L[illegible]T IN TELEVISION · SERVICING · AUDIO

RADIO — ELECTRONICS

HUGO GERNSBACK, *Editor*

DRIVE-IN THEATER SERVICE BUSINESS

A SUBMINIATURE RADIO RECEIVER

FIVE SERVICE AIDS

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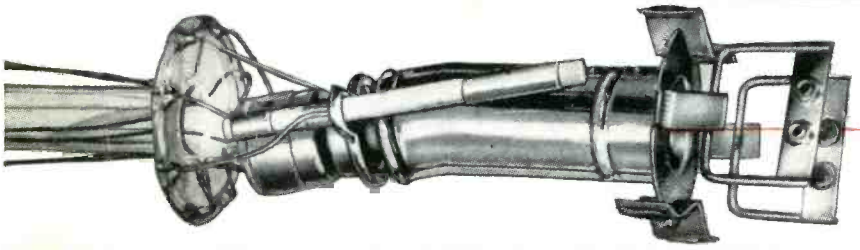
1951

30¢
U. S. and CANADA

BLIND IMPROVE TEST GEAR FOR ALL — SEE SERVICING SECTION

fine overall focus starts with the Du Mont BENT-GUN



- In big-picture tubes, more than ever, fine-line focus — clear across the screen — is an important function of the electron gun.
- In newer, wide-angle picture tubes, only proper gun design can correct the defocussing effects which deflection has on the cathode-ray beam.
- For uniform resolution, the control of beam-size by the new Du Mont Bent-Gun keeps the beam in focus from top to bottom and corner to corner.
- For better performance in bigger pictures, Du Mont Teletrons are your best buy.

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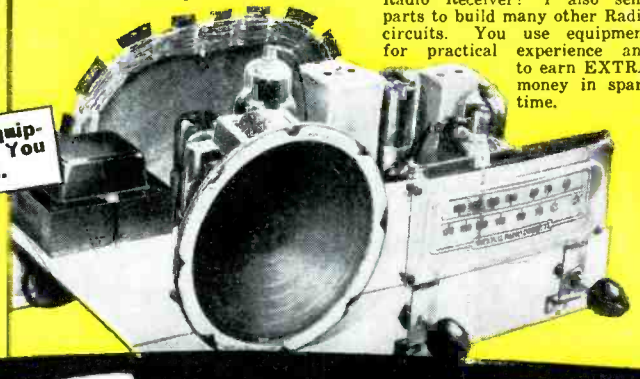

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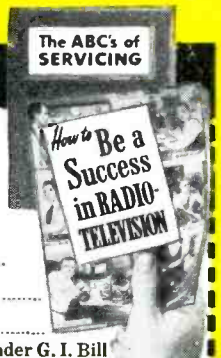

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ON THE COVER: Bob Gunderson and test gear in his radio lab, sound studio and ham shack at the Institute for the Education of the Blind, New York, N. Y. *Kodachrome by Avery Slack*

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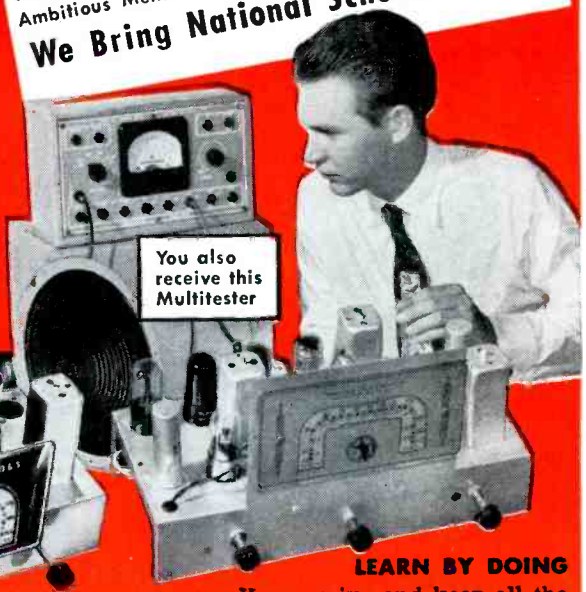

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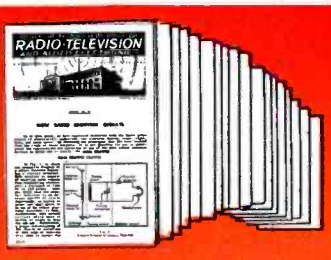

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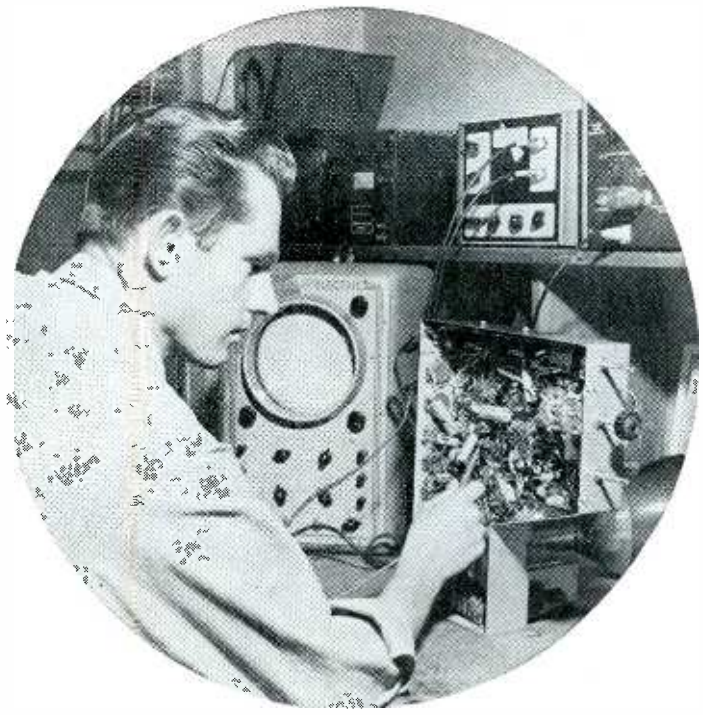

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Says

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"Call-backs on TV-service customers consume working time, and working time is what we have to watch at Conlan Electric. With 40,000 owners on our contract list in Greater New York, extra service calls can multiply to a cost figure that changes black to red. . . . Tube failures are a common cause of call-backs. We've found that good tubes—quality tubes—perform better, give much less trouble. G-E tubes have a top record with Conlan Electric. We feature them. We know that when one of our men installs a G-E picture tube or receiving type, chances are that customer will *stay satisfied!*"

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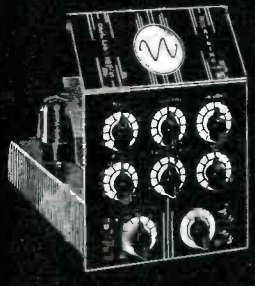
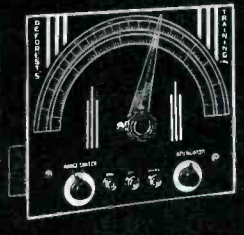
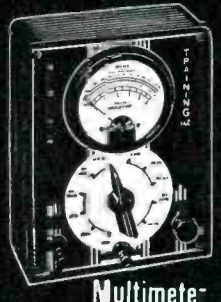


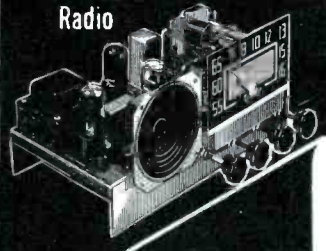
Oscilloscope



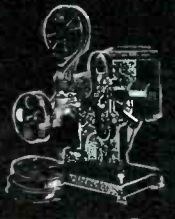
R-F Signal Generator



Multimeter



6-Tube Radio



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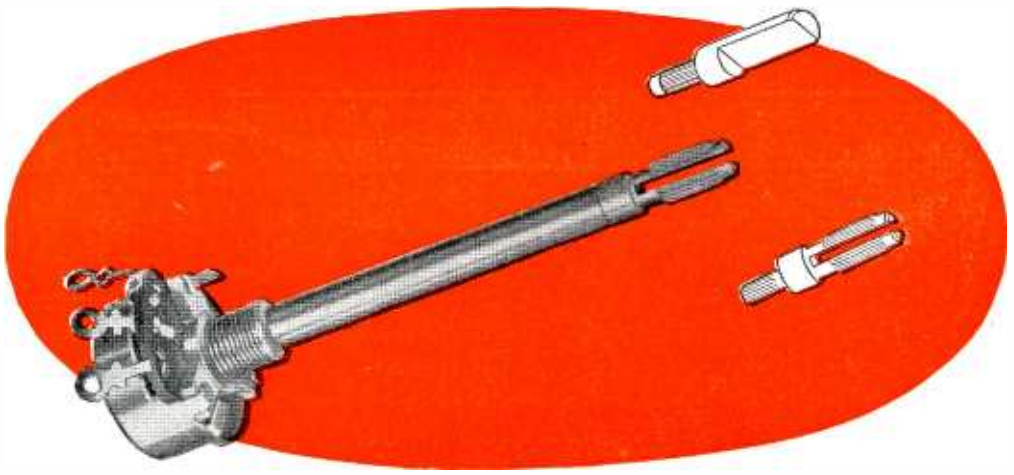
Now you can have the outstanding electrical characteristics of the *time-proved* Mallory Midgetrol . . . with two new time-saving features that make carbon control installation faster and simpler than ever before !

This sturdy $^{15}/_{16}$" control is supplied with a *permanently fixed, tubular brass shaft.* It is easily cut to required length. It can be adapted for split-knurl or flatted type knobs in a few seconds by inserting one of the two steel shaft-ends packaged with every Mallory Midgetrol. It has been designed to give you utmost convenience—without sacrificing the important advantage of a stable, permanently secured shaft.

In addition, switch attachment is made simple and sure by positive indexing and a design that permits secure locking in position without removing the control housing.



The Mallory Midgetrol gives you fast, sure, simple installation—with electrical characteristics specially engineered for critical applications in both television and radio. Precision-controlled carbon element assures smooth tapers, quiet operation, accurate resistance values and less drift in TV sets.

Make Sure! Make it Mallory!

Mallory Midgetrol*

Installation Time

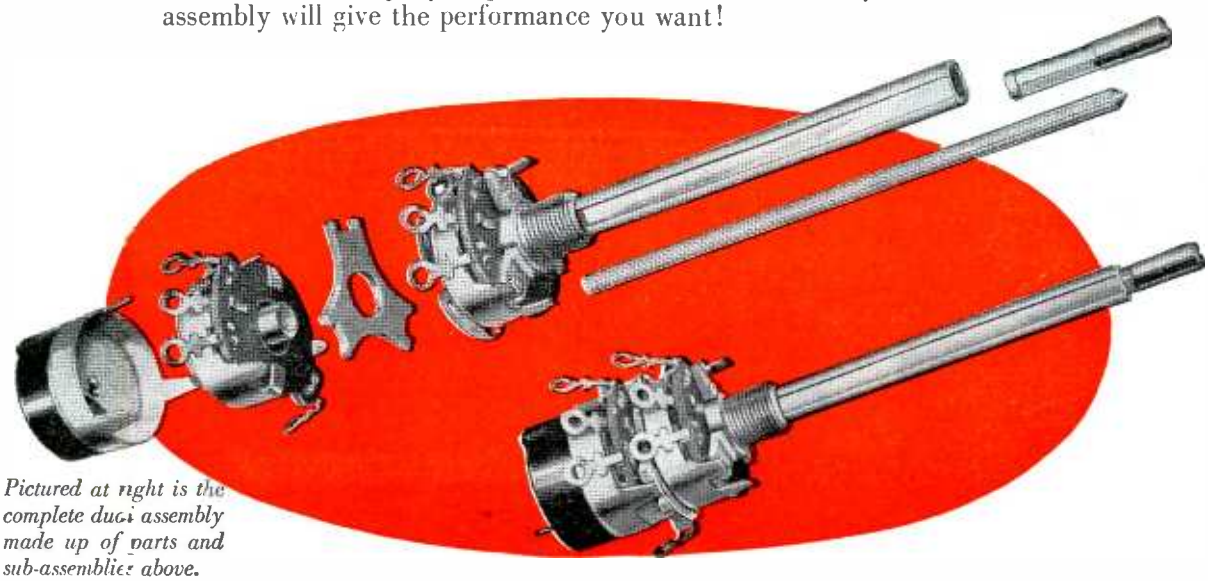
Dual Concentric Mallory Midgetrol

This revolutionary new control can be assembled in five easy steps, in less than five minutes—makes it possible for you to match a wide range of combinations immediately from convenient distributor stocks, and without the high "time" costs involved in more complex assembly operations.

The "exploded" view below illustrates the parts and assembled control sections supplied with each control. Extremely simple, brief instructions show you how to assemble them quickly and surely—without soldering—with only the simplest of tools.

As with the single Mallory Midgetrol, an AC Switch can be attached quickly—with no question of proper position, without removing the control housing.

The control is so designed that both front and rear sections are *factory-assembled and carefully inspected.* You can be sure that your final dual assembly will give the performance you want!



Pictured at right is the complete dual assembly made up of parts and sub-assemblies above.

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***Trade Mark*

The Radio Month

UNLICENSED BROADCASTING in Marysville, Ohio, was stopped suddenly by the FCC Jan. 5 last. Operating on 650 kc with a power of 150 watts, "Station WKGR" had been on the air for three months before an FCC representative walked in and told its surprised operators (and audience) "this is the FCC and this station is off the air."

The only licensed member of the station's youthful five-man staff (two are too young to vote) held a second class radio operator's ticket. Programs consisted almost entirely of recordings and news items from local papers.

TV AIDS MICROSCOPE to extend the possible range of microscopic study. In demonstrations conducted by scientists from Princeton University and the RCA laboratories, a Vidicon, RCA's industrial television camera, was mounted on an ordinary light microscope. The televised microscopic scene was transmitted to nearby receivers by cable (See photo below.)

Shown in the demonstration were the details of an amoeba, which appeared clearly on the screen, including breaking and reformation of membranes and movement within the cell. Movement inside a plant cell, magnified at 2,800 times, was also shown.

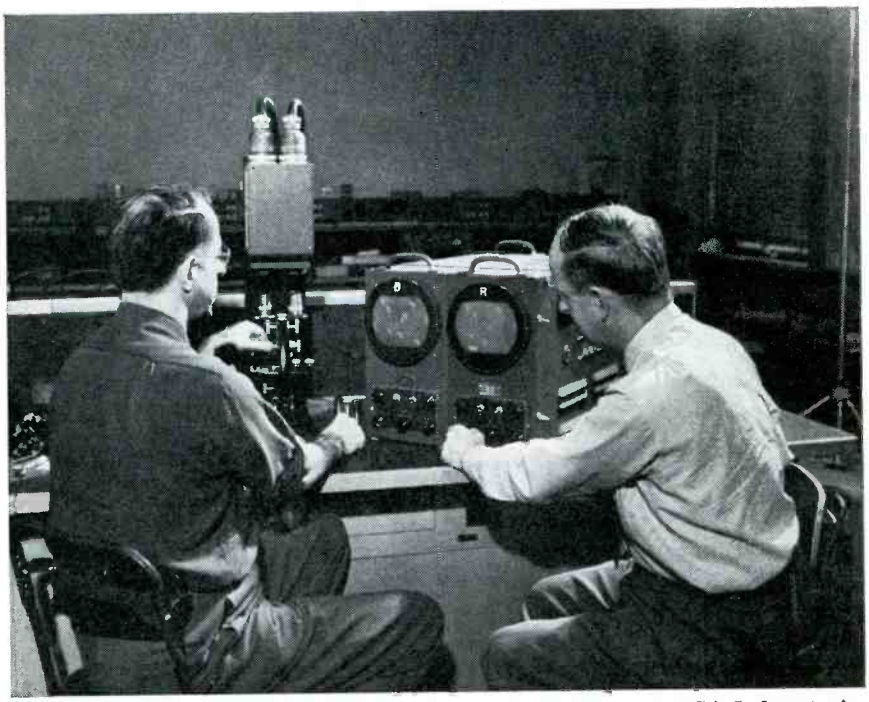
Besides giving sharper images than any previously available, the televised microscopy has the advantage that many specimens need not be stained to become clearly visible. Staining often kills a specimen, and in many cases a specimen must be killed before it will take stain. Previous highly magnified motion could be seen only by motion picture photography. This technique required intense lights which often killed the specimen, and of course also required processing a film, while the television cameras operate at relatively low light levels.

PRIORITY of invention of basic magnetron strapping has been awarded by the U. S. Patent Office to Dr. Percy L. Spencer, vice-president of the power tube division of the Raytheon Manufacturing Company. This action was based on a concession of priority by the United States by Dr. James Sayers of England and marks the end of a patent suit that has been in the courts many years.

FM TRUNK LINE, involving nearly two million miles of circuits, has been put into successful operation by the Western Union Telegraph Company. Described by two of the Company's engineers at the recent winter General Meeting of the American Institute of Electrical Engineers, the circuits use automatic switching that will virtually do away with manually handled messages, except in small towns. Message transmission will be speeded up, time lost because of system trouble and maintenance costs will be notably reduced.

ANNUAL CONVENTION of the Institute of Radio Engineers will be held this year in New York City from March 19 to March 22. Technical session will be 43 in number, with more than 200 papers to be read. The technical sessions will be held simultaneously at the Waldorf-Astoria Hotel and the Grand Central Palace, the latter also housing the exhibits as in previous shows.

A feature of the 1951 convention will be the large number of symposiums. Fourteen will be held; eleven of them by IRE professional groups. The other three will include a symposium on color television at which engineers of the chief systems will describe their techniques, an educational symposium on the problem of "matching schools to industry" and one on air traffic control problems.



Dr. A. K. Parpart of Princeton University and L. E. Flory of RCA Laboratories using the new microscope. The equipment is of the binocular microscope type.

IT'S "LOADED" WITH BETTER TELEPHONE SERVICE

Twenty of the Bell System's newest small loading coils—like the one at the left—are housed in the long black case, mounted in a cable splice. This type of installation permits the economical extension of city cables to serve out-of-town subscribers.

MANY more wires can be crowded into a cable sheath when the wires are fine. But normally, wires don't transmit as well when they are fine and closely packed.

Bell engineers long ago learned to make wires do better work by loading them with inductance coils at regular intervals. The coils improve transmission and let messages travel farther. But originally the coils themselves were large, heavy and expensive. The cases to hold them were cumbersome and costly too.

So year after year Bell scientists squeezed the size out of coils. To make magnetic cores of high permeability they developed Permalloy. Tough but extra-thin insulation permitted more turns to a core.

New winding machines were developed by the Western Electric Company. Coil size shrunk to one-fiftieth. Some—like the one shown above—can be mounted right in cables themselves.

The 15,000,000 coils in the Bell System today mean thinner wires, more wires in a cable—more economical service for you. They demonstrate once more how Bell Telephone Laboratories work continually to add to your telephone's value.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST

A NATIONAL association of electronic technicians and radio-television service dealers was formed in Washington January 28 by representatives of some 24 electronic technicians' associations. Charter members include the member societies of the New York and the Pennsylvania federations and other associations in Washington and New Jersey.

The aims of the new National Electronic and Service Dealers Associations will include improvement of the radio-television servicing industry and promotion of better understanding between electronic service technicians and dealers and the rest of the electronic industry; securing good relations with the public; raising the technical standards of the electronic technician; and cooperation with federal, state and municipal agencies in matters affecting radio-television servicing and the electronic service technician.

Temporary officers elected were: president, Max Liebowitz, New York City; vice-president, Norman Selinger, Washington, D. C.; corresponding secretary, Richard Devaney, Philadelphia; recording secretary, Roger Haines, Haddonfield, N. J., and treasurer, Vance E. Beachley, Harrisburg, Pa.

Next meeting of the new association was set for March 4 at Philadelphia.

FOUR-WAY TRAIN RADIO, an important adjunct to safe and efficient railroad operation, was demonstrated recently to FCC staff members who went on a 200-mile daylight freight train ride through the Erie Railroad's most difficult terrain—from the standpoint of radio reception. Over 90% of the Erie's main line between New York and Chicago is covered by the radio system, with 51 wayside transmitting stations spaced at intervals from 6 to 30 miles. Mobile stations are used in 108 diesel locomotive cabs and in 42 cabooses. Yard and terminal operations have four base stations and 30 mobile units.

TV SERVICE PROBLEMS, long a headache to the industry, are due for Federal investigation if a resolution now before Congress is passed. Sponsors of the resolution are seeking a thorough probe of "false and misleading" TV service contracts on the ground that TV service constitutes an interstate commerce. The New York State Legislature has a similar bill before it, and the New York City Council has been considering a bill to license firms that install or repair TV sets.

Almost nothing has been done to stabilize the service industry in the past year, and service technicians have had to cope with a marked deterioration of new sets because of careless workmanship, substitute parts, and poor inspection at the factory. Service firms also charge that distributors fail to meet their warranty obligations. Frank J. Moch, president of the Television Installation and Service Association of Chicage, stated that in that city alone distributors owe about $120,000 in replacement parts covered by warranty agreements to service firms. He also charged that a large part of the replacement parts, especially tubes, supplied by distributers would not perform satisfactorily. "At least 50% of receiver tubes sent to us in recent months have been worthless," Mr. Moch said. "Many of these tubes carry no code numbers and are out of the cartons—but we have strong suspicions that tubes sent in by some other dealer or service man are being sent back out to us. When these replacements fail to work, we are left holding the bag."

Latest stalling technique, according to service technicians, is that some distributors are issuing credits on defective tubes, but the credit is based on prices which have not been in effect for over nine months.

1950 EDISON MEDAL, annual award for high achievement in engineering, has been given to Otto B. Blackwell, of Plandome, L. I., retired assistant vice-president of the American Telephone and Telegraph Co. The award was given for "his pioneer contributions to the art of telephone transmission."

In addition to his work in telephone communications, including world-wide telephones linked by radio, Mr. Blackwell has been a leader in schools for training transmission engineers and was responsible for the first comprehensive transmission engineering bulletin for field use. He is also author and co-author of several important technical papers in the communications field.

The Edison Medal was established in 1904 by friends and associates of Thomas A. Edison to serve as an "honorable incentive to scientists, engineers and artisans to maintain by their works the high standard of accomplishment" set by Edison. It is awarded annually by the American Institute of Electrical Engineers for meritorious achievement in electrical science, electrical engineering, or the electric arts. Recipients of the award include George Westinghouse, Alexander Graham Bell and other outstanding scientists.

ROBOT CHESS PLAYER suddenly gave up the game when it was beating its master, Professor Torres Quevedo of Spain. "I broke the rules three times, and it's disgusted," the professor said. The game took place at the first International Congress of Machine Communications in Paris.

THE TENSION'S TERRIFIC

What-AGAIN?

FEEL LIKE THIS AGAIN TODAY? Back in '43, when Hytron first ran this ad, Hytron tubes were worth their weight in gold. T'aint that bad today. But, despite quadrupled production, it's bad enough. Hytron tubes are more in demand than ever before.

Defense . . . TV . . . radio . . . industry want more tubes than all the tube manufacturers can make. We know how it is. And how vital your needs for replacements are.

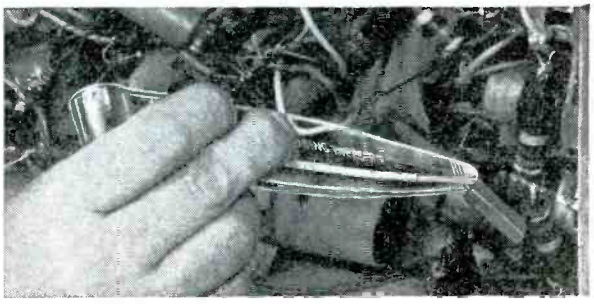
Despite the crazy demand . . . and the irritating shortages of materials, we're straining every effort to increase production for you. We'll give you more Hytron replacement tubes yet, or "bust a gut" trying.

OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS



Probing made Natural . . . Quick . . . Safe!

Pestered by elusive intermittents, shorts, opens, noise, feedback? Want to probe for them — with set operating? Without danger? Without detuning effects? Try new Hytron Probing Tweezers. The precise . . . safe . . . natural extension of your own fingers long sought for this job. Of rich, tough polystyrene with ideal electrical and mechanical characteristics. This contest prize winner saves time, money . . . *maybe your life*. Only 35¢ from Hytron jobbers. Get your Probing Tweezers today.

It's a Cinch! As natural as using your bare fingers. With set on, Hytron Probing Tweezers probe, grasp, and manipulate suspected wiring and components. Easily, surely ferret out: intermittents, shorts, opens, noise, feedback from adjacent wiring, etc. Free from danger of accidental shocks and shorts. Without disturbing normal performance of set.

Jaws of Probing Tweezers grip firmly. Have fine and coarse serrations for different sizes of wires, condensers, resistors, etc. High dielectric constant of polystyrene minimizes capacitive detuning. No pull by strong magnetic fields. Safely long for TV. Handily compact for burrowing into tight spots. Heat resistant, too, if you avoid very hot irons and components. You'll like this unique Hytron tool "by servicemen, for servicemen."

NEW!

HYTRON
Probing Tweezers
35¢ net

EIGHTH MEMBER OF THE HYTRON SERVICE TOOL KIT!

Merchandising & Promotion

Sylvania Electric Products has established the Sylvania Television Awards Foundation in an effort to improve the quality of TV programs. The company will make awards of "Sylvias" for the best TV program and to the best writer, producer, director, etc. Deems Taylor will serve as chairman of the committee of judges.

The Centralab Division of Globe-Union Inc., Milwaukee, Wis., announces a new volume control reference chart as an aid to the service technician. This new Adashaft chart shows the varied shaft and switch combinations available for Centralab replacement controls. It is printed on durable card stock and may be tacked on the wall.

The M. A. Miller Mfg. Co. announces two new packages for its replacement needles. One is an individual package for each Miller needle; the second is a handy dispenser box for counter and sales display.

Clarostat has a new bluish-green carton which supersedes the company's familiar kelly green package. Simple in design and free from excess copy, it is attractive and easy to recognize.

Jensen Industries has introduced a new phonograph needle display card. It holds

fifty packages of thirty needles each. The display is available through local distributors or direct from the company.

Servicing Business

Allen B. Du Mont Laboratories, Inc. is demanding that all its authorized TV service organizations and dealers who take on contracts provide notarized proof that they have established escrow accounts to insure funds paid out for service contracts.

RCA Service Company district managers were told that greater demands for servicing electronic equipment would put even heavier stress on the servicing industry which is already hard pressed by shortages.

The company also announced that it had more trained men in the field working on military installation, instruction and servicing in theaters of operation and at bases in the United States than at the peak of World War II.

General Electric vice-president Dr. W. R. G. Baker stated that the electronics industry can fulfill needed military requirements if permitted to convert on the basis of sound planning. He stated that TV-radio technicians are a reservoir of skilled labor that would be a great asset in time of all-out military production.

Sales and Production

The RTMA reported that TV picture tube production in the month of November continued at a peak rate. 914,804 tubes were produced, of which 98% were 16-inch or larger and over 60% rectangular. The association reported that 61,938 tubes were sold for replacement purposes in November.

RTMA president, Robert C. Sprague, stated that the radio-TV industry broke all records in production and sales of TV and radio sets in 1950. Preliminary estimates show that close to 7,500,000 TV receivers and over 14,000,000 radios were manufactured during the past year. Manufacturers' sales amounted to $1,700,000,000, an increase of 90% over 1949 sales.

NBC-TV Sales Planning and Research Bureau reported that TV set installations in the U. S. as of December 1, 1950, were 9,845,300, or 670,000 more than the previous month.

Show Notes

The committee of the 1951 Parts Distributors Show, which will be held in the Stevens Hotel in Chicago May 21-23,

ADD TECHNICAL TRAINING TO YOUR PRACTICAL EXPERIENCE

GET YOUR FCC LICENSE IN A HURRY!

THEN—Use Our Amazingly Effective JOB-FINDING Service

Get this Valuable Booklet FREE

TELLS HOW—

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

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

TELLS HOW— **Employers make**

JOB OFFERS Like These to Our Graduates Every Month

Telegram, August 9, 1950, from Chief Engineer, Broadcast Station, Pennsylvania, "Have job opening for one transmitter operator to start immediately, contact me at once."

Letter, August 12, 1950, from Dir. Radio Div. State Highway Patrol, "We have two vacancies in our radio Communication division. Starting pay $200; $250 after six months' satisfactory service. Will you recommend graduates of your school."

These are just a few examples of the job offers that come to our office periodically. Some licensed radiomen filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY With OUR Coaching AT HOME in Spare Time.

Name and Address	License	Lessons
Lee Worthy, 2210½ Wilshire St., Bakersfield, Cal.	2nd Phone	16
Clifford E. Vogt, Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch, 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoell, 110 West 11th St., Escondido, Cal.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-27, 4900 Euclid Bldg., Cleveland 3, Ohio
Approved for Veteran Training Under G. I. Bill

TELLS HOW—

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

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

GETS JOB WITH CAA

"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Dale E. Young, 122 Robbins St., Owosso, Mich.

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitter Engineer at WMMT."

Elmer Powell, Box 274, Sparta, Tenn.

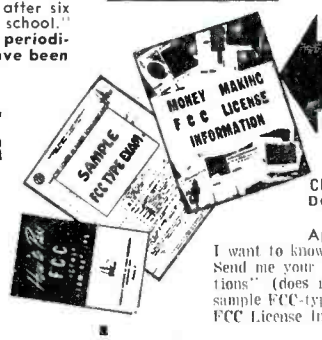
OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with me landing this desirable position."

Charles E. Loomis, 4516 Genesee Ave., Dayton, Ohio

Your FCC Ticket is always recognized in all radio fields as proof of your technical ability.



Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-27—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

Approved For Veteran Training Under G. I. Bill

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the valuable new booklet, "Money-Making FCC License Information."

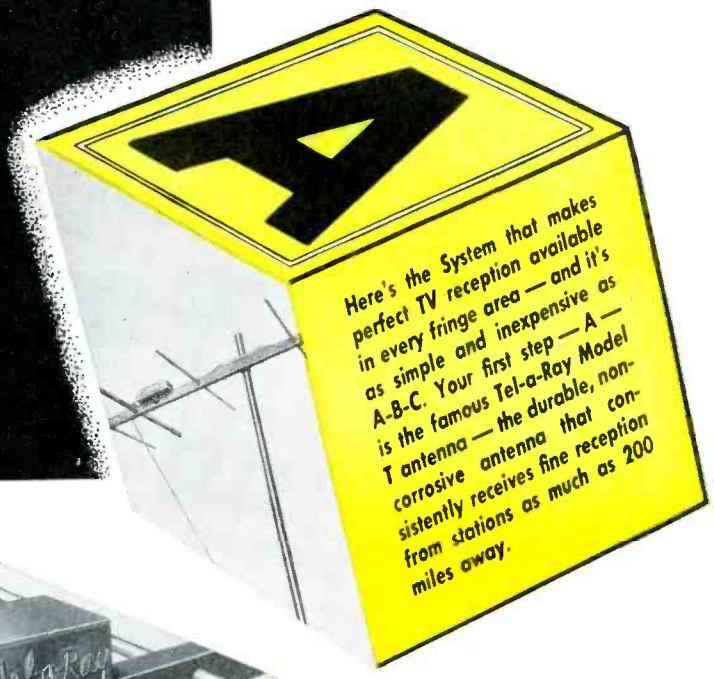
NAME.....

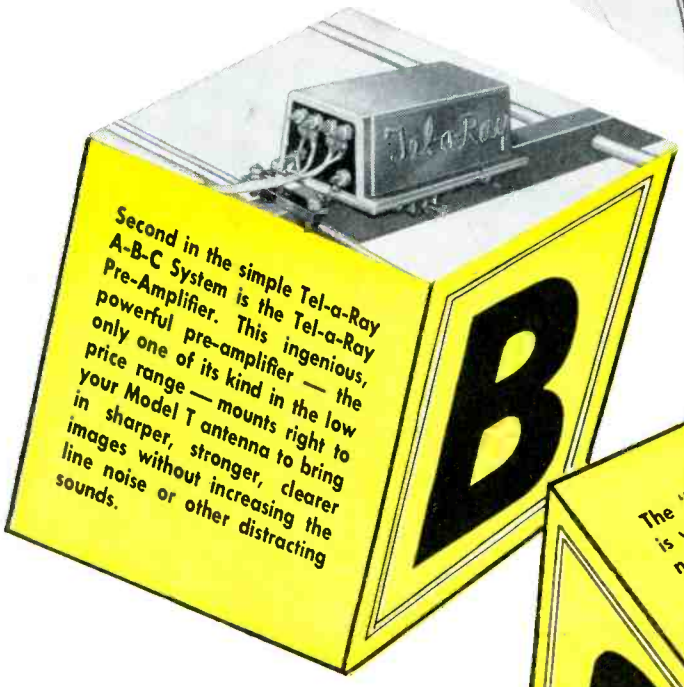
ADDRESS.....

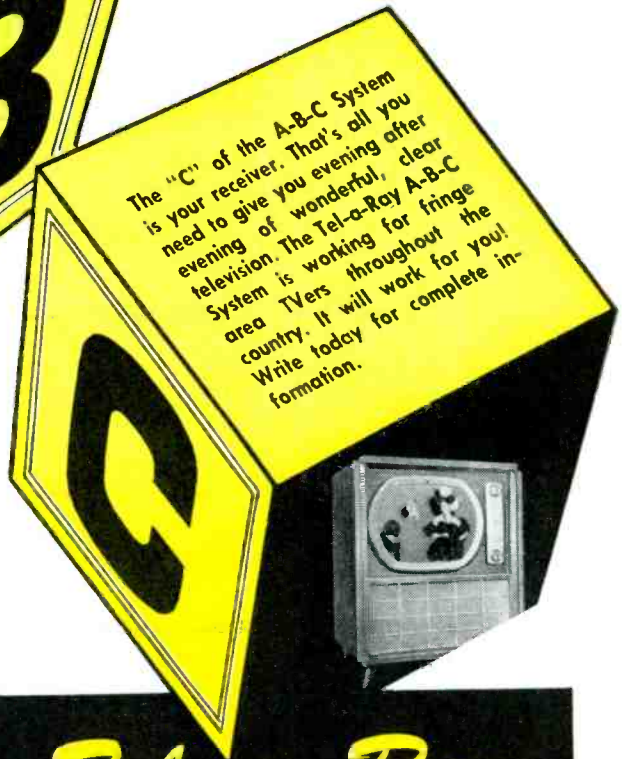
CITY.....ZONE.....STATE.....

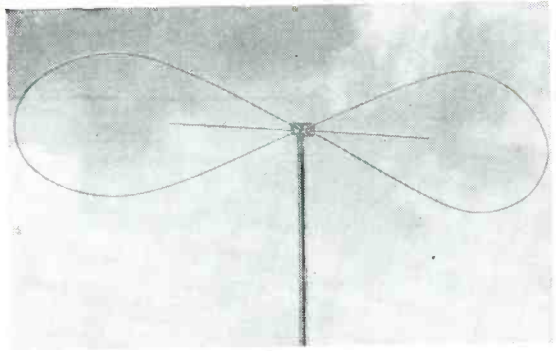
Paste on penny post card or send air mail.

you can have perfect reception when you know your TV A-B-C's









Your best bet for good primary area reception is the Tel-a-Ray Butterfly antenna. The Butterfly receives 13 channels and FM radio — is completely guaranteed against wind and weather damage. It sells for just $2.95 (suggested list).

Tel-a-Ray

ENTERPRISES, INCORPORATED

BOX 332E

HENDERSON, KENTUCKY

TRADE MARK

announced that, as in former years, all booths in the Exhibition Hall have been sold.

The National Electronic Distributors Association announced plans for its second Jobber Sales Show to be held in Cleveland, Ohio, September 10-13.

The Pacific Electronic Exhibit will be held from August 22 to August 24, a week earlier than the date originally scheduled.

New Plants and Expansions

General Electric officials okayed the construction of a new million-dollar electronics plant on a 60-acre site in Auburn, N. Y. The new plant is expected to be ready by early Fall. It was originally scheduled for TV receiver parts manufacture, but the present international situation may make a change in plans necessary.

General Electric also announced the purchase of a major part of the Union Bag & Paper Corp. plant in Hudson Falls, N. Y. It will use the plant to manufacture capacitors.

Thomas Electronics, Inc. has acquired 100,000 square feet of additional floor space in its present location in Passaic, N. J.

Westinghouse Electric Corp. announces the formation of an electronics tube division. The new division is planning three new plants to manufacture various types of tubes.

Stewart-Warner Electric, the radio-TV division of the Stewart-Warner Corp., has acquired a 100,000-square foot plant at North Kostner Ave., Chicago. It will transfer manufacturing operations now located at its main plant to the new building in April.

Electronic Measurements Corp., has moved its offices and factory to new and larger quarters at 280 Lafayette St., New York, N. Y.

General Cement Mfg. Co., Rockford, Ill., announces the acquisition of a new 30,000-square-foot plant which will be devoted to the manufacture of TV antennas and accessories.

U. S. Electronics Corp. has moved from Los Angeles to a new 6,000-square-foot plant in Santa Monica, Cal.

Gertsch Products, Los Angeles, has acquired additional facilities adjoining its present plant. The new floor space will be used for offices and engineering development laboratories.

Best Vue Products, TV antenna manufacturer, has moved its factory and offices to Brooklyn, N. Y.

Synthane Corp. of Oaks, Pa., fabricator of plastics for industry, has moved its New York district office to Bronxville, N. Y.

Pioneer Electronics Corp. has begun the production of TV picture tubes on the West Coast. The company occupies a 15,000-square-foot building in Santa Monica, Cal.

Financial Reports

	1950	1949
Cornell-Dubilier Elec. Corp. (Year to Sept. 30)		
Earnings	$1,757,524	$450,785
Sales	$23,927,117	$13,678,971

Hallicrafters Company
(November quarter)

Earnings	$451,636	$229,766
Sales	not given	

Dividends:

Hoffman Radio Corp. announced a regular quarterly dividend of 25¢ a share on common stock.

Howard W. Sams Co. announced a common stock dividend of 10¢ a share.

Western Electric Company gave a dividend of 75¢ a share on outstanding capital stock.

Business Briefs

. . . RCA Board Chairman Brig. Gen. David Sarnoff declared 1950 was the company's biggest year in history, with television accounting for about 75% of the total gross income.

. . . **Sylvania Electric Products** president Don G. Mitchell announced that the company closed 1950 with sales volume in excess of $150,000,000, or over 50% more than the previous year.

. . . **Admiral Corp.** head Ross D. Siragusa stated that the long-term outlook for TV is sound but the immediate future is uncertain. He anticipates a poorer year in 1951 than for the record 1950. He estimated Admiral's 1950 sales at approximately $230,000,000, of which TV accounted for $173,000,000.

. . . **Allen B. Du Mont Labs.** has established a cabinet styling department under the direction of the receiver sales division.

. . . **RCA Victor Division** has a new mobilization planning department to co-ordinate the division's activities with the needs of the Government in the national emergency.

. . . **General Electric** has created a departmental committee to offer aid in the electronics field to civil defense organizations. E. H. Vogel, manager of marketing, heads the committee.

. . . **NEDA** will now mail its weekly Washington report to any distributor who requests it. Previously it has been limited to NEDA members only.

. . . **Electro-Voice, Inc.**, Buchanan, Mich., is the twenty-second electronics firm to participate in the engineering services of Howard W. Sams & Co., Inc.

. . . **Zenith Radio Corp.** reports that tests on Phonevision subscriber television, which began January first, were favorably received by Chicago viewers.

