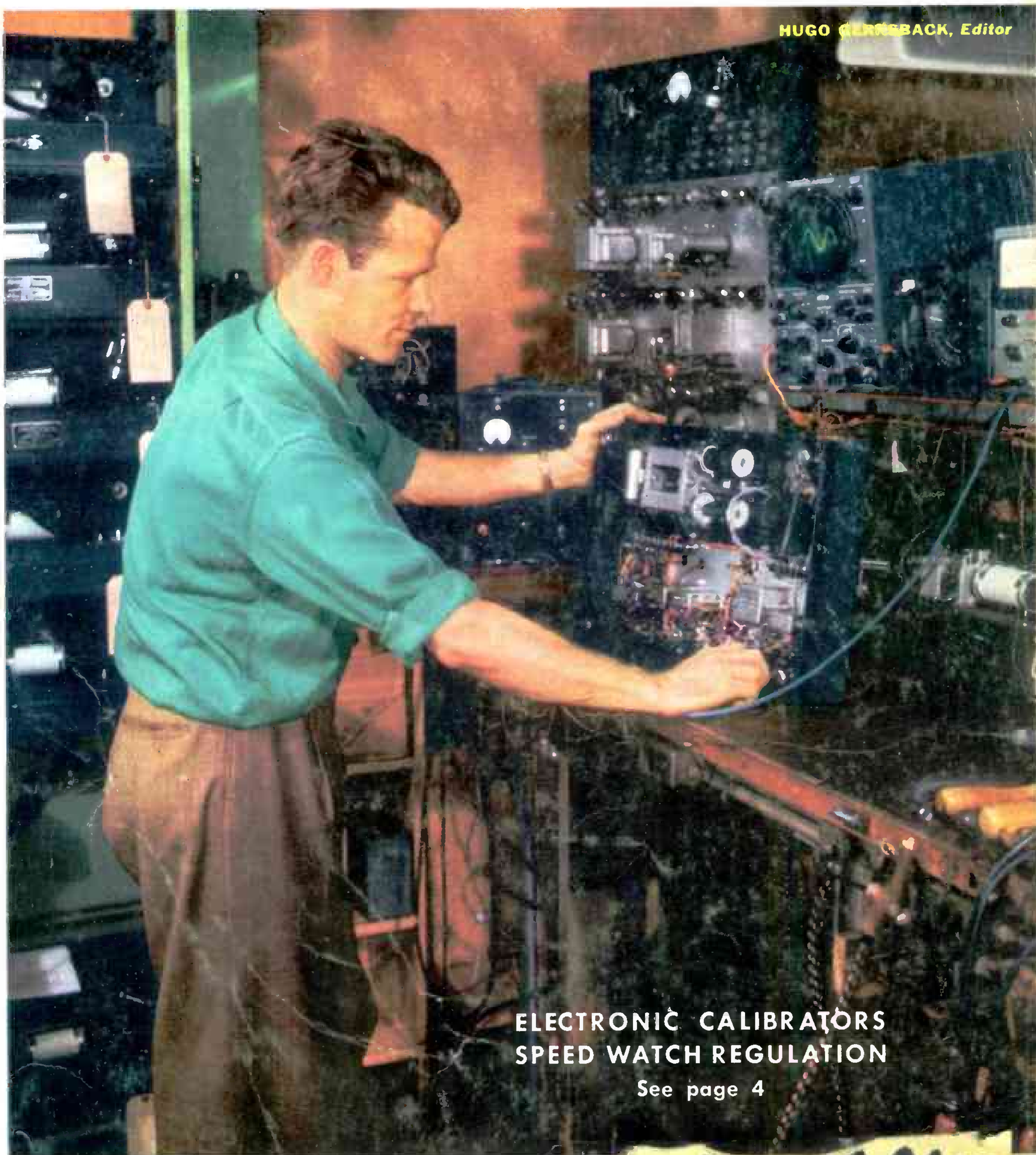
AUGUST 1953

RADIO-ELECTRONICS

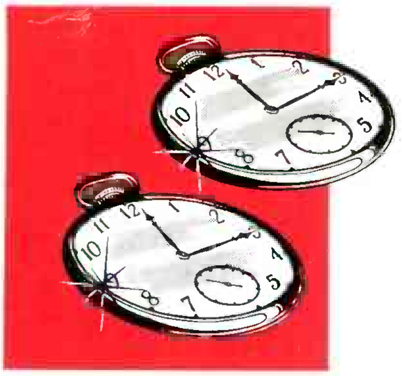
LATEST IN TELEVISION • SERVICING • AUDIO

30¢



30¢
U. S. and
CANADA

In this issue: **Scintillation Counter**
Loudness Contro



Watches may look alike in shape and size

The big difference in time-keeping performance depends on the "works" inside the watch.

It's what's inside that counts...

– in Radio Batteries too

The cells in RCA's new Alkaline "B" Battery, VS216, resemble two shallow soda bottle caps. Sandwiched between the two "bottle caps" are the elements shown in the sketch above. One cap serves as the positive terminal; the other, the negative.

It's what's inside a radio battery that makes the big difference in long-lasting performance, too. Take RCA's new Alkaline "B" Battery (VS216) for instance.

The Alkaline principle of operation makes possible more efficient utilization of the cell's active materials. Result: it is practical to reduce the size of both cell and battery.

The "crown-type" cell of RCA's new Radio "B" Battery is a compact, self-contained unit which delivers more useful energy per unit of volume than do conventional types of cells. Result: the RCA VS216 is 22 per cent smaller than conventional "B" Batteries formerly used in personal portables—YET it plays a new-design personal portable TWICE AS LONG as conventional 67½-volt types.

It's smart to sell RCA Radio Batteries—they're *radio engineered* for extra listening hours. RCA Radio Batteries are sold principally through Radio Dealers and Service Men.

Call your RCA Radio Battery Distributor and cash in on the big radio battery replacement market.

RADIO CORPORATION of AMERICA

RADIO BATTERIES — **HARRISON, N. J.**

I WILL TRAIN YOU AT HOME FOR GOOD PAY JOBS IN RADIO-TELEVISION

J. E. SMITH has trained more men for Radio-Television than any other man.

America's Fast Growing Industry Offers You

2 FREE BOOKS SHOW HOW — MAIL COUPON

I TRAINED THESE MEN

LOST JOB, NOW HAS OWN SHOP
"Got laid off my machine shop job which I believe was best thing ever happened as I opened a full time Radio Shop. Business is picking up every week."—E. T. Slate, Corsicana, Texas.

GOOD JOB WITH STATION

"I am Broadcast Engineer at WLPM. Another technician and I have opened a Radio-TV service shop in our spare time. Big TV sales here . . . more work than we can handle."—J. H. Bangley, Suffolk, Va.

$10 TO $15 WEEK SPARE TIME

"Four months after enrolling for NRI course, was able to service Radios . . . averaged $10 to $15 a week spare time. Now have full time Radio and Television business."—William Weyde, Brooklyn, New York.

AVAILABLE TO VETERANS UNDER G.I. BILLS

WANT YOUR OWN BUSINESS?

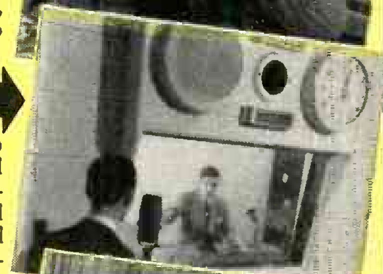
Let me show you how you can be your own boss. Many NRI trained men start their own business with capital earned in spare time. Robert Dohmen, New Prague, Minn., whose store is shown at left, says, "Am now tied in with two Television outfits and do warranty work for dealers. Often fall back to NRI textbooks for information."

1. EXTRA MONEY IN SPARE TIME

Many students make $5, $10 a week and more EXTRA fixing neighbors' Radios in spare time while learning. The day you enroll I start sending you SPECIAL BOOKLETS that show you how. Tester you build with kits I send helps you make extra money servicing sets, gives practical experience on circuits common to Radio and Television. All equipment is yours to keep.

2. GOOD PAY JOB

NRI Courses lead to these and many other jobs: Radio and TV service, P.A., Auto Radio, Lab, Factory, and Electronic Controls Technicians, Radio and TV Broadcasting, Police, Ship and Airways Operators and Technicians. Opportunities are increasing. The United States has over 105 million Radios—over 2,900 Broadcasting Stations—more expansion is on the way.



3. BRIGHT FUTURE

Think of the opportunities in Television. Over 15,000,000 TV sets are now in use; 108 TV stations are operating and 1800 new TV stations have been authorized . . . many of them expected to be in operation in 1953. This means more jobs—good pay jobs with bright futures. More operators, installation service technicians will be needed. Now is the time to get ready for a successful future in TV! Find out what Radio and TV offer you.

You Learn Servicing or Communications by Practicing With Kits I Send

This Is Just Some of the Equipment My Students Build. All Parts Yours to Keep.

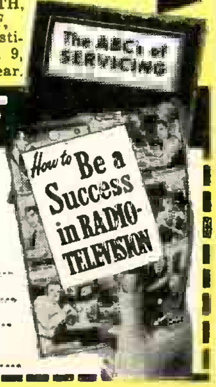
Keep your job while training at home. Hundreds I've trained are successful RADIO-TELEVISION Technicians. Most had no previous experience; many no more than grammar school education. Learn Radio-Television principles from illustrated lessons. You also get PRACTICAL EXPERIENCE. Pictured at left are just a few of the pieces of equipment you build with kits of parts I send. You experiment with, learn circuits common to Radio and Television.

Mail Coupon—find out what RADIO-TELEVISION Can Do for You

Act Now! Send for my FREE DOUBLE OFFER. Coupon entitles you to actual Servicing Lesson; shows how you learn at home. You'll also receive my 64-page book, "How to Be a Success in Radio-Television." Send coupon in envelope or paste on postal. J. E. SMITH, Pres., Dept. 3HF, National Radio Institute, Washington 9, D. C. Our 39th Year.

Television Is Today's Good Job Maker

TV now reaches from coast-to-coast. Qualify for a good job as a service technician or operator. My course includes ...ty lessons on TV. You get ...ical experience . . . work ...nits common to both ...d Television with my ...ow is the time to get ...for success in Television!



Good for Both-FREE

MR. J. E. SMITH, President, Dept. 3HF,
National Radio Institute, Washington 9, D. C.
Mail me Sample Lesson and 64-page Book, FREE. (No salesman will call. Please write plainly.)

Name.................................... Age..............
Address..
City..................... Zone......... State..........

VETS write in date of discharge ....

RADIO-ELECTRONICS

Formerly RADIO-CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION*

ON THE COVER (See page 26)
Technician Ralph Steen of American Time Products, Inc., makes some adjustments on a Watch-Master.
Color original by Avery Slack

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AUGUST, 1953

MEMBER Audit Bureau of Circulations

Vol. XXIV, No. 8

RADIO-ELECTRONICS, August 1953, Vol. XXIV, No. 8. Published monthly at Erie Ave., F to G Sts., Philadelphia 32, Pa., by Gernsback Publications, Inc. Entered as Second Class matter September 27, 1948, at the Post Office at Philadelphia, Pa., under the Act of March 3, 1879.
SUBSCRIPTION RATES: In U. S. and Canada, in U. S. possessions, Mexico, South and Central American countries, $3.50 for one year; $6.00 for two years; $8.00 for three years; single copies 30¢ All other foreign countries $4.50 a year, $8.00 for two years; $11.00 for three years.
EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 25 West Broadway, New York 7, N. Y. Telephone REctor 2-8630. Gernsback Publications, Inc. Hugo Gernsb[illegible] President; M. Harvey Gernsback, Vice-President; G. Aliquo, Secretary.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., Erie Avenue, F to G Sts., Philadelphia 32, Pa., or 25 West Broadway, New York 7, When ordering a change please furnish an address stencil impression from a recent wrapper. Allow one month for change of address.
BRANCH ADVERTISING OFFICES: Chicago: 100 E. Ohio St., Tel. SUperior 7-1796. **Los Angeles**: Ralph W. Harker, 1127 Wilshire Blvd., Tel. MAdison 6-1271. San F[illegible] Ralph W. Harker, 582 Market St., Tel. GArfield 1-2481. **FOREIGN AGENTS**: **Great Britain**: Atlas Publishing and Distributing Co., Ltd., London E.C.4. **Australia**: [illegible] Agency, Melbourne. **France**: Brentano's, Paris 2e. **Belgium**: Agence et Messageries de la Presse, Brussels. **Holland**: Trilectron, Heemstede. **Greece**: International Boo[illegible] Agency, Athens. **So Africa**: Central News Agency, Ltd., Johannesburg; Capetown: Durban, Natal. Universal Book Agency, Johannesburg. **Middle East**: Steimatzky Mi[illegible] Agency, Jerusalem. **India**: Broadway News Centre, Dadar, Bombay #14. **Pakistan**: Paradise Book Stall, Karachi 3. **POSTMASTER**: If undeliverable send form 3578 to: RADIO-ELECTRONICS, 25 West Broadway, [illegible] York 7, N. Y. *Trademark registered U.S. Patent Office.

ANOTHER D.T.I. EXCLUSIVE!

REAL OPPORTUNITY FOR YOU!

Easy-to-learn-from home MOVIES help speed you toward a PROFITABLE, BRIGHT FUTURE IN

TELEVISION

RADIO • ELECTRONICS

You use this 16 mm. Movie Projector and Films at HOME

Thanks to this exclusive D.T.I. home training aid, many important Television-Radio fundamentals quickly become "movie clear." Now you can actually see electrons on the march and other "hidden actions"—a wonderful advantage that's almost like having a teacher in your home.

RIGHT: At Home You Build and Keep this 5-INCH Oscilloscope

... one of the most useful test units in the TV-Electronic field, and almost a "must" for servicing TV sets. No need to buy a costly "scope" when you graduate. This quality, commercial-type unit will serve you for years to come.

LEFT: At Home You Build and Keep A Jewel-Bearing Multi-Meter

... an extremely handy meter. Together with the Oscilloscope, it can also help you "earn while you learn"—servicing in your spare time.

Act now!

MAIL THIS COUPON TODAY.
GET THIS EXCITING PUBLICATION.

89 WAYS TO EARN MONEY IN TELEVISION RADIO-ELECTRONICS

DeFOREST'S TRAINING, INC.,
2533 N. ASHLAND AVENUE,
CHICAGO 14, ILLINOIS

RE-8-J

I would like your Opportunity Bulletin showing "89 Ways To Earn Money In Television-Radio-Electronics"; also, complete facts about the training opportunities made possible by your organization.

Name____________________ Age_____

Address____________________ Apt._____

City__________ Zone____ State______

This great, billion dollar opportunity field now offers you a chance of a lifetime to get started toward a real job or your own profitable business. With the TV station limit now raised from over 100 to 2053, Television in the next several years will be headed for almost every community. Mail coupon today. See how you may prepare to cash in on one of the most active fields of our time.

GET STARTED this Wonderfully Practical Way

You don't have to know the first thing about Television-Radio-Electronics at present. D.T.I. supplies you at home with (a) *the knowledge,* (b) *practical experience* and (c) *employment service*—EVERYTHING YOU NEED to help you get started in Television-Radio-Electronics.

FIRST: You receive well-illustrated lessons.

SECOND: You use visual training movies—a great aid to helping you understand important basic points FASTER . . . EASIER . . . BETTER. D.T.I., alone, brings you this wonderful visual training method at home—the same type the armed forces, colleges and industrial organizations are using with such remarkable results.

THIRD: You get many shipments of parts for setting up your own Home Laboratory—working over 300 construction and test procedures for the practical experience you need. This includes building and keeping a 5-inch commercial-type Oscilloscope, a jewel-bearing Multi-Meter, and a big 21-INCH TV Set. D.T.I. also offers another home training, but without the TV Set.

FOURTH: Upon completing your training, you can then get the fine help of D.T.I.'s effective Employment Service—which has nation-wide contacts with many employers of trained Television-Radio-Electronic men.

If preferred, you can get all your training in D.T.I.'s thoroughly equipped electronic training laboratories in Chicago. Get the complete story. We believe what we have for you will really surprise you. MAIL THE COUPON TODAY.

"ONE OF AMERICA'S FOREMOST TELEVISION TRAINING CENTERS"

—Established 1931—

MILITARY SERVICE

If subject to military service, the training information we have for you should prove very helpful.

DeFOREST'S TRAINING, INC.

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DeVRY *Technical* INSTITUTE

CHICAGO 14, ILLINOIS

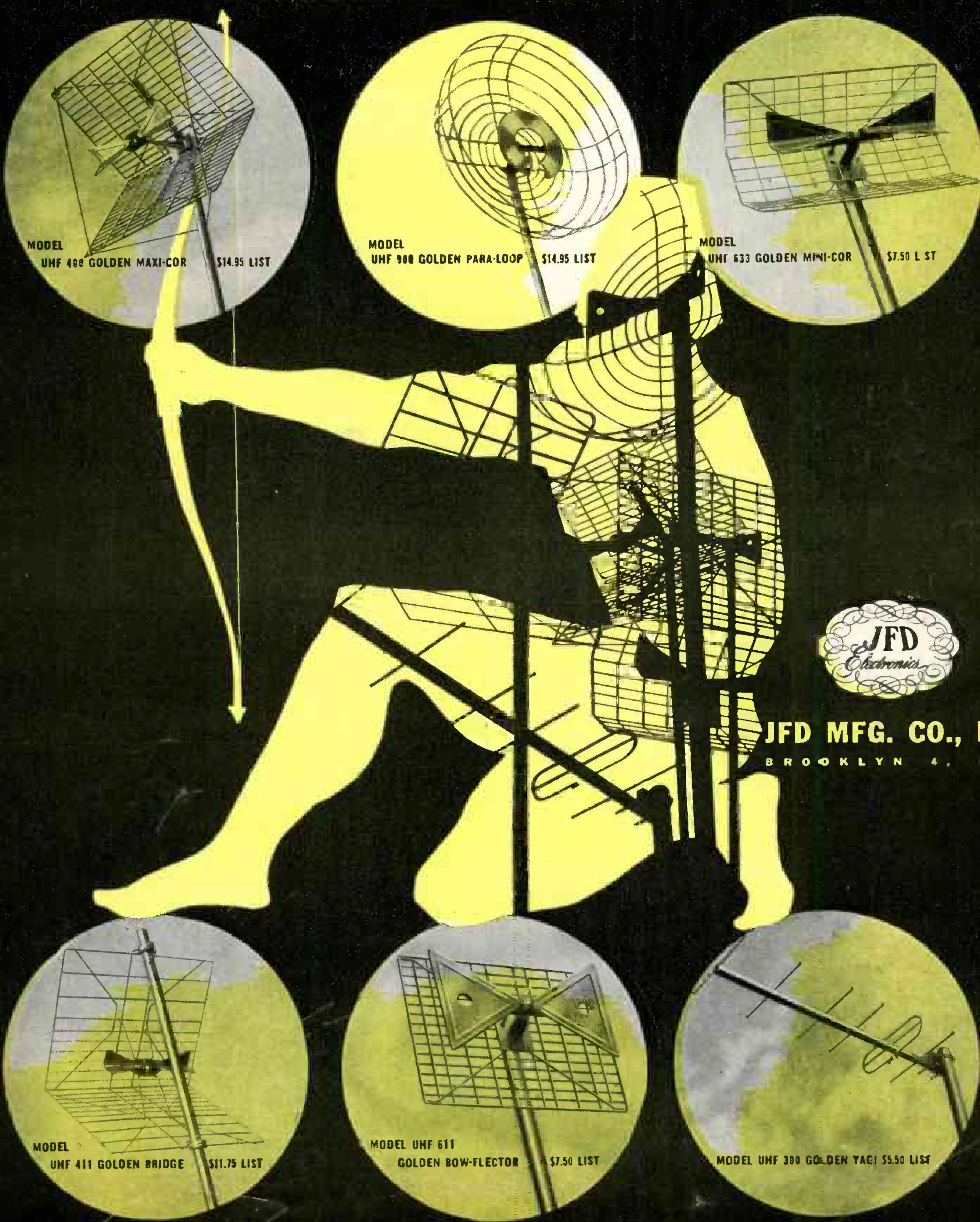

for Heavy Duty Applications
The most
Powerful
TV ROTOR
on the market
TR-2
Power When and Where You Need It . . . To Turn ANY TV Antenna Array Under All Weather Conditions—
Complete rotor with "COMPASS CONTROL" cabinet having illuminated "perfect pattern" dial (uses 8 wire cable) $49.95
RADIART
THE RADIART CORPORATION
CLEVELAND 13, OHIO
CORNELL-DUBILIER
SOUTH PLAINFIELD, NEW JERSEY

ANOTHER GREAT JFD FIRST

NEW JFD "GOLD SHIELD" UHF ANTENNAS ARE GUARANTEED AGAINST RUST FOR ONE FULL YEAR

Don't let antenna rust "eat away" your UHF profits with costly call backs. Only the spectacular new JFD "Gold Shield" UHF antennas are protected against rust and the serious damage rust causes to UHF pictures. JFD Bronzidite . . . the miracle anti-rust Army-Navy-Aeronautical "spec" plating . . . safeguards your antenna installation and your reputation. Every nut, screw, bolt, washer and bracket is "Bronzidite" plated. Depend on the new JFD "Gold Shield" UHF antennas . . . your guaranteed line to surer profits. See them at your Jobber or write for brochure #218.

BRONZIDITE



JFD Electronics

JFD MFG. CO., INC.
BROOKLYN 4, N.Y.

Burton browne advertising

WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS AND ACCESSORIES

NEW PRINTED-CIRCUIT manufacturing techniques, each with special features for simplifying mass production of precision components, have been announced by both RCA and Sylvania. The RCA process, now used in producing the company's new 44-mc i.f. transformers and traps, starts with a huge glass negative for photo-printing several hundred circuits simultaneously on a sensitized copper plate with a low-loss plastic back. After printing, an etching process removes the unexposed areas of the copper, leaving a sharply defined reproduction of the desired circuit. Flat coils and leads with line widths as small as .01 inch can be reproduced accurately.

RCA printed-circuit glass negative

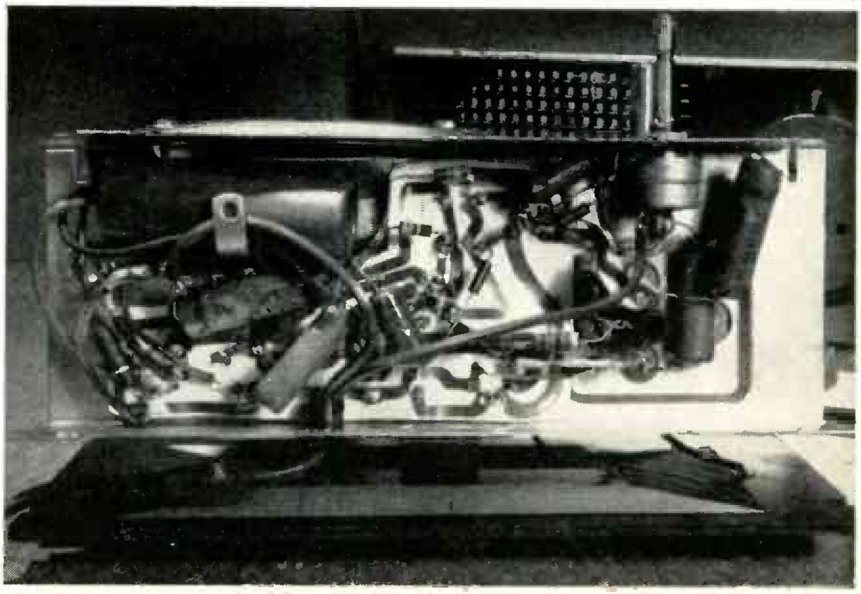
The Sylvania process makes it possible to apply printed circuits of extremely thin copper to flexible cloth surfaces, allowing considerable latitude in connecting the printed circuits to terminals of various sizes. A lacquer negative of the desired circuit is first pressed through a fine-mesh silk screen onto a stainless-steel plate. Then a plating process deposits copper only on the unlacquered areas of the steel. The copper plating is then stripped off the steel by pressing a large adhesive-coated cloth over the entire surface and giving it a quick, uniform, pull. Heat treatment or normal aging of the adhesive bonds the copper permanently to the cloth backing.

Any irregularities in the stainless-steel mother plate will be reproduced in the copper. This makes it possible to put permanent identifying marks and symbols on the printed circuit by etching or engraving them in the steel.

PURE "METALLIC" SILICON for use in transistors and other electronic devices will be produced by the Du Pont Company in a special new plant. Silicon has many of the semiconductor characteristics of germanium, and is one of the most plentiful of all elements—it is the basic element in sand and in many common rocks. However, the "metallic" form is extremely rare and difficult to produce in commercial quantities. It will be sold at $430 per pound.

A PRELIMINARY PILOT signal to help service technicians line up u.h.f. tuners and antennas several months before a new TV station goes on the air will be sent out for the first time in this country by WACH-TV in Newport News, Va. The FCC has authorized the new channel-33 u.h.f. station to transmit a 60-watt tone-modulated signal on its sound carrier frequency. This can be heard on split-sound receivers, and should produce sound bars on the picture-tube screen with only a slight adjustment of the fine-tuning control. An auxiliary signal generator will probably be needed to produce the 4.5-mc sound beat for intercarrier sets.

The chief advantage of the pilot signal will probably be in showing whether or not any reception at all is possible at a specific location, since it cannot predict the eventual strength of the actual picture signal, or possible ghosts from multipath transmission.



Sylvania flexible printed circuit forms basic wiring of this a.c.-d.c. radio.

NEW TV STATIONS on the air for the first time since the full listing on page 44 of last month's RADIO-ELECTRONICS include KCTY, Kansas City, Mo. (channel 25); WGBI-TV, Scranton, Pa. (22); WTPA, Harrisburg, Pa. (71); WCSC-TV, Charleston, S. C. (5); KSWS-TV, Roswell, N. M. (8); WROM-TV, Rome, Ga. (9).

In Canada, station CBOT, Ottawa (4), went on the air June 2, just in time to link Montreal and Toronto for the telecast of the Coronation.

A typographical error in last month's complete station list gave the call letters of WHIZ-TV, Zanesville, Ohio, as WH-12-TV.

A NEW V.H.F. TV CHANNEL in the 72-76-mc "blind-spot" has been proposed to the FCC by a Washington law firm representing unidentified broadcaster clients. The new plan would create "channel 4½" by moving the present special-service occupants out of the 4-mc gap between channels 4 and 5, and shifting channels 5 and 6 upward by 2 mc to 78-90 mc. This would displace a number of low-power non-commercial stations at the low end of the FM band, and, of course, would call for some modification to TV tuners.

Proponents of the "channel 4½" plan claim it would provide at least 24 major and medium-sized cities with needed additional v.h.f. outlets.

A CLOSED-CIRCUIT MEDICAL TV service in full color is planned by Smith, Kline & French Laboratories, subject to FCC approval. The service will run on a subscription basis and will pipe programs from hospital operating rooms, schools, and clinics direct to doctors' offices or homes. The possibilities of the SK&F system were demonstrated recently in New York, when a 6-foot picture of a delicate eye operation was produced with a CBS color projection unit.

EDDYING PUDDLES in the atmosphere are blamed by three Government scientists for poor fringe-area reception. Changes in the dielectric constant of the air produced by these eddies affect the transmission of the short wavelengths used for television, but have no apparent effect on longer waves.

COMMUNITY-TV SYSTEM operators and manufacturers held their second annual convention and technical meeting in New York City on June 8. The growing importance of this branch of the television industry was indicated by the large number of equipment exhibits, and by the fact that almost as much time was devoted to discussions of the legal and financial aspects of community TV as to electronics.

Milton J. Shapp, president of Jerrold Electronics Corporation, predicted that by 1960 between 10 and 15 million TV receivers in the U. S. alone will get their programs through community systems. The introduction of color TV will increase this number considerably, since even the slightest ghost can ruin color reception completely.

BAROMETER of the PARTS INDUSTRY

During June, 84 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. There was an increase in "change activity" as compared to May.

In price revisions by the number of manufacturers and products affected, the following summary illustrates the comparative trend for the months of May and June.

	No. of Manufacturers	
	May	June
Increased prices	24	36
Decreased prices	16	24

	No. of Products	
	May	June
Increased prices	368	1,112
Decreased prices	125	96

For a summary of the most active product categories, see the following tables:

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Access.	4	8**	5	8**	18	124**	7	121*
Capacitors	0	0**	0	0	1	4**	0	0**
Controls & Resistors	1	18*	0	0	0	0	0	0**
Sound & Audio	13	261*	8	33*	26	366*	19	192*
Test Equipment	8	99*	6	13*	5	17**	3	5*
Transformers	1	518*	1	2*	1	17**	1	2**
Tubes	8	205*	4	40*	9	54*	7	28*
Wire & Cable	1	3	0	0**	5	37*	3	25*

* Increase over May
** Decrease from May

* Increase over May
** Decrease from May

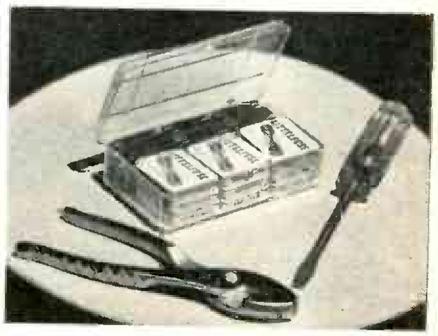
Comment: This month has seen the largest number of manufacturers reporting product changes in their lines since the introduction of the Barometer. Over the last-few months, as previously noted, Antenna, Sound and Audio, Test Equipment and Tube manufacturers have been the most active product groups.

This data is prepared by the staff of United Catalog Publishers, Inc., 110 Lafayette Street, New York, publishers of Radio's Master, the Official Buying Guide of the Parts Industry.

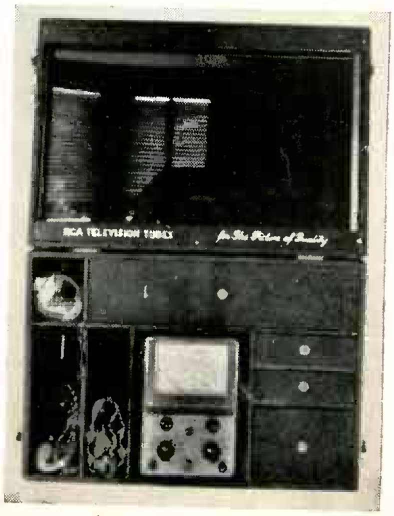
Merchandising and Promotion

RCA Tube Department, Harrison, N. J., is offering service technicians a chance to obtain a *Servi-chest,* a compact carrying case for parts, tools, and test equipment, complete with a large-size mirror. The offer is being made in connection with a sales promotion program on RCA tubes, from June 1 to August 31. The chest will be given to service technicians who buy 30 picture tubes or 750 receiving tubes during that period.

Littelfuse, Inc., Des Plaines, Ill., has revised and modernized its popular *One-Call Kit*. The new kit contains a compact selection of fuses which the company states will meet 95% of the service technician's fuse requirements. The company also released a revised edition of its TV Fuse Guide.



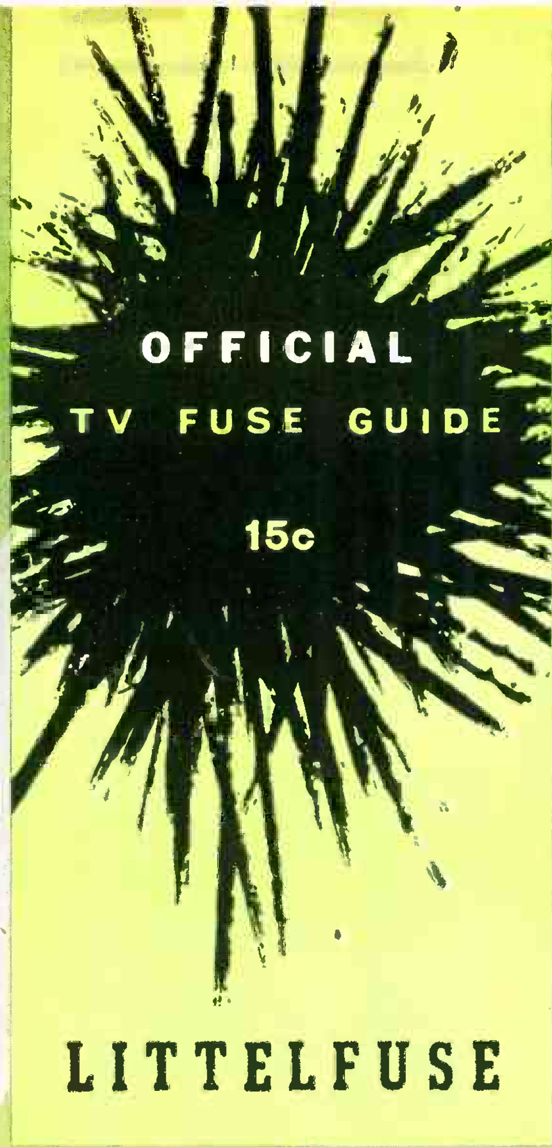
Littel fuse *One-Call Kit* assortment.



The new RCA *Servi-chest* bonus offer.

Raytheon Manufacturing Co., Receiving Tube Division, Newton, Mass., is sponsoring a $10,000 Transistor Application Contest, to be handled through its Special-Purpose Tube Distributors. The contest, directed to experimenters, engineers, and "gadgeteers," is designed to encourage development and experimentation in the field of transistor application. The contest runs from June 1 to August 31, 1953. First prize is $5,000.

Brach Manufacturing Co., Newark, N. J., a division of General Bronze Corp., introduced a new two- and four-set coupler display card as a point-of-sale display for distributors and service technicians.



Littelfuse 1953 TV Fuse Guide enlarged to include latest models

Both New—Both Needed

Littelfuse new One Call Kit adapted to include fuses being used in latest models—94 out of 100 times one call is all. Littelfuse Inc., Des Plaines, Ill.

Sprague Products Co., North Adams, Mass., is offering service technicians a large, colorful thermometer, through its distributors or directly from the company. The weather-sealed, aluminum-cased thermometer makes an effective display.

Simpson Electric Co., Chicago, released a flyer for distributor counter display and a direct-mail promotion on the Simpson model 262 volt-ohm-milliammeter, model 269 volt-ohm-microammeter, and model 1000 plate-conductance tube tester.

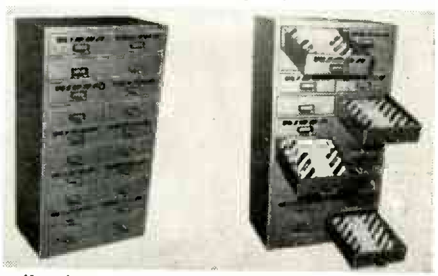
Westinghouse Electric Corp. will sponsor regular national telecasts of the National Professional Football League games next fall.

Channel Master Corp., Ellenville, N. Y., launched what it calls the largest, most comprehensive, local co-operative advertising program in the TV-antenna industry. Spearheading the campaign is a series of filmed TV spot commercials, each 90 seconds long. The

company believes this is the first time this medium has been used in TV-antenna advertising. Decals, window streamers, and counter displays round out the campaign.

All materials have been combined into a local advertising and promotion kit available through distributors.

John F. Rider Publisher, Inc., New York City, has made available to its distributors a steel cabinet for its *Tek-File* Packs. The company is also dis-



tributing a new collapsible steel-wire book rack for its paper-bound books. The rack is designed to fit on top of the new *Tek-File* cabinet.

Both are available to distributors on a special purchase offer.

New Plants and Expansions

Essex Wire of Detroit announced the consolidation of its Chicago Transformer Division in Chicago with Standard Transformer Corp., also in Chicago. The combined operation will be known as Chicago Standard Transformer Corp. (See People page 105 for executive appointments.) No changes in plant operations, personnel, or locations are contemplated.

Sylvania Electric Products announced plans for a new 416,000-square-foot TV set manufacturing plant in Batavia, N. Y., and a new TV picture-tube plant in Fullerton, Calif., to take care of the original and replacement requirements for TV picture tubes on the West Coast.

Raytheon Manufacturing Co., Waltham, Mass., is under way on a $1,750,000 modernization program on its South Lowell, Mass., plant. Electronic equipment for guided missiles is among the products which will be made there.

General Electric recently completed a three-story addition to its tube works in Buffalo, N. Y. The $100,000 addition will permit increased production of aluminized TV picture tubes.

CBS-Hytron, Danvers, Mass., purchased a new plant in Lowell, Mass., the first constructed under the city's industrial rehabilitation program. The new plant will be devoted to the manufacture of transistors and germanium diodes.

International Resistance Co., Philadelphia, opened a new sales office in Syracuse, N. Y., under the direction of James G. Perkins, Jr., general manager, Richard Johnson, assistant manager, and Anne Florek, customer service correspondent. All three have been with IRC for a number of years.

Allen B. Du Mont Technical Advertising Department moved to expanded quarters at 760 Bloomfield Ave., Clifton, N. J.

Walter L. Schott Co., Los Angeles, Calif., moved its Chicago warehouse facilities to larger quarters at 315 West Walton Place. Jack O'Donnell, present Chicago manager, is in charge of the new larger quarters and increased personnel.

PCA Electronics Inc., Santa Monica, Calif., has expanded its activities into the field of commercial and military types of transformers and toroids, through the acquisition of additional personnel, equipment, and facilities.

Electronic Coil Co., Burbank, Calif., was formed for the manufacture of r.f. coils. Henry J. Davis, president of Davis Electronics, is president of the new company, and E. K. Setzer, formerly with Standard Coil Products, is vice-president.

Radion Corp., Chicago antenna manufacturer, has branched out into the test equipment field with a new battery-operated u.h.f.-v.h.f. field strength meter. Several other new test equipment items are in the planning stage, according to Daniel T. O'Connell, vice-president and sales manager.

Hoffman Radio Corp., Los Angeles, expects to begin operations this month in a new $1,000,000 factory in Kansas City, Mo. The new plant will manufacture TV sets for the Eastern and Midwestern markets.

Pentron Corp., Chicago, leased quarters at 664 North Michigan Ave., to house its sales and display facilities. Manufacturing, engineering, and general offices remain at 221 East Cullerton St.

International Rectifier Corp. moved its New York offices to 501 Madison Ave.

START ON THE ROAD TO SUCCESS

Study the RCA TV Servicing Course in your spare time

ARE YOU SATISFIED with the position you now hold? Do you feel you're worth more money? Are you pleased with yourself, your work, your associates . . . and your future? What does the next year hold for you . . . and the year after that?

Are you content merely to plod along through the best years of your life . . . or do you want to get into more pleasant work . . . hold a well-paid job . . . perhaps establish your own business?

If you are looking for a REAL opportunity . . . If you want to GROW with a GROWING INDUSTRY . . . If you want to grasp the success that should be yours, *then we say to you, study TV Servicing.*

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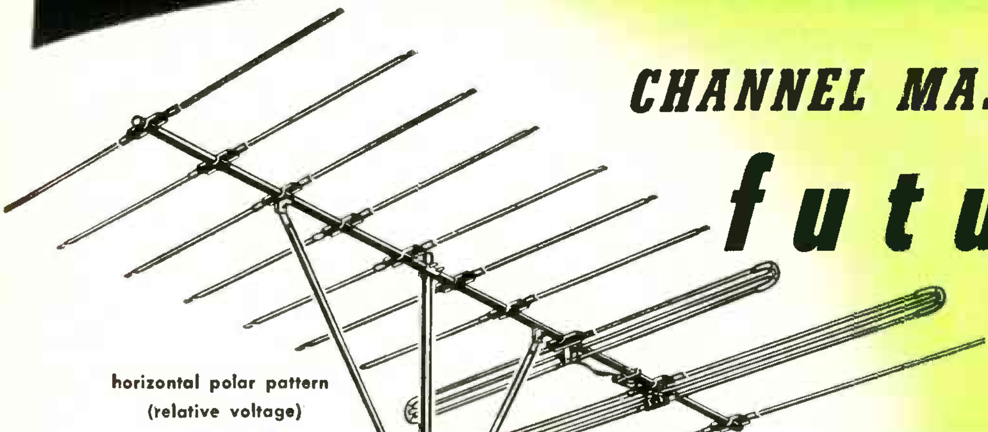
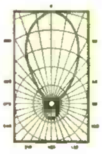
CHANNEL MASTER'S Newest futuramic



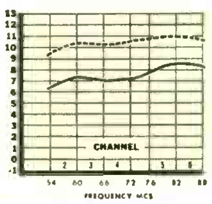
Completely covers every low band channel– 2 through 6

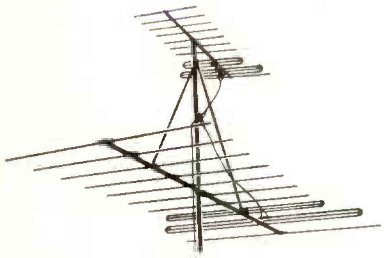
NOW the extraordinary high gain of a Yagi . . .
the razor-sharp directivity of a Yagi . . .
Not on just one channel — but clear across the entire Low Band!

horizontal polar pattern (relative voltage)



gain above tuned reference dipole





A high-low Futuramic combination is the most sensitive array ever designed for all-channel VHF reception. Just combine models 1173 and 1126.

Designed for service TODAY and TOMORROW in these 3 booming VHF markets:

Areas in which present VHF stations are changing channels (on the Low Band).
The Futuramic Yagi provides better reception than conventional Yagis on the present channels — and when the shift occurs this superior reception will continue on the new channel WITHOUT INTERRUPTION. And you can make your change-over installations NOW.

Areas in which a new VHF station is being added to the present one (on the Low Band).
The great number of single channel Yagis now in use will not bring in the new channel. If an additional Yagi is installed it will have to be tied into the present installation with separate leads and a switching system. However, one Futuramic will do the job of BOTH antennas — at lower cost — with better results on BOTH channels.

Areas served at present by two or more VHF stations on the Low Band.
You no longer have to compromise between conventional broad band antennas, and separate Yagis for each channel. The Futuramic gives you the full advantages of both. It combines highest gain and sharpest directivity with simple, economical installation.

Now — 6 great Futuramic models, designed for every reception area:

model no.	channels covered	list price
1173	7 — 13	$\$20^{83}$
1124	2, 3, and 4	
1125	2, 3, 4, and 5	
1136	3, 4, 5, and 6	$\$40^{97}$
1146	4, 5, and 6	
1126	2, 3, 4, 5, and 6	

CHANNEL MASTER engineering pays off on VHF!

FIRST IN PREASSEMBLED ANTENNAS

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MEMBER

RADIO BUSINESS

Webster-Chicago opened an Eastern Division office in Mount Vernon, N. Y., under the direction of C. S. Castle, a Webcor sales executive in Chicago for the past five years.

Visulite Co., New York City, has been formed to handle the sale of all radio hardware, r.f. probes, alignment tools, etc., made by Keystone Electronics, to the distributor trade.

Herman H. Smith, Inc., manufacturer of electronic components, is building a new plant in Brooklyn, N. Y.

E. F. Johnson Co., Waseca, Minn., purchased the inventory, tools, dies, and rights to manufacture the Signal line of telegraph instruments and keys made by the Signal Electric Manufacturing Co., Menominee, Mich.

Amplitronix, New York City, was organized as a new company for the development and manufacture of electronic equipment. Products include multiwaveform generators, projection oscilloscopes, electronic timers, and oscilloscope calibrators.

Business Briefs

. . . **Allen B. Du Mont Laboratories**, Teleset Service Department, Clifton, N. J., has instituted an accelerated service technician's training program in new TV areas with a follow-up in older markets to increase technical proficiency. Service clinics are being held in more than 40 new areas.

. . . **The Magnetic Recording Industry Association** was recently organized in Chicago by a group of executives of leading tape-recording manufacturers. Joseph F. Hards, vice-president of A-V Tape Libraries, was elected president pro-tem. An organizing committee was formed including R. J. Tinkham, Ampex Electric Corp.; R. S. Shoemaker, Dukane Corp.; Paul W. Jansen, Minnesota Mining and Manufacturing Co.; and J. L. Samuels of Webster Electric.

. . . **RCA Service Co.**, Camden, N. J., capped an intensive three-month campaign to achieve maximum efficiency and customer satisfaction in TV servicing, with the presentation of "President's Cup" awards to four of its TV service branches.

. . . **Radio-Electronics** will exhibit in Booth 905A at the 1953 Western Electronic Show and Convention in the San Francisco Civic Auditorium, August 19–21.

. . . **Sprague Products**, North Adams, Mass., was presented with a plaque by NATESA at its national convention in Kansas City, Mo. for outstanding business and service standards.

. . . **The Record Industry Association of America** presented Frank M. Folsom, president of RCA, with a gold record to commemorate the 50th Anniversary of RCA Victor's Red Seal classical recordings. Presentation was made by Milton R. Rackmil, president of the association and of Decca Records.

. . . NBC Research and Planning Department reported 23,256,000 TV sets installed in the United States as of April 1. This was the last of these reports to be published monthly. Future reports will be placed on a quarterly basis. END

NEW

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LOCKS OUT TROUBLE

ATTRACTIVE YELLOW MOLDED PLASTIC SHELL
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Can't be pulled out, even under soldering iron heat.

PATENT PENDING

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MOLDED PLASTIC PAPER

Capacitors

THE NEWEST ADDITION TO THE SM† LINE

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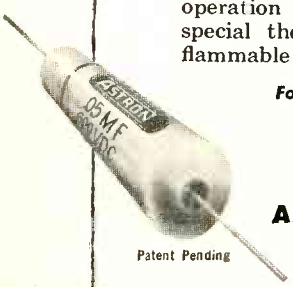
BLUE-POINT is suitable for continuous operation at 85°C. The bonded seal uses a special thermo-setting, heat-resistant, non-inflammable bonding agent—*positive* protection against moisture. Solder leads as close to the capacitor as you like—they *won't* pull out! Every BLUE-POINT is clearly marked with voltage and capacitance, bears outside foil identification. Every BLUE-POINT is *tested* and *guaranteed*. Look for the ASTRON BLUE-POINT when you buy capacitors from your jobber, or if he doesn't carry it, send us his name. Insist on ASTRON BLUE-POINT, the capacitor you *know* you can depend on. Order a supply today.

For complete performance characteristics, specifications and listings, write for Bulletin AB-20A



Patent Pending

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†Trade Mark Safety Margin capacitors for every radio, television and electronic use.

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A perfect small parts storage unit. Only 17" x 15" x 13". Has 48 transparent plastic jars.

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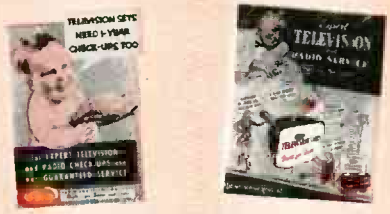
Double sided, formed plastic sign. 36" x 24" UL approved.

THREE DIMENSIONAL PLASTIC ILLUMINATED SIGN
A colorful "3-D" flasher illuminated formed plastic beauty.



DISPLAYS
Six color displays that sell your service.

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Two sided metal sign to catch the eye of passers-by.

TUBE AND TOOL CARRYING CASE
Holds 137 tubes — plus all regular tools.

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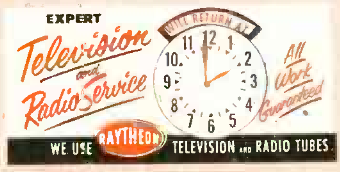
Pictured are only a few of the many useful shop aids and sales promotion items that Raytheon has made available to you. There are many others — job tags and record cards, imprinted stationery, post cards, ad mats, shipping labels, decals, paper bags, giant outdoor thermometers, etc. — all designed with your needs in mind. Many items are free, the rest available at very low cost. Ask your Raytheon Tube Distributor about them or write for free Booklet. Address your request to Department F, Raytheon Manufacturing Company, Receiving Tube Division, 55 Chapel Street, Newton 58, Mass.

TRANSPARENT PLASTIC WINDOW STREAMER



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Full length or jacket style.

ILLUMINATED TEST PATTERN CLOCK
A Telechron Motored beauty.

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Aptitude-tested Belden Intercommunications Cables are available for every type of installation and for every type of equipment. The permanence and trouble-free performance of Belden Inter-Com Cables assure you constant quality in your work. For more profitable installations, specify Belden Inter-Com Cable.

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Stranding	Solid	Solid	7x30	7x30	7x30
Nom. Diam (inches)	.145	.265	.310	.210	.220
No. Pairs	1	6	6	Not Paired	Not Paired
Insulation Thickness (inches)		.010	.010	.010	.010
Tinned Copper Shielding	None	None	None	Over 1 conductor	Over 3 conductors
	8740	8743	8747	8734	8735

GENERAL PURPOSE PLASTIC INSULATED CABLES.
Flexible, lightweight, and small diameter. Applications include control, annunciator, and communication circuits.

