation's missiles have to be better than normal. They don't just have to be good!

Honestly, Frank, maybe we can't prove superiority . . . but you can! You and thousands of men like yourself are proving it every day. I would suggest that as long as there is a doubt in your mind, why don't you find out for yourself by using Raytheon Tubes as others have done? I don't know of any other way.

Thanks for your letter . . . let's hear from you again real soon. I know you're going to be convinced.

Sincerely,

RAYTHEON MANUFACTURING COMPANY

Ray Raytheon

P.S. I'll be talking to you again next month.

Excellence in Electronics

Editor's Memo

When does a youth become a man? As far as we can see, it's about three years before his parents think he's grown up . . . and five years after he thinks himself a grown man.

Well, it seems like the young electronic maintenance industry is just passing through its trying years on the brink of maturity. It's grown up enough to be pushing the $3 billion mark in dollar volume. It's developed sufficiently to take care of more than 50,000,000 TV sets, and several times that number of radios. It's attracted some of the nation's largest manufacturers to cater to service technicians. It's located in every corner of the country, 63,500 outlets strong.

Big? You bet.

Mature? Not yet!

Consider these facts. Most technicians have completely inadequate business policies. Most do not belong to their local service associations. And even the associations themselves are unhappily battling with each other instead of uniting into a single effective force. Most shops carry inadequate inventory.

From another—and more fortunate—viewpoint, electronic maintenance still has a lot of growing to do: Dollar volume. Industrial repair is on the rise. Non-entertainment home electronics is on the horizon. And don't be surprised as you find more hi-fi manufacturers catering to service dealers.

In discussing the industry's promising future with various readers, I've heard a wide range of comments. At one extreme was the fellow who is disinterested in preparing for the future; he frequently wonders why his business has not grown much in recent years.

At the other extreme was the competent businessman, running a tight operation today, getting ready for tomorrow.

In the middle was one capable servicer who asked why things were so rough for him when the industry was growing so well. Of course, competition maintains pressure in all businesses. But even with his "rough time," in the past five years this man had bought a small house, sent his son through school and built up his bank account from almost nothing.

In preparing for tomorrow's opportunities, we'll find many rough challenges. By meeting these challenges, our industry will mature . . . and our incomes will grow.

Al Forman

Mr. Service Dealer...

Look what I've got for you!

OUR NEW 1959 PHILCO ELECTRONIC PARTS CATALOG IN 5 SEPARATE SECTIONS

A PROGRAM OF COMPLETENESS ...All year 'round

The finest and most complete in the industry!

The Philco Electronics Catalog is a complete service reference library for electronic parts and accessories. The data covers all Philco models and most models produced by other manufacturers.

1 Quick Reference Data for Radio and TV Products.

Knobs, Cabinets, TV Safety Windows, Parts Lists for TV and Radio, Service Substitution Data and Suggested List Prices.

2 Television Antennas and Accessories.

Outdoor TV Antennas, Indoor TV Antennas, Heavy Duty Rotors, Antenna Installation Accessories, Transmission Line.

3 Electronic Components.

Electronic and CR Tubes, Transistors, Diodes, Crystals, Rectifiers, Speakers, Batteries, Auto Radio Parts and Accessories, Test Equipment.

4 Needles, Cartridges and Phono Accessories.

Universal Full Fidelity Needles for all Phono Makes, Cartridges, Spindles, Motors, Tone Arms, Changers and Accessories, and Recording Tape.

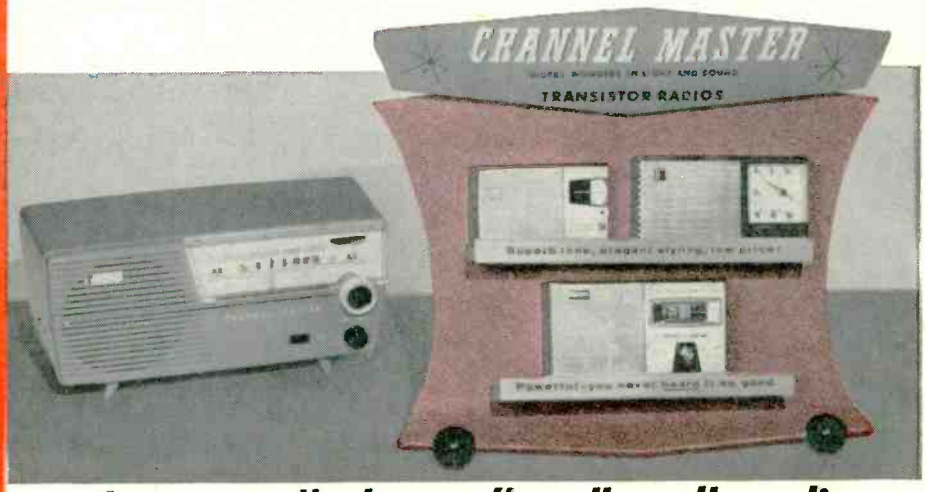
5 Universal Television Components and Transformers.

Listed by Manufacturer's Model and Chassis Numbers. Cross-Referenced by Manufacturer's Part Number. Easy to read code selector.

We have just received copies of the new Philco Electronics Catalog and it's the finest we have ever seen. The five separate sections make it easy to find anything you need. Come in and get your copy. You'll find that it will save you time, increase your profits and make your service jobs much easier.

See me... your local Philco Distributor... Today!

get this great new
TRANSISTOR RADIO DISPLAY



this extra "salesman" really sells radios

A. model no. 6502 **$39.95** list
B. model no. 6506 **$49.95** list
C. model no. 6511 **$54.95** list
D. model no. 6512, Short Wave and Standard Broadcast, **$72.50** list

also available: model no. 6514, Marine Band and Standard Broadcast **$74.95** list

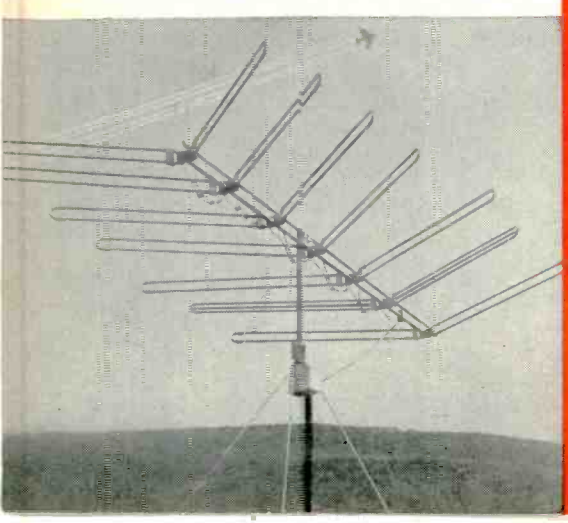
Channel Master's colorful, pilfer-proof display lets your customers see, touch, and play these outstanding radios—wraps up more sales than ever before. Use it to set up **your own complete transistor radio center** in less than 1 square foot of shelf or counter space. Ask your Channel Master distributor for full details.

Unmatched sensitivity, superb tone, handsome design, and low price have made Channel Master one of the country's largest-selling lines of transistor radios.

CHANNEL MASTER
TV ANTENNAS

Dealers sell more T-W's than any other fringe-area antenna—by far. The powerful T-W delivers the highest gains and front-to-back ratios of any all-channel VHF antenna. Its rugged construction provides more years of peak performance. And it's nationally advertised on network TV and in leading magazines. Recommend a T-W for your next installation—and help your business grow.

CHANNEL MASTER T-W
The World's Most Powerful TV Antenna



CHANNEL MASTER

works wonders in Sight and Sound

New! CHANNEL MASTER HIGH FIDELITY COMPONENTS

New components with a new idea: the "Practical Approach!" Channel Master's new hi-fi line is designed to eliminate confusion by directing the customer's attention to the 5 basic, practical considerations which apply to the selection of any high fidelity system: Performance, Ease of Operation, Versatility, Styling, and Cost.

The Channel Master line eminently satisfies each of these requirements. These are instruments of superb quality and striking appearance, offered at moderate prices. They reproduce with astonishing accuracy the entire audible spectrum with an absolute minimum of manual controls. The result is a true high fidelity system which satisfies the most discriminating audiophile... and yet can be used and enjoyed by virtually everyone.

Available in Eastern Areas only

Cabinets available in wood or metal.

Stereophonic Amplifier
Model No. 6600
audiophile net $119.95 without cabinet

The Channel Master 6600 stereophonic amplifier is an instrument of flawless electronic craftsmanship, embodying every advanced technical feature for full-range stereophonic sound reproduction. 16 watts on each channel (32 watt peak). Solid brass face panel.

AM/FM Tuner *Model No. 6100*
audiophile net $84.95 without cabinet

This outstanding tuner provides fine performance, pinpoint station selectivity and effortless flywheel tuning. Automatic Gain and Volume Controls on FM and AM prevent overloading by strong signals and maintain constant sound levels. Special multiplex output permits tuner to be adapted for stereophonic FM broadcasting. Solid brass face panel.

Monaural Amplifier *Model No. 6620*
audiophile net $79.95 without cabinet

This superb 20 watt (40 watt peak) amplifier faithfully reproduces every sound audible to the human ear. Modern feed-back circuitry assures minimum distortion and full-frequency range. Special adapter jacks make conversion to a stereo system simple and economical. Solid brass face panel.

***Tiny* Minstrel Speaker System**
brings concert hall realism to the home

Now, for the first time, full dynamic realism is achieved in a miniature enclosure only 9" x 9" x 16". Through the patented new "Acoustic Transformer" principle the entire air chamber becomes a phase matching air transformer which produces clear, undistorted sound from 50 to 15,000 cycles. The big sound and small size of Channel Master Minstrels make them ideal for flexible, space-saving, low-cost stereo installations.

audiophile net $29.95

for product literature contact your CM Distributor or write to

CHANNEL MASTER CORP.
ELLENVILLE, NEW YORK

LETTERS

To the Editor

Licensing Info Wanted

Editor, ELECTRONIC TECHNICIAN:

I have been a regular subscriber for years, and also an association member. In a drive for TV service licensing, the opposition has heard only one side. We urge any association or individual having a good working license to write to me. Independent opinions as to what licensing could do for us would also help. I would also like to receive copies of license laws now in effect.

SAM L. WINTON, JR.
7101 Conley St.
Houston 21, Texas

UL Approval Problem

Editor, ELECTRONIC TECHNICIAN:

I disagree with Jack Darr's article in your Feb. 1959 issue concerning parts procurement problems for special electronic equipment. I'm a fire insurance inspector. The unit described appears to be a flame supervisory device. It is regrettable that the manufacturer didn't get off his big fat dead duff and send the needed part express collect. However, my point is that in most cases the flame device is Approved, having met certain minimum specifications set up by Underwriters Laboratories. The device may be constructed of individual items that are UL approved, but the device as such is Approved only as a total item. The replacement of any part in the device by a part not listed as a direct replacement by the manufacturer in most cases disqualifies the device as an Approved device. The fact that the manufacturer has a crummy parts supply policy is beside the point. The repair should have been made with a part specifically designed for the device. I don't know what can be done to pry parts loose from some manufacturers, but in most cases the insurance company and UL will listen to your complaint. A stock insurance company usually can not blacklist a manufacturer's device if it carries UL approval (or FM—Factory Mutual —approval for mutual insurance firms), but it can "suggest" a similar UL listed device. A manufacturer in the doghouse has to improve his philosophy or go out of business. I don't want to discourage competent repairs on special electronic equipment, except where fire protection is involved.

JAMES C. SOUKUP

• *Here's a choice: Should a factory or hospital have its equipment inoperative at a critical time, or should a "non-approved" repair be made? In time we hope more manufacturers will learn to keep their replacement parts flowing freely.—Ed.*

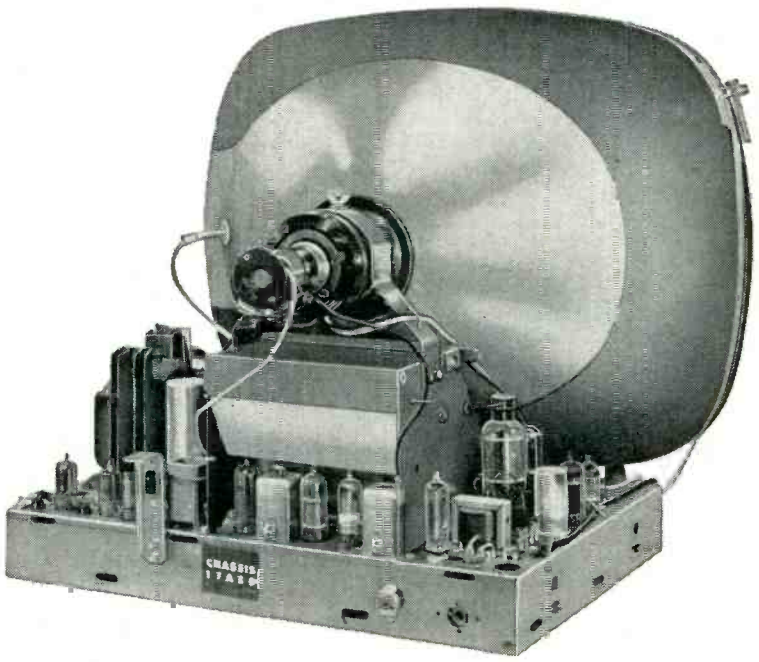
(Continued on page 13)

NO PRODUCTION

All parts accessible for easier, simpler servicing

12 REASONS WHY ZENITH TV MEANS MORE SATISFIED CUSTOMERS FOR ZENITH DEALERS AND SERVICEMEN.

1. **21-INCH (OVERALL DIAGONAL) PICTURE TUBE** mounted to chassis.
2. **SHORT NECK 90° TUBE** . . . reduces linearity and yoke problems.
3. **FIN-COOLED POWER TRANSFORMER** for greater cooling surface.
4. **TECHNICAL CONTROLS** on front of chassis in most models for ease of adjustment . . . no mirrors required.
5. **ALL ALIGNMENT** adjustments on top of chassis.
6. **ALL CIRCUIT TUBES** accessible for service without removing the chassis.
7. **TUBES ARE PLACED** in logical circuit sequence.
8. **NO PAPER ENCASED BYPASS CONDENSERS** . . . all are plastic or ceramic molded.
9. **NO HIDDEN PARTS** . . . all are easily replaced.
10. **NO PRINTED CIRCUITS IN THE CHASSIS**...all connections are hand soldered.
11. **PRECISION BUILT,** rugged horizontal chassis.
12. **NO SHORTCUTS** to impair the reliability.



Better performance, greater operating dependability, easier servicing—these are the results of Zenith's insistence on Handcrafted standard circuitry. And though it costs more to build, it gives you far more to sell.

Silicon Rectifier... ...1N2078

NEW Tung-Sol 1N2078 designed and made for simple, speedy TV replacement!

Tung-Sol's new 1N2078 diffused junction silicon rectifier possesses distinct advantages the service industry will welcome. Optimum physical and electrical characteristics combine to make 1N2078 convenient to handle and install, and assure your TV and radio service customers the high-grade performance they want and appreciate.

Small size, easy to install. Tung-Sol's 1N2078 is smaller than most semiconductor devices, at no sacrifice in efficiency. Long flexible leads can be quickly soldered to existing connections with no additional hardware. This is especially suited to printed circuitry.

Long life. Negligible voltage drop that remains stable over lengthy operation promotes long life. 1N2078 virtually unaffected by high current surges . . . maintains high B+ over full-length operation.

Special insulated case. Special case insulates against chassis shorts to further ease replacement. Also, 1N2078 dissipates its own heat . . . needs no heat sink . . . yet never requires derating. Only leads get hot.

You can replace any other device and, in some cases, rectifier tubes, with the new, high-quality Tung-Sol 1N2078. For complete information . . . to stock up, contact your distributor or: Tung-Sol Electric Inc., Newark 4, New Jersey.

1N2078 Maximum ratings (100°C) capacitive load:
(Similar types available with Peak Inverse Voltages ranging from 50 up to 600)

Peak Inverse Voltage	400 Volts
Continuous D. C. Reverse Working Voltage	400 Volts
Average D. C. Output Current	500 mAdc
Peak Recurrent Forward Current	5 Amps.
½ Cycle Surge Current	30 Amps.
Full Load Voltage Drop @ 25°C	1.1 Volts
RMS Input Voltage	130 Volts
Minimum Series Resistance (for capacitive filter)	5 ohms, 10 watt

TUNG-SOL®

(*Letters, Continued from page 8*)

Pix Tube Contract

Editor, ELECTRONIC TECHNICIAN:

I have written to the *Chicago Daily Tribune* to protest an ad for a picture tube contract in their *TV Week Magazine*. The advertiser offers a $5 contract for 10 and 12½"; $7.50 for 14, 16 or 17"; $10 for 19, 20 and 21"; and $15 for 24". They desire that the reader, their sucker, send in a coupon with money for a contract which would become valid 15 days after receipt. There is no charge for tube replacement, and no inspection is required. How is the reader treated who already has a burned out picture—and larceny in his heart—15 days later when he states his tube has gone bad? Does a reliable reader get a free replacement? I do not believe it.

O. J. COOMBES

Chicago, Ill.

Another Gimmick

Editor, ELECTRONIC TECHNICIAN:

Here's a very unusual practice by a Detroit manufacturer of pin crimpers. (Electronic Technician does not carry their ads.) In response to a request for descriptive literature, they write to you that they are sorry your distributor did not have the unit, and are sending you one COD.

MERLE BARKER

Concordia, Kansas

Hi-Fi Aid

Editor, ELECTRONIC TECHNICIAN:

Recently I changed from TV servicing to selling audio components. I have received Circuit Digests even before I could get a factory schematic. A leading consumer research magazine has made reports on high fidelity components which are misleading, incomplete and inaccurate. There is a need for a technician's magazine to report specs found in their own tests. Accurate technical remarks and reports of actual test readings will offer the TV technician the information he needs to increase his sales and improve his hi-fi component installations.

IRA M. LASH

Sam Goody Green Acres
Valley Stream, N.Y.

Scope Calibration

Editor, ELECTRONIC TECHNICIAN:

Your Feb. article, "Service & Lab Oscilloscopes," should be extended to other instruments. Also, I am interested in calibration information for scopes, including various approaches such as clipped sine wave, 400 cycle square wave and 1 kc square wave.

C. R. Hindle

Ghent, N.Y.

• *See "Practical Peak-to-Peak Scope Calibration Procedure" in this issue.—Ed.*

(*Continued on page 14*)

(*Letters, Continued from page 13*)

Circuit Digests

Editor, ELECTRONIC TECHNICIAN:

I am impressed with my first copy of ELECTRONIC TECHNICIAN, which is in place of *Service* magazine. However, the Circuit Digests are supposed to be filed for ready reference, and intermixing manufacturers is disturbing. It will pay in the long run to print one circuit on each sheet. In this way the sheets can be filed alphabetically by manufacturer.

R. A. BEYMER

Staunton, Va.

. . . Your magazine is very good. Keep printing as many of the new Circuit Digests each month as possible.

JOHN L. KARG

Karg Radio & TV
Cannonsburg, Pa.

• *We can either publish one schematic per sheet, which is less work for us, or as many circuits as we can digest into the monthly 16-page section. We bow to the will of the majority of our readers—largest number of circuits.—Ed.*

Back Isues

Editor, ELECTRONIC TECHNICIAN:

As a past subscriber to *Service*, I now find your magazine even more useful. Are back numbers of Circuit Digests available?

R. BRADFORD

Grampian Reproducers Ltd.
Feltham, Middlesex, England

. . . Could you send the 12 back issues of ELECTRONIC TECHNICIAN for 1958?

JOSEPH GAYDOSH

Clifton, N.J.

• *Back issues of the entire magazine are not available, but Circuit Digests may be obtained for 50¢ per complete section as published in any issue. Watch for the cumulative index of all schematics published to date in May Circuit Digests. —Ed.*

The Real Problem

Editor, ELECTRONIC TECHNICIAN:

Captive service is not the problem haunting small shops. These high handed methods have given me customers who still had warranties with captive service companies. The real problem lies in the loss of tube business to drug and grocery stores. The bulk of my work now is in sets from shops where equipment is inadequate. In a one-man operation I had a stock of 2000 tubes several years ago. Now I operate on less than one caddy: It is impossible to carry all types. Some tube companies have cut their code warranty coverage from 12 to 6 months. Special tube types have forced many shops to drop several brands of TV sets. Many service technicians are telling their customers not to buy certain brands or models of sets.

HAROLD HARFOOT

Ft. Lauderdale, Fla.

Use Delco Radio Service Parts!

8-inch "Hi-Fi" speaker, No. 8007 offers the most highs, the most lows, the most watts in a medium-price speaker. Designed for replacement use and high fidelity audio systems.

Your Delco Radio Electronic Parts Distributor carries the complete line, giving you fast, dependable service on the items you'll need for Delco Radio and other radio service work. Delco Radio also provides:

- Wide selection of special application parts
- Complete technical training program
- Effective warranty program
- Dealer identification signs

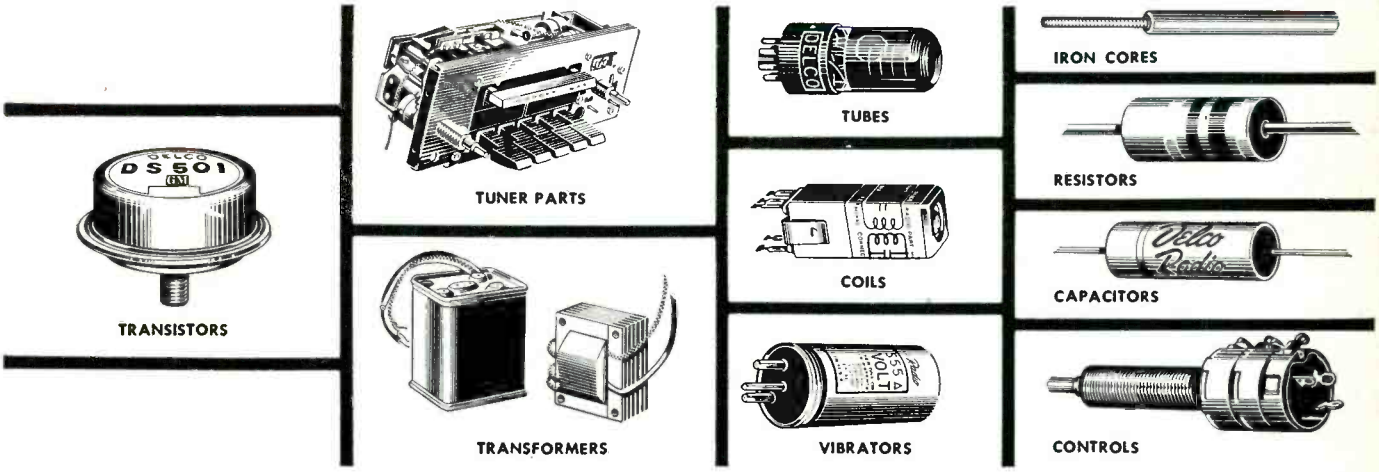
Get the facts today on this truly profitable dealer setup, and grow with General Motors!

Available *everywhere* through Electronic Distributors associated with . . .

GM U-M-S PARTS SALES
UNITED MOTORS SYSTEM

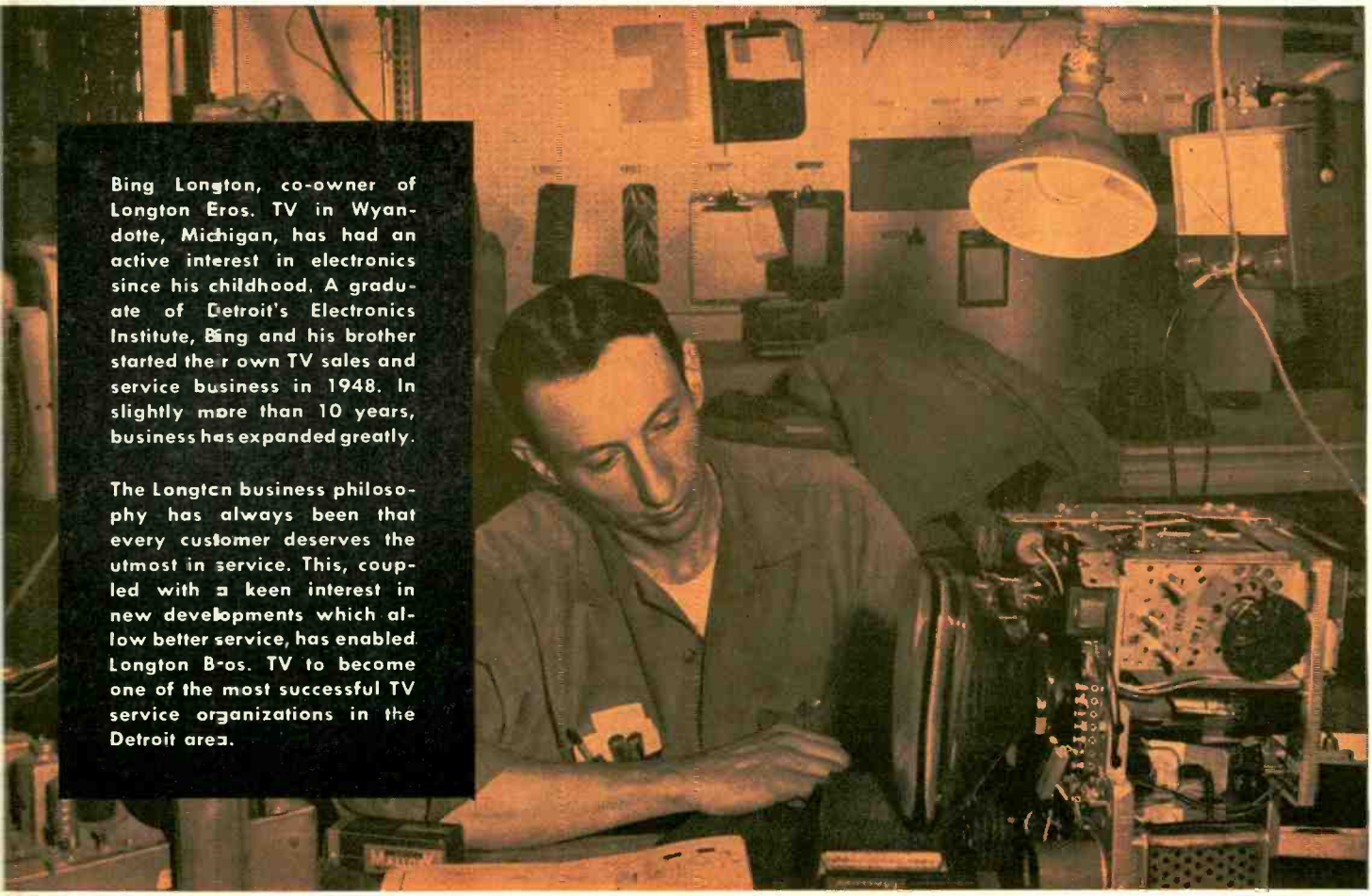
DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA



TV Technician Bing Longton says . . .

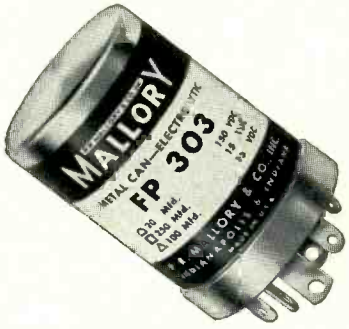
"We Can't Gamble With Customer



Bing Longton, co-owner of Longton Bros. TV in Wyandotte, Michigan, has had an active interest in electronics since his childhood. A graduate of Detroit's Electronics Institute, Bing and his brother started their own TV sales and service business in 1948. In slightly more than 10 years, business has expanded greatly.

The Longton business philosophy has always been that every customer deserves the utmost in service. This, coupled with a keen interest in new developments which allow better service, has enabled Longton Bros. TV to become one of the most successful TV service organizations in the Detroit area.

Put an end to call-backs with these quality Mallory products . . .



GEMS

Rugged, moistureproof, Mallory "Gem" tubular capacitors in an easy-to-use dispenser that keeps your stock fresh and clean—easy to find—no more kinks in lead wires. They're your best bet for outstanding service in buffer, by-pass or coupling applications.

RMC DISCAPS®

Are a product of the world's largest producer of ceramic disc capacitors. Long the original equipment standard, Mallory RMC Discaps are now available for replacement. They come in a handy 3" x 5" file card package . . . easy to stock, simple to use.

®A registered trade mark of Radio Materials Company, a division of P. R. Mallory & Co. Inc.

FP ELECTROLYTICS

The Mallory FP—the original 85°C. capacitor—now has improved shock-resistant construction and leakproof seal. Its etched cathode construction—standard in all FP's—assures hum-free performance. High ripple current ratings fit the toughest filter circuits.

Satisfaction . . . We Use Mallory Components for Replacement"

"Customers demand quality repair service, and at Longton TV the customer is *king*. We figure the best way to keep him happy . . . and protect our own profits, too . . . is to prevent complaints before they happen. So we give him the best in service and the best in replacement parts—that means MALLORY components. We've used them ever since we started in business, because we know we can always depend on MALLORY."

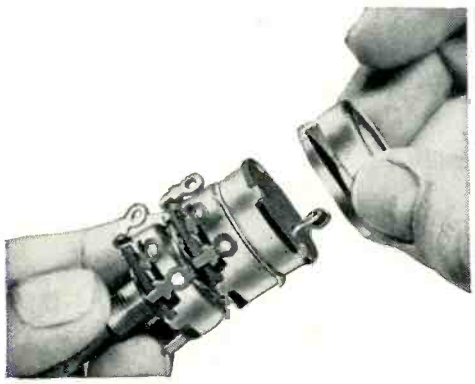
Whether you need capacitors, controls, resistors, silicon rectifiers or batteries, you get the highest quality components at sensible prices. The Mallory line is the widest in the industry, and Mallory "service-engineering" assures you fewer call-backs and more satisfied customers. See your Mallory distributor for a full selection of the parts you need.

Get TC capacitors at your distributor from this handy merchandise display.

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



STA-LOC* CONTROLS

New Sta-Loc design enables your distributor to custom build, in just 30 seconds, any of 38,000 combinations—eliminates waiting for out-of-stock controls. You can replace the line switch by itself, without unsoldering control connections.

GOLD LABEL* VIBRATORS

On critical auto radio servicing, use the Mallory Gold Label Vibrator. It gives longer, trouble-free service life. Mallory Gold Label Vibrators feature Mallory exclusive buttonless contact design.

Trade Mark

TC TUBULAR ELECTROLYTICS

Economically priced electrolytic filter capacitors with a reputation for doing an excellent job. They have been proved in performance and are backed by years of Mallory experience. Also special TCX type available for —55°C.

News of the Industry

SERVICE INSTRUMENTS CORP. named BARRIE BYRD as Export Mgr.

HEPPNER MFG. CO. has named RAYMOND F. CUNY Gen. Sales Mgr.

AMERICAN MICROPHONE MFG. CO. is celebrating completion of 30 years in business.

THOMAS ELECTRONICS, INC. announces a new warehouse facility in Cedartown, Ga. with WILLIAM NEGLIA as Mgr.

PYRAMID ELECTRIC CO. announces the appointment of KENNETH M. STEINKE to the post of Asst. Sales Mgr., Jobber Div.

ACME ELECTRIC CORP. has appointed C. L. FIEGEL as Eastern Sales Mgr. and KEN BURTON as Western Sales Mgr.

CLAROSTAT MFG. CO. has appointed E. W. KINGSBERY, JR. Gen. Sales Mgr. and member of its Executive Board.

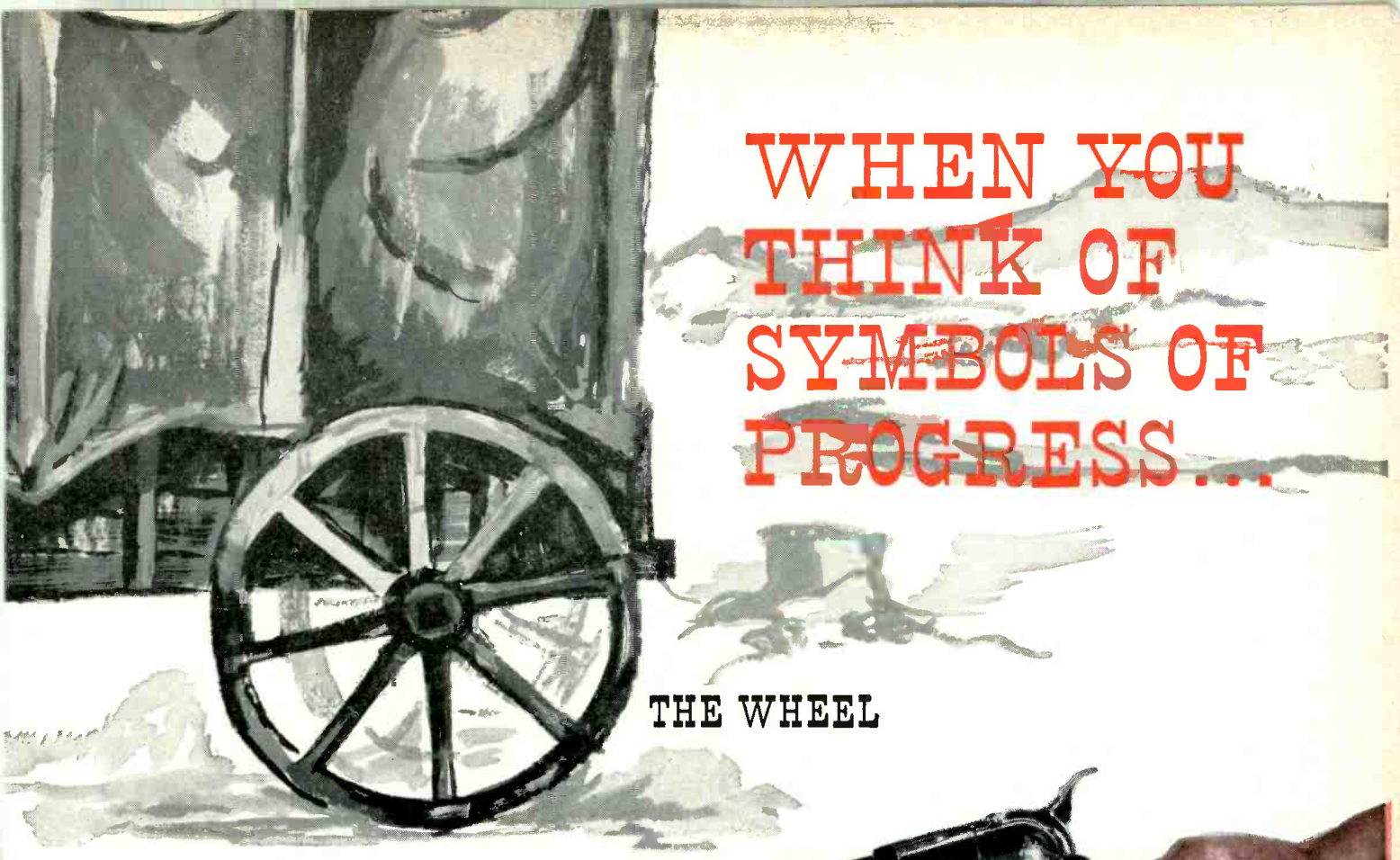
ZENITH RADIO CORP., N.Y. DISTR. CO., has appointed PAUL NEUBERT Gen. Sales Mgr. and GEORGE HART, Mdsg. Mgr.