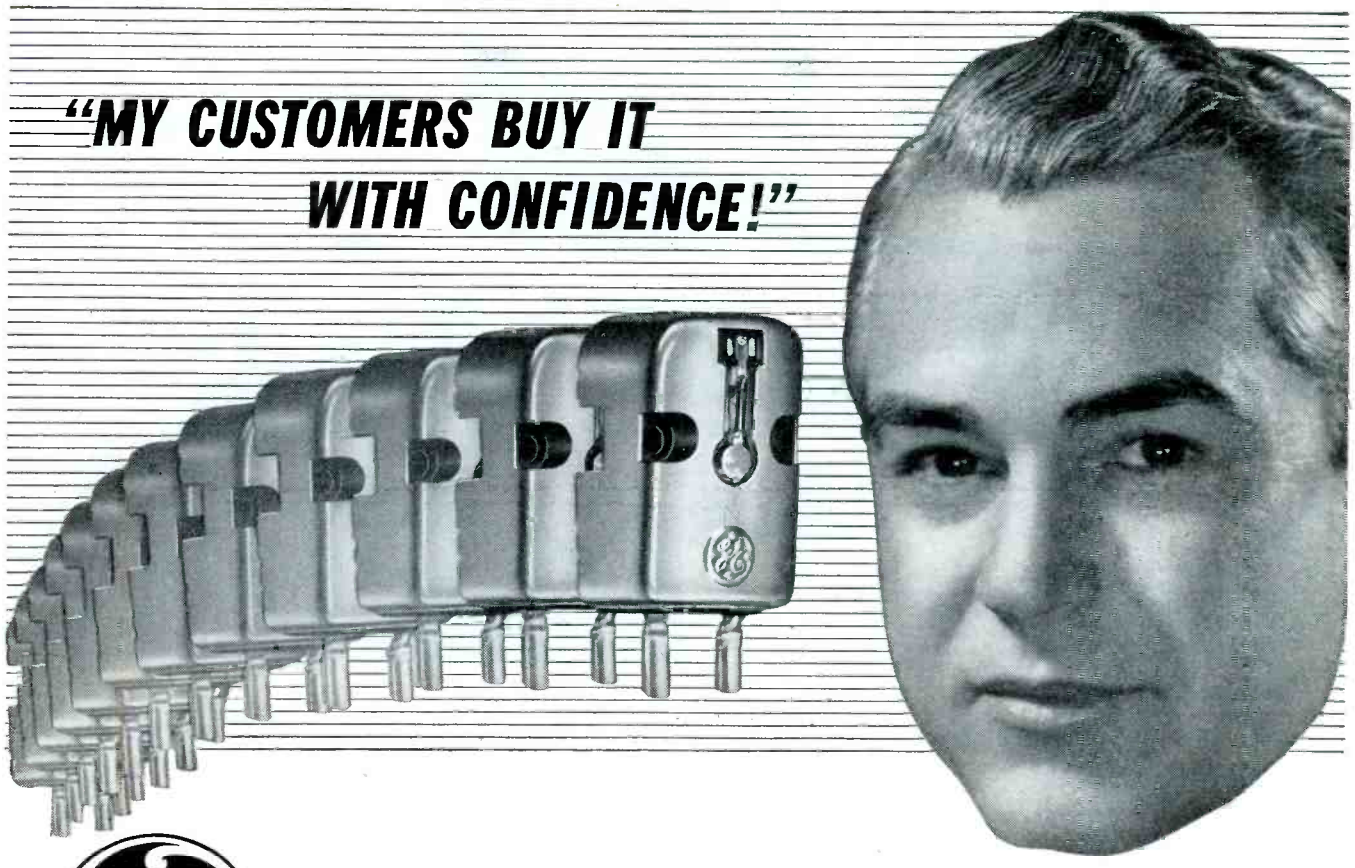
. . . **Bendix Home Appliances, Inc.**, has become a division of the Avco Mfg. Corp.

. . . **RCA Victor Division** admitted 106 employees who had completed a quarter century of service in 1950 into the company's 25-Year Club.

. . . **Lewis & Kaufman, Inc.** president, Jack Kaufman, headed a group which purchased the entire capital stock of Taylor Tubes, Inc., Chicago.

. . . **Clarostat Mfg. Co.** reported shipments of over $4,000,000 for the first nine months of 1950. The company anticipates a profit for this period of over $450,000.

. . . **The Allison Radar Corp.**, New York, was formed recently to manufacture and sell radar products for military and commercial use.



VARIABLE RELUCTANCE CARTRIDGE

MORE than 100,000 sold in 1950! Outsells all other brands of VR cartridges combined. That's why dealers like to sell it — people like to buy it; it's dependable, it offers more listening pleasure per dollar than any other cartridge on the market.

Orders from manufacturers are 'way up — you will see more and more G-E cartridges in new record players and combinations. Dealers and servicemen, too, are placing orders now for adequate stocks of these quality cartridges. Your customers deserve the best audio equipment you can give them. Phone or wire your distributor today, or write: *General Electric Co., Electronics Park, Syracuse, New York.*

Every dealer and serviceman needs one of these catalogs... complete specs and photos on G-E cartridges, styli, tone arms, pre-amps.

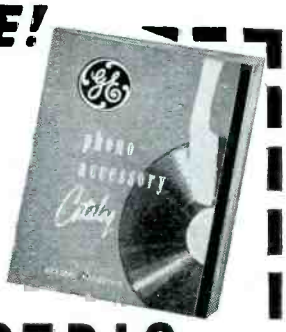
NEW CATALOG...GET YOURS FREE!

General Electric Company — Section 4531
Electronics Park, Syracuse, New York
Rush me the new G-E Phono-Accessory Catalog.

NAME_____

ADDRESS_____

CITY_____ STATE_____



GENERAL ELECTRIC

Military Inventions Wanted

. . . The radio-electronic inventor can render a service to his country . . .

By HUGO GERNSBACK

THE state of emergency proclaimed by President Truman on Dec. 16 makes it necessary for us to reorient our thinking on American security. The time when we could sit smugly behind our own "Maginot wall"—the atomic bomb—has now passed into history. We no longer have a monopoly on atomic weapons. The Russians now have them too, so our former exclusive weapon now is a commonplace.

Americans must realize what we should have known all along. Wars cannot be won by atomic bombs alone! We also must deliver them first in the face of determined air opposition by the enemy.

Nor can atomic bombs be used successfully against armies and men in the field. A-Bombs are not only too wasteful, but by saturating the ground with deathly radiation, stand in the way of the attacking army as well. In the end it is the foot soldier who wins the wars. For this reason it is doubtful that atomic bombs will be used in the field.

Meanwhile your country needs new weapons of a more prosaic type. *It is here that you can help your country.* We are giving most of this page over to the National Inventors Council appeal for military inventions. It should be studied by every reader of this magazine.

We give only four radio-electronic war devices now asked for by the Council and we shall print others from time to time as the Council announces them.

Government agencies are often slow in making their wants known, so our readers who have talent for new inventions should read the daily news items from the various war theaters and form their own opinion on required weapons.

We are only excerpting the vital data from the INFORMATION BULLETIN of the National Inventors Council. This may be secured by writing to the Department of Commerce, Office of Technical Services, Washington 25, D. C.

Information Bulletin

1. GENERAL INFORMATION—The National Inventors Council functions in an advisory capacity to the Department of Defense and other departments, agencies, and offices of the Government in evaluating, guiding, and analyzing inventions for the national defense and welfare. The Council membership comprises outstanding American inventors, scientists and industrial research experts having specialized experience in the development and utilization of inventions, together with the Commissioner of Patents and a representative of each of the three branches of the Armed Services.

The Council was originally created in the fall of 1940 by the Secretary of Commerce with the concurrence of the President. During the war years the Council screened over 200,000 inventions for the Armed Services. Many of them played an important part in the war—the magnetic mine detector, for example. The Council functions to:

1. Assist the public in submitting inventions or inventive ideas of value in the defense and welfare of the nation. 2. Acquaint the public with the problems confronting the Armed Services. 3. Refer all potentially valuable ideas to the Department of Defense or other appropriate agencies.

The Council restricts its activities to inventions relating to the Armed Services and other Government agencies. It does not assist individuals and firms in obtaining development contracts, nor does it finance the development of inventions. The Council will, however, place the inventor in contact with the proper authorities if his proposal appears to meet a need of the Armed Forces or some other Government agency.

2. PROCEDURE FOR SUBMITTING PROPOSALS—In order that inventions may receive prompt and fair consideration it is essential that the objectives and advantages of the invention be readily apparent. The inventor, should, in his own interest, completely disclose *the whole method* and principle underlying the operation of the apparatus or invention.

2a *Form of Submission*: No special forms are required for submitting proposals to the Council and the services of an attorney are *not* required. Consideration of inventions is facilitated if each proposal is submitted as a separate document, preferably typewritten, containing the following information in numerical order: 1. Name and address of inventor. 2. Title of the invention. 3. A brief statement as to the general nature and specific use of the invention. 4. A discussion of the particular point of novelty or superiority of the invention as compared with existing devices and/or practices. 5. A brief outline of any tests which have been conducted on the invention. 6. A summary of the patent status of the invention and the steps which have been taken to develop the invention or bring it to the attention of other Government agencies. 7. A complete discription of the invention which includes any necessary sketches, drawings and photographs.

2b. All suggestions should be addressed as follows: National Inventors Council, U. S. Department of Commerce, Washington 25, D. C.

2c. For prompt and accurate service all material should be typewritten in English.

2d. *Personal Interviews and Demonstration*: The National Inventors Council cannot provide funds for the transportation of an inventor or his representative to Washington or to other Government installations. While the Council staff is always available for personal interviews when an inventor is in Washington, it is usually not possible to take any final action on a proposal until it has been made in writing.

2e. *Submission of Models*: Models SHOULD NOT be forwarded unless specifically requested after a written description of the suggestion has been submitted and examined.

2f. *Retention of Submitted Material*: The Council is required by law to retain all original descriptive material as a matter of official Government record even if the material has been found lacking in merit. Since it is not possible to return submitted material, inventors are urged to retain duplicate copies of all material forwarded for review.

3. PROTECTION OF INVENTOR'S RIGHTS—While the Council receives and examines all inventions and suggestions submitted, it cannot give the protection afforded by a granted patent. Submission of an idea to the Council does little more than establish a date on which the idea was disclosed to a responsible Government agency. All submissions are held in secrecy and in confidence, and all possible safeguards are imposed to protect the inventor's rights. But the United States Patent Office is the sole statutory agency which can grant an inventor a limited monopoly in respect to his discoveries.

4. COMPENSATION—The submission to the National Inventors Council, under the provision contained herein, of any description, drawing or other data pertaining to an invention is solely for the purpose of determining its possible interest to the Government. Acceptance of a disclosure by the Council does not legally obligate the United States Government or act as an estoppel under the patent statutes. Likewise, the submission of an idea does not obligate the inventor to a prescribed course of action and he is entirely free to dispose of his ideas elsewhere.

The Council is not directly concerned with compensation or rewards to inventors, nor in the development of a promising idea into a useful device. Those agencies which might use a promising suggestion, such as the Army, Navy, Air Force, etc., are authorized to make arrangements with the inventor for the use of his invention. This direct method has, by much experience, been found to be mutually satisfactory. The Council works closely with all agencies and finds them able and willing to give full credit to all who present original useful suggestions.

Inventors are warned that they must assume all expenses incurred in preparing and presenting their ideas for consideration unless some Government agency specifically indicates in writing that expenses will be paid.

INVENTIONS WANTED

449 *NEW TYPE OF COMMUNICATION.* Scope: The development of a revolutionary new method of transmitting intelligence. Military Application: To augment or replace present systems. Status: Present systems in general depend on electrical impulses, electromagnetic waves, sound waves, etc. A system utilizing completely new concepts is desired.

450 *DESTRUCTIVE RAY.* Scope: To develop equipment of usable size capable of producing destructive or death rays effective at 500 yards without excessive power input. Military Application: To augment conventional weapons. Status: Investigations to date indicate that tremendous amounts of power would be required using present techniques and that a completely new approach is indicated.

451 *LIGHTWEIGHT EQUIPMENT FOR TRANSLATING SPEECH INTO WRITING.* Scope: To develop equipment of size suitable for general use, capable of translating ordinary speech into the written word. Military Application: General use in speeding up communications and in intercept of radio and wire communications. Status: All approaches to date have indicated that apparatus required using existing techniques would be extremely complicated and in the aggregate, extremely bulky.

452 *RADIATION INDICATING AND MEASURING EQUIPMENT.* Scope: To develop a convenient pocket size instrument that will give continuous indication of radiation intensity and cumulative dosage using techniques not presently employed in commercial instruments. Military Application: General use by individuals potentially subject to radiation exposure. Status: See current literature on commercial type instruments.

Midget Set Uses Subminiatures

A Tom Thumb set that has excellent reception over the entire broadcast band

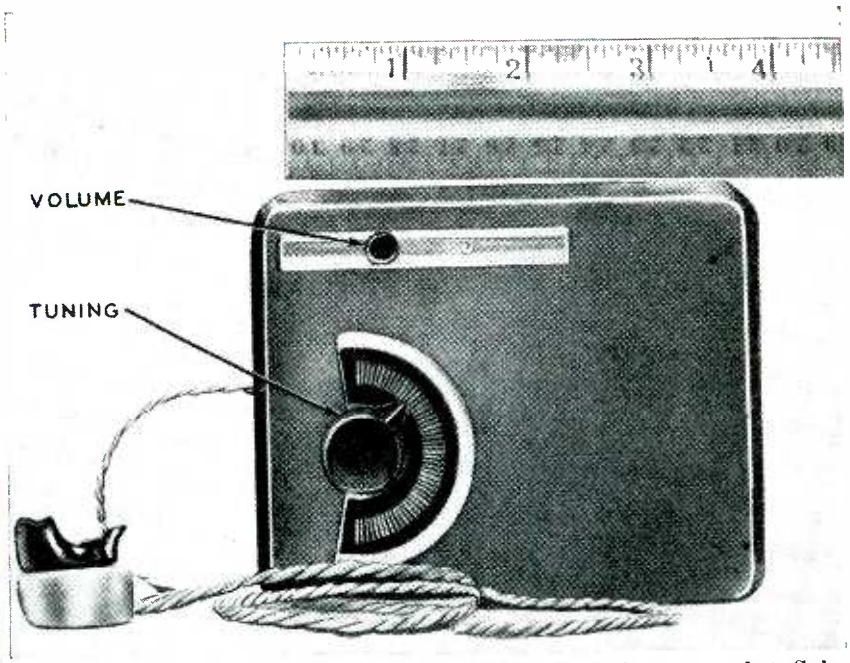
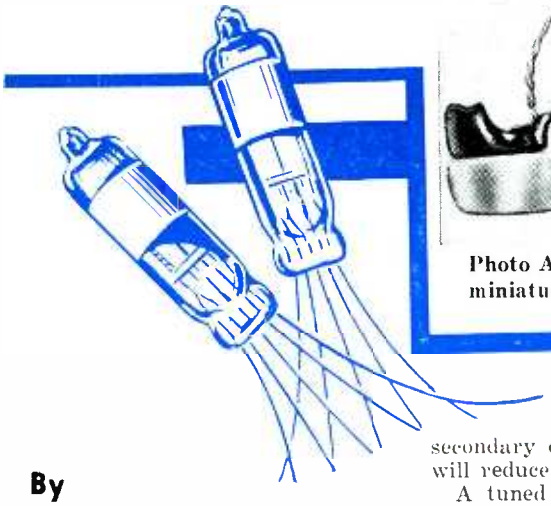


Photo A—This is a pocket size set that will really fit in your pocket. Subminiature tubes and a hearing aid earphone are used to keep the set small.



By
WILLIAM A. KUMM

NOW that subminiature radio components are generally available, it is possible and fairly easy to build pocket radios. The object of a personal portable is to have as small a set as possible that will still give us good reception. This can be achieved up to a point with the standard 4-tube miniature sets, so the question then arises: why not use subminiature?

This little receiver, shown in Fig. 1 and the photos, has a converter-oscillator, an i.f. stage, a crystal diode detector, and three audio stages which operate a hearing-aid earphone. It is 4 inches long, 3⅜ high, and 1½ inch thick.

Because each tube in this set has less gain than the tubes of a larger set, an extra stage is necessary. The best place for this extra stage seems to be in the audio-frequency amplifier, from both the point of view of battery drain and that of physical size. An experimental set was built with two i.f. stages, but because the components are so close together, it was practically impossible to keep the set from oscillating. Even the present set has a slight tendency to oscillate in the i.f. stage. A resistor of approximately 500,000 ohms across the secondary of the first i.f. transformer will reduce this tendency.

A tuned r.f. stage was also considered, but this requires an extra gang on the tuning capacitor, so the idea was rejected. One commercial subminiature receiver, the Belmont Manhattan, has a tuned r.f. stage for added gain, but it is tuned by a slug in each of the three coils and it uses an untuned antenna which, incidentally, is the cord to the crystal earphone.

The added audio stage requires only three more resistors and three more capacitors, and as the filament voltage of the CK505's is only 0.6 volt, the two tubes are put in series for the filament voltage of 1.35 volts. This saves a good 50 milliamperes drain on the A-battery, because ordinarily an extra tube would require an extra 50 ma for its filament. The audio stages use a standard hearing-aid circuit with the usual values of resistors and capacitors. It is feasible to use a 2-stage amplifier, in which case the diode-pentode in the subminiature series, the 2E41, would be used, but of course some gain is sacrificed by doing this. A CK503 is used for the output tube because it gives slightly more undistorted output than the 2E36 output tube normally used in the subminiature receivers.

The variable capacitor is one of the smaller ones that are used in the personal portables, with a capacitance of the antenna gang of 260 μμf approximately, and of the oscillator gang about 170 μμf. The appropriate oscillator coil was purchased along with the variable capacitor and it has a slug adjustment for tracking the low end of the broadcast band.

The i.f. stage uses two miniature transformers and is a conventional circuit. These are mounted behind the tubes in Photo B. A 1N34 crystal diode is the detector and the supply for a.v.c. voltage which is used to bias the converter and the i.f. stage.

A magnetic type of hearing-aid earphone is used so it requires an output transformer (mounted between the i.f. cans and the variable capacitor) to match its impedance of 11 ohms to that of the plate circuit which is on the order of 20,000 ohms. A crystal earphone might be used instead and this would do away with the output transformer because the crystal earphone is resistance-coupled. However an advantage to the magnetic earphone is that it is not effected by heat or humidity in the manner that a crystal phone would be.

The earphone, output transformer, and the volume control for this set were all obtained from a hearing-aid center. The earphone sells officially for $25, but some of the radio parts houses now have them at much more reasonable prices. This particular earphone was a gift from an obliging hearing-aid technician because it was burned out. A little work restored it to its original state. The output transformer was purchased

through a resistance of 1,000 ohms, there will be a 1-volt drop across the resistor. If 100 ma flows through 10 ohms, there will also be a 1-volt drop. The voltage across the resistor is tuned against the voltage of the potentiometer, with a similar null indicator.

Such a milliammeter can be made to replace the movement in your v.t.v.m., grid-dip oscillator, tube checker, or other instrument. The Wheatstone bridge can be made into an inductance or capacitance bridge by replacing the fixed arms with inductance or capacitance. (See "Simple Bridges for Inductance Checks" in the February, 1948, issue of this magazine for a number of circuits that can be used to measure inductance and capacitance.) The battery of course is removed and replaced by a source of audio frequency such as an oscillator or even the output of your communications receiver. The vibrator is removed and the phones connected center-to-center. As before, the bridge is adjusted for null or minimum signal.

We have combined voltmeter, ohmmeter, and milliammeter in a number of pieces of equipment, using the circuits of Figs. 1, 2, and 3 with suitable switching. Another useful gadget is a capacitor checker which consists of a capacitor decade and a relaxation oscillator made up of a neon tube, a resistor, and a 90-volt battery. The circuit is given in Fig. 4. Here we compare the pitch of the signal produced by the oscillator with the unknown capacitor in the circuit with that produced by one of the capacitors in the decade. This does not measure the capacitance exactly, but it does tell the operator whether the capacitor is between say 100 and 200 μμf. This is sufficiently accurate for many applications.

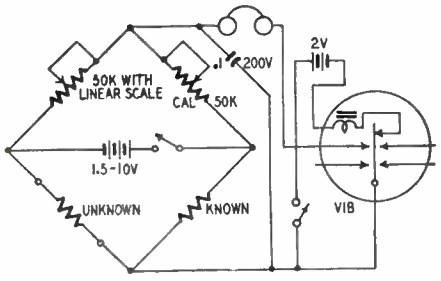


Fig. 1—A Wheatstone bridge circuit is used for this auditory ohmmeter. The circuit values may be altered for any convenient range of resistance values.

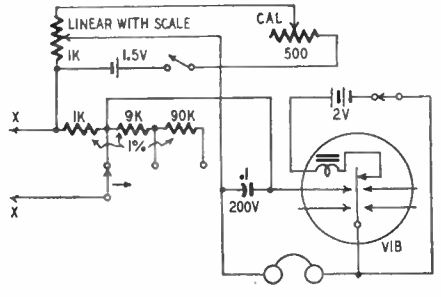


Fig. 2—A null-type voltmeter circuit. This measures d.c. voltage only, but can be used for a.c. with a rectifier.

A precision meter

A more precise capacitance meter is shown in Fig. 5. This is our most recent development and will measure down to 1 μμf or lower. It consists of two crystal oscillators feeding into a common mixer. These two oscillators are a kilocycle apart, so that the resulting beat note is 1 kc. A variable-frequency oscillator also feeds this mixer, and we have used the upper sideband as the indicating beat. The variable oscillator maybe be adjusted so that it will produce a beat note of 1 kc with the oscillator on its low-frequency side. This 1-kc note will zero-beat with the 1-kc note provided by the crystal oscillators. This is used as the reference or zero point for the measurement.

If a variable capacitor of the straight-line capacitance type is used and if say a 10-μμf capacitor is connected across the tank circuit of this oscillator, the capacitance of the main tuning capacitor must be decreased by 10 μμf to obtain the steady 1-kc note. Thus the decrease in tuning capacitance can be read in terms of the unknown capacitor. Any straight-line capacitance tuning capacitor may be used, and the coil L1 should be chosen so that zero-beat occurs when the capacitor is fully meshed.

This unit will also measure the drift and therefore will indicate the temperature coefficient of any particular type of capacitor. It is gratifying to note the great interest shown by sighted technicians when they learn that the blind can make such infinitely small measurements in capacitance.

Other circuits

A volume-level meter has been devised by one of the former students of the Institute, David Heavner, W2USQ. This device makes use of the principle that a neon tube is practically a short circuit when ionized and an open circuit when not ionized. An output transformer having two secondaries, one low-impedance for a headest and the other high-impedance, as for a crystal recording head, is used. When the neon tube is connected across this high-impedance secondary winding, the voltage across the winding ionizes the tube, producing practically a short circuit. This increases the load on the plate circuit. Therefore, the signal in the headset is distorted. The input to the device is arranged with a calibrated control, calibrated in terms of db or volume units, etc. Therefore, we have a peak-reading voltmeter which serves better than most VI meters. The circuit appears in Fig. 6.

The grid-dip oscillator (Fig. 7) consists of the standard oscillator commonly used for such a circuit. The indicator, however, is an auditory device. We have used a multivibrator working at audio frequencies and employing one of the dual triodes such as the 12AU7 or 6N7. The bias for the multivibrator is supplied by the grid circuit of the r.f. oscillator, so that loading the grid-dip meter causes the bias on both oscillators to decrease and changes the

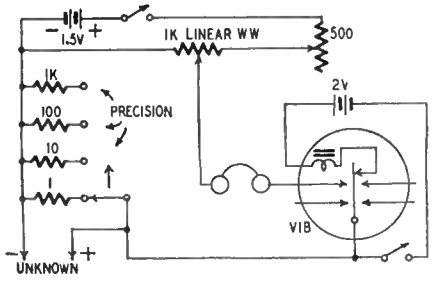
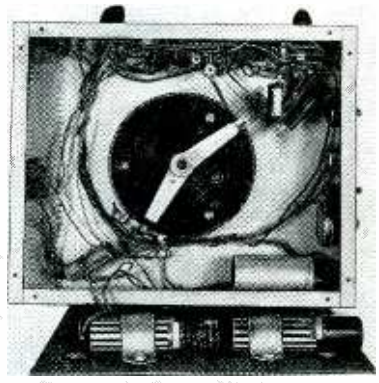


Fig. 3—An auditory milliammeter. This type of circuit can replace the movement of most common test instruments.



Interior of the volt-ohm-milliammeter. The large potentiometer is a piece of war surplus—a smaller one will work!

audio-frequency pitch in the headset or speaker. The unit is very satisfactory from 2 to 300 mc.

We also have a field-strength meter (Fig. 8) which consists of a 1N34 crystal diode, a tuned circuit, and an auditory indicator. This indicator uses a

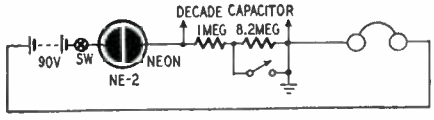
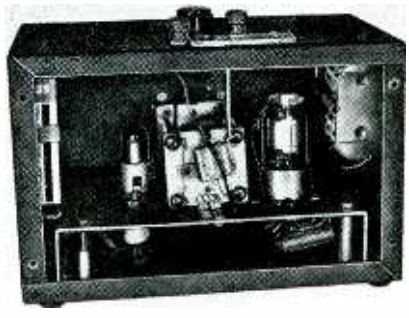


Fig. 4—A simple capacitance checker. Accuracy of this circuit is poor, but it is adequate for most service needs.



Rear view of capacitance meter of Fig. 5.

screen-grid tube with its screen and control grids connected together so that the tube becomes a high-mu triode. This grid and screen connection is returned to the cathode so the bias on the tube is zero and the resistance of the plate circuit of the tube (from plate to cathode)

is extremely high. This resistance is used as the resistance element of a relaxation oscillator, with a neon lamp and a headset in the plate circuit along with a 90-volt battery, and a capacitor connected from plate to cathode. When r.f. energy is rectified, the grid is driven positive and the plate resistance is decreased, with a consequent increase in oscillation frequency. This gives an auditory indication of the power output of the transmitter and also provides a

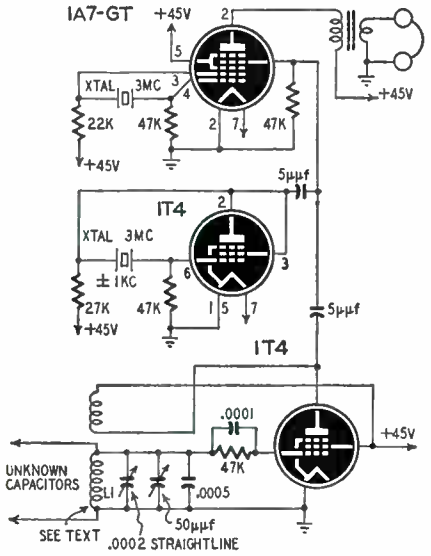


Fig. 5—A precision capacitance meter that measures down to 1 μμf or better.

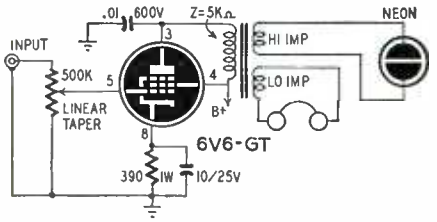


Fig. 6—An auditory volume level meter. This novel circuit produces distortion in headphones when signal is too high.

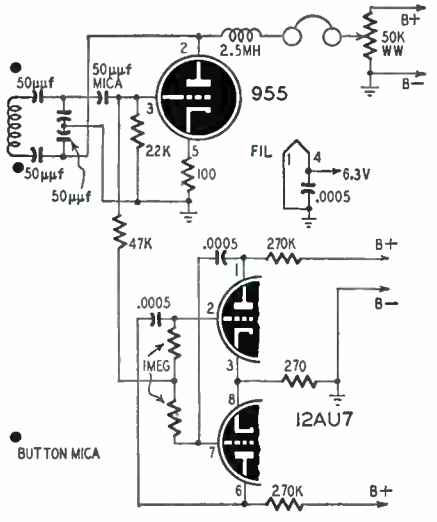
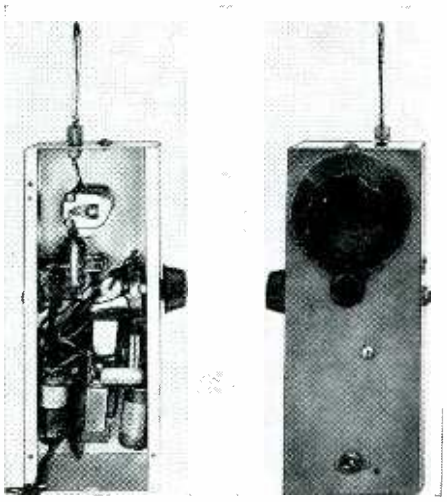


Fig. 7—Grid dip oscillator circuit is conventional, but the frequency of the multivibrator serves as dip indicator.



Grid-dip meter, front and rear views.

means of making excitation, loading, and other adjustments. It also will indicate whether the transmitter is being modulated upward or downward.

It is gratifying to note the ever-increasing interest being shown by the blind electronics technician. Many of them are being employed in the industry or operate service businesses of their own. *The Braille Technical Press*, published monthly, carries the only radio and electronics information printed in Braille. Included are articles taken from leading radio and electronics magazines. This magazine is supported by contributions from persons and corporations who are interested in the problems of the blind radio technician. It contains departments for the various interests—the amateur, the radio service man, the sound-recording technician, the beginner, etc.

The response of many sighted persons to this measuring equipment is highly interesting. Apparatus that will signal the operator when he is approaching the desired measurement or frequency is attractive to the amateur and the test-bench man especially. He need not look

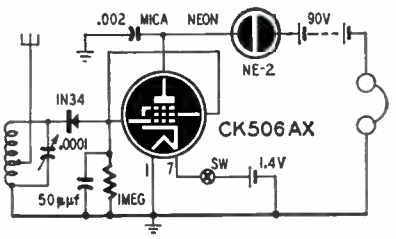
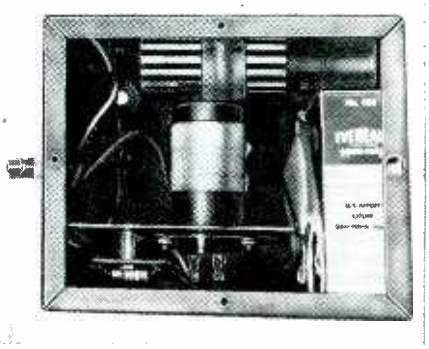


Fig. 8—This field strength meter circuit is a neon lamp oscillator. Frequency depends on r.f. signal strength.



The field-strength indicator with its batteries in place. A short antenna is plugged into the jack seen at the left.

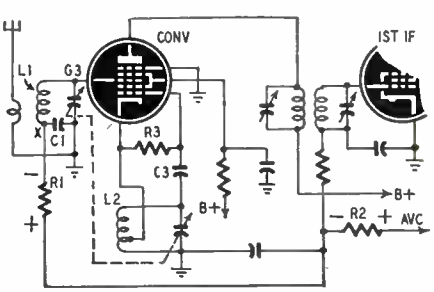
at a meter, but can simply listen for a null point or a rising note. The precision of the capacitance meter also has appealed to the sighted radiomen, and a number of them have constructed such instruments of this type as part of their standard equipment and find them much to their liking.

Every radio man knows that the most accurate instruments generally are those which use null type measurements (such as the Wheatstone bridge) or zero-beat measurments. Since these two types are most convenient for the blind, we are naturally most interested in developing equipment along these lines. The result is that we are developing a full line of radio test gear that we can use with full assurance of reliability and accuracy.

UNUSUAL TROUBLE

Sensitivity can be poor in sets having tapped oscillator coils, like that shown in the diagram, even when all voltages are correct and alignment is perfect. Connect a v.t.v.m. between B-minus and point X, the ground side of the mixer or antenna coil. A small negative voltage may be indicated. If this voltage is reduced greatly when the oscillator section of the tuning gang is shorted, the oscillator is *too strong*.

The full oscillator voltage appears across L2. The signal grid G3 is grounded for r.f. through L1 and C1. Therefore a part of the oscillator voltage is between G3 and the cathode. When positive peaks of the oscillator voltage are greater than the delayed a.v.c., if any, G3 acts as a diode plate. The rectified oscillator current flows to ground through R1, R2, and the remainder of the a.v.c. network to produce a negative voltage in series with the a.v.c. voltage. The sum of these voltages is sufficient to seriously reduce the gain of the stages connected to the a.v.c. line. (Tune to a no-signal spot.)



The remedy is to reduce the value of the oscillator grid leak R3 until the trouble is cleared up. Sometimes a new converter tube will do the trick.—*Roy K. Brandt*

Radio Set and Service Review

Rod antenna of RCA R-411 portable Is new departure in radio technique

Front view of RCA's new personal set.

NEWEST of RCA's battery-operated personal broadcast receivers, the B-411 weighs less than 3 pounds complete with batteries. It is only 5½ inches high, 7⅝ inches wide, and 2⅛ inches deep, fitting conveniently into a man's overcoat pocket, a woman's handbag, or the glove compartment of the family automobile. Tuning dial and volume control project slightly above the top of the case so the set can be tuned and its volume adjusted with the right thumb while holding the set by its handle.

Tested in downtown New York, it compared favorably with many much larger portables. Sensitivity was good and seemed uniform from one end of the band to the other. Selectivity on the high-frequency end was surprisingly good for a set of this type. A number of local stations between 1400 and 1600 kc popped in without a sign of oscillation, squeals, heterodynes, or cross-talk common to the high end of the band on many sets.

Unlike most other portables, this set does not use a loop. Its antenna is a ferrite rod ¼ inch in diameter and 7 inches long with one end inserted in the antenna coil. Hand-capacity effects were not noticeable. The directional characteristics of the antenna do not seem to be as sharp as a loop antenna but there is a very pronounced null when the end of the antenna rod is pointed in the direction of the transmitter.

The circuit

The model B-411 is a 4-tube superheterodyne powered by one 67.5-volt B-battery and a single 1.5-volt standard flashlight cell. It uses a 1R5 converter, 1V4 i.f. amplifier, 1U5 first audio, second detector, and a.v.c. rectifier; and a 3V4 power amplifier working into a 2 x 3-inch PM loudspeaker.

As will be seen from the diagram, the low side of the volume control is connected to ground through a 1,000-ohm resistor. This makes it impossible to turn the audio all the way down on a powerful local station. It is not clear why this resistor is used; however, its use may prevent the set's being accidentally left turned on when not in use. When tuned to a strong local, enough signal rides through at minimum volume to let you know the set is operating.

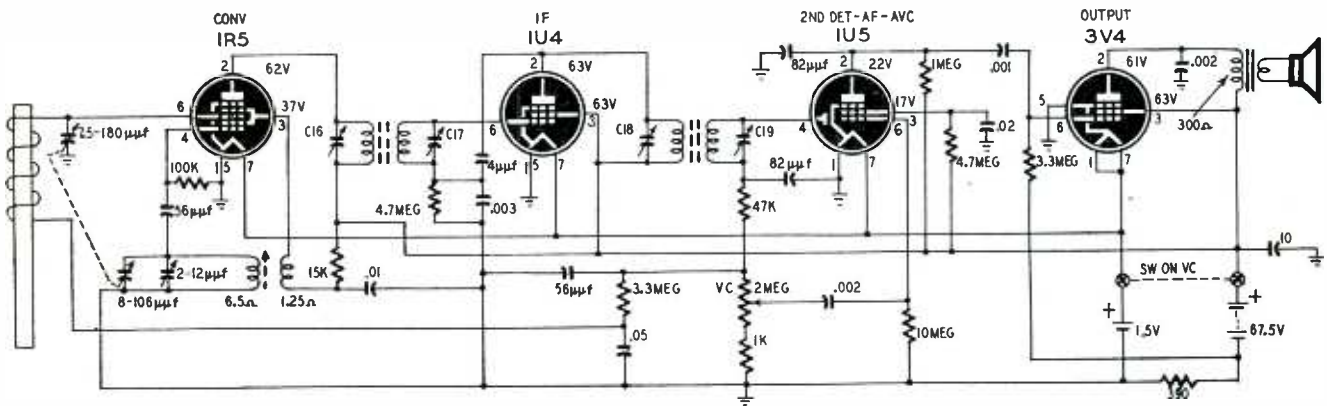
Grid-leak bias is used on the i.f. amplifier and contact bias on the first audio. The converter has some grid-leak bias plus the a.v.c. voltage which is applied when a station is tuned in. Approximately 3 volts of fixed bias is applied to the 3V4 output tube. Its 3.3-megohm grid resistor is returned to the negative side of the B-battery which is 390 ohms below ground. The combined cathode currents (approximately 8.45 ma) flow through the 390-ohm resistor to develop the bias.

Alignment procedure

Alignment procedures are simple. An output meter is connected between the 3V4 plate and ground and the volume control turned to maximum. To align the i.f.'s, connect the high side of a signal generator to the antenna section of the tuning gang through a .01-μf capacitor and the low side to the chassis. Set the generator to 455 kc and the receiver to a quiet spot near 1600. Adjust C18, C19, C16, and C17—in that order—for maximum output.

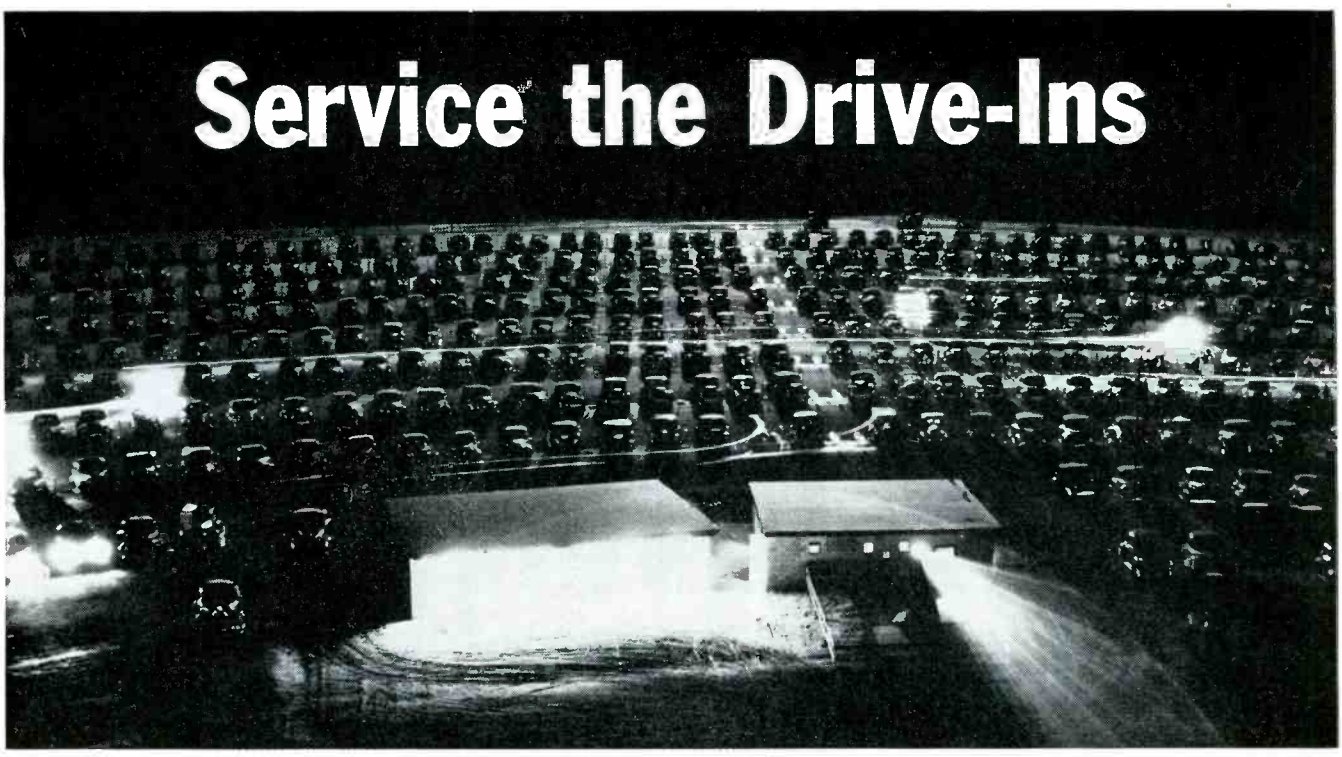
Set the receiver and signal generator to 1400 kc. Use a small loop to couple the generator to the antenna coil. Use coupling loose enough so the loop will not disturb the inductance of the coil. Rock the tuning gang while adjusting the oscillator trimmer for maximum output. Tune the set and generator to 600 kc. Rock the gang and adjust the oscillator slug for peak output. Repeat the procedure as a double check. Always keep the signal generator output low to avoid a.v.c. action in the receiver.

Inside view. The antenna rod is at top.