A.W.G. and No. Condrs.	22-4	22-3	22-5	22-7 18-2
Stranding	7x30	7x30	7x30	7x30 16x30
Nom. Diam (inches)	.168x.276	.140	.170	.245
No. Pairs	2			
Insulation Thickness (inches)	.015	.010	.010	.010 .018
Tinned Copper Shielding	Over 1 pair			
	8732	8443	8445	8449

Belden Radio WIRE

The *Aptitude-Tested* LINE


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KIT $19.95 WIRED $28.95
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LABORATORY PRECISION AT LOWEST COST
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● V Ampl: Resp. 10 cps – 1 mc ± 2 db; Sens. 10 mv rms/in. ● H Ampl: Resp. 10 cps – 200 kc flat, –4 db at 500 kc; Sens. 0.3 volts rms/in. ● V Input: 3-step freq.-compensated attenuator plus cathode follower; 3 meg Z. ● H Input: Cathode follower; 1 meg Z. ● Both V & H Ampls: push-pull output. ● Sweep Range: 15 cps – 100 kc. ● Sync: + INT., – INT., EXT., & 60 cps. ● Distortionless V & H Trace Expansion & Centering to 1.5 X full screen. ● Features: Return trace blanking; int. volt. calibrator; phasing control; direct connection to V plates of CRT. ● At Front Panel: sawtooth, 60 cps outputs; intensity mod. & ext. sync inputs. ● 10 tubes (6 dual-purpose) & 7JP1 CRT.
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RADAR HAZARDS

. . . New Operational Hazard of Microwaves . . .

By HUGO GERNSBACK

WHEN high powered radio transmitters became common in the 20s, it was noted that radio engineers and others in the vicinity of powerful, very shortwave transmitters developed artificial fever. This heat effect was not considered dangerous then, and indeed, the medical profession soon learned to use these waves under the name of shortwave diathermy. It is still being used today by the medical profession.

The postwar development of microwaves, particularly for radar, has brought about entirely new problems.

It appears that with greater powers soon to be in use, operational risks to personnel in the vicinity of microwave transmitters may become a cause for concern.

Recently, Sidney I. Brody, Commander (MC) U.S. Navy, gave a talk on the subject before the Aero Medical Association, in Los Angeles, California. Commander Brody stated that in the past, power output of airborne radar equipment has been moderate. It did not present any particular hazard to those exposed to the radiations. Guinea pigs exposed for eight weeks to a daily three-hour radiation of a radar set with a peak pulsed power output of 45,000 watts did not show any biological effects, even though such power was then considered very high.

The average power of a 45-kw radar transmitter used in the above experiments was in the order of 80-120 watts.

Present day radar beams represent peak pulsed power of a million watts or over, as compared to the 45,000 watts of a decade ago.

Commander Brody observed that the two frequency spectra, the "S" or 10-centimeter and the "X" or 3-centimeter bands, are now in current use. He stated that the effect on living organisms of the various frequencies of electromagnetic waves in these bands are thought to be essentially thermal in nature. It is not known so far whether there might be other than heat effects when living organisms are exposed to these radiations.

It has been noted that the 3-centimeter radiations used today in radar equipment can produce high thermal effects. The energy seems to be absorbed *near the surface of the skin.* When the power output becomes sufficiently high or if there has been long exposure to the radiation, the subject receives ample warning due to the high heat generated on the body. It is therefore thought that the 3-centimeter radiations do not seem to constitute a hazard for the exposed personnel. However, on frequencies in the vicinity of 10-centimeters, the conditions change because the high temperatures in this case occur about 1 centimeter *below* the surface in organs not cooled by the blood stream. Since the skin is not stimulated by this heat the subject does not perceive heat nor pain—he no longer has any warning. Therefore, the 10-centimeter radiations become dangerous.

Commander Brody observed that areas of the body possessing a poor blood supply have no effective temperature regulating mechanisms, as in the lens of the eye, the hollow organs, the gall bladder, the urinary bladder and parts of the gastrointestinal tract. These are potential danger points for the 10-centimeter radiations.

Rabbits exposed to constant power in a 3,000-watt field for 75 seconds were killed, while a 30-second exposure produced death in 2 minutes. Instant death to a rat resulted after only 22 seconds irradiation at that power, and 10 seconds of a 4,000-watt constant power output killed a hamster soon after exposure. In these animal experiments, high increases in body temperature produced heat paralysis of the respiratory centers.

One of the most important hazards, particularly for humans, is the production of cataracts following exposure to high power microwave radiations. This has been confirmed in many animal experiments with rabbits.

A spectacular illustration of the power output of radar equipment was conducted by Lockheed Aircraft Corporation. Dry steel wool in the radar beam was ignited at a distance of 100 feet. At 70 feet an explosion was produced by aluminum chips in a gasoline vapor-air mixture. Photoflash bulbs were fired at a distance of 323 feet. At 330 feet audible and visible sparking was apparent when metallic chips were shaken in a paper bag. With high power radar, these and other spectacular effects can be duplicated at even greater distances.

Commander Brody warned that individuals who have metal bone implants or metal plates covering a cranial defect may suffer dangerous burns when under high power radiations. Excessive heat may possibly be produced in metals carried by the individual working near these rays.

A very ingenious and simple safeguard has been proposed recently for radar maintenance personnel. Because neon gas tubes light up brilliantly in the presence of microwave radiations, they can be readily placed on the under surface of the men's cap visors. Now when the small neon tube flashes on an immediate and effective warning of dangerous exposure is given.

COVER FEATURE

Modern Watch-Rate Recorders

By HENRY O. MAXWELL

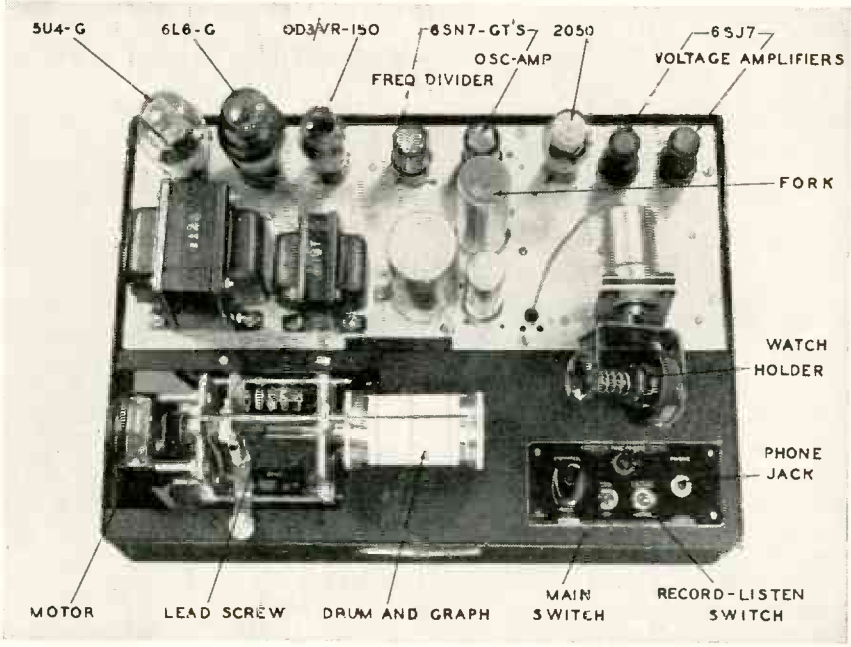
The Time-O-Graf and the Watch Master aid the modern watchmaker

THE modern watchmaker checks the accuracy of a watch with an electronic gadget called a *watch-rate recorder*. This not only tells exactly how accurate the watch is, but also provides a printed record which enables the operator to determine the cause of any inaccuracy without even taking the back off the watch. There are two popular types of watch-rate recorders. One is the Paulson *Time-O-Graf* and the other is the *Watch Master* made by American Time Products, Inc.

A watch-rate recorder compares the tick rate of the watch with a highly constant frequency over a short time interval. To present the accuracy in the form of a printed record, the frequency standard also drives a precision synchronous motor which moves a record chart at constant speed. With each tick of the watch a printer makes a corresponding mark on the chart.

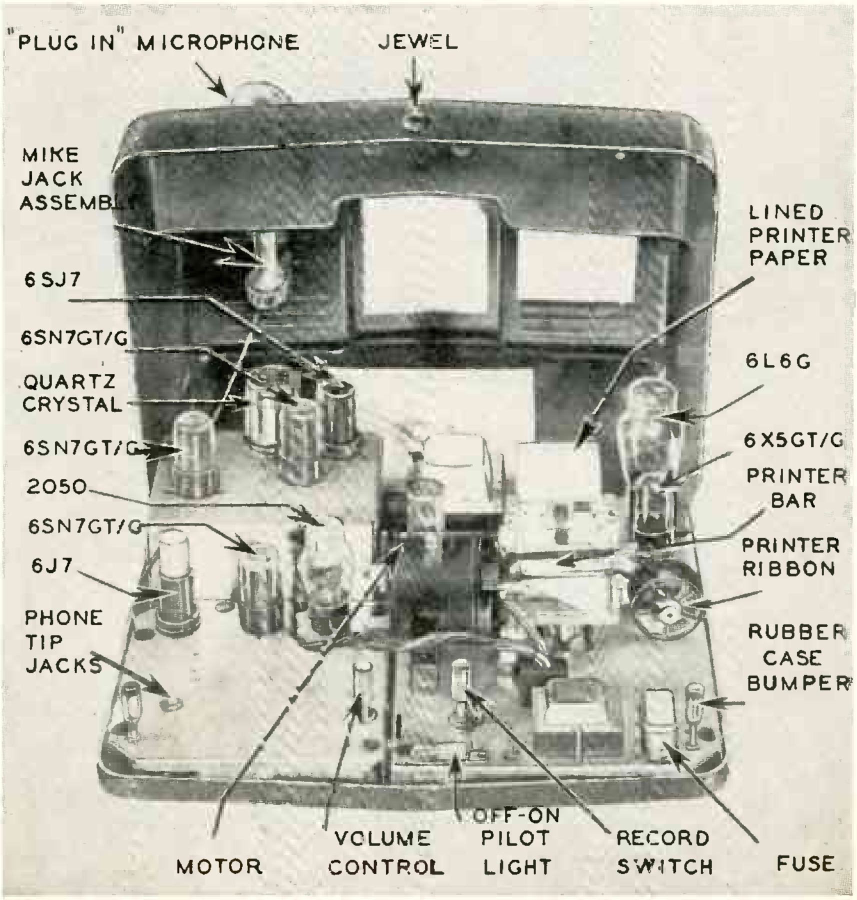
Although the frequency of commercial 60-cycle lines averaged over a 24-hour period is held stable enough to operate ordinary electric clocks with an accuracy of a few seconds per day, the *instantaneous* line frequency may vary enough to cause a *rate error* of as much as ± 5 minutes per day. This represents an error of 300 seconds out of 86,400, or 1 part in 288. To check a watch that is normally accurate to *one second per day*, the standard of comparison must be accurate to *at least one part in 86,400*.

Since there is a vast difference between the instantaneous accuracy of commercial power-line frequencies and the accuracy required for the standard, watch-rate recorders use precision temperature-compensated oscillators as standards. Frequency dividers reduce the signal from the standard-frequency oscillator to 90 cycles for the *Time-O-Graf* and to 60 cycles in the *Watch Master*.



Above-left —American Time Products' Watch Master watch rate recorder. The accuracy of the watch is indicated by a row of dots which are printed on the graph on the drum and show how many seconds it gains or loses in 24 hours.

Above—The Watch Master with cover removed. The microphone that picks up the watch ticks is built into a watch holder which can be tilted to check and record the performance of the watch in all possible positions.



The Time-O-Graf with cover removed. Paper tape comes off roll between spiraled drum and printer ribbon. Bar presses against ribbon to make dashed trace.

The Time-O-Graf

The block diagram of the *Time-O-Graf* is shown in Fig. 1. The watch-rate unit contains a microphone to pick up the ticks of the watch, an amplifier, and

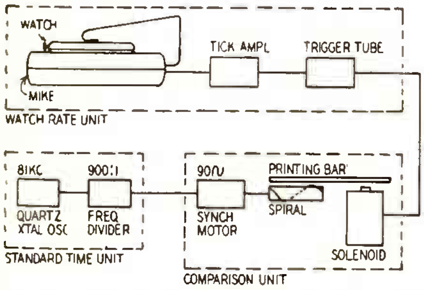


Fig. 1—Block diagram of the *Time-O-Graf* watch-rate recorder. The precision oscillator-divider chain drives the synchronous motor at 2,700 r.p.m. See text for complete details of operation.

a trigger tube. Each time the trigger tube fires, it energizes the solenoid in the comparison unit. The solenoid pulls the printer bar down against an inked ribbon and paper tape which rests lightly on the raised spiral surface of the drum. (See Fig. 2-a.) Since the printer bar can strike the raised spiral at only one point, each stroke prints a short dash-like line on the paper tape. The position of the line depends on the part of the spiral that is under the bar at the instant of contact.

The motor turns the drum at 2,700 r.p.m. (45 revolutions per second) and the tape advances at a speed of exactly 6 inches per minute. The drum is 2 inches long, so its length is scanned once each revolution at a scanning rate of 90 inches per second. The synchronism between the ticks of the watch and the speed of the motor can be compared to the synchronism between the horizontal sweep oscillator in a TV receiver and the horizontal sweep frequency at the transmitter. The constant-speed motor is equivalent to the precision sweep oscillator and the watch tick-rate is equivalent to the sweep oscillator in the TV receiver. If the oscillators are in sync, the picture elements lock in place. If they are not, each line of picture elements is displaced to the right or left.

It is much the same with the trace produced by the watch-rate recorder. If the watch is not losing or gaining time it is in sync with the drum. The spiral will be in exactly the same place each time the watch ticks, and the printer bar will produce a series of dashes in a straight row that runs parallel to the length of the tape and at right angles to the axis of the drum. If the watch is gaining time, it will be slightly ahead of the drum and the trace will slope up to the right. A watch that is losing time causes the trace to slope up to the left.

A calibrated rotating dial with seven parallel lines on a transparent plate is positioned directly over the tape as it emerges from the machine. When the dial is rotated so the parallel rules are parallel to the line of dots which the machine records on the tape, the gain or loss in seconds per day can be read from a calibrated scale. The drawing in Fig. 2-b shows how the error is read from the calibrated scale when the ruled lines are lined up with the trace on the tape. In this case the pointer at the bottom of the dial shows that the error is 45 seconds per day, and the pointer on the right shows that the error is *fast*.

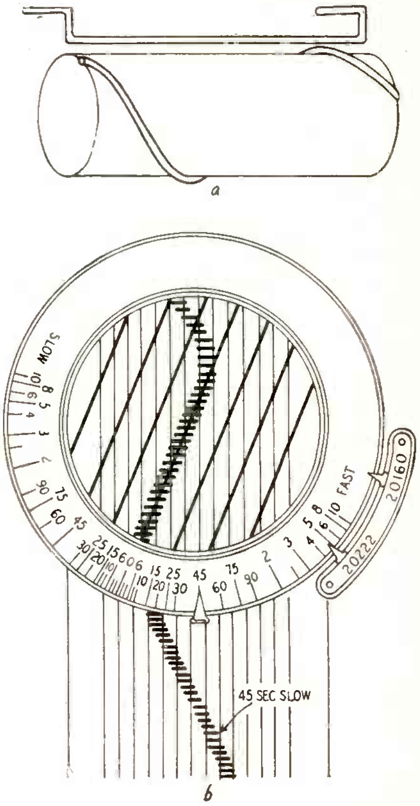
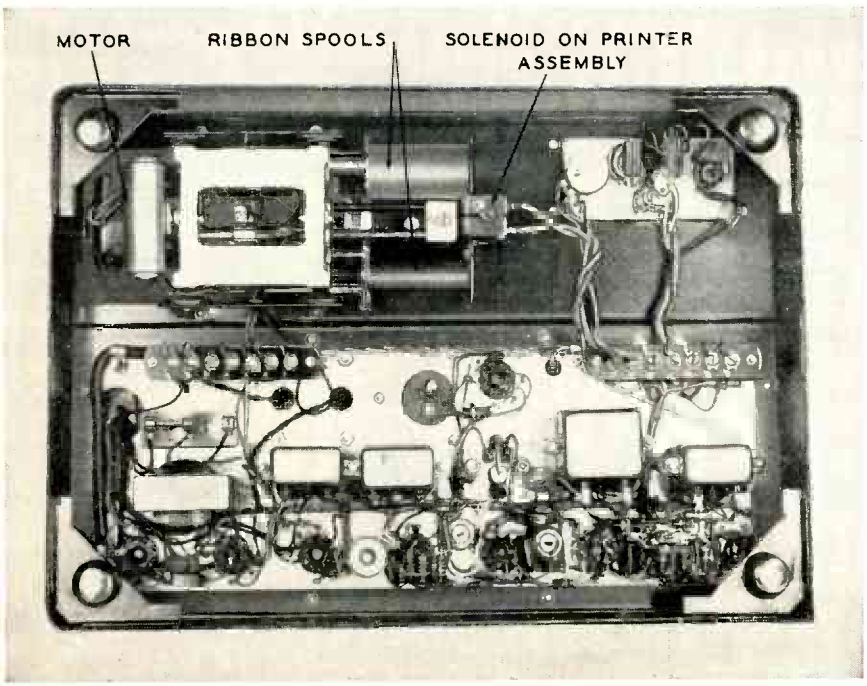


Fig. 2—(a) Drum spiral and printer bar. Each tick of the watch under test pulls the bar down, printing a short dash on the moving chart. If the watch is accurate to 1 second per day or better, successive dashes lie in same straight line at right angles to the drum axis. (b) Ruled dial is aligned with row of watch-tick dashes; calibrated scale shows total time in seconds gained or lost in a 24-hour period.



Under side of the Watch Master. Note the position of the ribbon and printer unit.

The circuit of the *Time-O-Graf* is shown in Fig. 3. The frequency standard is an 81-kc oscillator using a 6SJ7 (V1) and a precision quartz crystal cut to maintain its frequency with high accuracy regardless of normal variations in temperature. The 81-kc signal from the oscillator is stepped down to 90 cycles by a chain of blocking oscillators operating as frequency dividers. V2-a, V2-b, V3-a, and V3-b divide successively by 5, 6, 6, and 5. The 90-cycle signal is taken from the plate of V3-b and is fed to the grid of V7 where it is amplified and develops 140 volts at 90 cycles to drive the motor.

The ticks of the watch are picked up by a microphone and amplified by V4 and V5. The amplified ticks are fed to a headphone jack for aural checks and to the grid of the 2050 thyratron V6. Each tick produces a positive pulse at the grid of V6. The grid of V6 is normally biased for plate-current cutoff. The positive pulses from the output of V5 overcome the bias and fire the tube. The plate current flows through the solenoid which operates the printer bar. Thus, we have one dash on the tape for each tick of the watch.

Note that unlike most thyratron circuits, this one operates with d.c. on the plate. We know that the grid of a thyratron loses control over the plate current as soon as the tube fires, and the only way that plate current can be cut off is to interrupt the plate voltage

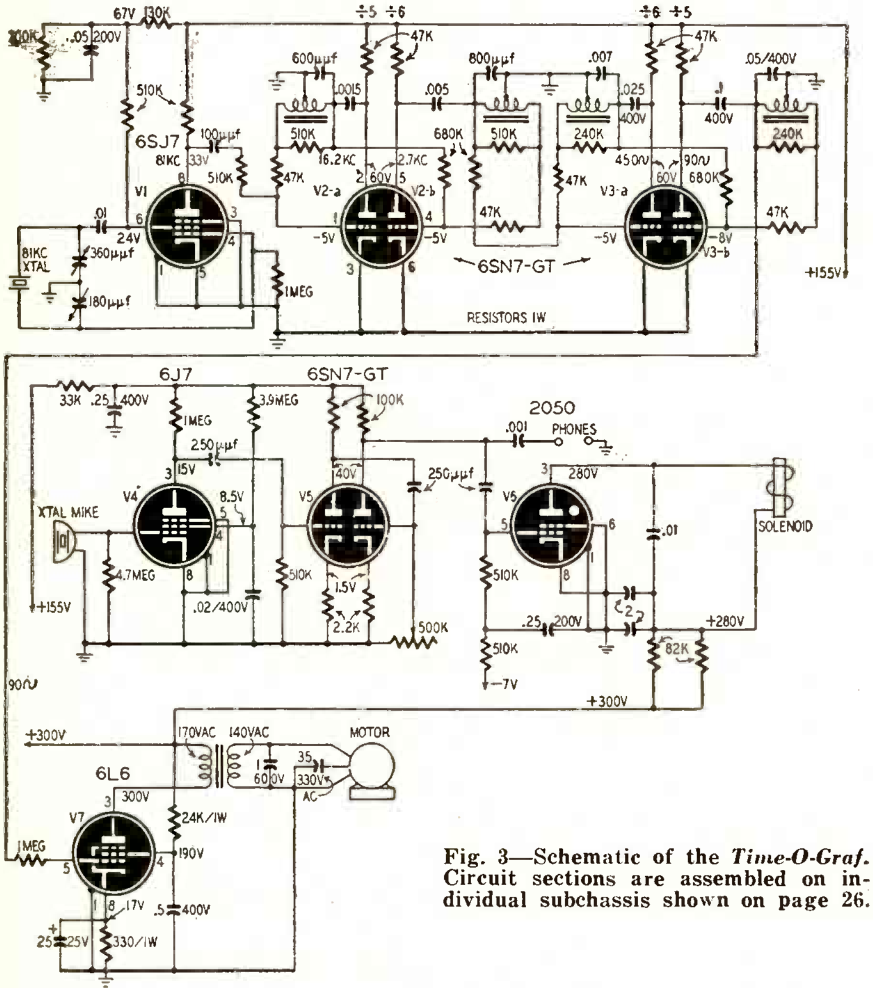


Fig. 3—Schematic of the *Time-O-Graf.* Circuit sections are assembled on individual subchassis shown on page 26.

or reduce it below the point needed to maintain conduction through the tube.

Fig. 4 is the basic circuit of the d.c.-operated thyratron. This is the self-extinguishing thyratron circuit that is mentioned fairly often in textbooks but is seldom seen in practice. R1 is approximately one-third to one-fifth the resistance of R2. The tube is biased to cutoff by the negative voltage on its grid. Capacitor C charges to the full B plus voltage E_b through R2. Since the tube is cut off, there is no current flow through R1, so full B voltage appears between the plate and cathode. When a positive pulse of sufficient amplitude is applied to the grid, it overcomes the fixed bias and the tube conducts. C discharges rapidly through the tube and R1, and develops a large voltage across R1. This reduces the plate voltage to approximately zero and shuts off the flow of plate current. C recharges before the arrival of the next positive trigger pulse.

Comparing the circuit of V6 (Fig. 3) with Fig. 4, we see that the solenoid takes the place of R1, and the two paralleled 82,000-ohm resistors are equivalent to R2. C is made up of the two 2-μf, 600-volt capacitors in parallel. When V6 is conducting, most of the current required to operate the solenoid is supplied by the storage capacitors.

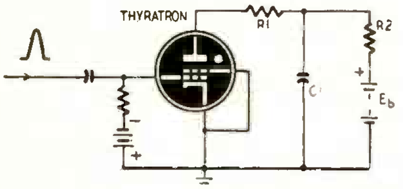


Fig. 4—Basic d.c.-operated thyratron circuit. Details are given in the text.

The Watch Master

Fundamentally, the *Watch Master* is very similar to the *Time-O-Graf.* The principal differences are in the frequency standard and in the system of recording. The Watch Master has a precision tuning-fork oscillator, and records on a paper graph attached to a drum which revolves at 300 r.p.m. (5 revolutions per second). The stylus is attached to a lead screw which drives it across the drum at the rate of one scan every 30 seconds. If the watch ticks in exact synchronism with the drum, the stylus prints a series of dots parallel to the axis of the drum. A fast watch causes the line of dots to slope up and a slow one causes the line to slope down. See Fig. 5. The graph is calibrated with a series of equidistant lines parallel to its width. The distance between two consecutive lines represents a gain or loss of 5 seconds in 24 hours. Every sixth line is ruled double width and the distance between the double-width lines indicate 30 seconds error per day.

Fig. 5 shows samples of typical Watch-Master recordings. Record A was made by a watch in exact agreement with the standard. Record B shows that the watch gains 20 seconds in 24 hours, Record C represents a watch which loses 30 seconds in 24 hours. To assist the operator in reading large errors, the chart is ruled lengthwise into two equal parts. This divides the observation time by two. Any errors observed on either half are 12-hour errors and must be doubled to get the 24-hour error rate. Record D shows how the vertical rule is used. The left-hand half shows the recorded trace

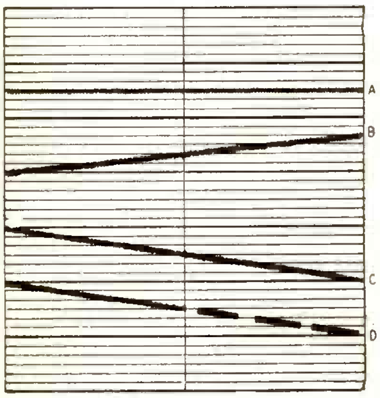


Fig. 5—*Watch-Master* record chart. Spacing between adjacent horizontal lines represents error of 5 seconds. Right and left sides are 12-hour periods.

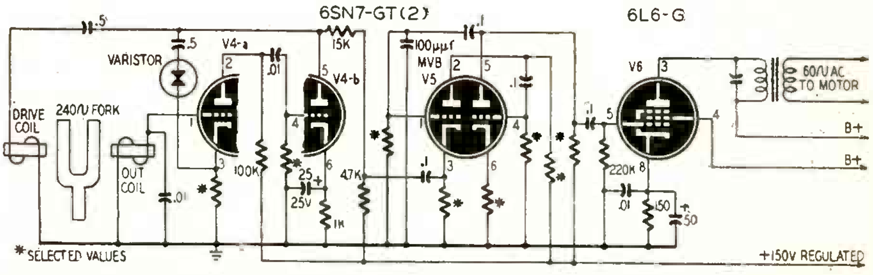


Fig. 6—Precision oscillator and frequency-divider circuits of the *Watch-Master* watch-rate recorder. Temperature compensation keeps the 240-cycle tuning fork accurate to 1 part in 100,000. The multivibrator (V5) fires on every fourth cycle, reducing the output to 60 cycles for driving the synchronous recording motor.

which covers three 5-second spaces—an error of 15 seconds in 12 hours—but this error must be doubled, making it 30 seconds for 24 hours. The dashed lines on the right-hand half show that when the original recording is extended, the error is the same as that recorded at C.

Recordings are taken in several positions: pendant up, pendant down, on the face, back, and in the three and nine o'clock positions. The readings may be very different in different positions. For example, the watch may run faster in any edge position than when face up or down, or it may be faster with the dial up than down. These differences indicate specific faults to the trained technician. For the watchmaker who may not be trained in the use of a recorder, they are listed in detail in a handbook supplied with the equipment, so that he can locate trouble in a short time.

Regulating the regulator

The circuit of the standard-frequency section of the Watch Master is shown in Fig. 6. The heart of the circuit is the temperature-compensated 240-cycle tuning fork. This maintains its accuracy to 1 part in 100,000—considerably greater accuracy than required for checking watches to 1 second per 24 hours. (A 10-volt meter with the same accuracy would read 10 volts ± .0001 volt at full scale.) The 6SN7-GT (V4) is the oscillator-amplifier. V4-a amplifies the 240-cycle signal from the fork and feeds it into amplifier V4-b. A part of the output of V4-b is fed back to the driving coil on the fork to maintain oscillation.

The output of the amplifier circuit is maintained at constant amplitude by the varistor in the negative-feedback loop. The resistance of the varistor varies in inverse proportion to the voltage applied to it. When the fork is vibrating weakly, a comparatively low voltage is induced in its output coil. The feedback voltage is small, and the gain of the amplifier (V4) is high. This increases the voltage in the driving coil. The feedback voltage through the loop increases with the voltage in the driving coil. The higher feedback voltage decreases the resistance of the varistor so a greater amount of feedback voltage is applied to the cathode of V4-a to stabilize the voltage gain of the circuit.

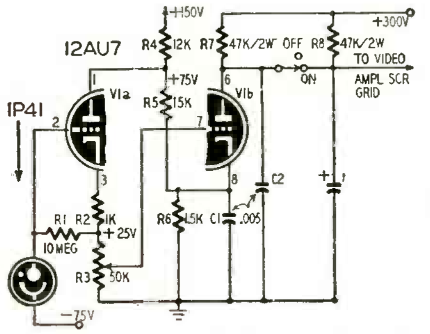
The 240-cycle output of V4-b is fed into multivibrator V5 which divides by 4 to reduce the frequency to 60 cycles. The 60-cycle signal output of V5 is amplified in the 6L6 and operates the 60-cycle synchronous motor which drives the recording drum and lead screw.

The watch-rate section of the Watch Master consists of a crystal microphone, cascaded 6SJ7 pentode voltage amplifiers, and a d.c.-operated 2050 thyratron in a circuit similar to Fig. 4. A solenoid in the plate circuit operates the printing mechanism. END

AUTOMATIC CONTRAST-RATIO CONTROL

By T. S. DIX, JR.*

ONE of the petty annoyances in watching television is the need for resetting the contrast control whenever the room lighting changes substantially. If you adjust the contrast for the best picture in a bright room, the screen glares badly when the room is darkened. If you adjust the control for comfortable viewing in subdued light, the



picture looks washed out when the room lighting is increased. To maintain an enjoyable contrast ratio at all times, the contrast control must be readjusted whenever the room illumination changes.

Part of any external light that falls on the face of the picture tube is reflected; the rest is transmitted through the glass face to the fluorescent screen. The transmitted light is added to both the light and dark elements of the image and decreases the contrast ratio. High room illumination may reduce the contrast enough to wash out the picture.

In order to eliminate washout and glare, we need something to supplement the contrast by an amount proportional to the intensity change in room lighting. Although neutral-density picture-tube filters are effective in increasing the *amount* of contrast, the change in contrast ratio produced by a change in room illumination is about the same with or without a filter; consequently, these are not the solution.

The solution lies in properly proportioning or balancing the room illumination and screen brightness.

The circuit shown in the figure maintains automatically the desired contrast ratio if the room lighting changes, by increasing or decreasing the gain of the video amplifier. The 1P41 phototube is mounted behind a translucent window on the control panel where it will receive light directed toward the picture-tube screen. The 12AU7 d.c. amplifier varies the video-amplifier screen voltage according to the amount of light. The circuit is used in the Westinghouse 21-inch console model 846K21.

Circuit Operation

The amount of light striking the light-sensitive cathode determines the amount of current through the phototube. An increase in light intensity causes a corresponding increase in phototube current. The 1P41 cathode is connected to a negative potential of about 75 volts. Its plate is returned to the junction of R2 and R3 through R1, a 10-megohm load resistor. This resistor must have a very high value, due to the small magnitude of phototube current. For the specified values of resistance, the grid of the cathode follower, V1-a, varies from approximately −10 volts in bright light to +5 volts in total darkness.

Since it is desirable to operate the cathode follower with a very high grid-circuit resistance, its plate voltage must be kept low to reduce gas current and prevent damage to the tube. For this reason, the plate of V1-a has an operating potential of only about 75 volts taken from the voltage divider R4, R5, and R6. R2 provides a small amount of cathode bias. END

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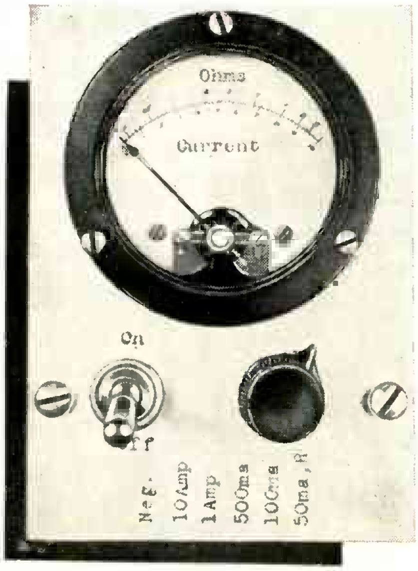
Suggested by Ivan Romashki

"He used to be a rubber man in a circus."

LOW-RANGE Ohmmeter



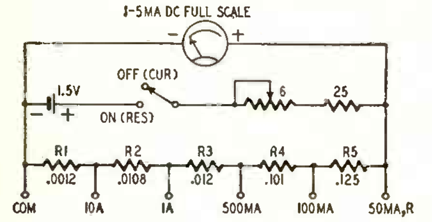
The meter panel is made of two sheets of Plexiglas with the ranges and switch designations typed out on a sheet of paper and sandwiched between them.

Transformer windings, coils, and resistors between .01 and 5 ohms may be checked quickly and accurately on this simple ohmmeter

By A. STRATMOEN

THE most popular service instruments for measuring voltage, current, and resistance are vacuum-tube voltmeters and 20,000-ohm-per-volt multitesters. While these instruments are ideal for measuring high values of resistance with low battery voltage, they have definite disadvantages in measuring low resistances—especially values smaller than 1 ohm. For example, one well-known 20,000-ohm-per-volt instrument reads 25 ohms at half scale on the lowest resistance range and requires a maximum current of 50 ma. This means that fractional resistance values are compressed into a very narrow region at one end of the scale.

The meter movements used in most of these instruments have a high internal voltage drop, generally about 250 mv.



Circuit of the combination low-range ohmmeter-multirange ammeter. Instructions for winding and adjusting the current-range shunts are given in the text.

This high value changes conditions in the low-voltage high-current circuits required for measuring very low resistances. An instrument designed to overcome the disadvantages of high-resistance types for reading current and low resistances is a handy supplement to the multitester. Besides, it is convenient to have an extra meter for reading current and still have the regular one free for other uses.

The meter shown in the photographs reads less than 0.25 ohm half-scale, and has five current ranges. It is easy to construct and operate and is very stable. It has no tap switches to introduce contact-resistance errors or possibly damage the meter through poor contact. Because there is only one resistance range, the zero adjuster seldom needs resetting. The design can be changed easily to cover other ranges of current or resistance. The movement used is from a 2-inch GE KX DW-52 0–1 thermocouple ammeter, but almost any instrument with a basic range of from 1 to 5 ma can be used. The important thing is that the meter movement must have a low voltage drop. In other words, the product of its resistance and full-scale current should be as small as possible.

The movements used in thermocouple ammeters are very efficient and are well adapted to this use. This one has a resistance of 5.6 ohms and a full-scale current of 2.15 ma, which means a 12-mv drop. This is only 1/20 of the 250 mv usually required.

When this meter is shunted to read 50 ma full scale (see the schematic) the combined meter and shunt resistance is only 0.24 ohm. Any external resistance connected *in shunt* with the meter and battery will decrease the total resistance and reduce the current in the meter arm. For example, 0.24 ohm across the COM-R terminals halves the circuit resistance and cuts the meter current in half. Thus the midpoint on the scale is 0.24 ohm, the value of the external resistance, and other calibration points can be computed or found by connecting various standard resistors to the test leads.

The actual calibration points on this meter cover .01 ohm to 5 ohms. Note that values under 1 ohm are spread out over more than three-quarters of the scale. This makes the meter very useful for measuring the resistances of small coils, battery leads, and filament circuits. It can even check contact resistance on switches, vibrators, and relays. The meter can be shunted to read even lower resistance values, but special low-resistance leads and contacts would be needed to make this lower range reliable. Even on the .01–5-ohm range the leads should be as short and heavy as possible, with good alligator clips—not prods—at the test ends.

The case is from a BC-1366 jack box and the jack strip is from a BC-345 control box. These jacks fit banana plugs on the test leads while the solder lugs on the strip are used to mount the shunts. The panel was made of two sheets of *Plexiglas* with a sheet of heavy paper between them. The labels for the controls and terminals were typed on the paper before the panel "sandwich" was put together. The meter is insulated from the metal case for safety in reading current in circuits above or below ground potential.

The following formulas are used to find the shunt resistance required for each current range, starting with the *highest range:*

$$R_s = \frac{E_m}{I_t - I_m}$$

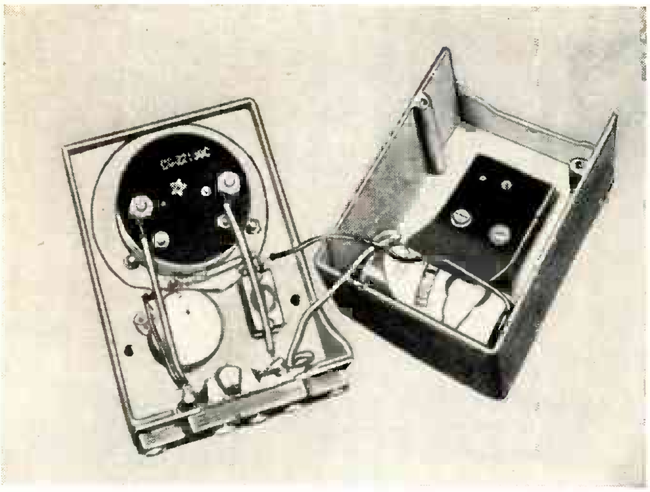
where R_s is the required shunt resistance, E_m is the voltage drop across the meter movement, I_t is the full-scale current range desired, and I_m is the basic current range of the meter.

For example, the shunt for the 10-amp range (on this meter) is

$$R_s = \frac{.012}{10 - .00215}$$

$$= .0012 \text{ ohm.}$$

The shunts for the lower ranges are



The meter case and jack strip were taken from war surplus equipment. See text. The meter is not grounded to the case for safety in measuring currents in circuits above or below ground potential.

made up by simply adding resistance to the shunt for the highest range (R1) to make up the total value required for R_s. Thus for 1 amp,

$$R2 = R_s - R1$$

$$= .012 - .0012 = .0108.$$

These formulas neglect the fact that the shunts not in use are in series with the meter, but the error is small except in the case of R4, which should be about 3% higher than the value obtained from the formula.

Enameled copper wire is used for the shunts. Suitable sizes for the current to be carried and the lengths for resistances required can be found in any wire table. For this meter or any other type of equal sensitivity and internal resistance: R1 is 3.5 inches of No. 16 wire; R2 and R3 are wound with No. 20 wires 12.7 and 14.2 inches long, respectively; R4 and R5 are No. 30 wire wound over ½-watt high-ohmage resistors (R4 consists of 11.8 inches of wire and R5 has 14.6 inches). The resistance of a linear inch of some of the more common sizes of copper wire is shown in the table. You can use it to determine the length of a given size of copper wire needed to make a resistor of a given value. Cut the wire about 50% longer than required to allow for trimming to exact length.

The three largest shunts in this meter are self-supporting, and the others are wound on ½-watt high-value resistors. Solder them all on the jack strip before making final adjustments.

For trimming the shunts to the exact lengths required you will need an accurate multirange ammeter as a standard and a controllable source of current.

Start with the 10-amp range and cut R1 until the meter reads about 9 amps full scale. Then go on to the next range and trim R2 until the full-scale current is 0.9 amp. Continue with the rest of the ranges until each reads about 10% less than the actual full-scale reading you want.

Now go over the whole procedure a second time, trimming each shunt closer to the final value. For maximum accuracy you may even have to give them a third trimming.

Some movements from thermocouple meters are not strictly linear, so it may be a good idea to make up a linear test scale first, and check the movement against a standard to see how far off linearity it is. Then you can make up a second current scale—one that reads correctly. Good cardboard for meter scales can be bought at most photo-supply stores.

Resistance calibration

After the shunts are correct, the resistance circuit may be connected up and calibrated. The first step here is to find the exact resistance of the meter shunted for 50 ma. Connect a heavy-duty variable resistor (about 1 ohm or less) across the test leads, and adjust it until the meter reads exactly half scale. Then find the value of the external resistor at this setting by passing a known current of 1 amp or more through it and measuring the voltage drop across the resistor as accurately as possible. This value can be marked on the resistance scale at the midpoint.

WIRE TABLE

Wire size (B&S No.)	Resistance (ohms) per inch
14	.000214
16	.000341
20	.000862
24	.002180
30	.008766

The corresponding current readings for other values of external resistance can be found from the formulas given below. These can be used either for marking resistance values directly on the meter scale or for an auxiliary chart. These formulas assume that the battery current remains constant. While this is not always true, it is not likely to cause any very serious error.

$$I_x = \frac{I_m R_x}{R_m + R_x}$$

Where I_x is the actual meter current, I_m is the full-scale meter current, R_x is the external resistance, and R_m is the combined resistance of the meter and its normal shunting circuit. As an example, the meter current in this case for an external resistance of 1 ohm would be

$$I_x = \frac{.05 \times 1}{0.24 + 1} = \frac{.05}{1.24}$$

$$= .0403 \text{ amp, or } 40.3 \text{ ma.}$$

At first glance this may seem like a laborious method of finding many calibration points on the meter scale, but for any given meter I_m and R_m are constants, and only R_x varies. Of course, if you have a number of accurate 1-ohm resistors, you can find any number of important calibration points by simply connecting them in parallel across the test leads and dividing 1 by the number of resistors. END

U.H.F. CHANNEL FREQUENCIES MADE EASY

by A. G. Hatfield, WN3SZT

A complete list of the channel limits and carrier frequencies for the 70 u.h.f. TV channels isn't necessary for reference if you will master this simple procedure. All you have to remember is that *channel 69 starts at 800 mc.* (Of course, it actually covers 800 to 806 mc). On all TV channels the picture carrier is 1.25 mc *above* the low end and the sound carrier is 0.25 mc *below* the high end.

For example, lets find the frequencies for channel 22. First we *subtract* 22 from 69. This gives us 47. Then we multiply 47 by 6 (the width of each channel in mc) and we get 282. Thus we know that channel 22 begins 282 mc *below* channel 69, and another simple subtraction (800 − 282) gives us 518 mc, the low-end frequency of channel 22. The upper end of the channel is 6 mc higher, or 524 mc. The picture carrier is 518 + 1.25, or 519.25 mc, and the sound carrier is 524 − 0.25, or 523.75 mc.

Expressing this method as a formula, we get

$$F = 800 - 6(69 - N)$$

where N is the number of the channel you are interested in, and F is its low-end frequency.

If you want to find a channel *above* 69—say channel 82—here is how it would be worked out. 82 − 69 = 13; 13 × 6 = 78; 800 + 78 = 878 mc, which is the lower end of channel 82. The formula for channels above 69 then becomes:

$$F = 800 + 6(N - 69)$$

After making a few tests you will find this method very easy, and you will not have to worry about keeping a table on hand. END

Circuit Shorts

SIGNAL-SEEKING TUNER

It promotes safe driving by automatically scanning the band and centering on the first signal picked up

By **ROBERT F. SCOTT**

PUSH-BUTTON tuning in modern car radios is primarily a safety feature—so that the driver can select a station without taking one hand off the wheel for more than a second or two and without taking his eyes off the road at all. There are other advantages, of course. With stable circuits and accurate prealignment the stations set up on the push-buttons always come in right on the nose, with minimum noise and best a.g.c. action to meet the wide variations in signal strength on the road.

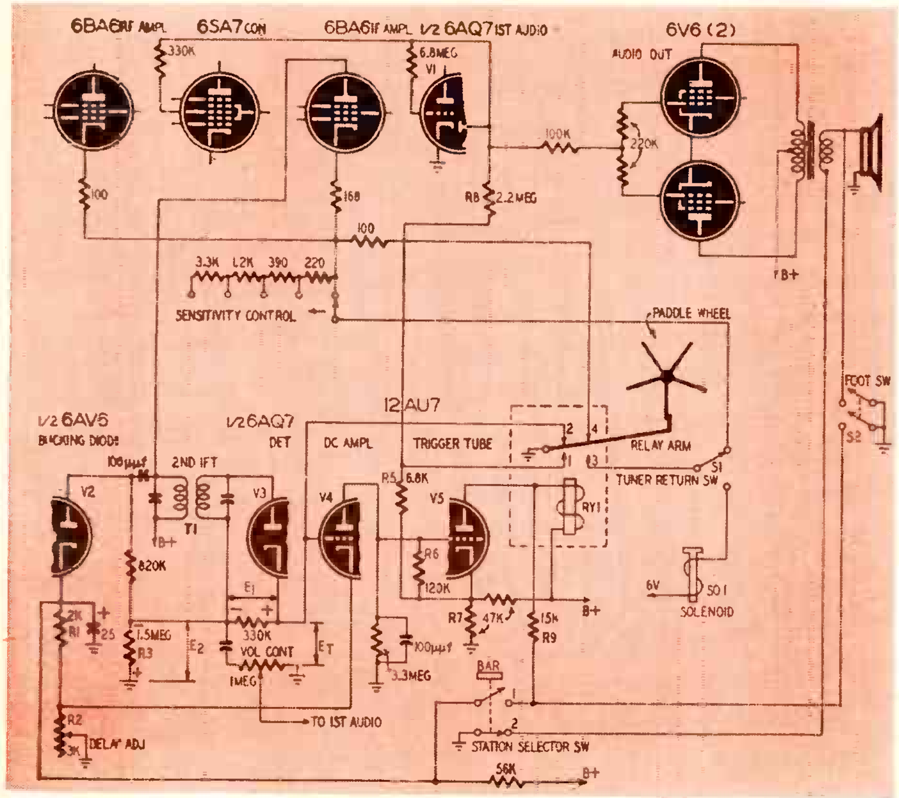


Fig. 1—Simplified schematic showing the principal elements of the Delco *Signal-Seeking Tuner*. The operation of the tuner is explained in the text. Minor circuit variations and different tube types are used in some models of Delco receivers.

About the only disadvantages of ordinary push-button tuning are the limited number of stations available and the need to realign the individual station selectors to new frequencies when the car moves out of a given service area.

The *Signal-Seeking Tuner* in some of the more expensive recent *Delco* auto radios enables the operator to select *any station on the dial* simply by pressing a station-selector switch or an auxiliary foot switch. Momentary pressure on either one automatically sweeps the tuner slowly across the broadcast band starting at the low end. It stops automatically at each station in turn. When it reaches the high end of the dial it reverses and returns to the low end almost instantaneously.

Receivers equipped with the signal-seeking tuner are permeability-tuned, with the cores of the antenna, r.f., and oscillator coils linked mechanically by a guide bar. This bar is driven by a spring motor through a gear train. The tuning motor is stopped at each station in turn by a trigger pulse derived from the incoming signal. This pulse de-energizes a relay so that its armature engages a paddle wheel on the gear train. A simplified circuit of the signal-seeking tuner is shown in Fig. 1.

Operation

Momentary pressure on the STATION-SELECTOR switch bar starts the tuner operating. Contact 2 of the switch opens first to break the voice-coil circuit and mute the receiver. When contact 1 closes, it completes the circuit from B plus to ground through RY1, R9, R1, and R2. The current through this circuit energizes the relay winding, which pulls down the relay arm. This releases the paddle wheel and transfers the ground connections from relay contacts 2 and 4 to contacts 1 and 3.

When the paddle wheel is free, the spring motor pulls the ganged tuning slugs out of the coils to sweep the receiver frequency toward the high-frequency end of the band until a station is tuned in.

When relay contact 1 closes, R5 is shunted across resistor R7 in the cathode circuit of trigger tube V5. This brings the cathode closer to ground (B–), increasing the plate-cathode voltage. The increased current through V5 keeps the relay closed so the tuner will continue to sweep after the station-selector switch is released.

The cathodes of the r.f. and i.f. amplifiers are returned to ground by the relay arm through the SENSITIVITY CONTROL, contact 1 of the *tuner-return* switch, and relay contact 3. The sensitivity control operates only during the sweeping operation. When the full resistance of the control is in the circuit, the gain is reduced and the tuner will stop only on a strong station. Decreasing the resistance allows the tuner to stop at weak stations as well.

Stopping the tuner

When a station is tuned in, i.f. voltages are developed across the primary and secondary of T1, the second i.f. transformer. Detector V3 rectifies the signal and develops a voltage E_1 across the diode-load resistor. This voltage is positive at the cathode and negative at the lower end of the secondary winding. Bucking-diode V2 rectifies the signal in the primary of T1 and produces voltage E_2 across R3. E_1 and E_2 have opposite polarity and their algebraic sum is applied to the grid of d.c. amplifier V4. When the resulting voltage becomes positive, V4 conducts.

The V4 plate current causes a voltage drop across R6 which biases V5 so the relay releases. At this point, the relay armature stops the paddle wheel and motor and transfers the ground from contacts 1 and 3 back to 2 and 4. Opening contact 1 removes R5 from the cathode circuit of V5. R7 now limits the current through V5 and RY1. The opening of relay contact 3 and the grounding of contact 4 removes the sensitivity control and grounds the r.f. and i.f. amplifier cathodes thru a 100-ohm resistor, so the set operates with full sensitivity. Note that the sensitivity control is in the circuit only during the tuning operation.

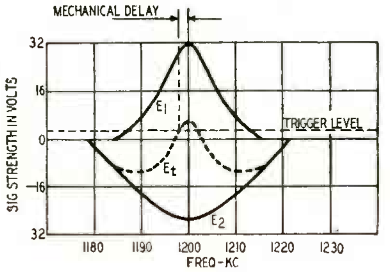


Fig. 2—Plot of control voltages E_1 and E_2 produced by a typical station signal. The dashed line E_t is their algebraic sum. E_t stops the tuner exactly on the station whenever it exceeds the trigger level (broken line).

When contact 2 closes, it grounds the grid of V4 and the cathode of V3. V3 now operates as a conventional diode detector. The negative d.c. component of the rectified signal which is ordinarily used for a.v.c. is now applied to the plate of V2 to keep it from conducting.

One of the features of this tuner is that it stops accurately on each station regardless of signal strength. Fig. 2 shows how the detector d.c. voltage E_2 and the bucking voltage E_1 developed by V2, combine to produce the positive voltage E_t required to trigger V5. The voltages are plotted against a station frequency of 1200 kc. The curve of E_1 is steeper and higher than E_2 because E_1 has the benefit of an additional tuned stage and because there is a positive delay voltage on the cathode of V2.