PERMA-POWER CO, has selected to serve as judges in their "Flight to Las Vegas" contest ALBERT J. FORMAN, Editor of ELECTRONIC TECHNICIAN and VERNE RAY, Editor of PF REPORTER.

P. R. MALLORY & CO. has formed a new subsidiary, P. R. MALLORY INTERNATIONAL, INC., with the following key personnel: LEON ROBBIN, Pres.; HANS G. BOEHM, Vice Pres.; P. R. MALLORY, Chmn. of the Bd.; GEORGE FOTHERINGHAM, Secty.; and RICHARD LEE, Treas. Also reported is the appointment of FRANK P. VENDELY, Eastern Regional Sales Mgr., Distributor Div.

PHILCO CORP., Lansdale Tube Co. Div., reports the following appointments: H. KENNETH ISLER, Mgr. Eng'g & Production; RAYMOND M. COTTER, Mgr. Operations; GEORGE W. PRATT, Mgr. Tube Operations; OTTO G. HONZL, Mgr. Quality Control; ROBERT F. LAKE, Mgr. Industrial Eng'g.; STUART L. PARSONS, Dir. of Equip. Devl.; A. ERNEST LYLE, Tech. Adm.; RICHARD S. MANDELKORN, Dir. of Planning; and for the semi-conductor operations, CLARENCE G. THORNTON, Dir. of Dev. and JOHN M. PALMER, Mgr.

(Continued on page 20)



WHEN YOU THINK OF SYMBOLS OF PROGRESS...

THE WHEEL

THE COLT 45 SIX-SHOOTER

TRIPLETT

MODEL 630 VOM

preferred by the professional who insists on quality

- Popular streamlined tester with long meter scales arranged for easy reading
- Single control knob for all 34 ranges
- Easy Operation; Minimum burnout possibilities
- Completely enclosed selector switch of molded construction; eliminates harness wiring
- Wide range—tests AC-DC volts (DC at 20,000 O/V); DC Microamperes, Milliamperes, and Amperes; Ohms (to 120 Megohms) Decibel and Output
- Heavy molded case ¼" thick for high impact, fully insulated

$44.50 NET

TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

Burton Browne Advertising

News of the Industry

(*Continued from page 18*)

WINEGARD CO. has appointed HANS D. SYLTEN as Electronics Research Engr.

CALVIDEO TUBE CORP. has moved into their new 40,000 sq. ft. plant in south western Los Angeles.

TOBE DEUTSCHMANN CORP. has promoted JOSEPH F. FERRANTE to Vice Pres.

ASTRON CORP. reports that it has embarked on the most extensive promotion in its history, a monthly campaign for their capacitors and r-f filters.

LESCARBOURA ADVERTISING, INC. announces that L. ARTHUR HOYT has joined their organization as client contact executive.

UNITED CATALOG PUBLISHERS, INC. reports that an additional high speed press and new addressing equipment have been installed to supplement present facilities.

TUNG-SOL ELECTRIC, INC. has appointed NEIL UPTEGROVE Adv. & Sales Prom. Mgr. and E. LESLIE PETER Mdsg. Mgr. of Automotive Markets.

MOTOROLA, INC., Semiconductor Div., announces the following appointments: RAYMOND G. HANSON, JR., Mgr. of Advg. & Sales Prom.; and THOMAS D. HINKELMAN, Mgr. of Product Planning & Mkt. Research.

GENERAL ELECTRIC CO., Semiconductor Products Department, has established a Rectifier Production Section with C. GRAYDON LLOYD as Gen. Mgr. and WILLIAM H. HALL, Mgr. of Mktg.

RADIO CORP. OF AMERICA, Int'l. Div., elected DOUGLAS C. LYNCH as Vice Pres. & Managing Dir. Also reported: the first transistor produced at the Findlay, O. plant; and the 20 millionth black and white TV picture tube at Marion, Ind.

RAYTHEON MFG. CO. announces the following appointments: GEORGE LOOMIS, Mgr. Receiving Tube Div., WILLIAM T. WELSH, Sales Mgr., Equipment & Systems Div.; CHARLES W. MARTEL, Adv. & Sales Promotion Mgr., Semiconductor Div. Also reported is the agreement by the respective firms' directors to the merger of RAYTHEON MFG. CO. and MACHLETT LABORATORIES, INC., subject to stockholders' aprpoval and the appointment by the Distributor Products Div. of FULLER & SMITH & ROSS INC. as advertising agency.

(*Continued on page 22*)

(News, *Continued from page 20*)

RADIO CORP. OF AMERICA announces the appointment of VICTOR C. HOUK as manager, market planning, industrial tube products dept., RCA Electron Tube Div., Lancaster, Pa.

CHANNEL MASTER CORP. announces the appointment of RICHARD DEUTSCH, Eastern Sales Supvr. and ROBERT CORTES, Western Sales Supvr.

ERIE RESISTOR CORP. announces the promotion of GEORGE P. FRYLING II to Vice Pres.-Mfg. and GEORGE F. KEMPF as Vice Pres. and Gen. Mgr. of ERIE RESISTOR OF CANADA, LTD.

PORTABLE ELECTRIC TOOLS, INC. reports the purchase of DRAKE ELECTRIC WORKS, INC., which will be operated as a wholly owned subsidiary of PORTABLE.

UNGAR ELECTRIC TOOLS, INC. announced the appointment of WILLIAM L. NEHRENZ as Gen. Mgr. of the firm and JOHN J. DUNLEAVY as Application Engr. for the metropolitan N. Y. area.

ZAM & KIRSHNER, INC. advertising agency, announces the appointment of MORRIS TARRAGANO as Account Executive. They have recently moved into new, larger quarters at 570 7th Ave., N.Y. 18, N.Y.

Reps & Distributors

ART CERF & CO. was named "Rep of the Year in Metropolitan N.Y." by the Metropolitan N.Y. Chapter of NEDA.

CHICAGO-STANDARD TRANSFORMER CORP. has appointed the F. EDWIN SCHMITT CO. as rep for the Stancor line in the metropolitan N.Y. area.

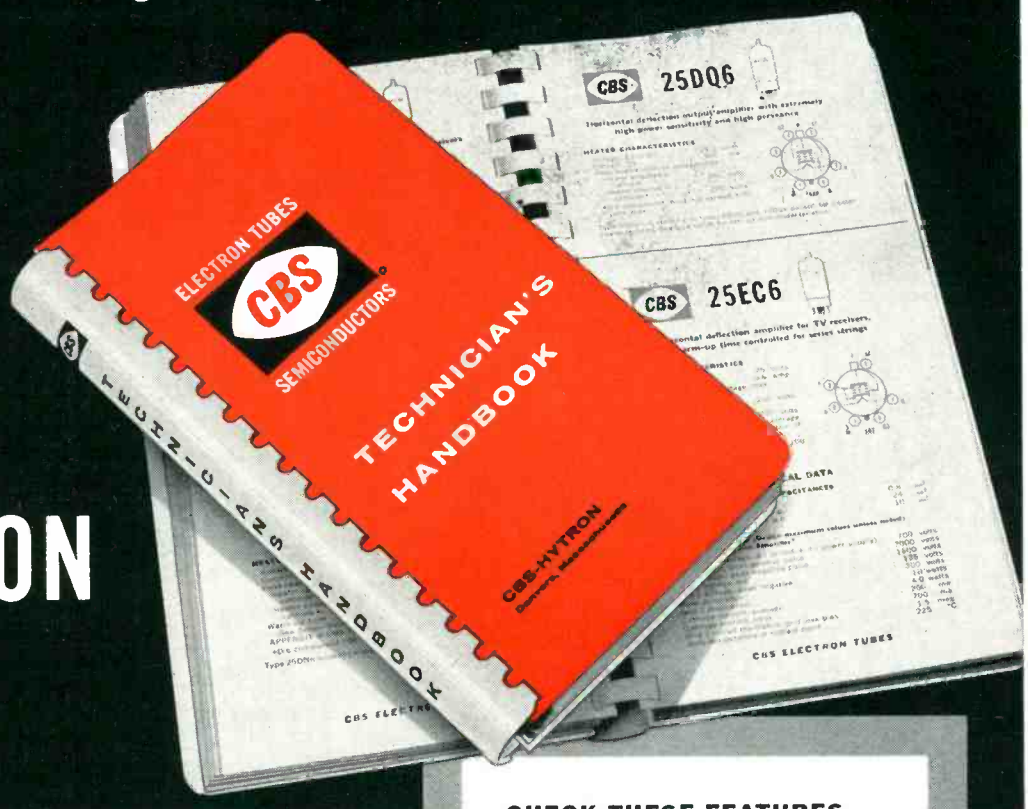
PLANET MFG. CORP. announces the appointment of two new reps: **L. J.** McTAGGART covering upper N.Y. state; J. MALCOLM FLORA, INC. covering jobbers and industrials in Mich.

ELECTRONIC REPRESENTATIVES ASS'N. announces the appointment of ALLEN I. WILLIAMS, JR. as Chairman of the Instrument Div. and HANK LAVIN as Chairman of the Legislative Committee. The Calif. Chapter reports election of the following officers for 1959: Pres., CHUCK AULT; V.P., E. C. NICKERSON; Secy., FRANK LEBELL; Treas., BOB VERMILYA.

(Continued on page 24)

designed by and for the technician

NEW 1959 EDITION $1.85

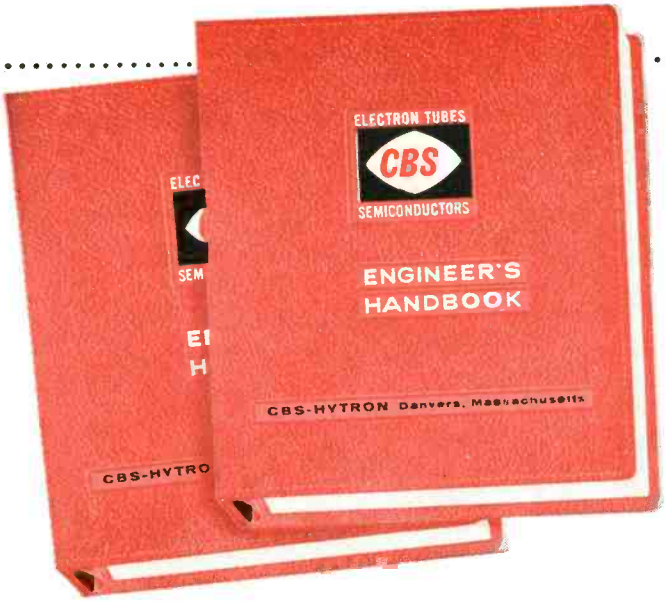


This new Handbook was designed especially for the technician. Planned for on-the-job use, it is compact, handy, rugged . . . lies flat when open. Its modern styling permits quick, easy reference. And, of course, it is up-to-the-minute, complete in one volume . . . with data for receiving, special and picture tubes as well as semiconductors. Get your copy today from your CBS-Hytron distributor.

Reliable products through Advanced-Engineering

CHECK THESE FEATURES

- 550 pages
- 1050 receiving tubes
- 390 TV picture tubes
- 270 special-purpose tubes and semiconductors
- Comprehensive data, popular types
- Reference data, seldom-used types
- Appendix especially for technicians



Engineer's Handbook

NOW TWO VOLUMES $10.00

Additional hard-cover binders:
$3.00 for 1, $5.50 for 2.

This modern Handbook has expanded into two volumes. It includes receiving, special and picture tubes and semiconductors. Features are: Complete EIA engineering design data on current tubes • tabulated quick-reference data for seldom-used types • 375 two-color design curves • over 700 pages, two colors • handy 8¼ by 9⅞ inches • sturdy hard covers • 16-ring metal binders • appendix • supplement service available. Order direct.

CBS-HYTRON, Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

Reps & Distributors

(Continued from page 22)

LITTELFUSE, INC. has appointed the WILLIAM J. PURDY CO. as the firm's rep in northern Calif.

REGENCY DIV., I.D.E.A., INC. reports the appointment of DAVE WAGMAN, INC. as their New York City rep.

UNGAR ELECTRIC TOOLS, INC. has named R. O. WHITESELL & ASSOC. rep for the Ky.-Ind. area.

VIS-U-ALL PRODUCTS CO. announces the appointment of THOMAS SHELBY & CO. as rep in western Pa. and W.Va.

SNYDER ELECTRONIC DISTRIBUTORS, INC., 39-25 Bell Blvd., Bayside, Long Island, N.Y. has been formed by JACK E. SNYDER and JOSH SNYDER.

JERSEY SPECIALTY CO. reports the appointment of the ANDERSON SALES CO. to handle their wire and cable line for New England.

JERROLD ELECTRONICS CORP. has appointed BLAIR SALES CO., INC. as rep in the metropolitan N.Y.-N.J. area for the Distributor Sales Div.

BRUNO-NEW YORK announces that they will give, with their compliments, a new Mark Series RCA Victor 21" Color TV set to each of the first 200 technicians, who purchase an average of two kinescopes (new or rebuilt) each week.

Catalogs & Bulletins

TRANSISTORS: A new data sheet covers new types of high-power switching transistors, which have quality benefits of the advanced cold-weld seal; and feature a stud-mounted package and maximum collector current of 13 amps. Semiconductor Div., Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J. (ELECTRONIC TECHNICIAN B4-6)

PHOTOCELLS: Over 25 standard selenium cell types are described in an 8-page catalog, "Selenium Photovoltaic Cells," (Bulletin PC-649A). Cell structure and operation, performance characteristics, output current curves, and typical applications are included. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif. (Write directly to manufacturer.)

(Continued on page 26)

For Checking Miniaturized Equipment, Pyramid's Model RC-1 New Resistance-Capacity-Ratio Bridge Tester. Budget priced . . . outstanding quality instrument . . . the RC-1 saves you both time and money. Precision-engineered, Pyramid's new model RC-1, Resistance-Capacity-Ratio Bridge Tester has a special low voltage bridge and stable vacuum tube amplifier for safe testing low voltage electrolytics such as commonly used in transistorized receivers.

Pyramid's RC-1, Resistance-Capacity-Ratio Bridge Tester is a functionally designed, sturdy, compact, lightweight unit, ideal for use by technicians, servicemen and engineers in radio, television (color as well as black and white), industrial electronics and all related fields.

PYRAMID MODEL RC-1 FEATURES:

- Special 3 volt amplifier for checking low voltage electrolytics used in miniaturized equipment such as transistor radios, etc.
- Capacity Ranges—from 10 mmfd. to 2000 mfd.
- Resistance—from .5 ohms to 200 megohms in 4 ranges.
- Ratio Test—provides quick reactance or resistance ratio between any two capacitors, inductors or resistors —range: .05 to 1 and 20 to 1. It can be used also to determine turns ratio of transformer windings within this range.
- Leakage Tests—handles all types of capacitors at rated voltages between 0 and 500V DC.
- Power Factor—0 to 60% (on capacitors from .1 mfd to 2000 mfd).
- Capacitor Test Voltages—variable between 0 and 500V DC in 17 steps.

PRICE: Dealer Net—$44.95

For further information about the RC-1 see your Pyramid distributor or write for complete technical data to: Pyramid Electric Company, Union City, N. J. EXPORT: 458 Broadway, N. Y. 13, N. Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal.

BURTON BROWNE/New York

PYRAMID ELECTRIC CO.

CATALOGS & BULLETINS

(Continued from page 24)

CARRIERS & CARTS: Oscilloscope carriers and instrument carts are featured in a new catalog. Technibilt, 905 Air Way, Glendale 1, Calif. (ELECTRONIC TECHNICIAN B4-8)

SPEAKERS: Catalog 165-C provides 16 pages of information, with illustrations, on Hi-Fi speaker systems, enclosures, kits, and components. Accompanied by a technical data sheet pertaining to speaker enclosures. Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, Ill. (ELECTRONIC TECHNICIAN B4-4)

ANTENNAS: Operating Manual No. HSK-3000 contains 16 pages of installation and maintenance instructions for the "Plug-Intenna System." Illustrations, charts, and photos are provided. Jerrold Electronics Corp., 15th & Lehigh Ave., Philadelphia 32, Pa. (ELECTRONIC TECHNICIAN B4-5)

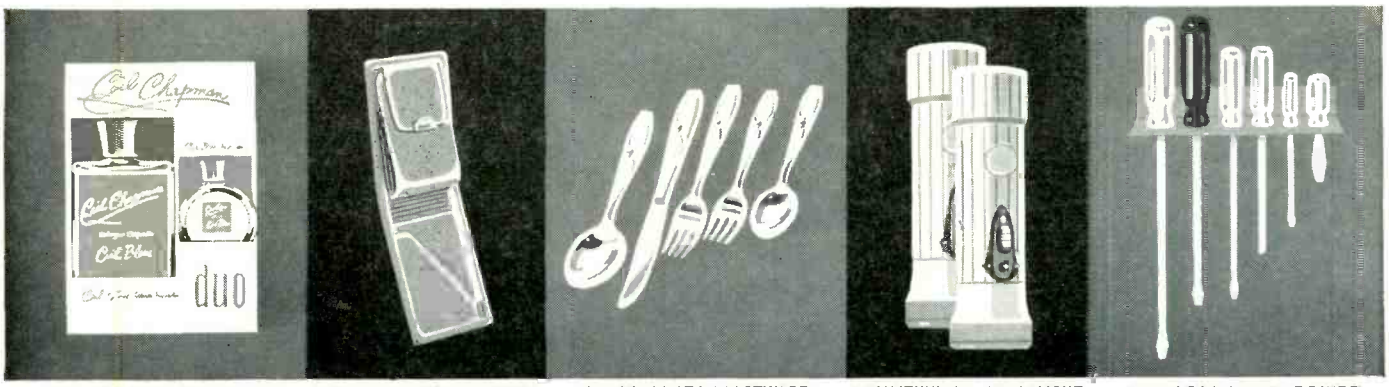
LACING CORDS: An illustrated, 4-page, brochure on 76 synthetic lacing cords and types, carried in inventory, lists tensile strength, diameter, stock colors, thickness, standard put-up, etc. Alpha Wire Corp., 200 Varick St., New York 14, N. Y. (ELECTRONIC TECHNICIAN B4-1)

FLYBACK TRANSFORMERS: The first issue of "Tips For The Serviceman," to be published periodically, covers "Simplifying Flyback Transformer Servicing." Detailed pointers on the horizontal output circuit are included. Chicago Standard Transformer Corp., 3513 Addison St., Chicago 18, Ill. (ELECTRONIC TECHNICIAN B4-2)

DIAL EQUIPMENT: An 8-page, illustrated, brochure covers dial equipment for mobile radio and radiotelephone systems. Included is a clarification of the similarities and differences between dial signaling on private and telephone systems. Secode Corp., 555 Minnesota St., San Francisco 7, Calif. (ELECTRONIC TECHNICIAN B4-9)

CAPACITORS: Monolithic, porcelain and silver capacitors, in five different designs and values from 0.5 mmf to 6800 mmf, are covered in a new, illustrated, Catalog 59-1. Information is included on manufacture; electrical characteristics; and design applications. Vitramon, Inc., P.O. Box 544, Bridgeport 1, Conn. (ELECTRONIC TECHNICIAN B4-7)

FREE!



CEIL CHAPMAN DUO. Glamorous Ceil Chapman Parfum and Cologne in a gold and blue gift package. It will delight the wife or girl friend . . . a welcome gift for any occasion.

WALES TOP GRAIN COWHIDE WALLET. A first quality man's wallet with pass case, zipper closing bill compartment, plus a secret section to hide your last twenty dollars.

STAINLESS STEEL FLATWARE. A five piece place setting of Wallace Stainless Steel tableware in the beautiful Northern Star pattern. Complete with lifetime guarantee.

POLYETHYLENE FLASHLIGHT SET. Not one, but two unbreakable flashlights made of lightweight, flexible polyethylene, the new miracle plastic. Use in the car and in your caddy.

PEERLESS SCREW DRIVER SET WITH WALL HOLDER. Six magnetized, alloy steel screw drivers in all the needed sizes. Complete with shockproof amber handles and handy wall holder.

YOUR CHOICE OF THESE 5 GIFTS

(Worth up to 4^{95}!) when you order the

Westinghouse

"TOP PROFIT FIFTY"

Electronic Tube Handi-Pak

Any one of these valuable gifts is yours when you order a "Handi-Pak" of the Top Profit Fifty Westinghouse Electronic Tubes—the types you'll need for 8 out of every 10 TV and radio service jobs. These pretested tube types were selected for fastest turnover and highest profit, and packaged in a special Handi-Pak you can take along on service calls. And don't forget: these are the tubes that are still standing up under the rugged Locked TV "Torture Test"—proving they work better and last longer to cut call-backs!

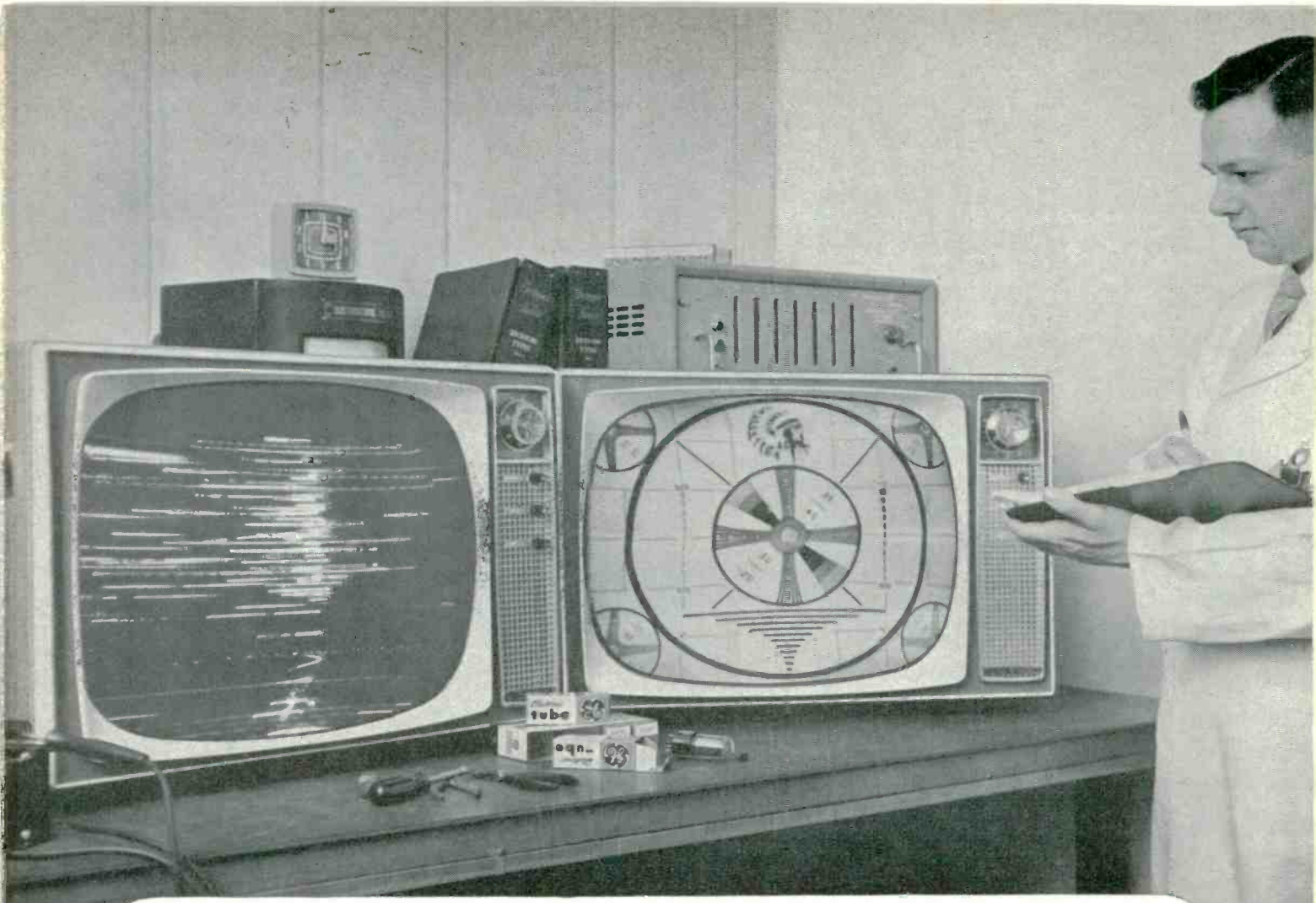
HERE ARE THE TUBES YOU GET IN THE TOP PROFIT FIFTY!

QUANTITY	TYPE	QUANTITY	TYPE
10	5U4GB	3	6AU6
10	6SN7GTB	3	6U8A
8	6CB6A	2	6BZ7
6	6BQ7A	3	6AX4GT
3	12AU7A	2	1B3GT

PLACE YOUR ORDER AND SELECT YOUR FREE GIFT TODAY!

YOU CAN BE SURE...IF IT'S Westinghouse

Electronic Tube Division Elmira, New York



CUT DAMPER-TUBE ARCING!

Have steady, dependable pictures with the new Service-Designed General Electric 6AX4-GTA (right)!

Side-by-side receiver tests show how prototype horizontal-damper tube occasionally will arc, cathode-to-plate (screen at left), whereas the new General Electric 6AX4-GTA continues to do its job reliably. The reason: a new, 15% larger cathode, with more emission area, consequently a lower operating temperature requirement.

New 6AX4-GTA also has faster warm-up, tapered pins, other improvements. Install this advanced tube to promote customer satisfaction, reduce call-backs. Service-Designed quality through and through! See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-111-202

ELECTRONIC TECHNICIAN

A Real Future In Industrial Electronics

This month we focus special attention on our Industrial Electronic Maintenance* section starting on page 43. This bonus section—just for this issue—expands our normal industrial coverage. It dramatizes the growing importance of the subject.

Home electronic sales and service have been the foundation and substance of the maintenance industry. In the past, and for years to come, repairing and selling TV, radio and hi-fi for the consumer will continue to account for most of the industry's dollar volume.

However, industrial electronic maintenance is a fast up-and-comer. Increasing numbers of electronic devices, valued at $1.38 billion annually, are being purchased by business and industry: Two-way radio for police, fire, transportation and field service; photoelectric controls for assembly lines; ultrasonic burglar alarms for warehouses; thyratron speed controls for motors; temperature controllers; induction and dielectric heaters; computers . . . and much more.

It is our purpose to aid our readers' efforts to prepare for this field. Some informative textbooks are available, and some fine electronic schools offer excellent industrial training courses to residents and correspondents.

Who Maintains Industrial Electronics?

Electronic technicians and field service engineers keep industrial gear in operation. They are divided into five different business and employment categories.

1. **Independent service technician outlets,** some 14,300 of the nation's total of 63,500, devote all or part of their business activities to industrial electronics. Industrial service volume was $76 million in 1958. An impressive rise is expected for 1959-60 and succeeding years.

2. **Electronic manufacturers and representatives** of some larger industrial producers have their own field service staffs. A company's sales must be great enough to justify handling installation and repair of the equipment they sell.

3. **End users,** such as factories and communication equipment operators, may have technicians on their plant maintenance staffs. Only large installations with very substantial numbers of electronic devices can afford such full-time service employees.

4. **Large service engineering firms,** sometimes affiliated with electronic manufacturers or industrial distributors, are responsible for a good amount of maintenance work.

5. **Government organizations,** both federal and local, have technicians on their payroll to maintain civil and military electronic gear.

Getting Into Industrial Electronics

As industrial electronics usage increases—and it is doing so quite rapidly—we may expect all of the above groups to increase their volume. Independent service technicians are ideally suited to handle a substantial amount of industrial business. They are familiar with circuitry and troubleshooting techniques. Additional specialized study and instruments will help develop their industrial capability.

From an industry-wide point of view, independent technicians must enhance their industrial know-how if they expect to get their share of this important business. Otherwise most of it will go by default to the other maintenance groups mentioned.

From a personal viewpoint, industrial maintenance should be attractive to many qualified independents, at least as a supplement to present TV work, if not outright specialization as time goes by. Much industrial work is on a profitable contract basis. Customer relations are often more pleasant than with consumers.

Industrial electronic maintenance offers a new professional dimension.

* *Trademark*

Tuning In the

MADNESS IN MASSACHUSETTS. House Bill 2009 in the Bay State would set a maximum fee of $3 for any service work performed on household appliances, including TV receivers and radios. Edward P. Burke, Philco service district representative, testified in opposition to the bill. In addition to a clear cut cost analysis proving that a service dealer can not stay in business at $3 per call, Mr. Burke made this laudable statement: "There is yet to be built, mechanical or electrical household devices that do not need installation, adjustment or repair from time to time; breakdowns must be properly diagnosed, worn parts replaced and original performance levels expertly restored. The efficient performance of such repairs requires skilled hands and trained minds. The public and the appliance industry relies, in a great measure, on qualified independent and dealer-employed servicemen . . ."

"I called you immediately—it has a flat tire."

PICTURE TUBE sales competition among prime manufacturers and rebuilders is intensifying, with price cuts and special allowances to jobbers becoming commonplace. This is a good time for service dealers to watch for good buys when they shop for replacement crt's. It's probable that several top name brands will have dual lines, both new and rebuilt. The resulting reduced price difference between top name pix tubes and lesser known locally rebuilt tubes is expected to help major prime producers recapture many of the sales lost in recent years.

AUTOMOBILE ELECTRONICS

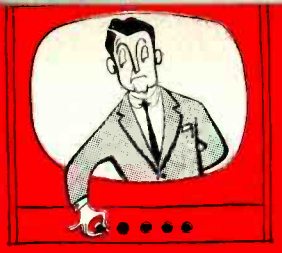
Experimental proximity warning device tells driver when an object is being approached too rapidly. Developed by General Motors' Delco Div., the system is sensitive to objects up to 100 ft. away. A waveguide antenna in one protruding nose cone sends out a 16,140 mc signal. The reflected signal is picked up by the antenna in the other cone. Based on the Doppler radar principle, the frequency differences between outgoing and reflected signals are compared, detected and amplified by transistors to suitable sound or signal light level. The frequency difference indicates the rate of closure toward the object.

FACTS & FIGURES covering the electronic industry are interestingly presented in the 48-page "1959 Fact Book" available for 75¢ from the Electronic Industries Association, 1721 DeSales St., N. W., Washington 6, D.C. It shows that some 1500 equipment assemblers, 2400 component manufacturers and 700 hardware and related producers accounted for $7.9 billion in sales in 1958. Add distribution, broadcasting and servicing, and the total is $13.3 billion. Factory sales of consumer products totaled $1.6 billion, or $100 million down from 1957. Other subjects covered are phonos, TV, components, tubes, industrial, and plenty more.

COLOR TV for just a few dollars? Think it can't be done? Well, it can't, and that's what the Federal Trade Commission believes. FTC charged M&M Specialties, 43 E. 19 St., New York City, with falsely claiming its colored plastic sheet designed to be fastened to TV screens will produce pictures in "real life color." This "Electronic-Age Miracle," as it was touted, was known as the Color V.

FROZEN VIDEO is made possible by a new Westinghouse camera tube, the Permachon. Designed for use in standard TV cameras, it has a special photoconductor material that stores any scene. After exposure, an electron beam scans the faceplate, and transfers the image to a picture tube for periods up to one hour. The scene can then be studied at leisure. Applications possible are in radar air traffic control, racetrack photofinish results without the need for film developing, medical fluoroscope studies, and even flashing a stored document on a screen for a busy executive.

Picture.....



TRANSISTORS are automatically tested and sorted according to use with the aid of a Raytheon-developed machine. It can detect the intrinsic qualities of as many as 1200 different levels of performance.

SCANOSCOPE wide-screen surveillance TV system by Grimson Color combines optics and electronics to get more information from standard TV pictures. A scene is optically squeezed to a 7 x 6 ratio through conventional circuits. At the monitor, the picture is electronically unsqueezed to provide a 7 x 3 aspect ratio with 75% more information than with a standard 4 x 3 system.

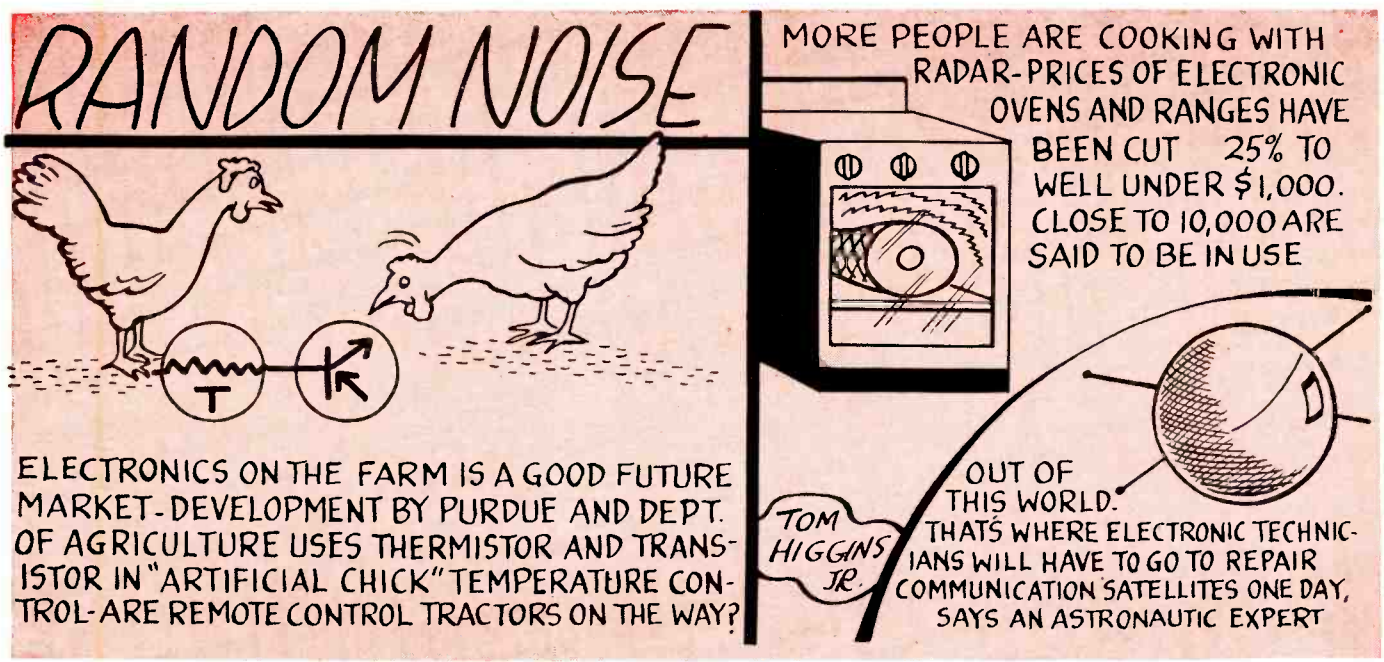
ELECTROLUMINESCENT panels in any one of six colors have been announced by RCA. A 0.002" layer of phosphor applied to a glass plate glows when 120 or 240-v. ac is applied. Previously only green was available. Now greenish yellow, deep yellow, blue, white and red are added. Potential applications include instrument panels and night lights.