The ferrite antenna rod is one of the unusual features of RCA's B-411 battery-operated personal portable broadcast set.

Service the Drive-Ins



Time exposure of a drive-in theater in operation. These increasingly popular outdoor movies offer many opportunities for the alert radio service technician.

New opportunity for profit from drive-in movies

By AARON NADELL

BEGINNING November, 1933, and continuing into the spring of 1934, the author wrote in this magazine, then known as RADIO-CRAFT, a series of articles entitled "Servicing the Talkies," which set forth the opportunities then open to radiomen in placing their skilled knowledge of electronics at the service of their local motion picture theater.

Time and change eliminate some opportunities, but usually bring others instead.

The opportunity for the radioman to offer his services to the local motion picture theater is very greatly reduced today, compared with the conditions of 1933-1934. That business has been stabilized. Nationwide professional organizations now service the motion picture theater at low rates, and under a variety of contract arrangements among which the theater owner can pick and choose to suit himself.

By compensation, however, the drive-in theater has sprung up everywhere since the war like a rash of gold mines pock-marking the whole country. Drive-ins are highly profitable. In some cases they pay back their entire investment in a couple of years. No conventional indoor theater can do anything like that. Drive-ins being profitable, their owners have money to spend, and they offer the radioman more opportunities than can be listed here.

The drive-in theater is a number of other things beyond just a theater. For example, and obviously, it is a parking lot, in need of traffic-control facilities. Next, it is a carnival, since practically all drive-ins today have—or are putting in—playgrounds for children, with opportunity for selling small public address systems for use with the playground features. Many of these playgrounds are rather elaborate and include pony rides, miniature train rides, and even boat rides. Some drive-ins are now adding swimming pools.

Again, the drive-in is a kind of restaurant. All theaters sell popcorn, candy, and the like, but most drive-ins also sell frankfurters, hamburgers, tamales, and other cooked foods—and candies, soft drinks and popcorn as well. Refreshment sales in drive-ins average three to one higher per patron than in indoor theaters. Where the radioman fits into that picture is that drive-in managers, anxious to promote their very profitable refreshment business, plug it extensively via microphone and special recordings.

The above refers to the drive-in of today. Today it is a theater, plus parking lot, plus carnival, plus restaurant. What it will be tomorrow nobody knows. These enterprises are not only growing furiously in number, they are also branching out into all sorts of auxiliary activities. Swimming pools have been mentioned. Some drive-ins also are putting in cocktail lounges. Many such theaters, particularly in the East, are now open to the public free during the afternoon as playgrounds and community centers, and numbers of them are offered to local churches for Sunday morning outdoor religious services.

Whoever concerns himself with drive-ins while they are still so new is walking over a newly found gold field where no one can say what nuggets may still be picked up. All anyone can say is that the field has not yet been picked over—it has scarcely been scratched.

Traffic must be directed. Cars wait in what is called the hold-out area until there is room for them in the theater proper. Ushers give instructions—direct the cars to the ramp and places where there is room for them. Traffic must be carefully directed also on leaving the theater, since local authorities do not want 500 or so unregulated automobiles suddenly dumped on a high-speed highway, and the theater owner cannot permit a situation in which the local authorities might take action against him as a public nuisance. A considerable staff of ushers is therefore necessary. If a small knapsack PA can enable one usher to direct more cars, the advantage and economy are obvious. The PA need not have tubes; there is now a carbon-microphone amplifier on the market in the form of a portable, battery-operated PA unit. The output is only 1.5 watts; but even that could help the usher make himself heard over the noise of racing motors. And any radioman, if he had reason to, could build a tube-operated, battery-powered, portable or knapsack PA system.

Such equipment would be useful also for general policing. Don't let anyone tell you that a drive-in is a glorified

lovers' lane, because that is the very last thing its owner can afford. Any complaints of that nature will get him into serious trouble with the local church and civic groups. The owner has a substantial investment; he is vulnerable. It is an axiom of the drive-in business that misconduct cannot be tolerated, and the grounds are continuously policed accordingly. The same ushers who do the policing also direct traffic at the end of the show, and the same portable PA equipment would be of use to them in both jobs.

Small PA units, not necessarily portable, can be useful at the playground, particularly where the drive-in collects extra dimes for rides on miniature trains or ponies. These enterprises commonly operate before the show starts and close down when the picture goes on the screen. A microphone obviously would be useful to the barker who sells such rides and help him sell more rides.

Recordings are often used for selling refreshments. A tempting sales talk is put on the in-car speakers to get more people to buy more popcorn, hamburgers, and soft drinks. Such records, supplied by a national source, cannot be expected to fit exactly any individual theater or its particular needs at any given moment. The local radioman, if he has a recorder, can make records exactly suited to the occasion, spiced with local remarks and references, and stressing just that particular article—frankfurters, tamales, or what not—which the owner wants to push at that time. The recordings in a more general vein, made on a national basis, cannot do this; therefore it is generally agreed among drive-in operators that the manager's use of a microphone is more effective in producing sales than use of a record. But if the manager records his own patter via the local radioman's equipment he is no longer tied to the microphone, but is free to attend to other matters.

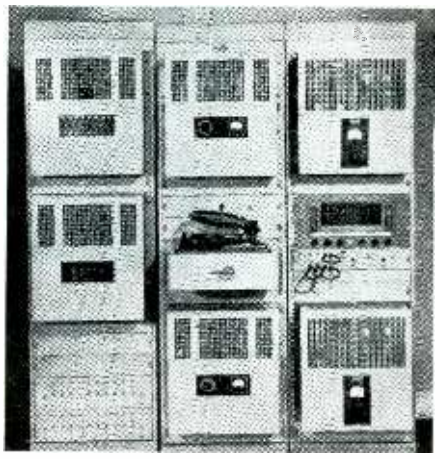
Recordings or microphone talks are also used for general audience control, such as to remind patrons to put the speakers back on the hooks before driving off, to wait for instructions from an usher before leaving the theater, and so on. Records in general terms are available for this, also, but they cannot carry the local touch that is so much more effective. The local radioman can provide such recordings.

The in-car speakers take a bad beating and often need repairs. They are dropped. Sonny-boys poke pins into them (though some of the more modern types are built to make it impossible for the pin to reach the cone). They are exposed to weather. Many manufacturers are now using weatherproof cones. The repair problem, however, in spite of all precautions and improvements, is still so serious that one company offers repair "insurance" at a flat rate of about $30 a week, the exact rate depending on the size of the theater. Many operators consider this high, and they also dislike the fact that they must buy extra speakers for use while the ones undergoing repair are en route to and from the factory. In some theaters the projectionists do the repairs (which amount principally to putting in new cones) at a fee added to their regular salary. Where this last condition obtains, the radioman will be well advised not to try to underbid the projectionist, whose good-will is invaluable; but it may be possible to work with him, doing the work for him on shares.

Theft of the speakers is one of the important problems in the drive-in. This is so serious that a number of manufacturers now offer speakers with an "uncuttable" steel wire in the connecting cable—but the steel wire is very far from uncuttable. Larcenous patrons bring factory wire-cutters with 3-foot handles and tremendous leverage, or hedge-cutters, or hack-saws. And although most speaker connection boxes are wired nowadays for post-lights as well as for sound, no manufacturer at present offers a post-box fitted with a relay that will flash a light—or flip off the post-light—if the speaker cable is cut. The radioman could install such a relay at a dollar or so per speaker—in a 500-car drive-in that would be about a $500 job—and since a stolen speaker may cost up to $12 or more to replace, a drive-in owner in an irascible mood because of thefts might be quite receptive to such a proposition.

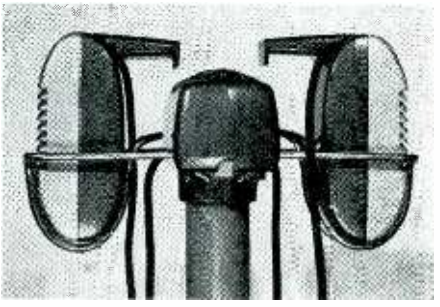
Except in the far South and California, most drive-ins close down for the winter and open in the spring, involving a great deal of work in disconnecting and storing in-car speakers, and protecting sound and projection equipment with grease, tarpaulins, or other means, and then in the spring replacing the speakers and reconditioning the apparatus in general.

The above suggestions by no means exhaust the possibilities. A radioman who has also done refrigeration work, as so many have, can find an important opportunity with the beverage machines and ice cream counters and machines, all of which are refrigerated. Such equipment usually is contract-serviced, but the service technician isn't always around, and loss of a night's sales, or several nights' sales, before he arrives, can be a serious loss.



The audio amplifier rack for a drive-in. Its 500-watt class-A audio output is enough to feed 1,000 in-car speakers at a standard ½-watt per loudspeaker.

The drive-ins are certain to evolve further activities. Whatever they may be, the drive-in will always deal with crowds, and therefore will always need public address facilities for addressing, selling, and controlling crowds. The alert service technician will find in these many opportunities for profit.



Typical in-car speakers for a drive-in, one for a car on each side of the post. These speakers take severe punishment and frequently need repairs.

The driver demonstrates how drive-in patrons take speaker from its post.

Fundamentals of Radio Servicing

Part XXV–Instruments and Tools

By JOHN T. FRYE

"TOOLS to him that can handle them," said Napoleon; and nowhere else are tools and knowledge more mutually dependent upon each other than in radio servicing. The skilled technician, without instruments with which to trace the invisible electricity through an ailing circuit, is helpless; and an unskilled person, although surrounded by every imaginable servicing aid, is equally at a loss.

Each tool mentioned in the paragraphs that follow will pay for itself many times over in a small owner-operated service shop, doing enough business to make time saved an important element of income.

Radio servicing equipment falls naturally into two broad classifications: trouble-locating tools and trouble-repairing tools. Let us first consider those that are used to ferret out the causes of receiver failure. These trouble-detecting devices are essentially "electronic" in the broad sense of that word; that is, they are actuated by or produce electrical voltages and currents that are, in turn, manifestations of electron behavior.

A versatile instrument

The old standby of the technician is the volt-ohm-milliammeter abbreviated v.o.m. This instrument has a variety of forms, but it is essentially a low-current meter that can be switched into suitable circuits for measuring alternating or direct voltages, direct current, or resistance. Various ranges are ordinarily provided for measuring each of these components. For example, the favorite v.o.m. used by the writer has the following ranges for indicating d.c. milliamperes, d.c. volts, or a.c. volts: 0 to 5, 25, 125, 250, 500, 1,250. The ohms scales run: 0 to 2,000, 20,000, 200,000, 2,000,000 and 20,000,000.

A v.t.v.m. (or v.o.m.), signal generator, soldering iron, and an assortment of hand tools forms the basic equipment needed to begin a radio repair business.

A choice of several ranges is an aid to accurate measurement. Service instruments are usually rated at an accuracy of *2% of the full-scale reading*. That means the permissible error on the 1,250-volt scale is 25 volts; but on the 125-volt scale it is only 2.5 volts. To insure good accuracy, the value being read should be at least 50% of the full-scale reading of the meter. This can be arranged with a wide variety of values to be measured, by having several meter ranges available.

Figs. 1-a, 1-b, 1-c and 1-d are diagrams of the basic circuits of a d.c. milliammeter, a d.c. voltmeter, an a.c. voltmeter, and a d.c. ohmmeter, respectively. The meter itself (M in all of the diagrams) is a d.c. meter with a sensitivity such that 1 ma or less of current will make it read full scale.

In Fig. 1-a, all the current passing through the probes must also pass through the meter, and the maximum current that can be measured is simply that of the meter rating. It is possible, as indicated, however, to switch *shunt* resistors across the meter so that the probe current can divide, part going through the shunt resistor and part through the meter. By proportioning the resistance of the shunt to that of the meter, we can allow any desired fraction of the total current to flow through the meter.

For example, if our meter has a resistance of 45 ohms and the shunt has a resistance of 5 ohms, 9/10 of the probe current will go through the shunt and 1/10 will go through the milliammeter. That means that every reading on our shunted meter scale now indicates exactly 10 times that amount of current is flowing in the probes, and we can arrange a new scale to show this amount with shunts of decreasing resistance, the meter can indicate increasing ranges of current.

In the voltmeter circuit of 1-b, suppose R1 has a resistance of 5,000 ohms. Neglecting the small resistance of the meter, that means that 5 volts across the probes will send exactly 1 ma of current through the meter, 2.5 volts will send 0.5 ma, etc. The current through the meter varies directly with the voltage across the probes. If we increase the value of the series resistance to 50,000 ohms, 50 volts will be needed to make 1 ma of current go through the meter, as you can see for yourself by applying Ohm's law. All we need do is make a new scale in which meter current is translated into volts-across-the-probes, and we have a voltmeter. Increasing the range of the voltmeter is simply a matter of increasing the value of the series resistance.

Measuring a.c. voltages looks as though it might present a problem (since our meter will react only to direct current) but it really isn't. We simply put a rectifier ahead of the meter; it jerks the zig-zag kinks out of the a.c. and makes it over into d.c. that our meter can handle. By employing proper values of resistance in the circuit of Fig. 1-c, our current-reading meter can be made to indicate the r.m.s. value of an a.c. voltage applied across the test prods.

Fig. 1-d is the diagram of a simplified ohmmeter. It consists of a battery, a fixed resistance, our meter, and a pair of test prods all connected in series. Suppose our battery is 4.5 volts and the resistor is 4,500 ohms. When our prods are shorted together the battery sends 1 ma of current through the meter, making the pointer swing over to the full-scale mark, which we label "0 ohms." Now, if we place a resistor between the probes, the current will be reduced and our pointer will not swing over so far. The scale of our meter can be marked so that the pointer will indicate the exact value of the resistance between the probes, for there is a fixed relationship between the value of this resistance and the amount of current flowing through the meter. While ohmmeters actually used in v.o.m. circuits are not this simple, they follow the same general principle.

A service shop without a v.o.m. is as

unfurnished as a boudoir without a mirror, but it must be admitted that this instrument, used as a voltmeter, has one serious objection: it draws appreciable power from the circuit being tested. Consider, for example, the typical screen-supply circuit of Fig. 2. The screen draws 1.5 ma of current and is fed through a series dropping resistor of 100,000 ohms from a 250-volt source. If we try to measure the screen voltage with our voltmeter, the current used by the meter will have to be added to that already flowing through the dropping resistor. Even if this current is only 0.5 ma, its value added to the 1.5 ma drawn by the screen will reduce the normal screen voltage of 100 to an *indicated* voltage of 50.

Other trouble finders

The vacuum tube voltmeter, abbreviated v.t.v.m., is designed to correct this. Basically, it employs the amplifying properties of a vacuum tube so that the voltage being measured is applied to the grid of a tube with the current-reading meter being in the plate circuit. Since no current flows in the grid circuit, no appreciable power is absorbed from the circuit being tested, and a much more accurate indication of voltage is had. In addition, the v.t.v.m. can easily measure resistance values up to one billion ohms, and it is practically impossible to injure the meter by employing too low a range for measuring a voltage—an easily made mistake that has sent many a v.o.m. to its last windup!

The v.t.v.m. is growing increasingly popular with service technicians, and if it were not for its two main disadvantages—most v.t.v.m.'s will not measure current, and all of them must have their vacuum tubes supplied with power either from the power line or from batteries—the writer would suggest it be purchased instead of a v.o.m. As it is, the purchase of such an instrument out of the shop's first profits is a sound investment.

The signal generator is another most important service instrument. Essentially it is a tiny portable transmitter that will produce an r.f. signal on any desired frequency from about 100 kc to at least 30,000 kc. This signal can be used in its pure r.f. form or with a 400-cycle tone modulation, and its strength can be varied from virtually zero to a value considerably stronger than would be put into a receiver by even a powerful local transmitter. This signal generator can produce the proper signal for exciting any stage of a receiver. It is absolutely necessary for the proper alignment of the i.f. stages of a superheterodyne receiver, and never let anyone tell you different! A good signal generator is one whose dial readings of frequency are accurate and stable, whose output can be precisely and smoothly controlled, and whose construction is such that it will retain these virtues year after year.

Some radiomen insist that a tube tester is not really a service instrument—it is just to sell tubes! What they mean is that a good technician can quickly spot an under-par tube by its effect on the receiver itself. While that is partly true, a tube checker often permits the discovery of a bad tube without removing the chassis from the cabinet; furthermore, the public has a beautiful and childlike faith in the infallibility of tube testers and are likely to be suspicious of a service technician without one; so you must have it.

These instruments vary widely in price and in simplicity of operation. None, unfortunately, will do a 100% job of revealing tube shortcomings; but even a low-priced tester will reveal 95% of the bad tubes. It is regrettable that, thanks to the steady stream of tubes hatched up by the tube engineers, a tube checker becomes out of date faster than a risque story at a salesmen's convention. That is one reason why many technicians are slow to buy the more expensive types of testers, preferring to use tube substitution to reveal the few defective tubes that a low-priced tester will not catch.

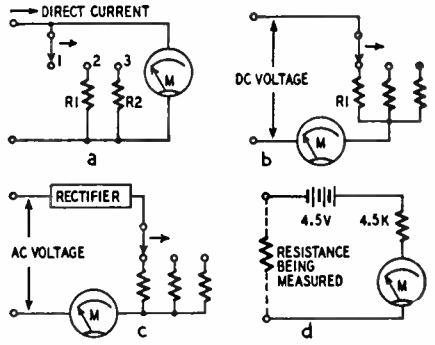


Fig. 1—The four basic v.o.m. circuits.

The most recent electronic bloodhound in the trouble-locating kennel is the signal tracer. This instrument in its most popular form consists of a high-gain audio amplifier preceded by a probe that contains a detecting or rectifying device at its business end. This detector may be either a vacuum tube or a germanium crystal, but its purpose is to strip away the modulation from any r.f. signal it encounters. The modulation can then be handled by the amplifier and heard in the tracer speaker. With such an instrument a strong modulated signal actually can be followed stage by stage through the receiver right from the antenna to the speaker. The exact stage where trouble starts is thus revealed, and then the v.o.m. or v.t.v.m. can take it from there.

The writer strongly feels that the less experience you have the greater is your need for a signal tracer. It will do for the inexperienced trouble-shooter what a good rabbit dog will do for a poor hunter—flush the game right out into plain sight! By all means have a signal tracer on your bench when you open the doors of your shop.

Other tools you need

A great deal more on the use of these various trouble-shooting tools will be said in the next chapter, but now let us turn to the tools that repair the trouble once it has been located. While these mechanical tools are more likely to be familiar to the average person, a few facts about their peculiar use in radio are worth mentioning.

The radio technician can never have too many screwdrivers. He needs them in all sizes from the tiny, long-bladed job used to loosen deep-set knob setscrews to the stubby, broad-bitted driver for tightening large chassis bolts. A good mechanic always selects the proper-sized screwdriver for use on a particular screw-head, and he *must* have the proper driver for use on Phillips screws that are being used more and more in radios. In addition, he should have a driver with a screw-holding feature for placing screws and bolts in the cramped quarters so often found in radio work; and he must have two or three of the special-insulation aligning screwdrivers for adjusting i.f. and r.f. trimmers.

A good set of hex-nut drivers is another required tool for the radio technician. The walls of the sockets should be thin so that the wrench may be slipped over a nut in a tight spot, and the stems should be hollow so that the wrenches can be used to tighten speaker-holding nuts on the extra-long bolts that are often used. A set of small end wrenches are also fine for adjusting speaker cone spiders and for working in places that will not allow even a hex-nut driver to be used. Finally, a small adjustable wrench should be available for handling the nonstandard nuts that are encountered all too often in radio work. A 1-inch vice-grip wrench is excellent for this purpose, for it can also serve as a small vise to hold parts together while they are being soldered.

Every service bench should have a pair of lineman's pliers, a pair of needle-nose pliers, a pair of flat-nose pliers, a pair of ignition pliers, and a pair of eyebrow tweezers. Time and again jobs will be found in service work that only one of these tools can do.

What the electric clippers are to the barber the electric soldering iron is to the service technician, and he should have good ones. The majority of service technicians today use a solder gun for most of their work because of such features as being always ready, quick cooling, safety, and economy of operation. At the same time, every service shop needs a heavy-duty conventional iron, say of 200 watts, for soldering to the chassis and for doing other jobs requiring lots of heat.

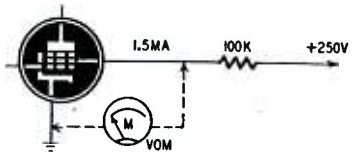


Fig. 2—The v.o.m. type voltmeter cannot be used in high resistance circuits.

In addition there are many miscellaneous tools used in service work: speaker shims for centering speaker voice coils about pole pieces; wire-strippers for doing a quick, neat job of re-

FIVE SERVICE AIDS

Eyes, ears, fingers, nose and brain are five excellent test instruments

By JESSE DILSON*

THE next time you reach for a whodunit to see how your favorite private eye catches the killer, just think of the radio repair business. Why? Your detective prods, probes, and theorizes to catch the menace to society; the radioman does the same thing—without headlines and hungry blondes—but he does it. His job is even tougher—he can't give a bum capacitor or tube the third degree and make it talk!

Service technicians and detectives alike have equipment that can't be supplied by instrument manufacturers. Noses, for instance. Most beginners are stumped right at the start in coping with a radio set: "What do I do first?" One good answer is to notice if the darned thing smells. If it does, and smells bad, something's been burned to a crisp. Sniff at the set's innards like a bloodhound, until your nose leads you to the guilty party. Then your brain comes into play. If it's a transformer, what could cause it to get all hot and bothered like that? Obviously, too much current. A short, maybe. Then out with the old ohmmeter and start to eliminate the innocent until you've sprung the trap on the guilty.

Finding a short can be troublesome—understatement if ever there was one. Suppose you trace a short to a point to which umpteen leads are connected. At that point, your ohmmeter tells you, there's a short to chassis (and you'd better use the lowest resistance scale on your meter to check that short, or you may find you've been sweating for nothing). Which is the lead that's sneaking off to ground? A detective knows how to deal with that one—a process of elimination. Disconnect each lead, put one probe of the ohmmeter on it and the other on ground—on the lowest resistance scale, remember, and carefully zeroed—and if the needle doesn't swing to zero, that lead is innocent of wrongdoing. When the miscreant is found, follow its path to the chassis, and don't give up until you have located the point of contact.

Suppose your nose takes you to a resistor. You take a look at it. It's been burned to a frazzle. Again, too much current. And why? You guessed it, from a short. Suppose it's a screen-dropping resistor. Every screen grid must have its bypass capacitor; and if that's shorted, the resistor is sure to fry. The capacitor may appear harmless. But many a wide-eyed innocent has knocked off his fellow man, so check it and make sure.

Speaking of smells, have you ever come across a set that exudes an aroma of rotten eggs? No matter how you describe it, it's a real bold *Phew!* Nothing like the crisp smell of a burned transformer, for example. It can be caused by a selenium rectifier developing a high-resistance "short" and overheating. I've seen service technicians try everything on this, including dousing it with Chanel No. 5.

Use your eyes, too!

The human eye may not be an electronic instrument, but it can do a good job on a radio. G.I. repairmen will remember that the first thing to do in maintenance "by the numbers" was "visual inspection." In English, that meant looking over the scene of the crime carefully, above and below the chassis, for things like broken connections, charred resistor and wax-dripping capacitors. It takes only a moment and may pay off. The best way to inspect a receiver is with the power off—don't just open the receiver switch, but pull the line plug out of the wall socket! That way you'll avoid unpleasant shocks. Even with the switch in off position, line voltage is still present somewhere in the set. If, to save time, you prefer to do your inspection with the set alive, a plastic highball stirrer makes a convenient tool for pushing aside wires while you're doing it. These stirrers (filched from a bar when the bartender is looking elsewhere) also make nice alignment tools if one end is filed to a chisel point.

Generally speaking, it's best to keep bare fingers out of a radio with the power on, but there are useful exceptions. To take one example, suppose you find a wisp of smoke trailing from a set chassis. One of the components in the neighborhood is getting a bit too hot for comfort, obviously. Your nose confirms this but won't point definitely to the sufferer. A fingertip laid on each component in turn (on its insulated portion, need we add?) will track it down. It may be difficult to tell if a set is really dead, especially if the room you're working in is noisy. The fingertips placed lightly on the speaker cone

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FUNDAMENTALS OF RADIO SERVICING (*Continued from page* 35)

moving insulation from wires; a metal saw for cutting volume-control shafts to proper length; a pair of good, sharp diagonal cutters that will bite a wire cleanly in two instead of just "gumming" it; an electric drill to drill out rivets and make holes in the chassis for mounting parts; a bottle of carbon tetrachloride for cleaning volume controls, switch contacts, etc.; a tube of Duco cement for repairing speaker cones and for fastening coil turns securely; and a bottle of acetone for softening this cement whenever necessary.

In addition, if you are going to do auto-radio servicing you will need a way of powering these sets on the bench: either a battery-and-charger combination or a battery substitute powered from the light line. And there are such things as capacitor checkers, audio-signal generators, cathode-ray oscilloscopes, distortion analyzers, impedance bridges, etc., that are very fine to have and which can be quite useful around the shop after you have acquired enough experience to use them and enough money to buy them, but you do not need them to start up business.

If you have the hand tools mentioned, and if your bench is decked out with a good v.o.m., a reliable signal generator, and an up-to-date tube tester, you will be starting out with as much equipment as most of the old-timers had when they began. Put the rest of your capital in a good set of service manuals, as the writer advised at some length in his article on this subject in the November, 1949, issue of RADIO-ELECTRONICS. The manuals will give you much more help than a whole room full of "advanced" servicing instruments when you are starting up in business—and for some time thereafter, too. These are a really worthwhile investment.

In the next and final chapter we shall discuss *how* a good technician uses all of these devices to locate and repair radio faults.

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...art

...will decide it ...doctor fee... ...an's ears come in ...he work, too. They ... sensitive to sounds ...usical maestro, but ...any abnormal quality ...duction. Some of the ...ates on the ears give ...s to what's wrong. The ...", for example. Not a ...um, not a whisper does ...s dead as Yorick. Look at ... see if they're lit. If so, ...ou ten that the speaker or ...ransformer is at fault. It ... With the tubes lit there should be some hum, sound of some kind, however faint, issuing from the speaker. And since there isn't, the sound-producing section of the set has gone wrong. That section is made up of the speaker working with the output transformer. A continuity check on the speaker voice coil and both primary and secondary of the output transformer will show which of your two suspects has done the job.

Excessive hum may be another dead giveaway, especially if it is not tunable —that is, doesn't change in intensity with changes in the position of the tuning dial. One logical spot to look for this trouble is the power supply filter, since its job is to avoid such hum. Since the filter capacitors are the weakest links, checking them is in order. Use the substitution check—temporarily replace, until the hum disappears, each capacitor with one known to be good. If this fails, replacing the power output tube will usually do the trick. Many power amplifiers use an unbypassed cathode resistor, and leakage developing between heater and cathode within the tube will place a 60-cycle voltage on the cathode with respect to ground—equivalent, of course, to a 60-cycle voltage on the grid with respect to cathode. Hence the hum. In receivers using full-wave power supplies the filter ripple is 120 cycles, so that hum will be an octave above the 60-cycle note that a bad output tube would cause.

Don't be too critical

There is such a thing as being too critical, even for the most conservative worker. If you find that a hum can be heard faintly by poking your ear directly into the speaker grill cloth, don't start tearing the thing apart to find a bum component. The chances are you won't find any. A good 90%—at a conservative estimate—of receivers operating off the a.c. line, with no other signal present, have an audible hum at the speaker. Filters *could* be designed to attenuate the hum level so the ear can't hear it, but in the average-quality set it isn't disturbing enough to warrant elaborate filters. After listening acutely to a set's hum for a while it may seem loud enough to blast windows across the street. Try to listen to it from the point of view of a fairly critical layman rather than a fanatical anti-hummer.

Bad filters and bypasses

Faulty filter capacitors can be responsible for another kind of ear-offender. In the cheaper table-toppers, these capacitors also function as i.f. screen bypasses. When they open, the screen grid in that i.f. amplifier tube is not working as a proper shield and the stage will oscillate. The set screeches like an agonized banshee. Bridging the suspected capacitor by one known to be good will put the finger on it. One of these "known-to-be-good" filters—about 20 or 30 μf—should be part of your kit, to be used only for such tests.

Distortion is a word which covers a multitude of sins, but one type is a fairly common symptom and points definitely to the faulty component. When speech or music sounds clipped and poor and the volume is low, the cause is usually the coupling capacitor to the output tube grid having developed a high-resistance leak. It's easy to check without disconnecting any leads. Just put the negative terminal of a voltmeter on the grid of the tube, with the positive on its cathode, and watch the reading. If it reads up the scale, the capacitor is O.K. But if the needle goes backward, it's that capacitor. Obviously, you can't hope to get faithful reproduction through an amplifier which is biased wrong—as it will be if the capacitor that keeps the B-plus off the output tube grid goes out of business. Another possible fault showing this same symptom is a gassy output tube, but that's usually supported by other evidence, such as a violet glow within the glass envelope.

Microphonics

Have you ever heard a set ring like one of Santa's sleigh bells? With the volume control turned down, a pleasant, resonant ping-g-g is occasionally heard, but with the set souped up a bit she really gives out with a sustained peal. This is the "microphonic tube" at work. Even if the tube was perfect when it left the factory, it may develop microphonics with age.

What happens is that the mechanical support of the tube grid weakens, and the grid vibrates, thus modulating the electron stream at the rate of mechanical vibration. The sound from the speaker starts the grid vibrating, which amplifies the sound electronically, and the amplified sound vibrates the grid some more, and so on. Exactly the same sort of effect is produced when the microphone of a PA system is too close to the speaker. To find the mischievous tube, do the same thing the little girl does—smack the tube lightly, but smartly, with the eraser end of a pencil with the set's volume control down. If that ping-g-g results, the tube is guilty.

To sum up, many troubles from which radios suffer can be found without the wholesale use of complex testing equipment. I haven't tried to list all possible symptoms and treatments, nor would I try to convince any technician that he needs nothing but a voltohmmeter. Certainly the efficient worker needs a signal generator, a tube checker, an oscilloscope; but he already has, without shelling out hard cash, a good instrument of his own—his own brain equipped with its five senses.[1] For that instrument, no others can provide an adequate substitute.

Suggested by Anthony A. Munnick, Budapest, Hungary

"D'you still think we should start by saying, "Big Chief see-um white man's magic music box?"

[1] With the exception of the sense of taste. When a radioman sticks his tongue in a set, it's time to wrap him in a wet sheet and call for the men in white!

Charles Gibson, shown here working on a midget set, opened up a repair shop in his garage. He now has a reputation for skilled work.

Sightless Technicians Learn Radio Servicing

By GEORGE B. MILLER

"I DIDN'T get rich servicing radios, but I can stand on my own hind legs and live independently. ... I had to have the guts, but I needed the training just as desperately." The quote is from a letter by Melvin Rothmiller who operates a successful radio service shop in Walthill, Neb. He is totally blind.

Mr. Rothmiller says further, "I know it is difficult for a person with vision to understand how a complicated mechanism like a radio could make sense to a blind person, but a blind person who has never handled the insides of a radio is at a greater loss. This one factor is the hardest obstacle for a blind person to overcome. I saw Von Peterson work with a radio, design special equipment, and operate so independently that the prospect of a similar existence carried me through those days Mama never told me there would be.

"I would do the whole thing over the second time if necessary, but I would rather see another blind person do it the first time."

Along with many other blind and otherwise handicapped persons, Mr. Rothmiller took his training at the Radio Engineering School in Omaha, Neb. Included among the students are multiple amputees, paraplegics, polio victims, arthritics, paralytics, and others with lesser handicaps. A deaf-mute has recently started training in the appliance repair course. In all cases where the graduate has intended to use his training to earn a living the results have been gratifying.

The school was originated and is directed by LaVon Peterson, cited in Mr. Rothmiller's letter. Blind himself, he has developed special test equipment to enable blind students to make accurate measurements and repair all types of radios, record players, PA systems, and similar equipment. Their notes, taken down in Braille, serve as both study and reference books. They also have a Braille tube manual for identifying tubes and basing arrangements. In most cases the students can identify a radio by name and by circuit and call off the tube lineup merely by sticking their fingers in the back of the set.

The training covers public relations, business practices, bookkeeping, and stock maintenance as well as radio servicing. In the appliance repair course, which includes armature and motor rewinding, it is impossible to tell whether a sighted or a blind person has done a rewind job, and in this work extreme neatness and accuracy is required. Blind students, through necessity, will do a better soldering job than a sighted person.

Charles G. Gibson, who lost his sight at the age of nine, graduated from the school early in 1949 and went home to Ogden, Utah, to open up his own shop. "I searched the town for a suitable location but could not find what I wanted, so I remodeled the garage at my home into a service shop and put up a 3 x 5-foot sign in the fr[illegible] business. The people hood have been very [illegible] their work to me.

"I had handbills and b[illegible] printed and got a couple o[illegible] in the local paper. I tell every to tell his friends. I'm not rich if business continues to pick up, making a good living in another y[illegible]

With less than an eighth-grade e[illegible] cation, but plenty of personality, abilit[illegible] and aggressiveness, Robert E. Freemole is running a successful radio service shop in Houston, Tex. "I installed a five-speaker PA system in one of our supermarkets, am attending TV schools, building guitar amplifiers, and have been working twelve to fifteen hours on repair work. I have recently added winding speaker fields and transformers and am doing very well." Bob Freemole and his wife are both totally blind.

Don's Radio Sales & Service in Waterloo, Neb., is another successful shop run by a blind technician, Don Misfeldt, who lost his sight in a hunting accident while attending college. "After almost two years my business has been accepted in the town just as any other business would have been. A reputation for fast and complete service with a guarantee to back it up brings in repeated business.

"It is a great satisfaction to me when a customer does not realize my pet nuisance—blindness. I have learned of customers leaving the shop and finding out later that their radios had been serviced by a blind technician."

These men, and many others like them, have accomplished what to the rest of us seems impossible, asking only that they be given a fair chance to demonstrate their ability.

Sightless, but full of determination, Melvin Rothmiller enjoys independence from state aid by repairing radios. He has recently taken up motor rewinding.

Electronics and Music

Part IX–Circuits of the Thyratone, a solo-type electronic instrument

By
RICHARD H. DORF*

Photo A—Thirty-seven keys control the 5-octave range of the Thyratone. Buttons at right are used to select the tone color combinations.

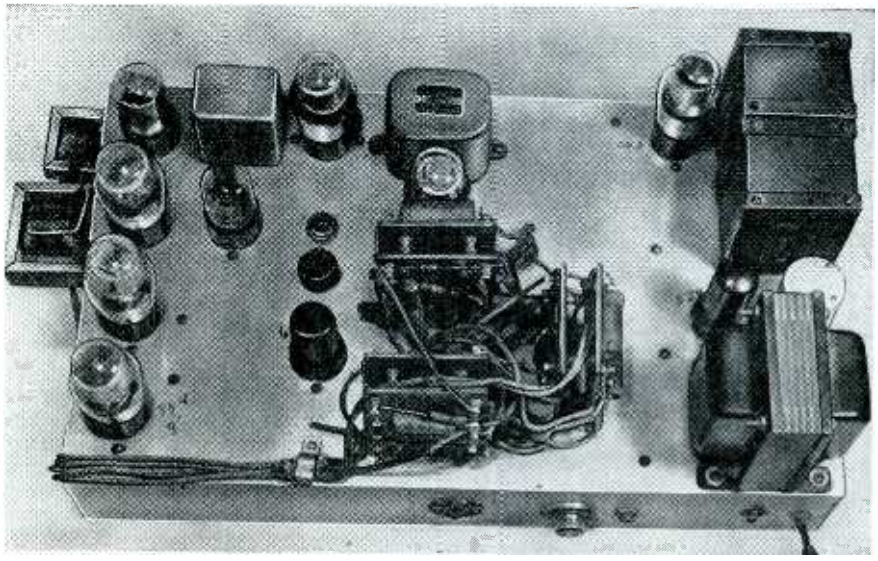


Photo B—Entire electronic circuit is on this 10 x 17 chassis. This unit is normally mounted inside the cabinet which houses the speaker.

IN THIS and the next article of our series we shall describe the Thyratone, an electronic musical instrument designed and constructed by the writer. The Thyratone is purely an experimental instrument, first designed on paper, then built and modified as various weak points showed up. It still has weak points, but each of these will be discussed as the description progresses and solutions to the problems will be suggested for the benefit of other experimenters.

The primary virtue of the Thyratone is that it is more truly a *musical* instrument than most of those which have been offered before to the individual constructor in the technical press. It not only provides a series of tones of the correct pitches but—more important—it includes genuine tone-shaping circuits to make the tones sound musical and to give a variety of tone colors both singly and in combination. The theory and background of tone-shaping methods is much too large a subject to discuss in a construction article, so the circuits will be described here only for construction purposes. Several articles later in the series will be devoted to tone-coloring.

What is the Thyratone?

The Thyratone is a monophonic or solo-type instrument, appearing, at first glance, to be much like the Hammond Solovox. It is similar in that its three-octave keyboard of foreshortened keys (Photo A) may be fastened to the front of a piano and the instrument can be played at the same time as the piano. Another likeness is that only a single key may be played at a time. But there the resemblance ends.

The block diagram of Fig. 1 gives an over-all view of the instrument. There are three tone generators operating at octave separation. The 8-foot generator produces three octaves of tones ranging from C_{40} (middle C—261.7 cycles—see frequency chart on page 42 of the August, 1950, issue) to C_{76} (2,093 cycles). The 16-foot generator produces a three-octave range from C_{28} (130.8 cycles) to C_{64} (1,047 cycles). The 32-foot generator produces pitches from C_{16} (65.41 cycles) to C_{52} (523.3 cycles). The nomenclature for the ranges is taken from organ practice for convenience.

When the Thyratone keyboard is fastened to the front of a piano the lowest key coincides with the position of middle C on the piano. Therefore, in the 8-foot range, sounding this note will produce an actual pitch of middle C. (For those not familiar with organs, the 8-, 16-, and 32-foot measurements refer to the lengths of organ pipes.) Pressing the same key but using the 16-foot range, the tone heard is one octave below what one would normally expect from that key. The 32-foot pitch is an octave below that. The Thyratone therefore has a total range of five octaves (plus one note—the top C).

The generators are all keyed simultaneously so that pressing any one key produces three notes an octave apart.

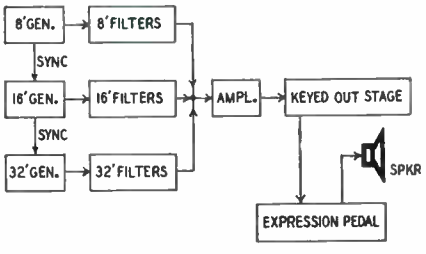


Fig. 1—Block diagram gives an over-all picture of how the Thyratone functions.

* Audio Consultant, New York City

The tones from each generator are fed to a series of L-R-C filters which alter the waves in such a way as to give a more or less close approximation of a standard organ tone. The three ranges are filtered separately, as Fig. 1 indicates, so that a bourdon tone, for example, is produced only in the 32-foot range, and an oboe is available only in the 16-foot register. There are four 8-foot tone stops, six 16-foot stops, and two 32-foot stops, a total of 12 tone qualities or stops in all. One or several may be in use simultaneously to give any type of mixture desired, just as in an organ. The tone colors will be described later in the discussion of playing.

The tones from the outputs of all the filters are mixed and amplified, then fed to a push-pull output stage. This stage is normally biased to cutoff. The cutoff bias is removed each time a key is pressed and an R-C time-constant network provides keying delay to eliminate clicks and thumps and give a good musical attack and decay. An expression pedal, consisting of a foot-operated 8-ohm T-pad, is placed between the output transformer secondary and the speaker. A preset volume control in the amplifier section allows the player to set maximum desired level so that the pedal can be operated over its entire range.