E_1 and E_2 are both developed from the output of the i.f. amplifier so both vary proportionally with the strength of the incoming signal. Therefore, trigger voltage E_t tends to remain constant regardless of signal strength.

When the tuner reaches the high-frequency end of the band, a tripper throws the tuner-return switch S1 and closes the circuit to a powerful solenoid SO1. This quickly pulls the tuning cores back all the way into the coil forms, resetting the tuning dial to the low-frequency end of the band, rewinds the spring motor, and resets S1 to its original position to break the solenoid circuit.

Muting the receiver

The methods of muting the receiver while tuning vary slightly in different receiver models. Fig. 1 contains a composite of these methods. When the STATION-SELECTOR bar is used, contact 2 opens the voice-coil circuit *before* contact 1 is made. If FOOT SWITCH S2 is used, the hot side of the voice coil is grounded before the relay circuit is completed through R9 and the second contact on S2.

The set is silenced during the tuning sweep by using the negative oscillator-bias voltage to cut off the first-audio and output tubes. When the set is on station, relay contact 1 is open and enough positive voltage is applied to the audio grids (through R8) to overcome the cutoff bias. A clamp diode in V1 prevents the audio grids from becoming excessively positive.

When S1 is tripped by the solenoid for the automatic return sweep it disables and mutes the receiver by ungrounding the arm of the sensitivity control, which is the cathode return of the r.f. and i.f. stages during the tuning process.

Some late Delco auto radios have an added feature which is called *Favorite-Station Tuning*. This is a combination of signal-seeking tuning and push-button operation. In this case, there are five push-buttons which the driver may quickly set to five stations. END

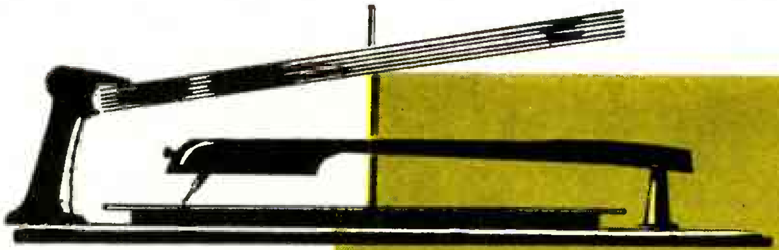
An Important Announcement

THE long-playing phonograph record and the development of wide-range, low-distortion pickups, amplifiers, and loudspeakers in the past five years has produced an unprecedented public interest in high-quality audio equipment for home use. Tens of thousands of people are purchasing equipment which will bring them a close approximation of live music. (See "Hi-Fi Comes to the Music Lover," October, 1952).

This presents new prospects and new problems to the technician. High-quality audio equipment requires a new type of servicing. Its owner is not interested in merely "getting it working," once it breaks down. He must have it working considerably better than the peak performance of most audio equipment to which the service technician has been accustomed. This is a new field for the man who will prepare himself to do an adequate job in it.

RADIO-ELECTRONICS has long appreciated the importance of audio in the electronic field. Since a survey some years ago revealed it as the second subject of interest to our readers, we have tried to print good articles on audio equipment, practises and techniques. The several series by Crowhurst and Fletcher Cooper, for example, rank with the best audio material printed in any American magazine.

With the present increase in the importance of high-fidelity audio, RADIO-ELECTRONICS is increasing its coverage of this subject. Beginning next month, our Audio section will become High Fidelity—Audio. The section will be enlarged and special attention paid to the high-quality aspects of audio. Among other features, the September issue will start a series entitled "High-Quality Audio," by Richard H. Dorf, known to readers of this magazine as an author of books and articles on audio subjects. A continuing review of new audio circuitry and components is planned, together with other features of interest and value to the audio technician. We will continue to present these subjects in the plain language of RADIO-ELECTRONICS, avoiding the esoteric terminology of the audiophile and the over-technical language of the sound engineer. Let us have any comments or suggestions as to how RADIO-ELECTRONICS can best serve you in the audio field. They will be studied attentively and acted on wherever possible.



SERVICING RECORD CHANGERS

Basic operating mechanisms—and how to keep them operating

By JOHN B. LEDBETTER*

PART I

DO YOU want a sure-fire way of increasing your shop income? Many service technicians have found the answer by selling, installing, and servicing record changers. The sale of even an inexpensive record player opens the door to future sales of records and accessories, and puts you on more intimate terms with your customer. Quite often this leads to the sale and installation of phono-combinations, automatic changers, tape recorders, or custom high-fidelity equipment.

From the service standpoint, record changers have at least two points in their favor. First, they require no expensive test equipment or large stock of spare parts. Second, they are not really complicated or difficult to service, once you have watched several different changers in action and understand their basic operation.

Basic changer operation

One good way to acquaint yourself with changer operation is to study instruction booklets and service manuals for as many types as possible. These manuals can be obtained from your local distributor or directly from the manufacturer. If possible, set up several types of changers and follow the action of each part as it goes through its cycle. (This will be easier if you mount the changer on a tall stand or shelf so you can see each part in its normal position, and then turn the changer through several cycles by hand).

You will find that all changers follow the same basic sequence:

1. Tone arm rises and moves clear of record stack.
2. Record drops to turntable.
3. Tone arm moves in, sets down on outer groove of record.
4. Cycling mechanism shuts off, allows record to play through.
5. Tone arm finishes record, trips cycling mechanism into action.
6. The entire sequence is repeated.

These operations are performed by adjustable cams, eccentrics, pusher rods, actuating levers, and springs. These may appear complicated in de luxe or automatic mixed-record changers, but careful study of the cycling mechanism will clarify its operation, and show up any trouble or misadjustments. After all, cams and tripping mechanisms perform the same jobs regardless of their shapes or whether they are mounted on a shaft, lever, cylinder, or flat gear surface.

Record-dropping mechanism

Most changers use either the *toggle-post* or *slicer* types of dropping mechanism. In the toggle-post or *pusher* type (Figs. 1 and 2), the records are stacked on an offset ledge on a bent turntable spindle, with the outer edges of the records resting on one or more supporting shelves. A roller or pusher rod forces the bottom record off the spindle ledge and drops it to the table.

In *slicer-type* record changers, the outer edges of the records are supported by rotatable *knives* or separator shelves. These knives release the bottom record while shifting support to the next record in line.

Record-tripping mechanism

Two methods are generally employed to trip the cycling mechanism. These are the *ratchet and positive trip*, in which the ratchet lever is operated by the tone arm at a certain point in its travel; and the *velocity trip*, in which the spiral finishing groove of the record swings the tone arm into contact with the tripping mechanism. The only disadvantage of the latter is its inability to play home recordings or old-type records (no inside spiral) except in the MANUAL position.

Servicing precautions

Before actually servicing or adjusting an automatic changer, give the assembly a general visual inspection. See that all gears, cams, springs, levers, rods, connecting links, etc. are in place and in good working order. Observing the following precautions will prevent possible damage to the changer mechanism:

1. Never use force to start or stop the motor or any part of the changer mechanism.
2. If the mechanism stalls, turn off the switch, remove records from the posts (or shelves), and allow the tone arm to complete its cycle.
3. Never leave a stack of records on the record posts or on the turntable. This will cause serious warping, especially in warm climates. Warn your customers against this practice.
4. Clear the shelves of warped or damaged records. These may cause jamming and may bend or warp the spindle in toggle-post changers, or damage the separator knives in slicer changers. Some changers have a safety clutch which prevents damage if the record or mechanism jams, but many do not.
5. Check all records for chipped or cracked surfaces. These defects may damage the pickup stylus—especially sapphire types.

Cleaning and lubrication

No record changer can function properly when it is clogged with dirt or old, gummy grease or oil, so the first objective in servicing should be *a complete cleaning* (and lubrication, where recommended). First, check the pickup stylus. Remove the guard if necessary, and clean out all dust and foreign matter with a fine brush. Then remove all dirt, dust, old grease, and oil from bearings, bushings, cams, raceways, and other moving parts with a fine brush and carbon tetrachloride (use naphtha if you prefer).

In some types of changers, you may have to remove a few parts from the assembly in order to clean and lubricate them properly. For example, the cam gear and actuator levers in changers like the Philco M-24 (Fig. 3) should be removed to lubricate the actuator stud and the cam-gear spindle. In other changers, lubrication of the motor and certain other parts is not recommended, so be sure to check the service manual or local distributor if you have any doubt as to the proper lubrication points.

You can generally tell which moving

* Engineering Writer, CONVAIR

Fig. 1—Garrard RC-80 3-speed changer has toggle-post-type record push-off.

Fig. 2—Webster-Chicago model 126 3-speed changer has push-off button.

parts are easy to reach or which parts should be removed for lubrication by running the changer through several cycles (by hand if practical) and noting the location and accessibility of the bearings, studs, bushings, and other points where friction occurs.

Parts not to lubricate

These vary with different changers. If in doubt, check with a local distributor or write the manufacturer. Generally, the following parts should *not* be lubricated *at any time*:

1. Trip fingers or receivers.
2. Selector assembly, except at specific points shown by the manufacturer.
3. Ratchet portion of the trip plate.
4. Motor drive shaft.
5. Rubber idler tire.
6. Motor drive belt or pulley.
7. Record-separator knives in slicer-type changers.
8. Spindle latch or plate. (Use powdered graphite in some cases.)
9. Dog latch, cam gear, or similar tripping mechanism.
10. Lifting lever where dog or tripping mechanism rides.
11. Friction-trip finger or washer.

If there is any grease or oil on these surfaces, remove it thoroughly with carbon tetrachloride. An oil-softened or slick idler tire or drive belt must be replaced.

Where oil should be used

When applying new grease and oil, use sparingly and only at the points specified in the manufacturers' instructions. Too much oil or grease may cause early failure by collecting dust and dirt, or may cause improper changer action from the start. Besides, oil from an overlubricated changer can find its way onto the customer's rug, or, in combination models possibly onto the speaker cone.

In changers like the Philco Model in Fig. 3, *oil* the following moving parts with SAE 20:

1. Tone-arm pivot pin (where it goes through holes in tone-arm bracket). This may be difficult to reach in some models unless the changer is partly disassembled.
2. Tone-arm shaft where it rotates in the bridge or locator housing.
3. Trip-plate bushing (inside). This also may be difficult to reach in some models.
4. Cam-gear spindle.
5. Turntable bearings (top and bottom).
6. Return-lever roller or return-gear segment.
7. Cam-gear index-lever roller.
8. Reject-lever pivot.
9. Actuator spindle and associated levers, washers, and bearings.

Use SAE 20 oil sparingly on:

1. Idler-support shaft.
2. Idler shaft.
3. Slider bar (toggle-post changers).
4. Shift roller pins.
5. Pulley shaft.
6. Underside of pivot bushing in the shifter plate.

(Many changers will not have all the above parts, or they may be called by different names, but it is well to know the general lubricating points of each type.)

Before lubricating the motor, remove the rubber belt and idler wheel wherever possible. After lubrication, be sure the motor shaft, pulley, or other parts contacting any part of the turntable drive, are free from oil and grease before replacing the belt (or tire) and idler wheel. Otherwise, slippage may result and these parts will have to be replaced. See that oil and grease are not allowed to soften the a.c. line cord or the shock-mount grommets.

Where to use grease

Use Texaco motor cup grease (unless otherwise specified by the manufacturer) on:

1. Top of push-off plate (or saddle).
2. Switch-lever slot, and point where it slides on motorboard.
3. Control-link slots.
4. Point where record-shelf separator shaft rides (slicer types).
5. Detents for record shelf.
6. Hold-down shaft and assembly.
7. Loops of hold-down springs where they hook on to record shelves, and where the hold-down arm pivots.
8. Set-down cam where the eccentric stud rides.
9. Points where record push-off blades ride on record shelves.
10. Cam gear (all cam surfaces and gear teeth except the dog latch or tripping ear).
11. All ball bearings.
12. Fulcrum points on changer control button (or selector switch).
13. Tone-arm lifting lever (elevator), where lever contacts main cam gear.
14. Record push-off lever (at end slide on bridge, at point where stud rides on bridge slot, and at the pivot pin).
15. Friction clutch (at stud. and at points where return lever and tone-arm actuator meet).
16. Cam surface of idler-wheel lifter (where used).
17. Detent surfaces.
18. Guide slots of shifter-plate or record-pusher mechanism.
19. Idler-shaft extension (in some changers), where it contacts lower shifter plate.
20. Bridge assembly (at the end and detent notches of the control slider, and on the upturned ears or dimples on the bridge assembly).
21. Cam gear (between the roller and gear surfaces, on all gear teeth and lateral cam surfaces, and on the upper surfaces of the cam where the selector hinge or arm rides).

On some toggle-post models, grease the main changer assembly at the following points:

1. Push-off bar, where it connects to its actuator.
2. Push-off actuator, where its dimples slide on the base plate.
3. The speed-selector ears, where *they* slide on the base plate.
4. The speed-selector hinge, where it contacts the base plate.
5. The speed-selector cam slot, detent surfaces, and the pivot point.
6. Turntable shaft (upper outside bearing only).
7. Detent assembly (roller stud, ear, and sliding guide surfaces).
8. The trip actuator (the guide surfaces and the ear on the trip lever which operates the reset lever).
9. The trip-actuating spindle.
10. The outside bushing of the horizontal actuator (this is the tone arm set-in mechanism).
11. The vertical actuator bushing, where the trip reset arm rides.

Grease the tone arm at the point where it rotates in the base support or "stanchion." In some cases, the push-off bar in changers like Figs. 1 and 2 may develop squeaks while cycling. To

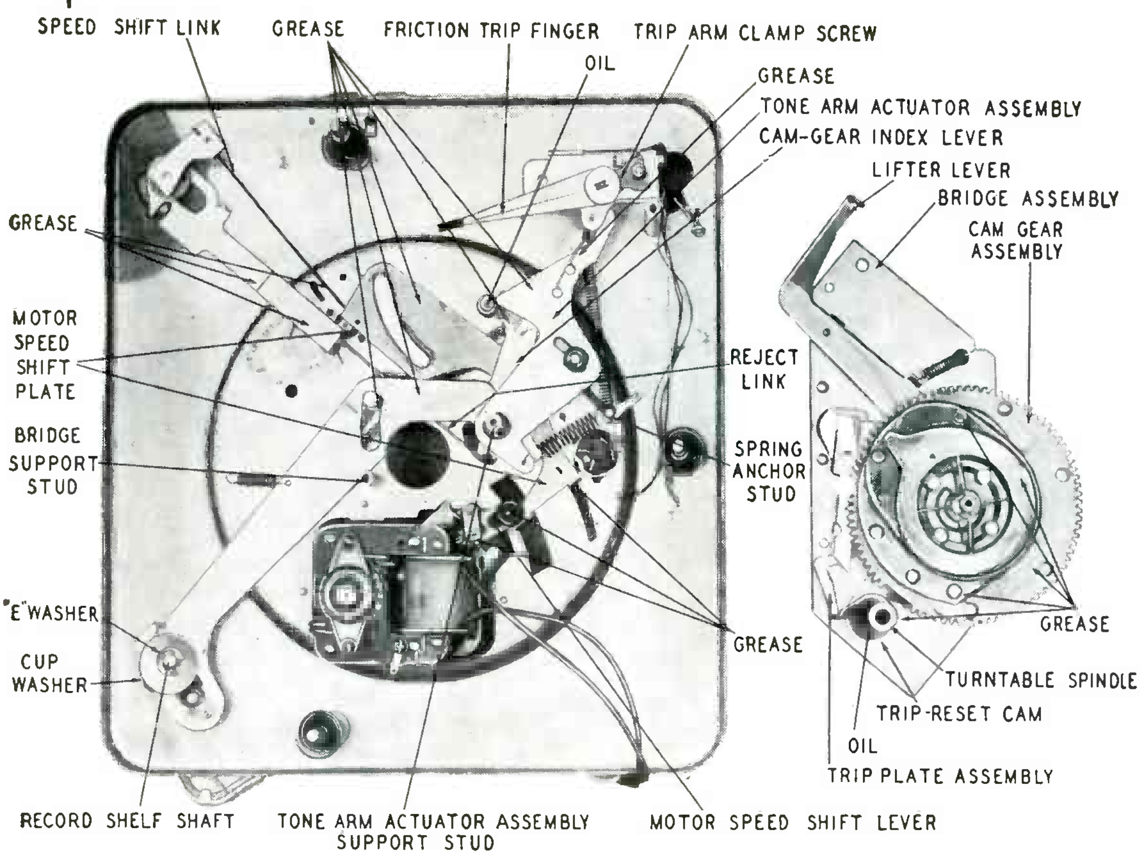


Fig. 3—Philco M24 changer mechanism, with parts identification and lubrication points referred to in the text.

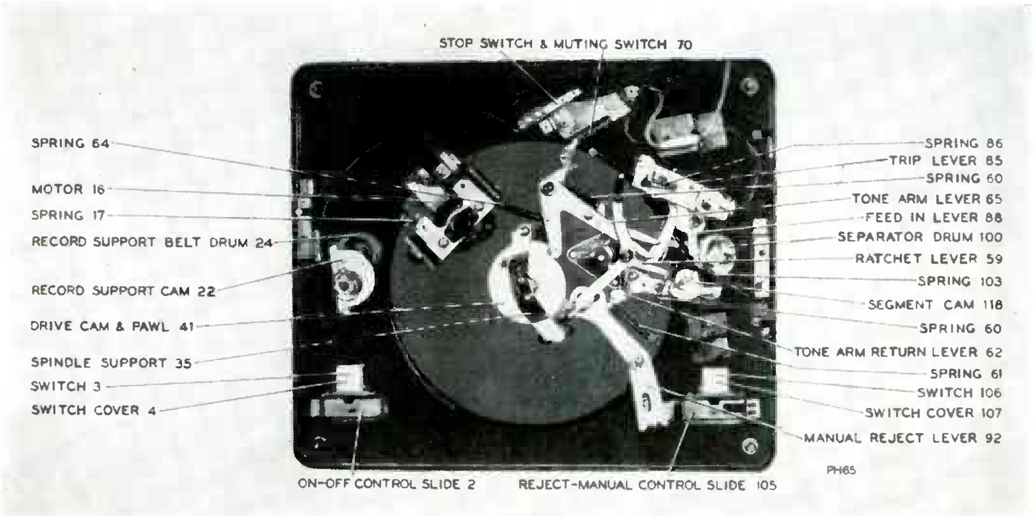


Fig. 4—Underside of an RCA slicer-type record changer (RP-176), showing the manufacturer's nomenclature for various parts of the mechanism.

correct, grease the following points *sparingly*:

1. Both ends of the push-off bar return spring.
2. Fulcrum of push-off rod.
3. Contact point of push-off bar and hanger.
4. Point where hanger pivots in the fulcrum plate.
5. Where push-off rod rides in the push-off bar.

On 2- or 3-speed changers which have a single tone arm and a cartridge selector, apply petroleum jelly or Dow-Corning DC-4 lubricant to the contacts of cartridge-contact plate and to the dimple of the cartridge-retaining spring. In most changers, some powdered graphite should be applied to the ear of the cartridge selector plate.

Adjusting needle pressure

An accurate gram scale (such as the Philco 45-9531) should be used to check needle pressure. Follow the manufacturers' suggestions wherever possible, since the recommended pressures vary, as well as the methods used to adjust the pressure. (Some changers have adjusting screws, while others rely on bending the tone-arm hinge bracket or mounting stud to decrease or increase the tone-arm spring tension. Counter-balances generally are unnecessary unless a different type of tone arm or cartridge must be used, or where an older type changer is being modernized.

Generally, needle pressure for 78-r.p.m. records should be from 1 to 1.25 ounces; for 33⅓- and 45 r.p.m. records, between 7 and 12 grams.

It pays to remember that changer troubles are very rarely caused by actual failure or breakage of parts in the operating mechanism in normal service. Most troubles are due to lack of lubrication; over-lubrication (or using the wrong lubricant at certain points); dirt clogging the mechanism; or improper adjustments. Of course, this doesn't imply that parts can't be broken by mishandling or forcing the changer mechanism out of its normal operating cycle. This happens all too frequently, especially where children have unsupervised access to the changer.

Part II of this series will deal with identifying and correcting specific troubles in several types of single-speed, two-speed, and three-speed changers.

(Photos and some of the notes used in this article are reproduced through the courtesy of Garrard, Philco, RCA, and Webster-Chicago.)

(TO BE CONTINUED)

TELEVISION CONSTRUCTION PERMITS

(as of June 25, 1953)

ALABAMA

WJLN-TV	Birmingham	48
WSGN-TV	Birmingham	42
WMSL-TV	Decatur	23
WKAB	Mobile	48

ARIZONA

KOOL	Phoenix	10
KOY-TV	Phoenix	10
KCNA-TV	Tucson	9
KVOA-TV	Tucson	4
KIVA	Yuma	11

ARKANSAS

KFSA-TV	Fort Smith	22
KETV	Little Rock	23
———	Little Rock	4
———	Pine Bluff	7

CALIFORNIA

KAFY-TV	Bakersfield	29
———	Bakersfield	10
KHSL-TV	Chico	12
KIEM-TV	Eureka	3
KJEO	Fresno	47
KPIK	Los Angeles	22
KUSC-TV	Los Angeles	28
KICU	Salinas	28
KITO-TV	San Bernardino	18
KFSD-TV	San Diego	10
KBAY-TV	San Francisco	20
KSAN-TV	San Francisco	32
———	San Jose	48
KEYT	Santa Barbara	3
KTVU	Stockton	36
KCOK-TV	Tulare	27
KAGR-TV	Yuba City	52

COLORADO

KRDO-TV	Colorado Springs	13
KDEN	Denver	26
KIRV	Denver	20
KFXJ-TV	Grand Junction	5
KCSJ-TV	Pueblo	5

CONNECTICUT

WCTB	Bridgeport	71
WSJL	Bridgeport	49
WEDH	Hartford	24
WNLC-TV	New London	26
WCTN	Norwich	63
———	Stamford	27
WATR-TV	Waterbury	53

DELAWARE

———	Dover	40

FLORIDA

WITV	Fort Lauderdale	17
WINK-TV	Fort Myers	11
WJHP-TV	Jacksonville	36
WOTV	Lakeland	16
WJDM	Panama City	7
WPFA	Pensacola	15
WEAR-TV	Pensacola	3
WIRK-TV	West Palm Beach	21

GEORGIA

WDAK-TV	Columbus	28
WTWV	Macon	47
WGOV-TV	Valdosta	37
WMAZ-TV	Warner Robins (Macon)	13

IDAHO

KIDO-TV	Boise	7
KTVI	Boise	9
KID-TV	Idaho Falls	3
KIFI-TV	Idaho Falls	8
———	Meridian	2
KFXD-TV	Nampa	6
KISJ	Pocatello	6
KWIK-TV	Pocatello	10
KLIX-TV	Twin Falls	11

ILLINOIS

WTVI	Belleville (St. Louis)	54
WBLN	Bloomington	15
WCIA	Champaign	3
WHFC-TV	Chicago	26
WIND-TV	Chicago	20
WDAN-TV	Danville	24
WTVP	Decatur	17
WSIL-TV	Harrisburg	22
WTVH-TV	Peoria	19
———	Quincy	10
———	Rockford	13
WICS	Springfield	20

INDIANA

WTRC-TV	Elkhart	52
———	Evansville	62
WKJG-TV	Fort Wayne	33
WJRE	Indianapolis	26
WNES	Indianapolis	67
WMRI-TV	Marion	29
WRAY-TV	Princeton	52
WINT	Waterloo	15

IOWA

WMT-TV	Cedar Rapids	2
KDIO	Davenport	36
KTLV	Des Moines	17
KQTV	Fort Dodge	21
KWTV	Sioux City	36

KANSAS

KTVH	Hutchinson	12
KSAC-TV	Manhattan	8
KOAM-TV	Pittsburgh	7
WIBW-TV	Topeka	13
KEDD	Wichita	16

KENTUCKY

WPTV	Ashland	59
WEHT	Henderson	50
WKLO-TV	Louisville	21
WLOU-TV	Louisville	41
———	Richmond	60

LOUISIANA

KSPJ	Alexandria	62
KHTV	Baton Rouge	40
KTAG-TV	Lake Charles	25
KFAZ	Monroe	43
KNOE-TV	Monroe	8
WCNO-TV	New Orleans	32
WJMR-TV	New Orleans	61
———	New Orleans	20
———	New Orleans	26

MAINE

WPMT	Portland	53

MARYLAND

WITH-TV	Baltimore	60
WFMD-TV	Frederick	62
WBOC-TV	Salisbury	16

MASSACHUSETTS

WSTB-TV	Boston	50
WTAO-TV	Cambridge	56
WSEE-TV	Fall River	46
———	Lawrence	72
WNBH-TV	New Bedford	28
WMGT	North Adams	74
WNOH	Northampton	36
———	Worcester	65

MICHIGAN

WBCK-TV	Battle Creek	58
WHFB-TV	Benton Harbor	42
WWTV	Cadillac	13
WKAR-TV	East Lansing	60
WCTV	Flint	28
WTAC-TV	Flint	16
WIBM-TV	Jackson	48
WKMI-TV	Kalamazoo	36
WILS-TV	Lansing	54
WTVM	Muskegon	35

MINNESOTA

KMMT	Austin	6
WTCN-TV	Minneapolis	11
KROC-TV	Rochester	10
WJON-TV	St. Cloud	7
WCOW-TV	St. Paul	17
WMIN-TV	St. Paul	11

MISSISSIPPI

WCBI-TV	Columbus	28
WGCM-TV	Gulfport	56
WCOC-TV	Meridian	30
WIOK-TV	Meridian	11

MISSOURI

KGMO-TV	Cape Girardeau	18
KFUO-TV	Clayton	30
KOMU-TV	Columbia	8
KACY	Festus	14
KHQA-TV	Hannibal	7
KCMO-TV	Kansas City	5
KFEQ-TV	St. Joseph	2
KETC	St. Louis	9
KSTM-TV	St. Louis	36
WIL-TV	St. Louis	42
KDRO-TV	Sedalia	6
KYTV	Springfield	3

MONTANA

KOOK-TV	Billings	2
———	Billings	8
KPOR-TV	Butte	4
KXLF-TV	Butte	6
KFBB-TV	Great Falls	5
KMON-TV	Great Falls	3
KGVO-TV	Missoula	13

NEVADA

KLAS-TV	Las Vegas	8
KZTV	Reno	8

NEW HAMPSHIRE

WKNE-TV	Keene	45

NEW JERSEY

WRTV	Asbury Park	58
WOCN	Atlantic City	52
WTLV	New Brunswick	19
WDHN	New Brunswick	47

NEW MEXICO

KGGM-TV	Albuquerque	13
———	Albuquerque	7
———	Clovis	12
KTVK	Santa Fe	2

NEW YORK

WROW-TV	Albany	41
WTVZ	Albany	17
———	Albany	23
WQTV	Binghamton	46
WBES-TV	Buffalo	59
WBUF-TV	Buffalo	17
WTVF	Buffalo	23
WECT	Elmira	18
WHCU	Ithaca	20
WIET	Ithaca	14
WJTN-TV	Jamestown	58
WKNY-TV	Kingston	66
WGTV	New York	25
WEOK-TV	Poughkeepsie	21
WRNY-TV	Rochester	27
WROH	Rochester	21
———	Rochester	15
———	Schenectady	35
WHTV	Syracuse	43
WWNY-TV	Watertown	48

NORTH CAROLINA

WISE-TV	Asheville	62
WAYS-TV	Charlotte	36
WCOG-TV	Greensboro	57
WNCT	Greenville	9
WHKP-TV	Hendersonville	27
WPAQ-TV	Mt. Airy	55
WNAO-TV	Raleigh	28
WTOB-TV	Winston-Salem	26

NORTH DAKOTA

KFYR-TV	Bismarck	5
———	Bismarck	12
KNDK	Minot	10

OHIO

WICA-TV	Ashtabula	15
WCIN-TV	Cincinnati	54
———	Cleveland	65
WOSU-TV	Columbus	34
WIFE	Dayton	22
WIMA-TV	Lima	35
WMAC-TV	Massillon	23
WLEC-TV	Sandusky	42
WHHH-TV	Warren	67
WUTV	Youngstown	21

OKLAHOMA

———	Miami	58
KLPR-TV	Oklahoma City	19
KTVQ	Oklahoma City	25
KCEB	Tulsa	23

OREGON

———	Eugene	13
KTVF	Eugene-Springfield	20
KBES-TV	Medford	5
KPIC	Salem	24

PENNSYLVANIA

WCHA-TV	Chambersburg	46
WGLV	Easton	57
WAZL-TV	Hazleton	63
WARD-TV	Johnstown	56
WWLA	Lancaster	21
WMRF-TV	Lewistown	38
WIP-TV	Philadelphia	29
WENS	Pittsburgh	16
WKJF-TV	Pittsburgh	53
———	Pittsburgh	13
WTVQ	Pittsburgh	47
WARM-TV	Scranton	16
WTVU	Scranton	73
WILK-TV	Wilkes-Barre	34
WRAK-TV	Williamsport	36
WNOW-TV	York	49

RHODE ISLAND

———	Providence	16

SOUTH CAROLINA

WACA-TV	Camden	14
WIS-TV	Columbia	10
WNOK-TV	Columbia	67
WGVL	Greenville	23
WCRS-TV	Greenwood	21

TENNESSEE

WOUC	Chattanooga	49
WTVT	Chattanooga	43
WJHL	Johnson City	11
WCEE-TV	Knoxville	26
WHBQ-TV	Memphis	13

TEXAS

KRBC-TV	Abilene	9
KBMT	Beaumont	31
KDTX	Dallas	23
KLIF-TV	Dallas	29
KEPO-TV	El Paso	13
———	Fort Worth	20
KTVR	Galveston	41
KGBS-TV	Harlingen	4
KNUZ-TV	Houston	39
KTVP	Houston	23
———	Houston	29
KTVE	Longview	32
KFYO-TV	Lubbock	5
KTRE-TV	Lufkin	9
KTXL-TV	San Angelo	8
KALA	San Antonio	35
———	Sherman	46
KCEN-TV	Temple	6
KCMC-TV	Texarkana	6
KETX	Tyler	19
KNAL-TV	Victoria	19
KANG-TV	Waco	34
KTVW	Wichita Falls	22

UTAH

KUTV	Salt Lake City	2

VIRGINIA

WCHV-TV	Charlottesville	64
WBTM-TV	Danville	24
WVEC-TV	Hampton	15
WSVA-TV	Harrisonburg	3
WWOD-TV	Lynchburg	16
WMEV-TV	Marion	50
WACH	Newport News	33

WASHINGTON

———	Seattle	4
WMO-TV	Tacoma	13
KIMA-TV	Yakima	29
KIT-TV	Yakima	23

WEST VIRGINIA

WKNA-TV	Charleston	49
WTAP	Parkersburg	15
WLTV	Wheeling	51
———	Wheeling	7

WISCONSIN

WRBJ	Beloit	57
WEAU-TV	Eau Claire	13
WKOW-TV	Madison	27
WMTV	Madison	33
WCAN-TV	Milwaukee	25
WOKY-TV	Milwaukee	19
WNAM-TV	Neenah	42
WOSH-TV	Oshkosh	48

WYOMING

KSPR-TV	Casper	2
KFBC-TV	Cheyenne	5

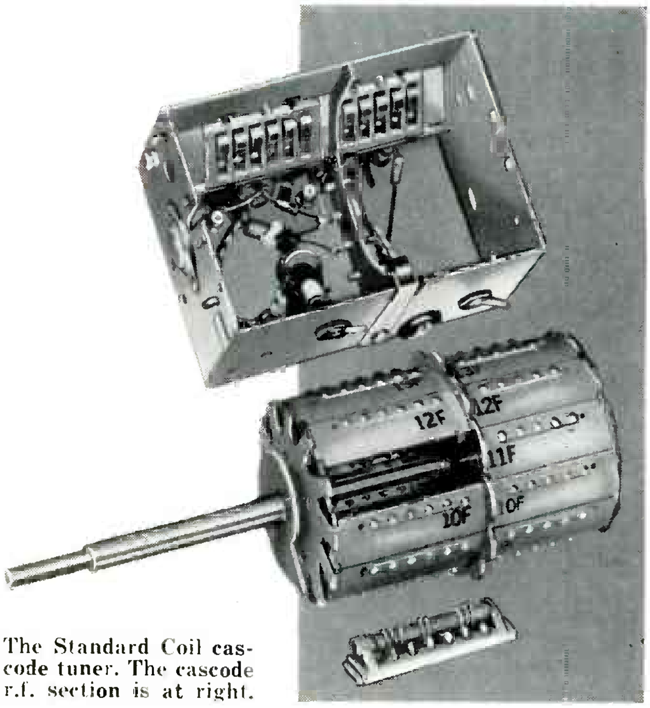
TERRITORIES

WKAQ-TV	San Juan, P.R.	2
———	Honolulu, Hawaii	4

Cascode Type Front Ends

Part 1—Input-tube noise and its effect on receiver sensitivity—the basic low-noise high-gain all-triode input circuit

By DAVID T. ARMSTRONG



The Standard Coil cascode tuner. The cascode r.f. section is at right.

THE maximum sensitivity of any receiver is determined largely by the characteristics of the first stage. The input circuit establishes the signal-to-noise ratio of the receiver and sets the ultimate limit of detectability of weak signals.

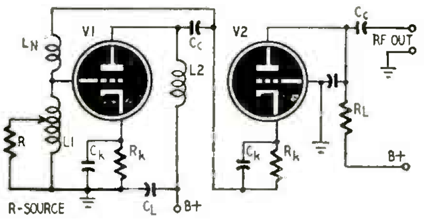


Fig. 1—The original cascode circuit developed at the Massachusetts Institute of Technology for radar i.f. amplifiers. The neutralizing coil L_N improves the inherent low-noise characteristics of the all-triode circuit.

For satisfactory reception the signal must be greater in magnitude than the noise at every point in the receiver. The minimum usable signal is determined not by the total amplification but by the noise voltages generated in the input stage. Some of these input-stage noises are contributed by the antenna, the power supply, and the passive circuit components, but these are beyond the set-designer's control, except for hum due to inadequate filtering. Assuming an ideal antenna, and perfect filtering, we are still faced with the problem of noise that originates in the first tube.

Tube noise

All tubes contribute thermal, contact, and shot-effect noises which are amplified in the tubes themselves and in succeeding stages along with the desired signal. Where the tube noise is of the same magnitude as the signal, or greater, the signal will be blanked out by the overriding noise in the circuit.

The noise generated in any tube increases with the number of grids, since voltages on any elements between the cathode and the plate will affect the electron stream. A pentode, with three grids, has inherently less noise than a pentagrid converter, which has *five;* and a triode—with only one grid—has the lowest noise level of all. Besides making their own contributions to the noise level, the extra grids in pentodes and multigrid converters are generally connected to resistors, bypass capacitors, and other circuit elements which add *their* noise voltages to the tube noise.

Tube noise also increases with the range of frequencies a tube must handle simultaneously. Any tube can deliver only a given amount of power, and a fixed percentage—say 20%—is represented by the inherent noise. If the tube is a straight r.f. amplifier, the remaining 80% is available for the desired signal. But if the same tube is operated as a converter, the available power is divided among the original signal, the oscillator signal, the sum of the oscillator and original-signal frequencies, and the difference between the oscillator and original-signal frequencies—*plus* innumerable harmonics and *their* sums and differences.

Thus the desired output signal—generally the difference between the oscillator and original signal—represents only a small fraction of the total output power, while the noise is still pretty close to 20%.

The best way to raise the sensitivity of a receiver, then, is to boost the desired signal as much as possible *before it goes into the converter stage,* without introducing too much additional noise. A 3-db increase in signal-to-noise ratio is equivalent to doubling the transmitter power; it is also equivalent to reducing the distance from the transmitter by about 15%.

One way of improving the signal-to-noise ratio without adding an r.f. amplifier stage is to overcouple the converter input circuit to the driving source. Of course there is some loss in gain as a result of overcoupling, but there is an optimum point at which the improvement in signal-to-noise ratio more than compensates for any loss of gain.

This gives only a limited amount of improvement, of course, and the best solution is still a low-noise r.f. amplifier. There are at least five advantages to be gained:

1. Additional voltage gain to feed a good husky signal to the converter.
2. Higher signal-to-noise ratio.
3. Additional tuned interstage circuits for improving selectivity and reducing image interference.
4. Isolation of the antenna from the local oscillator to reduce interference to other receivers.
5. The higher input impedance of an amplifier compared to a converter enables us to use a greater step-up ratio in the input transformer. Here we are faced with the problem of deciding what type of tube to use for the r.f. amplifier—triode or pentode? The triode has the lowest noise—but relatively low gain. The pentode has high gain—but high noise as well. Obviously, the ideal solution would be a stage that combines the best features of both—and we have one—the *cascode* amplifier.

Very few FM or TV receivers have more than one stage of r.f. amplification preceding the mixer, partly because of the complexity of ganging additional tuning circuits, and because this would mean an extra tube.

The cascode circuit is a means of using a single tube ahead of the mixer to provide the approximate gain of a two-stage r.f. amplifier, with the additional virtue of having an extremely low noise figure.

Since there are three basic types of r.f. amplifier—grounded-cathode, grounded-grid, and grounded-plate—there are nine possible combinations for two stages. Each combination has specific inherent characteristics and circuit virtues.

One of the most desirable combinations for low noise and good gain is a grounded-cathode input stage feeding a grounded-grid second stage; this is the basic cascode circuit.

The fundamental low-noise cascode circuit developed at the MIT Radiation Laboratory by Wallman et al., is shown in Fig. 1. A grounded-cathode triode feeds a grounded-grid triode. Two triodes so connected provide an over-all gain a shade better than the gain from a single high-frequency pentode in a grounded-cathode-type r.f. amplifier. But the noise figure improvement is considerable.

The stability of a cascode amplifier is achieved by loading down the output of the grounded-cathode input stage with the low input resistance of the grounded-grid stage; this prevents the input triode from oscillating because its full output power is absorbed by the grounded-grid stage. The neutralizing coil L_n (which may be omitted) improves the stability and effects some reduction in noise figure. Fig. 2 is a commercial version of the cascode circuit used in some recent TV tuners.

The input resistance of a grounded-grid amplifier is approximately equal to the reciprocal of the gm of the tube. Thus a tube with a transconductance of 3,300 micromhos would have an input resistance of approximately 1/.0033, or 300 ohms. Conventional plate-circuit loading in the first (grounded-cathode) stage for a bandwidth of 4 to 6 mc is 4,000 ohms; hence loading the output of the first triode with a low resistance like 300 ohms would broaden the bandwidth to as much as 50 mc. Tuning would be unnecessary, but at the same time there would be practically no discrimination against off-channel, spurious signals, and external noise.

The r.f. choke in series with the cathode resistor of the grounded-grid stage in Fig. 2 raises the coupling-circuit impedance enough to prevent loss of selectivity, but not enough to cause oscillation.

In Fig. 2 R_g is a grid-leak resistor which places the grid at ground potential for d.c. R_k is the bias resistor which makes the cathode positive with respect to ground and thus supplies bias to the tube. C_k is the cathode-bypass capacitor which effectively grounds the cathode for r.f. L1 is a slug-tuned inductor, designed to resonate at the desired frequency with the circuit capacitance. R_L and L1 form the plate-load impedance across which a.c. variations of the plate current develop an amplified output voltage. C_c is a blocking capacitor which isolates the cathode of V2 from the B plus voltage at the V1 plate.

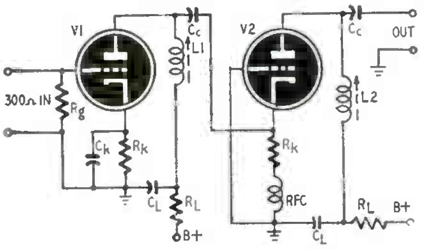


Fig. 2—A modern commercial version of the cascode circuit used as a low-noise r.f. amplifier in a television tuner.

Basically, V1 is a variable-resistance device, in which a large change in resistance is produced by a small change in grid-to-cathode voltage. The grid swings alternately positive and negative with respect to ground with the signal; since the cathode is at r.f. ground through C_k, the grid also swings positive and negative with respect to the cathode. This varies the internal resistance of the tube, changing the plate current, and the voltage drop through R_L. The change in plate-to-ground voltage constitutes the output and determines the gain over the input voltage.

A cascode amplifier tends to hold the triode plate potential fixed and still permit current to flow in a load resistor. Thus it behaves like a pentode, with the advantage that no screen current is required. It is an ideal circuit for single-frequency applications; at the same time it is better than existing circuits for the front ends in TV and FM receivers; finally, it makes an excellent i.f. preamplifier for a u.h.f. receiver. The circuit has shown a noise figure of only 0.5 db at 6 mc without critical adjustments of any sort. Practically all 1953 TV receivers use this circuit or one of its modifications for improved fringe-area reception.

Another commercial cascode circuit is given in Fig. 3. This is the r.f.-amplifier portion of the Standard Coil cascode tuner. This circuit has direct coupling between the first and second triodes. The B plus voltage divides about equally across the two triodes, so that the cathode of V2 is about 120 volts above ground. The grid of V2 is held at approximately the same d.c. voltage as the cathode by the voltage-divider network R1, R2, but is grounded for r.f. by the 800-μμf bypass capacitor C1.

Several high-gm twin-triode tubes have been developed specifically for cascode operation. These include the 6BK7, 6BK7-A, 6BQ7, 6BQ7-A, and 6BZ7. (The "A" types are recent improved versions of the 6BK7 and 6BQ7, with

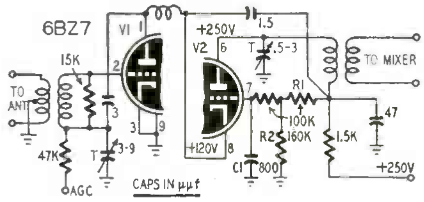


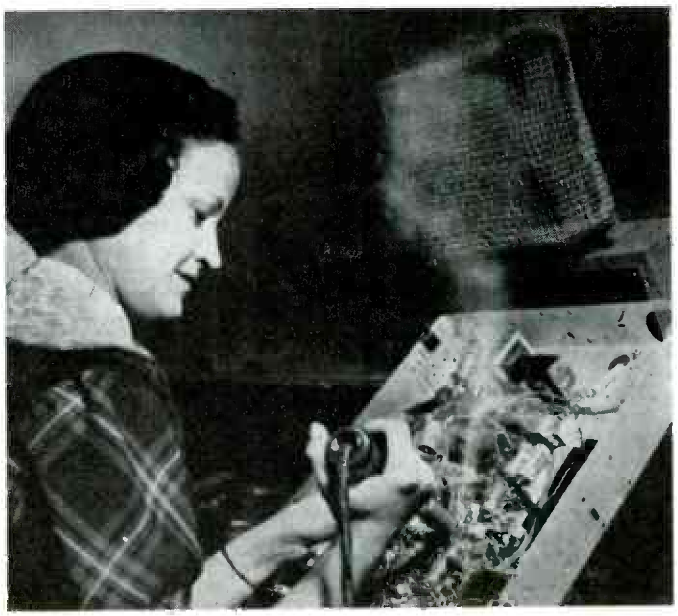
Fig. 3—A direct-coupled form of cascode circuit. This is the r.f. amplifier in the Standard Coil type 2232 tuner.

higher gm, better internal shielding, and higher input impedance.) Actually, special twin-triode types are not essential. Individual triodes can be used, provided the heater-cathode insulation of the second (grounded-grid) triode (in direct-coupled circuits like Fig. 3) can withstand the d.c. voltage between cathode and ground.

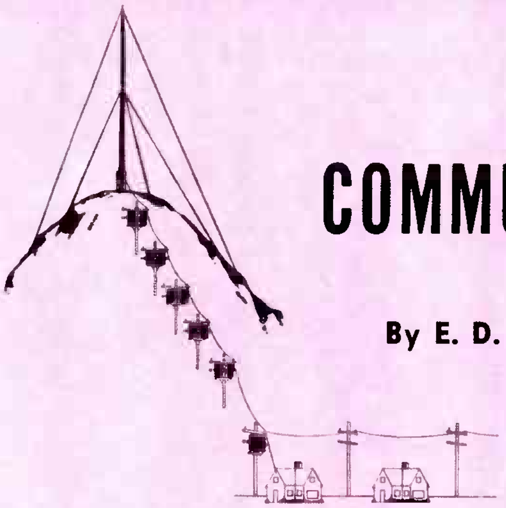
The special twin-triode types listed above have exceptionally high cascode transconductance, internal shielding between triodes to isolate each section.

(TO BE CONTINUED)

SIMPLE GADGET CUTS TV PRODUCTION HAZARD



Licking "solder smog" on the CBS-Columbia TV-set production line. A small electric fan, with the blades reversed on the shaft or bent to opposite pitch, pulls the soldering fumes away from the operator's face. Chicken-wire screening guards against possible accident.



COMMUNITY TV SYSTEMS

By E. D. LUCAS, JR.

Further details on circuit arrangements, equipment, and distribution systems used by several leading manufacturers.

(CONCLUSION)

MANY Jerrold and RCA community-TV installations have crystal-controlled converters to convert any high-band v.h.f. channels down to unused low-band channels; or to convert one low-band channel to another to avoid adjacent-channel cross-modulation. Thus a typical Jerrold system, like RCA's, is designed to distribute channels 2, 4, and 6 (or 2, 4, and 5) no matter what channels are received at the antenna site.

Three-channel operation, entirely in the low band, is utilized by both RCA and Jerrold to avoid the high cable attenuation inherent in distributing high-band channel frequencies. Thus in a typical case where channels 3, 6, and 10 are received, channel 6 is amplified without conversion; channel 10 is converted to channel 4; and channel 3 is converted to channel 2. RCA does this in two stages (3-to-12 and 12-to-2). Double conversion is desirable from channel 3 to channel 2 because a direct adjacent-channel conversion involves many sideband problems. RCA uses two 3-tube converters, to make the two-stage conversion from channel 3 to channel 2; and one similar converter for the channel 10-to-4 stepdown.

With many new u.h.f. stations now going on the air, manufacturers of community TV equipment will soon be providing converters of similar design to convert any desired u.h.f. channel down to a suitable unused v.h.f. channel.

Automatic gain control

RCA, Philco, and Jerrold all apply a.g.c. to the amplifier unit immediately following the preamplifier. Good a.g.c. is almost invariably required in community-TV installations because the signal level at the antenna site is likely to show wide variations, depending on the weather, the season, and the time of day or night.

In its tower system, RCA feeds back part of the signals from the input amplifiers through control circuits to supply a.g.c. voltages to compensate for variations in signal strength and changes in a.c. line voltage. The first part of a typical a.g.c. unit, (the Philco version, Fig. 1), has three high-gain r.f.-amplifier stages with narrow band-pass, tuned to the video carrier of the channel to be controlled. Then follows a detector stage and limiter, and the resultant detected voltage is filtered and applied to the control grids of the associated amplifier strip.

Jerrold provides a similar a.g.c. unit with a single r.f. amplifier stage preceding the detector. This unit will hold the output constant within 2 db under input variations up to 40 db.

Tower output amplifiers

The amplifier units to which a.g.c. action is applied are called various names by different manufacturers, but all provide the added signal level required for a long cable run from the antenna tower to the first line amplifier. In almost every community installation, the antenna tower or towers are on a hilltop—usually relatively inaccessible. In many installations, notably Harrisburg, Lewistown, and Lock Haven, Pa., and Palm Springs, Calif., the hilltop antennas can be reached only on foot after a hard climb. Hence it is important to get as much gain as possible at the antenna site, so that the next amplifier can be located at a comparatively accessible spot.

For example, at Palm Springs the antenna site is on top of a 2,800-foot peak. International Telemeter, using equipment of its own design, achieves an output level of over 1.25 volts per channel at this site. This high output makes possible a cable run of about 6,700 feet to the next amplifier, which is located on flat terrain that can be reached by motor vehicle.

As a common-sense precaution at such inaccessible sites the operators of most systems have installed complete duplicate equipment, including spare antennas, preamplifiers, output amplifiers, and a.g.c. Telemeter controls the changeover to stand-by equipment, when necessary, with coaxial switches operated by relays from the Palm Springs distribution center, 10 miles away. In the system at Harrisburg, Pa., two separate cables bring the signal down from Fort Hunter Ridge where the duplicate equipment is installed; and switching to stand-by equipment is done manually at the end of the jeep road at the base of the ridge.

Philco uses a mixer amplifier (Fig. 2) following the preamplifier stage, into which the outputs of the individual channel-preamplifier strips are fed. In exceptional cases, where signal level is high enough (2,000 microvolts or more), the preamplifier may be omitted and this strong signal fed directly into the mixer amplifier. Most important precautions include: (a) Signal inputs from each channel into the mixer amplifier should be of approximately the same value; (b) this level should be at least 1,000 microvolts or higher, in order to maintain a high signal-to-noise ratio; (c) input level should not exceed 8,500 microvolts, or there may be trouble from cross-modulation and sync instability. The first two of these precautions apply to practically all makes of output amplifiers; however, most types can handle a higher input level without overloading.

Gain of these Philco mixer-amplifier strips is peaked at the high end in proportion to the attenuation *vs.* frequency characteristics of RG-11/U cable, since this system does not use channel converters. Gain ranges from 33 db at channel 2 to 45 db at channel 13, making it possible to run about 1,400 feet of RG-11/U or SP-75 cable from each of the two mixer-amplifier outputs to the first line amplifier.