PRINTED CIRCUITS have replaced conventional wiring in a novel motor announced by Circuit Research Co. This French invention was introduced in the U.S. by Printed Motors, 30 Rockefeller Plaza, New York City. The pancake-shaped motor uses flat disc-like printed coils. A 25 hp dc unit would be 15" in diameter, and cost less than $50, compared to several hundred dollars for a conventional motor.

CALENDAR OF COMING EVENTS

Apr.	14-15:	4th Conference on Industrial Instrumentation & Control, Illinois Institute of Technology, Chicago, Ill.
Apr.	16-18:	Southwestern Regional Conference, Dallas Memorial Auditorium and Baker Hotel, Dallas, Texas
Apr.	18-19:	NATESA Directors' Meeting, Hermitage Hotel, Nashville, Tenn.
May	4-6:	National Aeronautical Electronic Conference, Biltmore Hotel, Dayton, Ohio
May	6-7:	7th Regional Technical Conference & Trade Show, University of New Mexico, Albuquerque, N. Mex.
May	6-8:	7th Regional Technical Conference & Trade Show, University of New Mexico, Albuquerque, New Mex.
May	6-8:	Electronic Components Conference, Ben Franklin Hotel, Philadelphia, Pa.
May	8-10:	Council of Radio & TV Service Associations, Annual Tele-Rama, Sheraton Ritz-Carlton Hotel, Atlantic City, N. J.
May	11-13:	Joint Conference on Automatic Techniques, Pick-Congress Hotel, Chicago, Ill.
May	11-13:	Radio Technical Commission for Marine Services, Assembly Meeting, Mount Royal Hotel, Montreal, Canada
May	18-20:	1959 Electronic Parts Distributors Show, Conrad Hilton Hotel, Chicago, Ill.
May	25-27:	American Society for Quality Control, Annual Convention, Public Hall, Cleveland, Ohio
July	3-18:	The Associated Radio & TV Servicemen, Illinois, Navy Pier, Chicago, Ill.
Aug.	18-21:	Western Electronic Show & Convention (WESCON), San Francisco, Calif.
Aug.	21-24:	NATESA Convention, Congress Hotel, Chicago, Ill.

HATS OFF to KMOX-TV, St. Louis, for keeping the service technician in mind when it relocated its transmitter. In a letter to local servicers, the station anticipated reception difficulties caused by the move.



Troubleshooting &

Simplify Tuner Repairs By Treating Them As An Integral

TV TUNER SERVICE

Aspects
- *Electronic*
- *Mechanical*

Functions
- *R-F Amplifier*
- *Local Oscillator*
- *Mixer*

Troubleshooting Techniques
- *Signal Injection*
- *Voltage Measurements*

Test Equipment
- *VTVM*
- *Signal Generator*
- *Scope*
- *Bias Box*

Sensible Approach

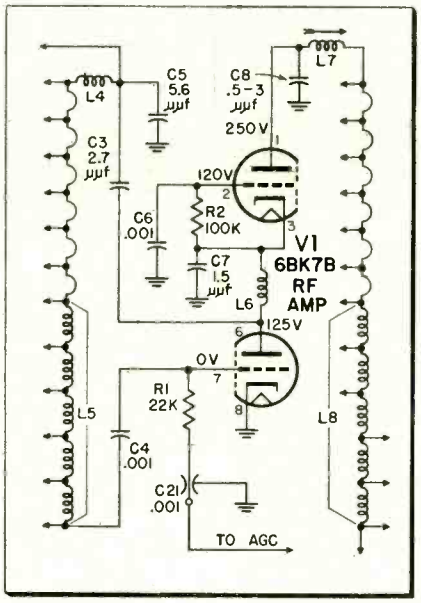
AL DIAMOND

• Tuner troubles have dismayed many service technicians. Some look upon the front end as a necessary evil and a sub-assembly to be avoided. There is still a substantial traffic in complete tuner replacement. Much of this activity can be avoided. Not so long ago, in the pre TV days, receivers for home use operating in the VHF band were in the realm of Hamdom and a bandwidth of 6 mc was fantastic. The entire AM broadcast band (535 kc to 1,605 kc) is only 1.07 mc wide. It is no wonder then that when a little black box (containing over 100 contacts, a host of coils, components, and innocent looking gimmicks which can change the frequency just by a change in their position) doesn't get all the channels, or the picture and sound aren't quite right, or intereference rejection is poor, or some handy andy with an uncalibrated screwdriver went to work, that the servicing technician proclaims, "You need a new tuner."

Outside of fire and severe mechanical damage, tuners are repairable. Most mechanical defects can be found by visual inspection. Parts procurement is a recognized problem and if the local distributor can't help, the manufacturer may be contacted directly. The time element is a factor and it sometimes takes less time to get another tuner than it does to get a part for it. However, experience has shown which parts are most likely to break down, and most of the needed parts are readily available. Mechanical trouble is a subject unto itself. What causes most of the tuner shyness is usually not the mechanical troubles but the electronic problems.

Several valid reasons exist for the, "I hope it's not the tuner," attitude. Low signal levels; inaccessible circuitry; high frequency leakage and drift; and sensitivity to, external noise, test instruments, probes, lead dress, shields, supply voltages, agc, etc. Don't give up . . . tuners can be serviced.

Fig. 1—Voltages in a cascaded circuit can be checked only with the tube plugged in. Potential on pins 2, 3 and 6 are developed by the voltage divider action of the tube.



As in any AM superheterodyne receiver, the front end in a TV set has 3 separate functions: (1) r-f amplifier; (2) local oscillator; and (3) detector or mixer. Even though the tuner is a complete subassembly which can be removed and serviced as a separate unit, it is best to troubleshoot and repair it while it is still in the set. If removal of the tuner is necessary, the trouble should be first located. Nothing would be more frustrating if the tuner were removed and taken apart, only to find that there is nothing wrong with it. Of course a substitute tuner could be hooked up to help localize the trouble to the tuner or the set, but another tuner might not be available, and enough complications could develop to create misleading results. Some sets already on the drawing boards will have plug-in tuners.

Signal Injection

In place of another tuner, an AM generator, tuned to the center frequency of the i-f amplifiers, and modulated by a 400 cycle note can be fed into the grid of the first i-f amplifier. If the signal is present at the output of the second detector or CRT, the chances are that the trouble is in the tuner. Signal generator output levels and stray coupling must be considered to avoid erroneous conclusions. It is possible for a signal to bypass a defective i-f stage, either by brute force, or by

Repairing TV Tuners

Part Of The Set. Only 3 Test Points Used To Localize Trouble

leakage. AGC voltage should be monitored in all tests. Because of the high impedance encountered in the grid circuit it is desirable to use a VTVM to minimize loading and other misleading effects. If there is any doubt about the proper functioning of the agc circuits, use a low impedance bias box to overtake the agc voltage and peg the bias at about —3 volts. The article "Understanding and Troubleshooting AGC Circuits," in the July 1958 issue of Electronic Technician describes a practical approach to agc circuits, and explains the technique of overriding agc.

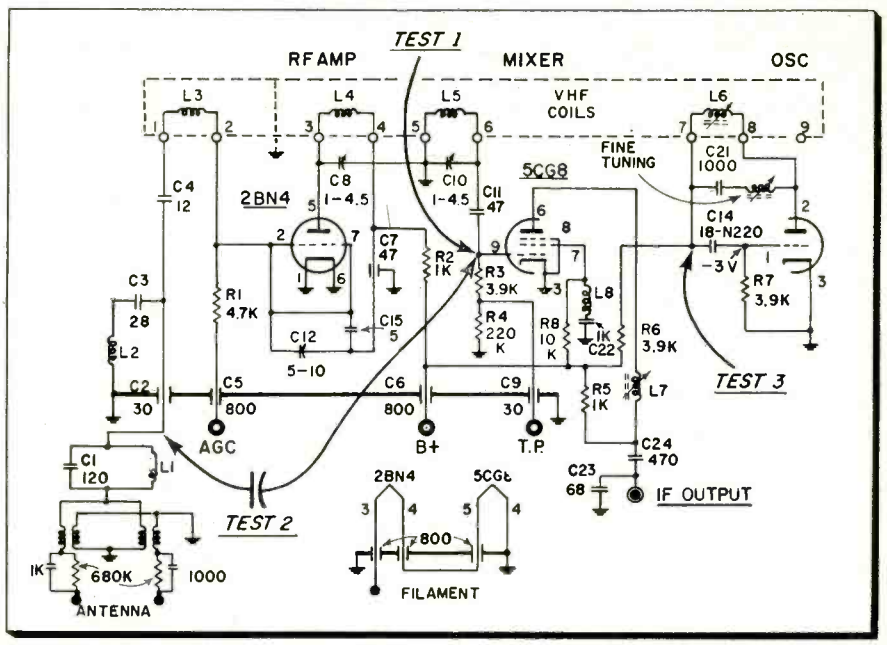
Troubleshooting

Once it has been determined that the trouble exists before the first i-f stage, and that the antenna and signal conditions are not at fault, actual troubleshooting of the tuner can commence. It should be realized that there are many troubles which are obviously tuner faults, and it is possible to head directly to a particular stage, even to a single defective component as soon as the symptom is recognized. This is especially true when a run of similar troubles develop, either with a particular type of tuner, or with a particular make and model of receiver. Tube substitution with known good tubes is still the quickest way to determine if the tubes in use are good or bad.

Signal injection techniques are probably the most reliable. While it is possible to signal trace with the scope, signal levels in the tuner are quite low, and may not be large enough for some demodulator probes and scopes. The VTVM comes in quite handy, and can be used, first as a quick preliminary check, and later in a more detailed manner. Whichever technique is used first is a matter of individual preference. In many instances more than one procedure and some ingenuity may be required. Perhaps the most rapid approach is to attack the major check points with a VTVM and then if necessary to use the signal generator. Assuming that there is no audio or video information getting past the tuner, and that the rest of the receiver is able to function normally, it is only necessary to find which of the three tuner functions is inoperative. If no external check points are provided, or if they are unknown, it is a simple matter to use an extension socket having exposed terminals. Plate and screen voltages can be checked quite rapidly. This check should be made with the tubes in the socket. Cascaded circuits cannot be checked otherwise. As shown in Fig. 1, the 125 volts on pin 6, the plate of the first triode section, is developed across the top half of the tube. If the tube is not in the socket, there will be no voltage on pin 6. Because of the voltage divider action of this tube and direct coupling, even the grid and cathode, pins 2 and 3 respectively, have almost the same B+ voltages as the plate of the lower tube. When checking each individual tube section, it is advisable to measure voltage with respect to the cathode of that particular section. This is especially significant when looking at the grid bias voltage. Notice that the grid, pin 2, is 5 volts negative with respect to its cathode, even though it is 120 volts above ground. At this time it is also convenient to measure the agc voltage on pin 7. AGC voltage will vary from set-to-set and depends upon the amount of signal getting past

(*Continued on page 92*)

Fig. 2—If a modulated I-F signal injected at the grid of the mixer goes through, trouble exists either in the oscillator or R-F amplifier. The R-F stage can be jumped by a capacitor. Test 3 consists of using the signal generator as a substitute for the local oscillator. Signal may be coupled through the tube's envelope.



Solder Joint Reliability

Temperature Characteristics Of Tip, Solder And Flux Are Critical

ALVIN B. KAUFMAN

• The cause of solder joint failure is generally attributed to poor soldering technique, i.e. cold joints, excessive heat, improper flux, etc. The actual cause of solder joint failure is of course much more complicated than this. In printed or etched circuit boards, failure may be caused by poor choice of board material, improperly set eyelets, and other miscellaneous factors. It is clear, however, that at the final count the soldering tool and the technique with which it is used, assuming other factors equal, determines the joint reliability.

Unfortunately, technicians are too likely to select one soldering iron and use it for all purposes. This compares with using a sledge hammer for driving tacks or nails. No one soldering tool is suitable for all uses.

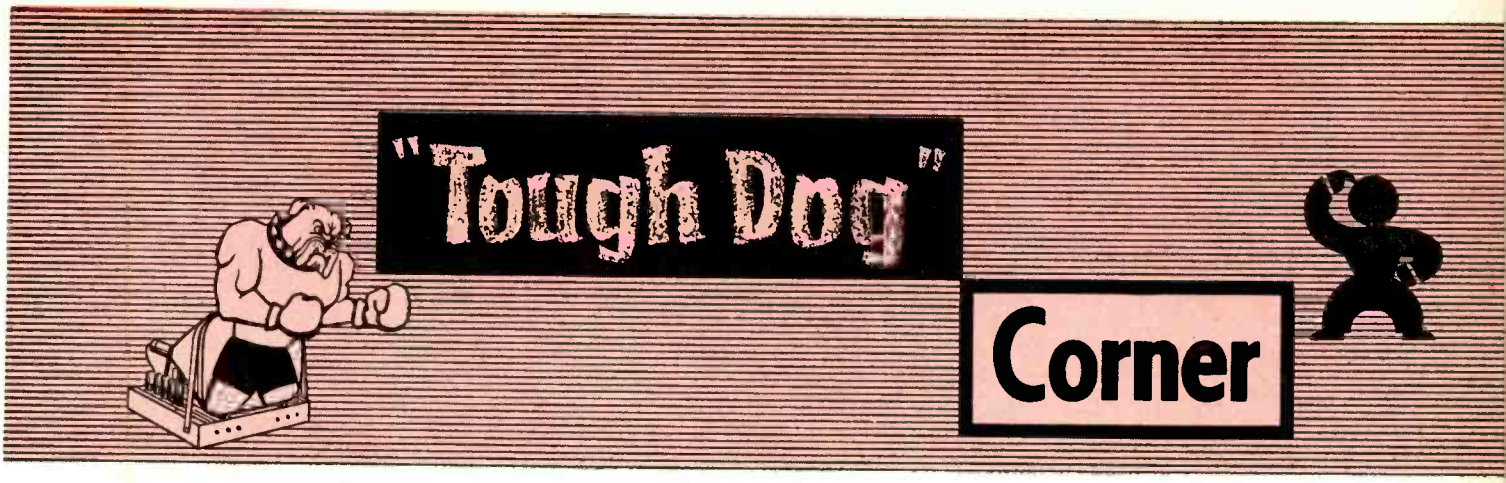
In considering the use of a soldering iron, the user generally, as has been the practice, considers wattage as the major factor. Actually thermal capacity of the iron bit and its temperature are the parameters by which the soldering iron should be selected. Wattage is not even indicative of the time required to reach operating temperature, nor of the iron's capability to solder a component to terminal or chassis.

Rosin melts at about 260°F and at the eutectic temperature of soft solder (361°F), rosin is sufficiently active for the solder to take even before the liquidus temperature of the solder is reached. At the liquidus temperature (361-425°F), rosin is very active, but at 550°F, seven percent of the rosin volatizes, while at slightly higher temperature all fluxing action will cease. Thus the flux activity is largely dependent on temperature. It is not difficult to recognize that the improper application of electric irons which are designed to produce temperatures of 750-800°F, but which are actually known to rise to nearly 1100°F, will readily render rosin inactive. Proper flux activity produces metallurgical changes (inter-metallic bonding of solder elements to base material), whereas excessively low or high temperature interferes with fluxing and the securing of good bonding strength.

The use of higher temperature irons, appears to coincide with the use of higher temperature fluxes, which quite often do not possess residues negating leakage resistance and corrosion. Note also that metal surfaces that are perfectly good for soldering can be made resistant to soldering by unnecessarily high temperatures. Further, it is known that the grain size of tin-lead alloys is dependent on temperature and, particularly, on the rate of cooling. Consequently the higher the temperature, the greater the rate of cooling. Under certain conditions, this rapid cooling and change in grain size will appreciably affect the strength of the solder in the joint.

Commercial 60-40 and 50-50 soft solder have been empirically tested

(*Continued on page 66*)



Difficult Service Jobs Described by Readers

No High Voltage

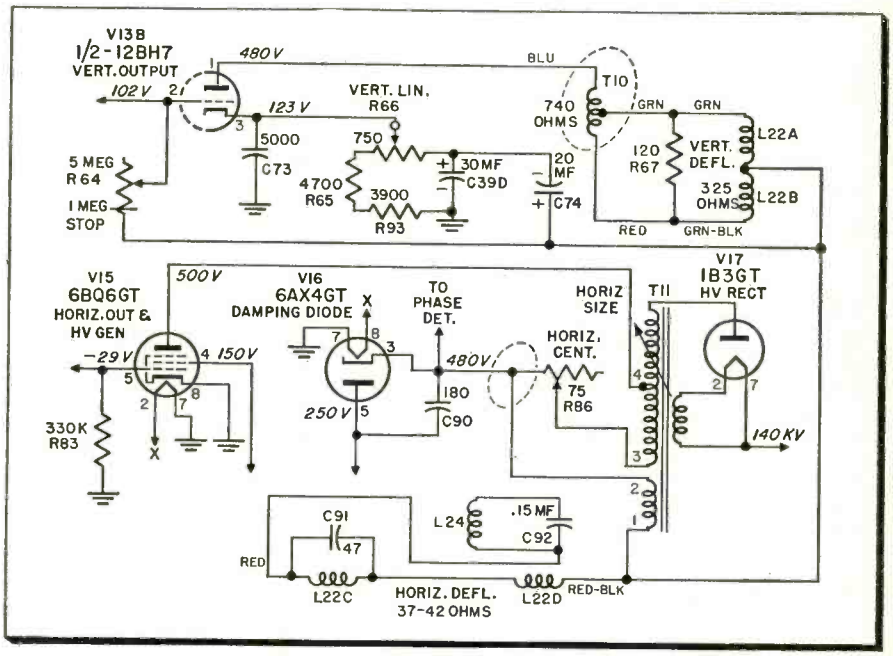
A Motorola, chassis TS408B, with no high voltage gave me a hard time. First the tubes were substituted in the customer's home. Horizontal oscillator, horizontal output and damper were changed. The cap of the 1B3 was disconnected to eliminate this tube and its circuitry as a possible cause of trouble. I even pulled the 12BH7 vertical output and oscillator tube in an attempt to restore high voltage. After obtaining no results and unable to make further progress, the set was brought to the shop. Voltages were checked, B+ was about 30 volts low, all horizontal voltages were within tolerance, except boost voltage, which was down to 210 volts. The scope showed sufficient saw tooth drive from the oscillator. Bias was about normal on the 6BQ6. Resistance checks were also normal in the damper and horizontal output circuits. Even though the yoke checked perfectly good, a new one was tried because it was suspected that it was breaking down under load. This did not help. The flyback had a clean bill of health. Coil L-24 was next, it was open. Thinking that the problem was solved I replaced it, turned on the set—still no high voltage.

About this time, I was ready to pull my hair out, having checked and substituted all possible parts in the horizontal circuit, including capacitor C-74 going to vertical circuit. All this time I had been under the impression that I had disabled the vertical circuit by pulling out the 12BH7.

Drooped Boost

Some circuit was dropping the boost voltage. The CRT socket was disconnected, thus disabling the screen and focus supply lines from the boost circuit. Another resistance check was made from the damper cathode to ground. Suddenly the meter reading dropped to about 800 ohms. After the second wire was cut to isolate the short, it disappeared. Knowing that the vertical and horizontal yoke windings are internally connected, I clipped this wire and turned the set on. The high voltage came on with a pleasant sing. I placed my hand on the vertical output transformer, it was still warm from previous operation of the set, and then I had a pretty good idea of what was happening. I lifted the transformer above ground, it was shorted to the core. This happened only under load, except for that one instance. Confusion was also created because the damper current did not seem to be excessive. —*Wylie G. Soppington, Memphis, Tenn.*

Vertical output transformer shorted to ground killed high voltage.



TOUGH DOGS WANTED!

$10 for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Photos are desirable. Unacceptable items will be returned. Send your entries to "Tough Dogs" Editor, ELECTRONIC TECHNICIAN, 480 Lexington Ave., New York 17, N. Y.

Practical Peak-to-Peak Scope Calibration Procedure

Eliminate Common Errors

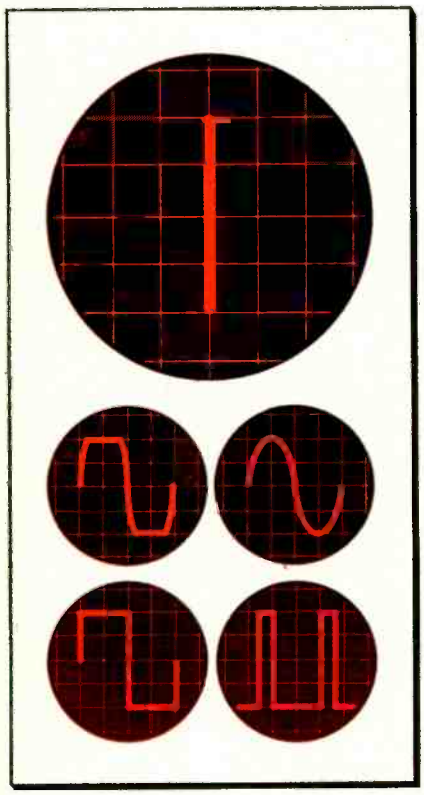
Compensate For The Probe Factor

TV Serves As Voltage Calibrators

ROBERT TURNER

• Many scopes have provisions for internal calibration. Some have varying calibrating voltages, and others have a fixed value. Internal calibrators are good, but if the technician is not aware of the pitfalls, misleading and meaningless interpretations will be his reward. Probe factor must be considered each time a reading is made. When a direct probe is used, there is usually no problem, but if a low-capacitance probe is used, it attenuates the signal fed to the scope. Peak-to-peak readings must be multiplied by an amount equivalent to the amount of loss in the probe to obtain a true reading. If the range switch on the scope is changed from the position in which calibration was made, then the technician will usually find himself performing a double multiplication, or a multiplication and division procedure, depending upon the direction of rotation of the range switch. If the range switch is properly compensated, if the ranges are truly as indicated, for example X 1, X 10, X 100, etc., and if the probe factor is known, then the mathematic manipulations will be perfectly valid, providing no mistakes are made. Fortunately, the vertical range switch can be relied upon in most scopes, but the gain control is another matter. Therefore, once the gain control is set, it is not to be touched, unless calibration procedure is repeated. Experience has shown that normal wear and tear will alter the characteristics of any electronic device. Measuring instruments and their accessories are no exception. Therefore, it is good practice to check the equipment from time-to-time.

Fig. 1—Regardless of waveshape, collapsing horizontal sweep presents a single vertical line for calibration and easier reading peak-to-peak voltage measurements.



Internal scope calibration is usually accomplished by switching the calibration voltage directly to the input of the vertical amplifier and adjusting the vertical range and vertical gain control for a desired size of vertical trace. It is often easier to predict the peak-to-peak display by collapsing the horizontal sweep. The vertical line thus obtained, makes it unnecessary to worry about horizontal frequency and sync settings. Its amplitude is also independent of wave shape, therefore it wouldn't matter if the calibrating voltage were a sinewave, clipped sinewave, square wave, or pulse. See Fig. 1. An important thing to keep in mind with internal calibration is that the calibrating voltage is applied directly to the vertical amplifier and not through the probe. If the probe attenuates the signal, the probe factor must be considered.

External Calibration

It is possible to calibrate the scope through the probe in use, and avoid the mathematics. The calibration procedure is exactly the same, except that the known calibration voltage is fed through the probe. This calls for an external voltage source. But it isn't necessary to buy or construct any. Most scopes have a 60 cycle test voltage available at an external jack or binding post. This may be 1 volt, 6.3 volts, or other voltage which can be readily determined. Some scopes have the internal calibrating voltage, which may be adjustable, at the external terminal. This is quite convenient.

But what happens if no such terminal is present? One gimmick is to use the 6.3 volt heater voltage in the TV receiver being serviced. In a series-string set the last tube in the string, usually the CRT, will have 6.3 volts across the heater.

Whatever voltage is used, don't try to calibrate the scope with a bias box (don't laugh, it's been tried). An a-c signal is desired. Actually any convenient known a-c voltage could be used. One other thing must be considered before calibrating the scope. The 6.3 volts is rms and must be multiplied by approximately 2.8 to obtain the peak-to-peak value. For practical purposes 6.3 volts rms can be considered as 18 volts peak-to-peak.

Multiple Ranges

The beauty of this procedure is that it can be used with any scope and no extra equipment is required. This procedure is particularly recommended when working with a strange scope and probes. It is easy to trip over an unknown instrument characteristic. Practical servicing requirements usually do not demand more than calibration for 1 or 2 volts peak-to-peak, per-inch, in most scopes. One volt-per-inch on the X 1 range would be capable of reading up to 4 volts, 40 volts and 400 volts on the X 1, X 10, X 100 range respectively, if up to 4 inches of deflection is used. The range of voltage readings would be doubled if the scope were calibrated for 2 volts-per-inch. If smaller voltage values have to be determined, calibration is set up on the X 100 range, or higher. Thus 1 volt-per-inch would become 0.1 or 0.01 volt-per-inch depending upon a one or two step movement of the control. This of course assumes that the vertical step control varies by a factor of 10 in each position.

1 Volt/Inch

To calibrate for 1 volt-per-inch, using an 18 volt peak-to-peak signal, and the probe with which measurements are to be made, connect the probe across the voltage source (6.3 volt heater) and set the vertical step attenuator to the X 10 position. Adjust the vertical gain control for 1.8 inches of deflection. Most scopes have 10 minor boxes or rules per-inch on the graph, so 18 minor boxes would be required. This means that each minor box is 1 volt, or 1 inch is 10 volts, 2 inches is 20 volts, etc. Do not touch the vertical gain control, once it's adjusted. The scope is now set for 10 volts-per-inch. Rotate the step control to X 1 for 1 volt-per-inch, and to X 100 for 100 volts-per-inch. To calibrate for 2 volts-per-inch the same procedure is followed except that the vertical gain control is set for 0.8 inch deflection, which is 8 minor boxes. This setting is 20 volts-per-inch in the X 10 position, as shown in Fig. 2.

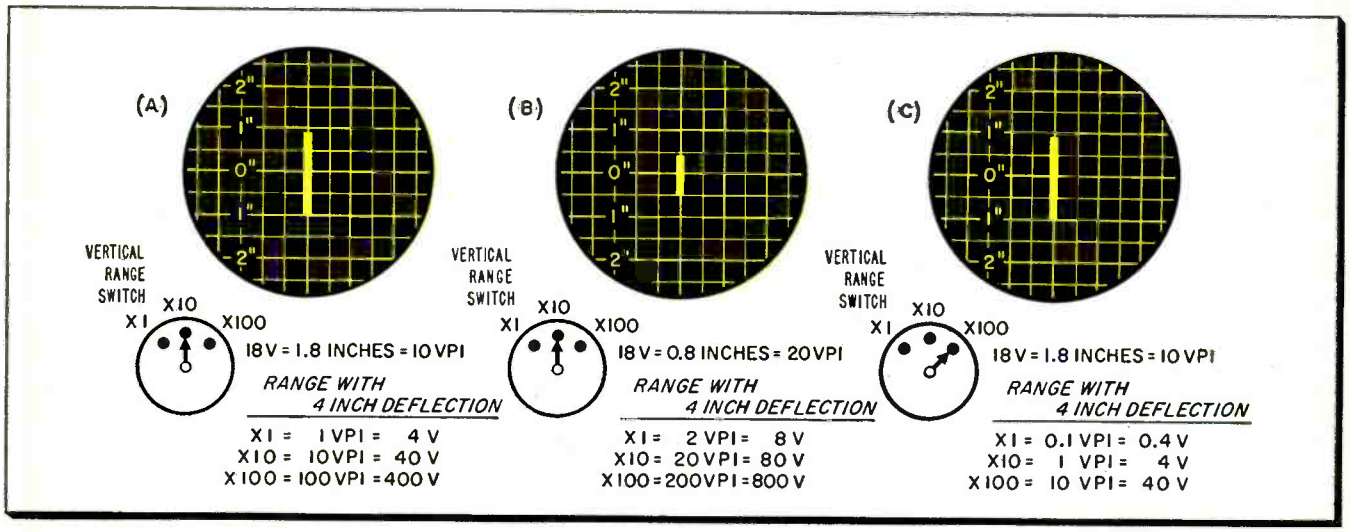
If for some reason it is not possible to obtain the desired trace during calibration, because the gain control has reached the limit of its travel, then it will be necessary to change the position of the step control. The X 1, X 10, etc., markings should be used as multiplying factors for each range and not as multipliers for reading. For example, if 1 volt-per-inch were calibrated on the X 10 range, 1 inch of deflection on the X 100 range would be 10 volts and not 100 volts.

If it is necessary to change probes, recalibrate the scope with the new probe. As a general rule, calibration points should be selected which will place the vertical gain control somewhere near its center position. Extreme ends should be avoided. Some confusion may set in when the vertical step control is adjusted to read a higher or lower range while the probe is still attached to the 18 volt source. Flipping the switch to the X 1 position will cause the trace to expand beyond the face of the CRT. In this position the scope is 10 times more sensitive, and the same 18 volts which swept 1.8 inches could now conceivably sweep 18 inches. If the control were switched in the other direction to the X 100 position, this trace would collapse to almost a spot the size of 0.18 inches.

Frequency Response

Up until now nothing has been said of frequency response of the scope and probes. If the response to the signal under test is different from that to the calibrating signal, then it will become necessary to either calibrate the scope at the same frequency, or use an appropriate correction factor. Fortunately for most service work and with most test equipment, this is not a problem. •

Fig. 2—TV set's heater voltage (18 volts peak-to-peak) may be used for calibration. Most any set of ranges may be established, depending upon the scope's sensitivity, and maximum voltage rating. Calibration shown on the X1 range is 1, 2, and 0.1 volt per-inch, respectively.



The Nuvistor— A New Tube Design

Unique Construction Reduces Size, Cuts Voltage Requirements

• A significant RCA development in electron tube design has been reported to represent a major breakthrough in tube size, performance, power drain, and reliability. Called "Nuvistors," the new tubes are in advanced development.

The name of the new tube design is based on the words "neuva" meaning new and "vistar" meaning prospect. Hence, the "new look" or "Nuvistor."

RCA will furnish developmental samples to the electronics industry within the next several months. A small-signal triode and a small signal tetrode will be offered at first and will be followed later by a beam power tube. According to present plans, limited commercial production is expected in 1960. The metal-envelope tubes lend themselves readily to mechanized production and reliable operation under heat and vibration.

In the demonstrations, RCA showed a completely "nuvistorized" TV tuner requiring low plate voltage. This tiny experimental tuner reduces volume by one third.

Construction Features

Construction of the Nuvistor starts with a strong ceramic base-wafer which serves as a platform. An array of tube electrode assemblies is erected on this platform. Each assembly is held rigidly in place by a tripod-like structure.

The electrodes are strongly supported from one end in a cantilever fashion. This construction feature eliminates the need for mica support discs or spacers. All the electrodes are small, light cylinders. They are able to withstand a high degree of shock or vibration because of their shape and low mass.

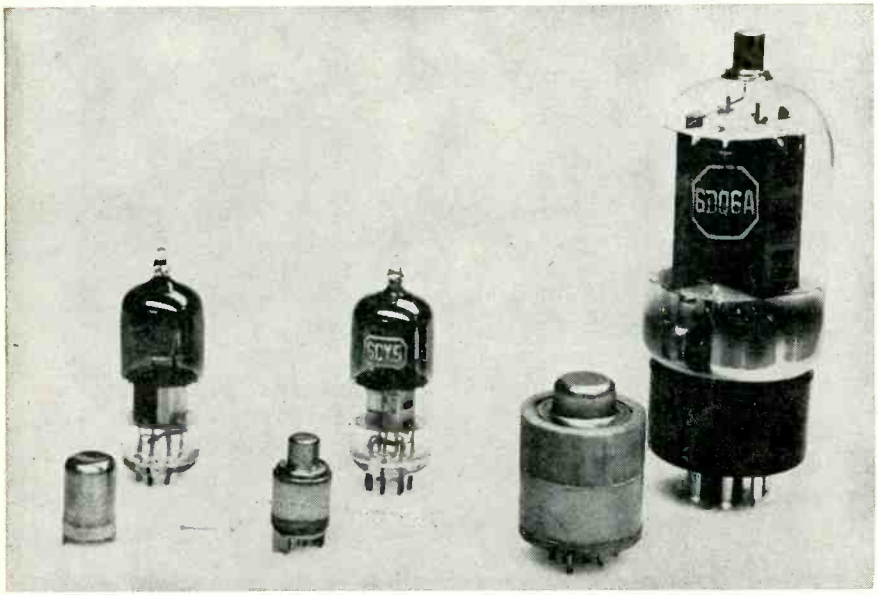
All the joints in the complete tube are processed at white heat (temperature of approximately 2,000° F) in a brazing furnace and then in a vacuum-exhaust furnace. As a result, the parts are joined in their original strain-free positions. Since the tube elements are accurately secured in this manner, the possibility of shorts developing in the tube during operation is greatly reduced.

Advantages of Construction

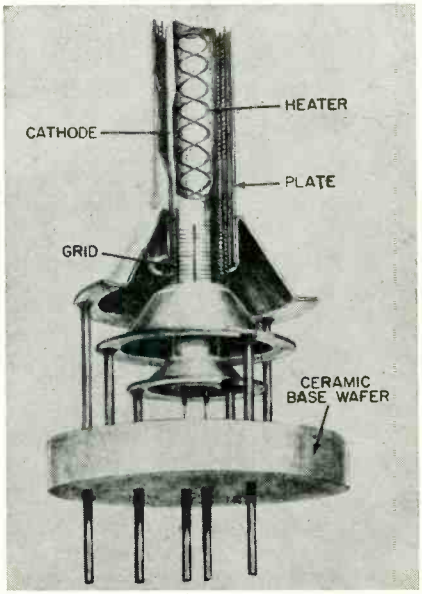
1. Cylindrical symmetry and cantilever support of the electrodes provide a combination of high cathode efficiency and permit the use of accurate jigs for parts assembly.

(Continued on page 60)

Developmental Nuvistor samples (l to r), triode, tetrode and beam power tube, compared to equivalent conventional tubes. Note indexing lugs at base of Nuvistor envelopes designed to facilitate insertion in special sockets.