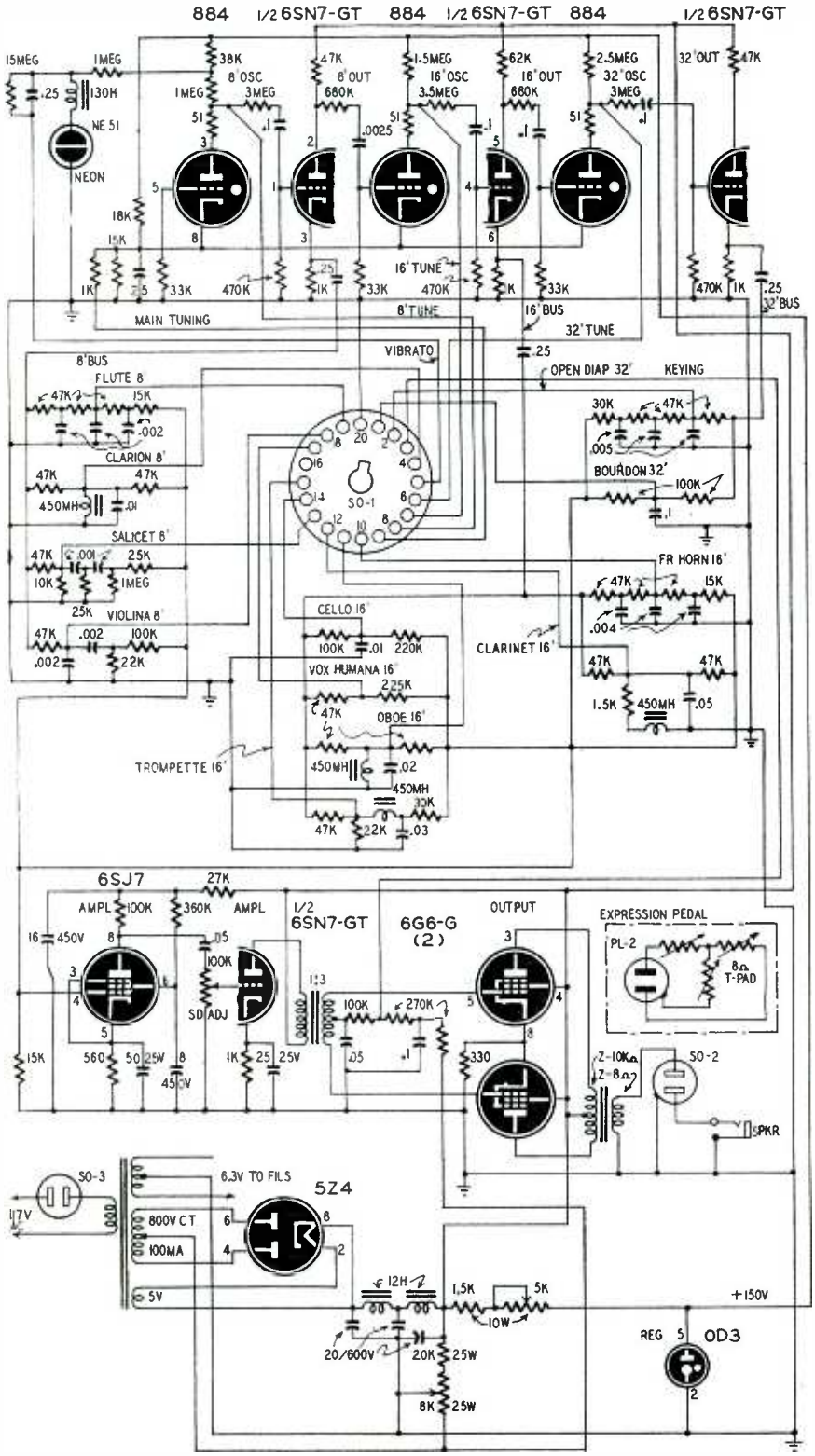


Fig. 2—Main circuit of the Thyratone, including amplifier and power supply.

What it looks like

The physical appearance of the Thyratone is illustrated by the photographs. Photo A shows the keyboard unit. There are three octaves of keys and, at the right, a control board. On the control board there are 14 push-button switches to control the stop combinations and the vibrato. At the upper left is the a.c. power switch. In this experimental model the front has been left open for access; in the finished product, of course, it will be closed. The wood will also be finished and the hole at the upper right will probably be filled with another push button. The entire keyboard unit may be fastened to the front of a piano with metal brackets in the same way as the Solovox is mounted. Because of the nonavailability of compactly built keyboards the writer did not bother to keep the keyboard unit especially small. Other constructors should try to do better in that respect, as long-legged players may find that there is not enough room underneath.

The chassis appears in Photo B. The entire electronic equipment, with the exception of the generator-tuning capacitors, is mounted on it, and the keyboard unit serves only for control. Normally the chassis is mounted within an ordinary loudspeaker enclosure along with the speaker. Photo C shows the expression pedal in position on the floor. A cable from it plugs into the chassis. The keyboard unit connects to the chassis through a 20-conductor cable terminating in a standard Amphenol 20-pin plug. An additional 2-wire line serves for the a.c. power switch.

The tone generators

Because of the type of tone-color filters used in the Thyratone, sawtooth waves are required from the tone generators. An additional requirement is three generators which will synchronize easily in exact octave relationships without having any of the synchronizing frequency appear in the output. In an experimental mood, 884 thyratrons (from which the instrument gets its name) were chosen. Gas-filled tubes are not the most stable oscillators, as they vary in characteristics with temperature and various tubes of the same type differ. A main tuning control was included, however, and operation is satisfactory as long as the tubes are not interchanged among the three genera-

tors. Replacements for burned-out 884's must be selected on a trial basis from a stock of them.

The diagram of the main chassis is given in Fig. 2. Each of the three 884's is used in much the same way as it would be for the sweep oscillator of an oscilloscope. A lead from the plate of each is brought to the keyboard unit, diagrammed in Fig. 3, where it is connected to one end of a string of capacitors. Pressing a key grounds the string at some point, giving a certain net capacitance between plate and ground to tune the oscillator.

The 8-foot oscillator is the "master." Its string has one capacitor for each note. When the junction between the leftmost capacitor and the next one (Fig. 3) is grounded, there is maximum capacitance between plate and ground, and the lowest 8-foot tone (middle C) is produced. When the next key is pressed, there are two capacitors in series between plate and ground, resulting in a lower net capacitance and raising the pitch. When no keys are pressed, the capacitance is the series net of all the units in the string, giving the highest tone. This system avoids off-color tones caused by accidentally pressing two keys at a time. With the string arrangement, only the lowest note of any several that might happen to be keyed at one time will sound.

There are four small contact springs under each key. A piece of flat metal is attached to the key bottoms and is grounded by contact with a square metal bar at the rear of the keyboard, on which the keys are mounted. When the key is pressed, this metal strip contacts all the springs, grounding each. Three of the springs under each key are connected to junctions between capacitors for tuning the 8-, 16-, and 32-foot generators. The fourth keys the output stage.

Since it is very difficult to represent this exact arrangement in a schematic diagram, the system of representation as in Fig. 3 is used. The four arrows for each key connected with a dashed line represent the single grounded metal strip. The small circles connected to the capacitors represent contact springs.

The output from the plate of the 8-foot 884 generator (Fig. 2) is connected to the grid of one triode of a 6SN7-GT amplifier through a 3-megohm attenuating resistor and a 0.1-μf blocking capacitor. Output is taken from the unbypassed cathode of the 6SN7-GT triode to form the 8-foot bus carrying 8-foot tones to the 8-foot filters. Output from the plate of the 6SN7-GT triode is fed through a 680,000-ohm attenuating resistor to the grid of the 16-foot 884 to provide synchronizing voltage. The plate of the 16-foot 884 is carried to the keyboard and a string of capacitors for tuning.

Referring again to Fig. 3, note that in the 16-foot string there is not a capacitor for every note but only one for every six or seven notes. This saving in capacitors is allowed by the fact that the 16-foot generator is synchronized. For each group of six or seven notes, the natural frequency of the oscillator is made slightly higher than the highest note; when the synchronizing voltage is fed to the 884 grid from the 6SN7-GT the frequency is brought to exactly one octave below the 8-foot tone. For greater stability, constructors may find it wise to use a few more capacitors, say one for every four notes.

The plate output from the 16-foot 884 is fed to the other triode section of the first 6SN7-GT. The cathode output of the triode is fed to the 16-foot filters and the plate output is applied as sync voltage to the 32-foot 884. The latter is tuned exactly as is the 16-foot gen-

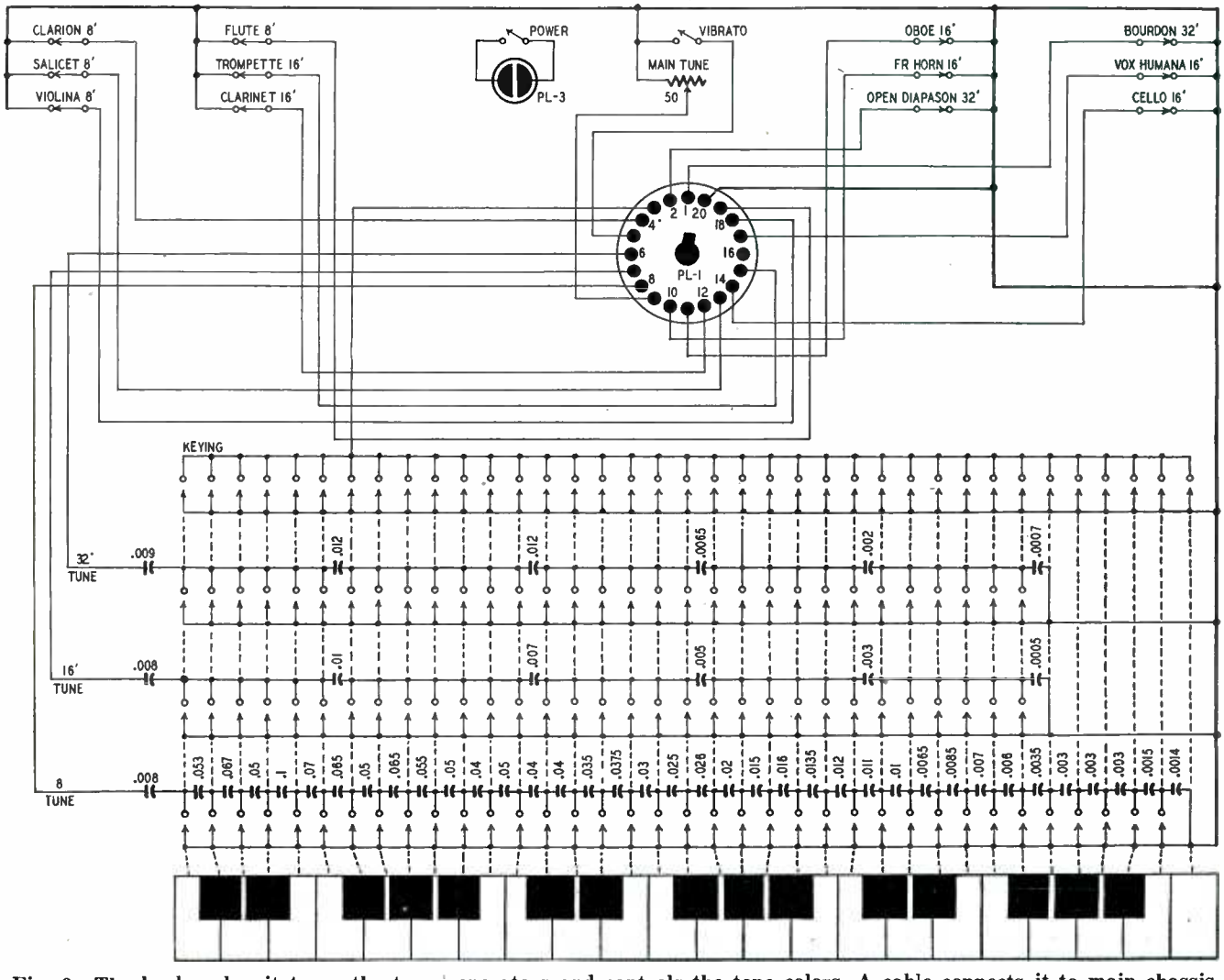


Fig. 3—The keyboard unit tunes the tone generators and controls the tone colors. A cable connects it to main chassis.

erator. It feeds one triode of a second 6SN7-GT, the cathode of which provides 32-foot tone for the 32-foot filters.

The cathodes of all three 884's are common and are placed a few volts above ground by a voltage divider between the B-supply and ground. The lower portion of the divider (15,000 ohms in parallel with 25 μf) is paralleled by a 1,000-ohm resistor, the lower end of which goes to a 50-ohm wirewound rheostat on the keyboard unit. Varying the resistance of the rheostat varies the grid-bias voltage of all the thyratrons and changes their pitch. It is used as a main tuning control to compensate for aging and heating. Its range is a little over a half-tone; if it were more it would materially upset the frequency spacing between notes.

The vibrato is provided by a variation of the standard neon-lamp oscillator, which includes a high-value inductance as well as the usual resistor and capacitor. B-voltage for the neon oscillator is taken from the junction of the 38,000-ohm and 1-megohm resistors

Photo C—Volume of the music is controlled by this specially made expression pedal. It rests on the floor in a convenient position for the player's foot.

in the plate circuit of the 8-foot 884. The capacitor across the lamp is normally ungrounded. To produce vibrato, that capacitor is grounded through a switch on the keyboard unit. The oscillations produced are nearly sine waves because of the storage action of the inductor. They vary the plate voltage of the 8-foot generator slightly at the oscillation rate, which is about 7 cycles; since gas-tube oscillators change pitch with a change in supply voltage, a frequency vibrato is produced. The 15-megohm resistor across the 0.25-μf capacitor discharges it after the bottom end is ungrounded (when the vibrato switch is turned off). Without the discharge the neon will not oscillate again when the switch is closed.

Tone filters

The theory of *formant filters*, as these are called, will be discussed in future articles. Suffice it to say here that they are due principally to Winston E. Kock, the principal designer of the Baldwin organ, and that they analogize electronically the acoustic action of an ordinary musical instrument. Their capabilities are not realized fully in the Thyratone because of the desire to avoid unnecessary complexities, but even here they do produce uncannily realistic imitations of many of the tones of a pipe organ. Briefly, they provide electrical resonances and rolloffs equivalent to the body resonances and acoustic absorption properties of ordinary instruments. For details see U.S. Patent No. 2,233,948.

The inputs of all the filters in each register are obtained from the corresponding bus and all filter outputs are paralleled. Because of the long lines involved in the Thyratone as it now exists, switching filter outputs to select tone colors or stops was found impractical. The stop buttons therefore are normally closed switches which short out the filters. Punching a button removes the short on the corresponding filter and allows the tone color to come through. The short circuit is made in the "middle" of the filter so that it will not appreciably affect input or output busses.

Amplifier

The outputs of all filters go to the grid of a 6SJ7. The amplified tones go to a volume control which is preset for the desired maximum level. From here the tone goes to the second triode section of the same 6SN7-GT used to feed the 32-foot bus. The plate is transformer-coupled to a push-pull 6G6-G output stage.

There are two reasons for keying this output stage. First, when no keys are pressed, all oscillators are tuned to their highest pitches by the capacitor strings. Second, a slow attack and decay must be provided so that the instrument does not sound like a code-practice oscillator. It is difficult to key a single-ended stage because, unless the attack is too slow for musical comfort, the rush of electrons from cathode to plate when cutoff bias is removed—even with a delay circuit—makes a thump in the speaker. This hazard is removed by using a balanced push-pull stage; the rush of electrons is in the same direction in both tubes and the two cancel in the output transformer (if the tubes are fairly similar).

To provide a negative bias, the bleeder of the power supply is tapped and the tap grounded. Thus the lower end of the bleeder is more negative than ground. In the model shown the power transformer produced insufficient d.c. voltage at the filter output (about 250 volts). Other constructors should use transformers with at least 400 volts each side of center-tap. This allows the tap on the bleeder to be moved up higher, giving more bias for good cutoff of the final stage, while still providing enough B-voltage for reliable operation of the 0D3 (which provides regulated voltage for the thyratron tone generators).

The negative end of the bleeder is wired to the center-tap of the driver transformer through an R-C network. A lead from the network goes to the keying contact springs on the keyboard unit. When a key is pressed the junction of the 100,000-ohm and 270,000-ohm resistors in the delay network is grounded. This removes negative bias from the output tubes. It takes a certain time, however, for the .05-μf capacitor to discharge the bias voltage, and the tubes do not conduct fully at once. When all keys are released the bias voltage is applied again, but delay of the sound decay is caused by the 0.1-μf capacitor, across which the bias voltage must build up.

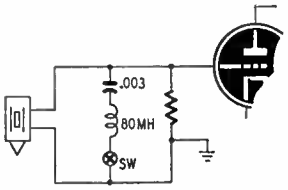
The delays are a little shorter than would be musically optimum, particularly the decay. The reason is that the sound must have disappeared by the time the key rises enough to take ground away from the tuning-capacitor contacts. The keying contact spring is purposely adjusted under each key so that it is the last to be grounded when the key is pressed and the first to be removed from ground when the key is released.

The expression pedal operates an 8-ohm T-pad which is placed between the output transformer and the speaker. This is the simplest way to control volume without running a high-impedance line to a grid potentiometer. A high-impedance line could easily pick up enough hum or other undesirable noise to be objectionable, even if well shielded. The pedal itself is simply two hinged boards with the attenuator sandwiched in between. A cable strung around its knob rotates the attenuator when the pedal is depressed. Pushing down on the pedal increases the volume.

Next month we shall describe the construction, adjustment, and operation of the Thyratone.

Simple Filter for Scratchy Records

It is easy to construct and install a filter which will make scratchy records sound much better. It consists of a coil



and capacitor connected in series across the pickup leads. Almost any small choke will do—a shielded r.f. choke is excellent. Try small capacitors of different values until you find one which gives the greatest reduction in scratch with the least reduction in volume. If your coil is around 80 to 100 mh, try a .003-μf capacitor and work up and down from there. Use large steps at first, and gradually work down to smaller ones.

The filter attenuates some of the highs, so it is advisable to wire in a switch as shown in the diagram. Avoid hum pickup by keeping the leads short and well away from a.c. leads.—*R. C. Sandison*

Audio Feedback Design

Part VI—Using the stability margin for amplifier testing

By GEORGE FLETCHER COOPER

IN THE earlier articles of this series the stability of the amplifier has been expressed in terms of the phase margin and the gain margin. These two ideas, which are very widely accepted, are extremely useful in designing an amplifier, but they are rather a nuisance when it comes to testing it. Even if you only make one amplifier, it is worth while to test it properly, because it may go unstable owing to tube aging or supply variations just when you are showing it off to an admiring aunt. And of course, if you make amplifiers for money you will not find many customers who want unstable ones.

Measuring the phase and gain margins is a difficult job, because the measurements have to be extended to a very high frequency, where the gain has fallen 20-30 decibels. Phase meters are available commercially, but I think that only the best equipped industrial laboratories have them. An oscillograph can be used, but it is a tedious and inexact method of measurement. An elegant way out has been described by W. T. Duerdoth, of the British Post Office. He has introduced a new quantity, the stability margin, which is easy to measure and which gives a clear indication of the stability conditions. This quantity is related to the shape of the Nyquist diagram, and although it cannot be used in the design stage so easily as the gain and phase margins, it does seem to be the answer to the testing problem.

To have something concrete to talk about, a typical high-end-response characteristic has been constructed, and is shown as Figs. 1 and 2. According to what we have seen in the earlier articles, the permissible feedback for an amplifier with this characteristic would be about 18 db, giving a phase margin of 25° and a gain margin of 6 db. The important part of the Nyquist diagram is plotted as Fig. 3.

To plot this we start by drawing a circle with center O, and a radius of, say, 20 cm. We also draw a line OX, to the left. This first circle is the zero circle, and we next draw a number of smaller circles, with the same center O. The circle with a radius of 10 cm, half the radius of the zero circle, corresponds to a drop of 6 db; the next, radius 2.5 cm, to a drop of 18 db; and so on. We can also draw the circle of radius 2 cm (= 20/10), corresponding to a drop of 20 db. The figure actually does not include the zero circle, because the region outside the 12-db circle is not of much interest to us.

Polar response curve

We must now plot the amplitude-phase-frequency response as a polar diagram. For each value of amplitude we can determine a frequency from Fig. 1, and the corresponding phase from Fig. 2. Thus in Fig. 1, 4.5 db gives us a frequency of 32, and in Fig. 2 a frequency of 32 gives us 72°. In tabular form:

Fig. 1		Fig. 2
4.5 db → 32	(f) → (f)	32 → 72°
7.5 db → 50	→	50 → 100°

Now draw a line OP, such that angle XOP = 100°, and fix P on this line at the 7.5 db level. This is actually at a radius of 0.422 × 20 cm (The 0.422 comes from the voltage ratio-decibel table to be found in most reference books, e.g., Terman's *Radio Engineers' Handbook*, page 1). The point P therefore corresponds to the amplitude and phase given in Figs. 1 and 2 at a frequency of 50. This we plot in Fig. 3. Repeating the process at 6, 12, 18 and 24 db we have enough points to plot the solid line. On a larger scale we can draw the dashed line, for which the original zero circle, if I had drawn it, would have had a radius of 160 cm. Going back to the full line, which is part of the Nyquist diagram—the rest, over on the left, does not concern us—we see that it crosses the 180° axis, OY, at the point L where the response is 24 db down.

As we have already seen, the condi-

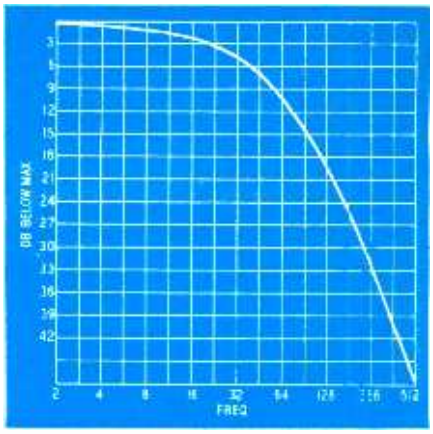


Fig. 1—The high-frequency response of a typical amplifier.

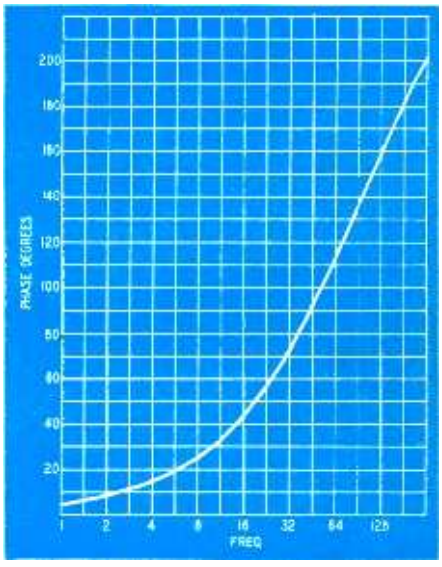


Fig. 2—The phase characteristic corresponding to the response curve shown in Fig. 1.

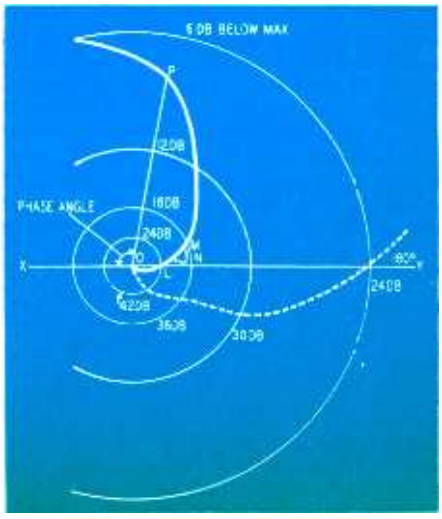


Fig. 3—This Nyquist diagram is a phase-amplitude curve on polar coordinates. Significant portion of curve only is shown.

tion for stability is that we should have less feedback than the drop of response at 180° here we must have less than 24 db feedback. This is a restricted case of a rule which is known as Nyquist's criterion. We define the point N as the point, lying on the line OY, at which the response has dropped F db, where F is the feedback. Then the curve must not

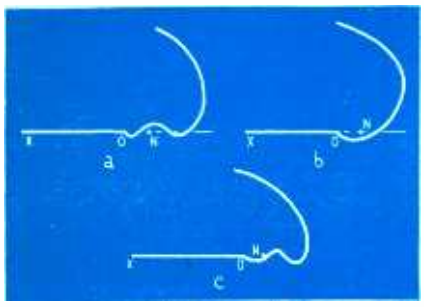


Fig. 4—Nyquist curves may cross the 180° line several times. The curve at *a* is stable, but *b* and *c* are unstable.

encircle N. Usually this just means a smooth run-in above N, like the curve we have shown, but the Nyquist diagram may take the form shown in Fig. 4-a without the amplifier being unstable. This particular form is called "conditionally stable" and it is a rather difficult form to use, because the amplifier becomes unstable if the gain falls. As a result, when first switched on, with the heaters warming up, the circuit will sing, and the resulting grid current may keep the amplifier in the unstable low-gain condition. These "conditionally stable" circuits are therefore used only rarely, and in applications where they are kept switched on permanently.

Stability margin

The important idea which Duerdoth has introduced is this: it is not just the pair of points L and M in Fig. 3 which matter, but how close the curve gets to N. The two points define the gain margin (L) and the phase margin (M), but the same values of these quantities would be given by the little dotted pimple on this curve. Yet an increase of gain of 0.1 db, and 1° of phase, would make the dotted loop encircle N.

Looking back to the first article, we had an equation for the gain with feedback K^1, in terms of the gain without feedback K and the feedback network attenuation β,

$$K^1 = \frac{K}{1 + \beta K}$$

We can write this as

$$\frac{K}{K^1} = 1 + \beta K$$

In Fig. 3, the distance OP is βK, and OP is actually a vector, which includes the phase of K (and of β, if the feedback path is not a pure resistance network). By taking the right account of the signs, and doing a little vector mathematics, we can show that $NP = 1 + \beta K$, so that the *length* NP is the ratio of the gain without feedback to the gain with feedback. In Fig. 5 the circles of constant NP are drawn for the same Nyquist diagram. The 0-db circle passes through O, the 6 db circle bisects the line NO, and the 12 db circle has a radius equal to ¼ × NO. It will be seen that the $K\beta$ curve almost touches the 12 db circle, so that the stability margin is 12 db.

By now the reader may be getting a little impatient: where is the simplification? The answer was hidden in the last paragraph. The stability margin is the amount by which the gain *with* feedback exceeds the gain *without* feedback at the critical points. To illustrate this I have calculated the effect of applying 18 db of feedback to the characteristics of Figs. 1 and 2. Fig. 6 shows the result. With feedback the response peaks up to 12 db above the response without feedback. With less feedback the peak would be flatter; with more feedback it would get higher until it shot right up off the paper—instability. To find the stability margin all we need to do, therefore, is to measure the effect of connecting the feedback at a number of frequencies until we find where the gain *increases* most with feedback.

The actual measurement is carried out using the circuit of Fig. 7. The oscillator is set to some frequency at the edge of the band, and the meter sensitivity adjusted to give a reading in the middle of the scale. A good way to decide where to start is to increase the feedback until the amplifier sings, and find the singing frequency. Then work down from this frequency (point L in Fig. 3). It is a good idea to add an oscilloscope to make sure that the amplifier is not overloaded. Then operate the switch, and note the change of meter reading. Repeat this procedure at a number of different frequencies until the peak has been located. I generally plot the results, giving the sort of curve shown in Fig. 8. There is not much advantage in doing this with a sharp peak, which can easily be located, but if the peak is a very flat one, as it is with exceptionally stable amplifiers, the stability margin curve is rather useful.

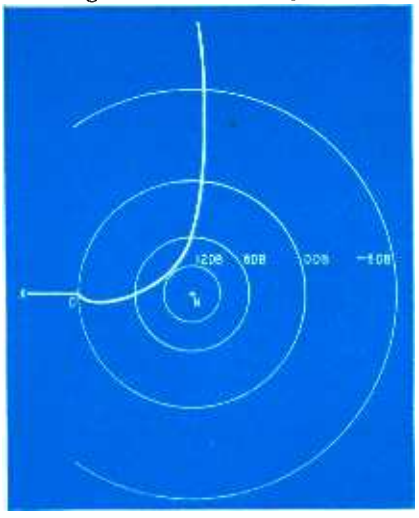


Fig. 5—The curve of Fig. 3 replotted to show the stability margin circles.

How much stability?

We must have a criterion for a satisfactory value of stability margin. It is not too difficult to see that a smooth Nyquist diagram, like the one we have considered, will give a stability margin of 6 db if the phase margin is 30°. This figure of 6 db is quite a good working limit for test purposes; for design work it is desirable to adopt a figure of about 4.5 db, to allow for errors in component values and high transconductance tubes. Very often, however, a still lower figure is forced on the designer by another consideration. Looking at Fig. 6 we see that with feedback we get a 9 db peak at the top end. Usually we should add a small capacitance across the feedback resistor to round off this peak. Automatically we should improve the stability margin, and without calculation I should estimate that in this circuit we could easily make it 2 db. Stability margin is thus closely associated with response: a flat response with a smooth rolloff will usually have a very good stability margin.

Looking only at the stability margin, a Nyquist diagram like the one shown in Fig. 9 would be ideal. The amplitude response here would be flat up to the edge of the band, where it would drop sharply about 8 db, and then follow a slope of 11 db per octave. When the feedback factor was reached there would be a small flat step, giving the arc of a circle round N, and then down the response would plunge. By the phase area thereon this response is very efficient: you can read more about this in Terman's *Radio Engineer's Handbook*, page 218 *et seq.* It is not easy to control the response as exactly as this if there is an audio transformer in the circuit. There is another disadvantage, too. Suppose the forward gain changes: it may rise or fall as the supply voltage changes, or with tube aging. The effect is equivalent to moving N to the left or to the right. Decreasing the gain by 6 db will bring the corner C very close to N, and although the amplifier is still stable, this does mean a high peak in the response. Increasing the gain by

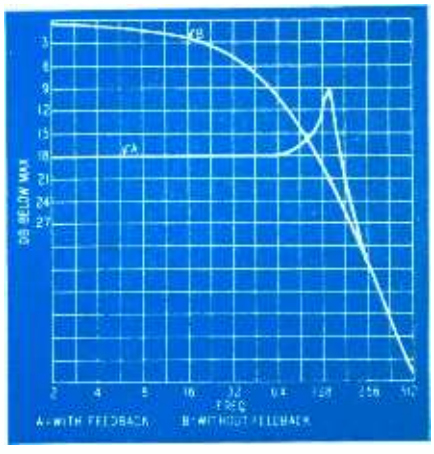


Fig. 6—Feedback reduces gain in the working band, but may actually cause an increase at the outside of the band, as these two response curves indicate.

6 db will make the amplifier unstable.

A more sophisticated diagram is that shown in Fig. 10. This allows more room for manoeuvre when the gain increases. Any reader who has reached the point of using circuits giving complicated diagrams of this sort can refer to Duerdoth's paper and the discussion on it, in *Proceedings of the Institute of Electrical Engineers*, Vol. 97, Part III.

Fig. 7—Circuit for checking stability.

Component tolerances

It is appropriate to point out here what the effect of component tolerances will be. If you use commercial capacitors and resistors you cannot, with economy, get values better than 10%. The effect of a 10% change in either capacitance or resistance is a phase shift of 3° at the characteristic frequency, where the phase shift is 45°. In a 3-stage amplifier, if all resistors and capacitors are 10% wrong in the most harmful direction, the phase will be in error by 18°. On top of this there may be a small error due to the decoupling circuits, so that at the worst we may expect 20°. Of course, it is not likely that we shall have all components at the limit values. If we do we must either use others or else select sets of upper- and lower-limit resistors, using upper-limit resistors in one stage and lower-limit resistors in another. Alternatively, R-C sets can be chosen to give the right characteristic frequencies. This problem arises only if you are making a number of amplifiers which have rather tight specifications.

The most important practical case of component tolerances arises in the push-pull transformer design at low frequencies. Care must always be taken to allow for an unbalanced d.c. component in the plate windings due to differences between the tubes.

All the discussion of the stability margin has been devoted to the high-frequency stability. At low frequencies, which the region around 1 cycle is usually the important one, there seems to be no really satisfactory solution. My own method is to increase the feedback until the amplifier becomes unstable. If the instability is at high frequencies the stability margin is used as the test criterion; if the instability is at low frequencies, working feedback is used as the criterion. There is now available a range of very low-frequency test equipment, mainly intended for servo mechanisms (which are feedback amplifiers built around machinery), but we just don't have any. Most of my amplifiers do seem to rest against the high-frequency limit.

In the next article I hope to discuss the use of positive feedback for improving amplifier performance. This is a powerful but rather dangerous technique. Used carefully it can give very good results.

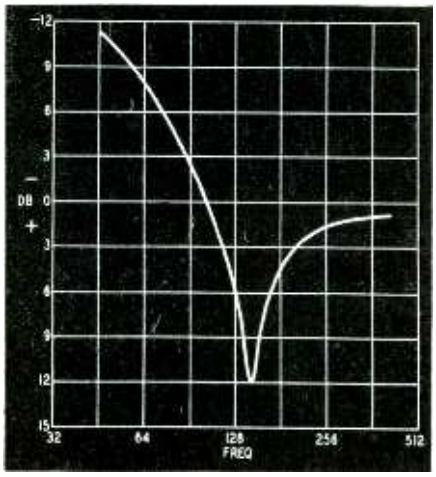


Fig. 8—A curve of this type is plotted by using the circuit of Fig. 7. In this case stability margin is 12 db.

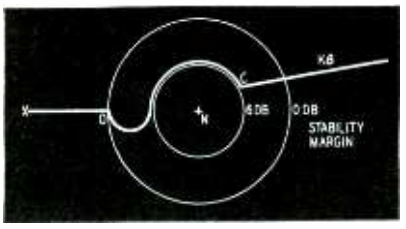


Fig. 9—An enlarged view of the center of the Nyquist diagram showing how to get a 6-db stability margin economically without an excessive phase margin.

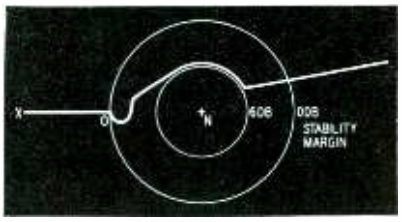
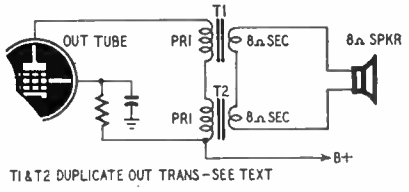


Fig. 10—This Nyquist diagram allows for change in the working conditions.

Improving Radio Fidelity

By HERBERT MICHELS

If you want to improve the response of an audio amplifier without purchasing an expensive high-fidelity output transformer, you'll probably find that two inexpensive transformers will meet your needs. In an actual test, an amplifier having a response of 200 to 8,000



cycles with a single output transformer was made flat within 2 db from 50 to 12,000 cycles merely by using two output transformers in series as shown in the diagram.

The upper limit of the frequency range of an output transformer is determined by the distributed capacitance of the primary winding. This capacitance being high in inexpensive transformers, appears as a low capacitive-reactance shunt across the primary, and signals above approximately 8,000 cycles are attenuated. Using two transformers in series halves the distributed capacitance, doubles the capacitive reactance, and extends the upper limits of the response curve.

The low-frequency response is also improved through the use of two transformers. The primary inductances add to produce twice the inductance of a single winding. The higher inductance increases the inductive reactance shunting the primary and lowers the point at which the lows begin to fall off. In this way you can save the cost of a transformer having a high-inductance primary and a heavy iron core and still get a good response.

The transformers preferably should be of the same type. Each—if used alone—should match the output tube to the speaker.

Although this method of improving fidelity can be a great help, always remember that the response of a system is no better than that of its components. The input to the amplifier, whether it be from a tuner, phono pickup, or microphone, should have high fidelity. The speaker should faithfully reproduce the audio signals fed into it.

At first glance, it may seem strange that two identical transformers connected in series will match the same source and load as either of them alone. This is true because the impedance ratio does not change when they are connected in series.

Assume that a transformer is to match a 4,000-ohm load to an 8-ohm speaker. The transformer turns ratio should equal the square root of Z_s/Z_p, where Z_p is the impedance of the primary (4,000 ohms) and Z_s is the secondary impedance (8 ohms). The turns ratio is $\sqrt{500}$ or 22.4 to 1.

If we assume that the voice coil winding of T1 or T2 has one turn, then the primary will have 22.4 turns. When the transformers are connected in series as shown in the diagram, the number of turns in the effective primaries and secondaries are doubled so that there are now two turns on the secondary and 44.8 on the primary. Although the number of turns on both windings has been doubled, the impedance ratio remains constant.

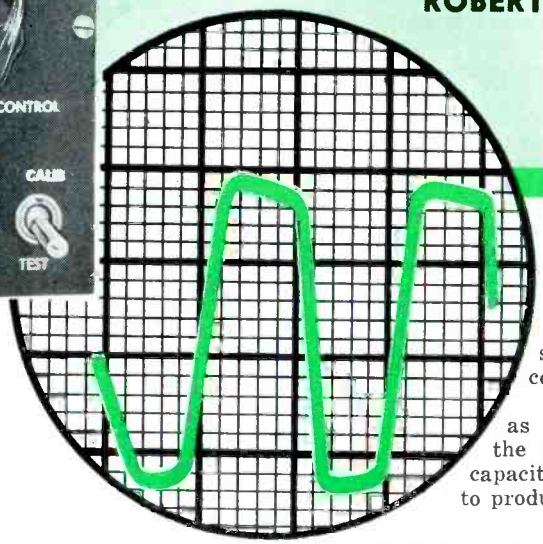
(This method may increase fidelity but will not minimize distortion caused by core saturation.—*Editor*)

Accurate Scope Calibrator

Increase the usefulness of your scope with this simple peak calibrator

By
ROBERT F. SCOTT

Front panel photo of the peak-to-peak voltage calibrator. The meter can be any with a movement of 1.5 ma or less.



Select a fixed resistor somewhere around the center of this range. The diode load may be as low as 50,000 ohms if the values of the coupling capacitor and R1 are selected to produce a good square wave.

TELEVISION, radar, loran and many other types of electronic equipment use nonsinusoidal voltages. If the wave-form or amplitude of these voltages is wrong, the equipment does not work right. For example, if the picture on your television screen does not extend to its full width or height, low deflection voltage may be the reason.

Manufacturers commonly supply oscilloscope waveforms and list their peak-to-peak voltages, as an aid to the service technician. It is easy to observe the waveforms on a scope, but measuring peak-to-peak voltages is another story. You cannot get accurate readings on conventional v.t.v.m.'s or a.c. voltmeters because they are not designed or calibrated to measure pulses, square waves, or other nonsinusoidal voltages.

The peak-to-peak voltage calibrator whose circuit appears in Fig. 1 provides known square-wave voltages which are fed into the scope and compared with the positive and negative tips of the signal under test.

The constant voltage used for calibrating is not affected by normal line voltage fluctuations because the two diodes connected back-to-back act as clipper-limiters. Diode D1 of the 6AL5 has its cathode biased positive at 150 volts. Approximately 300 volts a.c. is applied to its plate. This diode does not conduct until the positive half-cycle of the alternating voltage exceeds 150 volts. D2 is connected in reverse with its plate biased 150 volts negative and a.c. applied to its cathode. It does not begin to conduct until the negative peak of the sine wave is above the bias voltage.

If the diode load—the voltage control and multiplier in parallel—is very large and R1 is comparatively small, the voltage across the load will be a square wave because of excessive drop across R1 during periods of conduction in the diodes.

The resistors in the multiplier are the only critical components in the calibrator. The capacitor in series with R1 may be as low as .005 μf. The values of R1, the voltage control, and the multiplier resistor may vary widely from those shown on the diagram. These can be determined experimentally as will be shown later. The diode load should not be too low. If it is, the a.c. will be bypassed around the diodes. Furthermore, the rise time of the square wave increases as the load decreases. If R1 is too high or too low, the diodes do not limit the peaks during conduction. You can select a value for this resistor by substituting a 250,000-ohm variable resistor and varying it through its range while observing the waveform on the scope. Measure the resistance in the circuit at points where the peaks start to round off.

Calibration

Before deciding on values for the voltage control and multiplier resistors, connect a variable resistor and high-resistance voltmeter between the a.c. line and scope as shown in Fig. 2.