The Jerrold output amplifier or "re-amplifier" also provides a stagger-tuned strip for each channel as shown in Fig. 3. Gain is about 54 db on the low-band strips, while high-band gain is 51 db or less. The outputs are mixed by connecting the strip outputs in parallel through short sections of RG-59/U cable cut to simulate half-wave resonant lines. Hence at each strip's output, the signal looks forward into a matching 72-ohm terminal and back-ward through a half-wave resonant line at the high impedance of a series-antiresonant circuit.

Telemeter has also developed its own head end equipment, with individual amplifier strips, associated a.g.c., and collector (mixer) amplified outputs. Details on this equipment are not yet available, although it is being used successfully at Palm Springs. However, it is revealed that average gain of over 50 db has been achieved.

A few installations have used equipment made by Lyn Mar Engineers, Philadelphia, Pa., a company which designs custom head ends to meet the specific signal conditions of each antenna site. One successful installation is at Carlisle, Pa., and includes strip-type stagger-tuned preamplifiers, channel converters, and output amplifiers with a.g.c.

In the SKL broad-band system, where individual amplifier strips are not used, sufficient amplification at the antenna site can be achieved only by cascading broad-band amplifiers. Experience indicates that a maximum of three SKL amplifiers can be cascaded without cross-modulation or sync tearing.

Line amplifiers

As shown on the block diagrams in Part I, all commercial community-TV installations have standard line amplifiers at suitable intervals along the cable network. These amplifiers are used to help bring TV signals from the antenna site to the community—unless the head-end equipment has given the signal enough of a boost—and then to maintain a satisfactory level for distributing these signals to subscribers in the areas to be served.

Individual-channel line amplifiers are provided by several manufacturers. The RCA design calls for a two-strip amplifier for each channel, with each of the two strips including three stagger-tuned 6AK5 stages. Over-all two-strip gain ranges from 55 to 60 db; frequency response is flat within 3 db over the 6-mc bandwidth of each channel. Output is about 1.25 volts r.m.s. across 72 ohms, permitting spacing of about 2,300 feet between amplifiers with SP-75 cable. Remember that this is a low-band distribution system only, with any high-band v.h.f. channel converted to an unused low-band channel.

RCA is said to be developing a seven-channel community system for distributing both high- and low-band signals, without conversion, but has not announced it yet.

Philco utilizes a relatively low-gain line amplifier, again with a strip for each channel. Since there is no channel conversion, the high-channel strips are given extra gain to compensate for the increased cable attenuation at these frequencies. Low-band line-amplifier strips have two 6CB6 stages feeding a 6AK5 output, with gain ranging from 15 db on channel 2 to 19 db on channel 6; high-band strips have five 6AK5 stagger-tuned stages with gain ranging from 29 db on channel 7 to 33 db on channel 13. This design allows for about 1,100 feet of RG-11/U or SP-75 cable between amplifiers.

For low-band community systems, using converters in most cases, Jerrold employs strip-type line amplifiers ("reamplifiers") like the schematic of Fig. 3. These strips have a maximum output of about 1.5 volts, gain averaging 54 db and flat response within 0.5 db over each channel's bandwidth as typical specifications. Spacing of about 2,000 feet between amplifiers using SP-75 cable is typical. This type of Jerrold equipment, distributing channels 2, 4, and 6 no matter what three channels are received at the antenna site, has been very widely installed.

However, recently in areas where several TV channels can be received, especially in southern California and in the vicinity of New York City where seven channels are available, Jerrold has designed several community-TV systems that have broad-band line amplifiers. The Jerrold broad-band line amplifier has separate strips for the low and high v.h.f. bands, and an ingenious arrangement to compensate for cable attenuation. The first line amplifier contains both high- and low-band strips. The second amplifier has only a high-band strip, while the third has both strips, and the fourth again has the high only. This technique gives the additional gain required on the high band, and amplifiers can be spaced

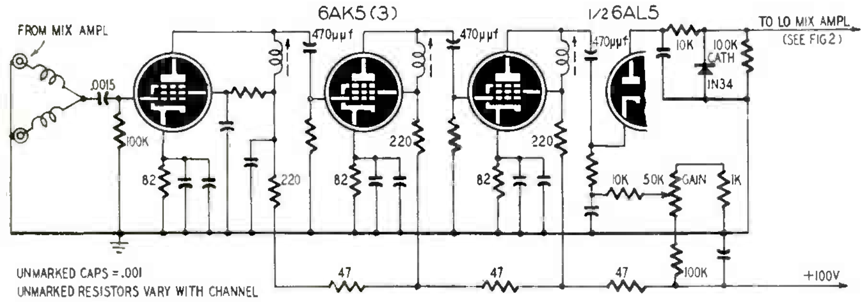


Fig. 1—Philco a.g.c. amplifier-rectifier circuit for a single low-band channel.

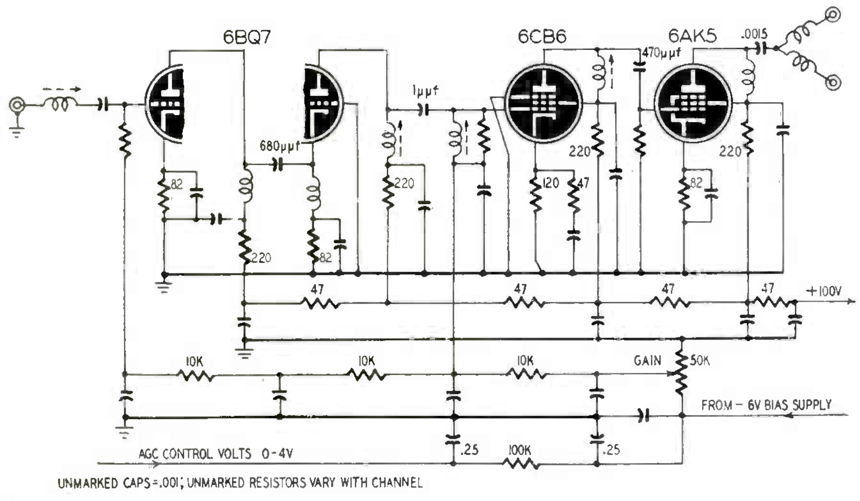


Fig. 2—Circuit of the Philco output ("mixer") amplifier used for feeding signals from individual-channel preamplifiers at the antenna into the main system line.

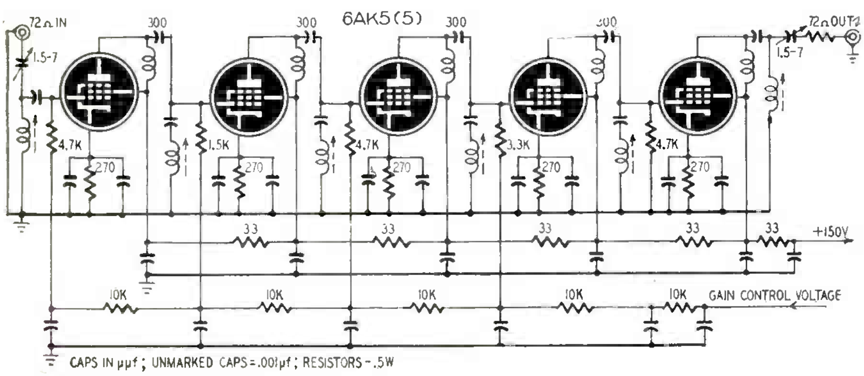


Fig. 3—Jerrold single-channel line-amplifier strip for any low-band station.

about 1,000 feet apart along the main feeder and branch lines.

In the SKL distribution system, using the "distributed" broad-band line amplifier (see Part I), it is necessary to use an equalizer either at the output or input of each line amplifier to compensate for different cable losses at various frequencies. If the system is designed for seven-channel operation, channel 13 represents the limiting frequency (highest attenuation) and only about 650 feet of SP-75 can be used between these broad-band amplifiers, which have a gain of only 20 db. This relatively close spacing on the line becomes a serious handicap in designing a large community-TV system, requiring a large number of amplifier stations and hence more power outlets, higher power consumption, and more maintenance locations. One possible solution is to use two SKL amplifiers in cascade at each location and thus achieve about 40 db gain.

Telemeter has designed a "dis-

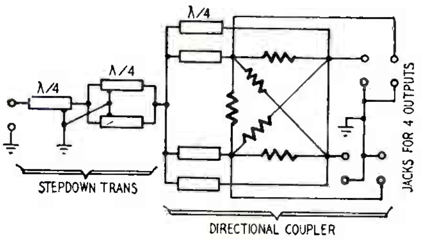


Fig. 4—Circuit of SKL 4-outlet directional coupler. Impedance-matching transformers are quarter-wave sections of low-loss coaxial transmission line.

tributed" broad-band line amplifier similar to the SKL. This new model has numerous advantages. Construction is in three units—a power supply and two amplifier strips. The latter each have twelve 6AK5 tubes for a total of four chain-type stages with good stability and reliability and no need for alignment or realignment. Average voltage gain ranges from 40 to 46 db (100 to 200 times). Electrically, improvements have been made such as winding all the delay-line inductances on machine-threaded plastic rods, and adding a dependable voltage-regulated power supply. A typical mechanical advance is the placement of tubes on top of the strips where they are easily accessible for checking and replacement.

This Telemeter broad-band line amplifier has tilted gain *vs.* frequency from about 40 db at channel 2 to 46 db at channel 13. Although channel equalizers are still necessary and have been included in the Palm Springs system, the amplifier tilt helps compensate for higher cable attenuation on the higher channels.

Distribution systems

From the line amplifiers, the TV signals are distributed to feeder cables and thence to subscribers' homes by a variety of techniques.

For example, RCA utilizes distribution transformers to split the signal from the main cable into feeder cables. Next, "extension units" are inserted into each feeder cable. These are weather-tight, resistive, tap-off fittings. The value of resistance in each fitting depends upon the distance from the amplifier and length of lead-in to the home. The object is to deliver about 1,000 microvolts of signal on each channel distributed, to the TV-receiver terminals. It is also important, obviously, to provide isolation between adjacent sets connected to the system and to prevent local-oscillator radiation in a noisy receiver from feeding back into the cable. Thus the impedance presented by the tap-off unit must be the best compromise, considering all the factors involved.

In the home, a wall-outlet unit with a 72-to-300-ohm matching device (usually a resistive network rather than a matching transformer, for economy) is used to terminate the community TV system. The subscriber, or the dealer who sells him a television set, connects the receiver to this outlet with ordinary 300-ohm line.

Philco utilizes a similar technique of distribution, except that its resistive isolation units are inserted in the main trunk lines, instead of the feeder lines. This apparently simplifies the distribution system. Actually, it presents the serious disadvantage that service must be interrupted every time an isolation or tap-off unit is inserted in the line to connect a subscriber's home.

The directional coupler, developed by SKL is another ingenious means of passive signal distribution. Fig. 4 shows a four-output coupler schematically. This has four quarter-wave transmission-line matching transformers with inputs in parallel and outputs feeding separate loads. Insertion loss of this unit is 6.5 db, while attenuation between outputs is about 26 db.

Telemeter utilizes a two-output directional coupler of its own design for splitting the output from its line amplifiers. Here insertion loss is about 3 db and attenuation between outputs is 20 db. If more than a two-way split after the amplifier should be required, additional couplers are inserted. The tap-off units are specially designed capacitive couplings inserted into SP-75 feeder cable with RG-59/U or SP-76 cable used for the lead-in to the home. The value of capacitance is chosen on the basis of the same factors as RCA utilizes in selecting resistances for tap-offs: distance from amplifier and length of lead-in to the home.

The distribution method employed by Jerrold is much more elaborate. An electronic splitter called a WADO unit is used to divide the signals from the main trunk line into feeder lines. The WADO most commonly used has three outlets (see Fig. 5) and features low insertion loss, about 3 db gain, and an attenuation between input and output outlets of more than 54 db. The disadvantage of this unit is that it requires power, as against passive splitters, and thus results in additional maintenance problems and higher operating expense.

Feeder cables are run from the WADO, and into these cables are inserted capacitive tap-off units. Capacitance values range from about 2.2 to 7.0 μμf depending on the distance from the WADO and length of lead-in to the home. A typical Jerrold system utilizes RG-59/U cable both for feeder lines and for lead-ins or "drops" to subscribers' homes. Wall outlet boxes similar to RCA's are used inside the home.

Cables and radiation

In a typical community-TV system, the cost of the coaxial cables, supporting wires, line hardware, and the labor of installing them generally exceeds the total cost of all electronic equipment by a wide margin. Further, the performance and design of amplifiers and associated distribution units depend to some extent on the types and quality of cables specified. Obviously, selecting the right cable for each part of the system is highly important.

One major consideration that was largely overlooked in pioneer community installations is *radiation*. With amplifiers having outputs of up to 1.25 volts or more, radiation from ordinary coaxial cable, connectors and even a.c. power lines near the amplifier has been objectionable for two reasons: (1) radiation often interferes with existing TV antennas and receivers nearby; (2) such radiation also makes it possible to bootleg reception by placing an antenna near the radiating cable.

Of course, radiation from cable is not the sole offender. Amplifiers must be properly shielded; they are usually mounted in weathertight metal cabinets which are carefully grounded. A low-pass power-line filter should be used inside each amplifier cabinet to prevent r.f. leakage to the power line. All cable connectors and tap-off units should be approved types and should be wrapped with weatherproof tape and then painted with plastic-base paint to keep out moisture.

Both to prevent radiation leakage and also as a protection against lighting damage, the outer copper-braid shield of the coaxial cable and the steel support strand or "messenger" to which this coaxial is lashed, must be grounded at frequent intervals. Telephone company specifications state that "the outer conductor of TV cable and its supporting strand shall at all times be electrically continuous throughout the system . . . TV cable strand shall be bonded to Telephone Company strand at the first and last poles . . . and at every tenth pole between." (See page 108 in the July RADIO-ELECTRONICS.) Most systems ground every fifth pole.

Different types of coaxial cable are used for the various parts of a community TV system. For long cable runs in unpopulated areas—say from the antenna site to the edge of town—the main requirement is a low-loss cable. Shielding against radiation is not so important because there are no TV sets. Among cable types preferred for this application are Amphenol 21-125 and Federal K-14 coaxial cables. Both have approximately the same specifications: 0.870" O.D.; weight 40 lb. per 100 ft.; single center conductor of No. 9 copper, polyethylene dielectric, and one copper braid shield covered with grey vinyl jacket; impedance 71 ohms; attenuation ranging from 0.55 db per 100 ft. at channel 2 to 1.40 db at channel 13's frequency. This type of cable has been used by Telemeter for its 9-mile run from antenna site into Palm Springs, and for a shorter run by Jerrold at Williamsport, Pa.

For long cable runs where radiation *is* a problem, one solution is a new coaxial cable with extremely low losses, developed in Germany and produced in the U.S. by Phelps-Dodge. This Styroflex cable has a solid outer conductor or shield of aluminum; then a helical winding of polystyrene in multiple-laminated strips bonded to the aluminum with a thin polystyrene envelope; and a center conductor of solid copper or *Copperweld* wire inside the helix. Typical attenuation for the ¾-inch cable ranges from 0.45 db per 100 feet at channel 2 to about 0.80 db at channel 13. Telemeter made the first community installation with this cable at Palm Springs and has developed special connectors for use with it.

The cable most widely used originally in community-TV systems is the familiar RG-11/U supplied by several manufacturers. This 75-ohm cable was originally used for all main trunk lines, but now is being replaced in populated areas by a double-shielded version such as Federal SP-75. Specifications include 0.470-inch over-all diameter; weight 12.7 lb. per 100 feet; a center conductor of 7/21 stranded copper, polyethylene dielectric, and two outer copper-braid shields each covered with a black vinyl jacket. Attenuation per 100 feet ranges from 1.40 db at channel 2 to 3.20 db at channel 13.

RG-59/U cable was used originally for lead-ins or "drops" to individual homes—and now occasionally for feeder lines—but it is now being replaced in many instances with double-shielded SP-76. Specifications of the latter are 0.325-inch over-all diameter; weight 7.9 lb. per 100 feet; attenuation per 100 feet from 2.8 db at channel 2 to 6.1 db at channel 13.

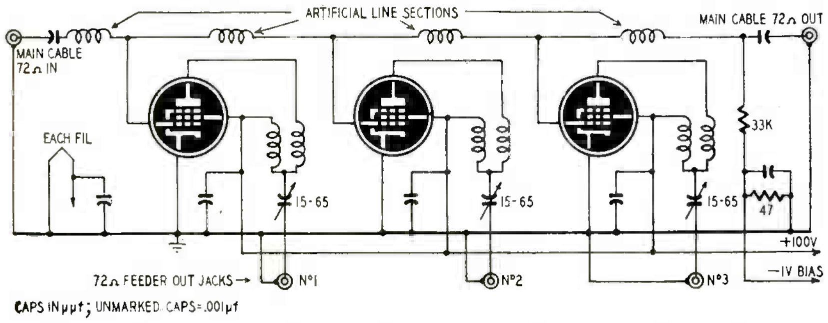


Fig. 5—Schematic of Jerrold Wado 3-way distribution line splitter.

Connectors, while small, are highly important and often a source of trouble. It is essential to use cable connectors, chassis connectors and tap-off units which make firm electrical contact at all temperatures, and despite wind, sleet, and snow. Sometimes it is preferable to use a good splice instead of a connector.

Conclusion

Bringing television to a community means adding a new type of public utility to the existing telephone and electric power facilities. Thus a community-TV system should be organized like a telephone company. Even though neither the FCC nor any of the State public utilities commissions have as yet taken jurisdiction over community-TV, these systems require utility-type operation to provide reliable service to subscribers.

Several community-TV companies, including those in Harrisburg, Hazleton, and Pottsville, Pa., now serve more than 1,500 subscribers. At an average installation charge of $135 per home, plus a monthly service and maintenance charge of $3.75, these community operations have become big business.

Technical progress has been rapid in the three years of commercial community-TV's history. Obviously, operators of such systems must expect rapid obsolescence of electronic equipment; but their cable lines, properly installed and maintained, should be good for many years.

In planning a new community installation, it might be well to keep in mind the following suggestions as to electronic equipment:

1. Specify amplifiers and other units that will handle all 12 v.h.f. television channels. Even though your antennas may be able to receive signals from only two or three stations now, you should allow for future stations coming into your area. Remember that if you have unused v.h.f. channels, and u.h.f. stations become available, you can convert them to v.h.f. at the antenna site and distribute the signals on a v.h.f. channel. Also, you may wish to use one channel for a closed-circuit subscription or "pay-as-you-see" TV operation such as Telemeter is now developing.

2. Because not all TV sets have adequate adjacent-channel selectivity, *don't try to distribute adjacent channels via a community system*. If you can receive adjacent channels, convert one to an unused channel separated from others by a guard band.

3. To obtain adequate a.g.c. action at the antenna site, use individual-channel preamplifiers and output amplifiers at the "head end." This will help maintain a balanced signal level on all channels and prevent cross-modulation.

4. If you plan to distribute several channels, it makes sense to use broad-brand line amplifiers.

5. For branching or splitting equipment, low-loss passive networks are logical because they require no power, they have no tubes, and both maintenance and operating costs are minimized. Further engineering development is needed here—as in other phases of community-TV—to achieve the greatest efficiency.

6. There are many more problems than meet the eye, or can be covered in this article, but don't be discouraged. The rewards for the operators of a successful community-television system are well worth the effort. END

An earlier article describing master TV systems appeared in our January, 1953, issue ("TV Distribution Systems," by Eric Leslie, page 34). It discussed a number of equipment types, including apparatus by Brach, Industrial Television, Amplitel (equipment manufactured by Transvision) Electro-Voice, Blonder-Tongue and Taco.

VERTICAL "SELECTIVITY"

Truth can be stranger than fiction but the following account is by all means fiction.

A chronic complaining TV owner called upon her service technician to adjust her ailing TV. The service technician, with due respect, came within a short while and was surprised to find the set in apparently good working order. Questioning of the customer disclosed dissatisfaction with the quality and sharpness of the picture. Eager to please and assure the customer that she was receiving the best service available, the service technician went through the procedure of refocusing and adjusting the set with the customer looking over his shoulder. After a while, tired and very unhappy because of the customer's discourse on how wonderfully clear the set had been when it was new, the service technician turned the vertical control knob and as the frames slipped slowly over one at a time he ventured, "You pick the clearest picture and I'll lock it there."

So she did, and he did, and everybody was happy. —*Al Katz*

TELEVISION? ...it's a cinch!

By E. AISBERG

Fifth conversation, second half: How and when a capacitor charges and discharges—the exponential curve—and that neon lamp again

Story without an end

WILL—I'm still thinking about that time-constant. If it indicates the time in which the capacitor charges to two-thirds of full capacitance, then it should take half again as long to complete the charge. So our capacitor with the .02-second time-constant would take .03 second to charge completely?

KEN—Mistake! I've news for you, Will, the capacitor will *never* charge completely!

WILL—But that's nonsense! Why—after a reasonable time—shouldn't the voltage across the capacitor terminals rise to the voltage of the supply?

KEN—Don't you know, that in the Creation of the World of Electronics, first was the electron and the proton. Then after a few other labors, was created Ohm's law. And since then everything has been done according to that law.

WILL—I know that the current that charges a capacitor has to follow Ohm's law. But what's that got to do. . . ?

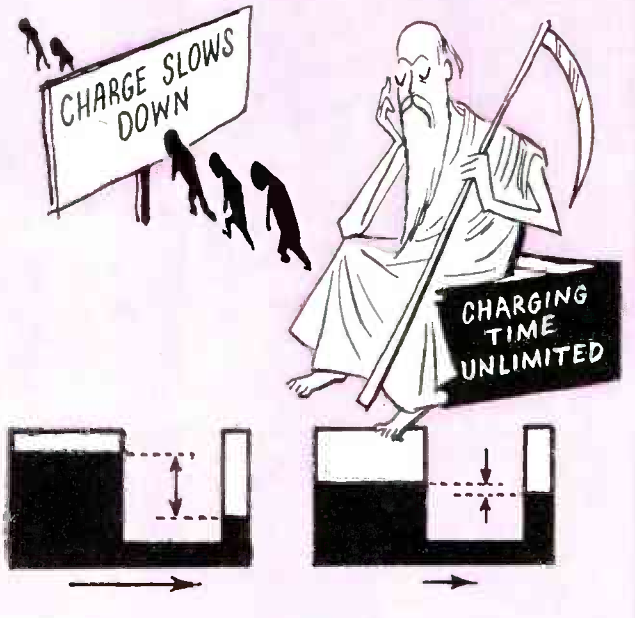
KEN—Wait a minute! Is this current you're talking about constant or variable?

WILL—Since the voltage, the resistance and the capacitance are all fixed, there's no reason why the current should vary.

KEN—Yes, there is just one reason. The thing that attracts electrons from the supply terminal to the capacitor plate connected to it is the difference in potential between that plate and the (negative) terminal of the supply source. At the beginning of the charge, that difference is equal to the full voltage. But as the capacitor plate begins filling up with electrons, the difference decreases. And the longer the charge lasts, the smaller that difference becomes. Now what happens to your rate of charge?

WILL—Obviously, the current will drop as the voltage does. The closer the capacitor is to full charge, the slower the charging will be.

KEN—Now suppose our supply source is 100 volts. If the time constant is .02 second, at the end of that period the voltage across the capacitor plates is 65 volts roughly. In another .02 second, the voltage will have increased ⅔ the difference between 65 and 100 volts. So we'll find about 89 volts across the plates. Another two-hundredths of a second later, we'll measure 97 volts . . .



WILL—But this is never going to end! If each time you increase the voltage across the capacitor by only a fraction of what is needed to reach the supply voltage, it's mathematically impossible ever to reach it!

KEN—Correct, Will! The capacitor never gets to full charge. Oh, it would get pretty close to it in a few centuries, but . . .

WILL—But, by the same token, it's impossible for the tank of water C we were talking about yesterday to be filled to the level of tank E, because, if water is to flow into it, there must be a *difference* of level!

KEN—Just to show how the charge drops off, here's the curve showing the law a charging capacitor follows. It's called an exponential curve, by the way. The curve of a discharging capacitor is exponential, too.

WILL—But then you couldn't use capacitors to control the spot deflection. You need a *linear* voltage variation, represented by a straight line, not this exponential kind of curve.

KEN—Theoretically, you're right. But practically, we can use these curves, as long as we use a very small part of the curve. Such a small section can be treated like a straight line.

WILL—I see. Just the same as a small part of the earth looks flat, even though it's part of a sphere.

KEN—And, if there *is* a little curvature, we can correct for it by introducing a little distortion which tends to curve it in the opposite direction.

The electronic switch

WILL—I can see that a time-base is a very simple setup. A voltage source, a capacitor, and a resistor, are pretty standard equipment. But what bothers me is the switch. How are you going to get a switch that'll open (for almost no time) 15,750 times a second?

KEN—You're pretty sure it won't be a mechanical device . . . ?

WILL—I'll admit that beforehand. Electronics all the way! But what kind of a tube do you use to do that kind of a job?

KEN—Believe it or not, you can use a gas tube. And you can make a sawtooth oscillator with an ordinary neon tube.

WILL—I know a neon tube can transmit radio signals. Like that one that used to be on the cafe sign . . .

KEN—The tube we'll use belongs to the same family! But we need only a very small one—a little glass bulb, with two electrodes in the form of halves of a disc, or a spiral or cylinder, and filled with neon at low pressure.

WILL—No filament?

KEN—No more than any other neon lamp. You remember we discussed a neon TV lamp used with the Nipkow disc; it was a nonfilament type, too. Our lamp lights when the voltage between the two electrodes rises to more than a certain voltage called the "voltage of ionization." At that voltage the molecules of gas are disassociated or *ionized.* As the positive ions drift toward the negative plate, and the negative ions and free electrons toward the positive one, a current is set up. The space between the electrodes actually becomes a conductor. To stop the ionization (and the light) all you have to do is drop the voltage below a certain point. For example, some types of neon tube require a voltage of 110 to light, or "strike." To extinguish them, the voltage has to be dropped to about 80.

WILL—And how can you use it as an automatic switch?

KEN—Easy—just put it across the capacitor C.

WILL—Why this dot in the symbol for the neon tube?

KEN—That just shows it's a gas tube.

WILL—I think I can see what happens. The voltage of the supply source has to be higher than the ionization voltage of the neon tube. So, as long as the voltage on the capacitor is below that value, it keeps on charging normally. But just as soon as the voltage across the capacitor is higher than the ionization voltage, the tube lights and the capacitor discharges through the gas tube almost as if it were short-circuited. Then, when the voltage drops far enough, the tube goes out, becomes a nonconductor, and the charge starts again.

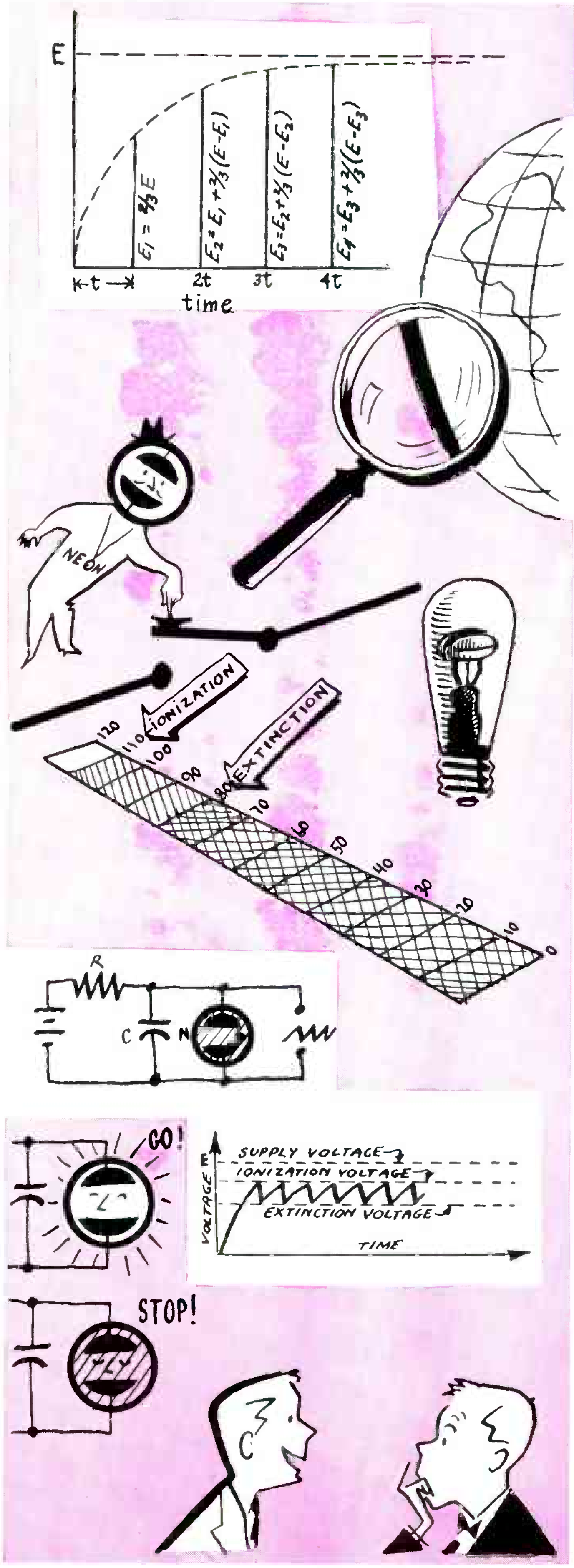
KEN—Perfect! All you have to add is that—in our example—the voltage varies between the ionization voltage of 110 and the *extinction voltage* of 80. So we have an amplitude of 30 volts. And the frequency can be selected by choosing the right values for the resistor and capacitor.

WILL—I suppose that every television receiver uses two neon oscillators then—one for the horizontal, and one for the vertical deflection voltages?

KEN—Not at all, Will. Not a TV set being made today uses a neon oscillator.

WILL—That would make things too simple and easy, eh?

(TO BE CONTINUED)



TV SERVICE CLINIC

Conducted by MATTHEW MANDL*

An example of the type of intermittent horizontal picture displacement discussed in one of this month's clinic questions.

YOU can save considerable time on many service calls if you have a field-strength meter. It tells you immediately whether poor picture and sound are caused by a defective antenna system or by receiver troubles. Thus, if the signal strength in microvolts at the receiver end of the transmission line is abnormally low, you avoid many needless tube and voltage checks. Because of this time-saving feature more and more television technicians take a field-strength meter along with their other test equipment on service calls in customers' homes.

A typical field-strength meter contains a conventional tuner, two video i.f. stages, a crystal detector, a calibrated meter, and a power supply. Since the important characterisic is the *strength* of the picture carrier, and *not* the picture detail, wide-band video i.f. amplification is not necessary and only two narrow-band, high-gain stages are used to keep the number of circuits at a minimum.

A stage of audio amplification is usually provided so headphones can be used for checking the presence of the video signal. (This is *not* the accompanying sound of the station being received, but the characteristic sync buzz and crackle of the picture carrier.) One of the more elaborate meters has a 7-inch picture tube for visual observation. Since this feature involves sweep and high-voltage circuits, the unit is much bulkier than the other types.

Readers have asked if old 7-inch television receivers can be used for field-strength meters. The answer is definitely "yes." The meter circuit is quite simple, and Fig. 1 shows the arrangement used in several commercial models. An 0-1 d.c. milliammeter is inserted below the video-detector load resistor as shown. The .002-μf capacitor shunts a.c. signal components around the meter. Because of wide variations in antenna characteristics, local receiving conditions, and internal simplicity, a direct-reading microvolt scale is not used. Instead, a chart is furnished with the meter, showing the relative microvolt values for various meter indications throughout the television channels.

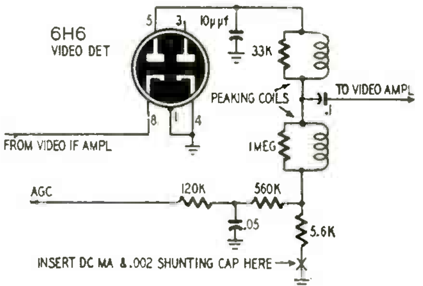


Fig. 2—Video-detector circuit of the Hallicrafters T-54 and T-505 7-inch TV receivers. These can be adapted for relative field-strength measurements by inserting a milliammeter at point X.

The same meter principle can be applied to most 7-inch receivers such as the Motorola VT-71 or the Hallicrafters T-54 and 505, although the last two are much too heavy for convenient portability in their original cabinets. The video-detector circuit of the Hallicrafters T-54 and 505 is shown in Fig. 2. The detector-load resistor (5,600 ohms) is unsoldered from the chassis and the milliammeter and its .002-μf shunting capacitor are inserted at X. The positive side of the meter goes to ground. The peak current flow will depend on the signal strength of the station, the sensitivity of the tuner, and how well the receiver is aligned. Check the current readings with a multirange milliammeter first for the strongest station received. With receivers having a.g.c., simply adjust the fine tuning control for maximum signal. In sets without a.g.c. the contrast control will affect the gain ahead of the meter and this must be adjusted in addition to the fine tuning. From the readings obtained, choose a meter with a range slightly higher than the maximum signal, or change the value of the load resistor to suit the meter on hand. The relative polarity of the rectified signal may necessitate reversing the meter terminals.

The meter scale can be calibrated for *high*, *medium*, and *low* signal levels, or calibrated in microvolts against a standard if desired, although the calibration will be accurate only if the same antenna is used for all measurements and there are absolutely no changes in the receiver characteristics. The former method will suffice, however, for quick checks during servicing calls, once the proper signal-level readings for good reception have been established.

For u.h.f.-antenna readings, a converter is used between the lead-in and the field-strength meter. Many u.h.f. converters have a gain of *1*, and thus will not affect calibration of the field-strength meter. For converters with a greater voltage gain, the meter will have to be recalibrated for the u.h.f channels.

Intermittent splitting

We have run across a defect in an RCA 9T57 which has fooled us up to now. The picture jumps into two pictures almost two inches apart; then just as quickly resolves back into one picture. The condition gets worse after the receiver warms up. Preliminary inspection of the various components and tubes hasn't been too fruitful up to

*Author: Mandl's Television Servicing

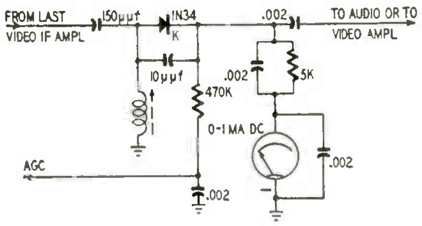


Fig. 1—A typical indicating-meter circuit used in commercial TV field-strength meters. Almost any standard TV receiver can be converted for this purpose. See the text for full details.

now. What could cause such a condition? E. A. H., Feeding Hills, Mass.

A rapid picture displacement along the horizontal will impress two pictures on the screen which often resemble ghosts (see photograph). This can be caused by an intermittent or open coupling capacitor in the horizontal a.f.c. circuit. A defective part in the horizontal oscillator control-tube circuit can also cause this condition by creating a rapid phase shift between sync timing and horizontal oscillator frequency. Another cause is a rapid change in the idling voltage applied to the horizontal deflection coils.

Try a new 6SN7-GT horizontal oscillator tube first, regardless of whether or not the old one checks good in a tube tester. Also check B voltages in the horizontal system during the time the intermittent occurs. Align the Synchroguide system according to the step-by-step procedures listed in the service notes for this receiver, checking the amplitudes of the broad and narrow waveform peaks with an oscilloscope. Check all resistors and capacitors in the grid and plate circuits of the 6SN7-GT oscillator control tube. An intermittent part here will affect phasing and can cause picture shift at a rapid rate.

Direct-drive conversion

I wish to convert an RCA 8T244 using an output transformer and matching yoke from a Du Mont RA-165 receiver. I also have the necessary width and linearity coils, but from a study of the schematics of the two receivers I note a considerable difference in the circuits. Can the Du Mont parts be used in the RCA-type circuit? J. F. J., Minneapolis, Minn.

These parts are for a *direct-drive* horizontal output system instead of the conventional flyback system in the RCA. For best results substitute the complete horizontal output circuit of the Du Mont RA-165 for the horizontal system in the RCA receiver.

The direct-drive system is critical with respect to distributed capacitance and lead dress. For this reason the 6BG6-G tube in the RCA should also be replaced with a 6BQ6-GT tube with circuit changes to conform to the Du Mont. Since the RCA damper filament is fed from a separate winding on the power transformer, it will be suitable for the 6W4-GT damper of the Du Mont circuit. The new circuit will furnish 14,000 volts for the second anode of the picture tube. (For additional information on this topic, see page 42 in the February, 1953, RADIO-ELECTRONICS.)

Overheating components

A Westinghouse H-605-T12 came in with a burned-out deflection coil. After replacing this, I found the feed choke overheats and the width control burns out. I am using a substitute deflection coil and am wondering if this is contributing to the trouble. The picture is stretched at the left and compressed at the right. I would appreciate your advice. C. M., Detroit, Mich.

The left-hand stretch indicates excessive drive. This is probably causing excessive currents in the three parallel 7A5 horizontal output tubes. In this receiver, an unstable horizontal oscillator will also cause improper drive with resulting burnouts because of excessive current.

To begin with, try a new 12AU7 horizontal oscillator tube, and adjust the ringing coil for best stability at the center setting of the hold control. Check all resistors and capacitors between the multivibrator and the grids of the 7A5's for off-values. Replace if incorrect by more than 10 percent. In particular make sure the coupling capacitor to the grids of the 7A5 tubes and the common cathode capacitor are not leaky.

If these procedures do not help, the deflection coil probably does not match the horizontal output transformer and should be replaced.

Earphone circuit

How can I attach a pair of headphones to an RCA 2T60 receiver so the speaker can be switched off during use of the phones? R. W., Long Island, N. Y.

Fig. 3 shows the circuit for adding headphones to this receiver. Since the volume control is in the grid circuit of the 6AV6 first-audio amplifier, it will regulate the volume to the headphones when the latter are switched into the

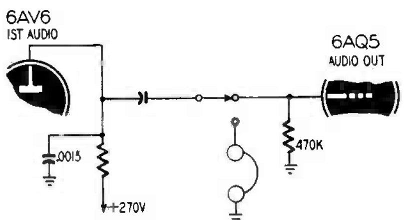


Fig. 3—Circuit for using headphones with an RCA 2T60 television receiver.

circuit. A single-pole double-throw switch is necessary, as well as a single-circuit jack for the headphone plug. A closed-circuit jack can be used instead of the s.p.d.t. switch, but this would necessitate removing the phone plug from the jack when speaker output is desired. With the switch, the phones can be left in the circuit and switched in as desired. For much lower volume levels, the switch and phones can be placed in the grid circuit of the 6AV6 first audio amplifier.

Stacking bars

What should be the length of the stacking bars for a conical or double-V type of antenna? The lowest channel to be received is No. 2. E. W., Lexington, N. C.

Most manufacturers space antennas approximately one-quarter wavelength apart for the lowest channel to be received. This favors the higher channels —which are usually weaker. If the antennas are spaced *one-half wavelength*, the *lower* channels will be favored. Quarter-wavelength spacing for channel 2 is approximately 50 inches, though 44 inches can be used if channel 2 is fairly strong in the area.

Lead-in mounting

I would like to install television transmission lines inside the walls of a new housing project. The homes have no attics or basements; the floors are concrete and the roofs flat. I have in mind running the line through some sort of conduit so that new line can be pulled through if needed. I understand this would create considerable losses, however, and I would appreciate your suggestions regarding the best enclosure for ribbon lead. L. S., Vallejo, Calif.

Ordinary 300-ohm ribbon lead would suffer considerable signal loss if run through any metal pipe, mast, or conduit. However, you could use rubber or plastic garden hose (the latter preferred). This would be rigid enough so that the transmission line could be pulled through easily, or removed and new line installed if the occasion ever arose. The line should be kept clear of parallel house wiring or water pipes.

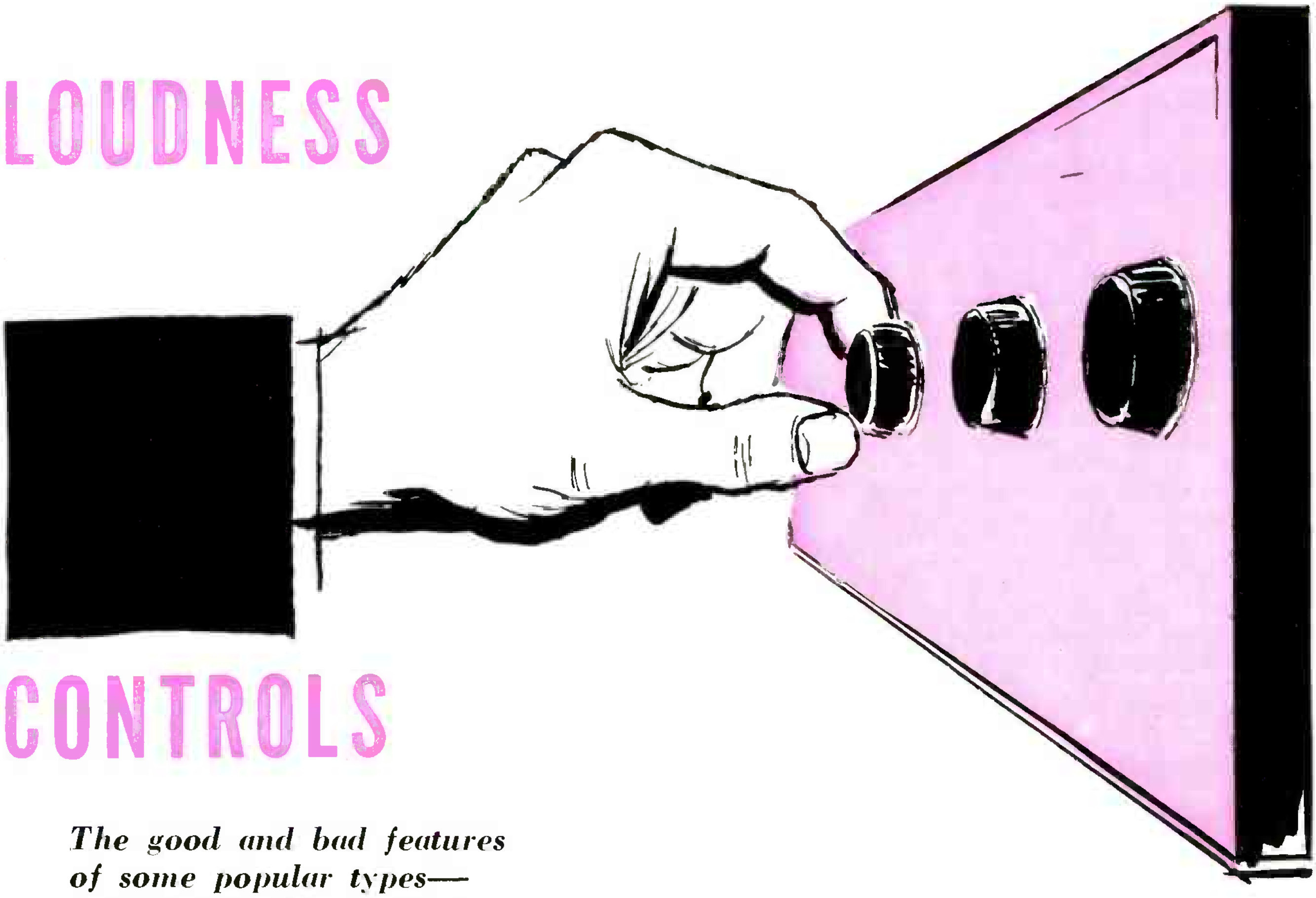
Picture quality

In a Techmaster 1930R-C receiver, the picture quality is poor. Focus is sharp, yet picture definition is inferior to what it should be. I have checked tubes, voltages, and components without finding anything wrong. The tube is a 21EP4. Do you think it would help to rewire the receiver to conform as closely as possible to the original RCA 630 receiver? R. M., New York, N. Y.

While the original RCA 630 receiver circuit was well designed, it was primarily for use with 10-inch tubes, and did not contain keyed a.g.c., a cascode tuner, or other refinements. Modern versions of this circuit contain these improvements, plus changes for increased deflection and high voltage for the larger-screen picture tubes. The 6S4 in the Techmaster, for instance, has considerably greater vertical deflection efficiency than the original 6K6. The same is true of the 6CD6 horizontal output tube and the 6W4 damper. Thus, a change back to the original 630 circuit would certainly not improve definition and would result in much poorer performance and insufficient second-anode voltage and sweep for the large-screen picture tube. The trouble is undoubtedly in tuner tracking and video-i.f. alignment. Use an *accurate* marker generator, linear sweep generator, and oscilloscope to check over-all alignment and tracking. If incorrect, follow the detailed alignment procedures in the service notes.

Note: Letters sent to the Clinic are answered directly, and only those of general interest are published. Enclose a *stamped, self-addressed envelope* and give the *manufacturer, model,* and *chassis numbers* of the receiver. Detail all symptoms carefully and list the corrective procedures or checks undertaken prior to writing. Questions on these pages have been condensed because of space requirements and generally have been more detailed than shown. END

LOUDNESS CONTROLS



The good and bad features of some popular types—and the way they ought to work to match our hearing **By M. G. O'LEARY**

THE year 1947 marked a turning point in the development of sound reproduction. Up to then, amplifier-construction articles in electronic periodicals usually dealt with units having push-pull 6V6 or 6L6 output stages with little or no negative feedback. A few designers—some of them simply old-fashioned, others with valid technical reasoning—recommended triode output stages, but in those days 2A3's, 6A3's, or 6A5-G's were about the best tubes triode enthusiasts could muster, and the problems of biasing and driving them without transformer coupling were perplexing and discouraging. In May, 1947, the Williamson circuit appeared in print for the first time[1]. Concurrently, numerous other audio improvements appeared, and the rate of development has accelerated until today's audio enthusiast does not have to build his own equipment to get all the special gadgets and circuits he wants.

Audio dealers' shelves are loaded with all kinds of variable-equalization preamplifiers, dynamic noise suppressors, variable treble cutoffs, variable low-frequency cutoffs, volume expanders, continuously variable bass and treble controls, beam-power-output amplifiers with feedback, triode-output amplifiers with feedback, Williamson amplifiers, *ultralinear* amplifiers with feedback, single-ended push-pull-output amplifiers, transformerless amplifiers, and, last but not least, *loudness controls*.

The loudness control is not a new development. Even back in the 1930's some of the better radios were equipped with simple versions—usually a tapped volume control with about 20% of the cold end bypassed to ground with a capacitor. See Fig. 1. This gave a certain amount of bass boost at low volume settings to bring out low notes which otherwise would have dropped below hearing level.

Present-day loudness controls come in several forms. Some are step-type volume controls, which reduce the volume in 2- or 3-db steps while simultaneously boosting the bass proportionally. These generally have a maximum boost of about 20 db at 50 cycles [2,3]. Others are continuously variable controls which boost both bass and treble as the volume is lowered [4,5]. The International Resistance Company sells a ready-built control of the latter type, the "LCI Loudness Control." (This control is also available as a kit or can be assembled from standard IRC control sections and commercial resistors and capacitors. See Fig. 2.—*Editor.*) All these so-called "loudness controls" are more or less complicated versions of the original tapped and bypassed volume controls.

The audio world is not entirely happy over loudness controls. The controversy that rages over them is as big as the one that raged in former years over beam-power *versus* triode output. Of all the arguments pro and con, some of those *against* loudness controls are:

1. Low-level playback should sound the same as low-level "live" listening, such as you might expect at the extreme back of a concert hall. Boosting highs and lows by some arbitrary ratio will result in unnatural reproduction at low listening levels.
2. Loudness controls increase high-frequency distortion and make the lows sound muddy.
3. They introduce transient distortion.
4. AM, FM, and phono channels generally supply different input levels to the loudness control. Thus any fixed compensation ratio will be wrong for two of the three sources.
5. Differences in original recording levels and characteristics and different playback conditions will change the

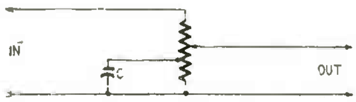


Fig. 1—Compensated volume control. As the slider moves down to reduce volume, capacitor C bypasses high frequencies around the lower resistance element. This introduces an *apparent* increase in low-frequency response.