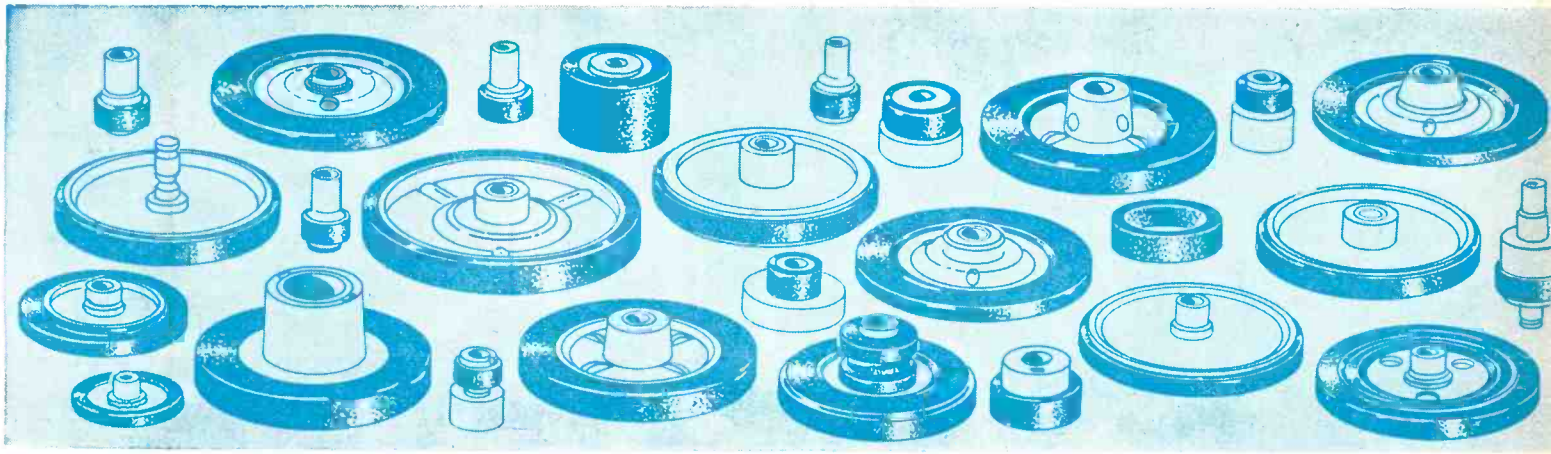


Triode cross-section shows three flange supports mounted on rods. Cathode, grid and plate are each held by one flange, respectively. Cylindrical design allows rapid assembly of all parts on jig simultaneously during fabrication.



Rumble, Flutter, And Wow In Record Players

Troubles In Power Transfer Components Subjected To Normal Wear And Tear Can Be Easily Rectified



PERRY SHENEMAN

• In spite of modern recording techniques, high quality amplifiers, elaborate speaker systems and ultra sensitive pickups, we are still faced with one of the major problems that plagued Edison over a half century ago—speed variations and noise from the record turning mechanism. Amplifiers and associated components can be designed to remove, favor or hide most unwanted frequencies, variations caused by changes in turntable speed cannot be removed, and noise frequencies from the turning mechanism are difficult to suppress.

The exact reason isn't known why the number 78 was chosen for the record speed in the early efforts to put sound on wax. It is believed to have been mostly chance. However, the high record speed was used deliberately in an effort to minimize the host of unwanted sounds. Recording at a high rpm, while preventing the introduction of some unwanted noise frequencies also limited the reproduction of some of the desired frequencies, therefore records of the time had a narrow frequency response. The advantages of recording at half this record speed, with a corresponding multiplication of the frequency response, was known even in those days. In fact, records were released with a turntable speed of 33⅓ rpm some 40 years ago. However, the advantages of a wider frequency response were more than offset by motor speed variations, and the results were far from successful.

With modern recording technology and improved rotating mechanisms, a relatively wide range of frequencies at low rpm can be reproduced with considerable success. However, we are still plagued with noise frequencies from the record turning mechanism (rumble), high-speed turntable variations (flutter) and slow turntable speed variations (wow). It could be said in all fairness, that as long as records are used for audio reproduction, the criterion of good sound depends upon what makes the record go 'round and 'round.

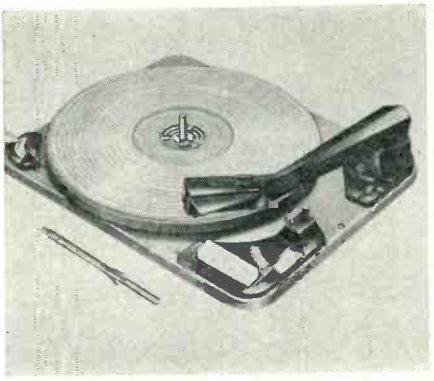
The phono motor in the average record player is a shaded-pole type and develops roughly 0.0025 horsepower at an armature speed of 1750 rpm. The initial rpm is reduced by a speed reduction system. An idler wheel transfers the rotational mo-

(*Continued on page 85*)

New Audio Products

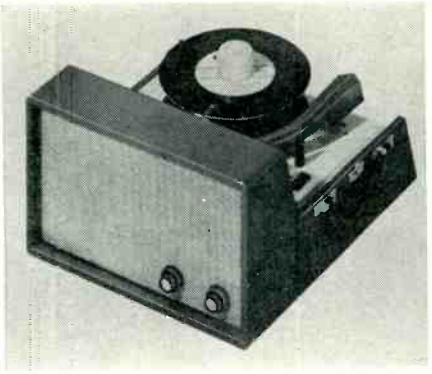
For more information, write in ELECTRONIC TECHNICIAN's new product code number on coupon on page 76.

United CHANGER



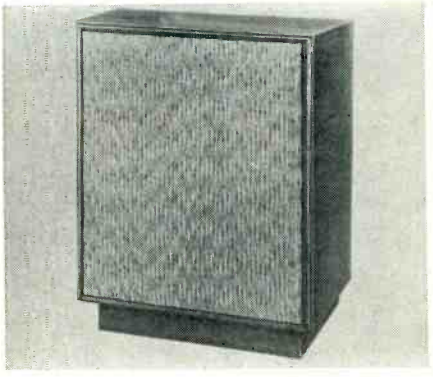
The Dual-1006 is a combination 4-speed turntable and record changer. It will track at 2 grams. There is a built-in direct reading pressure gauge. One-piece tonearm employs a snap-in cartridge holder. The stereo-mono switch includes a phase-cancelling feedback circuit which removes vertical noise signals that results when mono records are played with stereo cartridges. It will intermix any record from 5" to 12". United Audio Products, Inc., 202-4 E. 19th St., New York 3, N.Y. (ELECTRONIC TECHNICIAN 4-1)

V-M '45' STEREO PHONO



Lightweight Model 301 (16½ lbs.) portable stereo phono system which plays 45 rpm stereo discs consists of two units which clip together. It also plays 16 rpm records. The record playing section contains a dual-channel amplifier, record changer, all controls and a 6" speaker. The detachable second-channel section contains a matching speaker. It has a dual loudness control. The dual channel amplifier is rated at 4 watts (peak) each channel. $59.95. V-M Corp., Benton Harbor, Mich. (ELECTRONIC TECHNICIAN 4-2)

GE ENCLOSURE



A five-cubic-foot "distributed port" 12" speaker enclosure, the "Stereo Classic" EN-50 series, is proportioned for minimum width. Price is $69.95. The enclosure features an optional front panel tweeter mount opening with a removable cover plate. The seven "distributed port" openings are in the rear panel. The two rear panel terminal connections, for the leads from the amplifier, are marked "plus" and "minus" for correct speaker phasing. Dimensions are: 31⅝" H., 23¼" W., 16¾" D. General Electric Co., W. Genesee St., Auburn, N.Y. (ELECTRONIC TECHNICIAN 4-4)

Shure STEREO PICK-UP

The Stereo Studio Dynetic phono reproducer, an integrated tone arm and moving-magnet cartridge, is designed for use with professional turntables. It will track at less than two grams. Price $89.50. Channel separation is more than 20 db at 1000 cps; frequency response is 20 to 20,000 cps (±2½ db); output voltage is 5 mv per channel at 1000 cps; compliance, vertical and lateral, both 8.0×10^{-6} cm/dyne. Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. (ELECTRONIC TECHNICIAN 4-3)

Regency RADIO-PHONOGRAPH

Transistor radio TR-22 operates on 3 flashlight batteries for over 1,000 hours. A phono plug on the back permits any record player to be plugged in and played through the radio's speaker. Price is $29.95. Available as an accessory, Model RP-3 is a battery operated 3-speed record player that plays 3,000 records on one set of four D flashlight cells. A phono jack is provided to simply plug into the TR-22. The crystal pick-up has a turnover sapphire. The RP-3 is priced at $29.95. Regency Div., I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26, Ind. (ELECTRONIC TECHNICIAN 4-7)

Fisher REMOTE CONTROL

Model RK-1 remote control permits stereo speaker levels to be controlled anywhere in the listening area. Designed for use with the Model 400-C master audio control, this attachment makes it possible for the listener to set the volume and balance his speakers at the point where he hears the program instead of at the control center. It consists of a two-knob control assembly, 30 feet of conncting cable, and an adapter plug. Size is 4" × 2⅛" × 1¼". Price is $17.95. Fisher Radio Corp., 21-21 44th Dr., Long Island City, N.Y. (ELECTRONIC TECHNICIAN 4-6)

Weathers RECORD PLAYER

The K-601 is a stereo record player featuring the Stereo-Ramic cartridge, Microtouch tonearm and Synchromatic drive turntable. Specifications are: frequency response, 15 to 30,000 cps; compliance 6×10^{-6} cm/dyne; dynamic moving mass, 1.0 mg; tracking force, 2

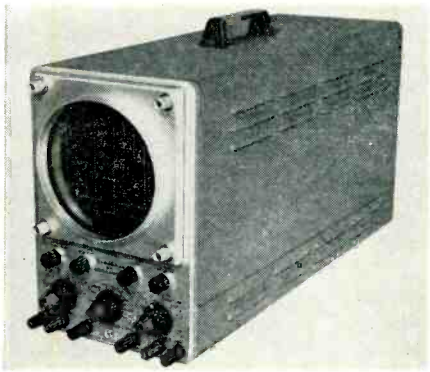
grams (factory set); turntable speed, 33⅓ rpm; stylus, 0.7 mil; separation, 25 db; s/n, —60 db; rumble, —70 db; flutter, 0.1%; wow, 0.15%; output per channel, 25 mv. Price: K-601D (diamond) $119.50; K-601-S (sapphire) $111.75. Weathers Industries, 66 E. Gloucester Pike, Barrington, N.J. (ELECTRONIC TECHNICIAN 4-5)

Latest Test Equipment

For more information, write in ELECTRONIC TECHNICIAN's new product code number on coupon on page 76.

Heath OSCILLOSCOPE

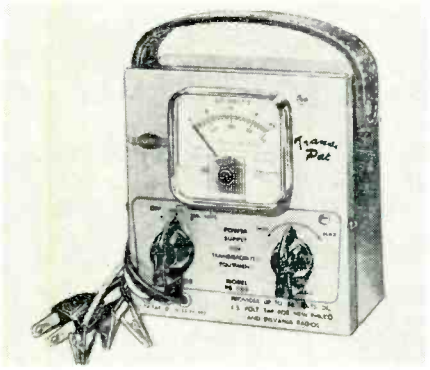
Model 1 OR-1 5" dc oscilloscope kit features identical dc coupled vertical and horizontal amplifiers, with low relative phase shift characteristics, 5ADP2 flat-face crt and edge-lighted graticule. Both vertical and horizontal channels feature dc to 200 kc bandwidth (1 db



point) and a sensitivity of 0.1 v. peak-to-peak per cm. Coupling may be either ac or dc as selected by the input attenuator switch. A multi-vibrator type recurrent sweep generator provides a linear, sawtooth waveform. $119.95. Heath Co., Benton Harbor, Mich. (ELECTRONIC TECHNICIAN 4-19)

Sencore "TRANSI-PAC"

The PS-103 Transi-Pac is a complete isolated power supply designed to replace batteries during repair of transistor radios. It provides from zero to 24 v. output with a 1.5 v. tap to operate radios with a tapped supply, such as Philco and Sylvania. These radios can-



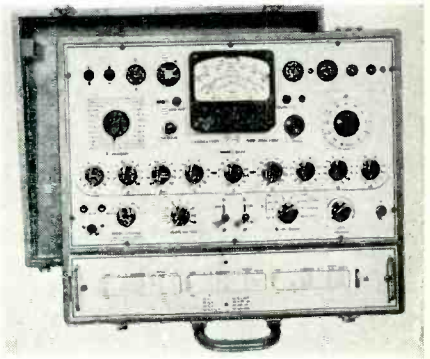
not be operated without this tap. The PS-103 will operate other transistorized equipment without high current relays. It will supply up to 200 ma on peaks and will operate continuously at 100 ma. Metered output. $17.95. Service Instruments Corp. (Sencore), Addison, Ill. (ELECTRONIC TECHNICIAN 4-20)

EICO POWER SUPPLY →

Model 1020 transistorized, dc power bias supply is a supply for transistor radios, hearing aids, preamps, instruments, and other transistor devices. It will bias tubes and offset avc and agc voltages. Output voltage, 0-30 v.dc., continuously variable; max. continuous output capacity, 150 ma. 0-12 v., 200 ma. 12-24 v., 300 ma. 24-30 v; ripple (120 cps), 1/500 of 1% at full load. Kit is $19.95. Wired $27.95. Electronic Instrument Co. (EICO) 33-00 Northern Blvd., Long Island City 1, N.Y. (ELECTRONIC TECHNICIAN 4-15)

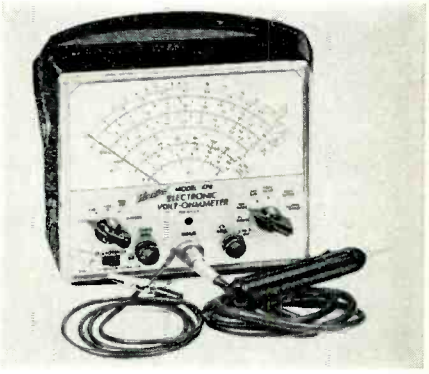
Triplett TUBE ANALYZER →

Portable dynamic mutual conductance tube analyzer, Model 3444, measures true Gm without any compensating factors. Very low (33 ohm) plate impedance for best correlation. Includes lab type tube analysis features. Four direct reading Gm ranges: 0-1,000 micromhos; 0-3,000 micromhos; 0-10,000 micromhos; and 0-30,000 micromhos; dc filtered leakage measures 0-10 megohms at 85 volts. The Triplett Electrical Instrument Co., Bluffton, Ohio. (ELECTRONIC TECHNICIAN 4-16)



Hickok METER →

Model 470 electronic voltohmmeter features a 7-in. meter. The new high sensitivity 0-0.5 v. dc range is designed for transistor bias tests. The new ac-ohms-dc single unit probe eliminates the inconvenience of individual leads. Ranges: dc and ac rms, 0-1500 v.; peak-to-peak, 0-4000 v. Ohmmeter has excellent readability from 0.2 ohms to 1000 meg. Frequency response is 30 cps to 2.5 mc. The Hickok Electrical Instrument Co., 10523 Dupont Ave., Cleveland 8, Ohio. (ELECTRONIC TECHNICIAN 4-17)



Precision VOM →

Improvements have been added to the Model 120 VOM. Newly incorporated is the chromed-mirrored scale plate which eliminates parallax. The number of ranges is increased from 44 to 59. The ac and db frequency response has been widened to be flat from 15 cps to 100 kc, ± 1 db. Features include sensitivity of 20,000 ohms/v. dc and 5,000 ohms/v. ac; extra-low resistance, voltage and current ranges. $44.95. Precision Apparatus Co. Inc., 70-31 84th St., Glendale, L.I., N. Y. (ELECTRONIC TECHNICIAN 4-18)

SHOP HINTS

Tips for Home and Bench Service

Scope Checks Horizontal Components

A defective horizontal output transformer, yoke or coil in the deflection circuit of a TV receiver can sometimes be difficult to diagnose. (Usually substitution with a good component is the only sure method.) An open winding is easy to check but shorted turns are not so easy, resistance measurements are not always conclusive.

The following method of checking horizontal deflection components will indicate shorted turns without removing the component from the circuit, with the receiver turned off. The individual component (or complete horizontal deflection system) is connected to an oscilloscope probe with a pulse (supplied by the oscilloscope) connected to the same point. A waveform can then be produced that will look like the illustration if the component is good or bad.

To check a component, connect the scope's probe to one end of the coil and the probe's ground lead to the other end. Connect this pulse to the scope's probe. Adjust the horizontal sweep frequency of the scope according to the table.

Component	Sweep Rate (CPS)
Width coil	2500/5000
Horizontal linearity coil	2500/5000
Horizontal output transformer	500/1000
Deflection yoke	2500/5000
Receiver deflection circuit with yoke connected	2500/5000
Receiver deflection cricuit with yoke disconnected	500/1000

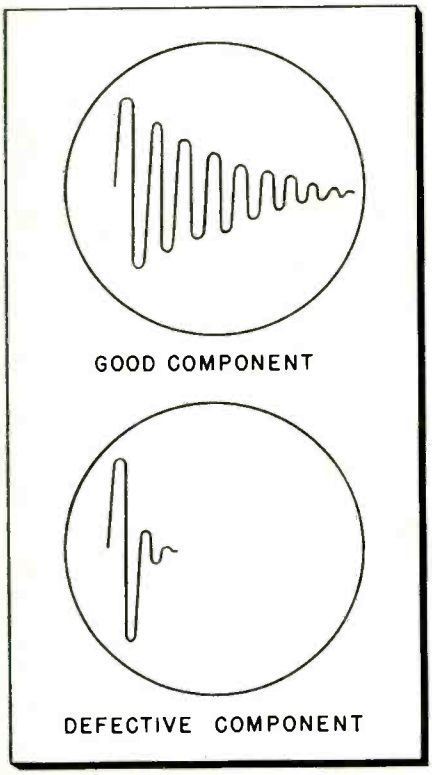
Set scope's sweep rate for part being tested.

A complete receiver deflection system may be checked by removing the plate cap of the horizontal output tube and connecting the oscilloscope probe and pulse to the cap lead of the transformer. Connect the ground lead of the probe to the receiver chassis. One shorted turn of the horizontal output transformer will produce the short, damped waveform characteristic of a defective component. The effect of shorted turns may be seen by shorting the filament winding of the horizontal output transformer while checking the transformer with the oscilloscope.

To obtain the pulse from an oscilloscope a small modification is necessary that will not affect the performance of the oscilloscope.

Remove the "GROUND" binding post on the front panel that is farthest from the vertical input attenuator. Enlarge the hole in the front panel and replace the binding post using fiber washers to insulate it from the panel. Connect one end of a 680 mmf. capacitor to the binding post. The other end is connected to the cathode of the horizontal sweep oscillator.—*RCA Service Co., Camden, N. J.*

Good parts show prolonged ringing. Fewer oscillations occur when shorts are present.



Hot Penny Removes Tube Socket

I have recently had trouble replacing defective tube sockets on a 1958 Chevrolet hybrid radio. The tube socket pins break very easily especially when inserting tubes with bent pins. In an effort to replace these sockets with an improved type, it is necessary to remove the old socket. Not having the special tools, I imagined that this would be a prodigious job. I tried melting and wiping off excess solder from each pin with a stiff wire brush, according to instructions received at one time. After carefully melting and wiping off in this manner, I futilely attempted to pry the socket loose and almost cracked the board, but still no luck. I then placed a copper penny over the seven pins and applied my regular solder gun. The socket almost dropped out by itself.—*Marco Ling, Phoenix, Ariz.*

In time sockets and boards may be improved, so that they are trouble-free. However, for some time to come, proper desoldering tools cool many tempers.—Ed.

Go—No Go Tube Socket Test

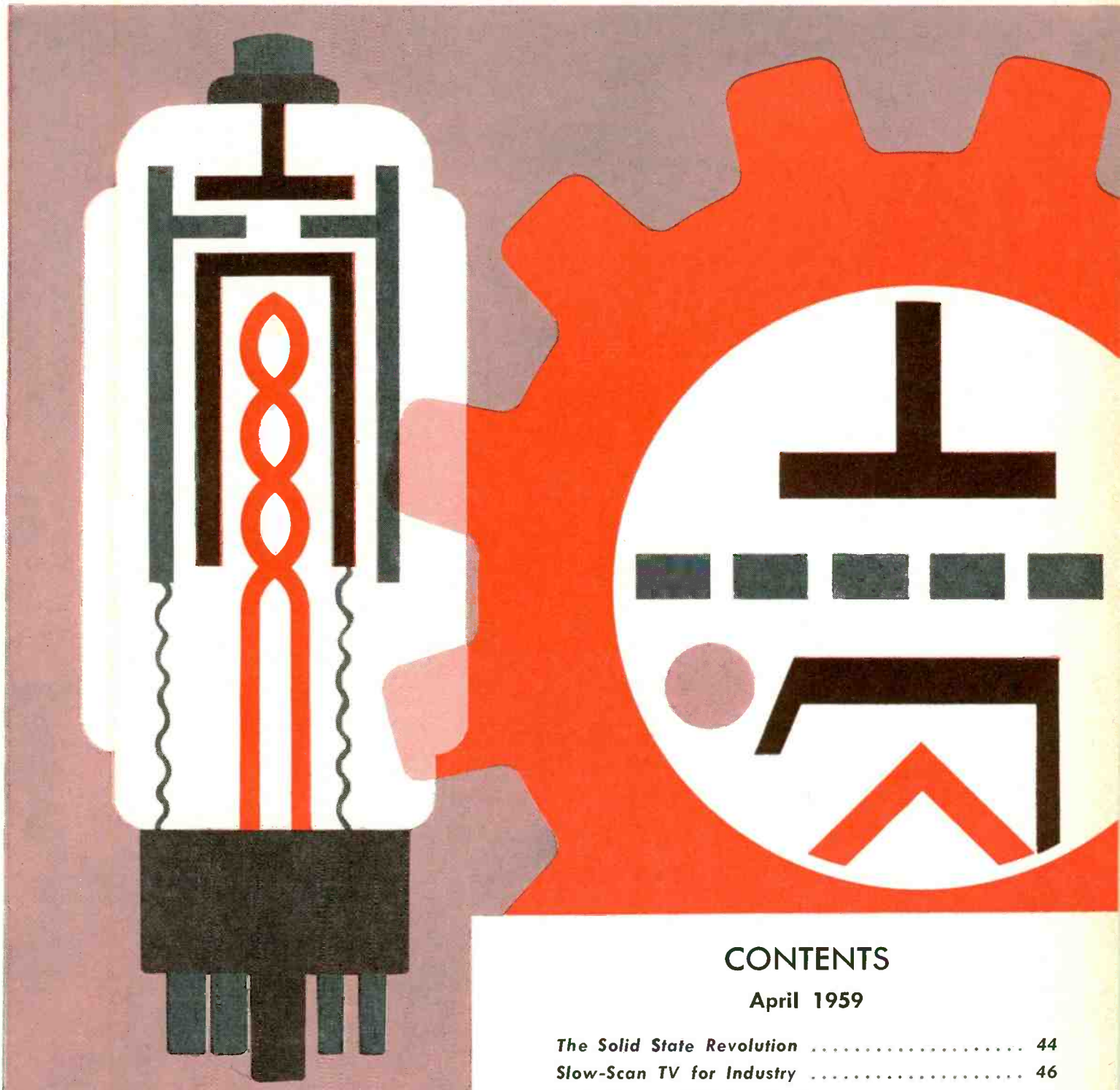
To locate a loose pin socket on a 7 or 9-pin miniature tube socket: Carefully remove a pin from the base of a defective 7 or 9-pin tube. Mount this pin in any suitable holder and probe each opening in the socket. A snug fit indicates good contact. A loose fit points to a potential trouble spot. Bend the contacts to tighten, and retest. It may be necessary to replace the individual pin holder or the complete socket depending upon the circumstance. I would like to see this idea incorporated in a service tool with a 7-pin probe on one end and an octal on the other.—*Alan W. Dodge, Roslyn Heights, N. Y.*

SHOP HINTS WANTED!

$3 to $10 for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Photos are desirable. Unacceptable items will be returned. Send your entries to "Shop Hints" Editor, ELECTRONIC TECHNICIAN, 480 Lexington Ave., New York 17, N. Y.

INDUSTRIAL ELECTRONIC MAINTENANCE

Trademark



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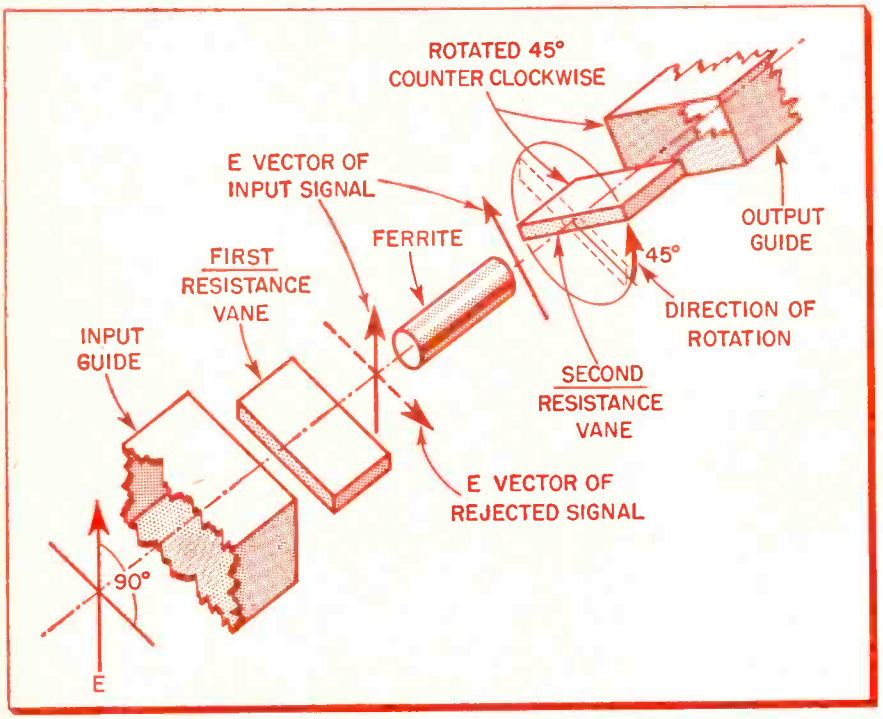


Fig. 1—Ferrite isolator rotates voltage vector 45° and permits the input signal to pass through the second resistance vane. Reflected signal, if any, starts out at a 45° angle, is rotated another 45°, and is blocked by the first vane.

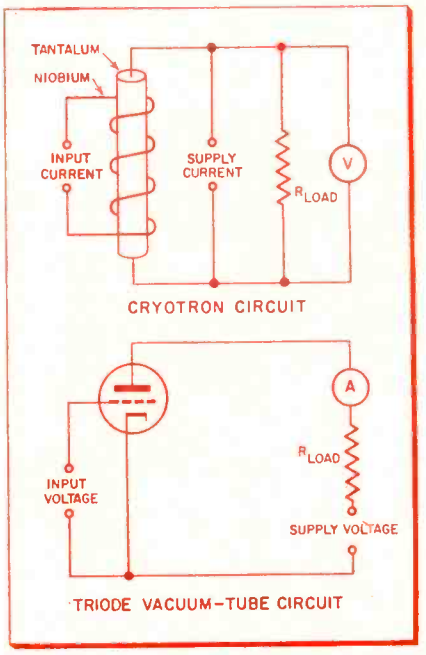


Fig. 2—The cryotron is a low-temperature switching device, which is superconductive at 4.2° Kelvin. Small tantalum rod and niobium control winding have no resistance at this temperature. It is current controlled in contrast to tube circuit which depends upon voltage.

The Solid-State Revolution

Ferrites, Cryotrons, Semiconductor Controlled Rectifiers, Unijunction Transistors, Four-Layer Diodes & Microminiaturization

ALLAN LYTEL

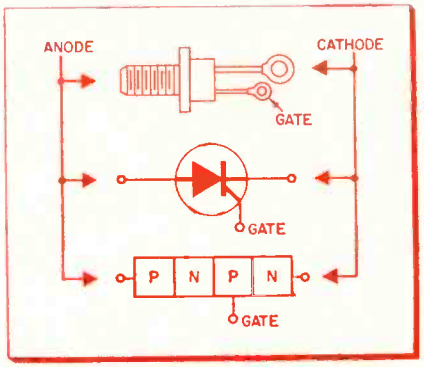
• Solid-state devices are performing circuit functions, once only dreamed of. Ferrites, low-temperature amplifiers, microminiaturization, unusual transistor-like devices, and other solid-state materials are being developed at an increasing rate for use in electronics.

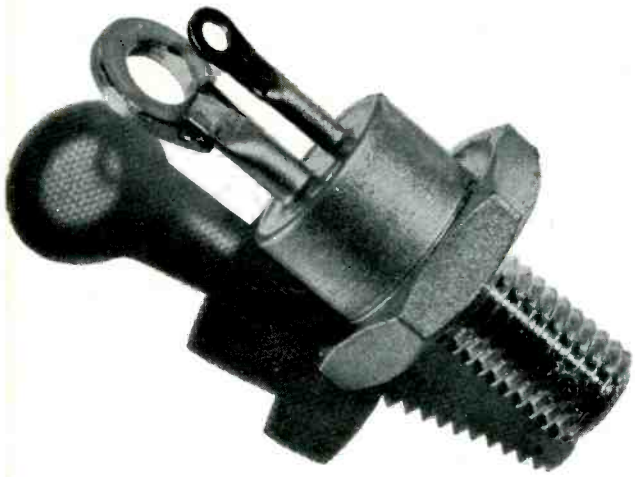
Microwave Ferrites

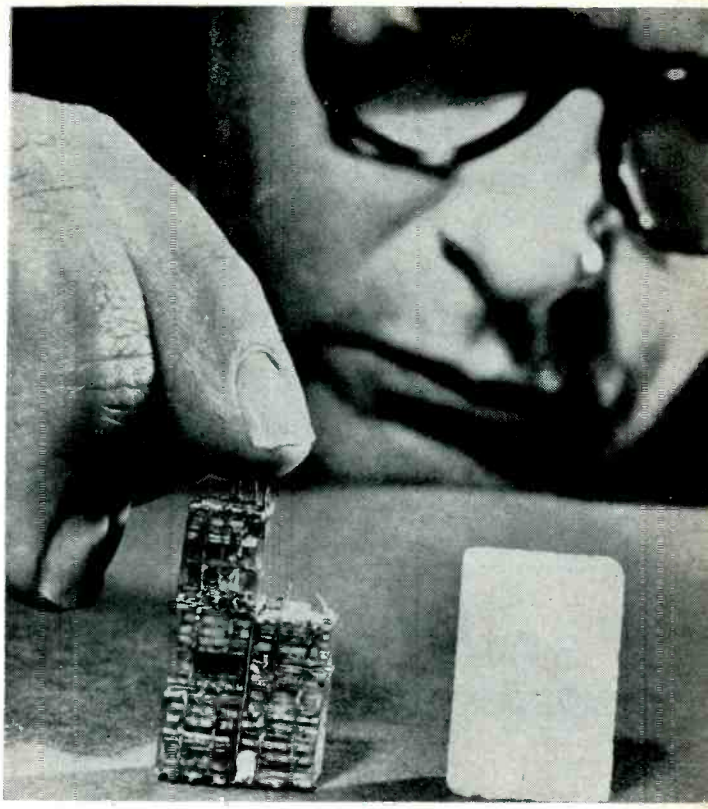
Ferrites are ceramic magnetic materials made from oxides of metals such as iron, cobalt, nickel, aluminum, magnesium, and manganese. While they are metallic and magnetic they are nonconductors and their hysteresis loss at microwave frequencies is very low. The electrons of the ferrite material are affected by external magnetic fields. Since the discovery of ferromagnetic resonance, in 1946, a whole new series of r-f components has been developed.

Isolators or one-way transmission lines are important ferrite devices. A type of low-power isolator is shown in Fig. 1. This is a circular section of waveguide fed by a rectangular guide. The input signal has a voltage vector, at right angles to the first resistive vane, and is not affected by it. The ferrite loaded section of the guide rotates the E vector by 45°. This rotation makes the input signal perpendicular to the second vane, and it passes through with only a small amount of loss, usually less than 1 db. If a signal is reflected from the load back into the output guide, its E vector is already at a 45° angle at the output end of the isolator. The reflected signal is rotated another 45° and becomes parallel to the first resistive vane, which absorbs the energy. In this way the reflected energy is prevented from passing through.

Fig. 3—Semiconductor controlled rectifier is similar in action to a thyratron, and can handle loads up to 1,000 watts.







Radio receiver, no larger than a lump of sugar, is made of micro-modules. Building blocks measure 0.3 in. square and promise size reduction of electronic equipment of ten to one or better.

Fig. 4—Rectifier conducts only when signal is applied to the gate, providing source voltage does not exceed 200 volts. The gate loses control, after conduction starts.

Other ferrite devices are also available for use in transmitters and receivers.

Microminiaturization

More and more components are being packed into less and less space in compact packages of electronics. Miniaturized receivers and transmitters, no larger than a package or two of king-sized cigarettes are on the market. Even this is only just miniaturization. Microminiaturization produces much smaller equipment. Solid state materials can be used to form all types of components such as resistors, capacitors, and transformers. They may be combined in many ways to produce complete units having several circuit functions. An example of this new technique is a recently developed ceramic-wafer module which is 0.3 inches square by 0.01 inches thick. The materials on the wafer may be resistive, capacitive, insulating, ferromagnetic, or semiconducting. Wafers may be stacked and potted to form a complete circuit. In a recent demonstration, a five-module radio in a fountain pen type of case was shown. The pen also contained the loop antenna and variable capacitor. Micro-modules are but one example

(Continued on page 80)

SLOW-SCAN TV

Bandwidth
Conversion
Flicker
Frequency Response
Horizontal Scanning
Horizontal Resolution
High Persistence
Illumination
Smooth Motion
Still Pictures
Vertical Resolution
Vertical Scanning

Slow Scan TV For Industry

High Resolution Pictures Transmitted Over Radio Or Wire Links Utilize Narrow Bandwidth

EDWARD NOLL

● Slow-scan or slow-sweep technique permits transmission of a high resolution picture over radio or wire facilities. Its bandwidth is only a small fractional part of that required for conventional TV transmission. In fact, TV pictures can be sent over regular telephone lines with this process. A high resolution slow-scan picture can be sent over a regular 8,000 cycle telephone line of the type usually employed in radio broadcasting. The system is ideal for data transmission, bank checks, signatures, and other business information.

The slow-scan process has one major limitation. A narrow bandwidth system, under 25 kc, is unable to convey a moving picture. Motion in the picture would not be followed and would appear as a streak or blur. However, there are many applications where there is only slight movement over a long period of time. By proper choice of line and field scanning rates some limited motion can be conveyed. It may be possible to select an appropriate bandwidth to convey the information, which lies somewhere between the 4 mc employed in regular TV transmission and the less than 10 kc required for a stationary scene in narrow-band TV work. It would appear then that an ideal slow-scan system would be one with adjustable line and field rates, the choice of rate depending upon the degree of motion to be conveyed and the bandpass of the transmitting medium.