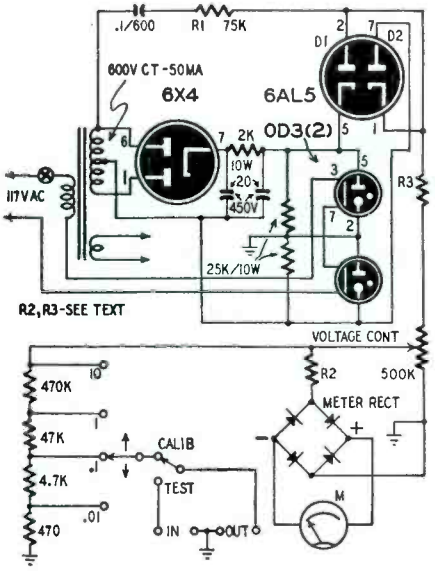
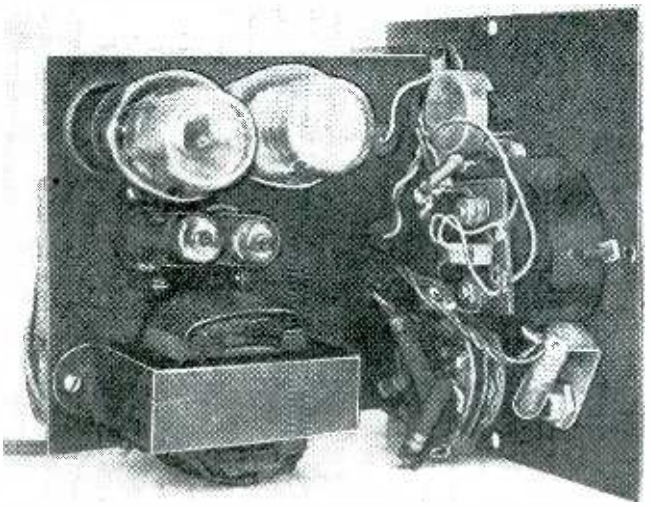
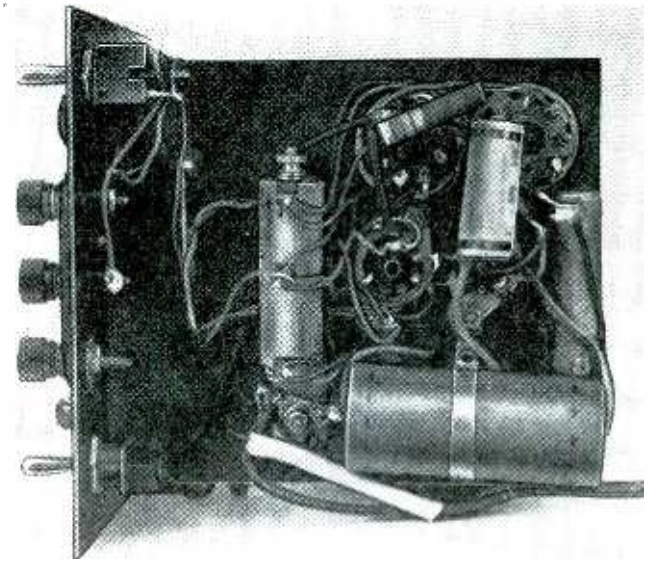


Fig. 1—Schematic of the peak-to-peak calibrator. It has four voltage ranges which supply known square waves that are used to calibrate an oscilloscope.





Top-chassis photo of the instrument is shown above. At right is a bottom view.

Adjust the horizontal gain for convenient deflection—2 and 4 inches for 3- and 5-inch scopes. Leave the gain control set—do not move it. Disconnect the meter and variable resistor. Connect leads across the diode load and note the deflection and wave shape on the scope. Adjust the load resistor and R1 for 100 volts or more peak-to-peak. Replace the load resistor with a potentiometer having approximately twice its value. Make up the multiplier from resistors having a total value approxi-

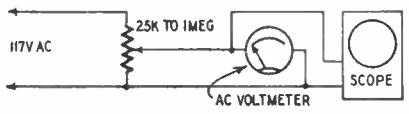


Fig. 2—Hookup for meter calibration.

mately equal to twice the value of the original load resistor.

The meter has a basic movement of 1.5 ma or less. Ours is a surplus 500-μa instrument having 15- and 600-volt scales. We selected the 15-volt scale and jockeyed values in the calibrator for a 150-volt peak-to-peak square wave.

Connect the calibrator to the scope, set the multiplier to MULTIPLY BY 10, and adjust the voltage control to 100 volts peak-to-peak deflection on the scope. Replace R2 with a variable resistor of 150,000 ohms or more and vary it until your meter reads exactly 100 volts. Turn off the calibrator and measure the resistance remaining in the circuit. Replace this with fixed resistors hand-picked to make the meter read correctly.

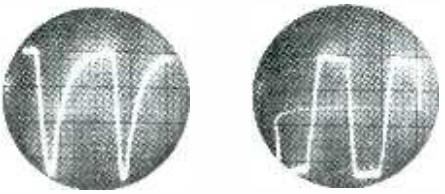
If the calibrator delivers more than the full-scale voltage of the meter, insert resistor R3 and vary its value until the meter is at exactly full scale when the voltage control is set for maximum voltage. If you use care in selecting resistors for the multiplier, the output voltage can be reduced in four steps—each being one-tenth the one above it.

The multiplier values in Fig. 1 are nominal values only. The calibration will be exact if each resistor is one-tenth the value of the one above it in the multiplier string, except for the lowest range (470 ohms in the diagram). This resistor should be one-ninth the next high value. The precision of the multiplier will depend on the precision with which these resistors are selected.

The frequency of the calibrator output is 60 cycles (or the same as the line frequency). The instrument therefore calibrates the oscilloscope for that frequency. If the calibration is to be accurate for other frequencies, the response of the vertical amplifier must be flat to 60 cycles.

Operating instructions

Connect your probe or test leads to the IN terminal of the calibrator and connect the output (OUT) terminal to the scope. The GND terminal is a com-



The calibrator in use. The waveform at left is from a TV sweep oscillator. The one at right is the calibrator output set at the same peak-to-peak deflection.

mon return for the scope and equipment under test. In the TEST position, the signal feeds from the receiver directly to the scope. Adjust the vertical gain control for a convenient deflection. Set the vertical positioning control so the signal under observation is centered on the screen. Throw the function switch to the calibrate (CALIB) position and adjust the multiplier and voltage control for the same peak-to-peak deflection. Multiply the meter reading by the setting of the multiplier.

If the voltage being observed is symmetrical, the operation may be speeded up by flipping the function switch rapidly while adjusting the voltage control until the peaks of the signal and standard voltage are equal. An enterprising constructor could work out a combination of a calibrator and electronic switch so the standard and unknown voltages can be superimposed.

When you have completed the calibrator, you will find it worth while to check the tubes in your scope and record the deflection for at least one setting of the vertical and horizontal gain controls. By making periodic checks with the calibrator, it will be easy to detect changes in the performance of the scope. Weak or gassy amplifier tubes will produce less deflection for a given input voltage and setting of the gain controls. A weak high-voltage rectifier will show up in the form of greater deflection and less brightness for a given voltage input.

Materials for Calibrator

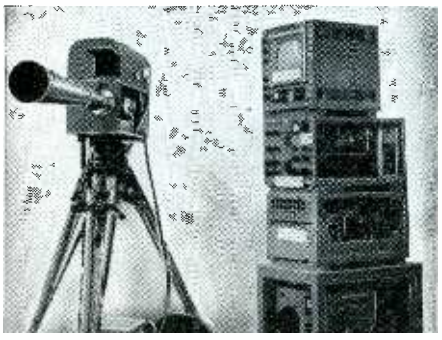
Resistors: 1—470, 1—4,700, 1—47,000, 1—470,000 ohm, ½-watt (selected for multiplier); 1—75,000 ohm, ½ watt; 1—2,000, 2—25,000 ohm, 10 watt. 1—500,000-ohm potentiometer. R2 and R3 depend on meter used.
Capacitors: 1—0.1 μf, 600 volt, paper; 1—20 μf, 450 volt, electrolytic.
Miscellaneous: 1—power transformer, 300-0-300 v. a.c. at 50 ma; 1—6X4, 1—6AL5, 2—0D3 tubes and sockets; 1—meter, 1.5 ma or less; 1—meter rectifier; switches, hookup wire and assorted hardware.

THE MANUFACTURER HELPS

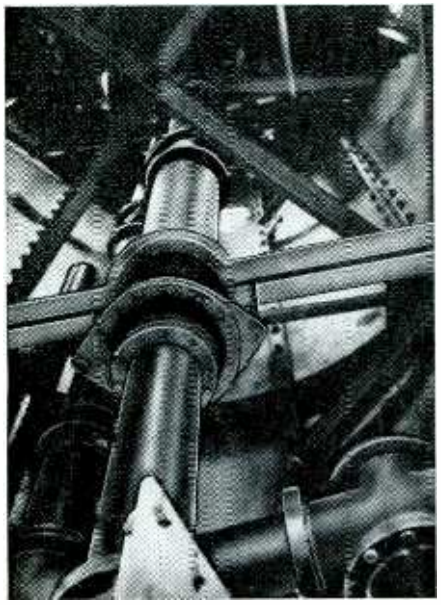
An interesting case of manufacturer-ham cooperation is reported from Queens, Long Island, N. Y. When confronted with about a dozen complaints of interference on TV receivers in his neighborhood, W2ZKV, in that area, sent out a call for help to the RCA Service Company. The local manager of the company attended a meeting of hams in the neighborhood to study the facts of the case, and technicians checked W2ZKV's equipment and the TV receivers of RCA set owners who had entered complaints. The interference was eliminated by installing filters in the receivers.

TV Advances in Britain

By R. W. HALLOWS



The new BBC outside-broadcasts camera, as shown at the National Exhibition.



A view of Sutton Coldfield's diplexer which mixes sound and video at antenna.

This HMV model 2901 is a combination receiver in the high-priced class.

IN BRITAIN today the emphasis is emphatically on bigger television pictures. Progress toward this goal seems, though, to be on a different line than in the United States. Our tube manufacturers don't turn out standard types of cathode-ray tubes bigger than 15 inches. Larger ones are made, but in small quantities; their use in televisers is so limited (to a few sets specially made to the orders of millionaire enthusiasts or research laboratories) that for practical purposes they may be said to play no part in British TV receiving technique.

Rightly or wrongly, tube manufacturers here have chosen to concentrate on the small, superbrilliant tubes required for projection reception. And I'm not at all sure that they haven't got something there. Give the designer of big-picture TV receivers a reliable, long-lived projection tube plus a low-priced corrector lens for the Schmidt optical system, and he's likely to produce something that gives a fine large picture, doesn't cost overmuch, and can be fitted into a neat and not too bulky cabinet.

That's how our designers see it. They have the tubes, for our manufacturers have got over most of the difficulties and are now turning out projection tubes which are not giving many headaches to users or to service technicians. Also, they've got the right sort of corrector lens at the right sort of price, thanks to the newest processes of molding Perspex.

Low cost projection

An example of what can be done is the Philips 600A console which gives a 140-square-inch picture with the accompanying sound and costs the equivalent of $185. In this and other prices, by the way, I have taken no account of purchase tax, for that is a government charge and not one made by manufacturers. To obtain the local equivalent prices add the sales tax prevailing in your area.

I can testify personally to the quality of the images obtained by projection methods. Not long ago, I had the opportunity of seeing the same TV program reproduced on two screens of identical size placed side by side. One was a standard projection set, costing less than $200; the other, a special model, was the finest direct-viewing receiver that could be made, regardless of cost. With a 19½-inch tube and providing nothing but TV sound and vision, its price came out at around $2,000. I admit that the expensive receiver gave rather better images; you'd expect that. But the projection televiser was so nearly as good that I was in no doubt that, in the unlikely event of my having the equivalent of $2,000 in my pockets, I'd far rather have the projection receiver and $1,800 (or even quite a bit less) than the big-tube televiser and no change on the transaction.

Typical British sets

From the picture of the Dynatron "Ether Sovereign" you'll see that what I call the complete-home-entertainer type of apparatus includes some handsome pieces of furniture. This model contains an all-waveband radio receiver, a phonograph with automatic record changer, and a televiser showing an image of about 120 square inches. The price? About $1,200.

Another noteworthy outfit of this kind is the HMV model 2901, offering all-wave radio, record changer-phono, and a 150-square-inch picture for $700.

Between these big fellows and the "poor man's" televisers (giving vision and accompanying sound only and priced at $72 to $115) there's a big choice of receivers, none with less than a 12-inch tube. The tendency is for the medium-priced equipment to include an all-waveband radio receiver and to cost somewhere about $180-220.

An interesting set in the middle-price class is the Ambassador TV2 table model, at $126, which is what we call an SV (sound and vision) type—a straight television receiver without radio or phonograph. Stand a televiser in a cabinet of the usual shape on a table with its back next the wall and *it* dictates where *you* must sit, if you want good viewing. But the back of this Ambassador set is an arc of a circle: no matter if it's within a ¼ inch of the wall, you can swing the set, which is mounted on a turntable, so that *it* suits the chair that *you* have chosen.

At least a dozen manufacturers offer televisers at less than $100. Most of these have 9- or 10-inch tubes and all are of the SV kind. The lowest priced televiser is offered by the Baird Co. With a 50-square-inch picture, it costs $72. About a dozen other models, some with 12-inch tubes, are obtainable at $100-120. One of these, the Pye V30 has a very effective single-tube line time base. Details haven't yet been released, but I hope to have them for you before very long.

Our national TV chain is going ahead

Relays and Their Operation

Part II — How relays can be used in a number of remote control circuits

By JOHN E. PITTS, JR.

STANDARD telephone practice is to establish two reference points, "battery" and "ground." Ground, of course, as in radio work, is the common return circuit not necessarily

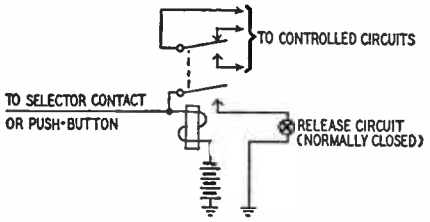


Fig. 12—Simple relay locking circuit.

connected to an earth ground, but general practice is to do so. Battery usually denotes 24 or 48 volts of direct current —the common source of power for all relays, whether obtained from an actual battery or a low-voltage rectifier. The positive pole is normally grounded, except where otherwise required.

In a nonoperated condition a relay usually stands with either battery or ground on one terminal of its coil. To operate the relay it is necessary only to complete the circuit and cause the relay to pull up momentarily or to lock up, whichever is desired. A lock-up circuit is shown in Fig. 12. To cause the

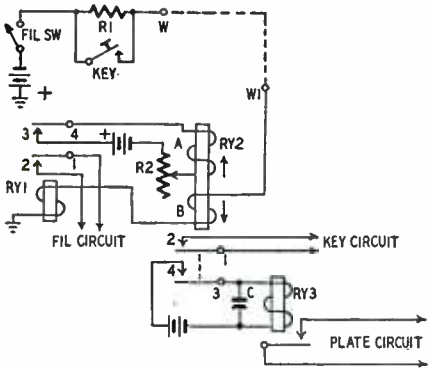


Fig. 13—A single-wire remote control circuit to operate a c.w. transmitter.

relay to release it is necessary to do one of three things momentarily — remove ground or remove battery, breaking the lockup circuit, or short-circuit the relay coil, in which case a resistor would be inserted in the battery lead to the coil.

Fig. 13 shows a control circuit suitable for a c.w. transmitter which controls filament, plate, and keying functions over a single control wire, using the ground as return. The system operates as follows.

The FIL switch is closed to operate RY1, turning on the filaments of the transmitter through contacts 1 and 2. Contacts 3 and 4 on this relay close the battery circuit to the bias winding of RY2 through the A coil of RY2. The purpose of this winding is to neutralize the magnetizing effect of the line current which flows through the windings of both RY1 and B of relay RY2. Both of these windings should have approximately the same resistance. For ease of adjustment, both windings of RY2 should be of the same resistance also. They should be wound simultaneously, so that the magnetizing effect of each winding is the same. The current through A is then adjusted by means of the R2 resistance to be the same as the current through the B winding with the telegraph KEY open.

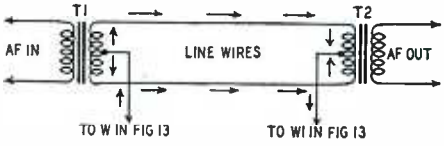


Fig. 14—A simplex circuit that uses a single pair of wires to convert the circuit of Fig. 13 for phone operation.

The A current is poled so that the fields produced by the two windings cancel and do not operate RY2. This is termed *differential operation.*

To put the transmitter on the air after the filaments have been turned on by operating the FIL switch, it is necessary only to send a dot on the key, shorting R1 at the control point, and increasing the line current. General practice is to double the line current during the marking or sending condition. The spacing current then would be the normal line current, unkeyed. At the first dot, contacts 3 and 4 of RY2 close and energize the RY3 relay, a relatively high-resistance relay, 5,000 ohms or more, with a high capacitance C bridged across it. The action of this capacitor is to hold RY3 operated during keying pulses, being momentarily charged by the battery, and discharging through the RY3 coil. This will hold the plate voltage on the transmitter during keying. Depending on the capacitance—a 100-μf, 25- or 50-volt capacitor should be satisfactory—and the coil resistance and spring adjustment of RY3, the relay will hold up for two to four seconds, which should be sufficient.

When circuits of this type are operated over lines of several miles, it is better to supply two batteries, one at each end, connected series-aiding, so that the line resistance and capacitance will appear at the midpoint of the circuit and not cause distortion of the keying pulses.

Should one fortunately be able to lease a telephone line between the operating point and the transmitter, many possibilities present themselves. On just one pair of wires it is possible to obtain one 2-wire voice circuit and one or two d.c. telegraph circuits, for keying or circuit control.

Simplex circuits

Fig. 14 illustrates a simplex circuit suitable for use with the control equipment shown in Fig. 13, in addition to a pair of wires for voice transmission to modulate the transmitter. Transformers T1 and T2 are respectively plate-to-center-tapped 500-ohm line and center-tapped 500-ohm line to grid. An amplifier of two or three milliwatts output may be used to furnish sufficient audio to drive a voltage amplifier connected to the secondary of T2. The simplex leg at T1 allows d.c. to flow from the center-tap of T1 to the line terminals of the coil, and since the current flows as indicated by arrows, the magnetic force is zero in the transformer winding. The simplex coil at T2 receives the d.c. from the line and it flows from the coil center-tap through the relay winding and returns to the battery at T1 via ground. Thus the a.f. voltages are imposed on the d.c. in the circuit with no

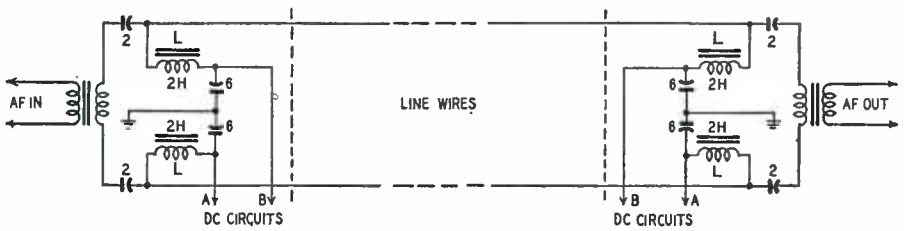


Fig. 15—In this circuit a single pair carries one a.c. and two d.c. circuits.

effect between the two. The current in this case, however, should be limited to a maximum of about 60 ma.

shown. The chokes, L, are about 2 h each. The current here should be limited to about 30 ma. If straight open-and-

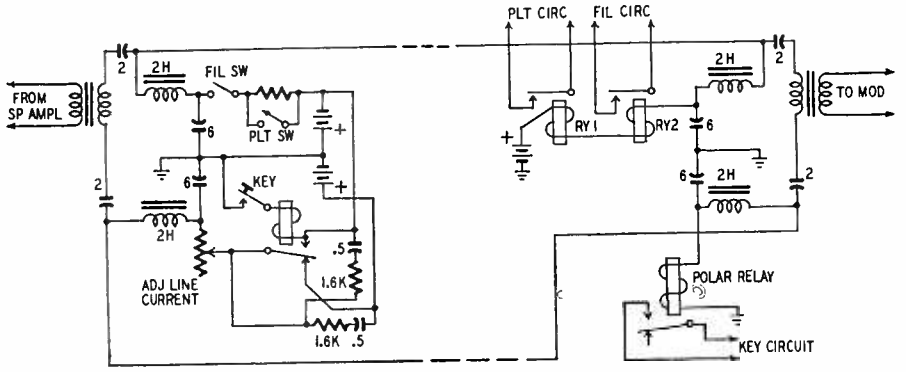


Fig. 16—Phone-c.w. transmitter remote control circuit with an audio circuit.

A composite circuit is shown in Fig. 15, which allows one voice circuit and two d.c. circuits on one pair of wires. Here T1 and T2 may be the same as Fig. 11-a, but need not be center-tapped. Line capacitors are 2-μf and should be as near as possible the exact same capacitance as the other capacitors, as

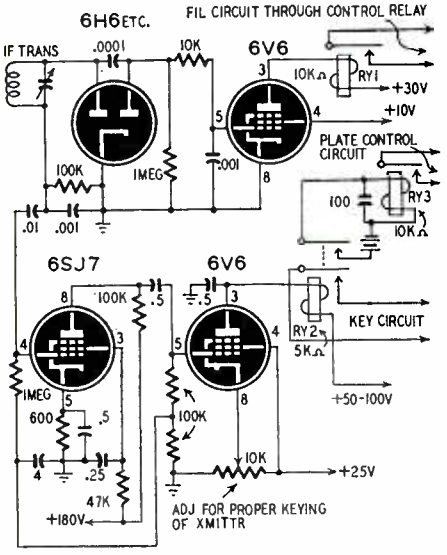


Fig. 17—A radio-operated remote control circuit for a c.w. transmitter.

close or neutral operation of the control circuits is used, operation is apt to be sluggish, due to the large capacitance involved. Therefore, to key a telegraph transmitter over this circuit, a polar relay should be used, as shown in Fig. 16. The spring of RY1 is adjusted to make the armature operate at twice the current required for RY2.

Radio control

Where wire facilities are not available, radio control circuits must be used. Perhaps the simplest control source is the rectified carrier voltage from a half-wave detector, such as the type 6H6 or 75.

Such a circuit does not lend itself to the same type of operation as illustrated in Fig. 13. However, by using the carrier voltage to operate relay RY1 in Fig. 13, and a superimposed tone to operate RY2 and RY3 relays, the same result is achieved. The essential features are shown in Fig. 17.

As previously pointed out, control circuits become exceedingly complicated when they perform several operations, unless selective switching, using some form of rotary switch controlled by impulses, is used.

Rotary selectors

The fundamentals of a rotary selector circuit are shown in Fig. 18. In this particular circuit it is possible to obtain nine separate selections, in any order, reserving the tenth digit, or zero, as a master release. The operation is as follows, all relays except RY1 being shown in the nonoperated position.

Assume that we wish to operate the equipment associated with RY6 contacts. The digit 3 is dialed and the impulse contacts of the dial open three times, releasing the armature of RY1 three times. The RY1 contacts are closed three times. On the first closure RY2 is operated, opening the normally closed back contact and removing ground from the wiper arm of the selector. RY2, being a slow-release relay, does not respond to the dial pulses, but remains operated. This prevents relays on contacts 1 and 2 from being falsely operated as the wiper arm passes over them. As soon as RY2 operates it closes the circuit to RY4, which operates, opening its contacts, and prevents the battery, which is now standing on the reset magnet RY5 through the closure of the off-normal contacts, from operating the RY5 magnet. The off-normal contacts close as soon as the wiper arm operates, to prepare the reset magnet path.

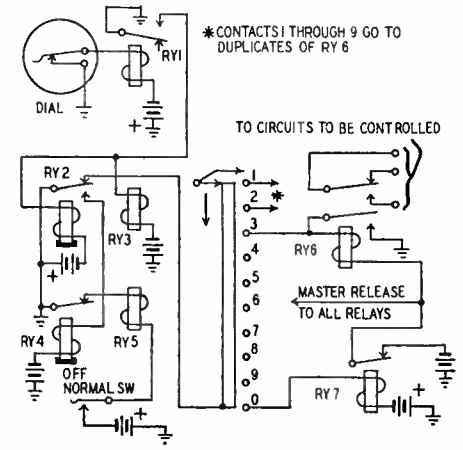


Fig. 18—Basic circuit of a selector. Separate batteries for all relays are shown, but a common unit can be used.

The wiper has progressed to the third contact, and the dial has stopped. Since RY2 no longer receives pulses, it releases, putting ground on the wiper arm. The wiper, standing on contact 3, connects ground to the winding of RY6, operating the relay. RY6 remains operated, through the lockup contacts on its coil.

When RY2 releases, it also removes battery from the RY4 coil, but this relay, being slow-releasing also, for a moment does not put ground on the reset magnet through the RY4 contacts. It is during this short space of time, about half a second, between the release of RY2 and the release of RY4 and subsequent operation of the reset magnet, that control relays are operated. Were RY4 not included, the ground would stand on the wiper for too short a time to operate the control relays. When the reset magnet operates, its armature disengages the pawl from the ratchet on the wiper arm shaft, and the wiper restoring spring returns the wiper arm to its normal position, below the number 1 contact.

By the same procedure, all the control relays may be locked up, and in any order. After any or all of the control relays have been operated and it is desired to release them, the digit O is dialed, momentarily energizing the master release relay RY7. The battery supply to all the control relays flows through the normally closed contacts of RY7. When the digit O is dialed, RY7 operates for the space of time between the release of RY2 and the release of RY4, which is sufficient to release all relays locked up.

A standard phone dial is used in conjunction with equipment of this type. The pulsing contacts are designed to open when the dial is operated, the number of pulses corresponding to the digit dialed. Auxiliary contacts are usually supplied to accomplish other functions during the operation of the dial; however, these vary with different dials.

Since minor switches usually are supplied with two or more banks of contacts, we need not be limited to just nine choices.

At first contemplation of the above, you may throw up your hands in despair at the complexity of the circuits, but if you analyze them one part at a time, studying its operation thoroughly, you should have no trouble.

All the relays described in this article are obtainable on the surplus market. The telephone-type relays are standard items stocked by the Automatic Electric Company or the Graybar Company, both of which have offices in the principal cities.

How an Electric Brain Works

Part VI—Although no genius himself, Simon now helps us to understand how an electric brain is put together

By EDMUND C. BERKELEY* and ROBERT A. JENSEN

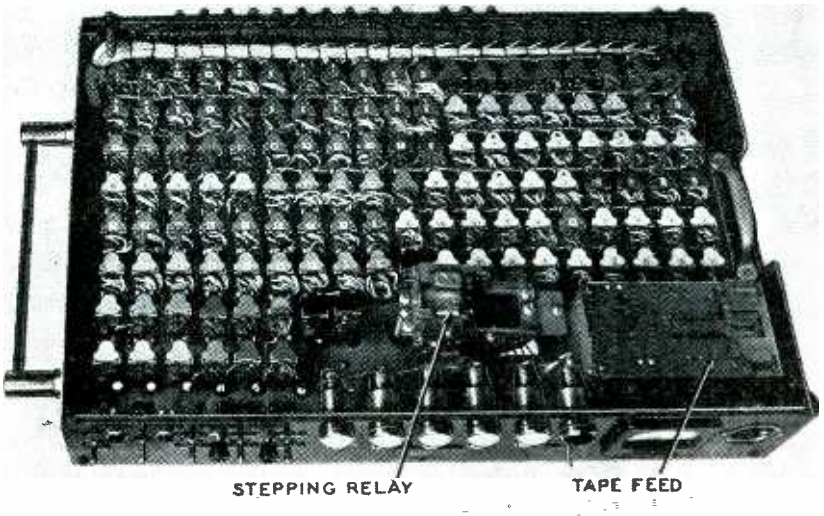


Fig. 1—A photo of Simon with his top cover off. He has 120 relays that make up his gray matter, as well as a few spares for development in the future.

MOST of the operations that are essential for an electric brain have now been explained and illustrated. In previous articles, we have covered relay circuits for:

storing and transferring information;
performing arithmetical operations;
arranging automatic control.

* Author: *Giant Brains*, John Wiley & Sons, Inc.

Now, how do we put all these operations together, so that we actually succeed in making a complete electric brain that will work successfully?

As usual in this discussion, we shall keep to a simple example and leave out the more complicated sides of questions, so that principles may be made clear. But instead of having to talk about hypothetical examples, this time we can talk about an actually existing example—the baby mechanical brain Simon that we have described previously.

The machine Simon was pictured in the October, 1950, issue of RADIO-ELECTRONICS, and some more pictures of it are given here. A top view is shown in Fig. 1, and a bottom view in Fig. 2. Because Simon does not have covers in these pictures, some idea of what the machine is really like may be gained from them.

From the top view we can see that Simon has:

a front panel, with lights, buttons, switches, and a meter;
a tape feed, for feeding 5-hole paper tape;
a stepping switch, for timing the machine; and—
some 120 active relays, for operations.

The bottom view shows:

some banks of small rectifiers;
some capacitors, for spark suppression; and
a lot of wiring.

When finished in May 1950 Simon knew only the numbers 0, 1, 2, and 3. As a result of changes of his circuits made in August 1950, however, Simon now can take in numbers from 0 to 15 and can report numbers from 0 to 31. With some more changes, Simon could handle bigger numbers still.

Earlier we said there were five parts to every mechanical brain: input, output, storage, computer, and control. Where are these various parts in Simon located?

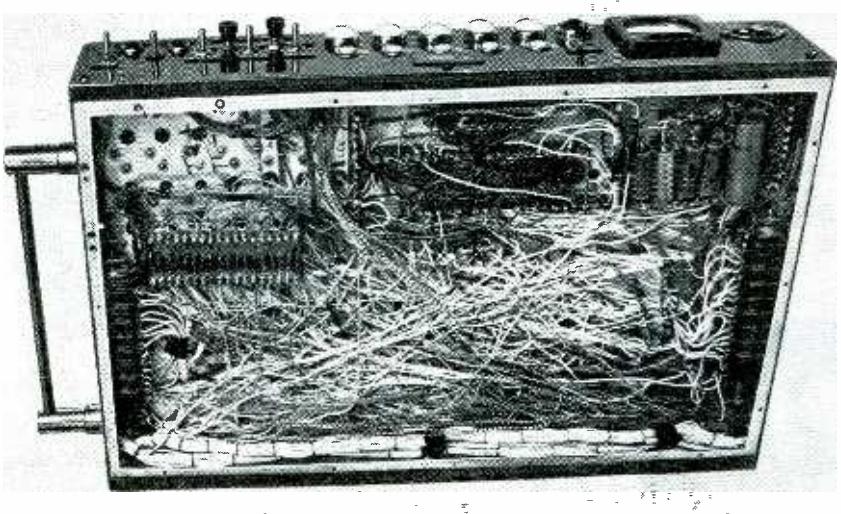


Fig. 2—Simon's underside is mostly a lot of wiring. He also has some small selenium rectifiers and some capacitors that are used for spark suppression.

Input

The *input* of Simon consists of 5-hole paper tape, the tape-feeding mechanism (see Fig. 1), and switches and buttons (see Fig. 3). These are all the ways in which you can give information to Simon so that he will know exactly what to do and in what order to do it.

Ordinarily, when you want to run a problem on Simon, you write out the commands (with 1's and 0's, using binary notation) cycle by cycle on a piece of paper. This is called the *coding* for the problem. Then you punch this coding onto a piece of tape, put the tape into the tape feed, and turn on the power. The tape runs, and Simon clicks away, "thinking," as he works out the answers to his problems.

You may, if you wish, give Simon general instructions applying to any one or more numbers, and then put the numbers into the machine by hand from

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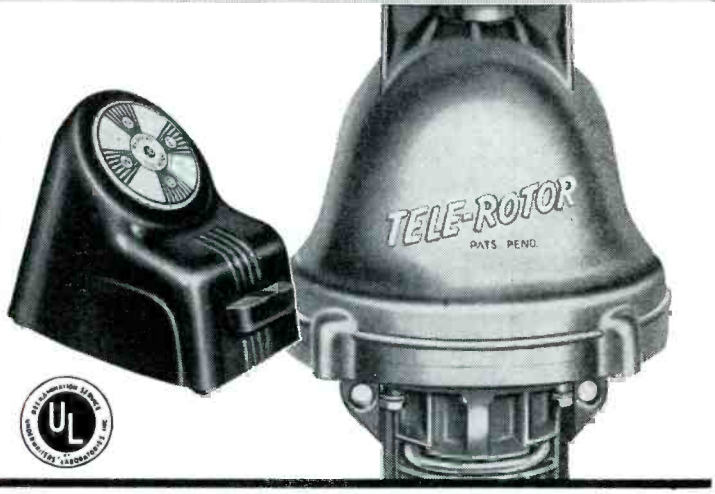

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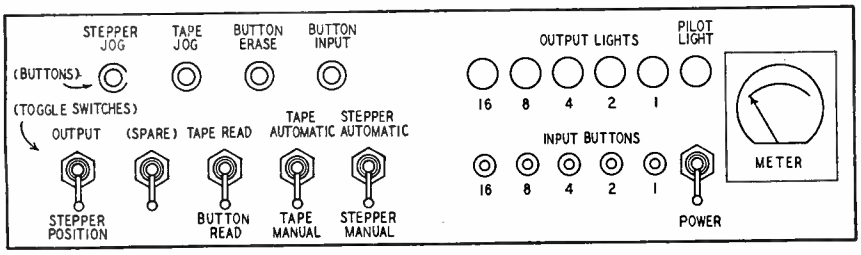


Fig. 3—Diagram of Simon's front panel showing his controls and indicators.

time to time at appropriate points. You can tell Simon to stop at an appropriate place, by punching into the tape an indication for a "programmed stop," as it is called. When Simon makes a programmed stop, you press any one or more of the buttons numbered 8, 4, 2, 1 (see Fig. 3). This action inserts the number which is the sum of the figures selected, into the button relays (register BR in Fig. 4). Then to transfer the number from the button register into Simon's regular input register (register IR 2 and IR 1 in Fig. 4), you press a button called BUTTON INPUT (see Fig. 3). Finally, you press the STEPPER JOG button (see Fig. 3), and Simon runs on, automatically reading and obeying the tape.

Table of Relay Abbreviations

Abbreviation	Name of Group	Purpose
ASR	Auxiliary Stepping Relay	Slow down the stepping switch.
BR	Button Register	Temporarily record numbers in instructions from buttons.
CR	Computer Registers	Compute
ER	Entrance Relays	Allow information to enter registers.
IR	Input Registers	Temporarily record numbers from the tape or the buttons.
OR	Output Registers	Hold answers, to be shone in the output lights.
PR	Program Relays	Record programming information from the tape or from the buttons, and control Simon.
RR	Reset Relays	Reset, release, or clear registers, so that new information may be stored in them.
SPR	Step-Position Output Relay	Allows the position of the stepping switch to be read in the output lights.
SR	Storage Registers	Store information until used.
SYR	Synchronism Relays	Arrange that the tape and the machine cycles shall be automatically in synchronism.

Output

The *output* of Simon also is on the front panel (see Fig. 3). It consists of five lights, called OUTPUT LIGHTS 16, 8, 4, 2, and 1. In these lights any number from 0 (no lights shining) up to 31 (all five lights shining) can be indicated. For example, if OUTPUT LIGHTS 16, 4, and 1 are shining, the number indicated is 16 plus 4 plus 1, or 21. You program Simon so he will stop when a result has been delivered. You can examine and, if you wish, copy the result; and then, when you press the STEPPER JOG button, Simon will run on.

The sixth light on the front panel is a red pilot light which shines when the power is on; and the meter reads the voltage at which Simon is operating. Simon will operate at 20 to 35 volts d.c.

Storage, computer, and control

The functions of storage, computing, and control in Simon are carried out by relays. Of course, a good deal of the control is also expressed in the tape, but relays take the information from the tape and operate with it.

A diagram showing all the 129 relays of Simon is given in Fig. 4. Each relay is represented by a rectangle placed in the correct physical location (compare Fig. 4 with Fig. 1). There are 19 columns, corresponding to the columns shown in the photograph. Fig. 1, and 8 rows (the two bottom ones incomplete) corresponding to the rows shown in Fig. 1.

The relays in Simon may be designated in either one of two ways, according to location in the machine, and according to function.

For wiring purposes, the relays are designated by location, that is, by row (a single letter C, D, E, F, G, H, N, or P) and by column (a number 1 to 19).

But for purposes of understanding Simon, the functional designations are useful. To designate a relay by its function, each relay has an abbreviation that may have three parts. Part 1 is two or more letters, to tell the kind of register. Part 2, if any, is a number, used to number off registers all of the same kind. These numbers are not always consecutive, for reasons that will be explained later. Part 3, if any, is a number in parentheses, used to tell the binary digit being handled by that relay.

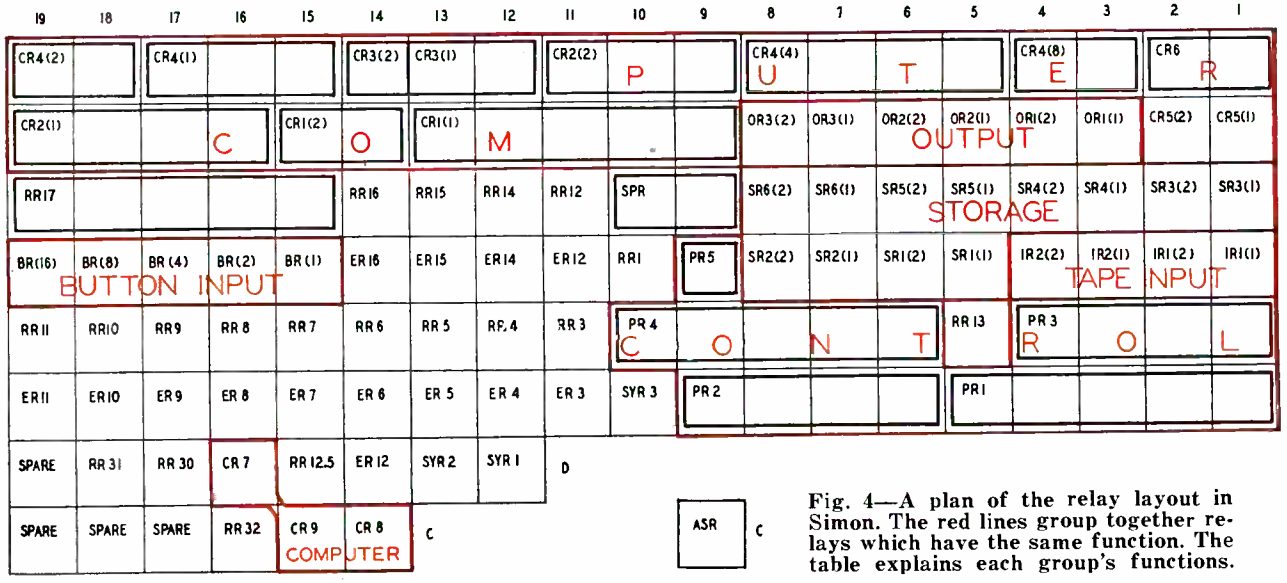
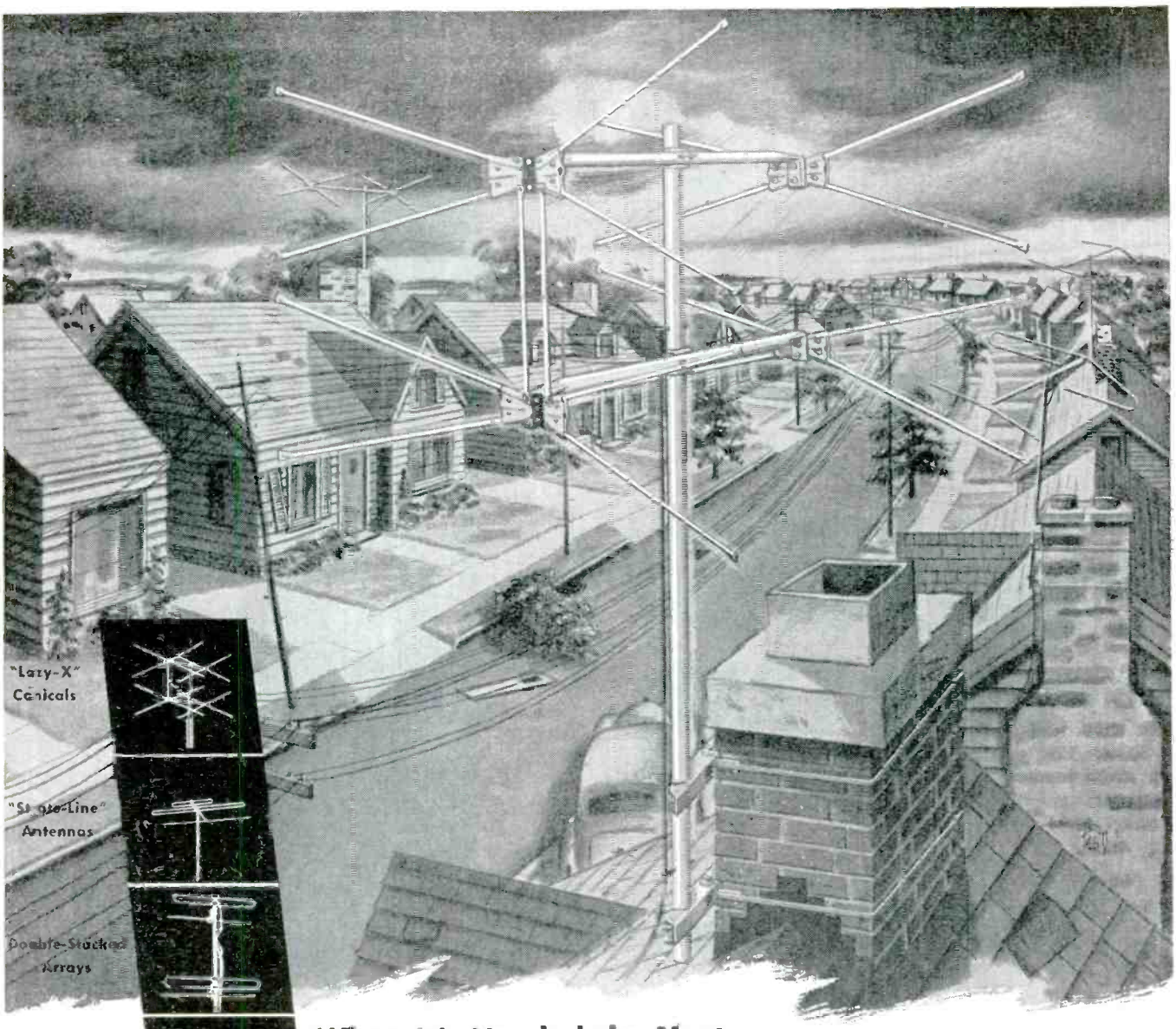


Fig. 4—A plan of the relay layout in Simon. The red lines group together relays which have the same function. The table explains each group's functions.