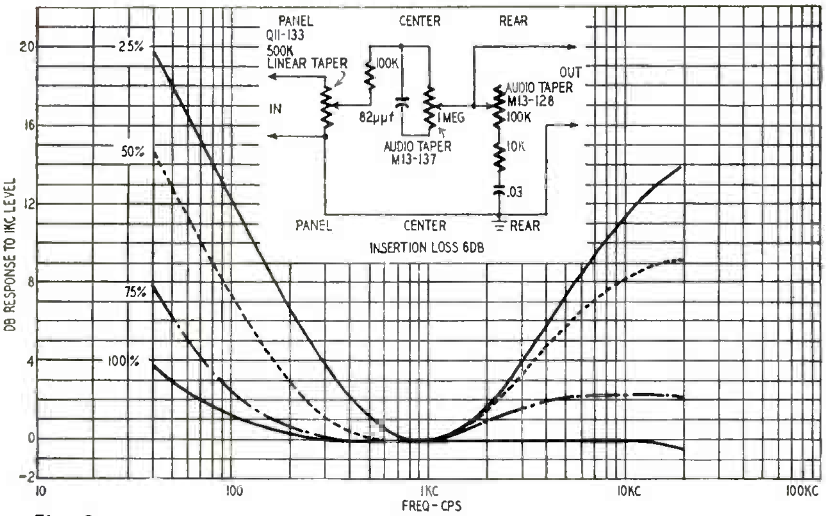


Fig. 2

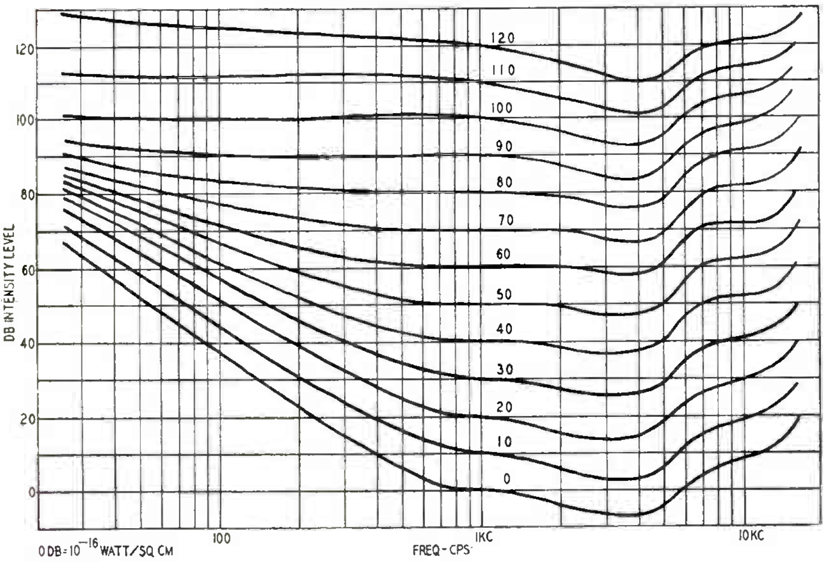


Fig. 3

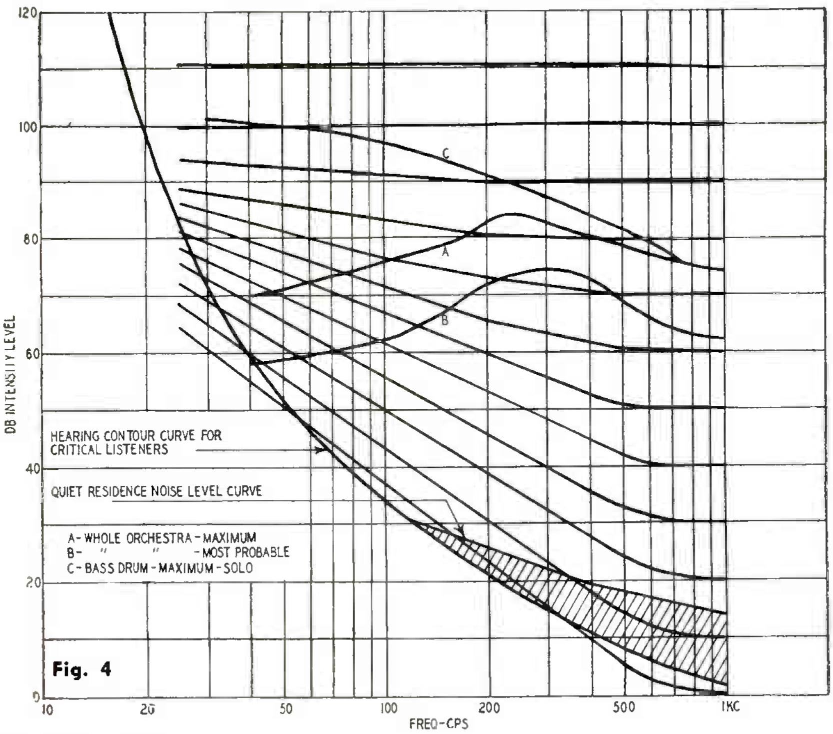


Fig. 4

amount of compensation required.

In reply to these criticisms, the loudness-control proponents point out that their control makes low-level playbacks sound wonderful (an argument that is difficult to refute); and it allows them to vary the volume with only one knob without the worry that they may miss a single note. They say they prefer to hear the score as it was written, not as it might sound in the lobby of the concert hall. Probably the most significant factor in the controversy is the difference in what different people *like to hear;* and because of this, the controversy will probably not be settled soon—if ever. Second in importance is that the basic reasons for using loudness controls are often misunderstood by the control designers.

Seeking a solution

After hearing and reading all the arguments pro and con, I finally decided to do a little analytical study of the matter to satisfy my own curiosity. My aim is to reproduce music at home to sound as natural as possible—that is, what *I* think is most natural. (Others may disagree with my taste in this.) I have no loudness control—but I do have variable bass boost (up to 22 db); a variable turnover control; and continuously variable treble boost and cut—plenty of flexibility.

It has always been obvious to me that the right settings of all these controls for one recording are by no means the correct settings for all recordings—even those produced by the same company. Some recordings have a thin bass no matter how the controls are set, while others are just the reverse. Those who infer that these differences are probably due to shortcomings in my rig should read the very thorough technical reviews of new records in three magazines [6,7,8]. I am not the only one who notices these discrepancies.

If a one-knob control of three functions—volume, bass, and treble—will really do the job expected of it and do it correctly, the logical process of progress through simplification demands its adoption. But when some recordings require more or less bass or treble boost (or both) than others, one wonders if any one-knob control can really be an adequate solution.

Fig. 2—Circuit of IRC "Loudness Control," with typical response curves.

Fig. 3—Fletcher-Munson equal-loudness curves. The curves show the relative intensities needed at various frequencies to produce sounds of the same apparent loudness as a 1,000-cycle reference tone. Note especially the high intensities needed for low frequencies at the lower loudness levels.

Fig. 4—Curves of maximum and probable orchestra volume (A,B), and bass-drum volume (C), superimposed on the low-frequency portions of the Fletcher-Munson equal-loudness contours. Note also hearing-contour and residence noise-level curves. See text for details.

Fletcher-Munson curves

The underlying reasons why bass and treble compensation is required at all at low playback levels are best shown by the series of Fletcher-Munson curves in Fig. 3. These are *equal-loudness* curves which show the intensity levels required at various frequencies to produce a sound judged by the listener to be as loud as the 1,000-cycle reference intensity level. It is important that we understand exactly what these curves represent—else we may fall into the error of interpreting them as bass- and treble-boost curves. To simplify it, let's take a look at a couple of typical examples.

Suppose three tones—100, 1,000, and 10,000 cycles—come through an ideal reproducing system with *equal loudness.* (Remember, *loudness* is how they sound *to you.*) If the 1,000-cycle tone has a *measured intensity* level of 90 db, the 100-cycle output will also have to be 90 db, *but the 10,000-cycle note must have an intensity of 99 db.* Now assume that we turn down the volume control to reduce the intensity level by 40 db. The 10,000-cycle note will now *sound* slightly weaker and the 100-cycle tone *very much* weaker than the 1,000-cycle tone. The curves explain why this is so: The 1,000-cycle tone at 50-db intensity is on the 50-db equal-loudness curve, but the 50-db intensity level at 100 cycles (the original 90 db minus 40-db attenuation) is on the same *equal-loudness* curve as a 20-db intensity level at 1,000 cycles; and a 59-db intensity level at 10,000 cycles (99 db minus 40 db) is on the same loudness curve as a 46-db level at 1,000 cycles. Examining the curves again, we see that the equal-loudness curve for a 50-db intensity level at 1,000 cycles intersects the 100-cycle ordinate at 67 db, and intersects the 10,000-cycle ordinate at 63 db. Thus, without touching the volume control, we can again make these three tones *sound* equally loud if we turn up the bass control to boost the 100-cycle tone 17 db (67–50db), and turn up the treble control to boost the 10,000-cycle note 4 db (63–59 db).

Suppose we try one more example. Let's adjust the ideal reproducing system so that 100-, 3,000-, and 10,000-cycle tones come through with equal loudness, at a 1,000-cycle intensity level of 60 db. The curves show that the 100-cycle tone now has a 72-db and the 10,000-cycle note a 73-db intensity. Now suppose we want to attenuate the output by 30 db. The 1,000-cycle note will now be at a 30-db level, while the 100-cycle tone will have an intensity of 42 db (72–30 db), and the 10,000-cycle tone 43 db (73–30 db). The 30-db curve through 1,000 cycles cuts 100 cycles at 57 db. A *15-db boost* (57–42 db) at 100 cycles will make the two notes sound equally loud again. The 30 db curve crosses 10,000 cycles at 42 db. A 1 db *cut* (42–43 db) will make the two notes sound equally loud.

These examples are designed to emphasize the fact that Fletcher-Munson curves are *equal-loudness* contours, *not* bass- and treble-boost curves. Some loudness controls seem to be designed under the misconception that the curves show the amount of boost required. A recent article by John R. Schjelderup[9] clearly brought out the proper interpretation of these curves and suggested a compromise control designed to boost both bass and treble to compensate for the difference between the level of the original performance and the playback level. For example, if the orchestra performed into a microphone at a level of 90 db and we play the recording at home at a 50-db level, we simply set the proposed control at 40 db (the difference), and both bass and treble automatically get the right amount of compensation.

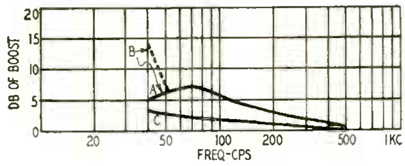


Fig. 5—Low-frequency compensation required for playback 10 db below the original performance level in Fig. 4. Dashed line represents additional boost needed to bring very low frequencies above hearing-contour curve. See Figs. 6, 7 and 8 for curves of other levels.

This is a very nice solution to *one* of our problems, but skeptics will have a field day with it. For instance: "How many people know the db level at which a performance was recorded? And even if the record label shows it, do we all have to add VU meters to our amplifiers to find out the exact playback level?"

Schjelderup *et al* seem to have overlooked one important point: When an orchestra is playing at an over-all level of 90 db, the individual instruments are playing at many other different levels. Any one instrument may be played at several different levels during the course of a composition. For instance, there are soft double-bass passages and loud double-bass passages. If the loudness control compensates properly for the loud passages, does it also compensate properly for the softer ones?

However, Schjelderup brought out a very important point in his article, one which the reader can see if he inspects Fig. 3 again. While loudness compensation might require as much as 29-db boost at 30 cycles, *the amount of treble boost need never exceed 4 db.* Take a look at the curves—above 1,000 cycles none of them are flat, but they are all very nearly parallel. No two of them deviate from parallelism by more than 4 db. Thus the bass region is where nonlinear loudness compensation is most important, and it will be simpler, yet sufficient, if this inspection of the technical aspects of the loudness control is confined to the bass regions of the spectrum only.

The Jensen Manufacturing Co. has published a series of technical monographs. Monograph No. 3 ("Frequency Range and Power Considerations in Music Reproduction") contains some interesting curves. One series of curves shows the average distribution of sound-pressure levels for all frequencies over the audible spectrum when a typical orchestra is playing. The portions of these curves between 20 and 1,000 cycles are reproduced in Fig. 4 superimposed on the Fletcher-Munson curves of Fig. 2. Curve A represents the maximum r.m.s. values, defined as the intensity level which is exceeded only 5% of the time in the particular frequency band. Curve B represents the "most probable" or average levels, lower than the maximum levels by as much as 14 db at some frequencies. Curve C represents the maximum loudness levels for a solo bass drum.

Two other curves are superimposed on Fig. 4, both from this same technical monograph. The first is the "Hearing Contour Curve for Critical Listeners." The area below and to the left of this curve represents the region in which no sound at all is heard by a critical ear even though sound is present; for instance, a 30-cycle note at a level of 60 db or a 200-cycle note at 20 db. The other curve is the "Quiet Residence Noise-level Curve"; sounds below this level of course will not be heard at all.

Now we have the frequency-distribution levels of a typical orchestra performing for a typical recording. It seems reasonable to assume that curve B represents what the microphone would hear during the major portion of the performance. However, it would also hear the sound represented by curve A during certain intervals, and that of curve C at less frequent intervals. Let us assume that we are playing back this recording in our home through an ideal reproducing system at various levels below the original performance level. Suppose these lower levels are steps of 10-db attenuation each. From the Fletcher-Munson curves we can predict how much bass compensation will be required at each playback level for each of the curves A, B, and C. This compensation would be such that whenever any one of the curves represented exactly the content of the music, the playback would *sound* exactly the same, but at a lower level—as it did to those who were present at the actual performance. Curves representing the necessary compensation at the various attenuation levels from 10 db to 50 db are shown in Figs. 5, 6, 7, 8, and 9 respectively.

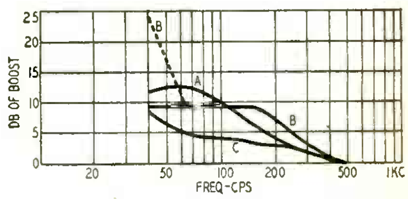


Fig. 6—Compensation for playback 20 db below original performance level.

These curves prove at least one thing: the amount of compensation cannot be fixed even for a specific playback level. It may differ for the different passages in any one musical composition. For example, if we are playing back at a listening level 30 db below performance level, as in Fig. 7, and we compensate for the maximum-level curve (A), the bass of the average-level passages (curve B), will be a bit heavy in the 70–100-cycle region, and a bit thin in the 200–400-cycle range; a loud bass-drum passage would be disproportionately loud.

The dashed lines in Figs. 5 to 9 represent the compensation required if we are not to lose some parts of the music completely. For instance, if curve B is attenuated 30 db and equalized as shown in Fig. 7, frequencies from 72 cycles down will be below the "Hearing-Contour Curve" and will not be heard unless boosted as indicated by the dotted line. This much equalization of course, would make a burst on the

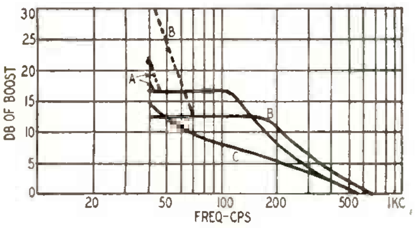


Fig. 7—Compensation for playback 30 db below original performance level.

bass drums sound as though the drummer were right in the room.

It may surprise many of the proponents of loudness controls to learn that their devices do not always let them hear all the music actually being played. Take a look at Fig. 9. Even with loudness equalization, no average-level music below 90–120 cycles (depending on the compensation curve of the control) is heard when the original performance is played back softly, at

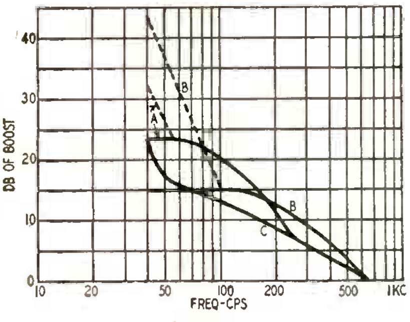


Fig. 8—Compensation for playback 40 db below original performance level.

an attenuation of 50 db.

I cannot be certain about the conclusions that readers will draw from all this; I can only state my own. To me, the most important conclusion seems to be this: Assuming we have an ideal reproducer, we are not likely to hear the music exactly as it was heard during the performance unless we play it back as loudly as it was

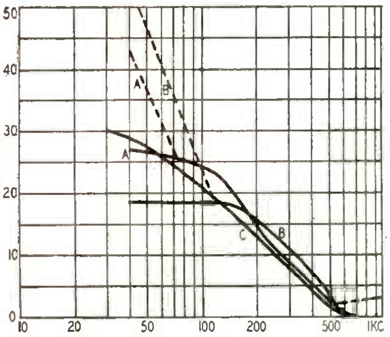


Fig. 9—Compensation for playback 50 db below original performance level.

played originally. Since 99.9% of the time it is impractical (to say the least) to play it this loudly, we must be satisfied with a type of playback compensation which most closely approaches the relative sound values of the original performance. Under certain conditions a loudness control might do an excellent job. But with different recording techniques, playback-room resonances, loudspeaker peaks and dips, and amplifier shortcomings, it is unlikely that a single loudness control will satisfy many of us. With exhaustive experiments a gadgeteer might tailor such a control to work well with his own particular set of conditions, but we suspect that even in this case, different recording techniques, and different types of musical compositions will at times demand additional adjustments of bass and treble controls.

Certain types of loudness controls boost the treble as much as 15 db at 10,000 cycles. Such designs are the result of a misunderstanding of the Fletcher-Munson curves and will certainly result in a screechy treble if the highs are not attenuated simultaneously with another control. Through the same misunderstanding these controls might also overboost the bass. Such controls, used by trusting but not-too-technical high-fidelity enthusiasts, are probably responsible for much of the criticism directed at loudness controls. Properly designed ones, even though they must be considered as only fair compromises at the best, should impress many critical listeners as being very nice additions.

Most loudness controls—and most bass-boost controls—have a uniform rate of low-frequency boost which starts somewhere between 500 and 1,000 cycles and which continues to climb right down to 20 cycles. It is well worth noting that Figs. 5 to 9 do not suggest such a nice uniform rate of boost. However, since most of us do not have speakers that are flat right down to the lowest audible bass note, it is probably better—at least for the time being—to inject a little extra bass boost.

Perhaps some genius will design a *dynamic* loudness control which will automatically vary the loudness compensation according to the type of musical passage being played. Until that day, we are still going to need our separate bass and treble controls, *with or without a loudness control.* Since bass and treble controls can do everything a loudness control can do, it's only logical to ask, "Why bother with a loudness control at all?" END

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3 Full Range Loudness Control, J. Winslow, February, 1949, *Audio Engineering.*
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5 The Loudness Control—An Aid to Higher Fidelity, R. Picket, March, 1952, *Radio and Television News.*
6 *High-Fidelity Magazine.*
7 *Audio Engineering. Record Review.*
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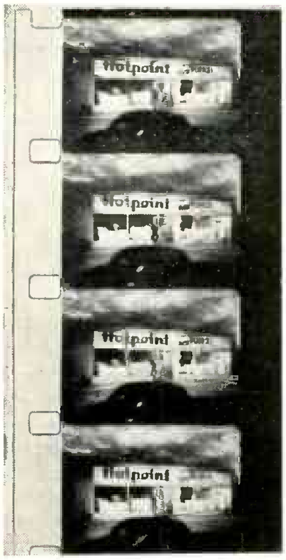
9 A Proposed Solution to the Loudness Control Problem, J. R. Schjelderup, September, 1952, *Audio Engineering.*

"Don't you think he's carrying this hospital idea too far?"

Suggested by Walter Rehrig, Allentown, Pa.

MAGNETIC FILM RECORDING



provides sound tracks for old or new films—allows instant playback without processing of any kind

By I. QUEEN

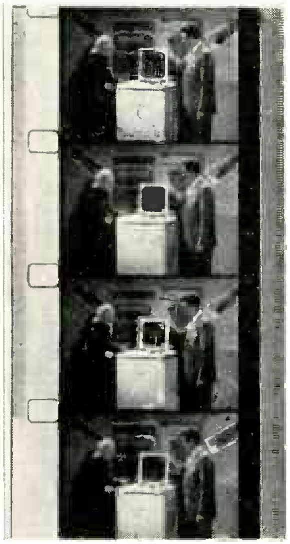


Fig. 1—"Full-stripe" and "half-stripe" magnetic coatings on 16-mm film. "Half-striping" allows both optical and magnetic sound to be recorded on the same film.

Magnetic striping is the most significant advance in the movie-sound field since the introduction of talkies. Several manufacturers are now equipped to coat 16-mm films with a magnetic-oxide soundtrack. This magnetic stripe provides all the advantages of modern tape recording. Sound can be recorded and erased as many times as desired. It is ready for playback immediately after recording. Extensive lab processing and special studio facilities are no longer needed. It has been estimated that the cost of materials for a 10-minute sound and color 16-mm film would be about $200 with the new recording method. The same film made *professionally* with optical sound-on-film would cost $3,500 or more.

In most cases the magnetic stripe is applied to the film after it has been exposed, processed, and edited. Then sound is recorded on the magnetic stripe

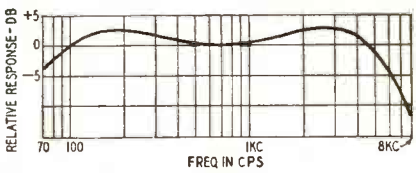


Fig. 2—Over-all frequency response from recording to playback of RCA model 400 magnetic-stripe projector.

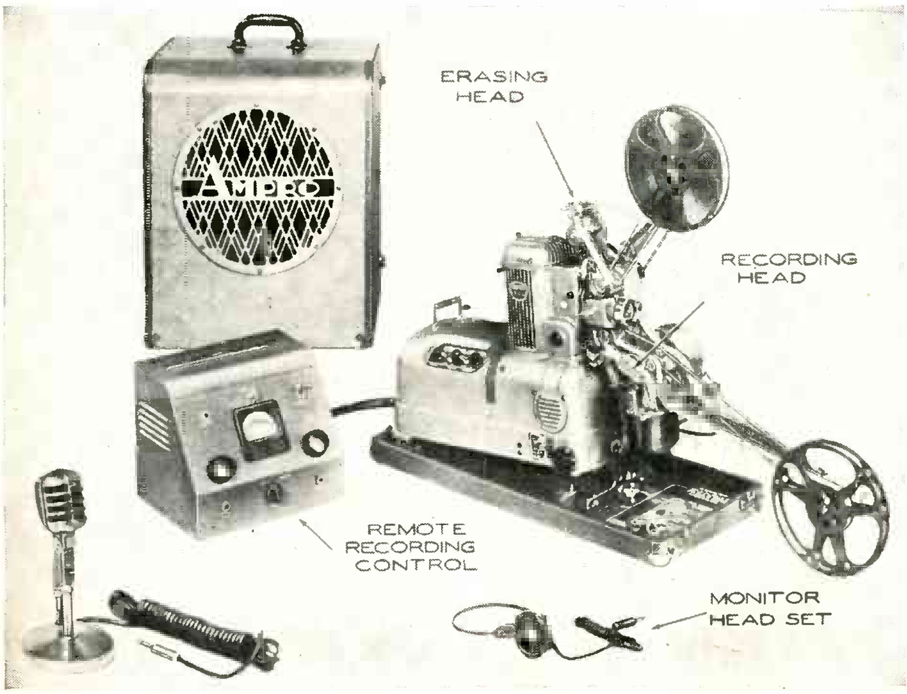
while the film is shown. Thus the commentator or performer can synchronize the sound and picture. If an error is made or if the track proves unsatisfactory, it is easily wiped off and a new one can be substituted.

If a film already carries an optical track, a half-width magnetic stripe is added. This leaves half of the original track. Thus the user has a choice of the original optical track (which, of course, is a permanent part of the processed film) or the stripe (which can be changed at will). Fig. 1 shows full-stripe and half-stripe tracks. Of course, the film must be single-perforated.

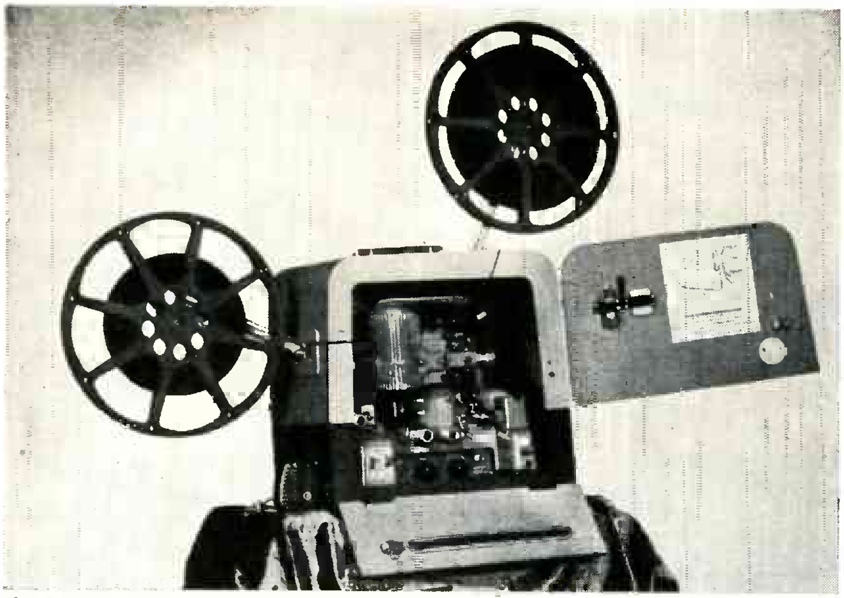
Reeves Soundcraft, Bell & Howell, and Eastman Kodak are among film processors who are now equipped to stripe 16-mm films.

New movie projectors are being manufactured to accommodate the new sound films. Models have already been announced by RCA, Bell & Howell, and Ampro.

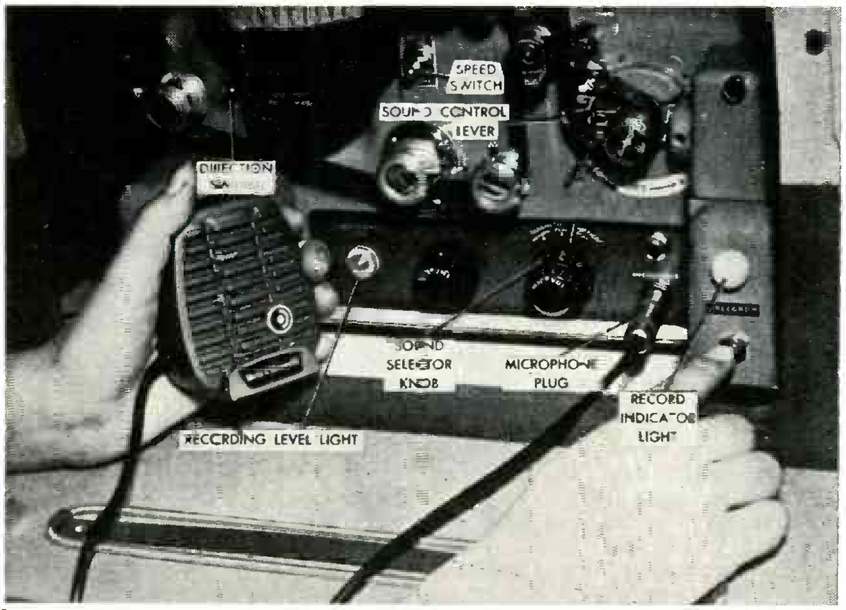
These machines can reproduce optical or magnetic tracks, they record magnetically, and serve as public address amplifiers. They give a choice of speed —16 or 24 frames per second. The faster speed is equivalent to 7.2 inches per second, nearly equal to that of most tape recorders.



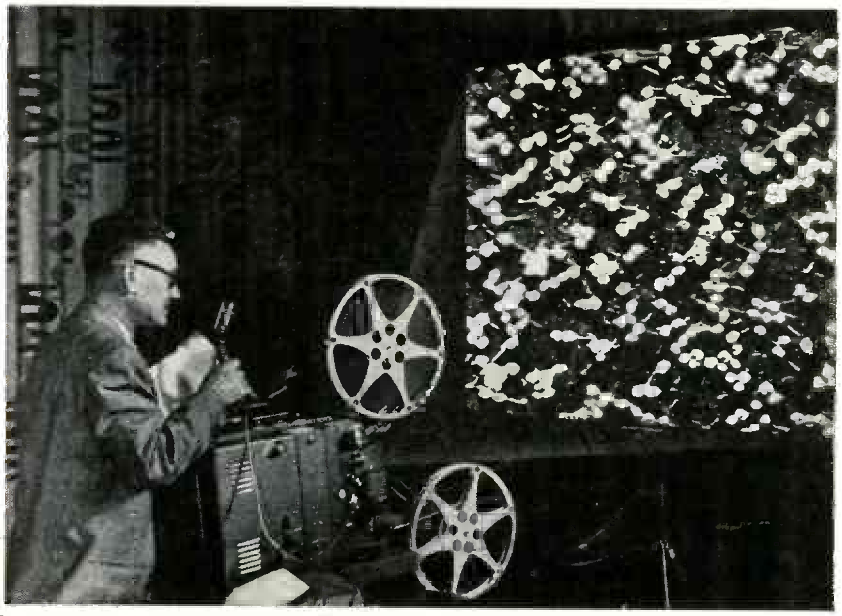
Ampro optical-magnetic sound-film projector permits recording from remote microphone to reduce noise pickup and is equipped for headphone monitoring.



Bell & Howell *Filmosound* 202 optical-magnetic sound-film projector-recorder.



Close-up of the principal operating controls on the Bell & Howell *Filmosound* 202.



New RCA model-400 magnetic-sound-track film projector has special features to reduce hum and magnetization problems in direct recording. See details in text.

RCA model 400 projector

This projector features special design to eliminate hum and to provide high-fidelity recording and reproduction. For example, the sound head has four distinct adjustments: azimuth, lateral, pressure, and bearing. The last adjusts with respect to the sound-drum curvature. The magnetic head is mounted on an arm which may be rotated for maximum output from a standard h.f. recording. Special care has been taken to avoid head magnetization which may introduce hiss and noise. Bias current is adjustable in steps instead of all at once. The motor may be rotated axially for minimum hum. The positions of the power transformer and input transformer also may be shifted for the same purpose. A hum-bucking coil is connected in series with the magnetic head. This coil is adjustable to the best compromise position between the *on* and *off* conditions of the projection lamp. All ground loops have been eliminated.

The frequency response of the RCA projector is 80-7,200 cycles. (Fig. 2). Signal-to-noise ratio is 50 db with tone control in FLAT position. Output is 10 watts.

Filmosound model 202

This Bell & Howell projector has phono and mike inputs usable separately or for mixing speech and music. The sound-drum assembly includes a mirror system for reflecting light for optical reproduction. It also carries the magnetic head. Levers rotate either the magnetic head or mirror into position as required. Accidental erasure is prevented by a special button which must be depressed for recording. This can be done while the motor is running in the *forward* direction. A pilot lamp indicator shows when the projector is in the *recording* position. A neon lamp indicates recording level. This projector has an output of 9 watts at 5% distortion.

Ampro Premier 30

This projector features a remote recording control. Sound to be recorded can be picked up and controlled in another room, away from projector noise, if desired. A VU meter measures recording level. A high-fidelity 12-inch baffled speaker is included. Monitoring is done by headphones. Mike and phono inputs may be mixed. Magnetic and optical soundtracks may be played back in any sequence.

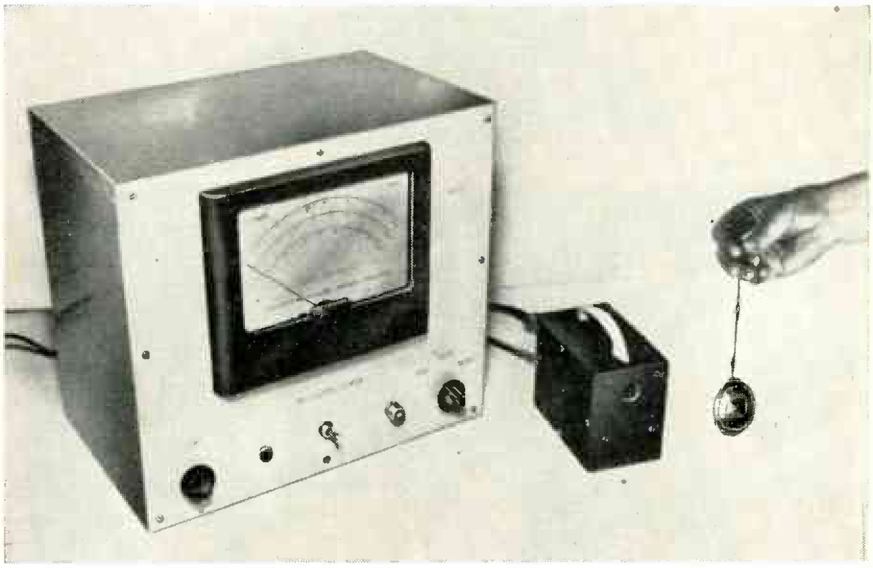
The amplifier has an output of 15 watts.

Magnetic sound films are finding many applications in education, business, and entertainment. Heretofore, silent films were generally used in these fields because of the high cost of optically recorded sound. Even when suitably titled, these silent films lacked the interest and effect of talkies. Now, through the inexpensive process of striping, sound is available. Quality is high, so that either music or speech can be recorded satisfactorily. END

Detect or measure atomic radiation with this sensitive and accurate

SCINTILLATION COUNTER

The scintillation counter in use. A radioactive specimen held in front of the probe window emits atomic particles which activate the counter circuit. The meter indicates relative intensity of radiation in pulse counts per minute.



By ED BUKSTEIN*

THE scintillation counter, like the more publicized Geiger counter, is an instrument used to detect and measure radioactivity. The chief disadvantage of the Geiger counter is its long *dead time*. This is the interval —usually about 100 to 200 microseconds —which follows the detection of an atomic particle. A Geiger tube is completely ionized during this interval and the instrument is unreceptive to other atomic particles. As a consequence of this long resolving time, the Geiger counter will respond only to the first of several particles entering it in rapid succession.

The scintillation counter has evolved from a device invented in 1903 by Sir William Crookes. The original device, the *scintilloscope*, is a hollow tube with a screen of zinc sulfide at one end and a magnifying lens at the other. Zinc sulfide produces a brief flash of light each time it is struck by an atomic particle. An observer looking through the magnifying lens can determine the degree of radioactivity of the substance being studied by counting the number of flashes. The accuracy of this counting method is limited by the observer's vision and reaction time. In the modern scintillation counter, a phototube "observes" the flashes of light. This tube produces a pulse of voltage for each flash and associated circuits measure the frequency of the pulses. The resolving time of a scintillation counter is so short that the limit is usually set by the speed of the associated electronic circuits. Because of its greater accuracy the scintillation counter is rapidly gaining in popularity and has already largely replaced the Geiger counter in many laboratories where radioactivity measurements must be made.

Phosphor characteristics

Zinc sulfide is not the only phosphor used in scintillation counters. Much experimental work has been done, and is still going on, to find a phosphor combining maximum light output and minimum decay time. Decay time is the duration of the flash of light produced by the phosphor under the impact of an atomic particle. Unless this interval is extremely short, it limits the resolving time of the instrument.

Anthracene, naphthalene, thallium-activated sodium iodide, and calcium tungstate are some of the phosphors that have been used.

Naphthalene, of course, is nothing more than the substance used for ordinary moth flakes. Clear pieces of this material may be obtained by slowly heating a quantity of moth flakes until they become molten, and then slowly cooling to solidification. A phosphor in powder form, like calcium tungstate or zinc sulfide, may be mixed with a small amount of clear cement to give it a sticky consistency. This solution is then painted on a portion of the glass envelope of the phototube—the portion facing the cathode. After the phosphor is cemented in place, the phototube should be wrapped with black tape to keep out ambient light. Most of the phosphors mentioned are available from chemical supply houses. In addition, some organizations specialize in this field (National Radiac, Inc., Newark, N. J., for instance).

Photomultipliers

Because the amount of light emitted by the phosphor under bombardment is relatively small the phototube must be extremely sensitive. For this reason, a *photomultiplier* tube is invariably used in scintillation counters. This tube, like the ordinary phototube, contains a photosensitive cathode which emits electrons when illuminated, and an anode to collect these electrons. But in the photomultiplier tube the electrons do not go directly from cathode to anode. Instead, they go in succession to a series of intermediate electrodes known as *dynodes*. Each successive dynode is operated at a higher positive potential than the preceding one. Each time an electron strikes a dynode, it emits several secondary electrons. These are drawn to the next dynode, and displace an even larger number of secondary electrons there. For each electron that leaves the cathode, a large number ultimately reach the anode. This gives the tube a high current gain.

The 931-A is a photomultiplier tube with nine dynodes. Its gain ranges from about 250,000 to 1,000,000, depending on the voltages applied to its elements. The 1P21 photomultiplier tube may also be used in this application. This tube has twice the gain of the 931-A, and is especially suitable for working at extremely low light levels. The recently developed 5819 and 6199 photomultipliers are designed specifically for scintillation counting.

Counter circuit

The scintillation counter described

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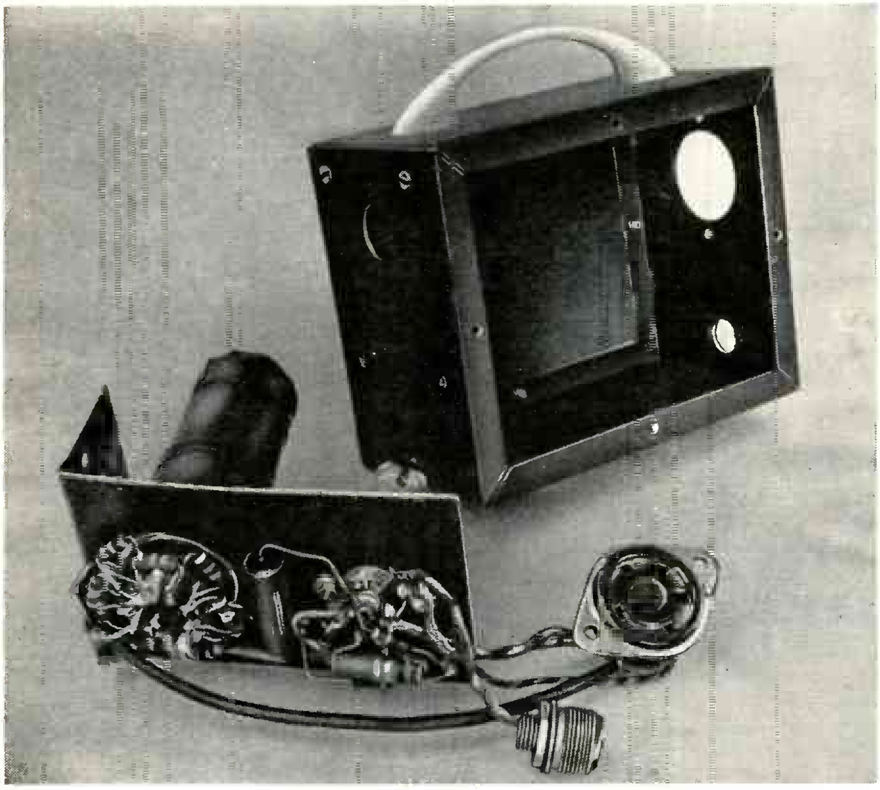
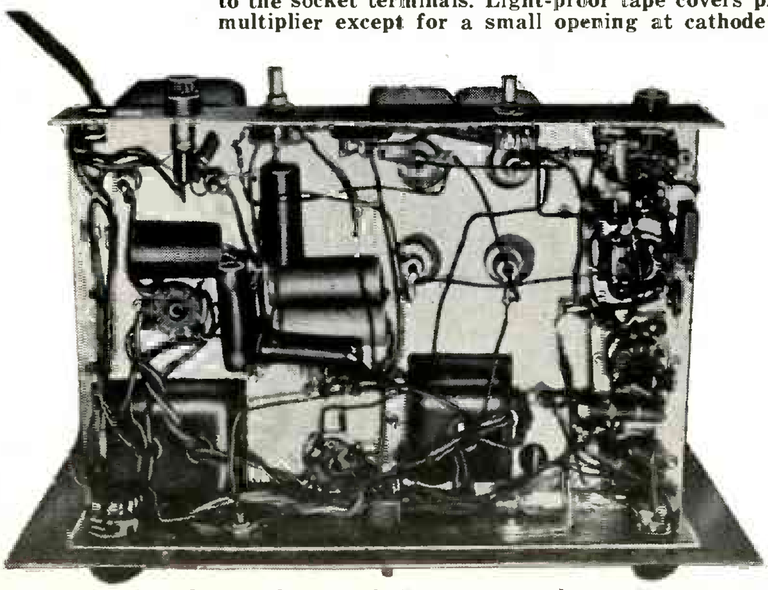
here consists of two units: a photomultiplier probe, and a counting unit. The schematic is given in Fig. 1. The probe unit, built in a 3 x 4 x 5-inch metal cabinet, has two tubes: a 931-A photomultiplier, and a 6AG5 amplifier. The counter chassis contains the actual counting circuit, the meter circuit, and two power supplies. A four-wire cable carries operating potentials to the probe, and a coaxial cable feeds the probe-output signals to the counter.

One of the power supplies uses a 6SN7-GT as a full-wave doubler to supply about 1,000 volts for the 931-A. The grid of one triode section in the 6SN7-GT is connected to a potentiometer bridged across a portion of the output voltage. This potentiometer controls the output voltage by varying the bias on the grid. The positive side of this high-voltage supply is grounded, so that the anode of the 931-A (from which the output is taken) is at zero d.c. potential. A voltage-divider network in the probe proportions the high voltage uniformly among the elements of the 931-A. The divider resistors are soldered directly to the photomultiplier socket terminals.

A half-inch hole is cut in the probe cabinet directly in front of the photomultiplier cathode to admit atomic particles. A small square of black paper cemented over the hole on the inside prevents outside light from affecting the 931-A.



The probe assembly. Voltage-divider resistors for the dynodes of the photomultiplier tube are wired directly to the socket terminals. Light-proof tape covers photomultiplier except for a small opening at cathode end.



Chassis layout of the counter unit.

Each flash of light from the bombarded phosphor produces a negative pulse at the anode of the 931-A. These pulses are coupled to the grid of the 6AG5 through the .002-μf capacitor. The 6AG5 is operated as a cathode follower to match the low impedance of the output cable. There is no voltage gain in this stage, but the output pulses have the same negative polarity as the pulses from the photomultiplier.

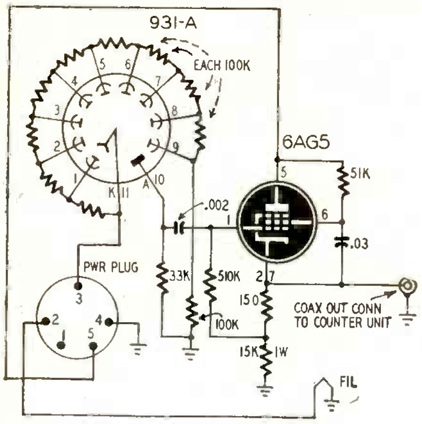
Pulses from the cathode of the 6AG5 are fed through the coaxial cable to the grid of V1 in the counter unit. V1 and V2 function as a pulse equalizer. This circuit—also known as a one-shot multivibrator—produces uniform output pulses in response to input pulses which may vary considerably in amplitude, duration, and waveform. The one-shot circuit differs from the conventional multivibrator in that one of the tubes (V2) is overbiased to prevent free-running operation. The circuit has one stable state in which V2 is cut off, and V1 conducts heavily through the positive bias applied to its grid from the 500,000-ohm potentiometer.

The circuit will remain in this stable state until a negative input pulse is applied to the grid of V1 through the 250-μμf capacitor. This reduces the plate current drawn by V1, and an amplified positive pulse appears at the V1 plate. This pulse overcomes the cutoff bias on the grid of V2. V2 conducts, and the sudden drop in voltage at its plate is fed back through C2 to the grid of V1, where it reinforces the negative input pulse, cutting V1 off completely, and swinging V2 to full conduction. The entire operation of reversing the conditions of the two triodes is practically instantaneous.

The multivibrator will remain in its new (unstable) condition until the charges on C1 and C2 leak off. These capacitors will discharge completely in approximately 50 microseconds through their respective 100,000-ohm grid resistors. The time required to restore the multivibrator to its stable condition is less than this time, however, since C1 and C2 discharge not merely to zero voltage, but to the original positive and negative potentials obtained from the voltage-divider circuits. This steepens the slope of the discharge curve and the multivibrator returns to its stable state almost instantly.

Each time V2 is driven from cutoff to saturation by a negative input pulse applied to V1, a positive pulse appears across the V2 cathode resistor. This is followed by a negative pulse as the circuit swings back to its stable state. The shape and amplitude of an output pulse taken from the V2 cathode are independent of the characteristics of the input pulse.

The initial positive bias for the grid of V1 is obtained from the 500,000-ohm potentiometer. The setting of this control determines the amplitude of the



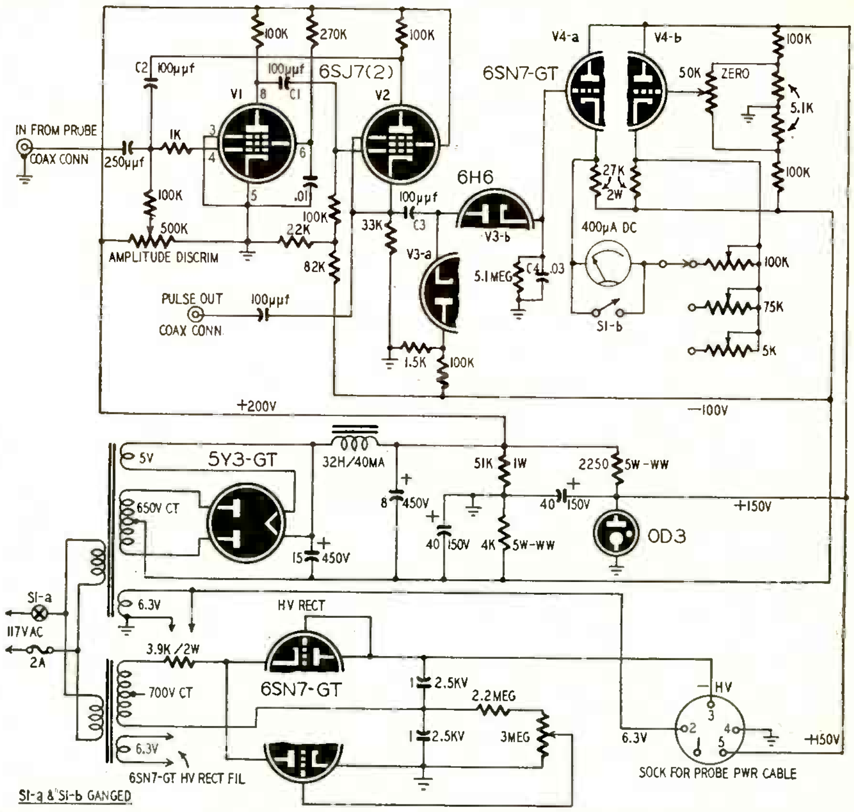


Fig. 1 (right)—Schematic of the scintillation counter. The 931-A and 6AG5 are mounted in the separate probe unit shown above. The probe power cable and connectors must be insulated for at least 1,000 volts.

negative input pulse required to trigger the circuit. This control, called the *amplitude discriminator*, is mounted on the rear apron of the chassis, and is adjusted to permit triggering by signal pulses but not by noise.

Count indicator

The pulse waveform from the V2 cathode is fed to the double-diode circuit V3-a and V3-b. V3-b conducts on each positive pulse and charges capacitors C3 and C4. Between pulses C4 discharges (but not completely) through the 5-megohm resistor. If the pulse frequency is low, C4 will lose most of its charge between pulses. If the pulse frequency is high, C4 retains most of its charge. Consequently, the average charge on C4 is a measure of the pulse frequency. The vacuum-tube voltmeter (V4) shows the average charge on C4 in pulses per minute.

Diode V3-a conducts during the negative alternations of the pulse waveform developed at the cathode of V2. In conducting, it discharges C3 which was charged when V3-b was conductive. This arrangement prevents a charge from accumulating on C3.

A variable voltage applied to the grid of one of the triodes of V4 serves as a zero control. This control is on the front panel and is used to zero the meter with no signal applied to V1. The meter has three ranges: 2,000, 10,000, and 50,000 counts per minute. Ranges are switched by connecting a different resistor in series with the meter. This instrument has a 400-microampere movement, but meters of other sensitivities may be substituted. The low-frequency accuracy of the instrument may be reduced if the meter requires more than 1 ma.

The high-voltage-control potentiometer is mounted on the rear apron of the chassis. This control is adjusted for highest signal-to-noise ratio from the photomultiplier. The best way to make this adjustment is to connect an oscilloscope to the coaxial output jack on the probe unit, and place a radioactive specimen in front of the probe. A combination of signal and noise pulses will appear on the screen of the oscilloscope, and they may be distinguished by removing the radioactive source and noting the effect on the pattern. Adjust the high-voltage control for the highest ratio of signal to noise. Since both signal and noise pulses are randomly distributed in time, they cannot be synchronized on the screen of an ordinary scope. This, however, is no hindrance.

The other power supply in the counter unit is a conventional full-wave circuit which provides positive and negative operating potentials for all the tubes except the 931-A. An 0D3/VR-150 in the output of this supply provides a regulated potential of 150 volts.

The toggle switch used to apply power to the unit is a d.p.d.t. type. One section is connected in series with the line cord, and the opposing section is connected across the meter. With this arrangement, the switch in parallel with the meter is closed when the line switch is open. This protects the meter from the transients which occur when the power is turned off.

Calibration

The meter may be calibrated by connecting the output of a square-wave generator to the coaxial connector of the counting-rate meter. To calibrate the 2,000-counts-per-minute scale, set the generator frequency to 33.3 cycles per second. Now adjust the calibrating resistor (in series with the meter) to produce a full-scale reading. Mark this point on the scale "2,000." The original scale can be replaced by a piece of white cardboard or heavy paper cut to the same dimensions. The frequency of the generator may now be reduced in steps, with corresponding numbers and markers drawn at the appropriate points on the scale. Calibration of the other two ranges is accomplished by repeating the above procedure. On the 10,000-counts-per-minute range, full-scale deflection should occur with the generator set at 167 c.p.s. On the high range (50,000 counts per minute), full-scale deflection should correspond to a generator frequency of 833 c.p.s.