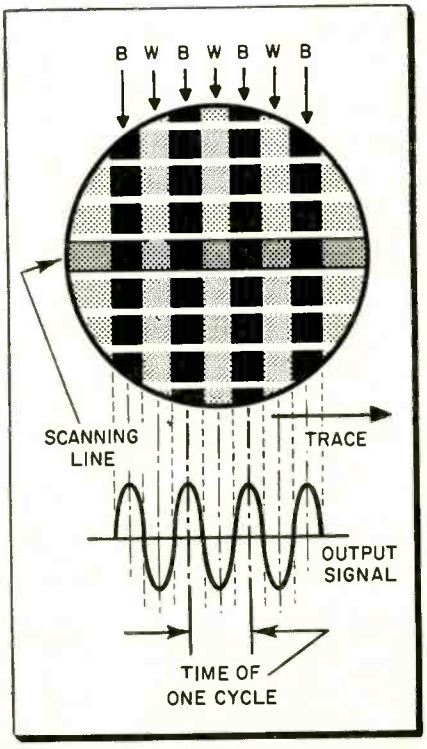


Fig. 1—If 400 elements are resolved along a horizontal line, and if the time to sweep one line is 53 μsec, as in a commercial telecast system the time required to sweep 1 element is 0.1325 μsec. If each element is alternately black and white the output signal frequency is 3.77 mc.

Bandwidth

An understanding of slow-scan principles can be best acquired by first considering those factors that influence the bandwidth and scanning requirements of a TV system. The vertical resolution or definition of a TV picture is determined by the number of active lines. The actual number of lines of definition is obtained by applying a suitable correction factor to the number of active lines. A correction factor of 0.8 is often used. If there were 500 active lines of picture the number of lines of vertical definition would be 0.8 times 500, or 400 line definition.

Horizontal resolution is a function of the limit of the high frequency response of the TV transmission system. Actually the horizontal resolution is directly related to the ability of the system to delineate the very abrupt brightness changes as the scanning beam moves across the image impressed upon the surface of the camera tube. These variations from the camera tube must be con-

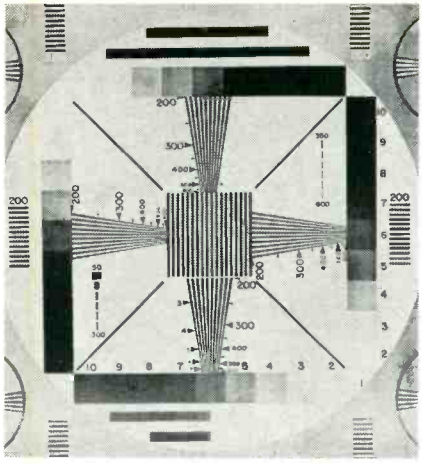


Fig. 2—Calibrated vertical wedges make it possible to predict number of lines of resolution and high frequency response.

veyed by the transmission system without distortion and must be reproduced in a faithful manner in the receiver. Actually, three factors determine horizontal resolution:

(1) spot size of camera tube beam,

(2) high frequency limit of the transmission systems, and

(3) the spot size of the picture tube beam.

In this discussion the influence of spot size can be discounted and it can be assumed that it is adequately small for the services to be provided. In a commercial telecast system the scanning beam sweeps from left to right across the screen in approximately 53 μsec. If the CRT is capable of resolving 400 elements along the line the time required to speed across two adjacent elements would be 0.265 μsec (0.1325 μsec per element). If one element were black and its adjacent neighbors to the right and left were white, the signal released by the camera tube would have to swing from maximum to minimum and back to maximum in 0.265 μsec. See Fig 1. This period or cycle time determines the frequency. Since the frequency is equal to the reciprocal of the time required for one cycle, the frequency in this case would be 3.77 mc.

Scanning Standards

An important fact to glean from this is that the frequency generated by the scanning beam in the camera tube depends on the abruptness of change of illumination in adjacent elements. A group of thin closely-spaced vertical lines would cause a high frequency video signal. It is for this reason that the high frequency response can be predicted by observing the vertical wedges in a test pattern. Fig. 2 shows a pattern having calibrated points along the wedges. Number of lines of resolution as well as frequency response can be determined. The choice of scanning standards is a compromise between horizontal and vertical resolutions. What is often good for vertical resolution results in poor horizontal resolution and vice versa. Increasing the number of active lines in a picture to improve vertical resolution can result in poor horizontal resolution unless the bandwidth of the system is also increased. Likewise setting up standards that permit the scanning beam to delineate more elements as it spreads across each line of the raster can only be accomplished with a sacrifice in vertical resolution if the same field rate is to be retained. A few examples will bear out these statements.

In the previous example it was assumed that the scanning beam traveled across the active portion of each line in 53 μsec. If the beam is slowed

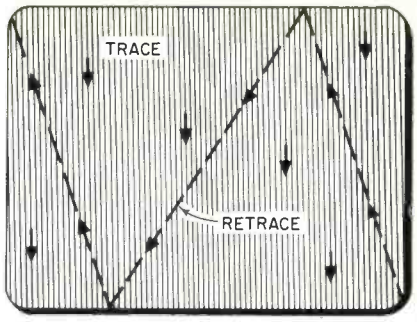


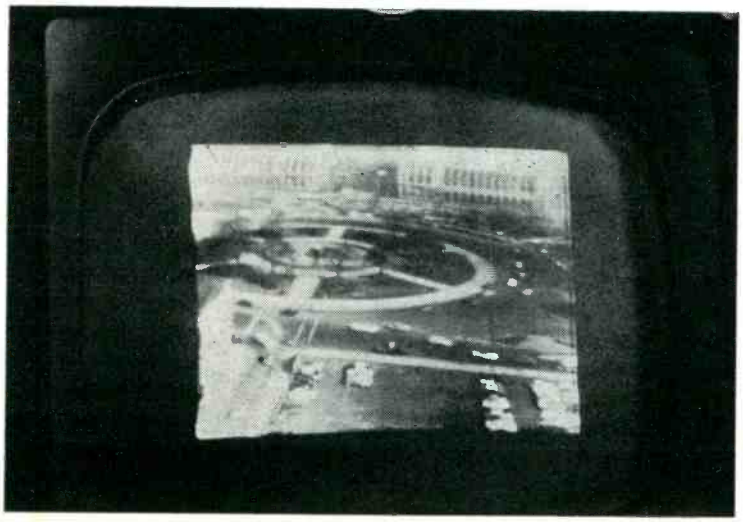
Fig. 3—Some slow-scan techniques tend to distort objects in motion. Vertical scanning may be of advantage in that it creates less skew distortion of lateral motion.

down to scan a line in 106 μsec, the signal frequency would be reduced to 1.88 mc. Hence an upper frequency limit of only half of the previous value would be able to resolve the elements along the scanning line. As a result, horizontal resolution would be the same and with a substantially lower bandwidth. This certainly demonstrates that good horizontal resolution can be rendered with a much narrower bandwidth if the velocity of the scanning beam is slowed down.

However, consider some of the additional problems that arise when a lower velocity scanning beam is employed. In the previous calculation it was assumed that a 60-field, 30-frame TV system produced approximately 500 active lines. If the scanning beam velocity is cut in half, the number of lines that can be scanned in 1/30th of a second is also halved. As a result the number of active lines in the picture would approach 250 instead of 500. It is true that the same horizontal resolution was retained at a lower bandwidth, but in turn the vertical resolution has been sacrificed. One

(*Continued on page 68*)

Quality of slow scan pictures is more than adequate for still as well as for some motional shots. Monitor shows fairly rapid moving traffic quite clearly.



Slow-scan cameras may be manually or remotely controlled, or fixed. Small size, and low minimum illumination requirements suggest unlimited uses.

Performance Of Magnetic Tape

Study Examines Tape Used In Recording Transmitted Data

BY THE NATIONAL BUREAU OF STANDARDS

Fig. 1. Measuring the remanent flux in a sample of magnetic recording tape. The measurement is carried out on tape (contained in glass tube) which has been previously magnetized in the large coil attached to the lower part of the test unit. The tape-containing tube is then rapidly passed through the smaller search coil and the remanent flux is read from the upper part of the unit which is an electronic equivalent of a ballistic galvanometer.

• An investigation of the performance of magnetic tape, used in recording the data transmitted by guided missiles and satellites, is being conducted by the National Bureau of Standards for the Air Force. The quality of such tape directly influences the usefulness of the recorded information. For this reason, specification limits and quality control are needed in production. Standard methods of measuring the magnetic properties of the tape which will help make such control possible are the goal of the present study.

Although magnetic tape is widely used in recording sound, data recording by this method has not been entirely satisfactory. Failure of the tape to record important data has at times been very costly, wasting time and money, and even destroying irreplaceable data. Because existing test procedures do not adequately measure all properties that affect performance, the danger of tape failure is ever present. To make possible at least a predetermination of quality that will in some measure guarantee tape performance, I. Levine and E. Daniel of the Bureau's sound laboratories undertook the present investigation of magnetic properties.

Magnetic Properties

It is the usual practice in tape specifications to express the magnetic properties in terms of retentivity and coercivity, measured by a hysteresis loop tracer. However, most telemetry recorders use high-frequency bias during recording, and the hysteretic constants mentioned can give only a rough indication of

performance under these conditions. Consequently, separate record and bias current data must also be provided in each tape specification. Such data are purely relative and, moreover, apply only to a specific machine; they cannot be accurately translated to another machine having a significantly different record gap length.

In developing a more useful method of measuring magnetic properties it was necessary to clarify the action of the hf bias. The Bureau found that the anhysteretic method of magnetization provides the key to an understanding of this recording process. Therefore, a simple semi-empirical theory was constructed which allows both recording sensitivity and bias for maximum output to be determined from the anhysteretic magnetic properties of the tape in question. The basic properties of a tape are completely specified in terms of three constants: oxide thickness, anhysteretic susceptibility, and critical field strength. The advantage of calculating tape performance in this way is that it provides a flexible method of comparing tapes which is completely independent of any particular recording machine.

The results obtained so far are confined to the long-wavelength performance of a tape under linear operating conditions. However, it should be possible to extend the treatment to short wavelengths by taking into account such factors as separation loss and phase effects. Also it seems likely that nonlinearity in recording can be related to the results of anhysteretic tests.

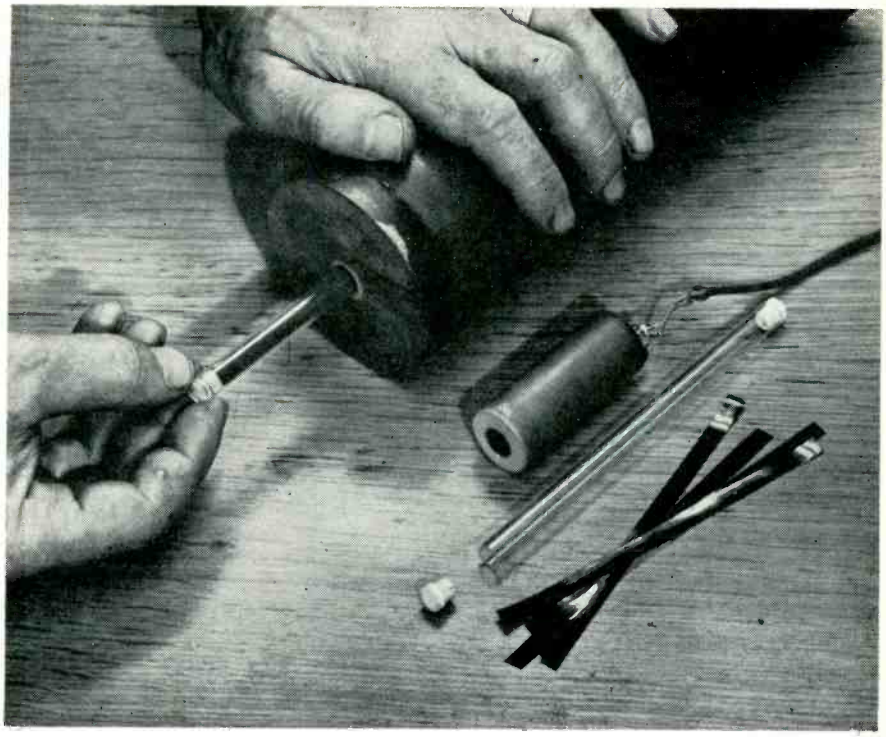


Fig. 2. A glass tube containing samples of magnetic recording tape is inserted into a magnetizing coil in preparation for a measurement of remanent flux at the National Bureau of Standards. The flux measurement, which will be carried out in the small search coil also shown, is part of a suggested basis for specifying tape performance in terms of anhysteretic magnetic properties. Strips of magnetic tape and an empty tube are included to illustrate a typical sample.

Measurements

Measurements are made under conditions simulating as closely as possible those encountered in use. The test sample, a tape of known magnetic area, is anhysteretically magnetized in a solenoid energized with a small direct current and a large alternating current (Figs. 1 & 2). The former is analogous to the signal and the latter to the bias component of the current through an actual record head. The remanent magnetization in the sample after the currents are reduced to zero is measured by passing the sample through a search coil connected to a fluxmeter. Reduction of the currents to zero takes place in two modes: (1) the gradual reduction of the ac to zero before removing the dc; and (2) the simultaneous gradual reduction of ac to dc to zero.

Although the latter mode simulates more closely the action of a recording head, the former is of value in determining the fundamental constants of the anhysteretic process. With the type of reduction first described, the remanent magnetization corresponding to a given small d-c field strength increases as the initial amplitude of the a-c field is increased to about 350 oersted, and remains fixed at a maximum value which is independent of any further increase in a-c field strength. The behavior of a given tape can be expressed in terms of two constants: the anhysteretic susceptibility, which is the ratio of the maximum remanent magnetization at a high a-c field amplitude to the d-c field strength; and the critical field strength, the a-c field amplitude required to achieve half the maximum remanent magnetization.

In practice it is unnecessary to take a whole series of measurements in order to determine the critical field strength. Just two measurements, one in each mode, give sufficient information to calculate both the anhysteretic constants. In calculating the magnetization of the sample, it is necessary to know the thickness of the oxide coating. This may be determined by measuring the overall thickness of, say, ten layers of tape, then stripping the coating with a solvent and measuring the ten layers of backing after allowing time for evaporation.

The chief difference between the action of the solenoid and that of a record head is that the latter does not provide a uniform signal and bias field strength throughout the depth of the coating. The effect of this non-uniformity may, however, be taken into account if the record gap length is known. Calculations of long-wavelength performance may be made which are in good agreement with absolute measurements carried out on an actual recorder. In particular, it is possible to calculate the bias field strength needed to obtain maximum output, and the recorded flux for a given signal field strength obtained under the maximal condition. •

Industrial Electronic Statistics

Volume Now Accounts For 18% Of Electronic Manufacturers' Output

Industrial electronic sales hit a record $1.38 billion in 1958, reports the Electronic Industries Association. The EIA found increasing use of electronic devices in a wide variety of business enterprises.

Computers

• Computers and data processing equipment account for the largest share of industrial sales, 21%, up sharply from 7% five years ago. Nearly 2000 units are installed in more than 1200 companies, and 3000 more were on order at the end of 1958.

Most heavily used in payroll processing, these units are also important in accounting and market research. Electronic computers are being developed to automatically allocate material and labor in production schedules. Specially designed computers are used in air traffic control, medical diagnosis, laboratory research and space flight problems.

FACTORY SALES TO THE INDUSTRIAL MARKET
(In Millions of Dollars)

TYPE OF EQUIPMENT	1954	1955	1956	1957	1958
Computers and Processing	$ 47.0	$ 72.0	$125.0	$ 265.0	$ 290.0
Testing and Measuring	110.0	145.0	170.0	210.0	220.0
Navigational Aids	60.0	65.0	70.0	95.0	100.0
Landmobile Microwave Broadcasting	90.0	95.0	120.0	150.0	155.0
Industrial Controls	343.0	373.0	115.0	150.0	160.0
Nuclear-Electronic Apparatus			22.0	27.0	35.0
Medical and Therapeutic			110.0	139.0	145.0
Commercial Sound			110.0	136.0	140.0
Communication			30.0	36.0	40.0
Miscellaneous			78.0	92.0	95.0
TOTAL	$650.0	$750.0	$950.0	$1,300.0	$1,380.0

Measuring Devices

Second in importance is the $280 million worth of testing and measuring equipment sold in 1958.

Densimeters, timers, microwave testers, spectrometers and voltage calibrators are used in every major industry. Ultrasonics, analyzers (for automobiles, for example) and temperature measuring equipment are providing valuable quality control and processing tools.

Controls

Automation items, such as industrial remote controls, counters, sorters and infra-red climbed to $160 million in sales.

By increasing productivity, these devices have proved their value in material processing, machinery direction, signalling and a multitude of other applications.

Nuclear-Electronic

Largest percentage sales increase was registered by nuclear-electronic apparatus, up 30% in 1958 to a sales total of $27 million.

There are more than 4000 licensed isotope users, plus many others operating under general agreements. The medical field treated one million persons with radioactive isotopes, accounting for $4 million in instrument sales. Geiger counters, reactor controls and dosimeters are typical important units.

Medical Electronics

In addition to nuclear apparatus, medical and therapeutic apparatus reached $145 million in 1958.

Among the many items included in this figure are cardiographs, diathermy, radiographs, X-ray, encephalographs, heart stimulators and automatic anesthesia devices. Still

(Continued on page 58)

Brainwashing Small Thyratrons

Practical Techniques Increase Speed & Efficiency Of Operation

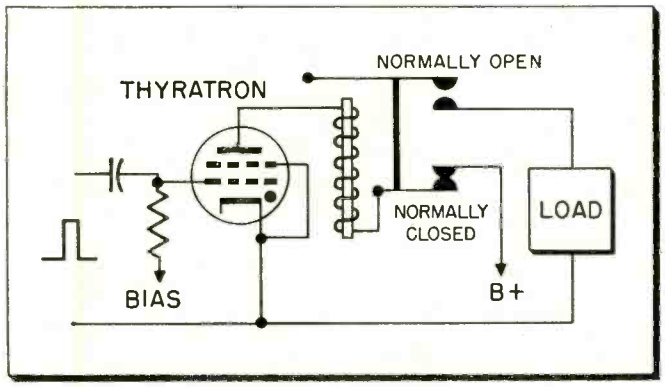


Fig. 1—Relay opens when tube conducts and removes B+. If it closes too soon, the tube will refire and set up an oscillation.

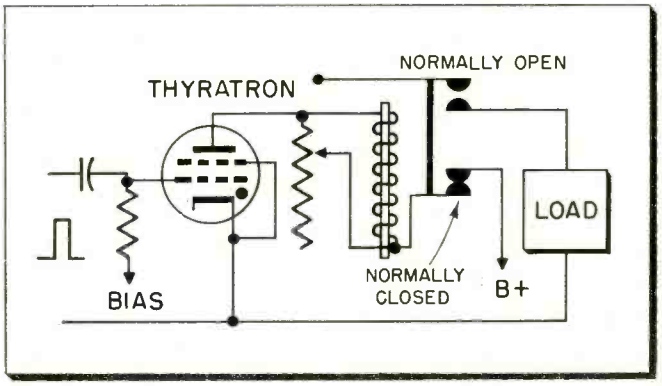


Fig. 2—Variable resistor inserts time delay feature, but it consumes B+ power. Less resistance causes longer delay.

RONALD L. IVES

• Brainwashing, according to the dictionary, is systematic indoctrination that changes or undermines one's political convictions. Thyratrons have neither brains nor political convictions, and one might well wonder what brainwashing has to do with these gas-filled tubes. Like other electronic components, they do have certain characteristics, which dictate their applications, capabilities and limitations. If some of these characteristics can be modified or overcome, so that the tube is capable of operating at a higher rate of speed, or perhaps more efficiently, even if it isn't brainwashing, it is certainly worth considering.

Thyratrons are fired by overcoming the grid bias voltage. Once current starts to flow through the tube it continues until plate voltage is removed. Once the tube conducts, the grid loses control. When plate voltage is removed and the tube stops conducting, the grid is once again able to regain control, providing proper bias voltage is present.

Either ac or dc voltages may be applied to the plate. In a great many thyratron circuits, where d-c plate voltage is used, difficulty is experienced in stopping conduction by just a momentary interruption of the

(Continued on page 61)

Fig. 3—Longer delay time is obtained by adding the capacitor, power loss is also reduced to a minimum, and resistor varies delay.

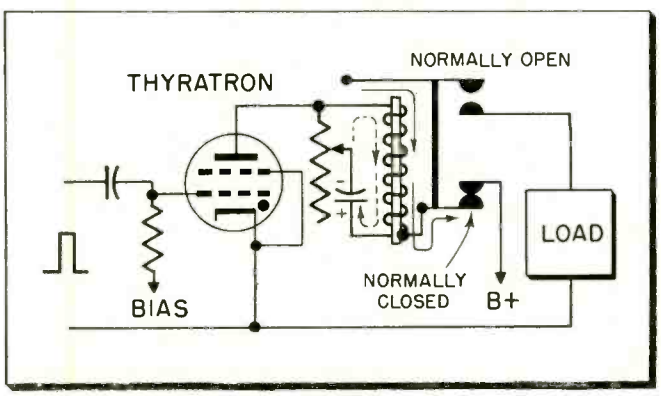
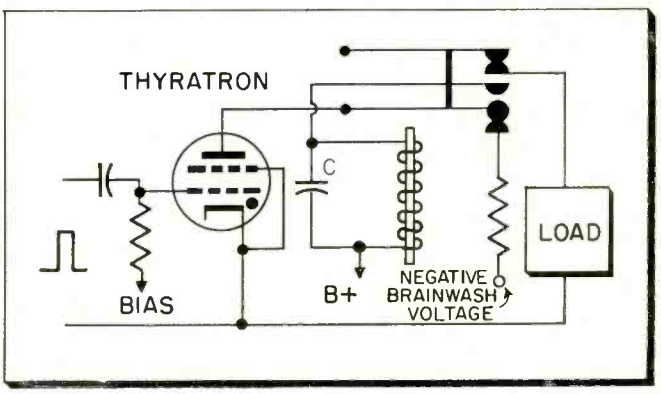


Fig. 4—Double-throw relay switches negative voltage to the plate of the thyratron and washes out residual ionization.



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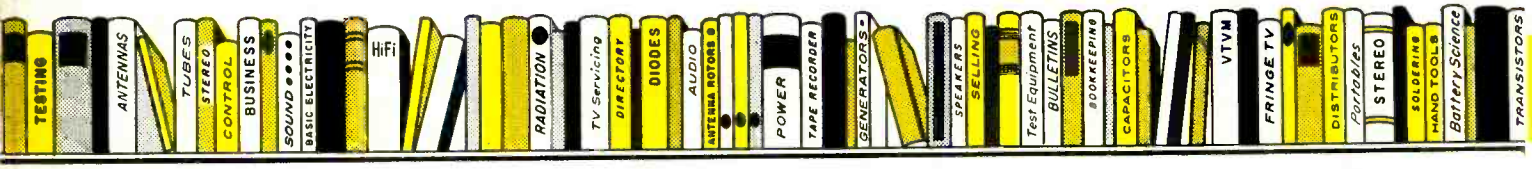

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By J. Derman, F. Makstein & H. Seaman. Both theory and practical construction designs are examined, along with maintenance techniques and procedure for determining size of air conditioner required. Covers motors, compressors, condensers, evaporators, regulating valves, circuits and other system elements. Soft cover, 160 pages. Price **$3.50**.

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By Sidney Platt. Excellent starting point for TV technician interested in learning about industrial electronics. Non-mathematical text explains circuitry and operation of power controls, relays, timers, photoelectric devices and instrumentation found in factories. Practical applications shown. Soft cover, 200 pages. Price **$3.90**.

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By Milton Kaufman. This sixth edition gives you the information you need to pass FCC license examinations. In question and answer form similar to actual FCC tests, all eight elements are covered, including law, radiotelephone, radiotelegraph, aircraft and ship radar. Abbreviations, code, etc. included. Hard cover, 736 pages. Price **$6.60.**

HOW TO SERVICE TAPE RECORDERS

By C. A. Tuthill. Starting with basic magnetic principles, the text goes through the recording operation, recorder mechanisms and circuitry. In addition to an explanation of the functions of the various recorder elements, the techniques for repairing various troubles and making tests are presented. Soft cover, 160 pages. Price **$2.90.**

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By Norman Crowhurst. This first assessment of the new stereo techniques sweeping the hi-fi field starts with the basics of binaural listening, and then concentrates on actual systems. Subjects include radio, disc, tape, recording procedure, speaker placement, system construction and theatre systems. Soft cover, 128 pages. Price **$2.25.**

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By Leonard Krugan. Here is a data-packed new revision of the 1954 edition, now including such material as surface barrier, intrinsic, drift, avalanche and spacistor types. Amplifiers and oscillators are covered. End of each chapter has helpful questions and suggested references. Soft cover, 176 pages. Price **$3.50.**

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By H. G. Cisin. Rapid TV trouble-shooting methods used here pinpoints cause of problem according to 24 sound symptoms, 213 pix symptoms and over 75 raster symptoms. Checks for each problem are noted. Also presented are explanations of rapid alignment technique and UHF servicing. Soft cover, 70 large pages. Price $2.

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Industrial Electronic News

For more information write directly to manufacturer

TV Translator

UHF TV translator rated at 100 watts has been announced. These automatic repeaters bring TV to remote areas. 12-page brochure describes uses and equipment available. Adler Electronics, 1 LeFevre Lane, New Rochelle, N.Y.

Trimmer Pot

Miniature trimmer potentiometer model W-10 has variable micrometer-type adjustment from 10 to 150,000 ohms. Size is 1.14" x 0.312" x 0.21". Technical data from Atohm Electronics, 7648 San Fernando Rd., Sun Valley, Calif.

Frequency Counter

New "EPUT" meter (events-per-unit-time) model 7153 indicates whether metered frequency is below, within or above two selected limits. Range is dc to 100 kc. Berkeley Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.

Filters

"Microid" low pass and band pass miniature filters are designed to withstand shock. Type TCLJ low pass ranges from 400 to 100,000 cps. TTJ band pass is for 15% width, 7,350 to 100,000 cps. Burnell & Co., 10 Pelham Parkway, Pelham Manor, N.Y.

Tower

Model 1810 galvanized steel tower for two-way radio and broadcast is produced in 10' sections for heights to 290'. Triangular cross-section. Communication Products Div. of APC, Mineral Wells, Texas.

Closed Circuit Camera

Ruggedized closed circuit TV camera is available as a transistor type, TC-200-RT, or with subminiature tubes, TC-200-RS. Size is 3¼" 3⅝" x 10½". Industrial Dept., Allen B. Du Mont Labs., 760 Bloomfield Ave., Clifton, N.J.

Microwave

Bulletin ECM-71 describes a new line of 6 kmc microwave relay equipment. Features up to 120 channels, plug-in units and klystron tubes. General Electric, Communication Products Dept., Lynchburg, Va.

Ultrasonic Drill

New Glennite 100-watt ultrasonic impact drill priced at $1100 rapidly slices and engraves such materials as ceramics, glass, tungsten and precious stones. Gulton Industries, 212 Durham Ave., Metuchen, N.J.

Temperature Control

Electronic temperature controller for electric heat furnaces is responsive to less than 1 μv from thermocouples, strain gages and radiation pyrometers. Bulletin GE-60001 from Hagan Chemical & Controls, Box 1346, Pittsburgh 30, Pa.

Solar Cell

For calibrating radiation measurements, the secondary standard silicon solar cell is available. 9% conversion efficiency. Price is $50. Bulletin SR-277 from International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Zener Diodes

New complement of silicon zener regulator diodes may be used in power supplies, clippers, bias controls and voltage references. Ratings to 10 watts, 3.6 to 30 v. ITT Components Div., International Telephone & Telegraph, 100 Kingsland Rd., Clifton, N.J.

Industrial TV

Illustrated 4-page brochure 6-100 describes two industrial TV cameras. Included are accessories such as remote-control pan-tilt and iris-focus units. Kin Tel Div., Cohu Electronics, Box 623, San Diego, Calif.

Precision Pot

New 25-turn precision potentiometer Model MD 20-25 has 0.0075% linearity. Size is 2" diameter, 2 9/16" long. Standard servo mounts are available. Litton Industries, 215 S. Fulton Ave., Mt. Vernon, N.Y.

Shielding Paint

RS14 Micropaint may be sprayed or painted on hi-fi, TV and industrial cabinets to yield a 3-ohm/sq. ft. resistance. Cuts radiation and provides ground protection. 5-gal. pail, $6.55/gal. Micro-Circuits Co., New Buffalo, Mich.

Wheatstone Bridges

Two wide range Wheatstone bridges contain electronic null detectors. Model MV-278A has 0.2% accuracy. Model MV-276A has 0.05%. Range of 276A is 1 ohm to 100 meg. Millivac Instrumented, Box 997, Schenectady, N.Y.

Radar Patrol

Improved portable radar speed control for one-man, one-car operation monitors traffic from a quarter mile to 150. Has mph meter. Can be set so only violators register. Monument Engineering, 1625 Bellefontaine St., Indianapolis 2, Ind.

Spectrum Analyzer

Expanded frequency range of Model SB-15 panoramic spectrum analyzer covers 0.1 to 525 kc. Signals are displayed on calibrated crt. For monitoring and unltrasonic analysis. Panoramic Radio Products, 514 S. Fulton Ave., Mt. Vernon, N.Y.

Solid State Relay

Solid state relay with no moving parts permits switching having snap action characteristics. Rated 10 mils to 10 amps. Contact contamination is eliminated. Pendar, Inc., P.O. Box 3355, Dept. C, Van Nuys, Calif.

Capacitors

Micro-miniature metallized paper capacitors are available in metal tubular styles. Designed for transistor circuits. Bulletin 113058 from San Fernando Electric Mfg. Co., West-Cap Div., 1509 First St., San Fernando, Calif.

Meter Relays

New meter relays, Models 95 and 195, come in 3½" and 2" round styles. Used in voltage indicators, alarms, etc. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

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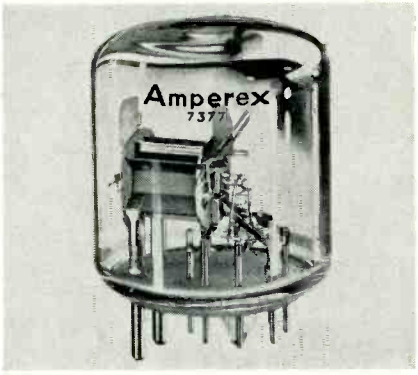
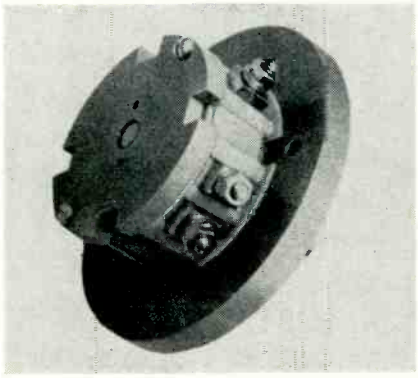
Amperex TRANSMITTER TUBE →

Type 7377 tube, a radiation cooled, indirectly heated, twin tetrode with low output impedance is efficient up to 1,000 mc. It is designed as an amplifier and tripler in mobile and small transmitters, in link communications for TV programs. Transconductance is 10,500 micromhos. Designed for push-pull, class C operation, the 7377 will deliver 4 to 5 watts. Heater voltage in parallel is 6.3. Typical plate voltage is 350 v. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N.Y. (ELECTRONIC TECHNICIAN 4-29)



Clarostat PRECISION POT →

The high-temperature version of its Series 42 wirewound precision potentiometer is designed to operate at temperatures up to 230° C. with a wattage rating of 0.25. Resistance change after 255 hours at 230° C. is less than 0.1%. Insulation resistance is 10K megohms min. Resistance tolerance of ±5% from 1 ohm to 100K ohms. Independent linearity is ±0.5%. Noise is less than 5 μv. Clarostat Mfg. Co., Dover, N.H. (ELECTRONIC TECHNICIAN 4-30)



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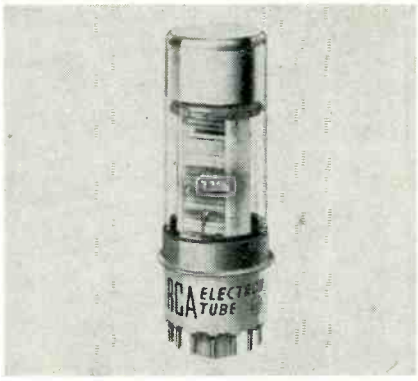
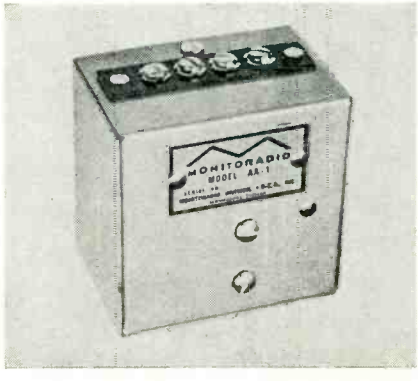
Type 7326 is a new 10-stage, head-on type multiplier phototube having a new photocathode. It is characterized by broad response range, high sensitivity, low thermionic dark current, and high conductivity even at low temperatures. The 7326 is well suited for use in flying-spot scanners, photometry, and scintillation counters. The spectral response from about 3000 to 7500 angstroms extends beyond the visible region. Electron Tube Div., Radio Corp. of America, Harrison, N.J. (ELECTRONIC TECHNICIAN 4-31)



Monitor MOBILE ALERT →

A new alert device for mobile dial direct radiotelephone systems, Model AA-1, may be used to intermittently actuate any type of alarm such as a light, bell or horn, etc. The unit is powered by any receiver simply by hooking into receiver B+. Normal alarm cycle is 5 seconds off ¾ second on, but may be varied. Alarm cancels when call is acknowledged. $19.95. Monitoradio Div., I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26, Ind. (ELECTRONIC TECHNICIAN 4-28)



Motorola POWER TRANSISTOR

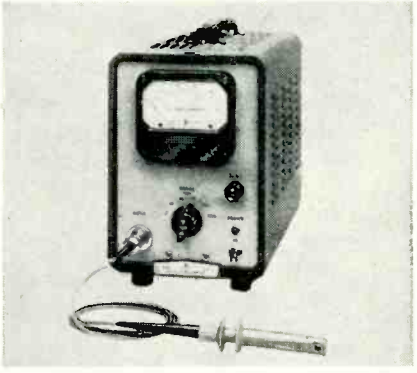
Featuring 25 amperes dc collector current, the new line of power transistors are numbered from 2N1162 through 2N1165. They are germanium PNP, alloy junction types with collector common to the case, and are designed for high current switching and audio applications. The 25 amp transistors are available with or without solder terminals. Collector dissipation rating is 50 watts. Motorola Inc., Semiconductor Products Div., 5005 E. McDowell Rd., Phoenix, Ariz. (ELECTRONIC TECHNICIAN 4-32)

Kaar UHF REPEATER

The TR502A repeater unit is designed in a rugged package for installation at remote points of high elevation so line-of-sight radio communications may be maintained. Operating frequency is 450 mc. Price is only $692. As applied to two-way radio, this repeater is a transmitter-receiver with special parts added. Its basic function is to receive a signal and automatically re-transmit it. When no hills are available, the relay station is sometimes installed as a combination base-mobile relay station. Kaar Engineering Corp., 2995 Middlefield Rd., Palo Alto, Calif. (ELECTRONIC TECHNICIAN 4-33)

Hewlett-Packard MILLIAMMETER

A clip-on dc milliammeter which provides a new time-saving method of measuring dc current. Model 428A employs a pen-sized probe which clips around a wire without interrupting the circuit. Current is then read directly on the milliammeter. Model 428A thus eliminates the necessity of breaking and



resoldering leads, and does not load the circuit under test. Ranges from 3 ma to 1 ampere in 6 steps. Accuracy is ±3% ±0.1 ma, unaffected by line voltage changes. It measures dc currents in the presence of ac. Particularly useful in transistor work. $475. Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif. (ELECTRONIC TECHNICIAN 4-34)

Simply by checking all the tubes in the TV set with **B&K DYNA-QUIK**

YOU CAN INCREASE YOUR INCOME

$50* PER WEEK

FAST AND ACCURATE

- Tests complete set in minutes
- Wins customer's confidence
- Saves costly call-backs
- Sells more tubes on-the-spot
- Avoids substitution testing
- Makes more money every day

***ACTUAL EXPERIENCE SHOWS TV SERVICEMEN AVERAGE**

2 extra tube sales PER CALL

5 calls per day in 5 days equal $50

Completely test each tube with laboratory accuracy!