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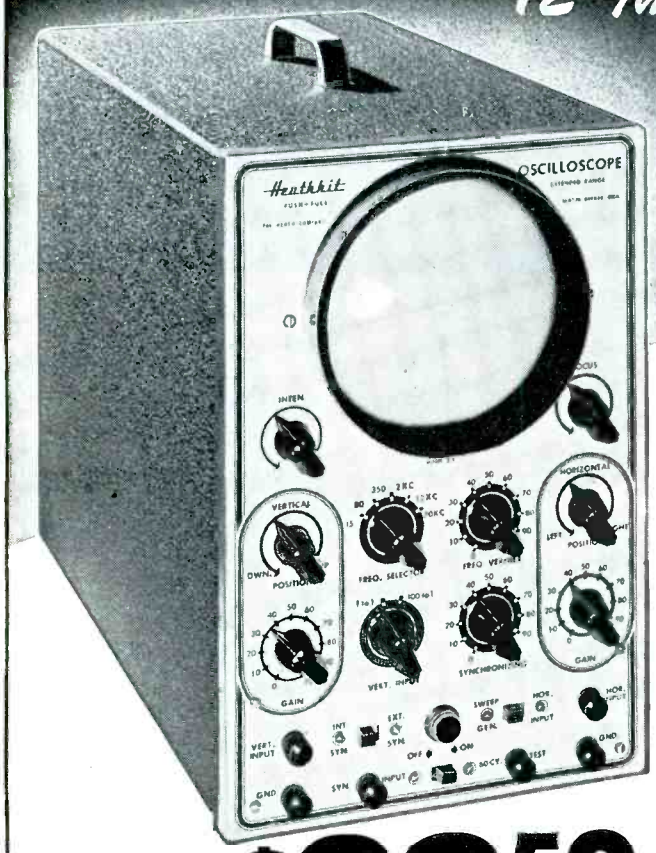

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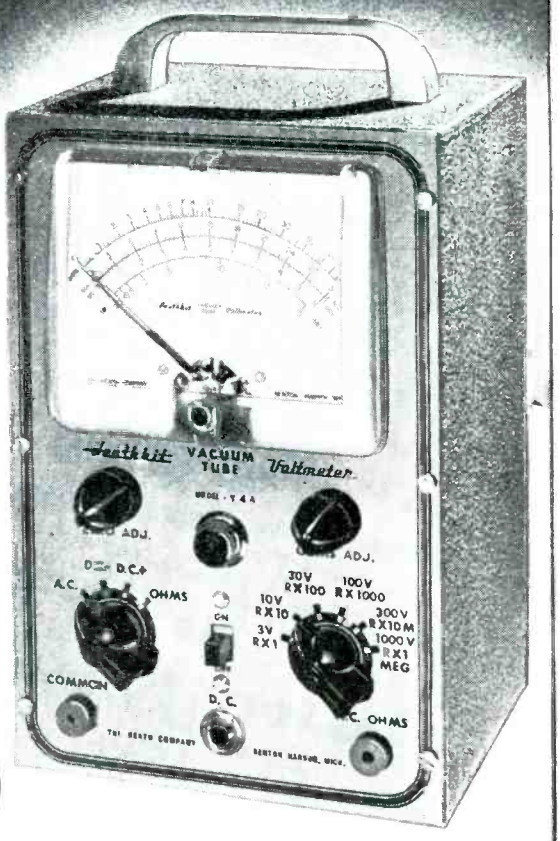

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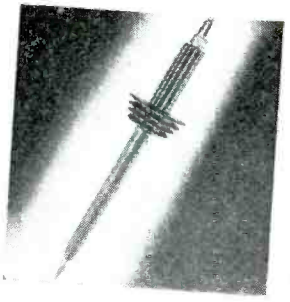


New 30,000 VOLT DC PROBE KIT

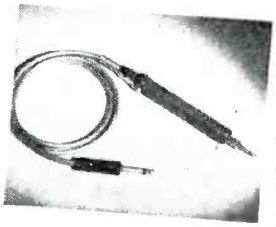
Beautiful new red and black plastic high voltage probe. Increases input resistance to 1100 megohms, reads 30,000 Volts on 300 Volt range. High input impedance for minimum loading of weak television voltages. Has large plastic insulator rings between handle and point for maximum safety. Comes complete with PL55 type plug.

No. 3366 High Voltage Probe Kit. Shipping Wt., 2 pounds. **$5.50**

Heathkit RF PROBE KIT

Crystal diode probe kit extends range to 250 megacycles ± 10% comes complete with all parts, crystal, cable and PL55 type plug.

No. 309 RF Probe Kit Shipping Wt., 1 lb. **$5.50**



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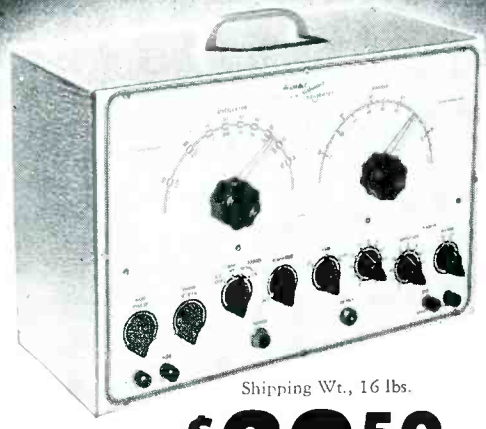
. . . BENTON HARBOR 20, MICHIGAN

NEW Heathkit T. V. ALIGNMENT GENERATOR KIT



Shipping Wt., 16 lbs.

$39.50

★ New simplified circuit for easy calibration and assembly.
★ New 2 band built-in marker covers 19 to 75 Mc.
★ New dual spider sweep motor for long life.
★ New blanking circuit gives base line for better alignment.
★ New variable oscillator gives high output fundamentals on high TV band.
★ New standby switch keeps instrument ready for instant use.
★ New 6 to 1 slow speed drive on both master oscillator and marker tuners.

The new Heathkit TV Alignment Generator incorporates the new developments required for modern TV servicing. An absorption marker circuit covering all possible IF bands and even several of the RF bands. The new blanking circuit provides a base reference line which is invaluable in establishing proper traces. The new sweep motor incorporates dual spiders in the speaker frame assuring better alignment and long life. The mounting of the speaker sweep motor has been simplified for easy alignment.

The variable master oscillator covers 140 to 230 Mc. thus giving high output fundamentals where they are most needed. Low band coverage 2 Mc. to 90 Mc.

A new step attenuator provides excellent control of output.

Planetary 6 to 1 drives on both oscillator and marker provides smooth easy control settings.

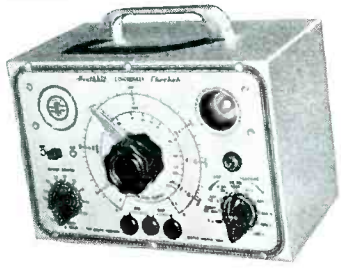
A standby position is provided making the instrument always instantly available.

Horizontal sweep voltage with phasing control is provided. No other sweep generator under $100.00 provides all these features — comes complete with instruction manual. Model TS-2.

Heathkit CONDENSER CHECKER KIT

Only

$19.50



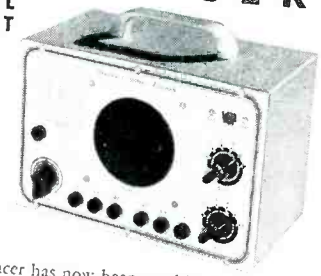
Features

- Power factor scale.
- Measures resistance.
- Measures leakage.
- Checks paper-mica-electrolytics.
- Bridge type circuit.
- Magic eye indicator.
- 110 V. transformer operated.
- All scales on panel.

Checks all types of condensers over a range of .00001 MFD to 1,000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read. A leakage test and polarizing voltage for 20 to 500 Volts provided. Measures power factor of electrolytics between 0% and 50%. 110 V. 60 cycle transformer operated complete with rectifier and magic eye tube, cabinet, calibrated panel, test leads and all other parts. Clear detailed instructions for assembly and use. Model C-2. Shipping Wt., 7 lbs.

NEW Heathkit SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50



Features

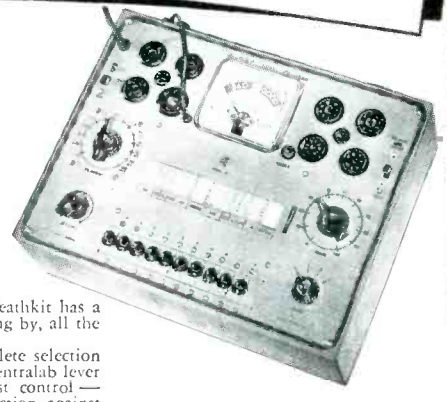
- High sensitivity
- Complete set of speaker impedances
- Tests microphones and PA systems
- Tests both single and push-pull speaker circuits

The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — detective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast — FM or TV receivers. The test speaker has assortment of switching ranges to match push-pull or single output impedance. Also test microphones, pickups, PA systems — comes complete — cabinet, 110 V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Model T-2. Shipping Wt., 8 lbs.

Heathkit TUBE CHECKER KIT

Features

- Sockets for every modern tube — blank for new types.
- Fastest method of testing tubes — saves time — makes more profit.
- Rugged counter type birch cabinet.
- Gear driven roller chart gives instant setup for all types.
- Tests each element separately for open or short and quality.
- Beautiful 3 color meter — reads good-bad and line set point.



Test your tubes the modern way — dynamically — the simplest, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open or shorted elements slipping by, all the advantages of the mutual conductance type without the slow cumbersome time consuming setups.

Your Heathkit Tube Checker has all the features — beautiful 3 color BAD-GOOD meter — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin miniatures — finest quality Centralab lever switches for each element — high grade birch counter type cabinet — continuously variable line adjust control — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against obsolescence. The best of parts — rugged oversize 110 V. 60 cycle power transformer — finest of Mallory and Centralab switches and controls, complete set of sockets for all type tubes with blank spare for future types. Fast action brass gear driven roller chart quickly locates the settings for any type tube. Simplified switching cuts necessary testing time to minimum and saves valuable service time. Short and open element check. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangements of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker Kit today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better assemble it now. Complete with instructions — pictorial diagrams — all parts — cabinet — ready to wire up and operate. Model TC-1 Shipping Wt., 12 lbs.

$29.50

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NEW 1951 Heathkit SIGNAL GENERATOR KIT

Features

- Sine wave audio modulation.
- Extended range 160 Kc. to 50 megacycles fundamentals.
- New step attenuator output.
- New miniature HF tubes.
- Transformer operated for safety.
- Calibrated harmonics to 150 megacycles.
- New external modulation switch.
- 5 to 1 vernier tuning for accurate settings.

A completely new Heathkit Signal Generator Kit. Dozens of improvements. The range on fundamentals has been extended to over 50 megacycles; makes this Heathkit ideal as a marker oscillator for T.V. New step attenuator gives controlled outputs from very low values to high output. A continuously variable control is used with each step. New miniature HF tubes are required for the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The set is transformer operated and a husky selenium rectifier is used in the power supply. The coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers.

A best buy — think of all the features for less than $20.00. The entire coil and tuning assembly are assembled on a separate turret for quick assembly — comes complete — all tubes — cabinet — test leads — every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator. Shipping Wt., 7 lbs.

$19.50

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

- Either sine or square wave.
- Stable RC bridge circuit.
- Covers 20 to 20,000 cycles.
- Less than 1% distortion.

Hundreds of Heathkit Audio Generators are used by speaker manufacturers—definite proof of their quality and dependability. The added feature of square wave opens up an entirely new field of amplifier testing. Uses the best of parts, 4 gang condenser, 1% calibrating resistors, metal cased filter condensers, 5 tubes, completely calibrated panel and detailed instruction manual. One of our best and most useful kits. Model G-2. Shipping Wt., 12 lbs.

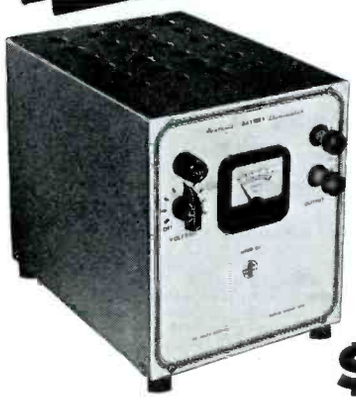
$34.50

THE NEW Heathkit HANDITESTER KIT

- Beautiful streamline Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-30-300-1,000-5,000 Volts.
- Large quality 3" built-in meter.

A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision dividers for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping Wt., 2 lbs.

$13.50



NEW Heathkit BATTERY ELIMINATOR KIT

Features

- Provides variable DC voltage for all checks.
- Locates sticky vibrators-intermittents.
- Voltmeter for accurate check.
- Has 4000 MFD Mallory filter for ripple-free voltage.

Even the smallest shop can afford the Heathkit Battery Eliminator Kit. A few auto radio repair jobs will pay for it. It's fast for service, the voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. Also serves as storage battery charger. Ideal for all auto radio testing and demonstrating.

$22.50

A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter for clean DC. 0-15 V. voltmeter indicates output which is variable in eight steps. Easily constructed in a few hours from our instructions and diagrams — better be equipped for all types of service — it means more income. Model BE-2. Shipping Wt., 19 lbs.

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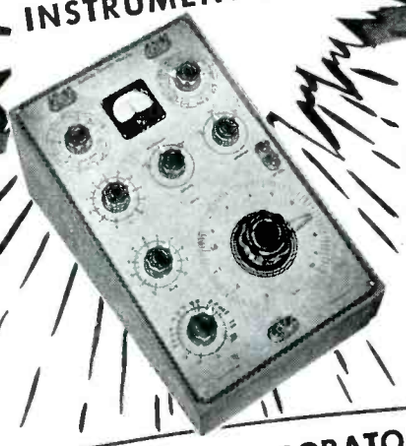
New LABORATORY INSTRUMENT KITS

HUNDREDS OF LABORATORIES USE

Heathkit IMPEDANCE BRIDGE as Standard



Features

● Measures inductance 10 microhenries to 100 henries ● Measures resistance .01 ohms to 10 megohms ● Measures capacitance .00001 MFD to 100 MFD ● Measures "Q" and power factor.

Measures inductance from 10 microhenries to 100 henries, capacitance from .00001 MFD to 100 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1,000. Ideal for schools, laboratories, service shops, serious experimenters. An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1,000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of Silver Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

$69.50

Internal 6 Volt battery for resistance and hummer operations. Circuit urilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Model IB-1. Shipping Wt., 15 lbs.

NEW Heathkit LABORATORY RESISTANCE DECADE KIT

Features

- ½% Accuracy
- Birch Cabinet
- Ceramic Switches
- Covers 1 ohm to 99,999 ohms

$19.50

The new Heathkit Resistance Decade is a handy tool for laboratory, school and service shop. Ideal for test setups, calibrating instruments, bridge measurements, selecting multipliers, etc.

Uses the finest Centralab ceramic switches, ½% ceramic decade resistors and heavy birch cabinet matching other laboratory equipment. The range is 1 ohm to 99,999 ohms in one ohm steps.

Finest quality throughout to withstand school usage — heavy aluminum panel — laboratory type binding posts — the fine decades are extremely simple to assemble — complete kit. Model RD-1. Shipping Wt., 4 lbs.

NEW Heathkit LABORATORY POWER SUPPLY KIT

Features

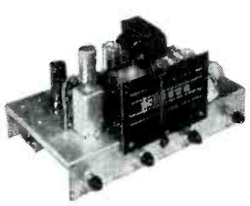
- **Supplies 6.3 V. AC at 4.5 Amps.**
- **Heavy duty construction.**
- **Handy for schools, labs., and service shops.**
- **Supplies variable DC 50-300 Volts.**
- **Shows voltage or current on 3½" meter.**

This new Heathkit Variable Power Supply Kit fills hundreds of needs — use it for experimental circuits — no need to build a separate power supply — use it for a test voltage to determine proper coefficients in unknown circuits — calibrate instruments with its variable voltage, etc. This new Heathkit supplies 50 to 300 Volts continuously variable DC together with an AC filament voltage of 6.3 Volts at 4.5 Amperes. A built-in 1 MA 3½" meter has proper shunts to read 0-500 Volts and 0-200 Milliamperes. The circuit uses a 5Y3 rectifier, two 1619 tubes as electronic control tubes to vary the output voltage with a single potentiometer. Case measures 7⅛" x 13" x 7⅛". Has instruction manual for assembly and use. Model PS-1. Shipping Wt., 18 lbs.

$29.50

Heathkit RECEIVER & TUNER KITS for AM and FM

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS



Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt., 10 pounds.

$19.50

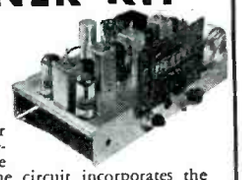
Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt., 10 lbs.

$23.50

Two new Heathkits. Ideal for schools, replacement of worn out receivers, amateurs and custom installations.

Both are transformer operated quality units. The best of materials are used throughout — six inch calibrated slide rule dial — quality power and output transformers — dual iron core shielded I.F. coils — metal filter condensers and all other parts. The chassis has phono input jack — 110 Volt outlet for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

TRUE FM FROM Heathkit FM TUNER KIT



$22.50

The Heathkit FM Tuner Model FM-2 was designed for best possible tonal reproduction. The circuit incorporates the most desirable FM features — true FM — ready wound and adjusted coils — 3 stages of 10.7 Mc. I.F. (including limiter).

Tube lineup: 7E5 oscillator, 6SH7 mixer, two 6SH7 I.F. stages, 6SH7 limiter, two 7C4 diodes as discriminator, 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. The R.F. coils are ready wound — mounted on the tuning condenser and the condenser is adjusted — no R.F. coils to wind or adjust.

A calibrated six inch slide rule dial has vernier drive for easy tuning. The finest parts are provided with all tubes, punched and formed chassis, transformers, condensers and complete instruction manual. Model FM-2. Shipping Wt., 10 lbs.

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ENJOY MUSIC AT ITS *Finest* WITH *Heathkit* AMPLIFIERS

NEW *Heathkit* HIGH FIDELITY 20 WATT AMPLIFIER KIT

$21.50

Features

- Push-pull 6L6's.
- Full 20 Watts output.
- Fully enclosed chassis.
- Provisions for reluctance pickup compensation stage.
- Cased high fidelity output transformer.
- Treble and bass boost tone controls.
- Full range of output impedances 3.2 ohms to 500 ohms.

The finest amplifier kit we have ever offered — check the features. This inexpensive amplifier compares favorably with instruments costing five times as much. Nothing has been spared to provide the best reproduction — an ideal amplier for the new Heathkit FM Tuner listed below.

Dual tone controls for control of both treble and bass. Bass control is of the boost type for maximum listening pleasure. Optional preamplifier stage for use with G. E. reluctance pickup or microphone. Uses inverse feedback to give excellent response over entire range. Tube lineup: 6SJ7 preamplifier stage, 6J5 phase splitter stage, two 6L6's in push-pull and 5Y3 rectifier. (6SC7 as optional compensation stage).

Uses highest quality Chicago Transformer Corporation cased output transformer with taps of 3.2, 8, 15, 60 and 500 ohms to match any speaker combination. Power transformer is conservatively rated for continuous operation in sound systems. Tone control gives maximum bass boost of 6 db at 70 cycles. Amplifier has maximum gain of 75 db. Response within 3 db 20 to 20,000 cycles. Shipping Wt., 17 lbs. Complete with all parts, tubes and instruction manual.

Model A-5A Amplifier with preamplifier for G. E. cartridges or microphone **$23.50**
12" 20 Watt Speaker, No. 326 ..... **7.50**

Heathkit ECONOMY 6 WATT PUSH-PULL AMPLIFIER KIT

$12.50

No. 304, 12-inch Speaker... **$6.95**

This new Heathkit Amplifier was designed to give quality reproduction at a very low price. Has two preamp stages, phase inverter stage and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watt output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at new low price. Better build one. Model A-4. Shipping Wt., 7 lbs.

Heathkit RECEIVERS and TUNER CABINETS

$4.95

Order No. 350 for FM tuner.

Blonde birch veneer cabinet for either the receivers or tuner. Modern styling is an asset to any room. 5" speaker fits in end of cabinet when used with receivers. Size 7 x 13½ x 8¼ inches. Shipping Wt., 5 lbs.
Order No. 345 for either receiver

Metal professional type communications receiver cabinet. Finished in deep grey to fit the panel supplied with Heathkit BR-1 and AR-1 Receivers (panel shown not included with cabinet). 5" speaker mounts in end of cabinet. Gives professional appearance to Heathkit receivers. Size 7 x 14 x 7¾ inches. Shipping Wt., 6 lbs.

5" Permoflux Speaker for either cabinet for use with either Heathkit Receiver No. 320 5" Speaker..... **$2.75**

$4.50

No. 335 Cabinet for receivers only.

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Quantity	Item	Price	Quantity	Item	Price
	Heathkit Oscilloscope Kit — Model O-6			Heathkit VTVM Kit — Model V-4A	
	Heathkit T.V. Alignment Gen. Kit — TS-2			Heathkit R.F. Probe Kit — No. 309	
	Heathkit FM Tuner Kit — FM-2			Heathkit H.V. Probe Kit — No. 336	
	Heathkit Broadcast Receiver Kit — Model BR-1			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit Three Band Receiver Kit — Model AR-1			Heathkit Condenser Checker Kit — Model C-2	
	Heathkit Amplifier Kit — Model A-4			Heathkit Handitester Kit — Model M-1	
	Heathkit Amplifier Kit — Model A-5 (or A-5A)			Heathkit Variable Power Supply Kit — Model PS-1	
	Heathkit Tube Checker Kit — Model TC-1			Heathkit Resistance Decade Kit — Model RD-1	
	Heathkit Audio Generator Kit — Model G-2			Heathkit Impedance Bridge Kit — Model IB-1	
	Heathkit Battery Eliminator Kit — Model BE-2			Heathkit Signal Tracer Kit — Model T-2	
	Heathkit Electronic Switch Kit — Model S-2				

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Please ship C.O.D. ☐ Postage enclosed for_____lbs.

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New Tubes of the Month

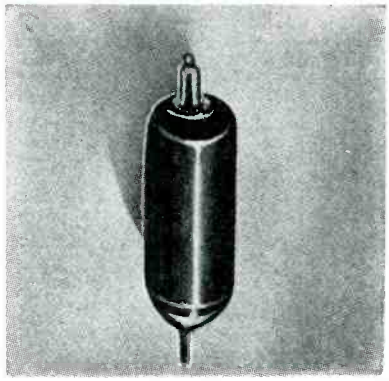
An important advance in television picture tube design is a 17-inch rectangular metal kinescope announced by RCA. Its shell can be produced on high-speed automatic machinery to reduce production costs and it is much less fragile and considerably lighter in weight than similar glass tubes.

Designated as the 17CP4, the new metal tube has a picture area of

17CP4

14⅝ x 11 inches with slightly curved sides and rounded corners. It has a frosted Filterglass faceplate to reduce stray reflections and increase picture contrast. Electrical characteristics of the tube are similar to those of the 16GP4; it has 16 kv as maximum anode rating; 410 volts maximum on grid No. 2; a 66° horizontal deflection angle; and 100 ma current in the focus coil.

A unique low-cost radiation counter tube, the CK1026, has been announced by Raytheon. The tube has its cathode on the outside of the glass shell in the form of an electrically conductive graphite coating called "dag" dispersion No. 154. It operates with 900 volts on the anode, and the glass shell acts like a high resistance in series with the tube. Maximum counting rate is 10,000



The new outside-cathode counter tube.

counts per minute and its total life is greater than 10^7 counts. The tube is designed for detecting gamma radiation in prospecting equipment.

G-E has a new thyratron, the GL-5855, for general control circuit operation over a wide temperature range. Its maximum ratings are: peak anode voltage, 1500; cathode current, peak 150 amp, average 12.5 amp; negative control-grid voltage, 250 volts before conduction and 10 volts during conduction.

DYNAMIC NEUTRALIZATION OF CLASS C AMPLIFIERS

By MARVIN H. KRONENBERG, W2IJU

The need for neutralization is one of the disadvantages of using triodes and poorly shielded tetrodes as r.f. amplifiers in transmitters. The usual procedure for neutralizing an amplifier is to remove its plate-supply voltage and apply normal r.f. grid drive. Set the neutralizing capacitor or capacitors so grid current is constant and there is no indication of r.f. in the plate tank when the plate tuning capacitor is tuned through resonance. Although this method takes considerable time, it is satisfactory when performed correctly on an amplifier which is operating properly. A considerably faster and more accurate neutralization method is used by many commercial operators. This operation, which may best be described as dynamic neutralization, is carried out while the amplifier is operating with normal load and plate voltage.

As most amateurs and commercial operators have noticed, the *maximum* grid current and *minimum* plate current (resonance) occur at the same setting of the plate tank capacitor when the amplifier is fully neutralized. All too often, this does not happen when the rig is neutralized using the method just described. Instead, the grid current may peak when the plate circuit is tuned slightly above or below resonance. It is possible to tell if there is too much or too little neutralizing capacitance by noting whether the peak occurs on the low- or high-capacitance side of plate-circuit resonance. The procedure for dynamic neutralization is based on these observations.

Follow these rules when neutralizing any r.f. amplifier by the dynamic method:

1. Set the neutralizing capacitors to a reasonable value. If the amplifier has been neutralized previously, the approximate settings will be known. Otherwise it may be necessary to determine the approximate settings by the usual neutralizing method.
2. Apply normal excitation, then turn on the plate supply and adjust the plate load to normal. Carefully tune the plate circuit on both sides of resonance and note the grid current. (a) If the grid-current *maximum* coincides with plate-current *minimum* leave it alone. The stage is fully neutralized. (b) If the grid current peaks on the *low-capacitance* side of plate-circuit resonance, *more* neutralizing capacitance is needed. (c) *Reduce* the neutralizing capacitance when the grid current peaks on the *high-capacitance* side of resonance.

Only a few trial settings are required to reach perfect neutralization as indicated by maximum grid current and minimum plate current occuring at the same setting of the plate tuning capacitor. Any amplifier neutralized by this method will pass any test for neutrali-

zation if it is free from parasitics and other defects.

It is simple to test the neutralization of any transmitter. Simply detune the amplifier. The grid-current meter will tell the story.

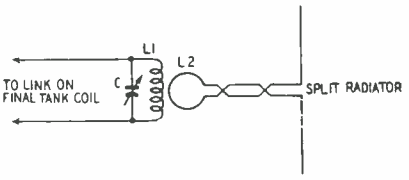
A final word of caution: remove the plate voltage from the stage before touching the neutralizing capacitors if they don't have long insulated shafts which can be reached while standing well away from the rig.

(If your rig is one of those compact jobs in a relay rack or cabinet, better pull the big switch and discharge the filter capacitors before making any adjustments. Those innocent-looking coils and plate caps can do a lot of damage. We had to learn the hard way.—*Editor*)

LINK COUPLING TO BEAM

By GEORGE W. MAKI, WØZGO

Link coupling is an efficient way to transfer r.f. from one stage of a transmitter to another. We have found that it works equally well in transferring r.f. from the transmitter to the radiator of a beam antenna. It has certain advantages over most matching systems. It's easy to adjust; one person can do it within a few minutes, there is no guess work, and you get more r.f. into the radiator.



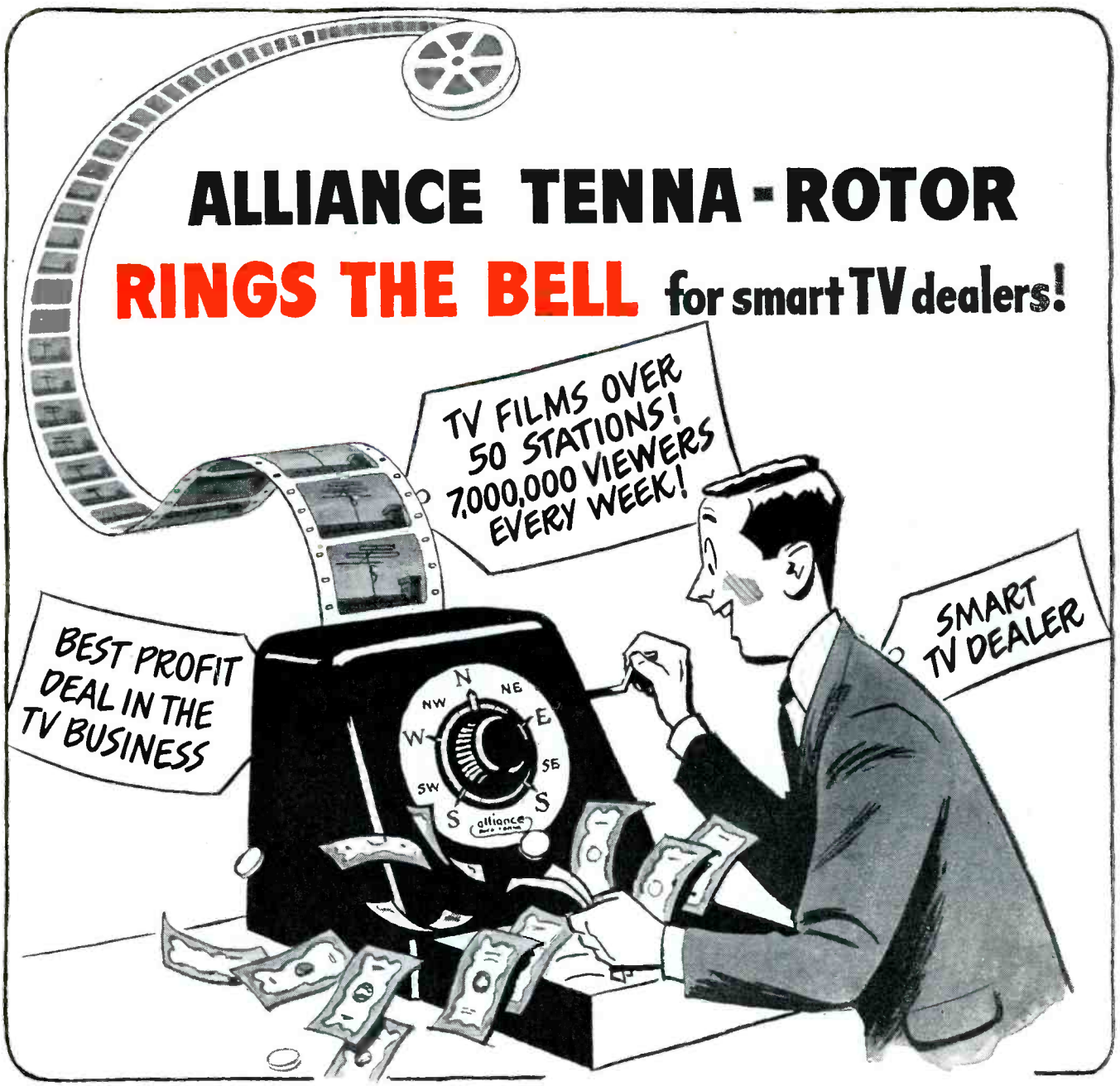
To feed a 10-meter beam, you simply construct a 10-meter tank circuit, wind a 1-turn link around the center of its coil, and mount the whole thing on the beam next to the radiator. The link connects across the center of the split radiator and the transmission line—any type will do—across the tank coil. Of course, you will want to enclose the unit in a weather-proof wooden box.

Adjustment is simple. Before you install the unit, place it near your transmitter final amplifier and resonate it wave-meter-fashion to the transmitter frequency. Keep this setting and install the unit on your beam. Then retune the final amplifier. It's a good idea to recheck the tuning of the link-coupling unit by holding a neon bulb on the radiator a few feet from center and tuning for maximum brilliancy. Last of all, recheck your final.

The drawing shows the coupling unit for a 10-meter beam. L1 is six turns of ¼-inch copper tubing wound with an inside diameter of 2 inches. L2 is a single turn of No. 12 rubber-covered wire wound tightly around the center of L1. The ends of L2 are twisted together to form a short link to the center of the radiator. C is a 50-μμf variable capacitor. A midget receiving-type unit will do for medium power. On high-power rigs, use a capacitor with sufficient spacing to prevent arc-over in damp weather.

ALLIANCE TENNA-ROTOR

RINGS THE BELL for smart TV dealers!



Be Sure You Have This Winning Combination

TENNA-ROTOR

The only fully automatic rotator. *Just set it and forget it!* Set the pointer . . . the antenna turns to that position and stops. North—East—South—West—direction indicator dial shows exact antenna position at all times.

Model HIR Tenna-Rotor

ALLIANCE TENNA-SCOPE

The new TV booster with one simple control. Gives maximum uniform high gain on all channels. Automatic on-off switch. Easy to install. An excellent companion item to Tenna-Rotor.

Tenna-Scope

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NEW DELUXE MODEL HIR IS FULLY AUTOMATIC!

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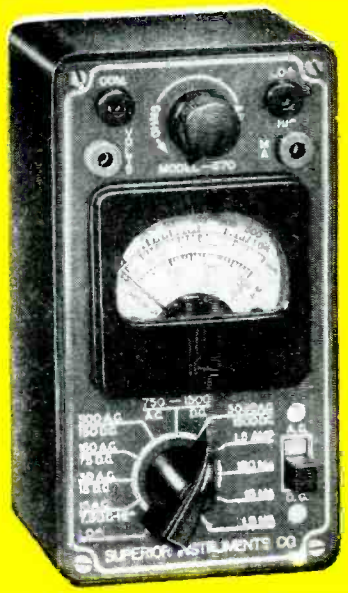

SUPERIOR'S new model 770

AN ACCURATE POCKET-SIZE VOLT-OHM MILLIAMMETER

(SENSITIVITY: 1000 OHMS PER VOLT)

FEATURES

★ Compact-measure 3⅛" x 5⅞" x 2¼".
★ 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.

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

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

$14.90 NET

Superior's new model 670

SUPER-METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: −10 to +18 +10 to +38 +30 to +58

ADDED FEATURE:

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

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

Superior's new model TV-20

20,000 OHMS PER VOLT MULTI-METER *and* TELEVISION KILOVOLTMETER

The Model TV-20 was designed to provide all the multi-meter measurement requirements of A. M., F. M. and Television. Unlike other recent models, which are actually standard V.O.M.'s converted to test the new Television Voltages, the Model TV-20 is a completely new unit. It provides the sensitivity, ranges and accessories which are needed to service F. M. and Television in addition to A. M. Radio. The High Voltage Probe for example, with a range of 50,000 volts and designed to withstand 100,000 volts, is an integral part of the instrument with a special compartment for housing it when not in use.

SPECIFICATIONS

- 9 D. C. VOLTAGE RANGES: (at 20,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000/50,000 Volts
- 8 A. C. VOLTAGE RANGES: (At 1,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000 Volts
- 5 D. C. CURRENT RANGES
  0-50 Microamperes
  0-5/50/500 Milliamperes
  0-5 Amperes
- 4 RESISTANCE RANGES:
  0-2,000/20,000 ohms 0-2/20 Megohms
- 7 D. B. RANGES: (All D. B. ranges based on ODb = 1 Mv. into a 600 ohm line)
  — 4 to + 10 db + 36 to + 50 db
  + 8 to + 22 db + 42 to + 56 db
  + 22 to + 36 db + 48 to + 62 db
  + 28 to + 42 db
- 7 OUTPUT VOLTAGE RANGES:
  0 to 2.5/10/50/100/250/500/1,000 Volts

ADDED FEATURE:

The Model TV-20 includes an Ultra High Frequency Voltmeter Probe. A Silicon V. H. F. Diode together with a resistance capacity network provides a frequency range up to 1,000 MEGACYCLES. When plugged into the Model TV-20, the V. H. Probe converts the unit into a Negative Peak-Reading H. F. Voltmeter which will measure gain and loss in all circuits including F. M. and T. V.; check capacity and impedance; test efficiency of all oscillator circuits; measure bandwidth of F. M. and T. V.; etc.

The Model TV-20 operates on self-contained batteries. Comes housed in beautiful rand-rubbed oak cabinet complete with portable cover, Built-In High Voltage Probe, H. F. Probe. Test Leads and all operating instructions. Measures 4½" x 10¼" x 11½". Shipping Weight 10 lbs.

$39.95 NET

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GENERAL ELECTRONIC DISTRIBUTING CO. DEPT. RC-3, 98 PARK PLACE NEW YORK 7, N. Y.

Superior's New Model TV-10

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing-aid, Thyratron, Miniatures, Sub-Miniatures, Novals, etc. Will also test Pilot Lights.
★ Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
★ Tests for "shorts" and "Leakages" up to 5 Megohms.
★ 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-10 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any line voltage between 105 Volts and 130 Volts.

The Model TV-10 operates on 105-130 Volts 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$39.50 NET

The New Model 200

AM and FM SIGNAL GENERATOR

SPECIFICATIONS

★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.
★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R.F. signal. Also available separately.
★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.
★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.
★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycle and an accuracy of 2% on the higher frequencies.
★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and aperating instructions.

$21.85 NET

Superior's new model TV-30

TELEVISION SIGNAL GENERATOR

ENABLES ALIGNMENT OF TELEVISION I. F. AND FRONT ENDS WITHOUT THE USE OF AN OSCILLOSCOPE!

FEATURES Built- in modulator may be used to modulate the R. F. Frequency, also to localize the cause of trouble in the audio circuits of T. V. Receivers.

Double shielding of oscillatory circuit assures stability and reduces radiation to absolute minimum. Provision made for external modulation by A. F. or R. F. source to provide frequency modulation. All I. F. frequencies and 2 to 13 channel frequencies are calibrated direct in Megacycles on the Vernier dial. Markers for the Video and Audio carriers within their respective channels are also calibrated on the dial.

Linear calibrations throughout are achieved by the use of a Straight Line Frequency Voriable Condenser together with a permeability trimmed coil.