The output from the cathode of V2 is also fed to a coaxial connector on the front panel of the instrument. Bringing the pulse waveform to the front panel increases the versatility of the instrument and makes it suitable for use with auxiliary devices such as a scaler-register circuit. END

Materials for counter

Resistors: 1—4,000, 1—2,250 ohms, 5 watts; 2—27,000, 1—3,900 ohms, 2 watts; 1—51,000, 1—15,000 ohms, 1 watt; 1—5.1, 1—2.2 megohms, 1—510,000, 1—270,000, 17—100,000, 1—82,000, 1—51,000, 2—33,000, 1—22,000, 2—5,100, 1—1,500, 1—1,000, 1—150 ohms, ½ watt.

Potentiometers: 1—3 megohms, 1—500,000, 1—100,000, 1—75,000, 1—50,000, 1—5,000 ohms.

Capacitors: (Electrolytic) 1—15, 1—8 μf, 450 volts; 2—40 μf, 150 volts. (Paper) 2—1 μf, 2,500 volts; 2—.03, 1—.01 μf, 600 volts. (Mica or ceramic) 1—.002 μf, 1—250, 4—100 μμf, 500 volts.

Miscellaneous: 1—power transformer, 650 volts c.t. at 40 ma, 6.3 at 1.5 amp, 5 volts at 2 amp; 1—power transformer, 700 volts c.t. at 20 ma or more, 6.3 volts at 0.6 amp; 1—32-h, 40-mo, filter choke; 1—931-A or 1P21 photomultiplier tube; 1—6AG5, 2—6SJ7, 2—6SN7-GT, 1—6H6, 1—5Y3-GT, 1—0D3 tubes; 1—11-pin socket (special) for photomultiplier; 1—7-pin miniature, 7—octal sockets; 2—5-pin sockets or female power connectors (chassis type); 3 coaxial chassis connectors; 1—coaxial cable with 2 male connectors; 1—0-400-μa d.c. meter (see text); 1—d.p.d.t. toggle switch; 2—5-pin male power connectors (cable type); 1—2-amp fuse and holder; 1—3 x 4 x 5-inch metal cabinet; chassis; terminals, hardware, wire, solder, phosphor material for coating photomultiplier tube (see text).

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LABORATORY-TYPE 12-VOLT BATTERY ELIMINATOR

A de luxe unit for servicing the newest types of car radios

By BASIL C. BARBEE

WITH the introduction of 12-volt electrical systems in several 1953-model automobiles, all of us who intend to service the radios or other electrical devices used on these cars will have to provide ourselves with 12-volt d.c. power sources. Many technicians will complain at the additional trouble and expense, but the change was really long overdue. The 6-volt systems had been overloaded for years by the large number of accessories found on the modern car.

A check on availability and prices of 12-volt battery eliminators showed that a new 12-volt unit sells for about 50% more than a new 6-volt type. I found it cheaper and more versatile to buy another 6-volt unit identical to the one I was using already, and connect them in series for 12-volt output, or in parallel for 6-volt output. The parallel hookup gives twice the current and much better voltage regulation than a single dual-voltage unit.

There are some inconveniences, though, in using two separate 6-volt packs. The series-to-parallel changeover and polarity reversal have to be made by disconnecting and reconnecting a couple of pieces of wire. If each pack is equipped with a voltmeter, it will be necessary to add the two readings to find the output voltage with the units in series; if each has an ammeter, you will have to add *their* readings to find the output current with the units in parallel. Besides, with the parallel connection the units must be adjusted to give equal output voltages.

I decided to combine the two 6-volt supplies into a single unit, with suitable switching arrangements to provide either 6- or 12-volt output, as well as instant reversal of polarity. In addition, I wanted to eliminate a few of the shortcomings of many commercial low-voltage supplies by providing higher metering accuracy, and continuous control of the output voltage from zero to

(CONTINUED ON PAGE 63)

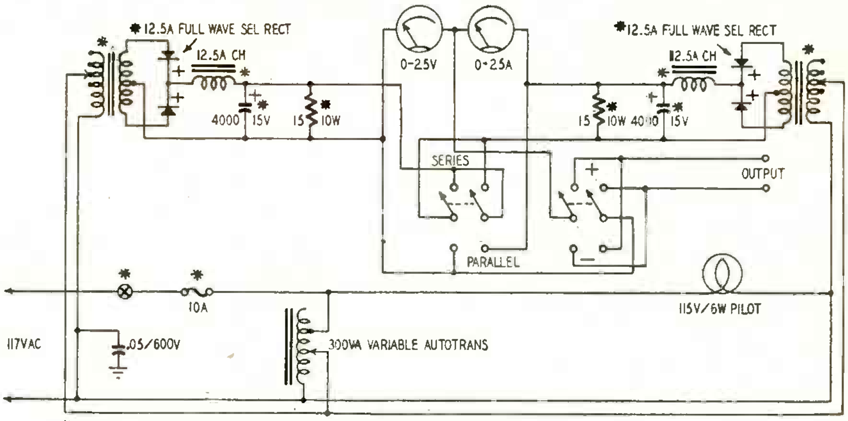
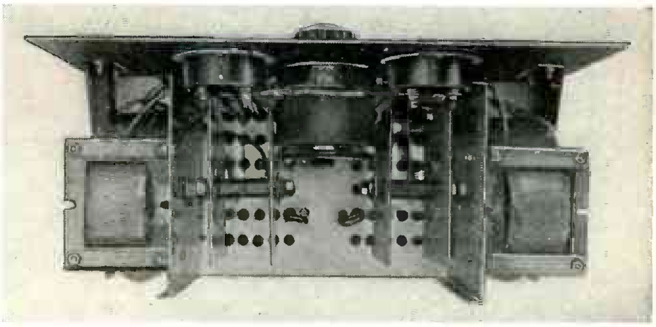
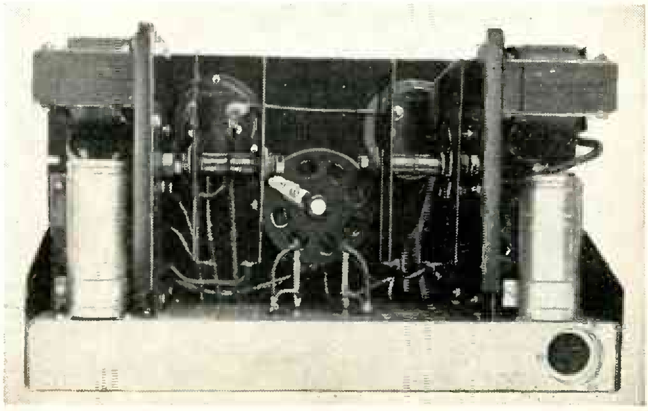


Fig. 1—Schematic of the dual-voltage battery eliminator assembled from two 6-volt power packs.

Front view of the 6-12 volt battery eliminator. Better-grade meters replace the duplicate units removed from the original 6-volt power packs. The *Powerstat* allows continuous control of output voltage.



Mounting of components on the front panel and twin subchassis. The left-hand section was transferred intact from the original cabinet, while the right-hand section was re-assembled in reverse for a symmetrical layout.



A rear view of the twin power pack, showing the locations of the electrolytic filter capacitors and the 2 bleeder resistors.

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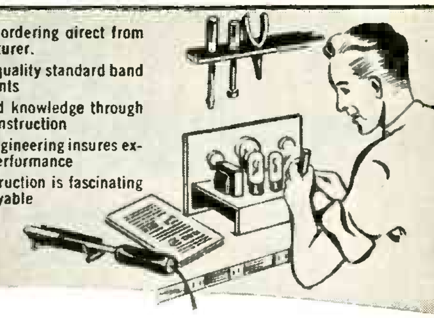


Heathkit MODEL O-8 OSCILLOSCOPE KIT

$43.50 Shipping Wt. 26 lbs.

The outstanding new 1953 model O-8 Heathkit Oscilloscope features the finest performance ever offered in this extremely popular kit instrument. Primarily intended as a general purpose oscilloscope for the faithful reproduction of actual wave forms and other electrical phenomena, it's vastly improved band width, good 100 KC square wave reproduction, three step vertical input attentuator, .025 volts per inch vertical sensitivity, etc., admirably qualify this instrument for TV and radio servicing, laboratory use, ham application and all general electronic development work. Improved vertical band width is obtained through the use of shunt peaking chokes with proper cathode compensation in the push-pull output stage. For additional flexibility of operation, provisions have been made for direct connections to the deflection plates, a Z axis input and a spot shape control for really fine focusing.

This beautiful kit is complete with all 10 tubes, including a 5" cathode ray tube, calibrated graph screen and flexible test leads. All necessary construction components, such as hardware, chassis, transformer, etc., and a detailed step by step construction manual, greatly simplify the assembly of this instrument.

Heathkit VOLTAGE CALIBRATOR KIT

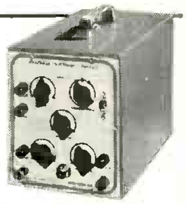
The use of a Voltage Calibrator will greatly increase oscilloscope usefulness. Provides a convenient method of making peak to peak voltage measurements by establishing a relationship between the unknown wave shape and the Voltage Calibrator. Voltage ranges .01–100 volts peak to peak. The Voltage Calibrator features direct reading scales and a regulated power supply system.

MODEL VC-2 **$11.50** Shipping Wt. 4 lbs.

Heathkit ELECTRONIC SWITCH KIT

The Heathkit Electronic Switch Kit will further extend scope usefulness by permitting simultaneous observation of two individually controlled traces. Continuously variable switching rates 10 cps to 2,000 cps in three ranges. Will also serve as a square wave generator over the range of switching frequencies.

MODEL S-2 **$19.50**



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Heathkit VACUUM TUBE VOLTMETER KIT

The beautiful new 1953 Heathkit Model V-6 VTVM, the world's most popular kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven through the production of over 70,000 VTVM kits. The Heathkit VTVM now features extended voltage ranges with 50% greater coverage on the DC range. New 1½ volt low scale provides well over 2⅓ inches of scale length per volt permitting faster measurements with greater accuracy. AC and DC ranges are 0–1.5–5–15–50 150–500–1500 volts (1,000 volts maximum on AC). Ohmmeter ranges are X1, X10, X100, X1,000, X10K, X100K X1 meg. Measures .1 ohm to 1,000 megohms. Other features are db scale, center scale zero adjust and polarity reversal switch. High 11 megohm input resistance virtually eliminates circuit loading.

The low anti-inflation price of this tremendously popular kit includes all tubes, necessary constructional material, test leads and the construction manual.

MODEL V-6 **$24.50** Shipping Wt. 6 lbs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

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A new amplifier type AC VTVM that makes possible those sentitive measurements so essential in laboratory or audio work. Ten voltage ranges covering from .01 RMS full scale to 300 volts RMS full scale. Input impedance 1 megohm with frequency response 20–50,000 cycles. Ten DB ranges from —52 to +52 DB. Four diodes in meter bridge circuit for maximum linearity.

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The ever popular Handitester is now supplied with a Simpson 400 microampere meter movement. Provides AC and DC voltage ranges 0–10–30 300–1,000–5,000 volts. Ohmmeter ranges 0–3,000 and 0–300,000 ohms. DC current measurements 0–10 and 0–100 milliamperes. A completely self contained portable instrument.

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Here is the long awaited Heathkit entry into the amateur radio field. The Heathkit AT-1 Transmitter kit is a well designed basic transmitter incorporating many desirable features and providing maximum over-all performance.

Convenient band switching eliminates the bother and annoyance of plug in coils. It is merely necessary to switch to the desired frequency and plug in your favorite crystal or VFO. This transmitter features a self-contained power supply mounted on the same chassis and cabinet enclosed to minimize TVI. AC line by-passed to reduce radiation.

The coils supplied with the Heathkit AT-1 are pre-wound and adjusted for the necessary frequency coverage of 80–40–20–10 meters. The entire kit is supplied complete with all tubes, coils, punched and formed chassis and cabinet, as well as all constructional material required. A detailed assembly and operation manual is also furnished.

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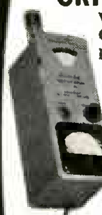

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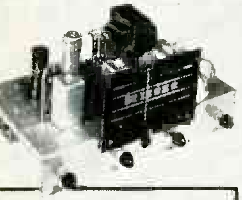

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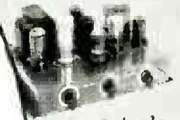

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maximum. The resulting low-voltage supply cost me only about $10 more than a new 12-volt manufactured supply and provides a far more useful piece of test equipment. At 6 volts output the regulation is more than twice as good as that of a conventional 12-volt supply operating at 6 volts, a highly advantageous feature when operating heavy or fluctuating loads such as receivers with automatic tuning devices, communications receivers, low-power transmitters, and small motors. Having a continuously variable output from zero to maximum is of great value in testing vibrators, electroplating, charging 2-volt storage cells, and miscellaneous testing.

The unit is shown in the photographs. It was built from two Stancor 752 *Master-Packs*, one of which was already on hand. The Stancor 752 seems to be typical of most manufactured and kit-form packs available, so most of the remarks herein should apply to other makes also. The heat-baffle (subpanel), on which the transformer, choke, and rectifier are mounted, was removed from each original pack, along with the filter capacitor, and transferred to an 8 x 17 x 2-inch steel chassis base. The capacitor mounting clamps were also transferred from the original cabinets to the new chassis to preserve the original parts layout, which seems to have been the most compact one possible. The assembly at the left end of the chassis was transferred with wiring intact, while the one at the right was torn down and reassembled in mirror-image fashion for symmetry and short leads. One-half inch of metal was removed from the top edge of each baffle to reduce the height of the front panel. This made it necessary to move each choke down ¼ inch. When tearing down and reassembling the rectifier stack of the right-hand assembly, take care not to scratch the surfaces of the plates, and reassemble them with the contact burrs in the same positions on the plates as before. The front mounting hole of the right-hand baffle must be moved about ½ inch to avoid conflict with the mounting of the transformer.

A variable line-input autotransformer, a 0–25 d.c. voltmeter, and a 0–25 d.c. ammeter were mounted on a 10½ x 19-inch steel relay-rack panel, which in turn was fastened to the chassis by a pair of chassis mounting brackets and by the controls extending through both chassis and panel. These controls, which are shown in the front-panel view, are from left to right: power switch, fuse, series-parallel switch, polarity-reversing switch, output terminals, and pilot light. A number of 7⁄16-inch holes were drilled in the chassis under the rectifiers to provide ventilation and to permit bringing leads through rubber grommets to the under side of the chassis.

The schematic is given in Fig. 1. The primaries of the two step-down transformers are connected permanently in parallel. Only one tap on each primary is used, since the variable input transformer provides all the voltage control necessary. Be sure to use the same tap on each transformer and pick one that will give an output (under load) of about 9 volts on the 6-volt range and 18 volts on the 12-volt range with the line-input control set at maximum.

The outputs of both rectifier-filter units go to the series-parallel switch. Following this switch are the voltmeter and ammeter, followed by the polarity-reversing switch, and finally the binding-post output terminals from one of the original packs. The left-hand binding post is grounded to the chassis. One side of the line is bypassed to chassis to eliminate the tunable hum sometimes experienced when operating mobile equipment without a ground. The two bleeder resistors are mounted between the rectifiers at the rear center of the chassis for ventilation, and to keep them away from the electrolytic filter capacitors, as their heat might be injurious. (This is the reason for the baffle between the rectifier and filter capacitor in the original pack.)

All connections carrying low-voltage d.c. should be made with No. 10 automotive wire. All other connections may be No. 18 pushback wire.

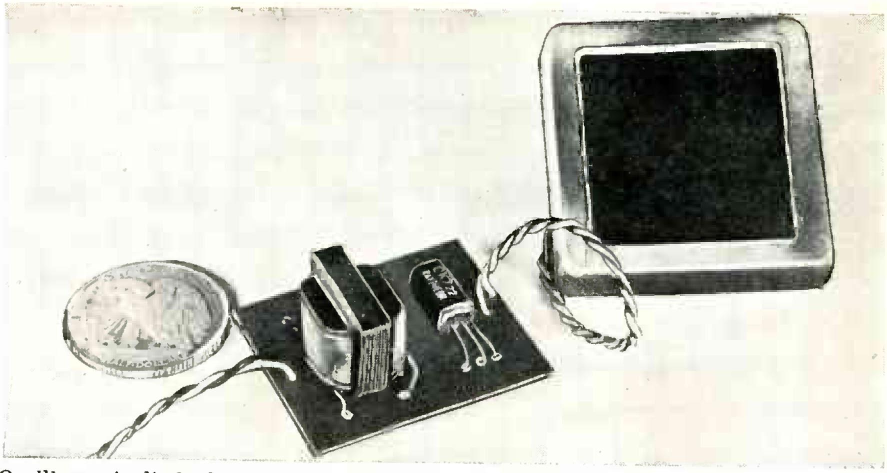
While the performance of this bench supply cannot equal some of the really fancy regulated types selling for $500 or more, it is so far superior to the everyday sort of pack that anyone using this supply in his daily work will find that the small additional cost was money well spent. END

Materials for battery eliminator

2—6-volt 12.5-amp battery eliminators (Stancor type 752 "Master Pack" or equivalent); 1—300-volt-amp variable line-voltage autotransformer (Superior Electric type 20 or equivalent); 1—0-25-volt d.c. meter; 1—0-25-amp d.c. meter; 1—6-watt, 115-volt pilot lamp and socket; 1—2-prong male power connector (chassis-mounting type); 2 d.p. d.t. 25-amp d.c. toggle switches; 1 s.p.s.t. toggle switch; 1—8 x 17 x 2-inch steel chassis; 1—10½ x 19-inch steel relay-rack panel; 1 pair—8-inch chassis-mounting brackets; hardware; wire; solder.

Suggested by Leland C. Wright, Cathlamet, Wash.

"High front to back ratio."



Oscillator is little larger than half dollar. Photocell power supply is at right.

TRANSISTOR OSCILLATOR IS POWERED BY LIGHT

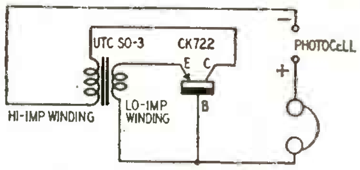
By RUFUS P. TURNER

THE high efficiency of the junction transistor and its ability to operate on extremely low d.c. voltages make possible many interesting low-powered devices hitherto unattainable in the electronic field.

A typical example is the miniature audio oscillator shown in the accompanying illustrations. It receives all its d.c. operating voltage from a self-generating photocell. An interesting fact to note is that both the active units in this circuit are semiconductor devices—the triode is a *germanium* transistor (CK722) and the power supply is a *selenium* photocell (International Rectifier Corporation Type DP-5 or equivalent).

In subdued room light, 0.02 millivolt r.m.s. is developed across a 2,000-ohm magnetic headset. A 100-watt lamp, 1 foot from the cell, gives a signal of 0.5 millivolt. From 1 to 2 millivolts can be obtained when the cell is illuminated by direct sunlight. All these signals can be heard easily in the headphones.

With the UTC type SO-3 Ouncer



The oscillator has very little circuitry.

transformer shown, the signal frequency is approximately 900 cycles and the waveform good. The frequency can be lowered by means of suitable capacitance values in parallel with the high-impedance winding of the transformer.

If the reader does not have a subminiature transformer available, any microphone transformer or line transformer (200 or 500 ohms to single or push-pull grids) will do the job. Connect the high- and low-impedance windings as shown in the figure. Polarity of the windings is important, since the phasing must be correct for oscillation. If the device does not oscillate readily when the photocell is illuminated, reverse the connections of *one* of the transformer windings.

While this oscillator is a novel gadget, it is not as much of a toy as it might appear first-hand. For example, in one very practical application, the output signal (which is proportional to the amount of light falling upon the photocell) may be amplified directly with a conventional amplifier, and the amplified output may be rectified and caused to operate a d.c. relay or high-current meter. For this purpose, the headphones may be replaced with a 2,000-ohm resistor across which the input terminals of the amplifier are connected.

In this way, one of the knottiest problems connected with self-generating photocells is solved—that of amplifying the low d.c. output of these devices. Stable d.c. amplifiers which might be used for the purpose are complicated, bulky, and expensive. The only previous alternative has been to chop the light beam to obtain from the photocell an "a.c." output which might be handled by a conventional amplifier, or to feed the d.c. from the cell into some sort of modulator whose a.c. output would be proportional to the applied d.c. This transistor oscillator converts the direct current from the photocell immediately into a.c. *without* light-chopping or modulation in bulky preamplifier equipment. It has no standby power requirements, no batteries to replace, no connections to the power line, and its active components have almost unlimited life. END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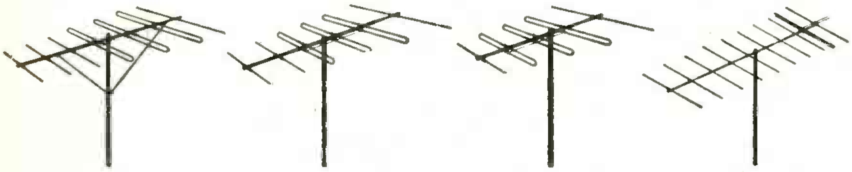

CAT. 1840
Triple-Driven
Seven-Element Yagi.
Five Channels – 2 thru 6

CAT. 1836
Triple-Driven
Six-Element Yagi.
Four Channels – 3 thru 6

CAT. 1824
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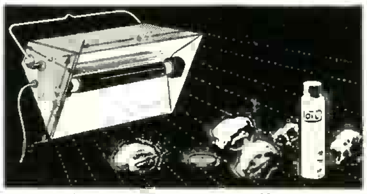
BLAK-RAY SELF-FILTERING ULTRA-VIOLET LAMP



BLAK-RAY 4-watt lamp, model X-4, complete with U-V tube. This lamp gives long-wave ultra-violet radiation having a wave-length of 3654 to 4000 angstrom units. Some of the substances made to fluoresce visibly when illuminated by U-V light are certain woods, oils, minerals, milkstone, cloth, paints, plastics, yarn, drugs, crayons, etc. This lamp is self-filtering and the invisible U-V rays are harmless to the eyes and skin. Equipped with spectral-finish aluminum reflector. Consumes only 4 watts and can be plugged into any 110 volt 50-60 cycle A.C. outlet. Will give 2000 to 3000 hours of service. It weighs but 1¾ lbs. Approved by the Underwriters Laboratories and has a built-in transformer so that it may be safely used for long periods when necessary. Extra U-V tubes are available.
Ship wt. 4 lbs.
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UNUSUAL BUY **$14.75**

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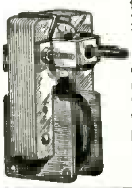

Sturdy shaded pole A.C. induction motor. 15 watts, 3000 rpm. 3"x2"x1¾"; 4 mounting studs; ⅞" shaft, 3/16" diameter; 110-120 volts, 50-60 cycles. A.C. only. When geared down, this unit can operate an 18" turntable with a 200 lb. dead weight. Use it for fans, displays, timers and other purposes. Ship wt. 2 lbs.
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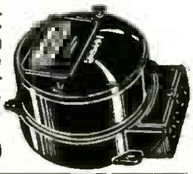

Leading makes—reconditioned. Ideal for trailer parks. 100-110 volts, 60 cycles, 2-wire A.C. 5 amp. Heavy metal case 8½" x 6¼" x 5". Easy to install. Ship. wt. 14 lbs.
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NOW ONLY **$4.50**

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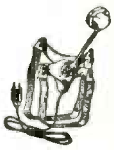

Lightweight 1 lb. carbon microphone. Aircraft type. Breastplate mounting, adjustable 2-way swivel. Easily fastened straps. For home broadcasts, communications etc. Complete with 6 foot cord, hard rubber plug. Sheradized plate, non-rusting finish. Ship. wt. 2 lbs.
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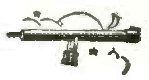

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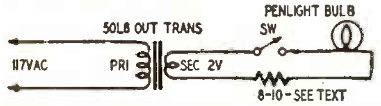
LOW COST TV TROUBLE LIGHT

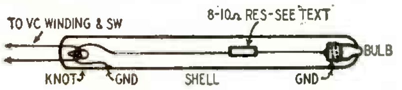
A flashlight today is a definite necessity to a television service technician. However, he is confronted with a problem. If he buys a small, lightweight flashlight, it uses miniature batteries which don't last long and require frequent replacement. His alternative is to use the large type of flashlight which runs on size D cells.



Circuit of the handy trouble light.

These batteries last reasonably long but the light is clumsy and heavy and can cause considerable damage, should it be dropped into the set.

This light combines light weight with low operating cost and convenience. The construction is simple. The line voltage is dropped down to 2 or 3 volts with a midget output transformer of the same



Pen-type TV trouble light construction.

type as that used in most a.c.-d.c. radios to match the 50L6-GT or similar output tube to the voice coil. With some transformers it may be necessary to place a 8–10-ohm resistor in series with the bulb in order not to burn it out. The line voltage is put into the high resistance winding of the transformer, and a cable, connected in series with a switch, is attached to the voice coil winding. This cable runs through a hole drilled in the rear of a small penlight-type flashlight and is soldered directly to the bulb in the tip. The transformer and switch fit perfectly into a large size metal Band-Aid box. It is advisable to purchase the box last, as the size of the transformer may vary. The switch is a rotary, s.p.s.t. type and is mounted in a ⅜-inch hole in the lid of the can. The drawings show the construction of the light.—*Stephen Kronigsberg*

A QUICK HIGH-VOLTAGE CHECK

There are times when we wish to check for high voltage on the second anode of a television picture tube. A quick and easy way is to hold a small neon lamp against the mask on the set. A glow indicates the presence of high voltage. The lamp glows brightly when checking metal tubes and is a little harder to detect when the picture tube is one of the glass types.—*Joseph Silver*

METER ECONOMY

When building a field-strength meter, grid-dip oscillator, or similar device, the usual practice is to buy a sensitive microammeter for use as the indicating meter. There is no need to purchase a meter if your volt-ohm-milliammeter can be used for full-scale readings of less than 1 ma.

Instead of installing a meter on the instrument that you are constructing, connect the meter leads to a pair of phone-tip jacks which fit the tips of the test prods used with your v.o.m. For field-strength metering, you can use a long cord with phone tips on each end. This will make it possible to watch the meter while you are some distance away from the reference antenna or field-strength tuner.—*Arthur Trauffer*

TAPE SHIELDS TUBE NUMBERS

After a radio tube has been handled a few times, the type numbers often become worn off and illegible. To eliminate this difficulty, I place a strip of clear cellulose tape over the numbers. This protects the numbers from wear and thus prevents the tube from becoming unidentifiable. This kind is particularly useful on tubes which are used for experimental work.—*John A. Comstock*

GROUNDING TV SETS

In trying to get a clear picture it is not uncommon for service technicians to go to great pains to orient the antenna properly and completely forget grounding the set. I have found cases where a ground made the difference between a fair picture and a good picture. In one instance I operated a set with only a ground and got excellent pictures on two out of three available channels. Remember to use the ground only on the ground terminal. It may be dangerous to use it on the chassis.—*B. W. Welz*

END

Here's how to increase your Auto Radio Repair Business!

There's one sure way to get ahead in the car radio repair business, and that's to be in a position to tap the vast market of Delco Radio-equipped cars and trucks that daily passes your door! To do this you need only sign up with Delco Radio, through your United Motors Electronics Distributor. Then, automatically, you have a reliable source for Delco Radio original equipment replacement parts, and for universal replacement parts. You will receive a complete and comprehensive Delco Radio Service Manual. You will regularly receive monthly issues of "Testing Tips," a bulletin giving the very latest factory information on testing and repairing Delco car radios. So if you want to increase your business—permanently—get on the Delco Radio team. Don't delay . . . contact your United Motors Electronics Distributor right away!

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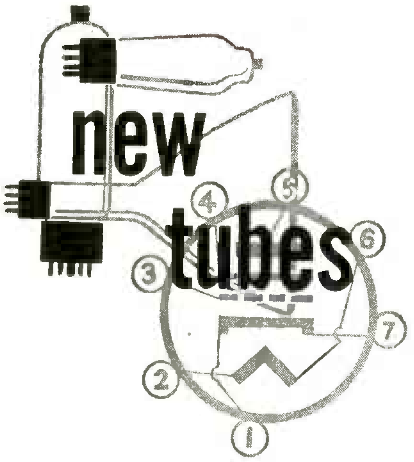


(and Transistors)

A new-size picture-tube —plus a whole flock of improved transistors

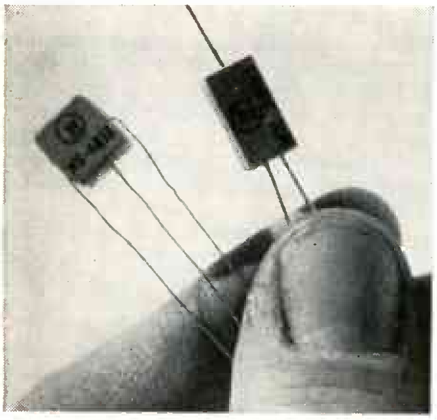
ONCE again manufacturers' announcements feature more transistors than tubes. We do have a new picture tube, though—the CBS-Hytron 24TP4. This is an all-glass rectangular type, with a 24-inch screen diagonal and an effective picture area slightly over 370 square inches. The 24TP4 is a magnetic-deflection and focus type, and has a spherical *Filterglas* face plate with aluminum backing. The bulb has an external conductive coating with a capacitance between 250 and 400 μμf for added high-voltage filtering.

Normal operation in TV receivers is at an ultor voltage of 14,000; grid 2 voltage, 300; and grid 1 voltage, −33 to −77. Under these conditions the recommended focus-coil current is 110 ma ±10%. Maximum ultor rating is 20,000 volts.

The 24TP4 has a diagonal deflection angle of 90°, and requires a yoke with a ½-inch flare radius. (Most standard 90° deflection yokes meet this requirement.) The new tube takes a single-magnet ion trap and has standard 5-pin duodecal basing.

Transistors

Westinghouse has announced two new transistor types—the WX-3347 and the WX-4813. Both types are designed for developmental work and are equipped with leads for direct wiring into circuit setups.



Two new Westinghouse transistor types.

The WX-3347 is a point-contact transistor for grounded-base operation. Under small-signal conditions it has a power gain of 18 db at a collector current of 2 to 3 ma. Cutoff frequency is 2 mc. The WX-4813 is a P-N-P junction transistor. As a grounded-emitter base-input amplifier it has a power gain of 30 db at a collector current of 1 to 2 ma.

The dispute over the merits of transistors in hearing aids (see "The Radio Month" in the June RADIO-ELECTRONICS) has prompted at least two manufacturers to bring out hermetically sealed models that they claim are impervious to the effects of body heat and moisture.

CBS-Hytron has brought out three moisture-proof P-N-P junction transistors hermetically sealed in metal-glass containers. The new transistors—2N36, 2N37, and 2N38—are especially suitable for hearing aids and other personalized equipment, and differ only in base current and current gain. Recommended operating conditions for all three types are as follows: Collector voltage, −6; emitter current, 1 ma; input resistance 1,000 ohms; load resistance, 30,000 ohms. Under these conditions the 2N36, 2N37, and 2N38 have current gains of 45, 30, and 15 respectively.

All three have the same in-line 3-pin basing as the RCA 2N32 shown in last month's "New Tubes" column.

(As a further step in improving the stability and life expectancy of its hermetically-sealed transistors, CBS-Hytron announced later that all junction transistors are now completely evacuated before sealing. The exhaust process removes polar molecules that might eventually deposit themselves on the junction boundaries and cause leakage and a gradual breakdown in the transistor's characteristics.—*Editor*)

Radio Receptor Company has also announced that it is producing three hermetically-sealed types in a case adapted from one designed for military equipment. These are P-N-P junction transistors, useful from d.c. to low radio frequencies in high-gain amplifiers, oscillators, and shaping circuits. These tiny units are sealed in a thin .120 x .343 x .375-inch plastic shell. Leads may be soldered in, or clipped to plug into a standard 3-pin socket.

Radio receptor sealed transistors.

Lead spacing insures proper polarity and fits the standard subminiature socket (proposed JETEC standard).

Excellent performance can be obtained with as little as .5 ma at 1.5 volts on the collector. Under these conditions the high-gain type RR 20 has a current amplification of 40 and a power gain of 36 db. The general-purpose type RR 14 and the economy type RR 21 have current amplification of 25. The RR 14 and RR 20 have a cutoff current of only 10 μa and a noise figure of 22 db at 1,000 cycles.

While on the subject of transistors, on June 1, Raytheon reduced the net user price of its CK722 junction transistor to $4.50.

Special tubes

An unusual decade-counter tube—the *Vidicount*-E1T—was announced by Amperex Electronics Corporation. The

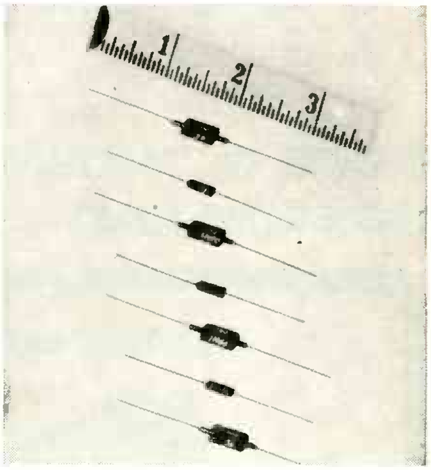
Amperex's new visual decade-counter tube.

E1T is a special form of cathode-ray tube that gives a direct visual count from 1 to 10, and combines the functions of several other tubes and components normally used in computer circuits. The cathode of the E1T generates a ribbon-shaped electron beam which passes in succession through 10 apertures in a cylindrical anode according to the number of counting pulses applied. The beam strikes a fluorescent screen lining the tube envelope, and produces a rectangular luminescent spot opposite the appropriate printed figure (from 0 to 9). The tenth pulse automatically resets the beam to its zero position and simultaneously applies a counting pulse to the following tube. Any number can thus be read directly with sufficient E1T tubes in cascade.

Crystal-diode chart

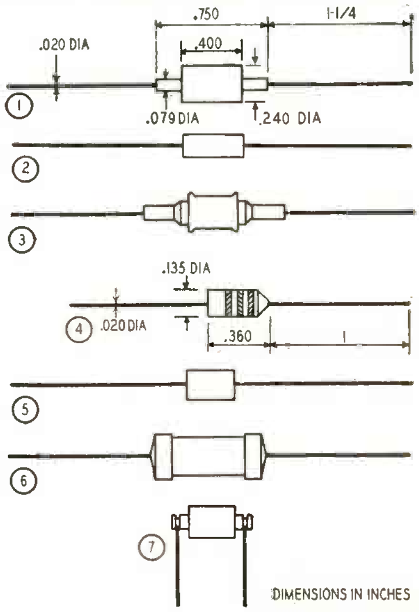
National Union Radio Corporation has compiled an interchangeability

chart showing the physical outlines and type numbers of the most popular crystal diodes and the equivalent National



National Union crystal-diode types.

Union types. This chart is reproduced here for the convenience of service tech-



FOR COMPETITIVE TYPE	OUTLINE	USE N.U. TYPE
IN34	6	NU34
IN34A	3	IN34A
IN38	6	NU38
IN38A	3	IN38A
IN43	7	IN69
IN47	7	IN70
IN48	1	IN48
IN51	1	IN51
IN54	6	NU54
IN54A	3	IN54A
IN55	6	NU55
IN55A	3	IN55A
IN58	6	NU58
IN58A	3	IN58A
IN60	6	IN64
IN63	1	IN63
IN64	1	IN64
IN65	1	IN65
IN69	1	IN69
IN70	1	IN70
IN72	1	IN72
IN75	1	IN75
IN81	1	IN81
CK705	2	NU34
CK706	2	IN64
CK707	2	IN54A
CK708	2	NU38
CK710	2	IN72

nicians who may have difficulty in obtaining replacements identified only by special manufacturers' part numbers.

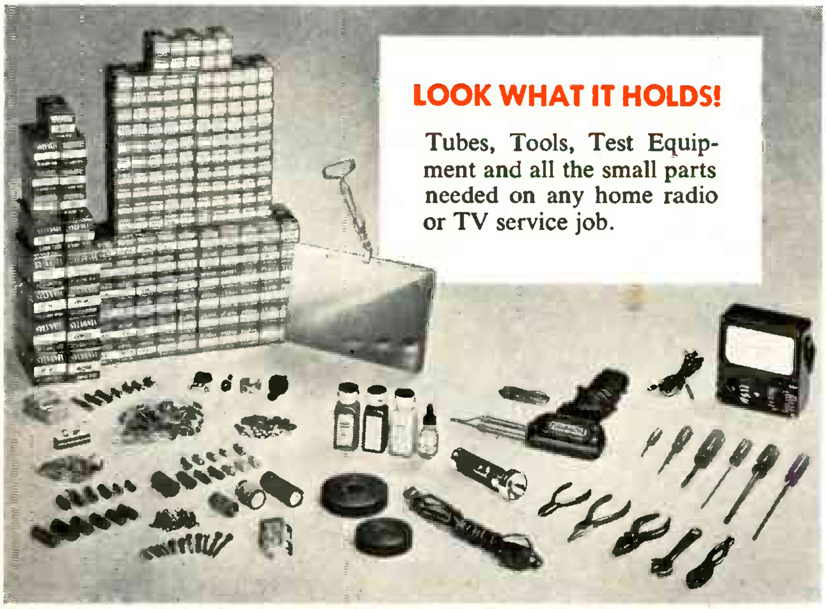
END

Servicemen! Here's Your Sylvania

T-N-T CHEST

(TUBE AND TOOL)

The Most Valuable Service Aid You've Ever Seen!



Talk about a useful servicing aid . . . this Sylvania T-N-T (Tube and Tool) Chest is really it! Carries more tubes, tools and parts than any chest on the market!

LOOK AT THESE FEATURES:

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- Waterproof Du Pont Fabrikoid cover
- Holds 187 receiving tubes
- Lightweight folding aluminum tool and parts tray
- Unbreakable plastic handle
- Brass-plated hardware
- Room for mirror and ohmmeter
- It's a complete, portable service shop!

ACT NOW . . . Offer Limited!

This chest is now yours for only $5.00 and 30 Sylvania Premium Tokens. Offer good only between August 1st and November 15th. See your Sylvania Distributor who has these kits now.

Remember, you get 1 Sylvania Premium Token with every 25 receiving tubes or with every picture tube you buy.

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University Tower Building, St. Catherine St., Montreal, P. Q.

TV "TOWN MEETING"

Several hundred TV service technicians from Ontario, Quebec, and even Manitoba attended the "Town Meeting of Television Technicians" held in Toronto May 11-14. This was the seventh in a series of "Town Meetings" inaugurated in 1949, and which appear to have been more successful in Canada than in the United States.

The program was conducted by A. C. W. Saunders and Aaron Dornbusch, of Boston, Mass., both veterans in radio and television servicing and instruction. The attendance at all sessions of the four-day trouble-shooting course was excellent.

NEWS FROM B. C.

Dave Banfield was elected president and Harold George, secretary-treasurer of the Radio Electronic Technicians of British Columbia at the annual meeting of the Association held at Chilliwack, B.C., on May 24.

The meeting occupied the entire day, from 11 am to 9 pm. Norm Tovey gave a report on proposed provincial legislation, and stated that it was highly possible that legislation desired by the service technician might be brought before the B.C. legislative assembly. A new proposed TV price schedule was approved for distribution to the membership.

It was decided to send two delegates from R.E.T.A. of British Columbia to the R.E.T.A. of Canada convention which was scheduled to be held in one of the midwest provinces in midsummer.

NEW JERSEY ELECTS

Harold B. ("Dusty") Rhodes, Paterson, was re-elected president of the Radio and Television Servicemen of New Jersey, Inc., at the fourth annual meeting of the association, held June 8. Other officers elected were: Fred E. Berdy, vice-president; J. Palmer Murphy, executive secretary-treasurer, and Jerome J. Gelram, counsel. All are of Paterson. Harry Weinberg and Norman Goodman of Paterson, A. Auerbach of Rochelle Park, and H. A. Shelladay, of West Milford, were elected to two-year terms on the eight-man Board of Trustees.

In his annual report, President Rhodes laid down three major fields in which a serviceman's association must be constantly active if it is to be successful and worth-while. The categories are: Services to members; public relations and advertising; and meeting industry wide problems. For the coming year he named Felix Bremy chairman of the Committee on Industry Relations, and James Ryan chairman of the Committee on Public Education.

NETSDA MEETS

The National Electronic Technicians and Service Dealers Associations met Sunday, June 7, at the ARTSNY Headquarters, 165 East Broadway, New York City.

Final details in the work of obtaining

a charter of incorporation for the organization were completed at this meeting. A resolution offering assistance to any associations who request aid in license problems was also passed.

The RTMA booklet "How to Get Good Television Service without Destroying Free Enterprise" was studied and discussed.

The next meeting was announced for July 26, at Lily Lake, Luzerne County, Pa., and will take place in connection with the annual clambake and picnic which has been an annual feature with the Luzerne County Association for some years. The meeting will be a joint one with the Pennsylvania State Federation.

PRSMA REJOINS STATE GROUP

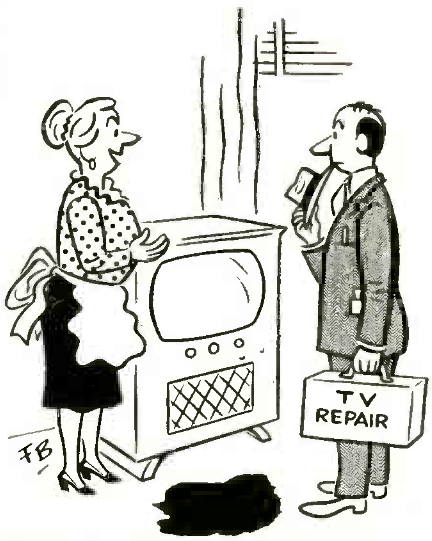
Highlight of the May meeting of the Federation of Radio Servicemen's Associations of Pennsylvania was the reinstatement of the Philadelphia Radio Service Men's Association to full membership in the Federation. The delegates from PRSMA at the meeting were Samuel Brenner, president of the association, and Al Haas and Stan Meyers.

The Federation adopted the resolutions drawn at the recent Paterson Eastern Conference (RADIO-ELECTRONICS, June, page 84). Plans for promoting local TV broadcasts of an educational nature, aimed at creating better understanding between the set owner and the organized TV service technician, were also discussed.

All affiliated chapters were advised to forward any local advertising of a questionable nature to the Federation secretary.

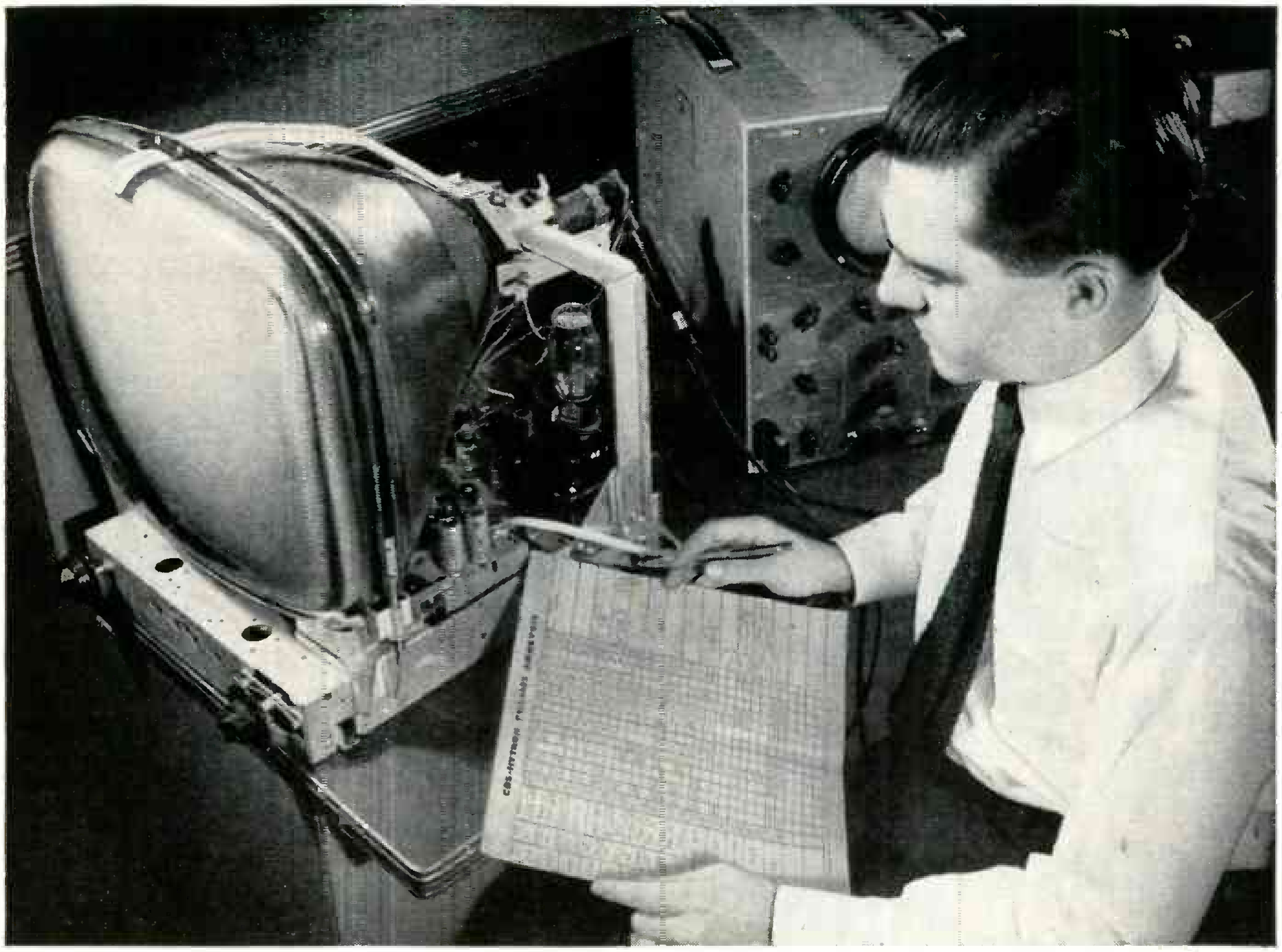
A Committee for Jobber Relations was named, consisting of Austin Renville of Wilkes-Barre, Bert Bregenzer of Pittsburgh, Henry Govan of Scranton, and William Deardorff of Chambersburg.

The meeting was held in Maurice's Restaurant, Philadelphia, May 17, with Federation president Milan Krupa in the chair. END



Suggested by Chase Bass, Colonial Heights, Va.

"We're moving to a small apartment. Could you convert it to ten inches?"



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Meet John Cunningham, a CBS-Hytron Commercial Engineer. John is beginning at the beginning for you. Socket by socket, he is analyzing the tube requirements of a brand-new TV set design.

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Constantly CBS-Hytron carries on teamwork like this. Socket by socket analysis. Day in, day out — with 9 out of 10 leading TV set makers. Both tube and set engineers pool their specialized skills. Scores of the nation's foremost TV set engineers help make endless CBS-Hytron improvements. Help assure you of unsurpassed performance in virtually *all* leading TV sets.

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ALUMINIZED PICTURE TUBES

27EP4 and 24TP4 . . . both *mirror-backed, spherical, electromagnetic types.*

Leading TV set makers demanded maximum brightness from their large-screen sets. Without strain on component parts. For them, CBS-Hytron introduced its *Mirror-Back* picture tubes. Mirror-like effect of their aluminized backing steps up light output. Adds sparkling brilliance to the picture. Gives greater contrast and freedom from screen discoloration. You, too, will want CBS-Hytron *Mirror-Back* tubes for replacement. Because your customers can *see* them recapture that bright, new-set sparkle. Order the performance-tested 27EP4 and 24TP4 from your CBS-Hytron distributor.

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SYNCHRONIZATION CONTROL

Patent No. 2,628,279
John H. Roe, Collingswood, N. J.
(Assigned to Radio Corp. of America)

In televising movie films, it is important to maintain exact sync between the projector and the vertical sync pulses. Each movie frame must be projected between scanning periods to avoid distortion. This new method maintains that synchronism. It is also suitable wherever motor-driven equipment needs to be synchronized with a series of pulses.

In Fig. 1, motor M drives a movie projector P and a pulse generator G. This generator charges capacitor C through a rectifier bridge, provided

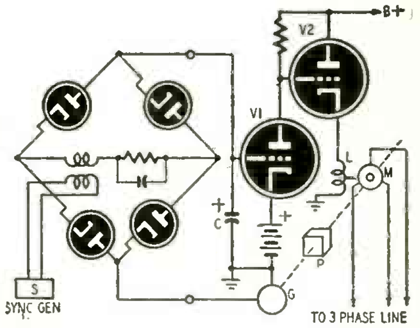


Fig. 1—Circuit of sync-control unit.

the latter conducts. Conduction is possible only when pulses from S bias the diodes. Thus a charge is delivered to C only when pulses from G and from S coincide. C is charged with a positive voltage, which is amplified by V1 and a d.c. amplifier (V2). The output coil L is the motor armature. Increasing the voltage across C lessens the torque on the motor M.

Fig. 2 shows various relationships between pulses from G and S. T2 shows the condition where the speed of M is correct. During the

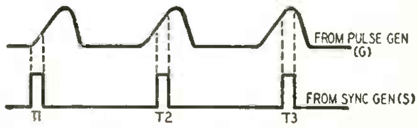


Fig. 2—Time relationships between generator and sync pulses. See text.

short pulse interval of bridge conduction, G delivers a charge to C. T1 shows an S pulse arriving too early. The capacitor charge is smaller than before because (at this instant) the output from G is low. At T3, S arrives too late. This time a relatively big charge is placed on C. As shown previously, this will slow down M and thus restore synchronism between projector P and the pulses.