Model 650 DYNA-QUIK

Today's Fastest, Most Complete Portable

TUBE AND TRANSISTOR TESTER

Professional-type tester used by more service technicians every day.

MEASURE TRUE DYNAMIC MUTUAL CONDUCTANCE

Thousands of technicians are doing a better servicing job and are making more money today with the famous B&K DYNA-QUIK. Completely tests each tube in seconds, with laboratory accuracy, in home or shop. *Measures true dynamic mutual conductance.* Shows tube condition on "Good-Bad" scale and in micromhos. No multiple switching or roll chart. Quickly detects weak, short-life, or inoperative tubes. Shows customer the true condition and life-expectancy of tubes in the set; sells more tube replacements per call. Assures customer satisfaction and protects the service guarantee.

Model 650 Dyna-Quik improves servicing, quickly pays for itself

Checks over 99% of the tubes most widely used in television receivers, plus popular home and portable radio tubes. Tests over 500 tube types. Lists over 125 most commonly used tube types, with settings, on socket panels for maximum operating speed. Complete listing in fast telephone index type selector. **Tests each section of multiple tubes separately** for Gm, Shorts, Grid Emission, and Life. Tests each tube for Gas Content. Provides instantaneous Heater Continuity check. Includes 16 spare sockets and sufficient filament voltages for future new tube types. **Transistor Section** checks junction, point contact and barrier transistors, germanium and silicon diodes, selenium and silicon rectifiers.

Net, **$169.95**

See Your B&K Distributor or

Send Now for Bulletin ST21-T

ANOTHER PROVED MONEY-MAKER

Deluxe Portable

CRT 400

Tests and Repairs Picture Tubes

Makes New Tube Sales Easier

Checks and corrects most TV picture tube troubles in a few minutes, right in the home, without removing tube from set. Restores emission. Checks leakage. Repairs shorts and open circuits. Life Test checks gas content and predicts useful life.

Net, **$59.95**

Adapters for Models 400 and 350 CRT's

Model C40 Adapter. For standard 6.3 volt filament 110° tubes and color tubes. Net, $9.95

Model CR48 Adapter. For the new 110° tubes with 2.34, 2.68 and 8.4 volt filaments. Net, $4.95

B&K

B & K MANUFACTURING CO.

3726 N. Southport Ave. • Chicago 13, Illinois

Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.

Export: Empire Exporters, 458 Broadway, New York 13, U.S.A.

Industrial Electronic Statistics

(Continued from page 50)

others are sanquinometers to analyze blood samples, and ultra-violet units.

Landmobile, Microwave, Broadcast

The $155 million sales in this category included the phenomenal growth of mobile radio with 700,000 transmitters in use at the end of 1958, a jump of 133,000 units. Two-way radio serves transportation, agriculture, mining, heavy construction and others.

Microwaves, used in telemetering, remote control, voice and data transmission, are divided into three user groups: Common Carrier, Broadcasting for relays, and Operational Fixed for industry.

Closed circuit TV jumped to $7.2 million, with the educational field playing an important role, plus commercial applications.

Commercial Sound

Sales of public address systems, coin operated phones, selective paging and theater sound equipment edged upward to $140 million.

Intercoms and audio-visual equipment are widely found in large plants, offices, schools and transportation depots.

Navigational Aids

$100 million of navigation equipment was sold in 1958. This included air and ground traffic control, autopilots, shoran, radio range and related equipment. CAA is directing considerable attention to such facilities.

Communications

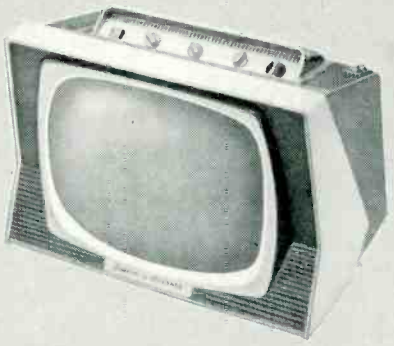
1958 saw sales rise to $40 million, in part attributable to the growth in airline electronic use. Ten years ago an airplane carried $12,000 worth of electronic gear; today it's $98,000.

Miscellaneous

Other electronic equipment such as automotive traffic controls, meteorological equipment and photoelectric devices, reached $95 million in 1958 sales.

See accompanying table for a statistical EIA analysis covering the years 1954-58. •

The new dualette™ by SYLVANIA



√ MORE THAN A PORTABLE √ MORE THAN A TABLE MODEL

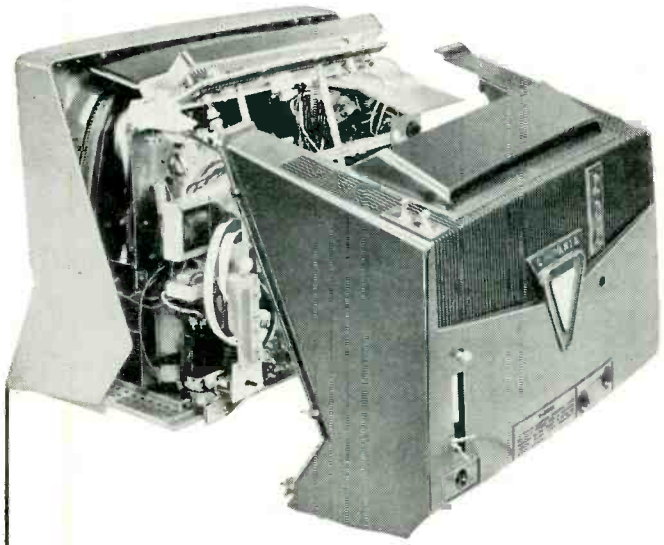
The set a serviceman can recommend to his best friend

- powerful fringe area performance
- long-life GERMANIUM OR SILICON RECTIFIERS
- exclusive "LIFETIME ENGRAVED CIRCUIT"
- shockproof, HIGH IMPACT STYRENE CABINET

for years of dependable reception

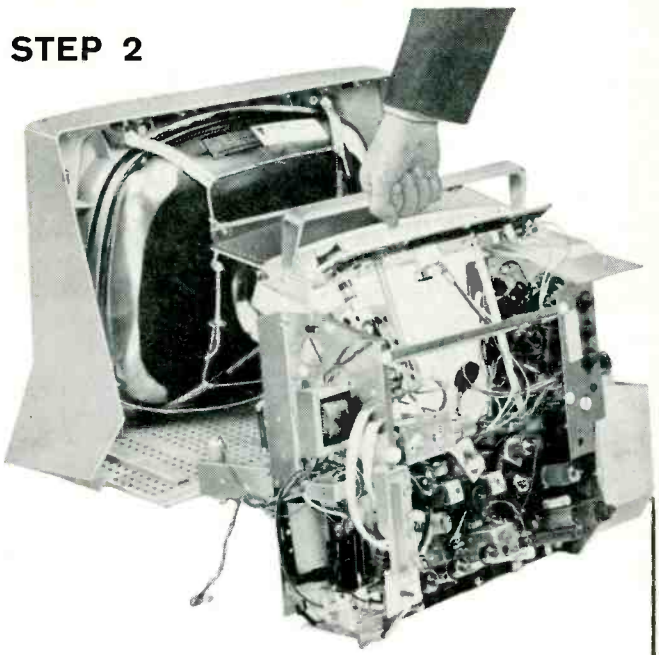
And, if service is ever necessary
TWO QUICK STEPS OPEN THE DOOR FOR ALL SERVICE JOBS

STEP 1



Take out only 8 screws to remove the back cover! All check points and tubes are accessible. A burned-out tube can be located in seconds! 90% of all service jobs and adjustments can be made without even removing the chassis!

STEP 2



Just two more screws remove the entire chassis! If it ever becomes necessary to pull the chassis, simply remove two more screws and lift it out. The dualette carrying handle becomes a carrying handle for the chassis!

Recommend SYLVANIA TV
—every set has a "LIFETIME ENGRAVED CIRCUIT"

The Nuvistor

(Continued from page 38)

2. By the use of brazing instead of spot welding for the joining of materials, a potential source of failure is removed and residual strain in assembly is eliminated.

3. There are no micas to fray under vibration or to interfere with high-temperature brazing and the exhaust processing of the tube.

4. High-temperature processing eliminates many of the gases and impurities that are difficult to remove during manufacture of tubes of conventional design in which glass and mica limit the processing temperatures.

5. Indexing lugs on the base of the Nuvistor permit safe and easy insertion into the tube socket and prevent damage to leads.

6. Because the tubes have been degassed at high temperatures, they can be expected to operate at temperatures in excess of those permitted with conventional types.

Characteristics

Typical requirements for one of these new small-signal triodes, useful for r-f amplifiers and local oscillators, are: Heater, 6.3 v, 0.14 amp; Class A plate voltage, 40 v; Amplification factor, 32; Transconductance, 10,700; plate current, 7 ma; and plate dissipation 1 watt max.

For a smal-signal tetrode Class A characteristics are: Plate voltage 75 v; Plate current, 5 ma; transconductance, 9000; and plate dissipation 2 watts max.

For a Nuvistor beam power tube Class A ratings are: Plate voltage, 65 v; Plate current, 600 ma; plate dissipation, 30 watts max. ●

"There, isn't that much more comfortable?"

Brainwashing

(Continued from page 51)

plate supply voltage. This trouble is due to the time it takes to deionize the gas in the tube. Conditions may be further aggravated by oscillations and potential carryover from the reactive components in the circuit.

Oscillations may also be set up by relays which keep hunting for a resting position. This often happens when the relay controlled by the thyratron is also the same relay used to disable the plate voltage. This tendency for the relay to buzzer can be understood by examining the circuit in Fig. 1. Plate voltage is applied through the normally closed contacts. An incoming signal on the grid, of sufficient amplitude to override the hold-off bias, causes the tube to go into conduction, and actuates the relay. The tube conducts until the plate supply is interrupted.

If this interruption is not long enough, restoration of the plate voltage will cause conduction to recur. Under some conditions, the plate circuit interruption must be as long as 0.5 or 0.6 seconds to prevent volunteering. The difficulty is more serious when tubes are operated with a minimum hold-off bias. The circuit may act as an electromechanical oscillator at a frequency of a few cycles per second. A latch or other hold-off device could be provided in the relay, but this would require resetting.

The deionization time characteristic of thyratrons depends upon the type of tube used, and to some extent upon its environment. This time could vary from as much as 35 minutes to as little as 40 μsec. Typical deionization time is on the order of 1,000 μsec. The less time it takes to deionize the tube, the sooner the plate voltage can be applied without causing the tube to conduct prematurely.

Time Delay

Time delay features may be built into the relay. The addition of a resistor, or capacitor, or both will eliminate or minimize the tendency to buzzer. The parallel resistor in Fig. 2 dissipates the stored energy in the relay coil, and helps to maintain

the flux in the electromagnet. Time delay can be modified by varying the amount of resistance in the circuit. Since the time constant of an RL circuit increases as the resistance decreases, the smaller the resistance, the longer will be the delay. However, there is a loss of power through this resistor. A capacitor placed in series with this resistor as in Fig. 3 offers several advantages, as well as the ability to delay the relay even more. Because tube current can no longer flow through the resistor the lost power is restored. The voltage drop developed across the relay coil when the tube conducts is also impressed across the capacitor, with the polarity as indicated. When the tube stops conducting, the capacitor will discharge through the relay coil, and tend to keep the relay energized. From inspection, this circuit would appear to be a natural oscillator tank, but the presence of the resistor and other resistances in the coil, do a fairly good job of reducing the Q of the circuit, and stray oscillations are quickly damped out.

Negative Plate Voltage

Experiments show that residual ionization may be washed out if, after operation, the plate is subjected to a strong negative voltage for a few microseconds. This can be brought about by using a single-pole double-throw switch in the plate circuit. When the plate current opens the circuit, a negative voltage is applied as shown in Fig. 4. By connecting the switch to the plate side of the load, flyback pulses and other oscillations in the load will not be impressed upon the plate of the thyratron.

When the brainwash circuit is connected and working properly, the rate of operation of the relay-thyratron combination is increased. The limit now being the reaction time of the relay or other switching device. This permits a rate of from approximately 5 to 60 complete operations-per-second with conventional relays, and up to 1,000 per-second, with special high speed relay devices, without spurious operations due to volunteering. It should be noted that thyratrons employed in a-c plate supply circuits, automatically have the advantage of this brainwashing function, each time the negative half cycle appears. •

The SIMPSON 260 TRADEMARK outsells all other VOMs combined!

Buy the VOM that's famous for ruggedness and dependability

260
VOLT-OHM-MILLIAMMETER
AC-DC
$43.95
Complete with Leads and Operator's Manual

Proof that the 260* is your *best investment* comes from hundreds of thousands of users who have made it the leading VOM over the years. But convince yourself! Take a 260 apart. Check the workmanship and materials. Examine the components. Analyze the circuits. Then put it through its paces in actual day-in-day-out service. You'll soon discover why the 260 is the world's best seller. See your Electronic Parts Distributor for the *preferred* VOM.

D.C. Voltage (20,000 ohms-per-volt): 0-250mv; 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.
A.C. Voltage (5000 ohms-per-volt): 0-2.5v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.
A. F. Voltage (with 0.1 uf internal series capacitor): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v.
Volume Level in Decibels (Zero DB equal to 1 milliwatt across a 600-ohm line): −20 to +10 DB; −8 to +22 DB; +6 to +36 DB; +20 to +50 DB.
D.C. Resistance: 0-2000 ohms (12 ohms center); 0-200,000 ohms (1200 ohms center); 0-20 megohms (120,000 ohms center).
Direct Current: 0-50 ua; 0-1 ma; 0-10 ma; 0-100 ma; 0-500 ma; 0-10 amp.

*Trademark

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Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd.
London, Ontario

SHIPPED ON APPROVAL

IN-CIRCUIT CONDENSER TESTER

Model CT-1

AN ABSOLUTE 'MUST' FOR EVERY SERVICEMAN!

Here is an in-circuit condenser tester that does the whole job. The CT-1 actually steps in and takes over where all other in-circuit condenser testers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation. . . .

in-circuit checks:

- Quality of over 80% of all condensers even with circuit shunt resistance present . . . (leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

Model CT-1 — housed in sturdy hammertone finish steel case complete with test leads **$34.50** Net

SIZE: W–6" H–7" D–3¼"

out-of-circuit checks:

- Quality of 100% of all condensers . . . (leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

SPECIFICATIONS

• Ultra-sensitive 2 tube drift-free circuitry • Multi-color direct scale precision readings for both quality and value . . . (in-circuit or out of circuit) • Simultaneous readings of circuit capacity and circuit resistance • Built-in hi-leakage indicator sensitive to over 300 megohms • Cannot damage circuit components • Electronic eye balance indicator for even greater accuracy • Isolated power line

MINI-CHECK TUBE TESTER

Model MC-1

A Real *ECONOMY* MULTIPLE SOCKET TUBE TESTER without sacrifice in *ACCURACY, SPEED* or *VERSATILITY*

Here is a multiple socket tube tester designed to meet limited budgets. Although low in price it boasts a unique circuitry that enables you to check over 600 tube types — and has a range of operation that far exceeds others in its price class.

Model MC-1 — housed in sturdy wrinkle finish steel case **$39.50** Net

SIZE: W–9" H–8½" D–2¾"

SPECIFICATIONS

• Checks emission, inter-element shorts and leakage of over 600 tube types. This covers OZ4s, series-string TV tubes, gas regulators, auto 12 plate volt, hi-fi and foreign tubes • 3 settings enable a test of any tube in less than 10 seconds • Employs dynamic cathode emission test principles • 3½" D'Arsonval type meter — most accurate type available . . . its greater sensitivity means more accuracy . . . its jewel bearing means longer life • 17 long lasting phosphor bronze tube sockets • Combination gas and short jewel indicator • 9 filament positions • Handy tube chart contained in special back compartment • New tube listings furnished periodically at no cost • Detachable line cord

plus these BONUS FEATURES . . . found in no other low price tube tester

✓ Checks for cathode to heater shorts ✓ Checks for gas content ✓ Checks all sections of multiple purpose tubes . . . will pickup tubes with one "Bad" section ✓ Line isolated — no shock hazard ✓ Variable load control enables you to get accurate results on all tubes ✓ Positively cannot become obsolete as new tubes are introduced.

IN-CIRCUIT RECTIFIER TESTER

Model SRT-1

Checks all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc.

With the growing trend towards compactness, portability and low price, TV manufacturers are resorting more and more to producing series-string TV sets employing selenium, germanium or silicon power rectifiers. Now the need for an in-circuit rectifier tester is greater than ever.

THE SRT-1 CHECKS ALL POWER RECTIFIERS IN-CIRCUIT AND OUT-OF CIRCUIT WITH 100% EFFECTIVENESS FOR:

✓ Quality ✓ Fading ✓ Shorts ✓ Opens ✓ Arcing ✓ Life Expectancy

Model SRT-1—housed in sturdy hammertone finish steel case complete with test leads **$29.50** Net

SIZE: W–6" H–7" D–3¼"

SPECIFICATIONS

- Checks all types of power rectifiers rated from 10 ma. to 500 ma. (selenium, germanium, silicon, etc.) both in-circuit or out-of-circuit.
- Will not blow fuses even when connected to a dead short.
- Large 3" highly accurate multi-color meter . . . sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests.
- Cannot damage or over heat rectifier being tested.

SIMPLE TO OPERATE Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales. . . .

TRANSISTOR TESTER

Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY

Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors can develop excessive leakage, poor gain, shorts or opens, the need for TRANSISTOR TESTER is great.

Model TT-2 — housed in sturdy hammertone finish steel case complete with test leads **$24.50** Net

SIZE: W–6" H–7" D–3¼"

SPECIFICATIONS

• Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current • Checks all diodes for forward to reverse current gain • All tests can be made even if manufacturers' rated gain is not available • Less than half a minute required for tests of either transistors or diodes • Large 3" meter is extremely sensitive yet rugged . . . with multi-color scales designed for quick easy readings • Power is supplied by an easy to replace 6-volt battery — current drain so small, service life almost equal to shelf life. Battery cannot be drained due to accidental shorting of test leads • Cannot burn-out its own meter damage transistor or diode under test • Long test leads and insulated te clips enable tests without entirely removing transistor from circuit • Te leads are identified by E.I.A. color code so that connection to the correct terminal is assured • Comes complete with replaceable transistor set-u chart that fits into a special rear compartment.

IMPORTANT FEATURE: The TT-2 cannot become obsolete as the circuitry is engineered to enable you to check all new type transistors as they are introduced. New listings will be furnished periodically at no cost.

EASY TO BUY IF SATISFIED

see order form on facing page

FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

❶ DC Probe ❷ AC Probe ❸ Lo-Cap Probe ❹ RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

SIZE:
W-7⅜"
H-9"
D-4¼"

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

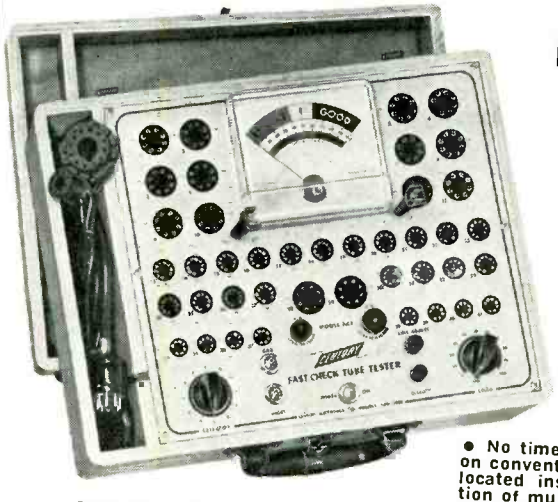
OUTSTANDING FEATURES

- Completely portable — self powered with long life batteries — permits use everywhere
- New advanced pentode amplifier circuit assures amazingly low battery drain
- Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s
- Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC
- Simplified multi-color easy-to-read 4-scale meter
- No heat operation assures rigid stability and accuracy
- Immune to power line fluctuations
- Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments
- Meter completely isolated — practically burn-out proof
- Hand-crafted circuitry eliminates the service headaches of printed circuitry
- 1% resistors used for permanent accuracy
- Separate RF ground return for low-loss RF measurement
- Micro-phone type co-axial connector
- Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 — fully wired and calibrated, housed in handsome hammertone finish steel case, complete with MULTI-PROBE, and thorough instruction manual covering all the applications in detail. **$58.50** Net



SIZE: W—14⅝" H—11¼" D—4⅜"

Model FC-2 — housed in hand-rubbed oak carrying case complete with CRT adapter **$69.50** Net

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- ✔ Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✔ Checks for inter-element shorts and leakage.
- ✔ Checks for gas content.
- ✔ Checks for life-expectancy.

SPECIFICATIONS

- No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers
- No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement
- Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale
- 41 phosphor bronze beryllium tube sockets never need replacement
- 7-pin and 9-pin straighteners mounted on panel
- Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out
- Special scale on meter for low current tubes
- Compensation for line voltage variation
- 12 filament positions
- Separate gas and short jewel indicators
- Line isolated — no shock hazards
- Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying direct from the manufacturer.

CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue, Dept. 504, Mineola, New York

CHECK INSTRUMENTS DESIRED

- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model MC-1 Mini-Check Tube Tester ..... $39.50 — $9.50 within 10 days. Balance $6 monthly for 5 months.
- ☐ Model SRT-1 In-Circuit Rectifier Tester ..... $29.50 — $4.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model TT-2 Transistor Tester ..... $24.50 — $4.50 within 10 days. Balance $5 monthly for 4 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

Please print clearly

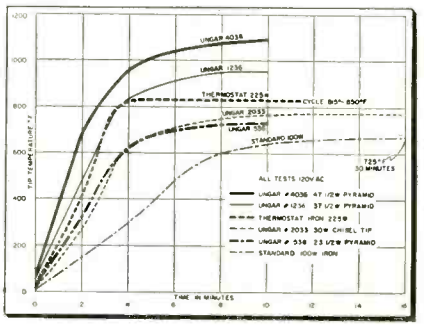
Address .....

City ..... State .....

Solder Reliability

(*Continued from page 34*)

to determine the effect of soldering temperature on solder granulation and joint strength. Micro-photographs of joints prepared, on copper, at both 40° and 400°F above solder liquidus indicate that only the higher temperatures produced coarse structures with evidence of solder film contamination with copper. The lower soldering temperatures produced finer structures with practically no visible evidence of copper contamination. Note, however, that the fluidity and wetting characteristics were poor at 40°F above liquidus, while at 400°F the solders were excessively fluid and tended to

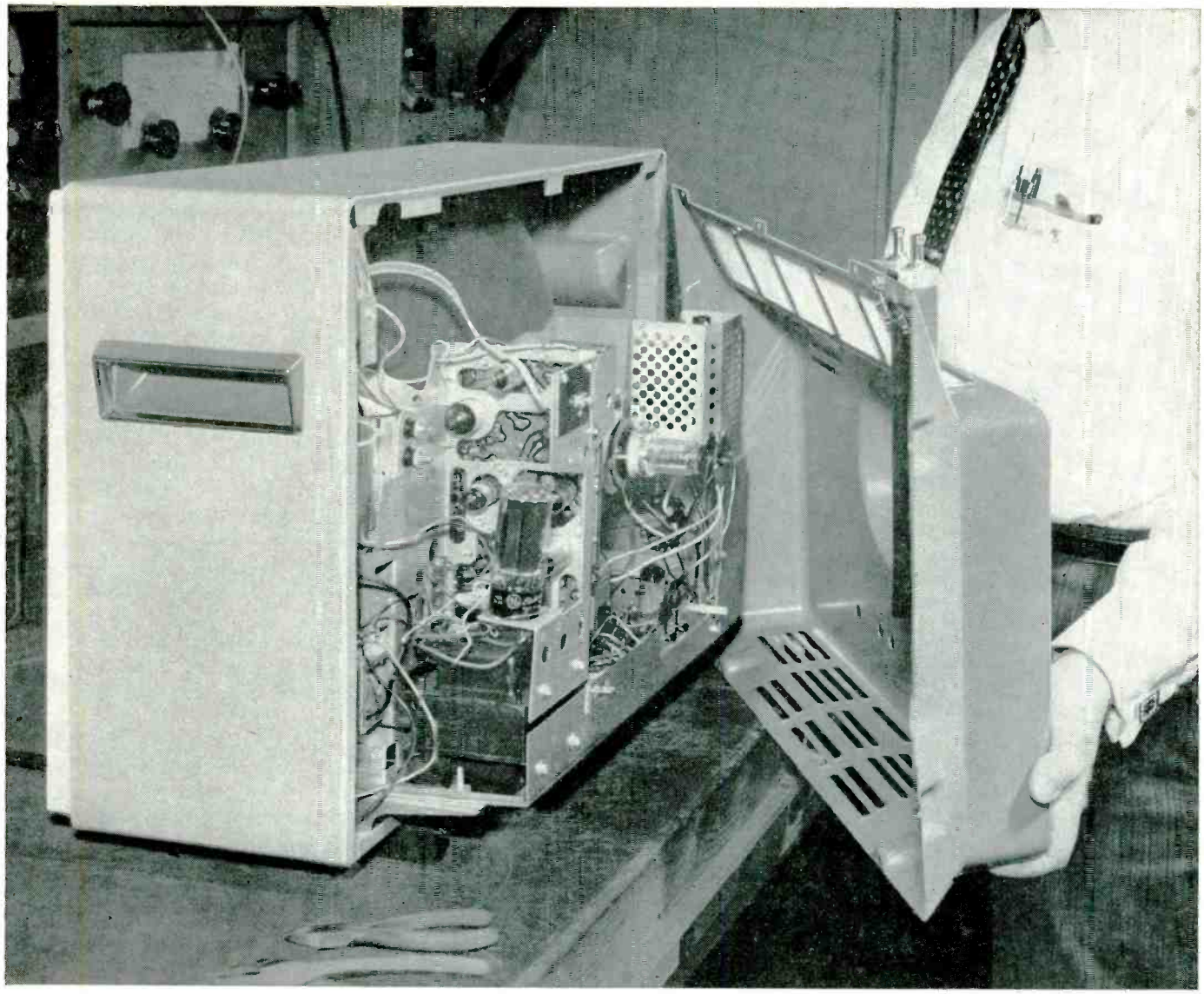


Temperature vs time characteristic. Stabilized tip temperature and thermal capacity are important soldering parameters.

run too much. It is apparent that either extreme of soldering iron temperature is unsatisfactory. Both the 60-40 and 50-50 solder were (based on 40°F liquidus temperature equalling 100% tensile strength) only 80% as strong as when soldered at 400°F liquidus temperature.

The data presented above indicates that the solder, flux and soldering iron must be considered in a coordinated way if reliable soldered connections are to be secured. Previously it was noted that iron wattage should not be the parameter by which a soldering iron is selected. Iron tip temperature and the thermal capacity which indicate its ability to bring a terminal or component into the proper soldering temperature range is the important parameter.

The free air iron tip temperature is generally fixed by the power dissipated in the iron element. The iron bit must have sufficient thermal capacity to bring the soldering area up to proper temperature quickly •



Take the back off the General Electric "Designer" TV set and you can **do 85%-90% of service jobs without pulling the chassis**

You cut your time-per-repair by up to 40% . . . make more calls—and money—in the same amount of time!

Take off the back and there you are—in easy reach of up to 90% of service jobs. Look at the chart!

Look inside! Both sides of the reliable printed circuit boards are easy to reach for service.

No series string filaments—no extension cables needed . . . the new "Designers" are certainly the easiest-to-service sets in all television. You'll wish *every* set was a General Electric "Designer."

Progress Is Our Most Important Product

GENERAL ELECTRIC

TEN TYPICAL JOBS THAT CAN BE DONE WITHOUT REMOVING THE CHASSIS

JOB	G-E "Designer"	Set A	Set B	Set C
Replace most resistors	yes	no	no	no
Replace most capacitors	yes	no	no	no
Replace deflection yoke	yes	no	no	no
Replace video detector	yes	yes	no	no
Replace audio detector	yes	no	no	yes
Replace horizontal phase detector	yes	no	yes	yes
Replace power rectifier	yes	no	no	yes
Adjust tuner oscillator	yes	no	yes	yes
Replace inter-stage transformers	yes	no	no	no
Replace size and linearity controls	yes	no	yes	yes

General Electric Co., Television Receiver Dept., Syracuse, N. Y.

Slow Scan TV

(Continued from page 47)

method of retaining the same vertical resolution is to decrease the number of frames or complete pictures that are transmitted per second. In other words if the frame rate of the TV system is reduced to 15 instead of 30, a 500 line condition can once again be established.

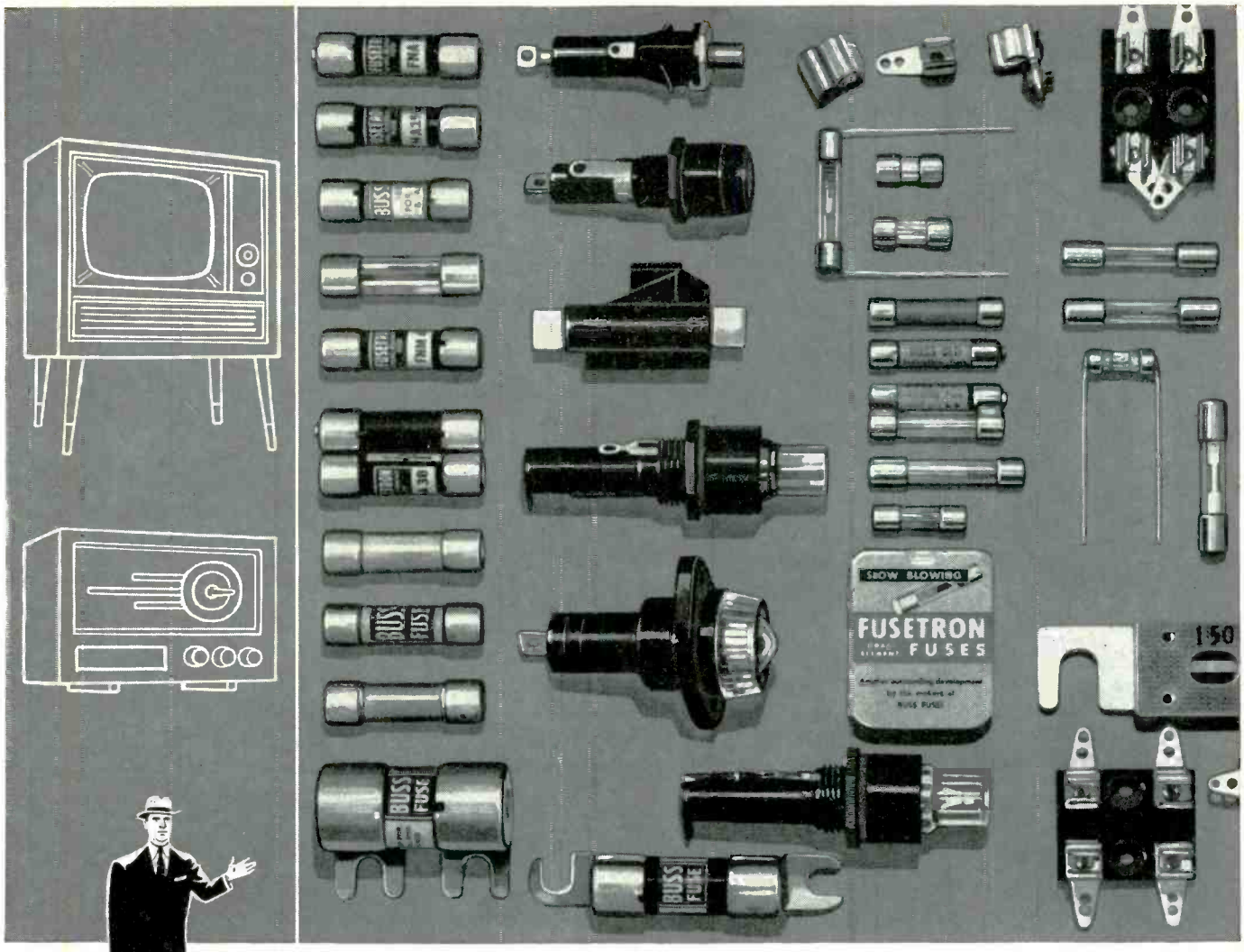
If this were done, a new problem would present itself because of slower vertical interruption rate. To prevent flicker a certain minimum vertical interruption rate is necessary. Commercial telecast systems use a 60-cycle field interruption rate to prevent annoying flicker. One way to reduce flicker, even at a low vertical interruption rate, is to prolong the screen illumination so that it does not die out appreciably during the vertical blanking and retrace interval. A higher persistence phosphor in the receiver's CRT could retain a reasonably high level of illumination during the vertical interruption time.

Smooth Motion

Still another serious limitation to the use of a low vertical picture rate and a long persistence phosphor must be considered. In motion pictures and in TV, smooth motion can be established only if a certain number of complete pictures are transmitted each second. To prevent jerky motion the motion picture industry uses 24 individual scenes per second, and in TV 30 complete pictures are transmitted each second. The use of a long persistence phosphor is also detrimental, because of its tendency to blur motion. This is pretty much the same as trying to take a picture of a fast moving scene with a camera having a slow shutter speed.