Stability assured by cathode follower buffer tube and double shielding of component parts.

SPECIFICATIONS Frequency Range: 4 Bands—No switching; 18-32 Mc., 35-65 Mc., 54-98 Mc., 150-250 Mc.

Audio Modulating Frequency: 400 cycles (Sine Wave). Attenuator: 4 position, ladder type with constant impedance control for fine adjustment. Tubes Used: 6C4 as Cathode follower and modulated buffer. 6C4 as R. F. Oscillator. 6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded co-axial lead and all operating instructions. Measure 6" x 7" x 9". Shipping Weight 10 lbs.

$33.95 NET

MONEY BACK GUARANTEE!!

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$ _____ (Payment in Full Enclosed)

$ _____ (Deposit Enclosed—Ship Balance C.O.D.)

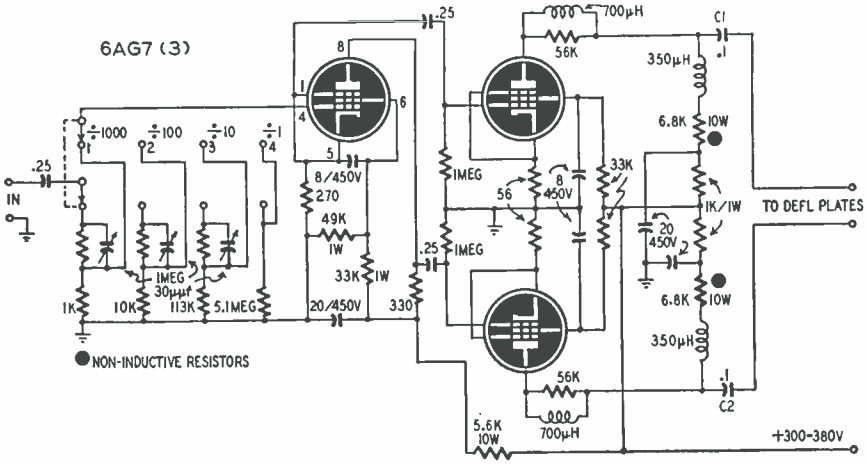
WIDE-BAND AMPLIFIER EXTENDS SCOPE RANGE

? *I am constructing a 5-inch scope and would like to have a diagram of a deflection amplifier which will be relatively flat from 60 cycles to 2 mc and useful to 4 mc. Please include a compensated attenuator and include instructions for adjusting it.—E. A. T., St. Louis, Mo.*

A. This amplifier will provide sufficient sweep voltage for most 5-inch C-R tubes. It is recommended by RCA for use in scopes using tubes of the 5UP-series. The high-frequency response of this amplifier is a function of the peaking coil values and stray capacitance.

A wide-range a.f. oscillator can be used to adjust the compensating capacitors in the attenuator. Feed in a signal around 20 cycles and measure the deflection on the scope. Measure the voltage at the input to the attenuator. Change the oscillator to around 20,000 cycles and adjust its output to the same voltage level as the low-frequency signal. Adjust the capacitor so the deflection on the scope is the same for the high- and low-frequency signals. Use this procedure for each capacitor. When the adjustment is made, the calibration will hold for all frequencies.

If the cathode of the C-R tube is grounded or near ground potential, C1 and C2 should be rated at 2,000 volts or more. When the cathode is returned to a high negative voltage, C1 and C2 may be rated at 600 volts.



Typical values for peaking coils are shown on the diagram. For best results, it may be necessary to experiment with these values. The larger coils may be Miller type 1050 variable inductors and the smaller ones standard TV peaking coils or sections from small pie-wound r.f. chokes.

Use noninductive 10-watt resistors in the plate leads of the push-pull 6AG7's.

COIL DATA FOR COMMUNICATIONS RECEIVER

? *I want to build the communications receiver described in the June, 1950, issue. Being in Brazil, I am not able to purchase the BC-453 and BC-454 receivers which supply some of the hard-to-get components. Can you recommend substitutes or tell me how I can make my own coils for L11, L12, L13, and L14? Where is the tap placed on L6?—E. D. S., Rio de Janeiro*

A. L11 and L12 are antenna and r.f. coils respectively for the 5-mc tuner. L11 and the secondary of L12 may be 12 turns of No. 24 enamelled wire wound to cover ¾ inch on a ¾-inch form. The primary of L12 is approximately 6 turns of No. 28 or 30 insulated wire interwound with the ground end of the secondary.

L13 may be a standard broadcast oscillator coil shunted with a 300-μμf trimmer to tune it to 1340 kc. L14 may be a Miller type 212-M5 or 612-M5 132-kc b.f.o. transformer with enough capacitance lumped across it to tune to 85 kc. If these transformers are used, the b.f.o. must be changed to the electron-coupled type. You can use a 4-pie, 5-mh r.f. choke as a substitute for L14 in the original circuit. Break the lead between the second and third pies. Two pies can be shunted with a .001-μf fixed capacitor and a 500-μμf variable capacitor to adjust the circuit to 85 kc. The remaining pies are connected to the grid circuit. It may be necessary to reverse the connections to the grid winding to make the circuit oscillate.

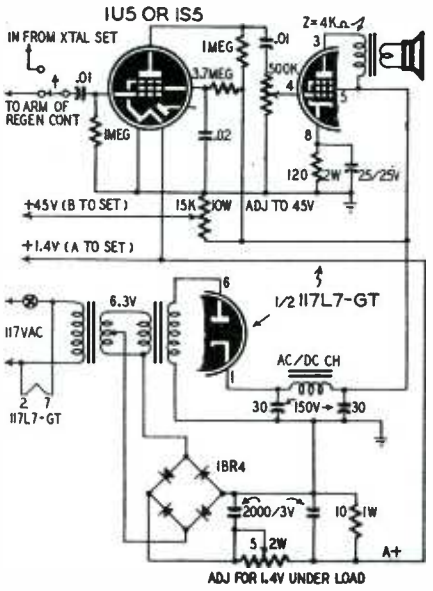
L6 is tapped at approximately the sixth turn from the ground end. If you wish to experiment with the circuit, set the tap at a point which gives least variation in grid current over the tuning range.

AMPLIFIER AND POWER SUPPLY FOR 2-TUBER

? *I have had good results with the two-tube receiver shown on page 84 of the January, 1949, issue, as well as with a number of crystal sets. I would like to construct a small unit to use as a power amplifier for the crystal sets and a combination power supply and amplifier for the two-tuber. I want to use an 117L7 as power amplifier and rectifier if possible.—K. E. McG., Toronto, Ont.*

A. The circuit is shown. If you want to

incorporate the unit in the two-tube set, replace the 1T4 a.f. amplifier in the two-tuber with this 1U5 or 1S5 in the circuit. The 117L7 is the power amplifier and B-supply. The 1BR4 (Mallory) rectifier supplies A-voltage for up to five 50-ma tubes. Adjust the 5-ohm resistor to deliver 1.4 volts under load and set the tap on the 15,000-ohm voltage divider to deliver the desired B-



voltage—up to 135 volts—under load.

This amplifier can be used to provide loudspeaker volume and operating voltages for most one- and two-tube battery sets. The output transformer can be any small unit wtih about 4,000 ohms primary impedance.

WIRE RECORDER CIRCUIT

? *I have a St. George basic wire recorder mechanism and would like to have diagrams of a converter and amplifier for it. Can you tell me where I can find suitable circuits?—G. T., Johnstown, Pa.*

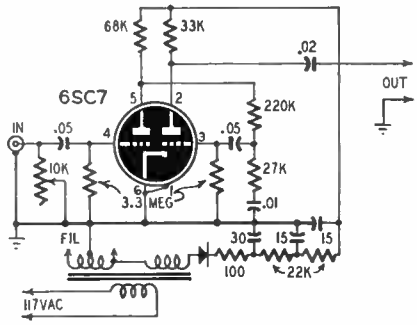
A. Recording mechanisms similar in many respects to the St. George unit are used in the Air King A275 described in our May, 1949, issue and in the Crescent H-2A1 recorder. A diagram of the electronic circuits used in this model will be found in Volume 3 of *Automatic Record Changer Service Manual* published by Howard W. Sams & Co., Inc.

Suggested by G. N. Manning, Dalton, Ga.

"I found the squeak in your radio, Lady."

MODIFYING G-E PREAMP

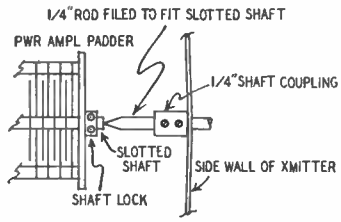
G-E recommends 6,800 to 15,000 ohms as the input resistor in preamplifiers for variable-reluctance pickups. While increasing the high-frequency response, the higher value reproduces scratch on old or poor records. I have replaced this fixed resistor with a 10,000-ohm potentiometer connected as shown. This



control can be adjusted to suppress scratch on old records or reduce the boosted highs on high-fidelity recordings.—*Albert L. Sohl*

ARC-5 CONVERSION

Some hams use ARC-5 and SCR-274-N command transmitters on two bands by switching out the ganged power-amplifier tuning capacitor and using the padder to tune the plate circuit to the second harmonic of the oscillator. The slotted shaft on the padder is hard to get at.

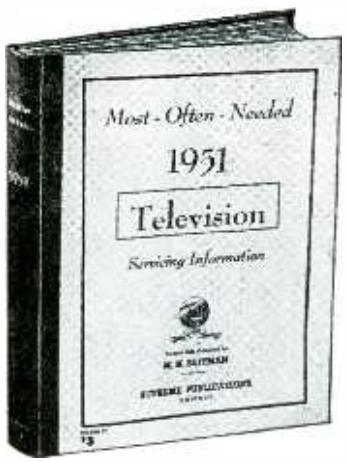


A fellow ham developed this simple method of coupling an extension shaft to the padder: A 3- or 4-inch piece of ¼-inch shafting is tapered at one end so it fits into the end of the slotted capacitor shaft. Insert this end of the shaft through the hole provided for screwdriver adjustments then slip a ¼-inch coupling over it. Force the shaft into the slot, then slide the coupling against the transmitter wall and tighten it so the wall is forced slightly outward. The springiness in the wall holds the shaft in the slot. Place a knob on the shaft to complete the job. The drawing shows this modification.—*Wm. Muessig, Jr., W7OKH*

COOLING A TV SET

Before I worked out this method of cooling it, my TV set would get very warm after operating for a couple of hours. A replacement phonograph motor was purchased and fitted with a 4-inch fan. I cut the bottom out of a 5-pound syrup can and mounted the motor in it. Small angle brackets were used to fasten the assembly to the perforated back of the set. With the motor leads connected across the primary of the power transformer, the fan draws out the warm air and set runs cool.—*Melvin Youngman*

New SUPREME 1951 TV Manual



New 1951 Television Manual

This newest giant volume of the series covers 1951 factory data on all popular television sets of all makes. There are circuit explanations, 192 pages of alignment procedure, test patterns, response curves, pages of waveforms, voltage charts, service hints, and dozens of large double-page circuit diagrams. Manual style binding. At your parts jobber or by mail, only..... **$3**

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Use the new 1951 TV manual and the earlier volumes (see listing at left) to help you with all TV repairs. Cuts hour-wasting jobs to pleasant moments. Use test patterns for quick adjustment, or look up probable cause of trouble in the pages of hints after simply observing fault in video picture. No equipment needed with these tests. Or use your voltmeter and compare values with many voltage charts included. With an oscilloscope you can get waveforms similar to hundreds illustrated using test points suggested and in a flash locate what used-to-be a hard-to-find fault. Order at our risk for a 10-day trial. Use coupon at bottom of page.

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The new 1951 TV manual is the most remarkable value offered by **Supreme Publications** in their 17 years of business. This giant-size television servicing manual at only $3, or the TV manuals for previous years for only $3 and $2 each, are amazing bargains and defy competition. There is nothing else like them. Each manual is a virtual treatise on practical television repairs. By normal standards, each such large manual packed as it is with practical facts, hundreds of illustrations, diagrams, charts, photographs, and expensive extra-large blueprints, should sell for $10—but as SUPREME special values they are priced at $3 and $2 each. Only a publisher who sold over one million TV and radio manuals can offer such bargains based on tremendous volume-sales.

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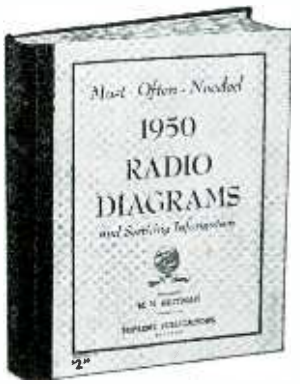

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Now you can benefit and save money with **Supreme** amazing manual scoop. This one giant volume has all the service data you need on all recent radio sets. Here you have clearly-printed large schematics, needed alignment data, parts lists, voltage values, and information on stage gain, location of trimmers, and dial stringing illustrations. This is the help you need to find tough faults in a jiffy. The new 1950 radio manual is a worthy companion to the 9 previous volumes used to an advantage by over 128,000 shrewd radio men.

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SAVING APPLIANCE CORDS

Soldering irons, electric toasters, irons, and hair dryers often have a heavy spring to protect the line cord at the point where it enters the body of the appliance in question. After some time, the insulation of the cord begins to wear at the point where it enters the coil spring. As soon as the wear is visible, stretch the spring until the worn spot in the insulation is well within the coils. This can be done several times before it becomes necessary to replace the cord.—*Carl Laine*

IMPROVING FRINGE PICKUP

TV or FM installations at some distance from the transmitter are often on the fringe of good reception where precise tuning of the antenna system will increase the signal enough to make it useable. Frequently this is inconvenient or difficult. A simple method of tuning which may produce satisfactory results is to wrap a piece of tin foil around the lead-in—this idea applies only to ribbon lines—and adjust its size and position for best performance. Fasten it permanently in place with cement or Scotch tape. In television fringe installations, it is usually desirable to have several individually tuned antennas rather than to try to make one work for all stations.—*Gray Trembly*

INTERMITTENT HEATER CHECKER

Intermittent heaters in a.c.–d.c. sets are hard to locate and have caused many service technicians to waste lots of time hunting for them. This little gadget will enable you to locate intermittent heaters in a comparatively short time.

It consists of one tube socket for each type of tube base and heater connections. The filament or heater terminals are wired in series with a 117-volt lamp. A 25-watt size will do the job for testing most tubes used in a.c.–d.c. sets. Check the wattage of the lamp to be sure that the drop across the tube will not exceed its normal voltage rating.

The lamp will remain lighted as long as there is continuity through the tube socket. An intermittent heater will cause the lamp to go off and on or flicker.—*Robert C. Sanford*

EXTENDING BATTERY LEADS

Servicing farm and portable battery radios can be hard on your nerves when the batteries are connected to the chassis through a short cable which does not permit them to be moved out of your way. Avoid this trouble by making 2-, 3-, or even 4-foot extension leads for the batteries most commonly used. Remove the socket or receptacle from an old battery. Mount it on one end of the extension cable and a male battery plug on the other. This makes it easy to shove the batteries to one side where they won't crowd the working area. Male and female snap-on connectors are used to make leads for batteries used in personal portables.—*H. A. Blake*

FIXED BIAS SUPPLY

Hearing-aid batteries are a handy source of bias voltage for audio amplifiers. I find that they weigh less and require much less space than the line-operated supplies they replace. Because of their low internal resistance, voltage regulation is just about perfect for all practical purposes.

They are available in 15-, 22.5-, 30-, 33-, and 45-volt sizes which make it possible to use one or more to come within 5 to 10% of the required grid voltage. Their life is long, particularly in circuits which do not draw grid current. Always mount batteries in the coolest part of the chassis because heat considerably shortens their useful life. —*M. Ort*

MARKING METAL PANELS

It is easy to make attractive, permanent, legible labels on aluminum, galvanized iron, copper, and other bright metals. Remove dirt and grease from the surface with carbon tetrachloride, then use a medium pen and a good grade of India ink for the markings. Take your time and make the lettering as neat as possible. You will be proud of the job when it's finished. When the ink is dry, apply a thin coat of lacquer or clear nail polish to preserve the lettering.

It is a good idea to mark the tube number next to the socket on all your equipment. This makes trouble-shooting easier and you can be sure of returning the tubes to the correct sockets when you remove them for testing.—*Frank J. Lutz, Jr.*

SPOTTING PA MICROPHONES

The public-address or remote broadcast operator frequently encounters a setup in which he must control the levels of a number of mikes, and pick-ups, and other devices. While the same situation exists in the studio, even an excellent operator occasionally cuts in the wrong mike on a remote job, because he is not familiar with the controls and mike locations in the temporary layout. Embarrassment may be prevented and a smoother program will result if each mike or other source is positively identified with its respective gain control.

Place a small dot of colored paint on or near each gain-control knob, a different color being used for each control. Each mike, pickup, etc., is marked with a color matching that of its control. The color labels should be temporary so that each new layout can be "tailored" to suit the circumstances.

An excellent material for such labeling is colored cellulose tape, which may be purchased in most office-supply stores. A strip of tape of the proper color wrapped around a mike stand, or a small square of tape stuck on the top of a phono pickup will be easily visible in a hurry.

Such a marking system is also convenient in similar fields, such as stage lighting, sound effects, experimental electronic work, and others requiring rapid association of controls.—*Richard H. Houston*

VARIABLE COUPLING FOR IRON-CORE TRANSFORMER

Patent No. 2,519,426
Dwight W. Grant, Bloomfield, N. J.
(Assigned to Bell Telephone Labs., Inc.)

This method permits gradual variation of transformer coupling from maximum to zero as desired, with no moving parts. The degree of coupling depends upon how much of the primary flux is permitted to link the secondary. Linkage is controlled by a current through a coil which biases or saturates part of the core and governs the linkage flux. The invention has possibilities as a magnetic amplifier or as a transformer of the variac type.

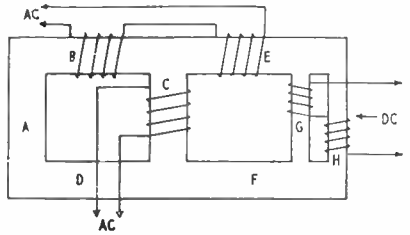

Fig. 1—Diagram of the transformer.

One form of the new transformer is shown in Fig. 1. Two a.c. coils are used, of which either one may be chosen as primary. Power is then available from the other a.c. coil. One coil is split in equal parts, B and E. The other is wound over the vertical leg C. These coils can be coupled only by flux linking them through the core.

The control coil has two equal windings, G and H. They are wound in opposite directions and are energized by d.c.

Fig. 2-a shows flux conditions with no d.c. input to the control coil. In this figure BE is used as the primary. Each half of it, B and E, generates the same amount of flux. At a certain

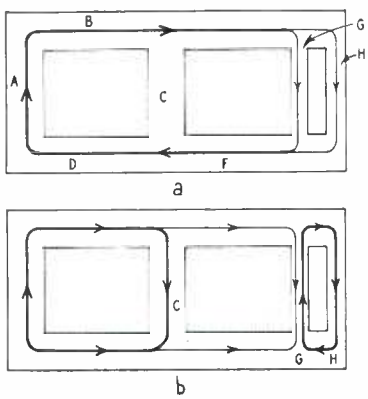

Fig. 2—Flux paths in transformer core.

instant the left half generates flux along DAB and *down* through C. The right half of this coil generates flux through G and H in parallel, then along F and *up* through C. There is no resultant flux through C because the two fields in it are equal and opposite. Coupling between primary and secondary is zero.

Fig. 2-b shows what happens when the control coil is energized. The core legs G and H are magnetically biased. The d.c. flux flows in a closed path and does not enter the remainder of the core. H can accommodate practically no additional flux (from E) without saturating. Flux from E enters G, however, because its direction is opposite to that which already exists. Because of the limited path, flux generated by E is considerably reduced. This leaves a net *downward* flux through C. The a.c. coils are now partially coupled.

If the d.c. is increased past the saturation value, no primary flux can enter either G or H. The entire primary flux is now generated by B alone. This flux flows downward through C without opposition, and achieves maximum coupling.

This invention thus not only provides a control device that effectively varies the coupling between two a.c. windings, but it also varies the coupling over a very wide range—from zero to maximum possible. Thus the invention might be used as a modulation device, with the modulation voltage applied to the control winding.

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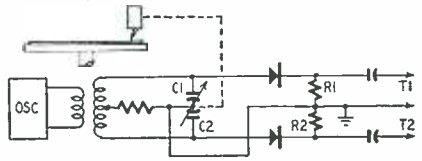
PHONO PICKUP

Patent No. 2,522,870
John W. Hammond, Towson, Md.
(Assigned to Bendix Aviation Corp.)

Like other pickups of this type, this improved capacitance pickup has a small vibrating mass (stylus and associated parts) which provides excellent high-frequency response and reduces record wear.

An r.f. oscillator which may be located at a remote point feeds a transformer through a low-impedance line. The transformer secondary is center-tapped and tuned to the oscillator frequency by a small dual capacitor, C1, C2. The center plate of this capacitor is a tiny piece of metal fixed to the stylus, and this plate is normally positioned mid-way between the outer plates. The r.f. voltage therefore divides equally across C1, C2, and equal voltages appear across the load resistors R1, R2. Terminals T1, T2 are at the same potential so there is no output.



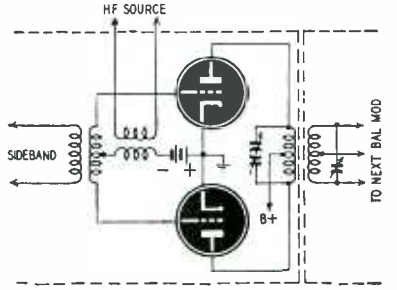
When a record is played, the stylus vibrates at an audio rate and carries with it the center capacitor plate. This plate is alternately displaced first towards one outer plate and then towards the other. For example, at some instant, capacitance C1 increases and C2 decreases. The r.f. tuning is not varied appreciably but the voltage across C1 is reduced and the voltage across C2 is increased. There is a corresponding change in the rectified voltages across R1, R2. During the next half-cycle of vibration the load voltages vary in the other direction.

Push-pull a.f. is available between T1 and T2. This may be amplified directly without need for an FM discriminator as in previous capacitance pickups.

SINGLE SIDEBAND MODULATOR

Patent No. 2,507,178
George L. Usselman, Port Jefferson, N. Y.
(assigned to Radio Corp. of America)

An improved single-sideband transmission system, in which the need for a large number of filters is eliminated, is claimed in this patent. Most single-sideband transmitters require several filters, this system uses only one. One sideband (the upper one) is progressively increased in frequency until it is in the desired band. The other sideband is eliminated without filters.



A balanced modulator (see figure) is fed with audio and 100-kc voltage. Sum and difference beats are generated. The 100 kc is cancelled by the balanced arrangement. The lower sideband is filtered out, leaving only the upper sideband (100.1-106 kc). Then a second balanced modulator raises the frequency still higher. Note that in this stage the lower sideband is equal to the original audio input (0.1-6 kc) and there is no difficulty eliminating it from the modulator output which is tuned to the other sideband (200.1-206 kc).

Additional modulator stages follow. In each case the h.f. is chosen so that the lower sideband is sufficiently below the upper one and is easily attennuated by the tuned modulator.

The balanced modulators are similar except for their frequency ranges. A typical circuit is shown. The carriers are fed in parallel to the tubes and are balanced out in the plate circuits. The sidebands are fed in push-pull. In each case the plate is tuned to the higher sideband.

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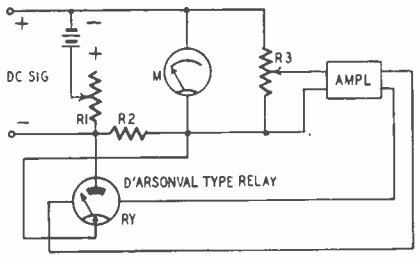
METER PROTECTION

Patent No. 2,516,756

Greer W. Cowley, Lincoln Park, N. J. and Donald E. Thomas, New York, N. Y. (Assigned to Bell Telephone Labs., Inc.)

This circuit protects sensitive meters against current overload in either direction. A large series resistor R2 limits current during an overload period. When normal conditions are restored this resistor is shorted out.



M is a d.c. instrument. A.C. signals must be rectified. A balancing circuit consisting of the battery and rheostat R1 sends reverse current through M. When the signal is normal, R1 is adjusted for mid-scale meter deflection and the meter can safely indicate within its range above and below normal.

The meter must be protected against overloading currents in either direction. If the signal exceeds a given level up-scale the meter is endangered. On the other hand, if the signal fails, a large reverse current flows from the battery through the meter.

To protect the meter, a part of the voltage across it is applied to an amplifier having a d'Arsonval-type relay (RY) as its output load. With normal signal, R3 is adjusted. So RY is deflected to mid-scale where the needle contacts a metal terminal and shorts out series resistor R2. With R2 shorted, M measures the d.c. signal. When the input varies too far above or below its normal range, the pointer of RY is deflected so it breaks the contact, shunting the current-limiting resistor.

The D'Arsonval type relay has a rotor and armature similar in construction to the D'Arsonval type meter movement. Its chief advantage is that it is much more sensitive than the ordinary type relay.

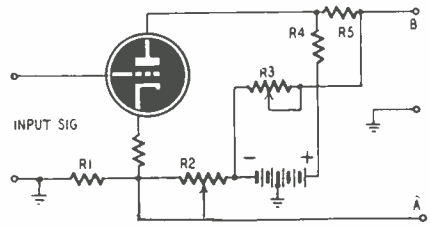
ELECTRONIC COUPLER

Patent No. 2,516,865

Edward L. Ginzton, Garden City, N. Y. (Assigned to Sperry Corporation)

This single-tube circuit is useful as a cathode follower, phase inverter, or source of balanced output. Its frequency response is far better than can be obtained by using a transformer to get a balanced output.

A tapped battery (or power supply) is the anode supply. It also feeds 2 circuits. One is R1, R2, and the other includes R3, R4, R5. Initially, with zero input, conductors A and B are set to ground potential. Resistor R2 is varied until the battery current through it equals the no-signal cathode current. Then A is at ground potential. B is at ground potential when the voltage drop across R3 equals the voltage between the negative battery terminal and ground.

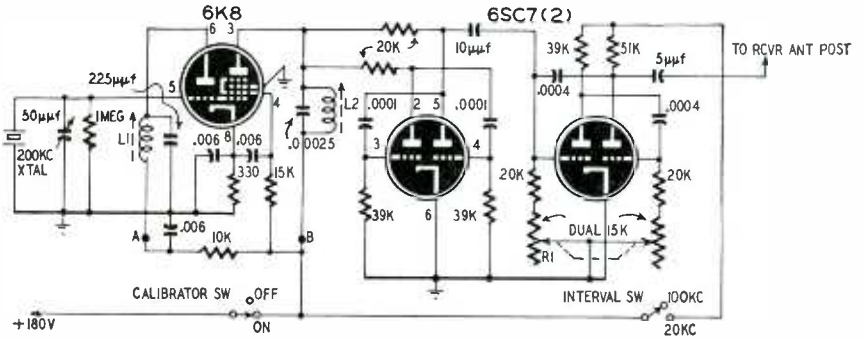


When a signal is applied, cathode and plate currents vary. If R1 equals R4, they produce equal voltage drops and the voltages at A and B change by the same amount.

The output between A and ground is the same as from any cathode follower. Phase is unchanged and voltage is proportional (but smaller) than the input. The output between B and ground is reversed in phase but its magnitude is the same as the cathode follower voltage. A balanced voltage is available between A and B. In each case the input voltage is not loaded because this circuit has a very high impedance input.

CRYSTAL CONTROLLED MARKER GENERATOR

Providing accurate marker points at 20- and 100-kc intervals throughout the broadcast and shortwave bands, this calibrator—a part of the BC-652—will prove useful for checking the calibration of signal generators and all-wave sets.



The triode section of the 6K8 is a 200-kc crystal oscillator and the hexode section is a 200-kc amplifier which drives the first 6SC7, a 100-kc multivibrator. The second 6SC7 is a 20-kc multivibrator synchronized with the signal from the 100-kc unit. Since the latter is stabilized by the 200-kc crystal, the interval between pulses is constant for the 100- and 20-kc multivibrators.

In the original model, L1 and L2 were tuned to 200 kc by varying the positions of the tuning slugs. Construction of the calibrator may be simplified by replacing L1 and L2 with 2.5-mh chokes or other suitable inductors and tuning them with 300-μμf padders.

The oscillator circuit L1 is adjusted by connecting a signal generator and a 75,000-ohm resistor in series across L1. Set the generator to 200 kc and connect a v.t.v.m. across the coil. Adjust the capacitor for maximum meter reading. The unit should be turned off for this adjustment. Turn on the unit and adjust the tuning of the amplifier plate circuit for maximum voltage across L2. If a v.t.v.m. is not handy, make both adjustments with the calibrator on. Touch a small neon lamp to the plate terminals and adjust for maximum brightness, or insert a milliameter at A and B successively and adjust for minimum plate current.

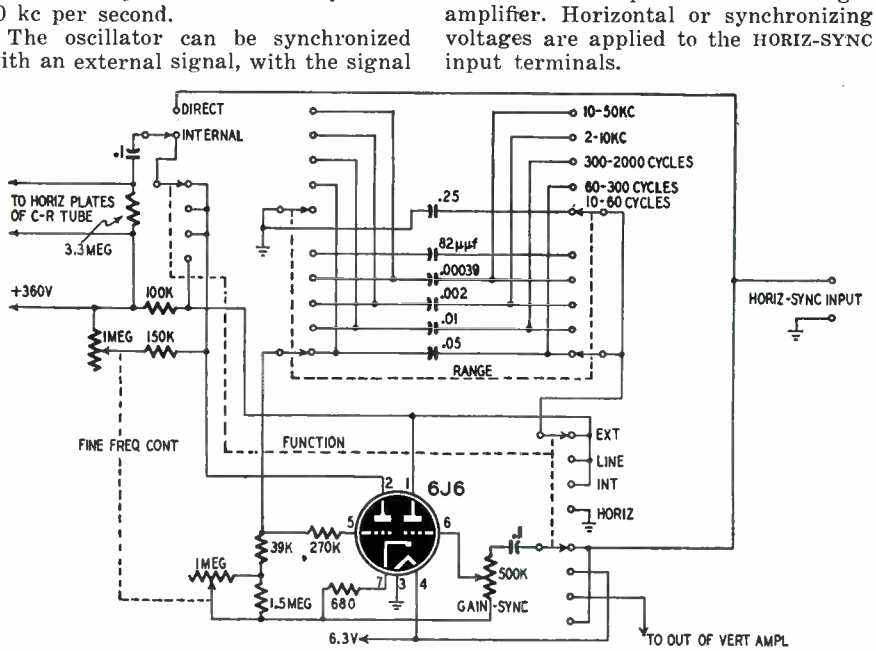
Connect the calibrator to the antenna post of a receiver and check the 100-kc beat against WWV or a broadcast station on 600 kc or any even-hundred frequency. Adjust the 50-μμf variable capacitor in the crystal circuit for zero beat between the marker and the standard.

Set the INTERVAL switch to 20 kc and adjust R1 so there are *four* beats—20 kc apart—between the 100-kc markers.

SWEEP GENERATOR FOR SMALL OSCILLOSCOPE

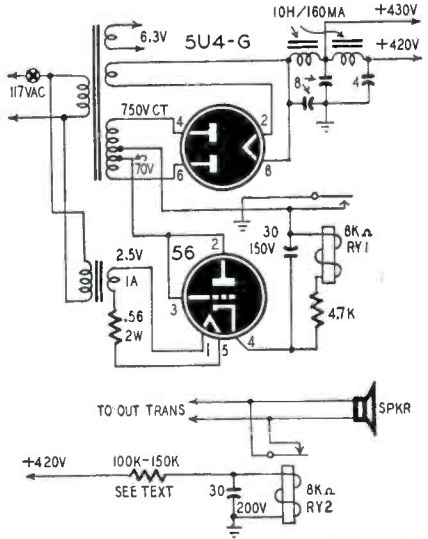
A novel hard-tube sweep generator which doubles as a horizontal amplifier is used in the Philco model 7019 2-inch oscilloscope. In this circuit, the 6J6 is connected as a variable-frequency multivibrator adjustable from 10 cycles to 50 kc per second.

The oscillator can be synchronized with an external signal, with the signal being applied to the vertical plates, or with the 60-cycle line; depending on the position of the FUNCTION switch. When this switch is in the HORIZONTAL position, one half of the 6J6 is inoperative and the other operates as a straight amplifier. Horizontal or synchronizing voltages are applied to the HORIZ-SYNC input terminals.



PROTECTIVE RELAY CIRCUIT

I had lots of trouble keeping filter, decoupling, and bypass capacitors in my amplifier and tuners which operate from a common 400-volt power supply. The rectifier tube reached operating temperature long before the cathodes of the other tubes. During the interval when the other tubes were not drawing current the rectifier was without a load and its output voltage was high enough to blow capacitors rated for normal operating voltages. A slow-heating rectifier wouldn't handle the load.



This relay-controlled time-delay circuit was developed to protect the capacitors against higher-than-normal voltages. A type 56 tube was connected as a rectifier on the 70-volt bias tap of the power transformer. Its load is an 8,000-ohm normally open relay with its contacts between the transformer center-tap and ground. A 0.56-ohm resistor is inserted in series with the 2.5-volt filament transformer to drop the voltage so the 56 does not conduct and close its relay until the slow-heating tubes in the tuner and amplifier have reached operating temperature.

A second relay, RY2 in the diagram, was added to eliminate the speaker thump produced when the first one closed. The 8,000-ohm coil of this relay was connected across the B-supply through a resistor of 100,000 to 150,000 ohms, and its normally closed contacts were connected across the voice coil on the speaker. When this relay is energized the short circuit is removed from the voice coil. The series resistor is adjusted so the relay does not close until the output tubes are drawing current.—*M. W. Harvey*

SMALL BATTERY RADIO

We don't claim that this set has high gain, good selectivity, etc., but it will provide lots of fun for beginners and experts alike. You can use almost any diode-triode that you like as long as you supply the necessary filament voltage. We used a 75 because it happened to be handy.

The tuning capacitor is a single-section job having a range of 11.2 to 381 μμf. Almost any single-section broadcast tuning capacitor will work

Ralph J. Cordiner was elected president of the GENERAL ELECTRIC COMPANY to succeed Charles E. Wilson who was appointed chairman of the Defense Mobilization Board by President Truman. Mr. Cordiner has served with the General Electric Company for 24 years. He had been executive vice-president and a director of the company since 1949.

Ralph J. Cordiner

Mr. Cordiner began his career in the electrical industry in Walla Walla, Wash., where he worked his way through Whitman College by selling electrical appliances for the Pacific Power and Light Company on a part-time basis. A year after graduating with high honors, he was offered a position with the Edison General Electric Appliance Company, which in 1932 was consolidated with General Electric's Appliance and Merchandise Department at Bridgeport. After a series of promotions, he succeeded Mr. Wilson as manager of the Appliance and Merchandise Department in 1938. In the post war years, Mr. Cordiner has been closely associated with the retiring president in planning the present organizational structure of G-E.

Julius Haber, former advertising and sales promotion manager of the RCA Tube Department, was appointed director of advertising and sales promotion for RCA technical products. In his new activities he co-ordinates the advertising and sales promotional functions of all RCA technical products, comprising those of the tube and engineering products departments. He is attached to the staff of L. W. Teegarden, vice-president in charge of technical products. Mr. Haber has been with RCA since 1922 except for one year when he organized the publicity department for Lord and Thomas, then RCA's advertising agency.

Julius Haber

John P. Taylor continues as manager of advertising and promotion for the engineering products department.

Captain David R. Hull, U.S.N. (ret.), assistant manager of the equipment divisions of RAYTHEON MFG. CO., was promoted to the post of manager of the department. He was also elected a vice-president of the company. Captain Hull had a distinguished career in the U. S. Navy from 1921 to 1948, specializing in electronics engineering work. He joined Raytheon in May, 1949.

Capt. David R. Hull

SYLVANIA ELECTRIC PRODUCTS, INC., raised four top executives to the post of vice-president. They are: **Arthur L. Chapman,** general manager of the Radio and Television Division and of the Parts Division; **Curtis A. Haines,** general manager of Operations of the Radio Tube and Television Picture Tube Divisions; **John B. Merrill,** general manager of the Tungsten and Chemical Division, and **Howard L. Richardson,** Director of Industrial Relations.

Frank Marshall, former sales manager of the Manufacturers Division of AEROVOX CORP., Bedford, Mass., was appointed director of manufacturer sales of Aerovox and its subsidiary, Electrical Reactance Corp. **A. E. Quick,** former sales manager of Electrical Reactance, succeeds Mr. Marshall as sales manager of the Aerovox Manufacturers Sales Division. **Karl Bretz** was promoted from assistant sales manager of the Electrical Reactance Corp. to sales manager. **James M. Kramp,** former assistant to Mr. Quick was made assistant sales manager. **Charles Golenpaul** continues to direct Aerovox jobber sales.

Sidney E. Warner

Sidney E. Warner joined the LAPOINTE-PLASCOMOLD CORP. in Windsor Locks, Conn. as director of engineering and research. Mr. Warner was formerly partner and chief engineer of the Aircraft Electronic Associates.

Major Ray A. Morris joined I.D.E.A., manufacturers of the Regency Booster, as assistant sales manager. Mr. Morris was formerly a factory representative of Edwin I. Guthman Co., Inc., of Indianapolis. He served in the Signal Corps during World War II and has been in sales and engineering in the electronic field for over twelve years.

Maj. Ray A. Morris

Gilbert C. Knoblock has been promoted to the position of general sales manager of the STANDARD TRANSFORMER CORPORATION, Chicago, manufacturers of Stancor transformers, according to an announcement by Jerome J. Kahn, president of the company. Mr. Knoblock has been associated with Standard Transformer for several years as advertising and sale promotion manager. He was formerly with a prominent Chicago advertising agency.

G. C. Knoblock

Robert A. Seidel was given the newly created post of vice-president and special assistant to the vice-president and general manager in a reassignment of duties made by the RCA Victor Division. The reassignments were made to assure effective operation under the

Floyd Makstein, field engineering manager at ***Emerson*** *recommends*

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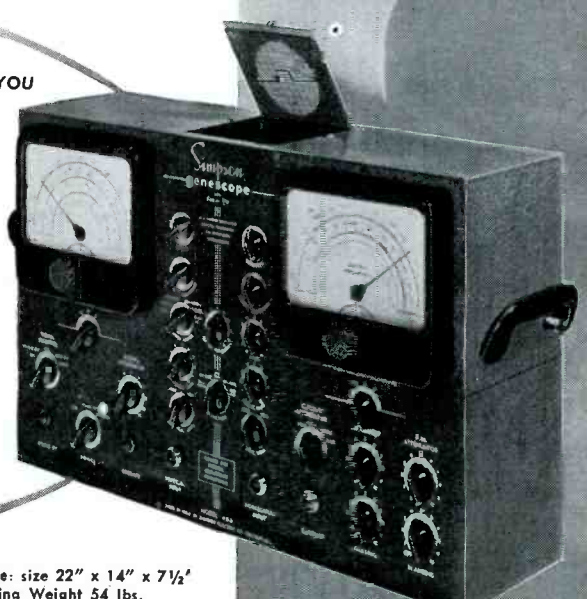
Continuously variable attenuator
Crystal calibrator: 5 megacycles ± .05%
Audio Oscillator 400 cycles
Output Impedance 75 ohms
Step attenuator for control of output

AMPLITUDE MODULATED OSCILLATOR
Band A: 3.3-15.6 megacycles
Band B: 15-75 megacycles
Band C: 75-250 megacycles
30% modulation at 400 cycles or unmodulated
Continuously variable attenuator
Visual method of beat frequency indication

OSCILLOSCOPE
Vertical sensitivity: 25 mv per inch
Horizontal sensitivity: 70 mv per inch
Linear sweep frequency: 2 cycles to 60 kilocycles
60 cycle sine sweep
Frequency essentially flat to 200 KC. usable to over 3 megacycles



CONSERVE CRITICAL MATERIALS

Simpson Model 480 Genescope: size 22" x 14" x 7½' Weight 45 lbs. Shipping Weight 54 lbs.
DEALER'S NET PRICE complete with Test Leads and Operator's Manual, $395.00.

fast changing national economic conditions. **Harold M. Winters** was made director of consumer products distribution, and **H. V. Sommerville** was named director of technical products distribution. Administration of the Regional Offices were placed under **Charles M. Odorizzi**, operating vice-president for the division. **Ralston H. Coffin** was made director of consumer products advertising and sales promotion.