A.F. OSCILLATOR CONTROL

Patent No. 2,630,482
Lee G. Bostwick, Chatham, N. J.
(Assigned to Bell Telephone Laboratories, Inc.)

Audio tones are frequently used for remote control of various types of electronic and mechanical apparatus and for selective calling in communication circuits. When the apparatus requires a large number of signaling frequencies, the tones must be comparatively close together in the spectrum and the receiver must have very selective filters to separate them. The Q of the filters must be considerably higher than can be readily obtained with conventional L-C constants.

This patent describes a frequency-selective bridge which uses a high-Q mechanically resonant device as one of its arms. The resonant device may consist of a tuning fork with one of its tines placed in a driving coil connected in one arm of the bridge as in Fig. 1. The electrical impedance of the driving coil consists of a

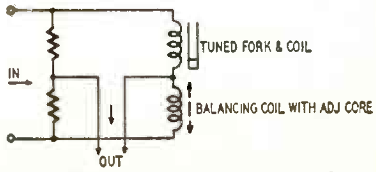


Fig. 1—Schematic of tuning-fork unit.

NEW PATENTS

damped impedance and a motional impedance. The former is the impedance of the coil when the fork is either blocked or when it does not vibrate because the frequency of the current in the driving coil is different from the frequency of the fork. Motional impedance is the change in the coil impedance caused by vibration of the fork.

In Fig. 1, the core of the balancing coil is adjusted so that the impedance in its arm is equal to the damped impedance of the driving coil and fork. Thus, at frequencies other than the resonant one, the fork does not vibrate, motional impedance is negligible, and the bridge remains balanced. At resonance, the fork vibrates and the motional impedance rises to unbalance the bridge. The high Q of the mechanically resonant circuit produces a response curve which is very sharp.

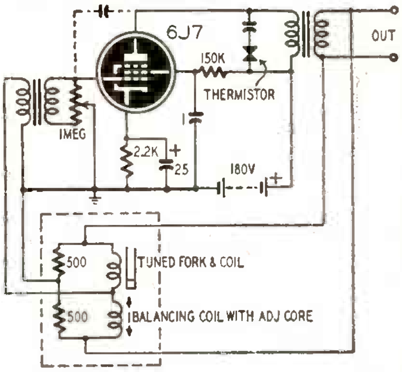


Fig. 2—The oscillator-control circuit.

Fig. 2 shows how the bridge in Fig. 1 may be used as the controlling element of a regenerative-type bridge-tuned audio oscillator. A portion of the output signal is fed back through the bridge to the input circuit. The gain of the oscillator tube is adjusted to be slightly larger than the loss through the bridge at the resonant frequency where the loss is at minimum. The thermistor is shunted across the output to limit the output voltage.

MEASUREMENT OF INDUCTANCE AND SELF-CAPACITANCE

Patent No. 2,626,981

Edward M. Shiepe, Brooklyn, N. Y.

Every coil or inductor has stray capacitance between its turns. This capacitance must be known before we can design a circuit to use the coil. Here is a new method for measuring both the *inductance* and *self-capacitance* of a coil.

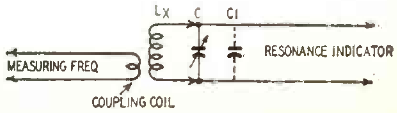
Let us assume that we have a perfect coil L_x, one with no self-capacitance. When a capacitor C is connected across L_x, the combination will resonate at a frequency

$$F = \frac{1}{6.28\sqrt{LC}}$$

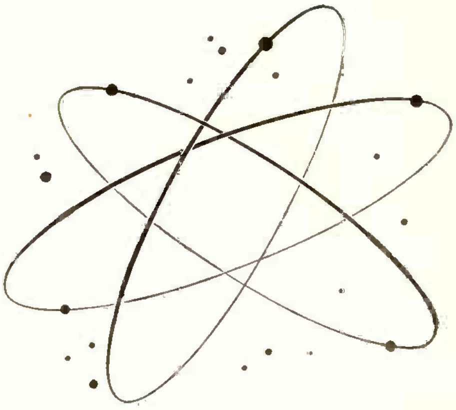
C may then be calibrated in terms of the *inductance* required to tune it to F. If we wish to use different frequencies, we must have a separate scale for each. With any *perfect* coil L across it, C will indicate the *same* value no matter which frequency is used, provided the correct scale is observed.

Unfortunately, there is no such thing as a perfect coil. Lx does contribute some capacitance of its own. Therefore when C resonates it to different frequencies, each calibration reading will be different. To measure the self-capacitance, an auxiliary capacitor C1 is connected across C in the standard measuring circuit in the drawing. C1 is calibrated in μμf, counting from maximum capacitance down to minimum. C is calibrated as before, but with *C1 at its maximum setting.*

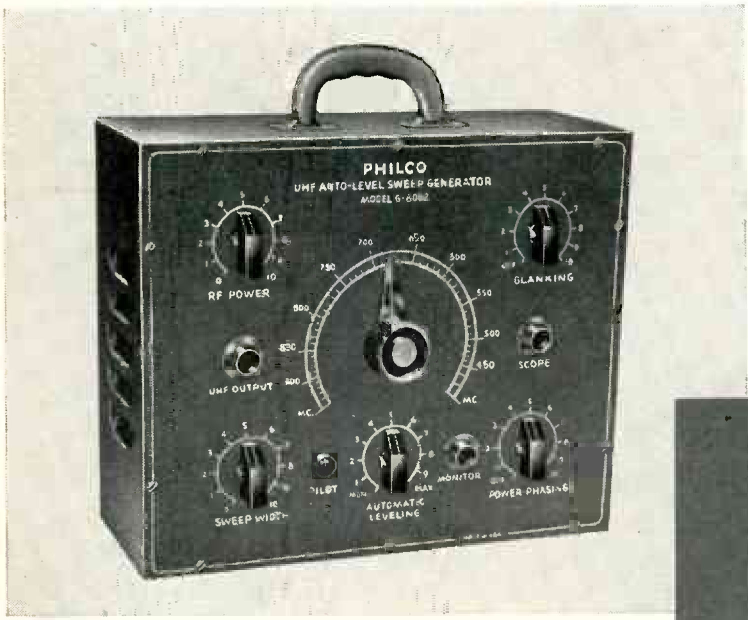
Therefore if we make measurements at 2 or more harmonics of F, C reads the *same* on each of the corresponding calibrated scales if we reduce C1 from its maximum value, by the self-capacitance of the coil. Of course, it is unlikely that C1 will be set correctly the first time. The chances are that several trial settings will be needed before we hit the right value. When C



Specifically DESIGNED FOR



PHILCO Test Equipment



UHF Auto-Level Sweep Generator

Model G-8002. The newest, most modern, most inexpensive UHF sweep generator on the market. Checks sweep alignment with *any* test oscilloscope. Its output is controllable . . . makes possible over-all trouble shooting and testing of low level units such as UHF tuners, boosters, converters, etc.

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Model M-8104. More features than any other unit at this popular price. Reads signal strength directly from the dial from 10 to 100,000 microvolts. A serviceman's time saver to measure actual TV picture signal strength.

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3-inch TV Oscilloscope

Model S-8200. The most practical portable unit available for bench or field servicing. Preset horizontal and vertical sweep rates take the guesswork out of trouble shooting. Ideal for television because of its high sensitivity and wide response.

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Model M-8100

Model M-8102

Model M-8100. The rugged PHILCO CIRCUIT MASTER is one of the finest vacuum tube voltmeters ever designed. With its companion unit the famous . . .

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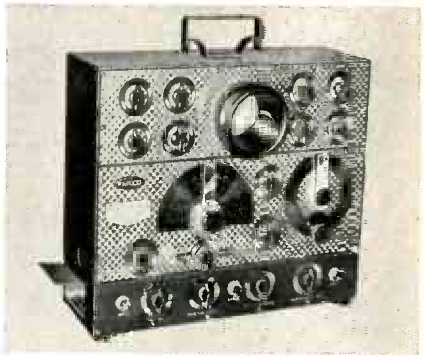

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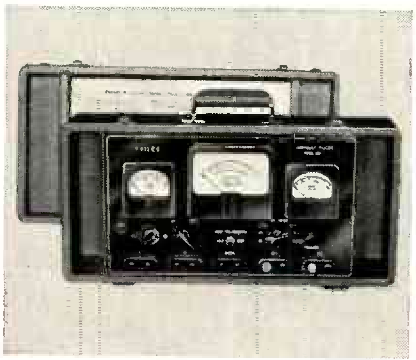

Appliance Tester

Model 5007. The ultimate in versatility. A one package, all purpose, portable appliance service unit. Permits over-all analysis of refrigerators, ranges, air conditioners and household appliances. With "pick-up" elements to determine temperature.

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CITY ____________________ STATE ________ gives the *identical* reading at 2 or more frequencies, it shows the correct *inductance* of the coil, and C1 shows the *self-capacitance*.

To simplify frequency requirements, this invention uses a crystal-controlled oscillator. The fundamental and its first four harmonics are available as measuring frequencies. A relay system automatically indicates which harmonic (or fundamental) is tuned. C is equipped with five corresponding scales. A v.t.v.m. indicates when resonance is reached.

4-TERMINAL TRANSISTOR

Patent No. 2,624,016

Charles de Boismaison White, London, England (Assigned to International Standard Electric Corp., New York, N. Y.)

This patent describes a special 4-terminal transistor suitable for trigger service. Three metal electrodes are plated on the crystal. There is a control element besides the usual emitter, collector, and base. No catwhiskers are used. Such a crystal exhibits a collector characteristic like that due to hysteresis. See Fig. 1.

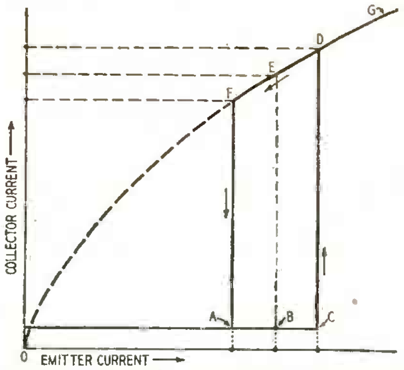


Fig. 1—Tetrode transistor response.

Normally the operating point is set to the center at B. Here the collector current is very low. If the emitter bias is increased, as by a positive pulse, the operating point moves to C, and the collector current rises abruptly to D (and then increases gradually to G as emitter current continues to increase). When the pulse dies out, the current will ease off to point E. On arrival of a negative pulse, collector current follows the path EF, then drops abruptly to A. The operating point returns to B at the end of the pulse.

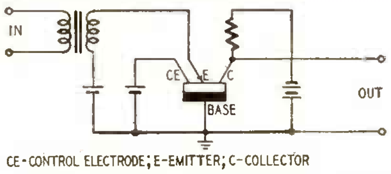
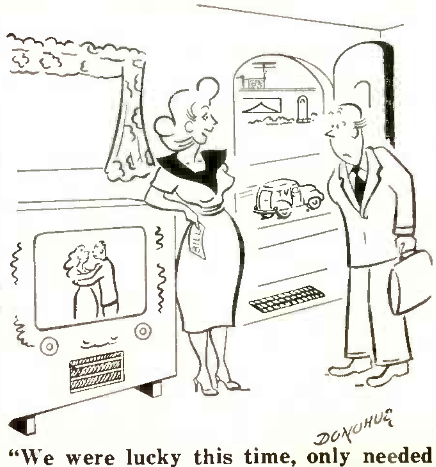


Fig. 2—Trigger circuit using the new-type plated-electrode tetrode transistor.

Fig. 2 shows the new transistor circuit. CE, the control element, is biased to a few volts. This voltage determines the actual shape of the hysteresis curve. The other elements function like those of a conventional transistor. END



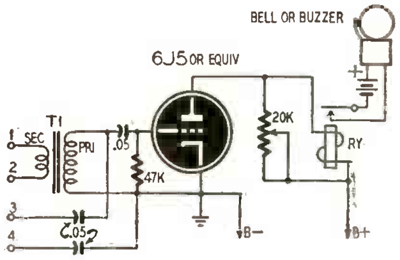
"We were lucky this time, only needed one tube! Something called a '27EP4'."

INTERMITTENT ALARM

Servicing an intermittent receiver is often a very annoying and unprofitable job because the technician usually has to stand by the set while waiting for it to cut out. If he attempts to do another job in the meantime, the intermittent set usually must be operated at an annoying volume level.

This intermittent alarm connects across the output of the receiver and operates an audible alarm when the set cuts out. The triode is a grid-leak detector with a relay in its plate circuit. When an audio signal is applied to the input of the alarm, the grid develops a negative bias which decreases the plate current flowing through the relay. When the audio signal drops or cuts out, the plate current rises and closes the relay circuit to the alarm.

T1 is a standard single-ended output transformer. Terminals 1 and 2 may be connected across the secondary of the set's output transformer and to silence the set disconnect the speaker voice-coil leads. Terminals 3 and 4 are used when connecting the intermittent alarm to a point in the set's audio circuit ahead of the output transformer. Terminal 3 is the hot lead and terminal 4 connects to the receiver chassis. In this case, replace the speaker voice coil with a resistor equal to its impedance.



The set should be supplied with a modulated signal from a signal generator to prevent the alarm from being triggered falsely by interruptions in the program from a broadcast station. The 20,000-ohm sensitivity control should be adjusted to the point where the relay just remains open with a given modulated input and setting of the receiver's volume control.

Materials for intermittent alarm

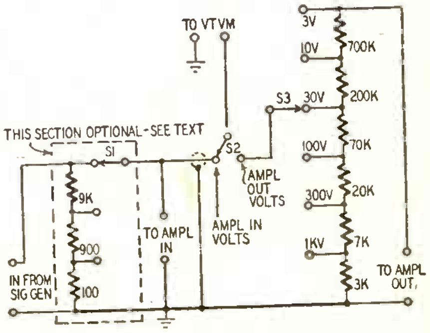
Miscellaneous: 1—output transformer (preferably with 15,000-to-25,000-ohm primary and 3-to-4-ohm secondary); 1—s.p.s.t. normally open relay with 5,000-ohm or higher coil; 1—20,000-ohm wirewound potentiometer; 1—47,000-ohm, 1-watt resistor; 3—.05-μf, 600-volt capacitors; 1—6J5 or equivalent; Tube socket, terminals, alarm, batteries, and hookup wire.

AMPLIFIER METERING SET

The frequency response of an audio amplifier or system is usually measured by feeding in a number of known frequencies at a constant voltage while measuring the output voltage with an audio v.t.v.m. Since most audio signal generators do not have a metered output, it is usually necessary to use separate meters in the output and input of the amplifier or use a single meter and switch it between the input and output circuits. In many instances, this makes it necessary to change the meter range each time you switch from one circuit to the other. This simple transmission measuring set eliminates the need for switching meter ranges.

The unit consists of an input attenuator (necessary only if very low input is desired or if the generator does not have a good built-in attenuator), a switch to connect the v.t.v.m. to the input or output of the amplifier, and an output attenuator to cut down the amplifier output voltage so it can be read on the same scale as the input voltage. The attenuator values are selected so the input and output voltages can be read conveniently on the 3-volt scale of an a.c. v.t.v.m.

S1 and S2 may be wafer switches with high-grade insulation. S2 may be a toggle or push-button switch with the v.t.v.m. wired to the amplifier input through the normally closed contacts. Noninductive resistors are used for the attenuators. The hot lead to the amplifier input should be shielded and as short as possible.



Materials for gain-measuring set

Resistors: 1—700,000, 1—200,000, 1—70,000, 1—20,000, 1—9,000, 1—7,000, 1—3,000, 1—900, 1—100 ohms, noninductive, 1% precision.
Switches: 1—s.p.d.t. toggle, wafer, push-button, or lever with spring return; 1—single-pole, 3-position wafer with low-loss insulation, 1—single-pole, 6-position wafer with low-loss insulation.
Miscellaneous: Input and output terminals, terminal strips, small chassis or utility box, hookup wire.

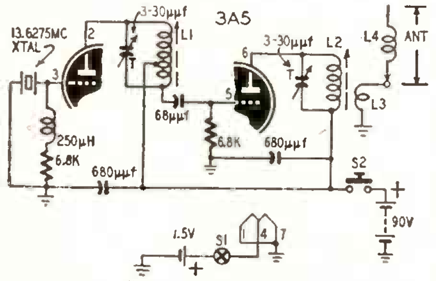
Set the generator to about 400 cycles. Adjust the v.t.v.m. range selector so the desired amplifier input voltage deflects the meter between one-half and three-quarters full scale. Starting with S3 in the highest voltage position, throw S2 to read amplifier output. Vary S3 until the meter reads about one-half scale. Leave S3 in the position while varying the generator to complete the frequency run.—*Paul S. Lederer.*

CITIZENS-BAND TRANSMITTER

Many of the radio-controlled models described in this and other publications can be modified for use in the 27.255-mc citizens band. The extent of the modification depends on the design and operating frequency of the original equipment. Equipment designed for the 10- and 11-meter amateur bands is the simplest to modify. The receivers can be tuned to 27.255-mc by making slight adjustments in the constants of the tuning circuits. If the equipment does not hit 27.255, try varying the spacing between the turns on the tuned coils. The L-C constants must be changed when modifying 2- or 6-meter receivers.

Most of the radio-control equipment described to date has been designed for amateur operators. Many of the transmitters either use self-excited oscillators or run power inputs far in excess of the 5-watt maximum allowed on the citizens band. The diagram shows the circuit of a simple citizens-band radio-control transmitter which is described in *National Radio-TV News*, published by the National Radio Institute.

The 1-tube transmitter operates from a 13.6275-mc crystal and delivers output on 27.255 mc. S1 is the filament switch and S2 is the pulsing switch. S2 may be a push-button, telegraph key, or a more complex keyer such as a telephone dial mechanism. The antenna is a base-loaded whip made from two sections of a replacement-type automobile radio antenna.



Parts for 27-mc transmitter

Capacitors: 2—3-30-μμf mica or ceramic trimmers; 1—68, 2—680-μμf ceramic.

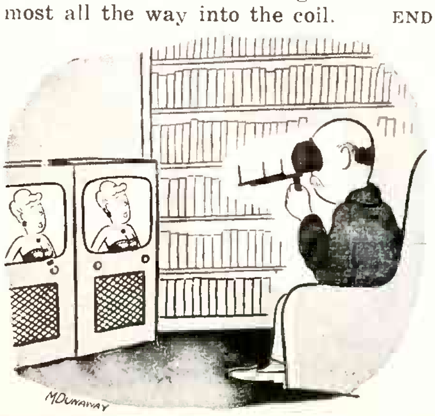
Resistors: 2—6,800 ohms, 1/2 watt.

Miscellaneous: 1—250-μh r.f. choke (Millen 34300 or equivalent); 2—National XR-50 coil forms; 1—13.6275-mc crystal; 1—crystal holder; 1—3A5 tube; 1—Miniature 7-pin socket; 1—B & W Miniductor; 1—spool No. 28 d.s.c. wire, 1—spool No. 24 d.s.c. wire; batteries, hookup wire, chassis, cabinet, switches, hardware.

L1 and L2 are wound on National XR-50 slug-tuned forms. L1 consists of 34 turns of No. 28 d.s.c. wire, tapped at the 17th turn. L2 has 12 closewound turns of No. 24 d.s.c. wire. L3 is a 3-turn coil, wound close around the cold (B plus) end of L2. L4 is a 13-turn section of B & W type 3014 Miniductor.

The antenna is made from the top half of a 3-section telescopic auto radio antenna. Extend the whip to full length and then cut it in two pieces so that about 10 inches of the center section remains connected to the tip. The top section is used as the transmitting antenna. L4 mounts at the base and connects in series between it and L3.

Tuning the rig is simple. Screw the oscillator slug about halfway out and adjust the oscillator trimmer for minimum plate current. Switch the meter to the amplifier plate circuit and adjust the output trimmer capacitor for minimum current with the slug turned almost all the way into the coil. END



NEW DEVICES

SPEED CONTROLS

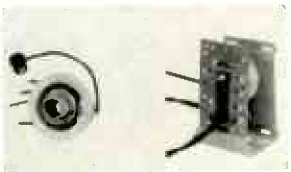
The Servospeed Division of Electro-Devices, Inc., 4-6 Godwin Ave., Paterson, N. J., has introduced a line of electronic *Servospeed* systems for the speed control of series or universal motors. A speed range of as much as 100 to 1 is achieved with motors having a base speed of 5,000 r.p.m. or higher. Three-wire motors may be controlled

for one direction of rotation and four-wire motors may be operated in either direction by use of a reverse switch.

Models are available to manufacturers in basic chassis form, and in cabinet-type models for buyers who wish to bench- or wall-mount the equipment.

NEW FLYBACKS

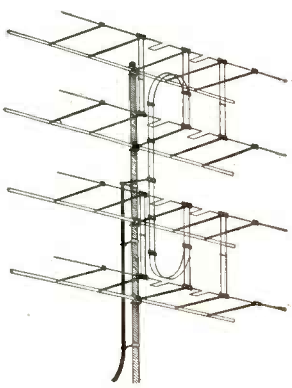
Halldorson Transformer Co., 4500 Ravenswood Ave., Chicago 40, Ill., has announced specific replacements for Philco flybacks.



Models FB407 and FB408 are coil assemblies made to fit the core pieces, terminal panels, and mounting brackets, etc. FB409 is a complete unit which replaces flybacks of electrically and mechanically important unconventional construction. High-voltage filament wires and instructions are provided with all units.

UHF-VHF ANTENNA

Finney Co., 4612 St. Clair Ave., Cleveland 3, Ohio, has announced an all-channel double colateral antenna designed for fringe-area reception. The antenna, the Finco 400-A, has 32 driven elements and weighs 8 pounds.



PORTABLE METER

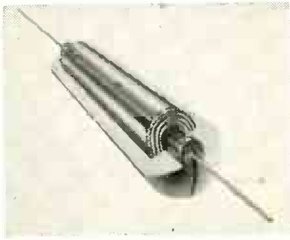
The Radion Corp., 1130 W. Wisconsin Ave., Chicago 14, Ill., has announced a battery-operated, portable field-strength meter, the FSM-5000. The unit

features continuous one-knob tuning for channels 2-83, microvolt readings of audio and video and sensitivity ranging from 5-50,000 µv on v.h.f. to 50-100,000 µv on u.h.f.

The meter is powered by standard A and B dry cell batteries, and battery condition is shown at all times on the dial. The FSM-5000 has separate input terminals for u.h.f. and v.h.f. antennas and a phone plug for audio monitoring of TV and FM signals.

NEW CAPACITORS

Astron Corp., 255 Grant Ave., E. Newark, N. J., has introduced a new, molded paper capacitor, the *Blue-point*. The housing is yellow, nonflammable molded plastic, sealed against heat and moisture by a thermosetting bond that becomes a part of the case. The bond also locks in the leads so that they cannot be pulled out.



The capacitors are dry-assembled and oil-impregnated for continuous operation at 85° C to permit extremely stable operation over a wide temperature range. They meet RTMA standards and withstand voltage tests specified by Underwriter's Laboratories. Blue-points are produced in all popular ratings and sizes.

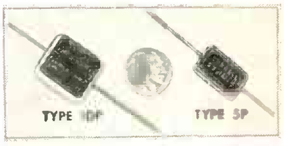
ANTENNA ROTATOR

La Pointe Electronics Inc., Rockville, Conn., has announced the VEE-D-X antenna rotator.

The unit will support over 200 pounds. Its control lever has both compass and numerical reference points. The VEE-D-X is available in green or mahogany.

MICA CAPACITORS

Cornell-Dubilier Electric Corp., South Plainfield, N. J., has announced a new series of high-voltage, midget mica capacitors, the *Hivomikes*. These are available in d.c. working voltages of 1,000, 1,500, 2,000, and 2,500.



Capacitance values are provided in a wide range in each voltage rating. Values cover both the conventional and preferred number system.

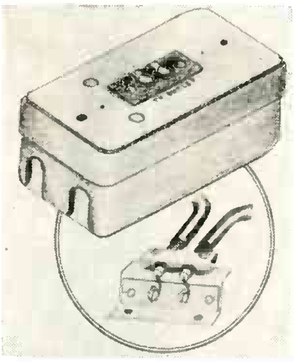
The small case sizes used in the 5W and 1D series have been retained in the new 5P and 1DP types.

NEW SPEAKER

Oxford Electric Corp., 3911 S. Michigan Ave., Chicago 18, Ill., has announced a 5½-inch permanent-magnet speaker, the model 55CMS. The unit has a 1.47-ounce magnet and is an excellent replacement for certain auto sets and other applications.

TV OUTLET

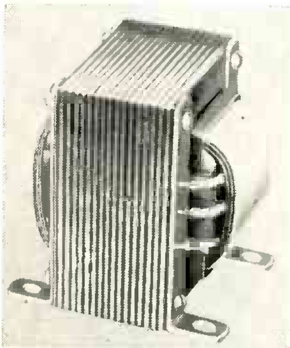
Blonder-Tongue Laborotories, 526-536 North Ave., Westfield, N. J., has developed a resistor outlet box for providing isolated TV outlets in all types of master-TV systems. The unit, model R01, will tap off from RG/11U or 59U



with only ½-db insertion loss. Signal attenuation of 17 db at the TV outlet terminal prevents interaction among sets in the system.

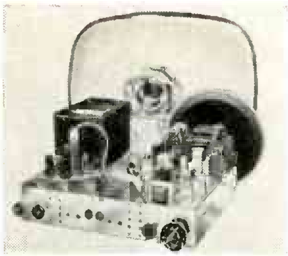
FILAMENT TRANSFORMERS

Merit Coil and Transformer Corp., 4427 N. Clark St., Chicago 40, Ill., has introduced 10 filament transformers for use with selenium rectifier applications.



TV CHASSIS

Tech-Master Products Co., 443 Broadway, New York 31, N. Y., has announced a 630-type television chassis designed for 27- and 30-inch picture tubes, as well as for the new 24-inch rectangular tube. Among the features of the model 2430-9 are 22-kv second-anode voltage, polyethelene-enclosed h.v. socket, quick-retrace flyback autotransformer, full horizontal and vertical sweep, edge-to-edge focus, and the latest 90° ferrite-core cosine yoke.



The chassis also has a color-converter connector, a phono-input jack controlled by a front-panel switch, and sound-take-off provisions for connection to external audio systems.

PAPER CAPACITOR

Sangamo Electric Co., Marion, Ill., has developed a new molded paper tubular capacitor—the *Telechief*—for TV applications. The capacitor uses *Humiditite*, a molding compound with high moisture-resistance characteristics. It

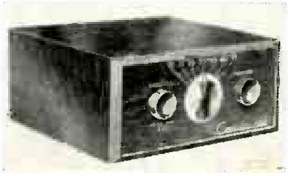
is designed to conform with the moisture resistance requirements of MIL-C-91A.

TAPE RECORDER

RCA Victor Division, Camden, N. J., has announced a portable tape recorder weighing 25 pounds, and measuring 14 x 12 x 9 inches. The recorder operates at 3.75 and 7.5 inches per second and records up to 2 hours of program material. It requires 105–125 volts, 60 cycles a.c. External speaker impedance is 3.2 ohms.

CONVERTER-TUNER

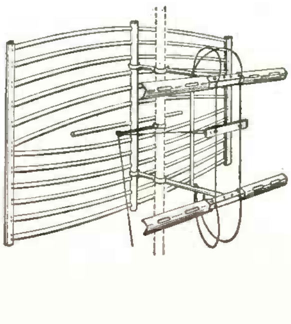
Allen D. Cardwell Mfg. Corp., 96 Whiting St., Plainville, Conn., has announced a u.h.f. converter-tuner. The tuner covers all u.h.f. channels and has a built-in i.f.-amplifier stage. Heater and B plus power must be supplied by the receiver. It measures 3¼ x 7¾ x 6½ inches.



The self-powered converter covers the 470–890 mc range and features a printed-circuit oscillator, one-knob tuning, and miniature size.

ALL-CHANNEL ANTENNA

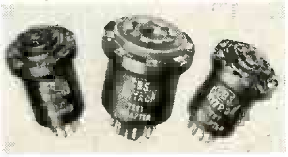
Davis Electronics, F.O. Box 1247, Burbank, Calif., announces the new improved *Super-Vision* all-channel TV antenna. The new unit is of the same basic design as the previous model, but has increased mechanical strength and bracing to withstand severe wind and weather conditions.



NEW DEVICES

TEST ADAPTERS

CBS-Hytron, Danvers, Mass., is producing 7-pin and 9-pin miniature, and 8-pin octal test adapters. All sockets test topside without disturbing wires or parts.



WAVE-TRAP METER

Vidaire Electronics Mfg. Co., Lynbrook, N. Y., has developed a wave-trap meter covering the entire i.f. and r.f. range. An interfering signal reaching the set through either the a.c. supply line or the antenna may be trapped by switching in the correct filter number on the *Fil-Test*. Both line and

antenna filters may be switched into their respective circuits simultaneously. The indicator then shows the particular filter or wave trap to install.

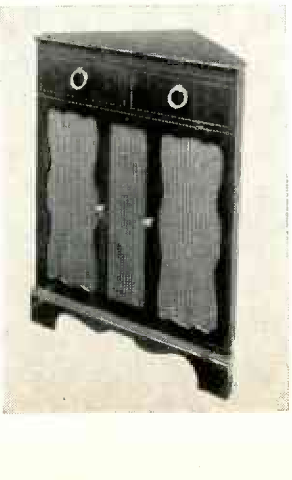
The unit measures 5⅜ x 3¾ x 1¾ inches and is well shielded to eliminate any interaction between the line and antenna filters and wave traps.

CORNER ENCLOSURE

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., has introduced a line of high-fidelity corner enclosures. The speaker is mounted on a baffle board behind a decorative front piece. High power-handling ability and low distortion are achieved by an internal horn arrangement which forms an extended horn with the floor and walls of the room, thereby loading the rear wave.

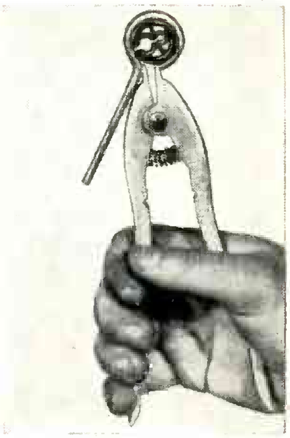
High efficiency is maintained by funneling the horn-loaded rear-wave energy through a port which further serves to operate the enclosure as a bass-reflex baffle, boosting the response in the low-frequency spectrum.

The enclosure is available in modern, traditional, or provincial styles in a wide variety of wood finishes. It is 37 inches high, 28 inches wide, and 15 inches deep.



EYE-OPENER

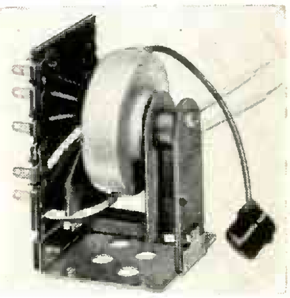
General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill., has introduced its *Eye-Opener* tool which opens the metal bail on a TV standoff to accommodate larger lead-in lines, and then squeezes it to its original position to hold the line tight.



NEW TRANSFORMER

Ram Electronic Sales Co., Irvington-on-Hudson, N. Y., has announced the model XO74 horizontal deflection and high-voltage output transformer. The unit was designed as an exact duplicate for transformers used in the latest sets manufactured by Arvin, Hallicrafters, Kaye-Halbert, Packard-Bell, RCA, Silvertone, Techmaster, and others.

The model XO74 features rugged, anticorona construction, edge-to-edge 70° deflection, compactness, and high-efficiency design.



UHF CONVERTER

Alliance Mfg. Co., Lake Park Blvd., Alliance, Ohio, has announced a new all-channel u.h.f. converter, the *Convaire*. It is designed for high gain and low noise, and operates on all standard 60-cycle line voltages. The *Convaire* has a single tuning control.

ANTENNA INSULATOR

Walter L. Schott Co., 3225 Exposition Place, Los Angeles, Calif., has announced the X-77 insulator for the Walsco corner reflector and *Reflectofan* u.h.f. antennas. The insulator is hollow and allows the lead-in wire to pass through the center. The manufacturer claims tests show the X-77 is 5

NO INTEREST!!

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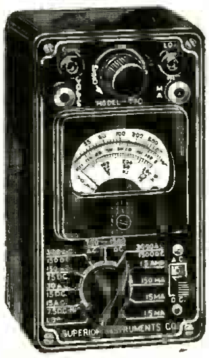
Superior's New Model 770

VOLT-OHM MILLIAMMETER



Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
4 D.C. CURRENT RANGES: 0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES: 0-500 Ohms 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛" x 5⅞" x 2¼".

$14.90 NET

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

TUBE TESTER

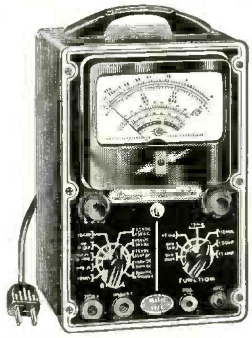
• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no 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. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover

$47.50 NET

Superior's New Model 670-A

SUPER-METER



A combination volt-ohm milliammeter plus capacity reactance inductance and decibel measurements

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,000 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼" x 9½" x 4½".

$28.40 NET

ADDED FEATURE

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

CONNECTS DIRECT TO ANTENNA POST

NO CONNECTION INSIDE RECEIVER

Features—

Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions. Only ....

$39.95 NET

Superior's Model 660-A—A NEW A.C. OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed HI-Q coils. • R. F. available separately or modulated by the internal audio oscillator. Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

The Model 660-A comes complete with coaxial cable, test lead and instructions ....

$42.95 NET

NEW TIME PAYMENT PLAN

ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-66, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ MODEL 770 .... Total Price $14.90
$2.90 down payment. Balance $2.00 monthly for 6 months.
☐ MODEL TV-11 .... Total Price $47.50
$11.50 down payment. Balance $6.00 monthly for 6 months.
☐ MODEL 670-A .... Total Price $28.40
$7.40 down payment. Balance $3.50 monthly for 6 months.
☐ TELEVISION BAR GENERATOR .... Total Price $39.95
$9.95 down payment. Balance $5.00 monthly for 6 months.
☐ MODEL 660-A .... Total Price $42.95
$12.95 down payment. Balance $5.00 monthly for 6 months.

☐ I enclose $______________ as down payment.
☐ Ship C.O.D. for the down payment.

Signature______________________

Name______________________

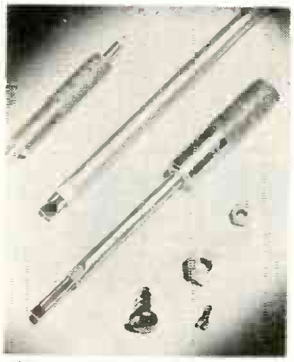
Address______________________

City______________________ Zone________ State________ times stronger than the conventional polystyrene insulator. The X-77 is non-hygroscopic and is silicone-treated to shed dust and moisture.

NUT STARTER

Aviation Service Supply Co., Denver, Colo., has introduced a tool to start small nuts and screws in hard-to-reach places. It has a special lever mechanism in the handle which controls the movable blades and adjusts them for gripping all standard nut sizes.

The tool has a lightweight aluminum handle and body and blades of drill rod steel. It accommodates nuts from No. 6 to ¼-inch and screws from No. 4 to No. 10.



25-WATT AMPLIFIER

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio, has announced an 8-tube P.A. amplifier with a power

output of 25 watts at less than 5 percent distortion. It has a peak power output of 33 watts. The unit's frequency response is 30 to 18,000 cycles ± 2 db.

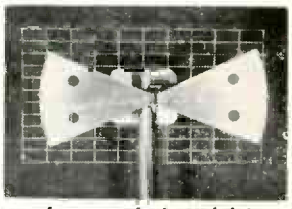
The model 3725-8 has provision for 3 microphone inputs and 1 phonograph input. The input impedance for the microphone channels is 3 megohms, for the phono channel, 500,000 ohms. Output impedances are 2.5, 4, 8, 16, 250 and 500 ohms; and there is also a 70-volt tap for constant-voltage systems. Power consumption is 150 watts on operation from a 117-volt, 50—60-cycle line.

The amplifier measures 11½ x 8 x 16½ inches and has a shipping weight of 34 pounds.

UHF ANTENNA

Insuline Corp. of America, 3602 35th Ave., Long Island City, N. Y., has introduced a bowtie antenna for channels 14 to 83 the *Tri-Fan*. The antenna proper, which uses a rectangular reflector screen, is bakelite-insulated. It measures 17 x 7 inches and the reflector is 20 x 11 inches.

END



All specifications given on these pages are from manufacturers' data.


Let it pour
Install an
RCA Weather-Resistant
Lightning Arrester
and forget it
THE RESISTANCE ELEMENTS in RCA Lightning Arresters are made of a remarkable, new *conductive rubber* that is *noncorrosive and impervious* to moisture . . . to provide *lasting* protection to TV and FM installations. Cap covers contacts. Losses are negligible even under extremely tough weather conditions.
Just mount, unscrew cap, insert transmission line in slot, and replace cap. It's as easy as that. Type 214X1 for indoors, type 215X1 for outdoors. *Both are listed by Underwriter Laboratories, Inc.*
See Your RCA Parts Distributor for
"the best lightning arrester to come down the line."
RADIO CORPORATION of AMERICA
ELECTRONIC COMPONENTS
HARRISON, N. J.

THE FUND TOPS $10,700

HELP-FREDDIE-WALK FUND

Last month (July), the Help-Freddie-Walk Fund started on its fourth year of service to little Freddie Thomason. Organized in July, 1950, to help Freddie, the five-year-old son of Herschel Thomason, radio technician of Magnolia, Arkansas, the Fund has forwarded over $10,700 to the Thomasons during the three years of its existence. Freddie, as most of our readers know, was born without arms or legs, and it is mainly through the contributions of hundreds of interested and encouraging people that he has been able to make the progress he has.

As his father recently wrote us: "The RADIO-ELECTRONICS Fund is continuing to grow. In fact, it is the biggest source of income for the Trust Fund, and we are very thankful for every penny of it.

"Freddie and his mother returned from the Institute (Kessler Institute for Rehabilitation, West Orange, New Jersey) a few days ago and she reports his progress was very good while they were there. They made some adjustments on his legs, and Dr. Kessler said they would probably start working on his arms next Spring. He will also have to have new legs again this Fall.

"As you can see, the expense never stops, and that is why we are so very thankful for your efforts in raising money for him. Without it we could do nothing, for the expense would be far beyond our means."

In these days of high prices and rising costs, we here working closely with Freddie and his family realize only too well how difficult it is to spare funds for contribution purposes. That's why we like to emphasize the fact that *NO* donation, *no matter how small* it may seem to the donor, is too small. Every penny helps, for pennies add up to dollars and dollars add up to Freddie's chance for a normal and constructive life.

Won't you send in your contribution as soon and as often as possible? No amount is too small to receive our sincere thanks and acknowledgment, as well as the grateful appreciation of all the Thomasons. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE WALK FUND
c/o RADIO-ELECTRONICS
25 West Broadway
New York 7, New York

FAMILY CIRCLE CONTRIBUTIONS

Balance as of May 19, 1953	$.. 602.50
FAMILY CIRCLE Contributions as of June 18, 1953	$ 602.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of May 19, 1953	$10,100.09
A Friend, Gahanna, Ohio	1.00
Jerry M. Pelton, Rock Falls, Illinois	10.00

MISCELLANY

Jim Griss, Galveston, Texas	10.00
RADIO-ELECTRONICS Contributions as of June 18, 1953	$10,121.09
FAMILY CIRCLE Contributions ..	602.50
TOTAL Contributions as of June 18, 1953	$10,723.59

IRON-COATED SOLDER TIPS

Soldering coppers dug up from the ruins of ancient Roman cities show that the technique of soldering—and even the shapes of the tools themselves—have changed very little in more than 2,000 years. Even though we now have an infinite variety of sizes and tips to do all the special jobs that modern industry has created, and heat our irons with electricity instead of in crude charcoal burners, we still use the same basic elements—tin, lead, and copper.

And, although we now have all kinds of special fluxes, and know exactly the right temperature to use for each type of soldering job, we haven't been able to change the basic law of physics that makes tin and copper unite in a soft, spongy mass (amalgamate) under the combined forces of heat and pressure.

But we do know at least one way to prevent amalgamation: Coat the soldering surface of the copper tip with *pure iron*. This plating process has been used for a number of years on tips for high-temperature, continuous-duty irons. Recently, the American Electrical Heater Company of Detroit, which makes "American Beauty" irons, announced an improved method of applying the iron coating that extends the life of tips in production-line service by as much as 100 hours.

This process deposits a coating of commercially pure electrolytic iron over a 2-inch length of the copper tip. The tip is then given special treatment to prevent oxidation and corrosion. END

Radio Thirty-Five Years Ago
In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

AUGUST 1919
ELECTRICAL EXPERIMENTER

How I Invented the Crystal Detector, by Greenleaf Whittier Pickard
Radio-Planes Watch Forests and Ranches
Radio Shell Locater for French Farmers
Airplane Antenna Reels, by Lester F. Ryan
A Review of Radio-Telephony
American Radio-Telephone Apparatus
Concentrated or Loop Aerials, by Prof. Lloyd M. Knoll, A.M.

tv dx IN AUGUST

A change of dx seasons is due in August. Sporadic-E skip, already beginning to dwindle in the latter part of July, will disappear almost completely for several months, after about the first week in August. This does not mean, however, that there will be no more of interest for the TV dx-er.

As has been the case all through the summer, fringe-area reception will continue generally good, and in the latter part of August there will be periods when signal levels from stations 100 miles or more away will reach phenomenal levels. Such reception will be steady, too, with little of the rapid in-and-out fading that characterizes the sporadic-E dx.

Reception on the high channels will show more improvement than on the lower ones during such periods of good tropospheric propagation, and even the u.h.f. channels will bear watching. Peak signal levels should occur in the early morning hours, the period around sundown, and in the late evening. Reception of low-band stations by tropospheric propagation is not likely to be possible over distances in excess of 250 to 300 miles, but the same weather conditions may bring in high-band signals from 700 miles or more on rare occasions. Increases in signal level may be noted on stations as near as 25 miles, in the v.h.f. range, and u.h.f. stations just a few miles away may show signal strength variations because of purely local changes in the weather conditions.

For some months now we've been asking for u.h.f. dx reports, and this month we have several. They are not "dx" as we think of it on the v.h.f. channels, but they do represent unusual reception for u.h.f., and consequently are of interest at this time. Observer Peters of South Orange, N. J., received WICC, Bridgeport, Conn. (43), and WFPG, Atlantic City (46), about 65 and 95 miles away respectively. These signals were received at levels from very weak to fair, on a night when v.h.f. reception was not up to normal. He uses a Mallory 101 converter and a corner-reflector array.

From Holland, Mich., observer Wieskamp reports reception of WSBT, South Bend, In. (34), over a distance of 85 miles, on a Regency converter and an All-Channel antena. The signal was weak, but he regards it as a tip-off that some fun is to be expected from TV dx-ing on the ultra-highs as well as in the v.h.f. range.

A v.h.f. dx-er from way back, Lou Matullo, Washington, Pa., is receiving two Youngstown stations, WKBN (27) and WFMJ (73), and WKST, New Castle, Pa. (45), at 77 and 74 miles, respectively. Lou observes that strong u.h.f. signals often appear when v.h.f. conditions are poor. We'll have more to say about this another time.

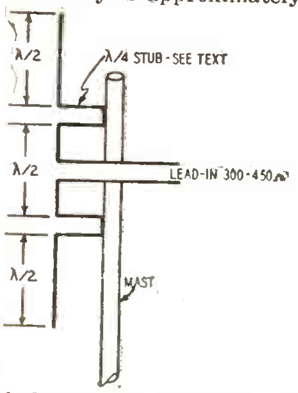
The prize u.h.f. dx so far reported comes from Burlington, N. C., where Nelson Teal has logged WROV, Roanoke, Va., 120 miles, on channel 27. Sound quality was good and picture fair, though WROV is operating on temporary low power. END

WATCH FOR THE SEPTEMBER ISSUE OF RADIO-ELECTRONICS ON THE NEWSSTANDS AUGUST 26

HIGH-GAIN VERTICAL ANTENNA

? *I have been using a quarter-wave vertical whip for receiving signals in the 150–170-mc band. Since this type does not supply enough gain, I switched to a Yagi with the elements oriented vertically for vertical polarization. This works out only when I rotate it so that it points directly at the fixed stations in the net. Is there any type of omnidirectional antenna that will supply more signal than a quarter-wave whip?—E. S. T., Bronx, N. Y.*

A. Probably the most practical antenna for your purpose is a vertical collinear array with three or more elements. The diagram shows a 3-element collinear array. The half-wave elements are separated by quarter-wavelength shorted stubs. The middle half-wave element is fed in the center with a transmission line having an impedance of 300 to 450 ohms. The gain of the 3-element array is approximately 3 db.



Gain of the array can be increased by adding half-wavelength elements. The increase is about 1 db for each element added. The array should be fed at the center. The impedance at the feed point is approximately 100 times the number of half-wave elements.

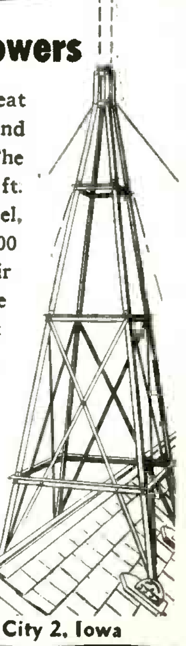
The physical length of the end half-wave elements may be found by dividing 5,616 by the frequency. The length of the inside elements is found by dividing 5,760 by the frequency and the length of the quarter-wavelength phasing sections (shorted stubs) is found by dividing 2,676 by the frequency. The frequency is in megacycles and the length is in inches.

If the antenna elements and phasing sections are made from rigid rods or tubing, the array can be supported by fastening the cold (shorted) ends of the phasing stubs to the mast. The antenna may be mounted on a metal mast which may be grounded for protection against lightning.

When using the antenna for transmitting, use a standing-wave ratio bridge or an *Antennascope*, and tune the transmission line or vary its impedance for a minimum standing-wave ratio on the transmission line.

CRYSTAL PICKUP EQUALIZER

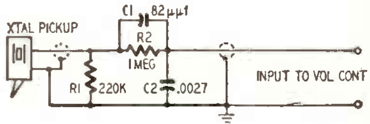
? *I have a phono amplifier designed for a crystal pickup. I've tried several different types of cartridges and none of them sound just right. The amplifier has a tone control but does not provide pickup equalization. I connect the*



QUESTION BOX

pickup leads directly across the crystal phono volume control. Please print a circuit of a suitable equalizer and show where it may be connected in the circuit of a typical amplifier.—S. H., New York, N. Y.

A. The diagram shows a typical crystal-pickup equalizer circuit which appeared recently in RCA phonograph and record-player service data. Raising the value of R1 increases the output voltage and the low-frequency response of the pickup. Increasing R2 or C2, or both, decreases the voltage output and the high-frequency response. An increase in the value of C1 results in higher output, particularly at high frequencies.



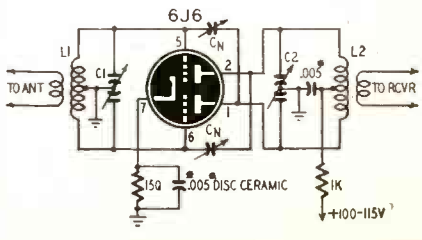
The equalizer should be connected between the output of the crystal and the input to the amplifier. The correct values may be determined by trial-and-error. When the correct values have been determined, the components can be mounted on lugs under the turntable or on a terminal strip and connected at some point in series with the pickup lead to the amplifier. The network should be shielded to prevent hum pickup.

BOOSTER FOR POLICE RADIO

? *I have a 6-tube a.c.-d.c. 152–173-mc receiver for police and emergency services. I have to run the volume wide open to get a readable signal. I've tried resonant whips and vertical dipoles without any improvement in reception. Will a booster improve the signal? If so, please print a diagram of a booster that I can build.—H. G. S., Detroit, Mich.*

A. The diagram shows a neutralized push-pull r.f. amplifier similar to the circuit used in many TV boosters. Tuning capacitors C1 and C2 are butterfly-type variables having a maximum capacitance of about 8 μμf and the lowest possible minimum capacitance. E. F. Johnson type 9MB11 capacitors or equivalents may be used. The neutralizing capacitors C_N are 0.5–3-μμf tubular ceramic trimmers.