To summarize, a number of changes in the scanning standards of a TV system must be made to produce a high quality picture with a slow-scan sweep. The velocity of the scanning beam must be reduced to define the many elements along a line with a sharply limited transmission bandwidth. The vertical picture rate must be reduced drasti-

(Continued on page 70)



Why it is more profitable to handle only BUSS Fuses!

BUSS fuses stay sold—customers stay satisfied because, BUSS fuses are made to protect, not to blow needlessly.

Every BUSS fuse you sell or install is tested in a sensitive electronic device that automatically rejects any fuse not properly constructed, correctly calibrated and right in all physical dimensions.

Your customers know and prefer BUSS fuses

The ready acceptance of the BUSS trademark as standing for fuses of unquestioned high quality is built upon the millions upon millions of BUSS fuses that have provided dependable protection in homes, farms and industry over the past 44 years.

Selling and installing KNOWN, 'trouble-free' BUSS fuses, saves you time and trouble and helps protect your reputation for service and reliability.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write for BUSS bulletin SFB.

BUSSMANN MFG. DIVISION,
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

459

BUSS fuses are made to protect - not to blow, needlessly.
BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON BUSS — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — McGRAW EDISON

(Continued from page 68)

cally to permit the transmission of a suitable number of lines per picture with a slower-moving scanning beam. To prevent flicker a picture tube with a long persistence phosphor must be employed. In conclusion a slow-scan TV system uses modified standards that permit the transmission of a high resolution picture in a limited bandwidth but at a sacrifice in the ability of the system to convey motion.

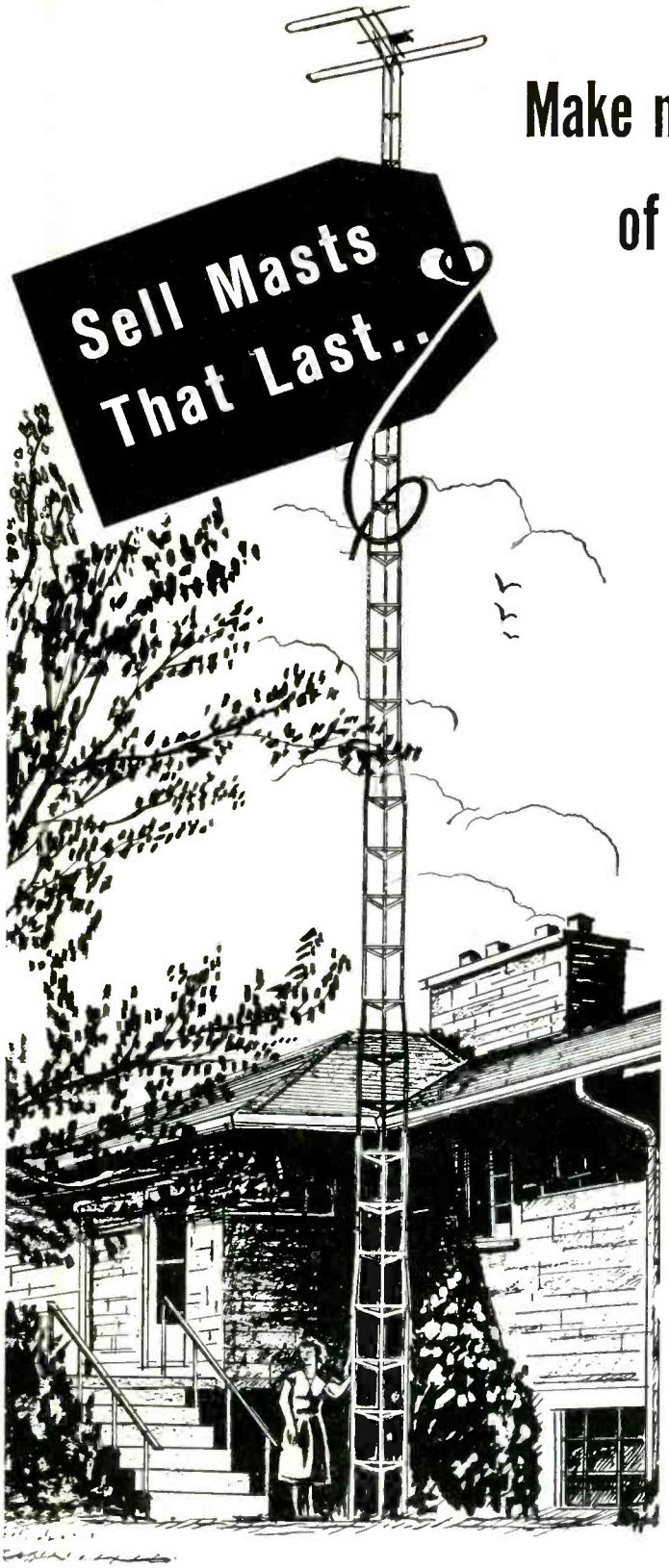
Still pictures of high resolution can be transmitted in extremely narrow bandwidths. For example, one of the practical slow-scan systems used to transmit still pictures of satisfactory resolution has a horizontal frequency rate of 60 per-second and a vertical frame rate adjustable in steps from one frame each two seconds, to one frame every seven seconds. The number of lines per frame can easily be determined. If 60 lines are transmitted per second and it requires three seconds to transmit a complete frame there would be 180 lines. With one frame to be transmitted each 6 seconds, the 60 cycle line rate would produce a TV picture of 360 horizontal lines. The number of lines of resolution can be found accurately by subtracting the number of lines lost during vertical blanking, and multiplying by the correction factor.

Illumination

In addition to the limited bandwidth there is still another important advantage to the slow-scan method. With a slow scan rate the target area of the camera tube is able to charge, under excitation of the light energy, over a much longer period of time before it is discharged by the scanning beam. As a result, even an object illuminated at a very low ambient light level can produce a very strong signal output. For example, a scene illuminated with only 2 foot candles can produce the same signal output from the camera tube as one illuminated by a few hundred foot candles using a fast scan. Illumination problems in conveying still pictures is practically non-existent in the slow-scan process.

The slow-scan picture tube must have a long-decay phosphor. Radar type cathode-ray tubes with P7 or P19 phosphors may be used. Their

(Continued on page 72)



Make more profit with masts, towers of Armco ZINCGRIP Steel Tubing

When you stock TV masts and towers made of Armco ZINCGRIP® Tubing here's why you make more profit:

- their attractive appearance and durability make them easy to sell. *They move fast.*
- they keep customers satisfied, bring buyers back to your shop for additional sales and service.

ZINCGRIP Tubing Resists Rust

Armco ZINCGRIP Tubing has a special zinc coating that gives long-time protection against rust. Masts keep their attractive appearance much longer than those made of electro-galvanized or painted tubing. And the tough zinc skin doesn't crack or peel when towers or masts are fabricated or erected.

ZINCGRIP Tubing Is Strong and Light

Armco ZINCGRIP Steel Tubing gives masts and towers the strength and rigidity to resist driving winds and snow and ice loads. It's light in weight for easy erection even where maximum heights are required.

Sell masts that last—masts and towers made of Armco ZINCGRIP Tubing. Let us send you the names of manufacturers of profit-making TV masts and towers made of this durable Armco steel tubing. Just fill out and mail the coupon.

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Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

(Continued from page 70)

brightness decay characteristics are such that the picture's repetition frequency could be reduced to 10 pictures per minute. Even at this low rate, the information at the top of the picture is still readable when the bottom line is being scanned.

Special slow-scan display tubes can be used for specific applications. Storage type tubes will become increasingly popular in slow-scan systems. The image of a received picture can be retained for as long a period as desired. An image can remain on the screen of some tubes even after the receiver is turned off. The information can be erased in these tubes in approximately 5 to 10 seconds by energizing the correct electrode of the picture tube.

Vertical Line Scanning

Slow-scan systems can also be evolved using vertical scanning lines instead of horizontal ones. In such a system the vertical repetition frequency could be established at a 60 cycle rate while the horizontal frequency would be substantially lower according to the number of vertical lines in the picture. For example, if one horizontal scan is made each five seconds, 300 vertical lines would be formed (5 times 60), less the number of vertical lines lost during retrace. See Fig. 3.

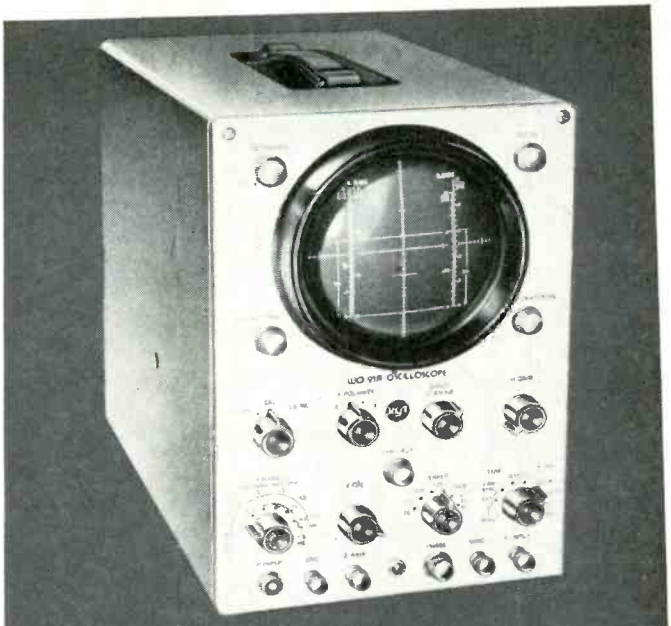
There is a definite advantage in the use of vertical lines instead of horizontal ones to convey a limited motion in a slow-scan picture. Object motion in slow-scan reproduction causes distortion which appears as contractions, expansions, or twists, depending on the direction of motion. Contractions and expansion appear less objectionable than twist and skew distortion. Horizontal motion, which is most common in TV scenes, produces a contraction and expansion type of distortion when vertical scanning lines are employed and a skew distortion with horizontal scanning lines. This is a point in favor of vertical scanning lines.

Slow-scan converters can be added to a standard TV system. On occasion, it might be expedient to transmit a picture to a slow-scan receiver several miles away, over telephone lines. The converter changes the fast-scan picture to a slow-scan signal and does not affect normal operation of the fast-scan system. ●

RCA
Color-TV Test Equipment

OPENS THE DOOR TO MORE PROFITS PER SERVICE CALL!

3 keys to more SUCCESSFUL SERVICE



RCA WO-91A 5-INCH COLOR OSCILLOSCOPE

Extremely useful for black-and-white, vital for color! The WO-91A is used to observe and measure color burst signals and trouble-shoot wide-band color circuits. A multi-scale graph screen makes peak-to-peak voltage measurements as simple as with a VTVM! Response: wide-band operation within ±1 db from 3 cps to 4.5 Mc; High-sensitivity operation within —1 db from 3 cps to 0.5 Mc; within —6 db from 3 cps to 1.5 Mc. Sensitivity: 0.05 volt peak-to-peak per inch (0.018 volt rms) in high-sensitivity position; 0.15 volt peak-to-peak per inch (0.053 volt rms) in wide-band position.

$239.50* complete with WG-300B two-way Direct Capacitance Probe and Cable, alligator clip and insulator, ground cable, green graph screen, instruction booklet.

RCA WR-46A VIDEO-DOT/CROSSHATCH GENERATOR

Designed for making static and dynamic convergence adjustments in color-tv sets, the WR-46A produces highly stable dot, bar and crosshatch patterns—will drive a picture tube directly without need of an external amplifier! Equalizer control provides for adjustment of "V" and "H" bar brightness. Video test pattern is exceptionally free of crawl and jitter. Pattern independent of receiver rf/if response.

$179.50* complete with sync-pickup lead, ground lead, output cable and instruction booklet.

RCA WR-61B COLOR-BAR GENERATOR

Essential for checking overall operation of color-tv sets and adjusting and trouble-shooting color phasing and matrixing circuits. Generates signals for producing 10 bars corresponding to the R-Y, B-Y, G-Y, I and Q signals. Crystal-controlled output signal consists of a picture carrier modulated by a color carrier, horizontal sync pulses and unmodulated sound carrier. All frequencies crystal-controlled for inherent accuracy and stability. Luminance signals provided at edge of color bars for checking luminance and chrominance registration.

$259.50* includes rf and video output cables, tv-input adapter, instruction booklet.

For technical bulletins describing features, specifications, and applications information on these instruments, see your nearest RCA Test Equipment Distributor, or write RCA Commercial Engineering, Section D-46-W Harrison, N. J.

RCA TEST EQUIPMENT ...preferred by professionals!

RADIO CORPORATION OF AMERICA

Electron Tube Division — *Harrison, N. J.*

*User Price (Optional)

"Suggestion Selling" For Technicians

Low Pressure Sales Mean Higher Service Dealer Profits

JOSEPH H. KERNER
SALES MANAGER
BLONDER-TONGUE LABS.

• At one time or another during your business career, you probably figured out the number of hours you work each week, and the number of service calls made in that amount of time. Then, you might have figured out your expenses and profits for each call made to arrive at your net profit.

After arriving at this figure, you may have concluded, "There are just so many hours in a week and just so many calls. This is all I can expect to earn."

Gentlemen, this is not so. At this point, you should begin to analyze your operating efficiency. Do you concentrate only on service? Do you realize that the time you spend in each home can be more efficiently used for both service *and selling*?

You are a good technician—an expert on TV and radio repair. Your customers know this and trust you because of it. This trust can work for you, as well as your customers, in other ways besides service. You can earn additional money by selling products allied to the electronic field. This selling is called *suggestion selling*, a method already proven profitable to many service technicians. It is easy and the results are often impressive.

This is how suggestion selling is done. You enter your customer's home to do a service job. Glancing around the room, you try to spot one or two conditions which, if improved, will ofter better service to the customer.

High Fidelity

For instance, you may notice the radio blaring away, pitifully full of static and interference. This is your cue to comment, "Ma'am, do you know that an FM-AM radio makes listening a real pleasure. You'll never hear noise like that on an FM-AM radio."

Let's analyze a Hi-Fi situation common in many homes to illustrate your selling potential. Many people don't realize that a moderately priced FM-AM tuner can be easily plugged into, or wired into their existing phonograph console. In some cases, all that is "low-fi" about the piece is the record changer and cartridge. You can show them how inexpensive it is to improve the sound quality by upgrading the phono.

Many music lovers are ready to junk their old phonos, opening the opportunity for you to sell them hi-fi components (you can buy them at favorable discount from your jobber), and charge for the labor of a custom installation. Remember,

(Continued on page 78)

TV TINKER-ACHES

Tinker with your TV and you'll *both* suffer! Your TV is not made to take tinkering. Disturb the delicate balance of its thousands of parts and you make your set go bad and yourself go bleary-eyed.

Take the easy way out . . . at the very beginning. Call in one of our TV servicemen. Have him check over your set and replace faulty parts with quality components like Sprague Capacitors.

DEALER IMPRINT HERE

DON'T SHOOT THAT TIRED TV!

There may be years of good viewing left in that TV set of yours. A little adjusting and few new parts—like Sprague Capacitors—may be all that's needed to give it new hope, new energy. Check with us. Our servicemen are trained to bring out the *best* in your set.

DEALER IMPRINT HERE

HE DIDN'T KNOW THE SET WAS LOADED!

There are parts in your TV set that hold electrical charges long after the set is disconnected. These charges might not kill you but they'll certainly shake you up!

Our TV servicemen have the instruments and knowledge to handle these and other TV problems. They'll locate the trouble and replace the defective parts with quality components like Sprague Capacitors. Your TV set will be working in no time . . . without danger to limb or life!

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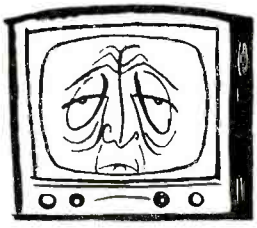

SUFFERIN' TV SETS!

Some TV sets spend almost their entire life sufferin' from poor focus, vertical squeeze, horizontal hallucinations, snow blindness, sound fatigue, and a hundred-and-one other ailments only a trained TV serviceman can cure.

Have one of our TV servicemen check over your set. He'll make the necessary adjustments and replace defective parts with quality components like Sprague Capacitors. Your TV will look so much better!

DEALER IMPRINT HERE

(Above advertisements are shown 75% actual size.)

4 READY-MADE ADVERTISEMENTS

to increase your TV business!

Just add your name to these advertising mats and you have a neat little newspaper advertising campaign that's packaged and ready to go to work for you. These advertisements tell people about your special talents, while reminding them that TV repairing is neither a health nor a happy do-it-yourself project.

Get your mats by sending $1.00 to Sprague Products Company, Att. Technical Service Dept., 65 Marshall St., North Adams, Mass. Ask for RP-200. Be sure to check your local Sprague Distributor for Sprague's many other Advertising and Service Aids . . . *to help you do better work and to increase your business.*

don't be vague . . . insist on SPRAGUE®

the mark of reliability

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU

FREE LITERATURE

To receive the literature below without charge, simply circle the numbers on the coupon corresponding to the items of interest. Cut out and mail to ELECTRONIC TECHNICIAN

1 **Hi-Fi:** "Suggestion Selling" is the theme of the second edition of "Money-Making Method of the Month." The technician's sales potential in Hi-Fi is presented with typical situations and suggestions on how to convert them to profits. (1B4: Blonder-Tongue Labs.)

2 **Fuses:** Bulletin SFB describes a fuse TV service kit assortment, selected on the basis of popular demand, which assures the technician of having the right fuse for the job. The clear plastic box simplifies inventory, and the fuses will not spill, scatter or be lost. (2B4: Bussmann Mfg. Co.)

3 **Transistors:** The new, expanded, edition of a 10-lesson home study course is described in folder PA-276. The course covers simplified basic transistor theory with practical theory and servicing techniques for amplifiers, oscillators, rectifiers and deflection circuits. (3B4: CBS-Hytron.)

4 **Controls:** A Guide lists all auto radio controls in use today and their equivalents. Exact replacement is made easy and enables the technician to handle more auto radio repair business. (4B4: Centralab.)

5 **Tubes:** The revised edition of booklet ETR-1541, on "Service-Designed" receiving tubes, includes detailed descriptions of construction changes in the 1J3, 6AF4, and 6 AF4-A. Also lists the entire line of broad tolerance tubes. (5B4: General Electric Co.)

6 **Test Instruments:** Model 590 Peak-To-Peak and RMS VTVM, and model 591 Wide Range Capacitance Tester are two new instruments for which descriptive literature is available. (6B4: Jackson Electrical Instrument Co.)

7 **Stereo:** "Service-File" is a technical file on stereo hi-fi components for conversions and replacements. Included are bulletins on hum elimination, installation, maintenance, etc. (7B4: Pickering & Co.)

8 **Stereo:** New literature is available describing basic amplifiers and preamplifiers for custom stereo systems. (8B4: Pilot Radio Corp.)

9 **Transistors:** A new, revised, interchangeability guide opens to 19 x 25 inches. It provides equivalents for over 200 EIA registered types, and includes typical applications, outline drawings and heat radiator requirements. (9B4: Raytheon Mfg. Co.)

10 **Towers:** A new catalog covers 10 different lines of towers, and a wide line of all types of accessories including masts, tubing and bases. (10B4: Rohn Mfg. Co.)

11 **Test Equipment:** Important features, specifications and prices, are included in a new illustrated booklet describing the firm's complete line of test equipment and service aids. (11B4: Seco Mfg. Co.)

12 **Capacitors:** Catalog C-912A is a handbook on the replacement of capacitors in air conditioners, refrigerators, motors, compressors and other applications. (12B4: Sprague Products Co.)

13 **Sound Equipment:** Two pieces of literature are available: A special chart showing how to assemble various types of sound systems to meet different needs; and a "Sound Installation Guide." (13B4: Stromberg-Carlson.)

14 **Transistors:** Literature is available on 8 transistors which will take care of over 200 PNP entertainment type transistors used in everyday service work, including auto radios. (14B4: Workman TV Inc.)

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This coupon must be used before May 20, 1959

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SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.
- **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.
- **CAPACITY RANGES** permit you to accurately measure all condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.

6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.

3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.

2 CAPACITY RANGES:
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5 D.C. CURRENT RANGES
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES:
— 6 db to + 18 db. + 14 db to + 38 db + 34 db to + 58 db

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

FEATURES:

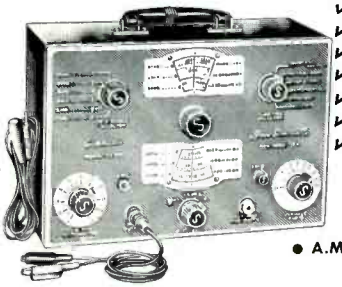
- A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.
- Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure unchanging accurate readings on all ranges.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only **$42.50**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!



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

This Versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

● A.M. RADIO ● F.M. RADIO ● AMPLIFIERS ● BLACK AND WHITE TV ● COLOR TV

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc.; 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

BAR GENERATOR; Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

The Model TV-50A comes complete with shielded leads and operating instructions. Only **$47.50**

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- Uses new improved SICO printed circuitry.
- Employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability • Meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

SPECIFICATIONS

• DC VOLTS — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • AC VOLTS (RMS) — 0 to 3/15/75/150/300/750/1,500 volts. • AC VOLTS (Peak to Peak) — 0 to 8/40/200/400/800/2,000 volts. • ELECTRONIC OHMMETER — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • DECIBELS —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • ZERO CENTER METER — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

AS AN AC VOLTMETER: Measures RMS value if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Comes complete with operating instructions, probe, leads, and steamlined carrying case. Operates on 110-120 volt 60 cycle. Only.. **$42.50**

SUPERIOR'S NEW MODEL TW-11 **STANDARD PROFESSIONAL**

TUBE TESTER

- ★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, 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 TW-11 as any of the pins may be placed in the neutral position when necessary.
- ★ The Model TW-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. All tube listings printed in large easy-to-read type.

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.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES: Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. **$47.50**

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NO MONEY WITH ORDER — NO C.O.D.

Try any of the above instruments for 10 days *before* you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. *No Interest or Finance Charges Added!* If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC.
Dept. D-593 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

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

All prices net, F.O.B., N. Y. C.

☐ **Model 80...Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.**

☐ **Model TV-50A...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.**

☐ **Model 77...Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.**

☐ **Model TW-11...Total price $47.50. $11.50 within 10 days. Balance $6.00 monthly for 6 months.**

Suggestion Selling

(Continued from page 74)

most people do not feel capable of making electronic hook-ups themselves.

The magic word today is "stereo" —an excellent market for you. Again, on your next house call suggest to your customer that she can hear stereo by having you add speaker, amplifier and stereo cartridge. Even extension speakers on monophonic systems may be welcome.

You will be impressed the first few times you use suggestion selling. Your customers can actually sell themselves. But remember, *low* pressure is the watchword.

Commercial Sound

Now take a look at the shopping area. Many retail stores in your neighborhood can benefit by adding background FM music.

Considering the fact that many of these stores would not be willing to undergo the expense of one of the piped-music systems, you can be sure that you will find some store owners willing to discuss the purchase of an FM-AM radio. If his store is large enough, he might use a complete Hi-Fi system.

While we are on the subject of background music systems, don't overlook all of the doctors, dentists, optometrists, podiatrists and other professional offices where patients can be made more comfortable listening to background music.

Make the most of the golden hours that you spend in the customer's home. Many service-dealers offer employees a split of the profits that result from a sales lead or the sale of any equipment while they are in the customer's home servicing a set.

If you are doing service work for other dealers, we are confident that they will be most appreciative for sales leads that you will bring in, and will certainly share their profits with you or pay commission on these sales. It is a fact that you do not have to be a high-pressure salesman to be a successful businessman. Just spend 2% of your time making sincere suggestions to your customers, and you might be very pleasantly surprised to discover a 200% increase in your profits. •

Audio NEWS LETTER

ELECTRO-VOICE names Arthur S. Johnson traffic manager.

V-M appoints Joel M. Rowley, ex-Westclox, as ad manager.

BOGEN-PRESTO announces the S1 stereo disc cutting head developed in their plant under Westrex license.

NEWCASTLE FABRICS introduces two modular roll racks for display of Acoustone grill cloth.

COLUMBIA is making a free home trial offer for its CD stereo cartridge. It expires April 30.

FANON introduces the FTS-20 and 22 telephone intercom systems supporting 20 stations and switchboard.

VIDAIRE announces the SS-8 and SS-16 constant impedance switchers for centralized multi-speaker control.

GLASER-STEERS Plexiglas dust cover for GS-77 changer allows free operation when changer is in use. Price is $9.75.

CLETRON announces the C-12-RW woofer with 2-lb. flat design ceramic Indox magnet. Rated to reproduce 16 cps.

SONOTONE names Richard J. Mahler general merchandising manager of the Electronic Applications Div., which includes hi-fi products.

EICO introduces the HF-14-watt power amplifier with Williamson circuit and push-pull EL84 output. Specs at 14 watts are 25 to 25,000 cps ± 0.5 db, IM 1.7%, harmonic 1% 50 to 5000 cps, and hum -90 db. Prices are $23.50 kit, $41.50 wired. Enclosure E-6 is $4.50.

Solid-State

(Continued from page 45)

of many uses for these solid state materials and devices.

The Cryotron

A simple, tiny, low-temperature device, the cryotron has been developed as a switching element. Fig. 2 shows a cryotron circuit compared to a triode tube circuit. Because digital computers have thousands upon thousands of switching circuits this cryotron could, if successful, reduce a computer the size of a room, to fit into a shoebox. Experimental devices operate at 4.2° Kelvin. At this temperature both the small tantalum rod and the niobium control winding are superconductive. Because there is no resistance in the tantalum rod there is no voltage across the load resistance. No input power is required, since in the superconducting state the effective zero resistance of the niobium winding requires no voltage for the input current. As the control or input current increases the magnetic field about the tantalum increases. At a critical value the tantalum suddenly develops its normal resistance and causes a voltage drop to appear across it and the load resistance. The cryotron circuit function is similar to the vacuum-tube triode circuit, but works in a different way. In the tube as the input or control voltage varies so does plate current. In the cryotron, as the input current changes the output voltage across the load changes.

Semiconductor Controlled Rectifier

Semiconductor devices to replace relays, switches, and thyratrons have been developed and are available for testing. One of these is the controlled rectifier. The solid-state thyratron or silicon controlled rectifier is one of the latest additions to the rapidly growing list of semiconductor devices. Neither a transistor nor a rectifier, but combining features of both, the controlled rectifier opens up broad new fields of application for semiconductors. Many circuits now utilizing transistors or rectifiers

may be greatly improved through the use of controlled rectifiers, and many new applications may now be converted to semiconductors due to the unique properties of the device shown in Fig. 3. It is potentially capable of causing a revolution of design ideas in the electronic and electrical industries because of its ability to change ac to dc and simultaneously to control the power fed into a load.

Recent developmental models,

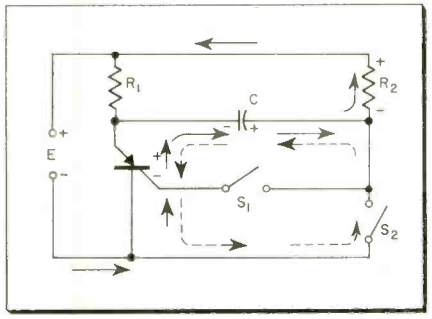


Fig. 5—Controlled rectifier switches D-C load. Momentary closing of switch S_1 starts conduction. Switch S_2 permits capacitor to discharge and apply a reverse voltage to block conduction, when closed.

about the size of a thimble, are capable of handling loads varying from 200 to 1,000 watts at a stud temperature of 125°C. When switching at full rating, the controlled rectifier dissipates only 0.5% of the controlled power. The controlled rectifier is a PNPN semiconductor consisting of three rectifying junctions. Breakdown of the center junction can be achieved by applying an appropriate signal to the gate lead, which consists of an ohmic contact to the center P region. Breakdown occurs at speeds approaching a microsecond. After breakdown, the voltage across the device is so low that the current through it is essentially determined by the load it is feeding. The controlled rectifier can switch 1,500 watts on the anode by the application of only 0.02 watt on the control gate. Peak current is as high as 150 amperes. For industrial control applications it can replace thyratrons, circuit breakers, relays, power transistors, ignitrons, magnetic amplifiers and other devices. Fig. 4 illustrates the opreation of the rectifier without a gate signal. The source voltage is applied in series with the load and the rectifier. The rectifier will not conduct if there is no signal applied to the gate, or if the peak voltage is 200 volts or less. The rectifier conducts when more

(Continued on page 82)

than 200 v is applied as in B. In C the peak applied a-c voltage is much greater than 200 v.

Conduction can be controlled by the gate which acts like the grid in a thyratron. The gate signal is generally applied from a high impedance source which may be either ac or dc. For firing control, the gate voltage should be positive with respect to the cathode. The gate input impedance ranges from 10 to 100 ohms at the firing point. As the gate current is increased, a critical point will be reached, and the device will break down at any positive anode to cathode voltage greater than a few volts. The gate loses control after breakdown and cutoff can only be obtained by reducing the anode voltage to zero. This is identical to the loss of grid control in a thyratron.

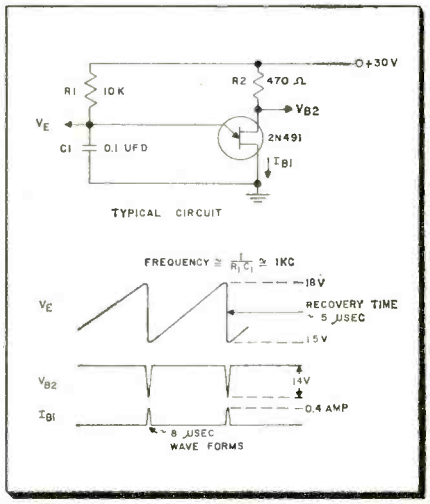


Fig. 6—Unijunction transistor used in relaxation oscillator circuit. Originally called double-base diode, it exhibits open-circuit-stable negative resistance characteristics and is useful for sawtooth and pulse generators, multivibrators, etc.

The controlled rectifier has wide potential application in industry. Firing may be accomplished in as many ways as have been devised for firing thyratrons. The gate of the controlled rectifier has a much lower impedance than the grid of a thyratron, and relies upon current for control rather than voltage. Fig. 5 shows how to use this device to switch a dc load. Momentarily closing switch S1 starts the conduction. The capacitor will charge after the switch is released. R2 determines the rate of charge. Closing switch S2 causes C to discharge and apply a reverse voltage which blocks conduction and turns off the rectifier.

The unijunction transistor is a new semiconductor component. Its action

can be related to that of the controlled rectifier in circuit design. Originally, it was called a double-base diode. It is different both in construction and operation from the conventional transistor, but the term transistor was used in the component's name because it meets the industry-accepted definition for a transistor. A transistor is generally said to be "any active semiconductor device having three or more terminals."

In contrast to the conventional junction transistor, the unijunction transistor is a device exhibiting open-circuit-stable negative resistance characteristics. Because of this it is primarily useful in switching and oscillator circuits. In addition, it has the unique ability to sense voltage levels, and temperature variations. Or by various circuit modifications, it can be made insensitive to temperature and voltage variations. These devices are particularly useful for relaxation oscillators, sawtooth and pulse generators, pulse rate modulators, pulse amplifiers,

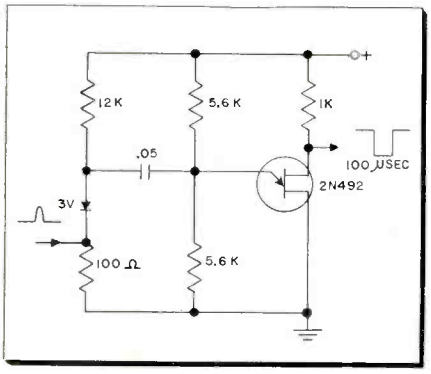


Fig. 7—One-shot multivibrator employing unijunction transistor lends itself to miniaturization.

multivibrators, flip-flops and time delay circuits. Because of the high peak current rating, 2 amperes, it is useful in medium power switching and oscillator applications where one unijunction transistor can do the work of two conventional transistors. In special voltage sensing and locking circuits, one unijunction transistor has been used to replace as many as five conventional transistors.

The unijunction transistor can be operated in a number of different circuit configurations so that any of the three terminals can serve as a signal input or load output. Externally it looks like an ordinary transistor. Internally it consists of a

(Continued on page 84)

(Continued from page 83)

uniform doped N type single crystal silicon bar with ohmic contacts at each end and an aluminum wire attached to the silicon bar between them. The two ohmic contacts to the silicon bar are called base 1 and base 2. The room temperature base-to-base resistance range is from 5,000 to 10,000 ohms. The aluminum wire connected to the silicon bar between the two ohmic contacts, forms a p-n junction, which is the emitter.

Fig. 6 shows the unijunction transistor in a relaxation oscillator using 2 resistors and 1 capacitor. With the values indicated, the frequency is about 1 kc. One output V_E is a sawtooth and the other, V_{B2}, is a pulse.

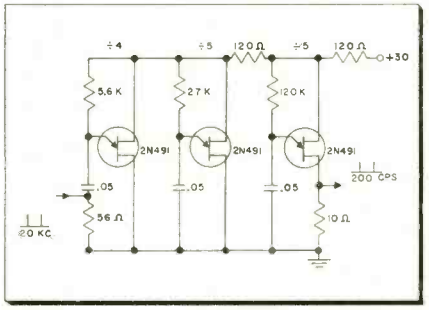


Fig. 8—Three unijunction transistors in frequency divider circuit provides a 100 to one count down ratio.

Many circuit variations are possible. Fig. 7 is a one-shot multivibrator and Fig. 8 is a frequency divider having a 100 to 1 count down ratio.

Four Layer Diode

The four layer diode is another transistor-like device which is a semiconductor switch. These devices have two states. One is an open-circuit condition where it acts as a high value of resistance in the 10 to 1,000 megohms range, the other is a closed or low resistance state, where it acts almost as a short circuit. This two-terminal device may be considered as a p-n-p and n-p-n transistor tied together in a single unit. At the proper applied voltage the center junction breaks down and current flows.

Other new and interesting solid state devices are the MASER, from molecular amplification by stimulated emission radiation; parametric amplifiers, where a variable inductance or capacitance provides microwave amplification; and the semiconductor capacitor. Truly, tomorrow's developments are some of today's far-fetched dreams. •

Rumble, Flutter

(*Continued from page 39*)

tion or power to the turntable by friction. The torque developed by the motor is enough to rotate the turntable and operate the change mechanism. Fortunately, the motor unit seldom needs major service. Occasionally, however, a motor will have a bent armature or defective bearings. Usually, just cleaning and a drop of light oil on the bearings is all that is required. Most of the trouble occurs in the power transfer components which depend upon friction.

Frictional Losses

If the amount of friction loss is small, the turntable speed may be correct, with only one or two records on the turntable. With a heavier load and during the change cycle, enough loss in power transfer may occur to slow down or stall the turntable. Loss of friction in the speed reduction system is easily recognized when it is due to excessive use of grease or oil on the pulleys or idler wheel, but much less obvious reasons often prevail. Dirt and dust become imbedded in the pores of rubber belts and idler wheels which cannot be removed, even with cleaning agents. Glazed rubber surfaces can be restored by cleaning and a little elbow grease. Best procedure to follow is to replace the rubber components. They are quite inexpensive. The tension spring that holds the idler wheel in position may be modified to apply more pressure by shortening the spring. Exercise caution and restraint, the chances are that the spring is just right, and trouble exists elsewhere. Excessive pressures may cause a loss of speed. This loss may be common to all speeds or affect only a single speed. Also check for worn motor mounts and defective turntable bearings.

Not all speed variations and other undesirable effects are due to normal wear and tear. Undesirable inherent characteristics are often the source of many complaints. Major modifications are often not advisable and it may be better to upgrade a hi-fi rig with a better changer or turntable. •

New Books

Book marked with an asterisk (*) may be obtained prepaid from Electronic Technician

***FUNDAMENTALS OF RADIO TELEMETRY.** *By Marvin Tepper. Published by John F. Rider Publisher. 136 pages, soft cover. $2.95.*

Interested in the techniques by which missiles and satellites relay their data to earth? This basic book clearly explains and illustrates how. Subjects include multiplexing, receiving stations, data recovery and recording, digital techniques and satellite telemetry. There is a bibliography for further reading, and appendices on standards. In addition to government applications, telemetry has great potential for industrial use. This book is interesting to read, and can lay the groundwork for commercial telemetry maintenance study one day.

1959 TECHNICIAN'S HANDBOOK. *Prepared and published by CBS-Hytron, Parker St., Newburyport, Mass. 550 pages, soft cover, plastic binding. $1.85.*

This impressive manual covers characteristics, basing and other data on more than 1000 receiving tubes, 330 picture tubes, plus transistors, crystal diodes and special purpose tubes. A section is devoted to seldom used tubes, and the appendix contains a glossary, interpretation of ratings, explanation of numbering system, color codes and other information. This is a truly worthwhile reference.

***VIDEO AMPLIFIERS.** *By Alexander Schure. Published by John F. Rider Publisher. 88 pages, soft cover. $1.80.*

A full explanation of how video signals are amplified is offered here, along with characteristic curves and fundamental mathematics. The questions of high and low frequency compensation are fully explored. One chapter is devoted to design procedure, and another to special amplifiers and measurements. Waveforms and representative circuitry are illustrated.

RECEIVING TUBE MANUAL. *Prepared and published by Electronic Tube Div., Radio Corp. of America, Harrison, N.J. 384 pages, soft cover. 75¢.*

Over 2,000,000 copies of the RCA Tube Manual have been sold since 1947. The new edition, RC-19, contains technical data for more than 625 receiving tubes and 95 picture tubes, including color. The informative sections on theory and applications includes TV circuits, hi-fi and radio. It's a real handy volume to have around.

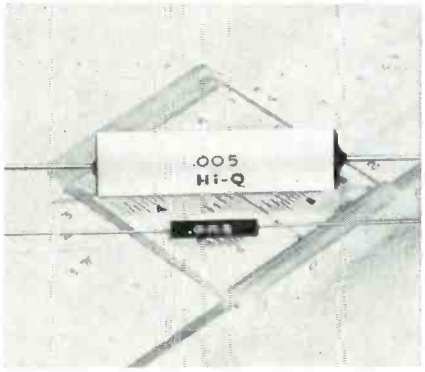
(Continued on page 90)

New Products

For more information, write in ELECTRONIC TECHNICIAN'S new product code number on coupon on page 76.

Aerovox CAPACITORS →

"Cerafil" line of ultra-miniature ceramic capacitors have wide application in transistorized circuits, hearing aids, airborne and spaceborne electronic equipment, and other requirements where space and weight are at a premium. The completely new design and construction features make it possible to obtain extremely high capacities per unit volume. Available in capacities from 10 μμf to 100,000 μμf in working voltages of 30 and 100 v dc. Aerovox Corp., New Bedford, Mass. (ELECTRONIC TECHNICIAN 4-8)

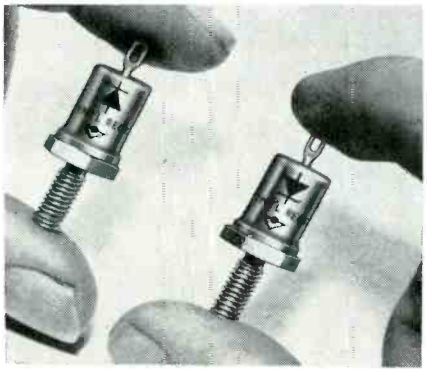


C-D CAPACITOR CABINETS →

"C-D Twin Treasure Chests" are metal storage cabinets to speed up bench service, turnover, and lend a neater appearance to service areas. Open section contains 12 "Preferred-Type" twist prong capacitors and has room for 6 more. Tubular section has 4 partitioned drawers which contain 16 "Blue Beaver" electrolytics and 73 "PM" mylar tubulars. Dealer cost is $49.95. Cornell-Dubilier Electric Corp., South Plainfield, N.J. (ELECTRONIC TECHNICIAN 4-10)

Int'l SILICON RECTIFIERS →

1500 PIV, 300 ma rated silicon rectifiers exhibit more stable characteristics at high temperatures than ever before. Reverse leakages as low as 100 μa at 75°C (at rated PIV of —1500 v dc). Maximum forward voltage drop at a test temperature of 25°C at 150 ma is 4.5 v. May be operated at temperatures up to 150°C. Especially suitable for airborne equipment applications. Technical data in Bulletin SR-226. International Rectifier Corp., El Segundo, Calif. (ELECTRONIC TECHNICIAN 4-11)



Association News

California

San Francisco TV Service Guild joins TSDA, San Mateo, in an arrangement to increase the latter's monthly publication, *TV Service*, and to knit the two groups more closely together.

Florida

RTTG has donated a 21" TV set to the South Florida State Hospital, with free installation and one year service. The hospital has no funds for this beneficial purpose.

Illinois

NATESA Scope notes that when servicers argue against difficult TV set designs they are arguing against their own best interests. "Instead of harping about design that often is senseless, why not welcome it. The tougher the manufacturer makes the set to service, the less likely that a part-timer or a set owner will tamper with it."

Indiana

Indianapolis TV Technicians Association reports that hearings were held on Senate Bill 149 providing for TV service licensing. Indiana Electronic Service Association leaders appeared to speak for the bill, but the Committee's decision is still inconclusive.

Michigan

TSA News reminds readers that three years ago they predicted: "Certain manufacturers will try to monopolize manufacturing, distribution and service of their sets . . . selling the factory-repair idea." TSA goes on to state that IDEA is fighting against factory service on behalf of independents.

Missouri

TESA affirms its support of 90-day warranties, pointing out, however, that there must be enough

profit to pay for service in this period.

Electronic Service Council's *Raster* backs selective buying, noting that it is a big stick with which one must tread softly. The solution is more give and take between manufacturer, jobber and technician.

New York

RTG of Long Island observes that the Certification Bill (see March ET) is not as drastic a step as licensing, but can do a great deal to stabilize the TV service industry.

Ohio

TESA, Cincinnati, notes that TV servicing is a good profession, but the large percentage of honest men must "get off their complacent derrieres" to do something constructive.

ARTSD, Columbus, boosts its motto: "Stop Crying—Start Selective Buying."

Texas

TEA, San Antonio, reminds members that the Clinic and Fair will want to draw even more people than the 700 in attendance in Dallas in 1958. Incidentally, the *SARTA News* publishes its cover upside down to point out that individual dealers must band together.

Washington

TSA, Seattle, reports that the City Council has been asked to investigate self-service tube testers, and to inspect and certify them the way butchers' scales and gasoline pumps are.

As We Go To Press

Reports are that the proposed legislation, in New York State, to test and certify TV technicians has died in the legislators' committee. Many bills were not considered because they had run out of time. However, the committee appointed by the Attorney General to promote fair practices and ethical standards in the TV supply and repair industries will continue to meet. One of the subjects suggested for the next meeting is the problem of counterfeit tubes. The bill (See March 1959 issue of Electronic Technician) is expected to be reintroduced at the next session.

New Books

(Continued from page 86)

***TELEVISION RECEIVER SERVICING.** *By Milton S. Kiver. Published by D. Van Nostrand Co. 320 pages, soft cover. $5.95.*

This fourth edition has been brought up to date with 150 new illustrations and a chapter on color TV operation and servicing. It is packed with much useful data on antennas test equipment, r-f, i-f and detector stages, agc, crt's, deflection, power supplies, FM, UHF, alignment interference. A number of sets and instruments in common use are illustrated. Technicians will find this book a good educational source.

***DESIGNING AND BUILDING HI-FI FURNITURE.** *By Jeff Markell. Published by Gernsback Library. 224 pages, soft cover. $2.90.*

This book for hi-fi enthusiasts discusses room layouts, design fundamentals, furniture styles, materials, construction and finishing. A number of commercially available enclosures are illustrated. Technicians making custom hi-fi installation should find many enlightening comments in this volume.

RADIO HANDBOOK. *By William Orr. Published by Editors and Engineers, Summerland, Calif. 800 pages, hard cover. $7.50 (plus 10% mail order).*

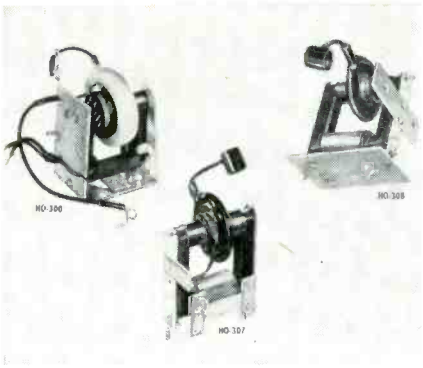
This 15th edition provides a wealth of data for technicians, hams and engineers. First principles of ac, dc, vacuum tubes, amplifiers and radio are covered. Then the text goes into transmitter, single sideband, TV, antennas, and much more. Sections are devoted to constructing equipment and instrument measurements.

Watch For The May Issue

The 1959 Electronic Technician Buyers Directory, the only directory in the electronic maintenance field, will be a feature of the May issue. Features include: product finding index; product listings; alphabetical listing of manufacturers with addresses; technical societies and industry associations; 1959 roster of technician associations; and electronic schools.

Stancor FLYBACKS

Three new flybacks include the HO-300, an exact replacement for Wells Gardner 53X355, used in 76 models and chassis, manufactured under various private labels including Airline, Coronado, Firestone, and Truetone. Also released at the stame time were flyback No. HO-307, replacing Setchell-Carlson parts T-123, T-124, WF-14, and WF-70, and HO-308, an exact replacement flyback for Setchell-Carlson part numbers T-201, T-132, T-133, WF-71, and WF-80. Chicago Standard Transformre Corp., 3501 W. Addison St., Chicago 18, Ill. (ELECTRONIC TECHNICIAN 4-21)



Triad TRANSFORMERS

TY series, a new line of transformers for transistor power supplies, provides dc output from mobile supplies of either 6, 12 or 28 v dc. These epoxy molded, toroidal type transformers are capable of exceeding the requirements for grade 5 class R units as specified in MIL-T-27A. They are rugged and compact. Can be stacked on a single mounting bolt through a centrally located hole, and series parallel connections are easily made to the peripherally located terminal pins. Operating frequency falls in the range between 2500 cycles for the higher power units to 5000 cycles for the low power ones. The square wave output characteristic may be converted to sinewave by use of filtering networks, available on special order. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif. (ELECTRONIC TECHNICIAN 4-14)

Trio SET CONNECTOR

Antenna lead-in breakage at the TV set is reportedly eliminated with the use of the new no-strip set connector. It grips the whole insulated wire. A light pull detaches the lead-in from the set. The base section adjusts to fit the terminal post spacing of all TV sets and the pin section fits a standard 300-ohm wall outlet. Price is $1.49 retail. As an introductory offer, a free unit is given with each of certain antennas in the line purchased by dealers. Trio Mfg. Co., Griggsville, Ill. (ELECTRONIC TECHNICIAN 4-22)

Tuner Repairs

(Continued from page 33)

the second detector. A range of —2 to —7 volts can normally be expected. Moving into the next stage, the oscillator section can be quickly checked in this manner.

An oscillator that is functioning will usually have about —3 volts on the grid. See Fig. 2. If the oscillator is dead, the voltage will drop (negatively) down to less than —1. The remaining voltmeter checks are on the plate of the oscillator tube and screen of the mixer. Oscillator plate voltage should be checked carefully, as it can cause an appreciable change in frequency. Voltmeter checks such as these are not exactly a scientific troubleshooting approach, but there are only about eight checks which can be accomplished in less time than it takes to warm up the signal generator and it can quickly lead to the seat of most trouble. The weakness of this procedure would be more evident if there were many points to look at. Signal injection on the other hand can in one check figuratively cut the circuit in half and predict which half has the trouble. If the generator used at the grid of the first i-f tube is transferred to the grid of the mixer and a signal goes through, then the trouble exists in the oscillator or r-f amplifier circuits. If no signal goes through, the difficulty lies in the mixer stage. There is always a possibility that a short or open exists in the coupling circuit between the tuner output and i-f input, and it should not be overlooked. Repairing defects in the mixer stage, except for mechanical and accessibility problems, is straightforward and similar to working on an ordinary amplifier circuit.

If the mixer and oscillator are functioning, some signal will usually get through from the antenna even if the r-f amplifier is defective. A simple check is to capacitively couple the antenna to the mixer and jump the r-f stage using a small external capacitor, or sometimes just feed the antenna leadin directly to the grid of the mixer. If the oscillator is out, it may be possible to use the signal generator as an external oscillator; its frequency should be set

either above or below the off-the-air signal frequency by a difference amount equal to the i-f frequency. This can be accomplished without worrying about the accuracy of the generator's setting. Simply vary the generator's frequency slowly about its approximate setting, and observe the results on the CRT. Of course the tuner should be set to receive the signal.

Thus it can be seen that the 8 voltage check points can be cut to 3 signal check points and a more positive indication of which stage is defective. Once the trouble has been isolated to a particular stage, the voltmeter, ohmmeter, capacitor checker, or parts substitution activities begin. Here too, a logical procedure should be followed. A few moments spent in trying to pinpoint the defective component, even before the soldering iron is put to the circuit, will pay dividends. Because of the high frequencies involved, and the nature of the circuitry, lead dress is critical, as is the values of components. Many of the components are small, and have very short leads. These parts are sensitive to heat and their values may be permanently changed by excessive temperatures, if not completely destroyed.

A few components, mostly in the oscillator circuit, are temperature compensated, and may be mounted in such a position as to take advantage of certain heat conditions within the tuner. Therefore, if replacement is necessary, it is best to get an exact duplicate, or at least be on the alert for drift and other side effects.

1. Do not change the position and lead length of components. A capacitor may have been purposely placed in the vicinity of a warm resistor to take advantage of its temperature coefficient. This is not necessarily a mistake which will lead to the early demise of the capacitor, so don't try to improve the design by putting more space between the components.

2. Do not use multiple components in series or parallel, if an exact replacement is not available. Two parallel 100,000 ohm resistors may come out to 50,000 ohms and may be suitable in many circuits calling for a 50,000 ohm resistor, but the danger of creating stray resonances and parasitic oscillations preclude their use.

3. Do not push, bend, or cut certain unterminated wires. The habit of pulling on loose threads can only lead to trouble. Some of these loose ends are gimmicks purposely installed either for certain tuned effects or for coupling. These components are inert and seldom require attention.

4. Do not be afraid to open up a tuner when it requires servicing. Those who are concerned about alignment will find tuners to be quite stable, and in most instances will not require more than simple oscillator adjustments. Where extensive repairs have been made, or when components in tuned circuits have been changed, or where someone tightened all the screws, then alignment procedure is required. Most manufacturers' service notes provide specific information for servicing and aligning their tuners.

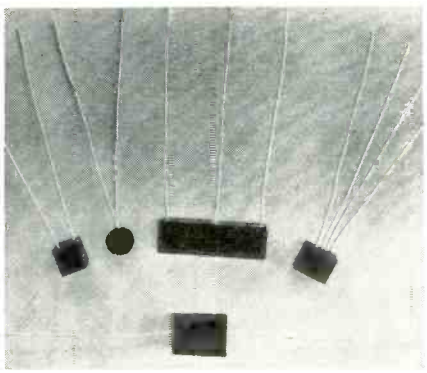
With a reasonable amount of precaution and a sensible approach, the tuner can be properly serviced. •

New Products

For more information, write in ELECTRONIC TECHNICIAN'S new product code number on coupon on page 76.

Radio Receptor RECTIFIERS →

ABC series, a new line of low-cost miniature selenium rectifiers, has a wide range of voltages and currents for use in half wave, full wave, single or 3-phase rectifier circuits. Heading the list is type ABA, ideally suited for rechargeable battery-operated appliances. It is a 130 v RMS, 20 ma rectifier rated with a resistive or inductive load. Different terminal arrangements available. Suitable for printed wiring boards. Radio Receptor Co. Inc., Semiconductor Div., 240 Wythe Ave., Brooklyn 11, N.Y. (ELECTRONIC TECHNICIAN 4-12)

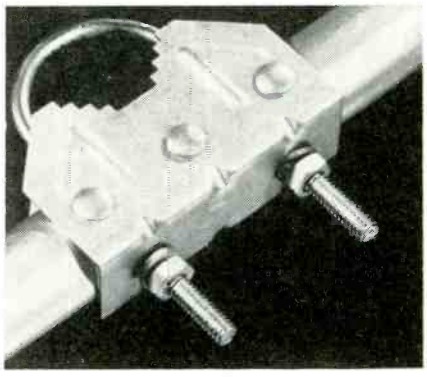


Weller SOLDERING GUN →

A new soldering gun, with dual heat feature comes in kit form and sells for $7.95 (Model 8200K). High and low heat, 90 and 125 watts, are obtained instantly. A prefocussed spotlight illuminates the work. A new high-efficiency tip utilizes copper for superior heat transfer and iron-plating for durability. Guaranteed for one year. Replacement tips, quickly interchangeable, cost 35¢ a pair. Weller Electric Corp., 601 Stone's Crossing Road, Easton, Pa. (ELECTRONIC TECHNICIAN 4-23)

Winegard MAST CLAMP →

Now standard equipment on all of the company's TV and FM antennas is a new "wrap-around" mast clamp. There are two reported major advantages. First, the installer cannot crush the antenna boom no matter how much he tightens the mast clamp. Secondly, the clamp automatically aligns the antenna on the mast, making a straight installation. The clamp is riveted to each antenna boom at the factory. It has ten embossings which make it strong enough to hold even the largest antennas. Winegard Co., 300 Scotten Blvd., Burlington, Iowa. (ELECTRONIC TECHNICIAN 4-24)

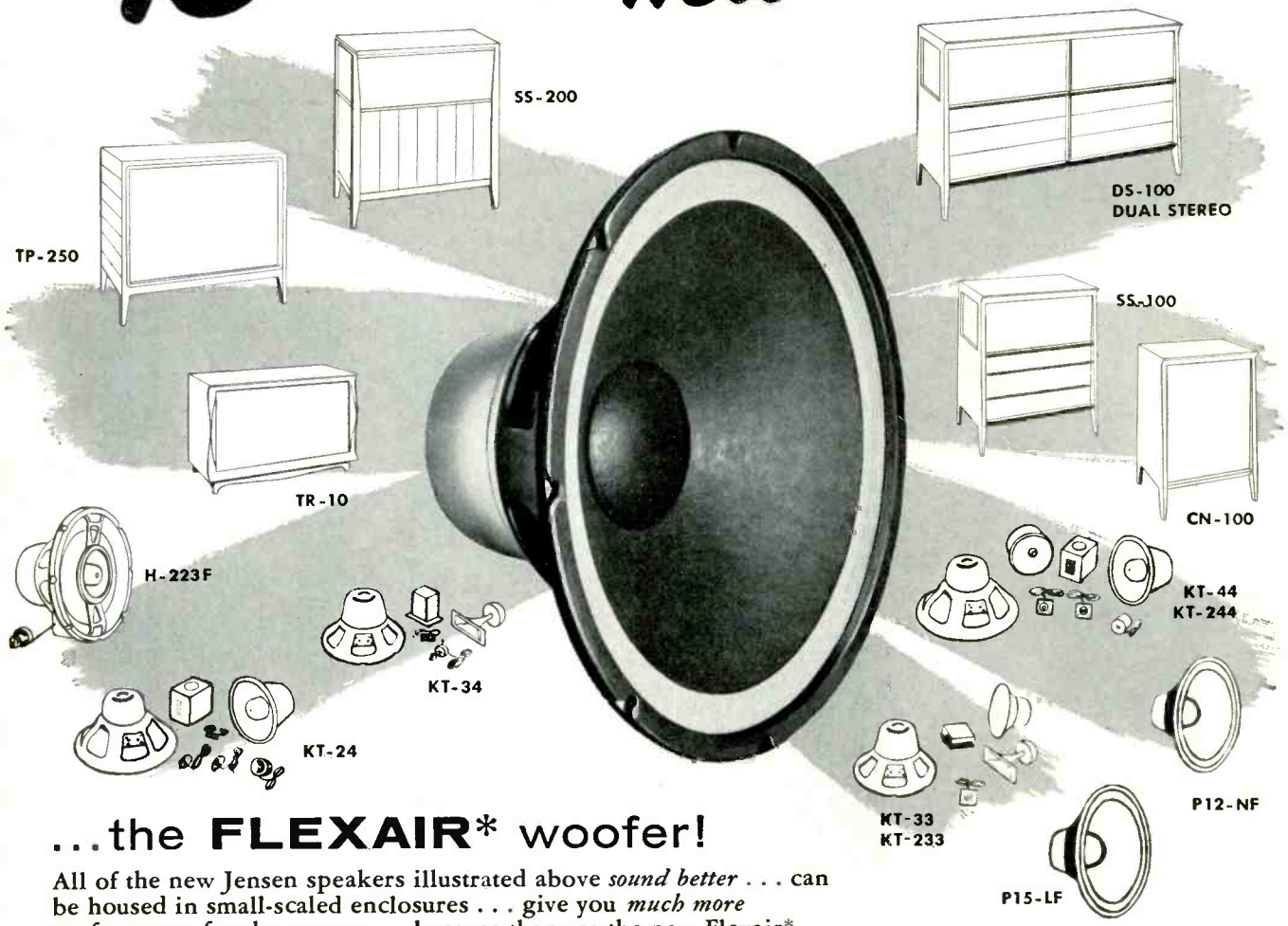


INDEX TO ADVERTISERS

April, 1959

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

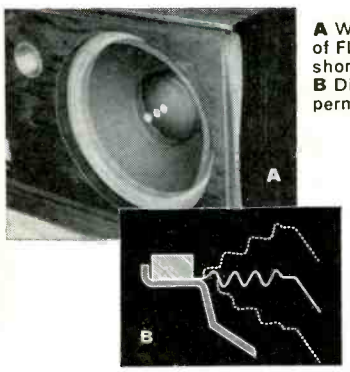
all 15 of these Jensen hi-fi speakers contain a *new* idea...



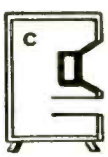
...the **FLEXAIR*** woofer!

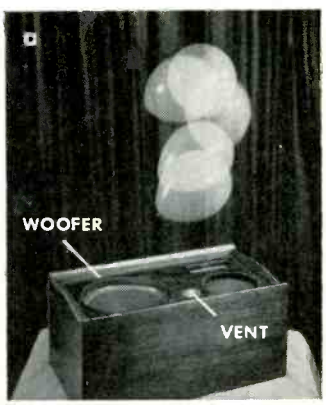
All of the new Jensen speakers illustrated above *sound better* . . . can be housed in small-scaled enclosures . . . give you *much more* performance for the money . . . because they use the new Flexair* woofer developed and perfected by Jensen.

Relative freedom of cone movement is not new but this is only part of the story. When used in a Bass-Superflex* tube vented enclosure, the Flexair woofer for the first time gives you *ALL* these important performance features for vastly superior, utterly authentic bass response: (1) Extremely long cone travel; (2) very high compliance throughout total travel; (3) very low resonance; (4) extremely low distortion; (5) high efficiency (will drive with a 10-watt amplifier). If you'd like to know more about this exclusive Jensen development, write for free Brochure KF.

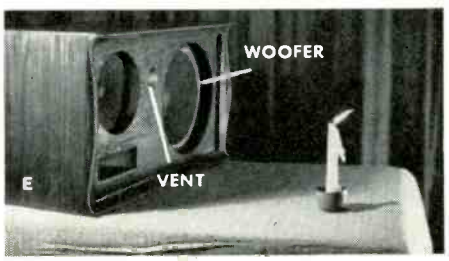


A White dot shows forward, central and inward positions of Flexair woofer cone during 1" movement. (Perspective shortens apparent distance between dots for inward travel). **B** Diagram shows extreme accordion action of annulus permitting linear extra-long cone travel.





C shows the scientifically proportioned tube vent used in the Bass-Superflex enclosure for extended bass and very low distortion with the Flexair woofer. Except for vent, enclosure is air-tight. Vent action during large motions of woofer cone is dramatically illustrated in the two unretouched photos at the right. Jensen TR-10 TRi-ette* (with grille cloth removed) was used in the experiments. In **D**, air filled balloon is kept in suspension by air flow from vent. Successive high speed exposures show rise of balloon when signal is turned on. In **E** a candle flame is deflected by air motion from tube vent with same low frequency signal.



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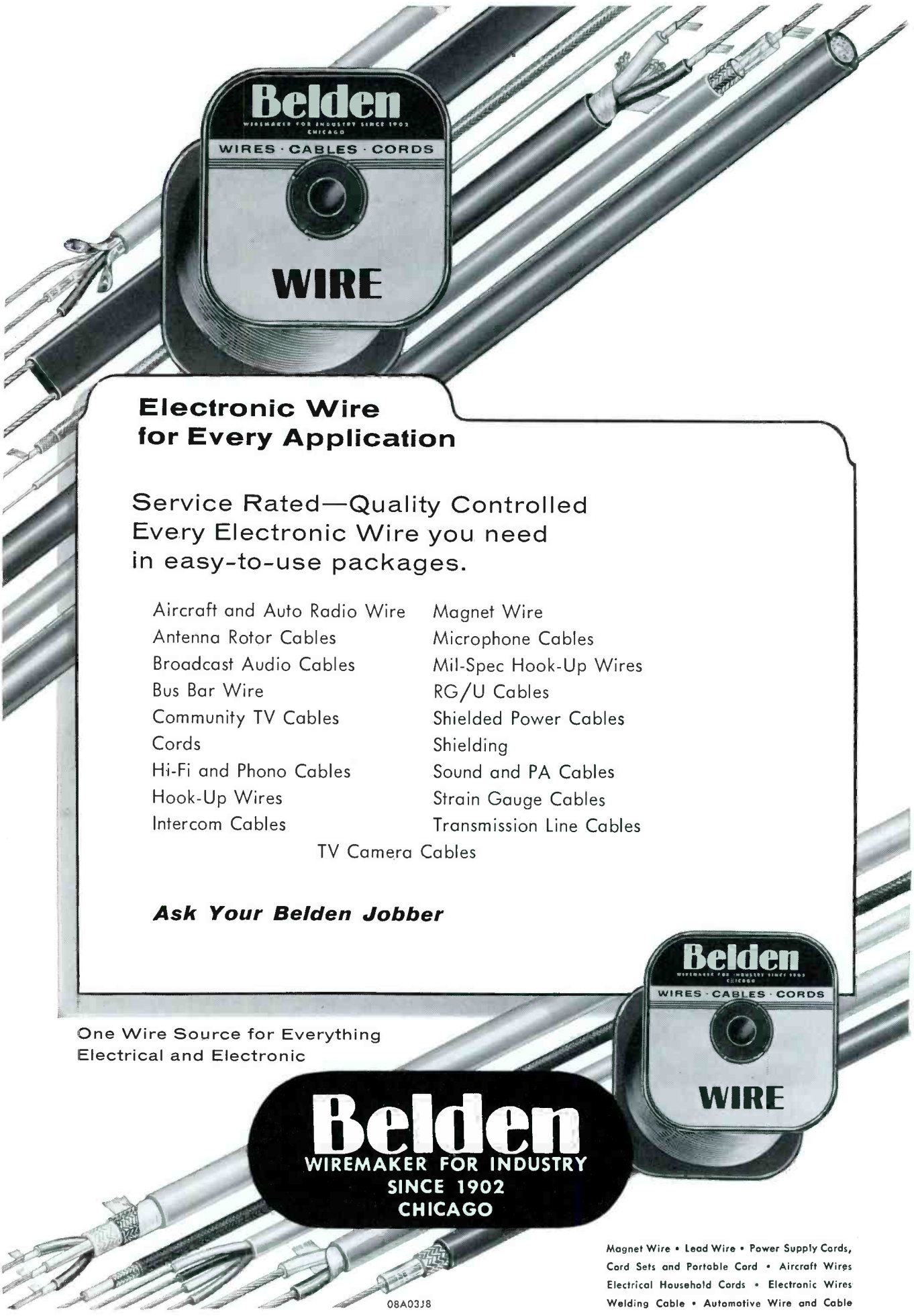
*T. M. J. M. Co.



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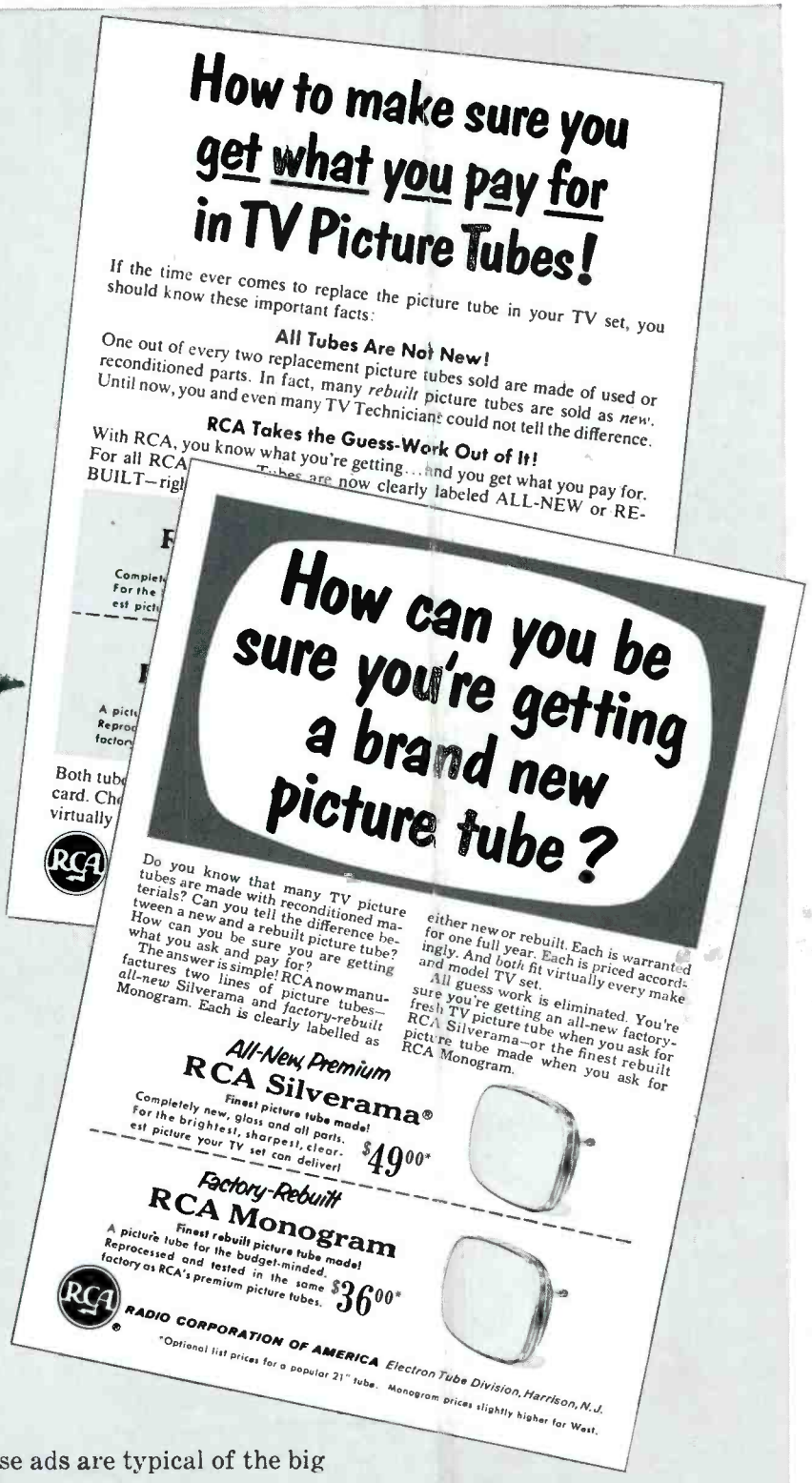

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If the time ever comes to replace the picture tube in your TV set, you should know these important facts:

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One out of every two replacement picture tubes sold are made of used or reconditioned parts. In fact, many *rebuilt* picture tubes are sold as *new*. Until now, you and even many TV Technicians could not tell the difference.

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Both tub... card. Ch... virtually ...

How can you be sure you're getting a brand new picture tube?

Do you know that many TV picture tubes are made with reconditioned materials? Can you tell the difference between a new and a rebuilt picture tube? How can you be sure you are getting what you ask and pay for?

The answer is simple! RCA now manufactures two lines of picture tubes—*all-new* Silverama and *factory-rebuilt* Monogram. Each is clearly labelled as either new or rebuilt. Each is warranted for one full year. Each is priced accordingly. And *both* fit virtually every make and model TV set.

All guess work is eliminated. You're sure you're getting an all-new factory-fresh TV picture tube when you ask for RCA Silverama—or the finest rebuilt picture tube made when you ask for RCA Monogram.

All-New, Premium

RCA Silverama®

Finest picture tube made!

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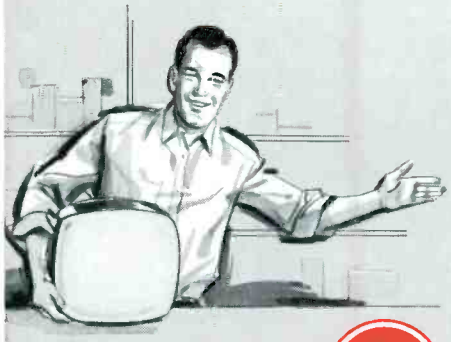
RADIO CORPORATION OF AMERICA Electron Tube Division, Harrison, N.J.

*Optional list prices for a popular 21" tube. Monogram prices slightly higher for West.



These ads are typical of the big advertising program for RCA SILVERAMA and RCA MONOGRAM Picture Tubes. You'll see these messages in TV GUIDE, LIFE, and the SATURDAY EVENING POST... on such leading TV shows as Steve Allen, Dave Garroway's Today, and Jack Paar.

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