Tuned windings of L1 and L2 consist of 5 turns of No. 18 enameled wire, wound in two sections of 2½ turns each. The coil sections are ⅜ inch in diameter and spaced ½ inch apart with a tap in the center. The antenna-input and output link windings are 3 turns of



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1A6G	.30	6BJ6	.39	12BA7	.60
1A7GT	.47	6BK7	.59	12BD6	.45
1AB5	.30	6BL7	.59	12BE6	.39
1B3	.65	6BQ6GT	.59	12BF6	.39
1B5	.30	6BQ7	.95	12BH7	.63
1B7GT	.30	6BZ7	.95	12BY7	.65
1C5GT	.43	6C4	.37	12C8	.34
1E7	.29	6C5GT	.39	12F5GT	.34
1G4GT	.24	6C6	.58	12J5GT	.42
1G6	.30	6C8G	.24	12J7GT	.34
1H4G	.30	6CB6	.44	12K7GT	.34
1H5GT	.40	6CD6G	1.11	12S8	.70
1H6	.24	6D6	.45	12SA7GT	.44
1J6	.24	6E5	.48	12SF5	.50
1L4	.46	6F5GT	.39	12SG7GT	.52
1LC5	.51	6F6	.37	12SJ7	.44
1N5	.46	6F8G	.24	12SK7GT	.48
1P5	.57	6G6G	.52	12SL7GT	.47
1Q5	.58	6HGT	.41	12SN7GT	.52
1R5	.45	6J5GT	.37	12SQ7	.44
1S5	.39	6J6	.52	12SR7	.49
1T4	.45	6J7G	.43	14J7	.30
1T5	.53	6J8	.30	14W7	.30
1U4	.45	6K5	.47	19BG6G	.95
1U5	.39	6K6GT	.37	19C8	.70
1V	.60	6K7	.44	19T8	.79
1X2	.63	6L5	.24	19V8	.89
2A3	.70	6L6	.64	24A	.63
2A4G	.24	6Q7	.45	25AV5	.83
2X2	1.50	6S4	.38	25BQ6GT	.62
3A4	.45	6S8	.53	25L6GT	.39
3E5	.46	6SA7GT	.43	25W4	.56
3Q4	.48	6SD7GT	.41	25Z5	.40
3Q5GT	.49	6SF5GT	.46	25Z6GT	.37
3S4	.46	6SG7GT	.41	26	45
3V4	.47	6SH7	.73	27	.39
5U4G	.45	6SJ7GT	.41	32L7	.89
5V4	.73	6SK7GT	.41	35B5	.40
5W4	.50	6SL7GT	.48	35C5	.39
5X4	.40	6SN7GT	.52	35L6GT	.41
5Y3G	.32	6SQ7GT	.37	35W4	.37
5Y3GT	.32	6SR7GT	.45	35Z4	.39
5Y4G	.35	6SS7	.42	35Z5GT	.37
5Z3	.46	6T8	.56	36	.60
6A7	.59	6U4	.60	41	.42
6A8	.62	6U5	.44	42	.42
6AB4	.44	6U6	.63	43	.55
6AG5	.43	6U8	.61	45	.55
6AJ5	.90	6V6GT	.39	45Z5	.49
6AK5	.75	6W4GT	.44	50B5	.39
6AL5	.38	6W6GT	.44	50C5	.39
6AQ5	.39	6X4	.37	50C6	.59
6AQ6	.37	6X5GT	.37	50L6GT	.41
6AR5	.37	6X8	.61	50Y7	.50
6AS5	.50	6Y6G	.48	53	.24
6AT6	.37	7A4	.47	56	.24
6AU6	.38	7AF7	.53	57	.58
6AV5	.83	7B4	.44	58	.60
6AV6	.37	7C6	.40	70L7GT	1.09
6AX4	.53	7E6	.30	75	.41
6AX6G	.24	7X7	.70	76	.44
6B4G	.64	12A8	.61	77	.57
6BA6	.39	12AL5	.37	78	.47
6BA7	.57	12AT6	.37	80	.35
6BC5	.44	12AT7	.56	83	.68
6BC7	.34	12AU6	.38	85	.59
6BD5GT	.59	12AU7	.43	117L7	.99
6BD6	.45	12AV6	.39	117Z3	.37
6BE6	.39	12AV7	.59	807	1.19
6BF5	.41	12AX4	.48	1274	.99
6BF6	.37	12AX7	.48	2050	1.85
6BG6G	1.25	12AZ7	.69	6113	1.00

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No. 18 wire, wound to a diameter of 3/8 inch and spaced to 1/4 inch. These links are inserted between the halves of the tuned windings.

To adjust the booster, connect it to a resonant antenna and the receiver with 300-ohm ribbon. Tune in a signal near the center of the band. (Squeeze or spread the turns on L1 and L2 so the signal comes in with C1 and C2 about half open.) Insert an iron tuning slug into the core of the tuned grid winding. If the signal increases, the inductance of the coil is too low. Decrease the spacing between the individual turns and between the halves of the coil. If still more inductance is needed, add about one turn to each half of the coil.

A decrease in signal strength when the powdered-iron slug is inserted indicates too much inductance in the coil. Spread the turns apart. Repeat the operation on the plate coil.

To neutralize the booster, disconnect the antenna and substitute a 300-ohm resistor across the booster input terminals. Turn up the volume on the receiver and adjust the neutralizing capacitors for minimum noise.

AMPLIFIER OUTPUT FOR TV SET

? *I have an RCA 6T71 TV receiver which I want to feed into a Williamson amplifier. I planned to disconnect the first a.f. amplifier but am afraid to do so because this tube is also used as the a.g.c. clamp. Is there any simple way of quickly connecting and disconnecting the external amplifier without making extensive alterations in the set or amplifier?—I. W. W., Middleboro, Mass.*

A. If you don't plan to play records through the TV set, you can rewire the TV-PHONO switch so that the output of the discriminator may be connected to the phono input jack on the back of the TV chassis.

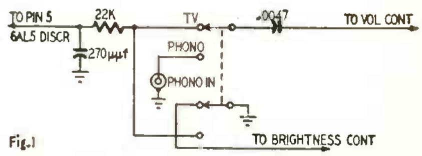


Fig. 1—Original phono-switch wiring.

Fig. 1 shows the original wiring of the TV-PHONO switch and Fig. 2 shows how the wiring may be modified. When the switch is rewired as in Fig. 2, the TV set plays through its own amplifier when the switch is in the TV position and plays through the external amplifier when the switch is turned to PHONO. The TV set can be connected to the amplifier input with a shielded lead fitted with a pin-tip phono plug. Keep this lead as short as possible to prevent high-frequency losses. END

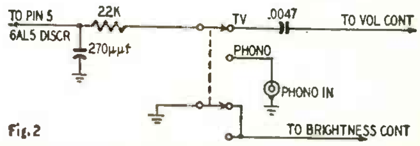


Fig. 2—Revised circuit for feeding audio output to external amplifier.

POLARITY OF YOKE LEADS

When the colors of the leads on a replacement yoke do not match the old ones, the odds are 3 to 1 that you'll make a wrong connection and get a reversed picture. But if the old windings are not entirely open, there's a simple way to match polarities and get the picture right on the first try.

Place the two yokes side by side, windings up, in the same angular position. Lay a narrow strip of cardboard across the coils and on top of this place a small compass—the cheapest kind will do. Now apply a low d.c. voltage to the old horizontal coils. Use one or two flashlight cells or the leads of your ohmmeter on a low range. The compass needle will align itself across the horizontal coils. The N-pole will point to one coil or the other. Note which one. Note polarity of battery leads as related to color of yoke leads, such as "positive on red lead."

Test the new yoke the same way. Proper lead polarity is indicated when the same direction of applied d.c. gives the same relative deflection of the compass needle.

Check the vertical coils in the same manner.

It is wise to tabulate the results, somewhat as follows:

HORIZONTAL	
Old	*New*
Red	Blue
Red-Black	Red
VERTICAL	
Old	*New*
Green	Brown
Yellow	Green

Then put back the marked new leads where the old ones came from, and there's your picture, right side up and reading left to right.—*Nicholas B. Cook*

PHILCO 46-1201

Intermittent loss of sensitivity so only local stations are received after a few hours of operation is a fairly common complaint on early production runs of this receiver.

The most common cause of this trouble is a defective second i.f. transformer. Check to see if it is marked with a blue dot. If not, it is one that was manufactured improperly.

Replace it with the manufacturer's replacement or one of equivalent quality.—*John Flint*

RCA MODEL 45EY3 AMPLIFIER

Hum or noisy operation may be a complaint in the 45EY3 amplifier. This may be caused by electrolyte leaking out of the filter capacitor and flowing between the contacts on the socket of the output tube, a 50C5, 50L6-GT, or 25L6-GT. Spillage from the capacitor will develop a leakage path between the contacts and cause hum in the output. It also corrodes the contacts and produces noise.

If there is evidence of electrolyte leakage on the socket, replace it and then reposition the capacitor to prevent a recurrence of the trouble. The capacitor is repositioned by sliding it through its mounting clip toward the rectifier end of the chassis until the lead end is even with the edge of the speaker frame.

As a preventive measure, the capacitor should be repositioned if the chassis is being serviced for any reason.—*RCA Radio Phono Television Service Tips*

SCOTT MODEL 16AC TV SET

Corona and arcing are fairly common complaints on this model. Arcing between the tube pins and the corona ring on the 1B3-GT can be prevented by wrapping the corona ring with Scotch No. 33 tape at the points where arc-burns are observed.

Arcing at the point where leads to the high-voltage transformer come through the chassis can be prevented by taping the lead where the arc occurs and then placing a folded ring of tape in the hole to serve as a grommet.

Arcing between the 1B3-GT plate and the top of the high-voltage cage can be eliminated by bulging out the metal cage to provide more clearance between it and the plate cap of the tube.

Corona discharge may occur from any sharp point on a soldered connection or from a sharp bend in a high-voltage lead. This can be eliminated by rounding off all sharp points on soldered joints with a soldering iron and applying anticorona dope. Dress high-voltage leads to avoid sharp bends and to increase spacing between the lead and grounded components.—*R. P. Balin*

ADMIRAL TV TUBE REPLACEMENTS

Tung-Sol or Admiral 6U8 tubes are recommended for vertical oscillator and third i.f. amplifier replacements in the Admiral series 19 chassis. The vertical oscillator circuit is critical and some 6U8's may not work satisfactorily in this application. A weak 6U8 may cause insufficient height.

Admiral-branded 6AX4's made by Hytron and Sylvania (identified by RTMA numbers 210 and 312, respectively) have shown a high rate of failure and are no longer being used in production. Hytron 6AX4's coded 243 or later are improved types which may be used.—*Admiral Radio & Television Service Bulletin*

CHECK THE METERS, TOO!

When servicing electronic equipment it is easy to fall into the habit of taking readings of built-in meters at their face values. This can waste a lot of time in unnecessary trouble-shooting.

If the equipment has seen hard service, the meters may be open or inaccurate because of corrosion or misuse. They will then indicate trouble where none exists or else hinder you by failing to indicate the correct symptoms which would give you a clue to the basic fault.

It's best to substitute temporarily your own multimeter to be certain that you are obtaining the correct readings. This, of course, assumes that your own instrument is in good shape. Is it?—*Y. O. Johnson* END

R. C. Cosgrove

Raymond C. Cosgrove succeeded William A. Ready who retired, as chairman of the Board of Directors of the NATIONAL Co., Malden, Mass. Mr. Cosgrove was formerly executive vice-president of Avco Manufacturing Co. and president of the RTMA.

Addison Holton, president of Essex Wire Corp., was elected president of the newly formed CHICAGO STANDARD TRANSFORMER CORP., (see "Radio Business"). Other officers include: **Arni Helgason,** vice-president; **J. J. Kahn,** vice-president; **L. S. Racine,** vice-president; **W. F. Probst,** treasurer; and **M. A. Roesler,** treasurer.

W. Walter Watts was elected vice-president in charge of the Technical Products Department of the RCA VICTOR DIVISION. He assumes the position formerly held by **L. W. Teegarden** who was elected executive vice-president of the RADIO CORPORATION OF AMERICA last February. **Theodore A. Smith,** previously assistant manager of the Engineering Products Department, succeeds Mr. Watts as vice-president in charge of the Engineering Products Department.

W. W. Watts

Dr. C. S. Szegho

Dr. Constantin S. Szegho was appointed vice-president in charge of research of the RAULAND CORP., Chicago. He had been serving as director of research.

Webster E. Barth joined LAPOINTE ELECTRONICS INC., Rockville, Conn., as general sales manager. He will co-ordinate the sales efforts of all the company's divisions, including Vee-D-X TV antennas and accessories, Press Wireless electronic devices and equipment, and the newly created Fiberglas operation. Mr. Barth was formerly a sales executive with Reynolds Metals Co.

H. H. Seay, Jr., vice-president and general sales manager of BELL SOUND SYSTEMS, Columbus, Ohio, was elected to the Board of Directors. **R. E. Grace,** assistant secretary, also was elected a director. Re-elected directors include: **F. W. Bell,** chairman; **E. W. Hosler** and **Tom L. Wheeler, Jr.** All corporate officers were re-elected, including F. W. Bell, president; H. H. Seay, Jr., vice-president, George H. Chamblin, secretary, and R. E. Grace, assistant secretary.

H. H. Seay, Jr.

Ralph R. Shields was appointed to the newly created post of product sales manager of television picture tubes for SYLVANIA ELECTRIC PRODUCTS, INC. He was formerly merchandising supervisor, television picture tubes, with headquarters in Seneca Falls, N. Y.

R. R. Shields

Charles E. Torsch joined ROLA Co., Cleveland, a division of the Muter Co., as chief television engineer. Prior to joining Rola, he was with General Electric.

C. E. Torsch

Edward L. Nung was named manager of the Tuner Division of P. R. MALLORY & Co., INC., Indianapolis, Ind. He was formerly with Sylvania.

E. L. Nung

Personnel Notes

. . . **Dr. W. R. G. Baker**, vice-president and general manager of GENERAL ELECTRIC'S Electronics Division, received the Medal of Freedom Award from Under-Secretary of the Army Earl D. Johnson for the application of electronics to the solution of Army research and development problems.

. . . **Don G. Mitchell**, chairman of the Board of Directors of SYLVANIA ELECTRIC PRODUCTS, was the principal speaker at the commencement exercises of Stevens Institute of Technology, Hoboken, N. J., at which he received the honorary degree of Doctor of Engineering.

. . . **Donald H. Kunsman** was elected a vice-president of the RCA SERVICE Co., Camden, N. J. **Gerald W. Pfister** succeeds him as treasurer and controller. Pfister was formerly manager of field administration in the Consumer Products Service Division.

. . . **Jacob Ruiter, Jr.**, Technical Advertising Manager of Allen B. Du Mont Laboratories, was elected president of INDUSTRIAL MARKETERS, of New Jersey, a chapter of the National Industrial Advertisers Association.

. . . **Michael Boris** joined SIMPSON ELECTRIC Co., Chicago, as assistant factory manager. He was formerly with Cline Electric Co.

. . . **Wallace E. (Barney) St. Vrain** joined MOSLEY ELECTRONICS, INC., St. Louis, Mo., as chief engineer. He was previously with Radio Station KXLW.

ONE SCIENTIST TO ANOTHER

Dear Prof. Glockenspiel:

Transistors are doomed! Thanks to inventive genius such as yours, the imaginations of lesser scientists like de Forest, Brattain, and Bardeen, will never be permitted to seriously damage the electronics industry with absurdities like the fantastic transistor folly. With a few refinements which are bound to come in time, a three-year-old child can, with your kit, produce any type of vacuum tube at a pathetically small cost.

Although it may take a few years, your vacuum tube kit can, and I believe will, revolutionize the industry! The elimination of a getter alone will save tons of alloy over a period of time. Not only could anyone duplicate known tube types, but now the common (all too common!) radio-TV service technician can add his own improvements, such as using resistance wire to form the grid element and eliminate the need for an external grid return, or mounting each element on a pivot so that parasitic oscillations could be tuned out by tilting the tube and varying the interelectrode spacing and capacitance.

I have been doing some work myself that will be of great benefit to mankind. By means of bone conduction and the inductive and capacitive reactions of nerve membranes I hope to eliminate all forms of transducers, including loudspeakers and cathode-ray tubes. The signal in the final stages of a radio or TV set will be transferred directly to the human mind by an *electrohomogenic* process. This will completely eliminate the high losses in power and fidelity inherent in the process of changing TV signals back to light for viewing by the inefficient human eye, and to sound for hearing by the poorly functioning ear. I believe the greatest advantage will be to enable totally blind and totally deaf people to see and hear television with greater clarity than it actually produced in the studio.

Naturally there is a mountain of detailed research required, so my new electrohomogenic process will not be made available to the public as quickly as your tube kit. However I do hope to have my work completed by April 1 *next* year.

PROF. ASKY LARKER
Lakehurst, N. J.

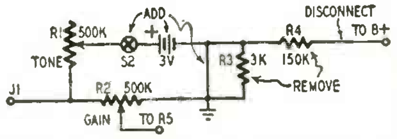
(The above was written in response to our annual April Fool story, an account of a kit which would enable the technician to assemble his own tubes, with prefabricated vacuum, and any constants the constructor wishes to select from the tube manuals.—*Editor*)

PSYCHOMETER SAFETY

Dear Editor:

Mr. Gish's article "Electropsychometer" in the May RADIO-ELECTRONICS was very interesting and I hope you will publish more along the same line in the future. Construction articles of this type seem to be too few and far between in most magazines available to the electronic experimenter.

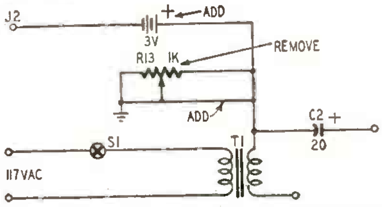
To anyone constructing the instrument described by Mr. Gish a word of caution seems advisable. *If* resistor R3 should by any chance open up, and resistors are notorious for doing just that, Ohm's law shows that about 120 volts d.c. would be applied to a person connected to the electrodes. The failure of R13 would lead to the same results.



Safety modifications suggested for one side of the Psychometer input circuit.

Such a calamity, if not fatal, would certainly not be conducive to peace and harmony—especially if the subject is one of the family.

The circuits in the figures eliminate this hazard by replacing the source of voltage applied to the patient with two 3-volt batteries, which would not be sufficient to injure the patient in any way.



The other side of the Psychometer input circuit modified for added safety.

Resistors R3, R4, and R13 in the original circuit are deleted. The negative end of the power supply is connected directly to ground (chassis) and S2 is inserted in the arm of R1 to prevent drain on the battery when the instrument is not in use.

ELLIOTT A. MCCREADY
Roseville, Michigan.

POWER-LINE TROUBLES

Dear Editor:

On page 147 of your May 1953 issue Mr. J.T.K. states that he has power-line fluctuations of 90 to 150 volts. I have had line-voltage troubles too, but never anything as high as 150 volts. I believe if Mr. J.T.K. checks his line at the meter box he will find that it is not grounded properly to a cold-water pipe or a regular grounding stake. One side of the house wiring or the center leg of a 220-volt feeder must always have a good ground connection. He may also have a poor power transformer on his feeder line, or one with an ungrounded center tap.

We were troubled with low line voltage when we first moved into our new home. We checked everything, but found the only solution was to balance our feeder with another feeder line. This trouble had been prevalent in this neighborhood for 15 years before we came here, but no one ever did anything about it.

C. L. LESSIG
Milford, N. J.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

WALSCO CATALOG

Walsco's 40-page, illustrated Catalog No. 53 is an attractive booklet which lists its complete line of electronic hardware, tools, chemicals, and TV antennas and installation equipment.

Free on request from the Walter L. Schott Co., 3225 Exposition Place, Los Angeles 18, Calif.

RADIO-TV INDEX

Supreme has issued the 1952 index to its publications, *Radio Diagrams* and *Television Servicing Information.* The radio manuals cover sets from 1926 to 1952, listed in alphabetical order by manufacturer. The television manuals cover sets from 1947 to 1952.

The company has also issued a 4-page leaflet listing all its publications.

Available on request from Supreme Publications, 3727 W. 13th St., Chicago 23, Ill. Enclose 3¢ stamp for postage.

VARIAC CATALOG

General Radio has issued a 12-page catalog describing the new *Duratrack*-type Variac. These variable autotransformers supersede earlier types and insure long, trouble-free life under severe industrial applications.

Copies free from General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

DIODE BULLETINS

International Rectifier's Bulletin GD-1 describes the characteristics of 11 germanium diodes. It is illustrated with photos and cross-section drawings.

The same company's Bulletin SD-1 describes 6 subminiature selenium diodes. Also listed are high-voltage, hermetically sealed, and power rectifiers, and photoelectric cells.

Available on letterhead request from International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

PAPER CAPACITORS

Astron's Bulletin AB-18 is a four-page leaflet giving performance characteristics and test specifications of their *Meteor* subminiature paper capacitors for operation to 125° C without derating.

Copies free on request to Astron Corp., 255 Grant Ave., East Newark, N. J.

ANTENNA HANDBOOK

Channel Master's 12-page *TV Antenna Handbook for VHF and UHF* describes more than 60 v.h.f. and u.h.f. antennas the company is now producing, and gives full technical data, including gain curves and directivity patterns on most models.

Copies free on request from Channel Master distributors.

ELECTRONIC LITERATURE

TRANSFORMER CATALOG

Triad's 1953 catalog TR-53 features an expanded line of TV components and industrial transformers. Included are toroids, inductors and pulse and transistor transformers and additional miniatures for special applications. The booklet also has a geophysical section.

Gratis from Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

U.H.F. BOOKLET

Taco Presents U.H.F. is a 10-page illustrated brochure pointing out "do's" and "don'ts" for technicians in u.h.f. areas. Among the subjects treated are the requirements of a good installation, theory of u.h.f. signal capture, ghost problems and directivity, cancellation of u.h.f. signals, signal probing, transmission of signal from antenna to receiver, transmission line, and receiver connections.

Copies free on request from Technical Appliance Corp., Sherburne, N. Y.

ANTENNA HANDBOOK

TV antennas and accessories are listed in a 36-page catalog issued by RMS. The booklet describes various types of u.h.f. and v.h.f. antennas, including Yagis, corner arrays, indoor u.h.f. and v.h.f. antennas, transmission lines, lightning arresters, mast mounting accessories and u.h.f.-v.h.f. antenna couplers.

Request Catalog 54 from Radio Merchandise Sales, 2016 Bronxdale Ave., New York 60, N. Y.

SPEAKER CATALOG

Quam's 1953 catalog lists five types of intercom speakers and three types of outdoor theater speakers, in addition to their regular line of electrodynamic and PM units.

Write for Catalog 70 from Quam-Nichols Co., 33rd Place and Cottage Grove Ave., Chicago 16, Ill.

CAPACITORS

Pyramid's new 20-page Catalog PG-3 contains complete engineering data, performance curves, construction styles, sizes, and capacitance and voltage listing for the subminiature units in their *Glasseal* line.

Available without charge on letterhead request to Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.

SPEAKER BAFFLES

Four models of speaker baffles are described in an illustrated brochure issued by Lowell. Flush-and surface-mounting ceiling types, a high-ceiling chandelier type, and a recessed baffle are shown.

Gratis from Lowell Mfg. Co., 3030 Laclede Station Rd., St. Louis 17, Mo.

RELAY BULLETIN

A bulletin describing the *Husky* line of relays has been issued by Price. It gives specifications for subminiatures, high-shock relays, high-current rotaries, and other types.

Copies free on request from Price Electric Corp., Frederick, Md. END

THE MAGNETRON, by R. Latham, A. H. King and L. Rushforth. Published by Chapman & Hall, Ltd., London. Distributed by Anglobooks, 475 Fifth Ave., New York 17, N. Y. 5½ x 8¾ inches, 142 pages. Price $4.25.

The magnetron, a war baby, has little competition when it comes to generating high power on the microwaves. It is now widely used in radar. This book describes its theory, characteristics, and applications. Many photos and diagrams illustrate the text. Most of the material is nonmathematical and can be understood by any radio technician.

The monograph begins with a discussion of radar requirements. The reader is introduced to klystrons and other microwave generators. Chapters on the magnetron follow. The anode block, output coupling methods, and cathodes are discussed. Mathematical calculations of magnetron Q, electron path, and efficiency are provided. The last chapters describe construction, testing, and applications of the magnetron.

A number of references are cited. Many appeared during wartime. These may be as difficult to obtain now as they were during the war years.—*IQ*

TV SERVICING SHORT-CUTS, by Milton S. Kiver. Published by Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 5½ x 8½ inches, 97 pages. Price $1.50.

Intelligent service work requires careful analysis and persistent tracking down of clues. Like a doctor, the technician must study the complaints and make tests before deciding on the course of action. No simple chart or question-answer guide can give the answer. This service book will be found very helpful. It lists 63 varied and typical TV troubles culled from service manuals as well as the author's own experience.

Each case history is carefully described, then analyzed. The author indicates the tests to be made to isolate the defective part. His method is general, so it often applies to any set, not merely the model mentioned. Circuit troubles, alignment, and interference are among the topics. Hints for the most effective repair and adjustment are included. Diagrams and photos appear often.

One index lists case histories by symptom and complaint. Another lists them by model and manufacturer.—*IQ*

"Wait 'til we get 3 dimensional pictures to tune in!"

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY

Page 113

Candler System Co.
Capitol Radio & Engineering Institute
Indiana Technical College
Indianapolis Electronic School
Milwaukee School of Engineering
RCA Institutes, Inc.
Tri-State College
Valparaiso Technical Institute
Western Television Institute

Radio-Electronics does not assume responsibility for any errors appearing in above index.

TV TEST INSTRUMENTS, by Milton S. Kiver. Published by Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 8½ x 11 inches, 147 pages. Price $2.00.

Every technician, even if he runs a one-man shop, needs the help of good test instruments. Considerable time and effort are saved when these are used correctly and intelligently. This book describes the more important equipment needed in modern servicing. Separate chapters deal with the v.t.v.m. (and various probes), signal and sweep generators, oscilloscope, and specialized TV instruments. The last chapters discuss TV and FM alignment, and how to use various types of test instruments in TV servicing.

The information is practical and complete. It will aid beginner and advanced worker.

U.H.F. CONVERTERS, Their Design and How They Work. Published by Howard W. Sams & Co., Indianapolis 5, Ind. 8½ x 11 inches, 41 pages. Price $1.00.

Tuners and converters for u.h.f. have only recently emerged from the laboratory. At this stage of the game there are few experts in this field and only meager information is available. This booklet can help the technician. It compares various models on the market, and describes the function of circuits, switches, and components. There are schematics, block diagrams, and photos of products made by 14 manufacturers.

This publication does not include data on trouble-shooting, alignment, or testing.—*IQ*

TV MANUFACTURERS' RECEIVER TROUBLE CURES, edited by Milton S. Snitzer. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 5¼ x 8¼ inches. Price $1.80. Vol. 1 covers Admiral to Du Mont, 115 pages. Vol. 2 covers Emerson-Jackson, 117 pages.

These volumes contain hundreds of useful hints for improving the operation of TV sets. The cures come from the manufacturer, who, after all, knows his own sets better than anybody else. Sets are listed by manufacturer and model. They advise how to cure manufacturing defects that sometimes crop up after sets leave the factory.

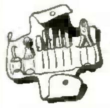
The cures are explicit and clear. They indicate just what resistor to replace, what control to turn. A wide variety of troubles are covered: buzz in sound, smear, wiggle, drift, foldover, tube failure, etc.—*IQ*

END

TV & COAX CABLE

300 Ohm Twinex. Heavy duty 65 mil all copper TV lead in, per foot 2¢; 100 feet $1.39; SPECIAL—1000 foot reel $11.95
RG59U 73 ohm TV Coax Cable MFGRD to rigid UHF specs. per ft. 5¢; 100 feet $5.00; SPECIAL 500 feet........$22.00

TOOL KIT



"My Buddy" 8 pcs. tool kit. 5 Interchangeable screw driver blades, 3 ft. steel tape Rule & Cutters. As shown $1.79
8 Screw Drivers, Assorted High Quality, Magnetized, Tool Steel, Hammer-Proof, Unbreakable Plastic Handles. 12" & smaller, incld Philips Type. "TAB" Special............$1.25
6 Pcs Set, as above $1.10

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We specialize in Rectifiers, Power supplies to specifications. Immediate delivery.

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	7.50
2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
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Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs
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18—12—9—CT—9—12—18V/4Amp... $8.75
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18 Volt 2Amp ....$1.98; 3 for $5.49

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10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL.....$11.98
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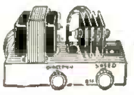

0 to 12 VDC/2 Amp. variable DC supply, uncased and completely built—Inpt. 115v/60 cy. Usable LAB supply, filament D. C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives ....$10.95   2 for $20.00

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12 Amp .01 Hy .1 Ohm 14.95
24 Amp .004 Hy .025 Ohm 29.95

YOU PICK THEM 59¢ WHILE THEY LAST
LOTS OF 10
Your selection of 10 at 59¢ each or smaller quantity at indicated prices.

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3X 15MFD/450VDC..98¢; 3 for 2.50
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25MFD/450VDC ....69¢; 3 for 1.95
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20MF/450V&20MF/25V ..3 for 1.95
50 mf/350vdc FP ....5 for 1.00
30-15-10 mf/250vdc .....5 for 1.00
40-20mf/250-25vdc .....6 for 1.00
30-2x20mf/450-25vdc ...3 for 1.00

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GE RPX041 Phono Cart...$4.49
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Pickup Arm & Xtal Hi-Outpt 2.39
PM 12" Hi-Fi British Speaker 4.98
PM 12" GE S1201D Speaker........18.69
PM 8" Blue 8T18-1 Permflux.........13.00
PM 5" Speaker Gud Tone........... 1.98
PM 10" Hi-Fi Woofer & Separate Horn Tweeter. 10 Watt 40-20000 cy......19.98
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Crystal Mike Cartridge (Lapel Type).. 1.98
Crystal Mike Cart. Ceramic Wetpruf.. 3.98

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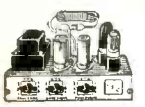
MODEL 1150 Hi-Fi 10 watt, less than 2% distortion—response ± 1DB 20 to 20000 CPS. HUM—70DB, separate bass & treble controls, 3 position selector switch, built in equalized pre-amps for GE Cartridge. Tubes 2-6SL7, 2-6V6GT, 5Y3GT "TAB" SPECIAL $29.95
MODEL 1150 & GE S1201D, Hi-Fi amplifier & Speaker SPECIAL $47.00

AUDIO AMPLIFIERS READY TO GO



Model 305MP 5 Watt Ampl, as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Ctnrls. Latest Compensated Tone Cntrl Design, Complete with Tubes $14.98
Model 100PO Phono OSC Phonograph Broadcasts Through Your Radio. No Direct Hookup. W/Tube $4.98
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STOCK NUMBER	SIZE	TEETH PER/IN	REG PRICE	"TAB" PRICE
701-20-10	20"	10 PT	$9.00	$3.95
701-24-10	24"	10 PT	9.75	4.15
701-24-8	24"	8 PT	9.75	4.15
701-26-8	26"	8 PT	10.85	4.25
701-26 6	26"	6 PT	10.85	4.25
701-26-10	26"	10 PT	10.85	4.25
701-28-8	28"	8 PT	10.85	4.35
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701-30-6	30"	6 PT	11.00	4.50

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0-150 VAC WSTGHS/ 2½/RND 60 cyc. 3.49
0-150 VAC/25-125cy/3½"Sq/RA35 . 5.98
0-1 MADC WSTGHS/3½"SQ/RA35.. 6.49
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RECTANGULAR CASE
.5MFD 1500VDC.......95¢; 2 for $1.50
5MFD 600VDC...... 1.50; 3 for 4.00
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1MFD 600VDC.......39¢; 3 for 1.00
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.1MFD 2000VDC......1.05; 5 for 4.50
2x.1MFD 400VDC ....49¢; 5 for 2.00

ESICO SOLDERING IRONS

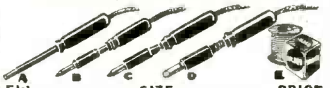

FIG.	SIZE	PRICE
A-55	Watt/⅜ Tip/11½ Lng/.38 lbs.	1.25
A-60	Watt/¼ Tip/12" Lng/.38 lbs.	1.91
B-100	Watt/⅜ Tip/12" Lng/.5 lbs.	2.55
B-130	Watt/½ Tip/12" Lng/.75 lbs.	3.17

ESICO INDUSTRIAL IRONS 120 VAC/DC
Similar to American Beauty types as shown
C-61A60/60W/⅛ Tip/7" Lng 3.20
C-#38/Am. Bty. 3138/100W/⅜ Tip 5.29
C-#58/Am. Bty. 3158/200W/⅝ Tip 6.30
D-#78/Am. Bty. 3178/300W/⅞ Tip 8.18
D-#98/Am. Bty. 3198/550W/1⅛ Tip 10.08
Solder 1 lb. Spool 062 Regular..... 1.29
With any soldering iron   Special 90¢
WRITE FOR QUANTITY PRICES

CU-24/ART 13
LOADING CONDENSERS

Three 25MMF 10,000V condensers P/o ART13 XMTTR. NEW $2.49
HI-VOLTAGE Ceramic Condensers. 4 mounted on aluminum plate rated as follows 185-200-280-400 MMF P/o ART13 SIG #2C6900-47A/-11 BRAND NEW $1.98

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36 Volt WILLARD Mini-BRAND NEW: 5 oz Designed Portable Equip Models.98¢; 4 for $3
(4) 36V Batteries w/acid $3.35
2V/20AH Willard PLUS 2V. Vibrator. 2.98
2V/20AH w/vib & acid 3.59
6V/6AH Willd NT6/BB214U 2.98
6V/6AH Battery w/acid 3.25
6V/40AH Battery 6.98
6V/40AH Battery w/acid 9.25
We ship acid in bottles. R'exp only

PALMER CLAW HAMMERS

98¢ Lots of 3
STANDARD SIZE 16 OUNCE BRAND NEW
Stillson Wrench 1st Quality 8".98¢
Stillson Wrench as above 10".$1.25

INFRARED SNOOPERSCOPE

SEE-IN-DARK TUBE
Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—data & tube, ea.....$4.98; 2 for $9.49
SNOOPERSCOPE PWR SUPPLY 1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram..............$6.98

FL-5 FILTER

Range or voice. Filters 1020 cycle audio. excellent for CW Work..59¢; 2 for $1.00

BANDPASS FILTER

Sharp Cutoff HIQ, Cased & Shielded 60, 90, 150 cycles..........Each $1.75; 2 for $3.00
UTC 854.1024.1250Cy.Ea.$1.50; 2 for $2.50

MICA CONDENSERS

Fig.	MFD	WVDC	PRICE
A	.033	600	69c; 5 for $2.50
A	.03	600	69c; 5 for 2.39
A	.02	600	69c; 5 for 2.25
A	.015	2500	1.75; 2 for 3.00
B	.01	600	56c; 3 for 1.20
B	.01	1000	49c; 3 for 1.25
B	.01	1200	69c; 3 for 1.49
B	.008	600	39c; 3 for 1.00
A	.005	2500	1.19; 3 for 2.95
B	.004	600	49c; 3 for 1.10
B	.002	1200	58c; 3 for 1.25
A	.002	2500	98c; 3 for 2.25
A	.001	1200	55c; 3 for 1.20
C	.00075	5000	2.98; 2 for 5.00
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
A	.0001	600	25c; 5 for 1.00
C	.0001	3000	89c; 3 for 2.00
C	.0001	5000	1.49; 4 for 5.00
C	.00005	3000	39c; 4 for 1.00

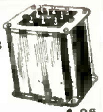
CONDENSER SPECIALS

2 MFD 330 VAC 1000 VDC
Prominent Mfg'r.
25¢ Lots of 10
..Smaller Quantities, each..49¢; 3 for $1.25
2MFD 600VDC Porcelain Insulators with Adjustable Mounting Clamp...3 for $1.50

TOGGLE SWITCHES

SPST GE 3A/250V......29¢; 4 for $.98
SPDT BKLT CSD Momentary.49¢; 5 for $2.00
DPST BKLT CSD 15A/125V.89¢; 3 for $2.50
DPST 20A/250V .....$1.25; 3 for $3.25
DPDT Center Off.................. 75¢
SPDT Momentary Both Sides....... 85¢
DPDT Center off Mom. 98¢ @ 6 for $5.00

POWER TRANSFORMERS



2500V for Crt 6.3V/.6A, 2.5V/1.75A csd Hvins 4/BC412 replmnt ...$7.98
1000VCT/45MA, 795vct/80ma, 360vct/55ma, 3x5V/3A, 6.3vct/1A, 6.3vct/.3A csd Hvins can be used 2x rating Raytheon Hypersil Core.......... 4.98
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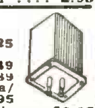
900V/35MA, 2x2.5V/2A, xclnt 1800-V'dblr two 2x2 fil. Windgs hsld... 2.25
840VCT/110MA, 530vct/21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/.3A...... 3.45
780VCT/250MA, 5V/6A, 12.6V/5.5A 7.95
770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95
720V/85MA, 5V/3.5A, 6.3V/3.5A... 2.98
700VCT/120MA, 2x6.3V/3A, 6.3V 1Amp ....$3.98; 2 for $7.25
700VCT/100MA, 2X6.3V/1.5A, 5V/2A, 115V Isolation-wndg 120MA.. 3.49
680VCT/200MA, 5V/3.5A, 6.3V/4A, 78V/1A...............$4.39; 3 for $12.00
500VCT/60MA, 6.3V/4A Hsld 2.98

FILTER CHOKES



12Hy/80ma/H'Sld/3KVins 2.25
10Hy/125ma/UTC/Csd/H'Sld/1Kvins 1.49
50Hy/125ma Csd/H'Sld .. 2.89
20 Hy/300ma or 15HY/400ma/12KVins 8.95
13.5Hy 1 amp 17 Kvins Raytheon...39.95
6 Hy/175ma, 250 ohm...1.49; 2 for 2.49
12 Hy/300ma, Hmsld 5KVins 4.95
10 Hy/85ma 550 ohm....95¢; 2 for 1.69
3 Hy/40ma UTC Hi "Q".95¢; 2 for $1.39

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2.5V/2A @ 79¢; 2 for $1.49; 10 for $6.49
6.3V/2AMP @ $1.08; 2 for......... 1.98
2.5VCT/10A 5KVINS 3.59
5VCT/10A/12KV INSUL G.E........ 8.25
5V/115A CSD KENYON HVINS.......16.95
7.5VCT/12A CSD KENYON 15 KVINS.10.95
24V/1.25A CSD @ $1.98. Two for.. 3.49
2X12V/2A or 24V/2A @ $3.98. Two for 6.98

CHROME VANADIUM SPEED DRILLS

29PCS CHROME VANADIUM SPEED STEEL. Top Quality for Machinists or all purpose use. Standard Full Length 1/16" to 1/2" by 64th's. With Huot Drill Index $9.69
12 PCS SET 1/16" to 1/2" Less Index $3.49
60 PCS DRILLS #1 to 60 with Index $7.98
13 PCS 1/16" to ¼" w/Index.....$2.69
¼" SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 60 Pcs Drills & Index. "TAB" SPECIAL $22.00
½" SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 29 Pcs Drills & Index. "TAB" SPECIAL $39.00

YOU PICK THEM $1.00 WHILE THEY LAST
LOTS OF 5
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SPRGE CRP 3 Vert Integrator Netwk 3 Res-3CNDS R only 3 LEADS 29¢ . 6 for $1.00
50 PWR Magnifier & Condsr . 2 for $1.25
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Controls, Popular Values ...5 for $1.25
Resistors, ½ & 1W, to 2 Megs. 50 for $1.25
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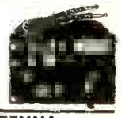
Sockets, Asstd. 8, 7, 5, 4P.12 for $1.25
Iron Core Slug & Screw...50 for $1.25
Knobs, Asstd. w/Insert...10 for $1.25

RHEOSTATS

Check these newly reduced prices
6 ohm 25W Model LH ..1.49; 2 for 2.49
15 ohm 25W w/knob ....1.49; 2 for 2.49
20 ohm 50W Model J ...1.98; 2 for 3.50
60 ohm 50W w/knob ....2.25; 2 for 3.98
100 ohm 50W Model K ...1.98; 2 for 3.50
200 ohm 25W Model D 1.49; 2 for 2.49
250 ohm 25W ....ea. 1.19; 3 for 2.98
300 ohm 225W Model P...2.98; 2 for 5.00
350, 500, 5000 ohm Slotted shaft. 25 watt ....79¢; 3 for 2.00

RM29



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TELEVISION ANTENNA

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FOLDED DIPOLE Hi & low antennas, all channel, sturdy const. $4.95
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DOUBLE-V Ant. All Channel, Sturdy Cons. w/Mtg Clamps & 100 ft. Twinex....$4.49
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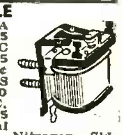
5 FOOT Interlocking Mast Sections, Hvy Duty, rustproof ....2 for $1.49, 10 for $7

RELAY SALE



SPST mini size 115VAC 3A cts......98¢; 3 for $2.75
SPDT min. size 115VAC 3A cts ..$1.39; 3 for $3.75
SPDT 24V DC, 5A CTS 98¢
SPNO 115 V AC, 15A CTS S'Dunn ..$1.98; 2 for $3.50
DPDT & SPNO 12 V DC, 10 A CTS $2.25; 2 for $3.75
DPDT Clare SK 5010, Octal Base 18-28V 2Amp Cts, Nitrogen Sld New Stock SPECIAL................$2.98

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Heinmann Magn. Bkrs. Amps: 3, 7, 9, 12, 15, 20, 30, 35, 40, 80, 180 ....$1.69; 10 for $15.98
Sq. D & CH Toggle Sw Brkrs. Amps: 5, 10, 15, 20, 25 . 98¢; 10 for $8.98
Klixon Thermal Push Button Bkrs Amps: 5, 10, 15, 20, 25, 30 89¢ ....10 for $7.98

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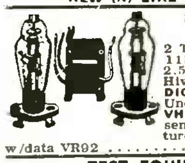
POWERSTATS & TEST EQUIPMENT

TYPE 20/volts 0-135/3 amp/LN..$10.98
Type 116U/volts 0-135/7.5 amp/LN 17.49
TYPE 1126/volts 0-135/15 amp/LN 42.98
TYPE 1226/volts 0-270/9 amp/LN 42.98
SIMPSON MODEL 260 VOM LN.... 34.98
HICKOK 600A Mutual Tube CHKR LN 142.98
GE ST4A Sweep Generator (N).....300.00
GE ST5A Marker Generator (N).....325.00
GE ST2A Oscilloscope (N)........275.00
HF-1 Oscilloscope, new special..... 79.95
NEW (N) LIKE NEW (LN)

866A KIT and XFORMER

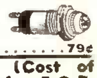


2 Tubes, Sckts, xmfr. 115v60cyc Inpt, outpt 2.5vct/10A/ Hivins $4.98
DIODE PROBE TUBE Unexcelled for No-Loss VHF testing. Ultra-sensitive subminiature-envelope. .New. w/data VR92 ....25¢; 5 for $1.

TEST EQUIPMENT

Model 102—Pocket Multimeter features: AC & DC 10 rngs to 3000 V, AC current 3 rngs to 600 ma, DC current 4 rngs to 1.2 amps, ohms 2 rngs to 1 megohm. Compact, accurate & durable construction. Std mfgr. "TAB" GTD display model. SPECIAL Post Paid................$[illegible].98
Model 106—Vacuum tube volt meter. Features include: AC&DC 10 rngs to 1000V, ohms 5 ranges to 1000 megohms, 5DB ranges, AC freq. response 25 to 100,000 cycles. Designed for field alignment of TV & Radio sets. Std mfgr. "TAB" GTD display model, SPECIAL Post Paid ....$[illegible].49
Model 106—In kit form Post Paid..$22.98
Model HVP—30,000 Volt probe for model 106. Display model "TAB" GTD. SPECIAL Post Paid $8.25
Write for Test Equip. Pamphlet

SOCKET ASSEMBLIES



PILOT LIGHT SOCKET, Bayonet with ½" jewel. As shown ......35¢; 5 for $1.25
PILOT LIGHT SOCKET 1" Jewel. Hi-Polish Finish. "TAB" Special...59¢; 10 for $4.50
1" PILOT, 1" LIGHT SOCKET, w/115V 3 Watt Bulb....................79¢

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*From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Postpaid) Within Continental Limits of U.S.A.
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OA2	.95
OA3/VR75	1.04
OB2	1.37
OB3/VR90	1.09
OC3/VR105	1.15
OD3/VR150	.90
1B3/8016	.81
1X2A	1.29
2X2	.63
2X2A	1.53
5R4GY	1.55
5R4GYW	1.75
5U4G	.69
5Y3GT	.43
6AG5	.79
6AG7	1.39
6AH5G	1.49
6AH6	1.22
6AJ5	1.10
6AK5	.74
6AK6	1.05
6AL5	.54
6AL7GT	1.29
6AN5	2.90
6AQ5	.85
6AQ6	.81
6AQ7GT	1.29
6AR6	2.98
6AS5	.79
6AS6	2.43
6AS7G	4.65
6AT6	.63
6AU5GT	1.10
6AU6	.59
6AV5GT	1.29
6AV6	.49
6AW6	1.89
6B4G	1.23
6BA6	.63
6BA7	1.27
6BC5	.81
6BC7	1.23
6BD5GT	1.65
6BD6	.83
6BE6	.59
6BF5	.65
6BF6	.65
6BF7	2.55
6BG6G	1.39
6BG7	1.98
6BH6	.63
6BJ6	.69
6BK7	2.15
6BL7GT	1.45
6BN6	1.79

6BN7	1.69
6BQ6GT	1.20
6BQ7	1.65
6C4	.50
6CB6	.69
6CD6G	1.89
6D4	2.70
6H6	.60
6J4	6.66
6J5GT	.47
6J6	.63
6K4A	6.45
6K6GT	.59
6L6	2.09
6L6G	1.35
6L6GA	1.35
6L6GAY	2.29
6SA7GT	.63
6SC7	.80
6SD7GT	.80
6SF5	.77
6SF7	.72
6SG7	.72
6SH7	.61
6SJ7	.70
6SK7GT	.69
6SL7GT	.80
6SN7GT	.69
6SQ7GT	.65
6SR7	.65
6SS7	.75
6ST7	.89
6V6	1.39
6V6GT	.87
6W4GT	.57
6X4	.60
12AH7GT	1.45
12AK5	1.98
12AL5	.75
12AT6	.89
12AT7	.72
12AU6	.72
12AU7	.63
12AV6	.49
12AV7	.98
12AW6	1.79
12AX4GT	1.20
12AX7	.79
12AY7	2.79
12AZ7	1.49
12BA6	.59
12BA7	.79
12BD6	.59
12BE6	.59
12BF6	.85

12BH7	1.29
12BY7	1.35
12BZ7	1.25
12SA7GT	.69
12SC7	.80
12SF5GT	.72
12SF7GT	.49
12SG7	.63
12SH7	.63
12SJ7GT	.59
12SK7	.72
12SL7GT	.65
12SN7GT	.75
12SQ7GT	.63
19T8	1.09
19V8	1.62
25BQ6GT	1.25
25L6GT	.69
25Z5	.79
25Z6GT	.99
28D7	1.35
35Z5GT	.69
50L6GT	.69
80	.69
81	1.69
82	1.19
82V	1.19
83	1.45
83V	1.79
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117L/M7GT	1.59
117N7GT	1.49
117P7GT	1.39
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CK501X	1.26
CK502AX	1.49
CK503AX	1.49
CK505AX	1.79
CK506AX	1.49
CK509AX	1.79
CK512AX	1.45
CK522AX	1.29
CK525AX	1.29
CK526AX	1.49
CK528AX	1.79
CK529AX	1.79
CK531DX	1.89
CK532DX	1.89
CK533AX	1.29
CK534AX	.99
CK536AX	.99
CK537AX	3.04
CK538DX	.98

CK539DX	2.19
CK543DX	.99
CK544DX	.99
CK546DX	1.99
CK547DX	1.98
CK571AX	3.40
CK573AX	3.49
CK1005	.85
1625	.33
2050	1.47
2051	1.15
CK5672	1.29
CK5676	1.29
CK5678	1.89
5687	5.49
CK5702	3.49
CK5703	1.29
Xtal Diodes	
1N21A	1.55
1N21B	2.89
1N21C	21.50
1N22	1.25
1N23	1.35
1N23A	2.20
1N23B	2.25
1N25	4.98
1N26	8.75
1N27	1.55
1N28	.64
1N34A	.90
1N35	1.65
1N38	1.29
1N38A	1.15
1N41	8.95
1N42	16.95
1N45	1.45
1N46	.69
1N47	4.00
1N48	.55
1N51	.45
1N52	2.39
1N54	.89
1N54A	1.15
1N57	.89
1N58	1.19
1N58A	1.15
1N60	.60
1N61	2.07
1N63/K63	2.49
1N64	.69
1N69	.98
1N86	1.15
1N87	1.15
1N88	1.15

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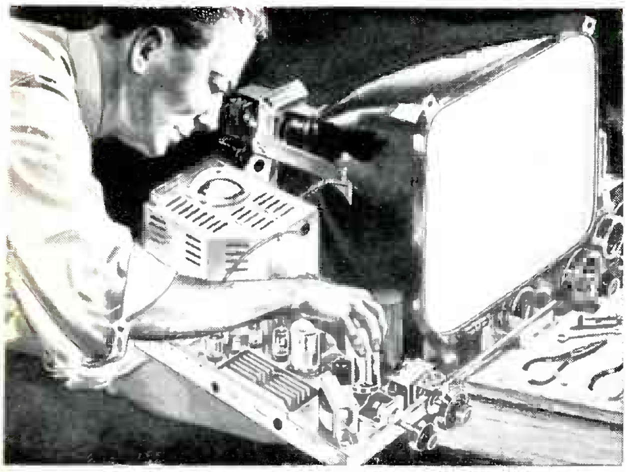

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