Personnel Notes

. . . **Robert A. Mueller** has been appointed distributor sales manager of the CENTRALAB DIVISION of GLOBE-UNION, INC.

. . . **Neal F. Harmon,** former sales engineer in Atlanta, Georgia, has been appointed to the post of civil defense planning co-ordinator of GENERAL ELECTRIC.

. . . **Stanley P. Lovell,** chemist, inventor, and 1948 recipient of the Presidential Medal for Merit, was elected a director of the RAYTHEON MANUFACTURING COMPANY.

. . . **Benjamin Ozaroff** was elected president of the FIDELITY TUBE CORP. of East Newark, N. J. The company also announced the appointment of **Matthew A. Camber** as national representative for the Manufacturers' Division and Leon L. Adelman as Metropolitan New York representative for the Jobber Division.

. . . **Ray F. Sparrow,** former vice-president in charge of sales of P. R. MALLORY CO., was elected senior vice-president.

. . . **John P. Boksenbom** was elected vice-president and **Donald H. Kunsman** was made treasurer and controller of the RCA SERVICE COMPANY.

. . . **J. B. Lindsay,** formerly with RCA Victor, joined the engineering department of THOMAS ELECTRONICS, INC.

. . . **Jim F. Smith** joined the Jobber Division staff of CLAROSTAT MFG. CO.

. . . **Rollie J. Sherwood,** was elected vice-president in charge of sales of the HALLICRAFTERS CO. **J. Harry La Brum** was elected a director. All other officers of the company were re-elected.

. . . **Al Bauer,** formerly with Emerson Radio & Phonograph, joined the TELEVISION EQUIPMENT CORP. as director of purchases.

. . . **Jerome Hollander** joined the engineering staff of OAK RIDGE PRODUCTS. He was formerly with Du Mont Labs. and General Electric.

. . . **J. D. Van der Veer** was elected sales manager for the Electron Tube Initial Equipment Division of TUNG-SOL LAMP WORKS, INC.

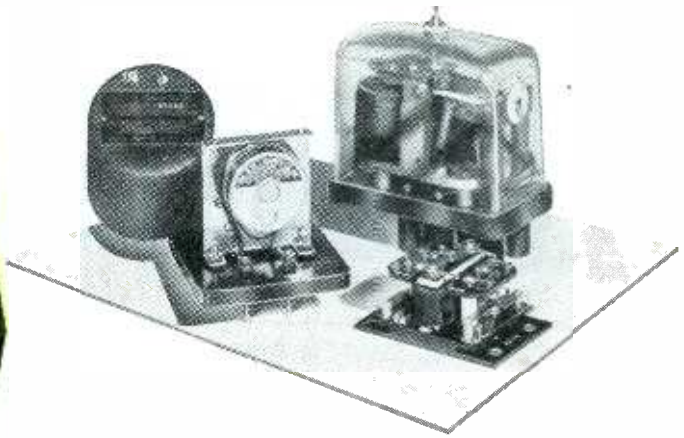
. . . **William P. Lear** was awarded the coveted 1950 Collier trophy for contributions to the advancement of the science of aeronautics. Mr. Lear won the award for his invention of a 36-pound automatic pilot and automatic approach control coupler which permits the safe landing of jet planes regardless of weather.

. . . **Robert B. Barnhill** was appointed to the post of manager of mobile radio sales for Bendix Radio Communications Division of BENDIX AVIATION CORP.

Special Relays—

OVER A MILLION IN STOCK!

Whether you require large quantities of relays for production runs or single units for laboratory or amateur work, Wells can make immediate delivery and save you a substantial part of the cost.



This list represents only a few types of Special Relays. We also have huge stocks of Standard D.C. Telephone Relays, Midget Relays, Contactors, Keying Relays, Rotary and Slow Acting Types as well as many others. Write or wire us about your requirements.

STOCK NO.	VOLTAGE	OHMAGE	CONTACTS
R-503	12/32 VDC.	100	3A, 2C
R-749	600 VDC.	...	Max. 28 Amps.
R-804	550 VAC.	...	1B/38 Amps.
R-250	115 VAC.	...	Adj. Cir. Breaker .04-.16A
R-579	220 VAC.	...	1B
R-294	27.5 VDC.	200	1B
R-686	115 VAC.	...	2C
R-246	115 VAC.	...	1B
R-246A	115 VAC.	...	1A
R-611	24 VAC.	...	1A/30 Amps.
R-283	12 VDC.	125	AC/10 Amps.
R-614	18/24 VDC.	60	1A/15 Amps.
R-262	.....	200	1C
R-245	12 VDC.	25	4 In. Micalex Lever
R-527	6/12 VDC.	50/50	In Series
R-544	12/24 VDC.	60/60	1C
R-255	.....	...	1A
R-669	75 VAC.	400 CYC.	1B, 1A
R-660	6 VDC.	...	⅜" Stroke
R-651	24 VDC.	100	Solenoid Valve
R-295	12 VDC.	275	Annuncitar Drop
R-230	5/8 VDC.	2	2A, 1C
R-813	12 VDC.	12	Wafer
R-275	12 VDC.	750	1A, 1B, 1C
R-716	24 VDC.	70	2A/5 Amps.
R-620	6/12 VDC.	35	2C, 1A
R-629	9/14 VDC.	40	1C/10 Amps.
R-778	8 VDC.	4500	1C/5 Amps.
R-720	24 VDC.	50	2C, Ceramic
R-500	12 VDC.	10/10	2C/6 Amps.
R-816	12 VDC.	10/15	2C/6 Amps.
R-811	48 VDC.	8000	1C
R-524	24 VAC/DC.	...	....
R-838	90/120 VDC.	925	2A
R-839	100/125 VDC.	1200	3A
R-840	115 VDC.	1200	2A
R-841	115 VDC.	1200	4A
R-842	115 VDC.	925	3A
R-843	115 VDC.	1200	3A
R-844	115 VDC.	1200	3A, 1B
R-845	220 VAC.	Intermit.	3A
R-831	7.5/29 VDC.	6.5	1A/250A, 1000A Surge
R-837	110 VAC.	...	2A/30 Amps.
R-835	24 VDC.	2800	1A Dble. Brk./10 Amps.
R-836	220 VAC.	...	2A Ddle. Brk./10 Amps.
R-566	115 VAC.	(Coil only, Not a complete relay)	
R-710	.....	150-Ohms. Coil Only	

MANUFACTURER & NUMBER	PRICE
G.E. Ant. Keying 500W 2C6530-653AR1	$ 2.25
Allen Bradley 810 Dashpot	5.95
Culter Hammer C-261173A34 Contactor	3.50
Westinghouse MN Overload	12.95
Adlake 60 Sec. Thermo Delay	6.95
Edison 50 Sec. Thermo Delay	4.25
Leach 1157T-5/20 Sec. ADJ. Delay	4.95
Cramer 2 Min. Adj. Time Delay	8.95
Cramer 2 Min. Adj. Time Delay	8.95
Durakool BF-63	4.25
Onan Rev. Current 3H4512/R24	1.00
Rev. Current Cutout 3H2339A/E1	3.50
W. U. Tel. Co. 41C Single Current	3.75
.....	.95
2Z7668 For Scr-274N	.95
G.E. Push Button Remote Relay #CR2791-R-106C8	1.65
G.E. Pressure Switch #2927B100-C2	.95
Clare 400	.95
Cannon Plunger Relay #13672	.95
.....	2.50
.....	2.15
Guardian Ratchet Relay	2.15
Ratchet Relay From Scr-522	4.25
Guardian BK-10	2.75
BK-13	1.45
Guardian BK-16	1.05
Guardian BK-17A	1.25
Kurman BK-24	2.10
45A High Power	1.35
Str. Dunn. Latch & Reset	2.85
Guardian Latch & Reset	2.85
Sigma 4R	1.65
Edwards Alarm Bell	.95
Allen Bradley-Bulletin #702 Motor Control	4.50
Allen Bradley-Bulletin #200E Motor Control	4.50
Allen Bradley-Bulletin #209 Size 1 Motor Control W/Type "N" Thermals	5.50
Allen Bradley-Bulletin #709 Size 2 Motor Control W/Type "N" Thermals	25.00
Allen Bradley-Bulletin #709 Motor Control W/Type "N" Thermals	5.50
Allen Bradley-Bulletin #200 Motor Control	4.50
Allen Bradley-Bulletin #202 Motor Control	4.50
Allen Bradley-Bulletin #704 Motor Control	4.50
Leach B-8	3.50
Leach 6104	2.75
Wheelock Signal, B1/39	1.95
Wheelock Signal, A7/37	3.45
Leach #6104	.75
Guardian #38187	.50

Wide Selection of Electronic Components at WELLS

- Tubes
- Resistors
- Condensers
- Wire & Cable
- Volume Controls
- Co-ax Connectors
- Relays
- Rectifiers
- Transformers and Chokes
- Micro Switches and Toggles
- Antennas and Accessories
- Electronic Assemblies
- Dial Light Assemblies

NOTICE!

Although our offices and showrooms were recently destroyed by fire, we are conducting business as usual from our new address.

Write For New Wells Catalog

Each relay is new, individually boxed, and unconditionally guaranteed by Wells

WELLS SALES, INC.

TELEPHONE: SEeley 8-4143

833 W. CHICAGO AVE., DEPT. Y, CHICAGO 22, ILL.

HELP-FREDDIE-WALK FUND

Readers' activities continue in high gear with the *Help-Freddie-Walk-Fund* and we are happy to announce that the Fund this month has reached $6645.93.

As our readers know by this time, Freddie Thomason, is the 2½-year-old son of the Arkansas radio technician, born both armless and legless. His parents report that Freddie is row becoming very anxious to use his artificial legs continuously and he made a further trip North last February, where the Kessler Institute for Rehabilitation at West Orange, N. J., will probably fit a new set of legs on him. As he continues to grow rapidly adjustments are necessary to keep pace with the growing child. These continuous adjustments are not only very exacting, but very expensive as well.

Here is Freddie with his mom and dad.

Several times a year Freddie's mother must bring him up North where he stays at the Institute so new appliances can be fitted on him. This is a most expensive routine which our readers can readily visualize.

This month we report club donations by the following:

$5.00 tendered by A. Glaser for all the employés at All American Television Company of Chicago, Illinois.

$20.00 collected by Charles E. Reed for a small group of voluntary members of the "Payday Dime Club" of New Bedford, Mass.

$15.00 tendered by George E. Winkler, Instructor, for the Radio Class at Pulaski High School of Milwaukee, Wisc.

$8.00 collected by W. W. McMichael for the Signal Department of the Pennsylvania Railroad Company at Perryville, Md.

$12.45 contributed by the Employees of Splendid, Inc. of San Juan, Puerto Rico.

$15.00 tendered by Arnold J. Kauder for the Standards Branch, U. S. Navy Electronics Laboratory of San Diego, Calif.

$37.00 collected by Frank W. Schoefield for the Employés of Trans-Canada Airlines and the Met. Office Stationed at the Moncton Airport, New Brunswick, Canada.

Your Editor also wishes to report with considerable gratification that one of our readers reported Freddie's case to the FAMILY CIRCLE magazine. The Editor, R. R. Endicott, will soon publish a story about Freddie and with the

very large circulation of this magazine (2,404,633 A.B.C.) we are certain that a good many contributions will be collected for Freddie.

We sincerely hope that our readers will continue their efforts to help make Freddie an able radio man when he grows up.

Please send in your contributions from time to time. Even the smallest donation will be highly welcome.

Make all checks, money orders, etc., payable to Herschel Thomason. Please address all letters to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS
25 West Broadway
New York 7, N. Y.

Balance as of December 19, 1950	$6145.23
Albert B. Allnutt—Silver Spring, Md.	3.00
Mr. & Mrs. Lyle Amos—South Charleston, O.	1.00
Anonymous—Glendale, Calif.	1.00
Anonymous—Wilmington Dela.	137.00
Anonymous—Milledgeville, Ga.	1.00
Anonymous—Rock Island, Ill.	1.00
Anonymous—Buffalo, N. Y.	2.00
Anonymous—Hamilton, O.	3.00
Anonymous—Havertown, Pa.	1.00
Anonymous—Lebanon, Pa.	1.00
Anonymous—Steelton, Pa.	1.00
Anonymous—Seattle, Wash.	2.00
Art's Radio Shop—Stanton, Nebr.	5.00
A Veteran of World War II—Portland, Me.	1.00
William B. Bailey—Los Angeles, Calif.	.50
John Basile—Milwaukee, Wisc.	2.00
James & Olive Baskerville—Amityville, N. Y.	5.00
Anthony Benevento—Long Island City, N. Y.	.50
Sydney D. Berman—Norton AFB, Calif.	3.00
W. J. Bluhm—Jamaica Plain, Mass.	3.00
Mr. & Mrs. Albert N. Bonomini, Jr.—Brookline, Mass.	10.00
W. H. Brooks—Oconomowoc, Wisc.	7.00
Robert N. Brotherton—New York, N. Y.	2.50
Bill Brown—Long Island City, N. Y.	1.00
Dick Bruzzone—Long Island City, N. Y.	1.00
Colonel Clare W. Bunch—Norton AFB, Calif.	5.00
Wm. Burt—Youngstown, O.	1.00
Olive Cherpak—New Britain, Ct.	1.00

H. Cockwell—Hamilton, Ont., Canada	5.00
Pat Collins—Long Island City, N. Y.	1.00
Communications Section, Newcastle Flight Civil Air Patrol—Newcastle, Wyo.	2.50
John W. Councill, Radio Supply Co.—Norfolk, Va.	5.00
Eloise M. D.—Hagerstown, Md.	5.00
Danbury Hats—Flushing, N. Y.	2.00
Employees of Splendid Inc.—San Juan, P. R.	12.45
Employees of Trans-Canada Airlines and the Met. Office Stationed at Moncton Airport —Moncton, N. B., Canada	37.00
Darby Faherty—Long Island City, N. Y.	.25
Robert K. Forsberg, WINWH—Worcester, Mass.	5.00
Donald P. Frankel—Norton AFB, Calif.	2.00
From all the Employees at All American Television Co.—Chicago, Ill.	5.00
From a TV Serviceman—New York, N. Y.	2.00
From the Boys at Radio Station K F B K—Sacramento, Calif.	7.25
Gerda & Rita Geerts—Malines, Belgium ...	2.00
Armin H. Graefe, Graefe Radio Service—Sheyboygan, Wisc.	2.00
Joe Guida—Long Island City, N. Y.	1.00
Hamilton Radio Shop—De Witt, Ark.	10.00
K. M. Hammell—Harrisburg, Pa.	5.00
W. S. Hane—Hillburn, N. Y.	2.00
M. R. Hauser—Inglewood, Calif.	1.00
Bertha Henry—Wallingford, Ct.	1.50
The Rev. Dr. R. Hill—Myrtle Beach, S. C. ..	.50
In Memory of G. W. Holmes—Toledo, O. ..	5.00
Eddie Howell—Dillon, S. C.	1.00
E. Hudock—Ann Arbor, Mich.	1.00
A. Ivanivsky—Brunswick, Germany	10.00
Edward A. Jones—Camden, N. J.	2.00
Michael F. Kebles—Bayonne, N. J.	1.00
Robert Kelly—Long Island City, N. Y.	.25
Isadore Kramer—Long Island City, N. Y. ..	1.00
W. A. L.—Cleveland, O.	2.00
Catherine R. Laing—Temple, Pa.	2.00
Mrs. Nicholas Lallo—Youngstown, O.	1.00
Joe Laracuenta—Long Island City, N. Y. ...	1.00
N. J. Laub—White Bear, Minn.	1.00
N. L. Lawrence—Hempstead, N. Y.	2.00
Ira L. Lee—Henagar, Ala.	1.00
C. F. Lundgren—El Segundo, Calif.	1.00
Mrs. James F. Mc Donough—Washington, D. C.	2.00
William E. Marshall—Oakland, Calif.	3.00
Carl H. Miller, W2PCF—North Wildwood, N. J.	5.00
Mrs. A. J. Moore, R. N.—Brooklyn, N. Y.	2.00
Larry A. Muchka—New York, N. Y.	2.00
Johnny Murphy—Long Island City, N. Y. ...	1.00
Mrs. Edith A. Newbegin—Newton Highlands, Mass.	2.00
Thomas Newman—Long Island City, N. Y.	1.00
Julius Oster—Long Island City, N. Y.	1.00
Edward Pavhia—Long Island City, N. Y.	1.00
Joseph Pavhia—Long Island City, N. Y.	.50
Payday Dime Club—New Bedford, Mass. ..	20.00
Precision Electronics—Teaneck, N. J.	2.00
Radio Class at Pulaski High School—Milwaukee, Wisc.	15.00
L. C. Riebe—Youngstown, O.	1.00
Michael Sabol—Clairton, Pa.	4.00
Erling B. Saxhaug—Chevy Chase, Md.	5.00
E. Scheiman—Parma, O.	5.00
Chris Schimmel—Long Island City, N. Y.	1.00
Geo. E. Settanni—Brooklyn, N. Y.	1.00
C. E. Sewell—Torrance, Calif.	1.00
Mr. & Mrs. John A. Sherbitz—Aurora, Minn.	2.00
Signal Department of the Pennsylvania Railroad Co.—Perryville, Md.	8.00
Roy Slight—Massillon, Ohio	5.00
Carroll Smith—Baltimore, Md.	1.00
Mr. & Mrs. D. Smith—St. Genevieve, P. O., Canada	1.00
Stephen T. Spear, Jr.—Baltimore, Md.	2.00
Standards Branch, U.S. Navy Electronics Laboratory—San Diego, Calif.	15.00
Emil Stoll—Long Island City, N. Y.	1.00
Nick Takush—Long Island City, N. Y.	1.00
Albert Tassi—San Francisco, Calif.	1.00
The Lawrence Chapter of the Beanbags—Lawrence, Mass	3.00
M. Tommy Tucker—Los Angeles, Calif.....	5.00
R. W. Tyler—Columbus, O.	5.00
J. A. Uehlinger—Port Arthur, Texas	10.00
Mr. & Mrs. B. Vitters & Children—Franklin Square, N. Y.	3.00
W6BMT—Los Angeles, Calif.	2.00
E. F. Weber—Riverside, Ill.	2.00
J. E. Williams—Beverly Hills, Calif.	5.00
Victor I. Zuck—Kenmore, N. Y.	2.00
Total contributions received to January 22, 1951	**$6645.93**

URGE POOL FOR ENGINEERS

Technical talent pool to create a reserve of engineering talent through registration with the Selective Service System is being urged by the Engineers Joint Council, an organization of five engineering societies. All men to the age of 70 holding engineering degrees, or working toward such degrees, in any of a list of "critical fields" would be required to register.

Radio Thirty-Five Years Ago
In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Electric Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931
Wireless Association of America	1908

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

MARCH, 1917 ELECTRICAL EXPERIMENTER

Using Gas Balloons to Support Wireless Antennae
Controlling Toys by Radio
de Forest vs. The Electrical Experimenter
Spark Gaps in Running Liquids
Tri-City Radio Laboratory
New Undamped Wave Tuner Has Adjustable Disc Core
Is Radio Transmission Due to Magnetism?, by J. S. Clemens
The Quenched Spark Gap, by Chas. S. Ballantine
A Wireless Lead-In, by Francis K. Fraser
A Rotary Receiving Tuner, by Oliver M. Black
Radio Condenser Hints, by Walter D. Sholl
A Batteryless Electrolytic Detector, by L. Mott-Smith

RESONANT CAPACITOR

Aerovox Corp.
New Bedford, Mass.

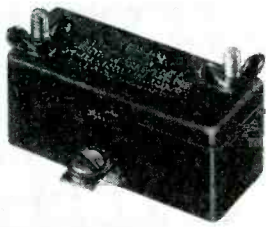
The new type RC resonant capacitors are available as .05-, 0.1-, and 0.2-μf units with 400-volt d.c. ratings. They are designed to serve as series-resonant circuits which present a short circuit

to frequencies between 425 and 485 kc. Because they have a much lower impedance at their resonant frequency than normal bypass capacitors of the same size, they provide more efficient i.f. filtering without increasing the size of the capacitor or improvising a trap by winding a series coil over it.

LIGHTNING ARRESTER

LaPointe-Plascomold Corp.
Windsor Locks, Conn.

The model RW-200 is the latest addition to the VEE-DX line of TV antennas and accessories. It is similar to the

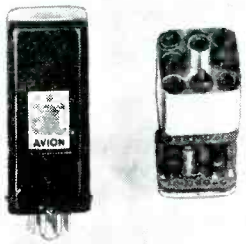


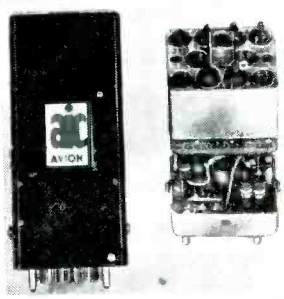
4-wire RW-204, but is constructed with only two sawtooth contacts instead of four. The RW-200 is designed to provide positive protection of all standard TV installations.

UNIVERSAL CHASSIS

Avion Instrument Corp.
New York, N. Y.

Designed as miniature plug-in circuits, the new Universal Electronic Chassis meets the demands for reduction in size and weight of electronic circuits used in analog computers, servomechanisms, and other devices. Circuits which can be designed to specifications on the universal chassis include a.c., d.c. and pulse amplifiers; mixers, ascillators, counters, and flip-flops. Eight to 10 subminiature tubes and their circuit components are housed in a metal case filled with a potting compound which provides mechanical support and protection from tropical and arctic conditions. The chassis meets specification AN-E-19.



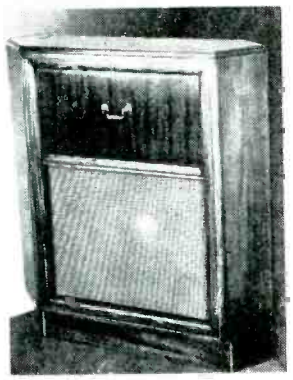


CORNER LOUDSPEAKER

Sun Radio & Electronics Co.
New York, N.Y.

The Realist, a new corner speaker system, features a 12½-inch woofer and an 8-inch tweeter mounted back-to-back. This arrangement is said to reduce hangover of the bass notes, while treble notes are reflected from the corner and distributed throughout the room. The system is available with a wide selection of speakers.

The cabinet, available in modern or



traditional design, is 36 inches high, 30 inches wide, and 18 inches deep. Standard finishes are natural or cordovan mahogany, walnut, and blond

RECORDING TAPE

Amplifier Corp. of America
New York, N.Y.

A new recording tape called Mugneribbon is the latest addition to the line of magnetic tape recorders and accessories produced by Amplifier Corp. of America. Red or black oxide coatings are available on paper and plastic tapes. All tapes are in the

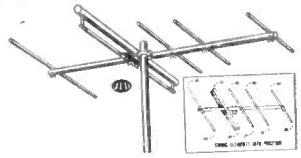
standard ¼-inch, 1,200-foot lengths on 7-inch nonwarping aluminum spools. A metal leader facilitates threading the tape onto standard takeup reels. Tapes are boxed in cardboard containers having cloth-hinged covers and tabular forms for indexing the contents of single- or double-track reels.

Manufacturing processes insure against flaking of the coating and lateral weave, and insure uniform high sensitivity, greater signal-to-noise ratio, and lower random noise.

YAGI TV ANTENNAS

JFD Manufacturing Co., Inc.
Brooklyn, N.Y.

Available in 12 models, each cut exactly to the frequency of a different TV channel, the new 5-element Yagi antennas are designed to provide high gain in fringe and remote areas. Three directors and a reflector produce a high front-to-back ratio which reduces reflections from the rear and minimize co-channel interference when the antenna is on a line between two stations on the same channel.



A high-impedance driven element provides a good match to 300-ohm transmission lines. A special jumper harness is available for connecting bays when a stacked array is required. Heavy corrosion-resistant aircraft aluminum is used throughout with 1-inch tubing being used for the boom and larger conductor of the driven element.

TELEVISION ANTENNA

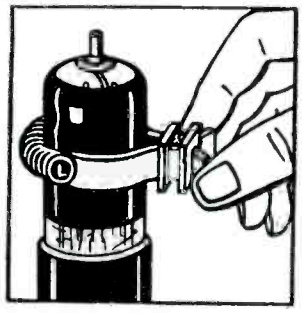
Channel Master Corp.
Ellenville, N.Y.

The new Clamp-On antenna may be installed outdoors or it may be clamped on windows, furniture, fixtures, etc., in an indoor installation. Its ball-mounted telescoping dipoles swing through a 360-degree arc and can be adjusted to form a horizontal V for reception on any channel in any direction.

OSCILLATION ELIMINATOR

Perfection Electric Co.
Chicago, Ill.

Vertical black bars appear in TV pictures when Barkhausen oscillation occurs in the horizontal sweep output tube. Oscillations set up near the screen grid of the tube are radiated to the input of the tuner and cause the dark bars to appear. These are especially noticeable in weak signal areas. However, a concentrated magnetic field near the source of the oscillation will usually eliminate it.



The Perfection Barkhausen oscillation eliminator is a small permanent magnet fastened in a clip in such a way that the clip can be slipped over the envelope of the oscillating tube. The magnet can be slid up or down or turned to the left or right until the dark bars disappear.

NEW BOOSTER DESIGN

I.D.E.A.

Indianapolis, Ind.

Because of allocation difficulties, the Regency TV Signal Booster has been redesigned to use less critical materials without sacrifice of performance. Known as the D8410, the new model will have much the same appearance, the only change being a new satin finish, gold colored metal panel for the dial face.

The new model has contra-wound bifilar coils with push-pull triode to give a balanced circuit. Internal impedance, both input and output, will match either 300-ohm ribbon line or 73-ohm coaxial cable. It is designed to boost reception on all twelve channels.

POTENTIAL TAP

Industrial Devices, Inc.
Edgewater, N. J.

The new type 400 PT potential tap consists of a water-thin plate which slips over the prongs of a standard line plug and two insulated tip jacks on flexible leads. The appliance to be checked is plugged through the potential tap into the power receptacle. Any voltmeter having phone tips may be used to check the voltage with the appliance on or off. In this way, voltage drop on the line under load can be read without removing the plug or wiring in the voltmeter.

TV MAST COUPLING

Technical Appliance Corp.
Sherburne, N.Y.

The new Taco mast coupling (catalog No. 189) is designed to couple securely wood or metal mast sections ranging from 1¼ to 1-5/16 inches. Made of heavy-guage steel, it is clamped to the mast sections by three ¼-inch bolts through the flange. The bottom of the clamp may be used as an anchor for guy wires. The design of this coupling is particularly suitable for wood masts because it distributes the pressure over a larger area than that covered by U-bolt clamps.

R-E IS NO SLOUCH

Dear Editor:

This is my first letter to RADIO-ELECTRONICS despite the fact that I have been a devoted R-E fan since early RADIO-CRAFT days. This magazine has always featured those certain special topics not to be found elsewhere in newsstand periodicals, thus making it one of my most impatiently awaited journals.

I agree most enthusiastically with the opinions held by Mr. V. Phillips who urged your continuation of experimental articles. The majority of experimenters need only a key idea in some instances or a slight push in the right direction to set them in motion. RADIO-ELECTRONICS certainly is no slouch when it comes to presenting food for thought.

The current computer principles articles by Mr. Berkeley are most informative. He has done once again, as he did with his fine book *Giant Brains*, a wonderful job making clear just how simple it is for a group of relays to perform various mathematical operations. Let's see this fine series run for many more months to come.

JOHN W. SPONSLER

Cambridge, Mass.

TUBE DATA ON CARDS

Dear Editor:

We need a tube chart which is printed on cards like a deck of ordinary playing cards of good quality. We can then select the suitable cards and put them on the bench beside the set we are working on. The tube's basing diagram should be large enough to be seen easily, and maximum ratings for each tube element should be clearly marked. The back of the card might contain other technical characteristics, as well as substitution data.

Such cards can be filed in a card index. Lost cards could be easily replaced, and cards for new tubes easily added. I for one would pay a good price for a gadget like this. It would pay for itself within just a few weeks just in the time it would save in thumbing through tube handbooks and trying to find data on new tubes.

J. R. WOOLLARD

Nashville, Tenn.

COYNE TELEVISION CYCLOPEDIA, by Harold P. Manly. Published by Educational Book Publishing Division, Coyne Electrical and Television-Radio School, Chicago, Ill. 5¾ x 6½ inches, 727 pages. Price $5.95.

Students and beginners in television will find that the alphabetical arrangement of television terms and their definitions makes this encyclopedia easy to use. The author covers the subjects in a clear, easy-to-read style without resorting to complex formulas or engineering terminology. It is not uncommon to find five or six pages of text and illustrations devoted to a single topic while more than 18 pages are devoted to some subjects.

Television students, set constructors, experimenters, and others seeking clear non-technical definitions of technical television terms will find this book a useful addition to their technical libraries.—*RFS*

TRAILBLAZER TO TELEVISION, by Terry and Elizabeth P. Korn. Illustrated by Elizabeth P. Korn. Published by Charles Scribner's Sons, New York, N.Y. 6 x 8¼ inches. Price $2.50.

In this human-interest biography of Professor Arthur Korn, early worker in the electric transmission of images and the inventor of the first facsimile system, is told the story of his attempts to transmit pictures electrically, his first successes with wire transmission, and his struggle toward the wireless transmission of pictures, with television as the ultimate goal.

The book is written by the late Dr. Korn's wife and daughter-in-law and illustrated by his wife.

WORLD-RADIO HANDBOOK FOR LISTENERS, edited and published by O. Lund Johansen, Copenhagen, Denmark. Distributed in U.S.A. by Ben E. Wilbur, East Orange, N. J. 6½ x 8½ inches. 112 pages. Price $1.25.

This handbook can be a valuable aid to shortwave listeners who delight in prowling the international radio lanes in search of elusive dx stations or voices from their home lands. It lists the call signs, frequencies, power, program schedules, location, street address or box number, musical phrases for the interval signal or musical signature, and names of leading station personalities.

Other books of interest to SWL's (distributed by Mr. Wilbur) are *How to Listen to the World*, by O. Lund Johansen (Price 30¢) and *Ham's Interpreter*, by OH2SQ (Price $1.00). The first discusses antennas for dx, differences in time, effects of atmospheric conditions on reception, and other subjects of interest to budding SWL's.

The latter book is written to assist amateur radiotelephone operators to pronounce numbers, letters, and phrases common to ham radio in English, French, Italian, German, Swedish, Finnish, and Spanish. With the aid of this book, many English-speaking hams should be able to carry on long enough to get a QSL from many foreign stations.—*RFS*

OPPORTUNITY AD-LETS

Advertisements in this section cost 35c a word for each insertion. Name, address and initials must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than ten words accepted. Ten percent discount six issues, twenty percent for twelve issues. Objectionable or misleading advertisements not accepted. Advertisements for May, 1951, issue must reach us not later than March 21, 1951.
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LANCASTER, ALLWINE & ROMMEL, 436 BOWEN Building, Washington, D.C. Registered Patent Attorneys. Practice before United States Patent Office. Validity and infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request.

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RADIO—TELEVISION—ELECTRONICS—TUTORING $5 per lesson—Mo. Tech., 3907 North 25th Street, St. Louis 7, Missouri.

SNIPERSCOPES & SNOOPERSCOPES WANTED. Any type, any condition. Needed immediately. Precise Company, 942 Kings Highway, Brooklyn 23, New York.

AMATEURS—RADIO AND ELECTRICAL RESEARCH Engineering. Hy Twillmann, R.R.#1, Chesterfield, Mo.

PRACTICAL RADIO AND ELECTRONICS COURSE FOR HOME-STUDY (1951 Edition), prepared under the direction of M. N. Beitman. Published by Supreme Publications, Chicago, Ill. 8 x 10¾ inches, 331 pages. Price $3.95.

All lessons previously issued in three small volumes of the *Practical Radio and Electronics* Course are published in this one large edition. It is prepared as a home-study course which we feel will make good supplementary reading for anyone who is just beginning to study radio and electronics. All pages have one wide and one narrow column. The former contains the text material and most of the illustrations. The latter carries the author's comments and suggestions and additional illustrations to simplify matters for the reader.

Volume 1, "Fundamentals of Radio and Electronics," covers 13 lessons designed to acquaint the reader with radio components, their values, and functions in electronic circuits. Volume 2, "Receivers, Transmitters, and Test Equipment," has lessons devoted to such subjects as receiver and transmitter circuits, automatic frequency control, FM, TV, antennas, and wave propagation.

We feel that Volume 2 can stand some revisions and corrections. In lesson 16, a listing of present amateur frequencies shows the 160-meter band to be 1715 to 2,000 kc. The 5-meter band which has not been used by amateurs since before the war is listed as 56 to 60 mc. Hams are now using 6

meters (50 to 54 mc). When the 160-meter band was reopened about two years ago, several blocks of frequencies between 1800 and 2000 kc were allocated for amateur use with limitations on locations, power and hours.

Lessons 23 through 53 (Volume 3—"Applied Electronics and Radio Servicing") contain brief non-technical descriptions of such equipment as X-ray machines, welding controls, strain gages, and other electronic equipment. In this volume, the section on radio servicing consists of three pages of case histories on various makes and models of prewar receivers.

Although the book will serve its purpose, as an introduction to radio and electronics, we feel that many of the diagrams and photographs are obsolete and should be replaced with illustrations of equipment more familiar to today's radio newcomer.—*RFS*

RECEIVING TUBE SUBSTITUTION GUIDE BOOK, by H. A. Middleton. Published by John F. Rider Publisher, Inc., New York. 8½ x 11 inches, 224 pages. Price $2.40.

A new and enlarged addition of *Wartime Radio Service*, published in 1944, this book lists pertinent information as to substitutions for approximately 750 receiving tubes.

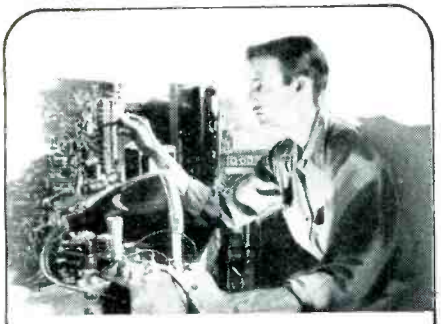
The information is listed in four columns. The first lists the original tube, the second, one or more possible substitutes when it is practical to replace the original, and the third lists the comparative performance of the replacements in terms of excellent, good, and poor. The fourth column lists the changes required for the substitution.

Following the 115-page substitution chart is a 25-page section giving heater wiring diagrams and other pertinent heater-circuit data on many current TV sets which are listed by make and model. Charts of tube characteristics, base diagrams, ballast-tube and resistor numbering codes, and other useful servicing information conclude the book.

Although we feel that this book is far from fool-proof, we are sure that it will save considerable time for the thinking service technician who may be called upon to substitute tubes to keep radios, amplifiers, and other electronic equipment in working order.—*RFS*

TELEVISION SIMPLIFIED, Third Edition, by Milton S. Kiver. Published by D. Van Nostrand Co., New York. 5½ x 8½ inches, 608 pages. Price $6.50.

The title of this book is somewhat misleading, because it's an explanation of the intricacies of television in terms that anyone with a basic knowledge of radio can understand rather than an explanation of simplified television circuits. Following the lines of the two previous editions, this new edition is brought up to date with the latest color television and the intercarrier system. For those who wish to gauge their progress through the book, a set of self-check questions has been added for each chapter.



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TELEVISION SERVICE ENCYCLOPEDIA (Second Edition). Compiled and published by P. R. Mallory & Co., Indianapolis, Ind. 8½ x 10¼ inches, 204 pages. Price $1.50.

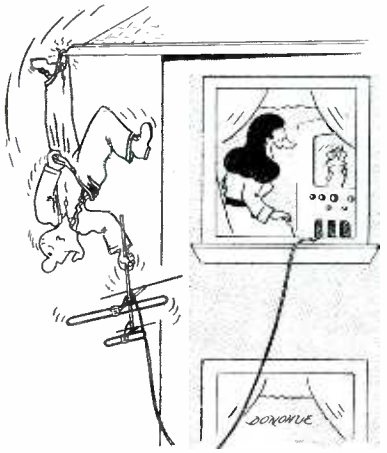
As useful to the busy service technician as a multimeter or signal generator is this manual of servicing information. Each of the 79 pages devoted to TV sets and 67 pages on latest AM and FM radios are divided into 16 and 19 columns, respectively. The first column of each page lists set manufacturers in alphabetical order and models in numerical order along with the chassis number when available. The remaining columns contain such pertinent data as function of controls, original parts numbers, manufacturer's symbol, and stock numbers of recommended Mallory replacements for capacitors, controls, and vibrators. Also included are tube complements, i.f. alignment data, references to the schematic in Rider's manuals and notes to the appendix which contains data on production changes, parts substitutions, and drawings showing the manner in which the part is connected.—*RFS*

ELECTRICAL COMMUNICATION (Third Edition), by Arthur L. Albert. Published by John Wiley & Sons, Inc., New York, N.Y. 6¼ x 9¼ inches. 593 pages. Price $6.50.

The third edition of this standard work is considerably expanded and revised. All types of electrical communication, from the wire telegraph to television, are discussed, and there is even a historical chapter devoted to earlier forms of our present systems, and to systems no longer in use.

The space devoted to all types of radio, and also to dial telephony, has been increased, as has the number of illustrations and problems. The student will find the list of questions at the end of each chapter very helpful, and the extensive list of references also appended to each chapter will be useful to those seeking more information on the subjects discussed.

The new edition is thoroughly modern, and waveguides, transistors, wideband amplifiers, and Klystrons take their place alongside coil-loaded cables and the 22-type repeater as communications equipment.



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ADVERTISING INDEX

RADIO SCHOOL DIRECTORY
(Pages 110-111)

Radio-Electronics does not assume responsibility for any errors appearing in above index.

RADIO LABORATORY HANDBOOK (5th Edition), by M. G. Scroggie. Published for *Wireless World* by Iliffe & Sons, Ltd. London, England. 4½ x 7 inches, 430 pages. Price 15 shillings.

The author describes methods of using available commercial or home-made equipment for making tests and measurements on electronic and electrical equipment. His subjects include the principal sources of power and signals, various types of measuring and acoustic instruments, methods of comparing receivers and amplifiers, and methods of plotting and interpreting the results of tests.

Diagrams and other constructional details are supplied on many types of test equipment. Circuits are designed for European tubes but a skilled technician should have no trouble adapting circuits to his needs.—*RFS*

PHOTOTUBES, CATHODE-RAY, AND SPECIAL TUBES, PG-101-A, published by RCA Tube Department, Harrison, N. J. 8½ x 11 inches, 19 pages. Price 15¢.

Designed for industrial, broadcast, experimental, and similar users, this new booklet has technical data on more than 150 tube types, including single-unit, twin-unit, and multiplier phototubes; cathode-ray tubes; TV camera tubes; TV monoscopes; low-microphonic tubes; u.h.f. tubes; and other types for special uses.

Technical information, arranged in tabular form for easy use, includes descriptions, ratings, operating conditions, dimensions, base and envelope connection diagrams, and applications. Spectral sensitivity curves for all phototubes are given, as are the characteristics of cathode-ray fluorescent screens.

SYLVANIA TUBE SUBSTITUTION MANUAL, published by Sylvania Electric Products Inc., Emporium, Pa. 8½ x 11 inches, 39 pages. Single copies gratis from Sylvania distributors.

This handy quick-reference manual has a general tube classification chart; substitution charts for battery type tubes, 150 and 300 ma tubes, transformer and auto tubes, television tubes, and picture tubes; plus a number socket diagrams for the most frequently needed changeovers.

CONVERSION BIBLIOGRAPHY

A revised listing of articles describing the conversion of various types of war surplus equipment and components are in the *Bibliography of Articles Concerning Conversion of War Surplus Equipment for Civilian and School Use* which may be obtained without charge by writing to the Office of Education, Federal Security Agency, Washington 25, D. C.

Most of the references are amateur conversion articles which appeared in radio magazines. However, several electronic and nonelectronic references are taken from *Industrial Arts and Vocational Education, Journal of Chemical Education, School Shop,* and *The Science Teacher.*

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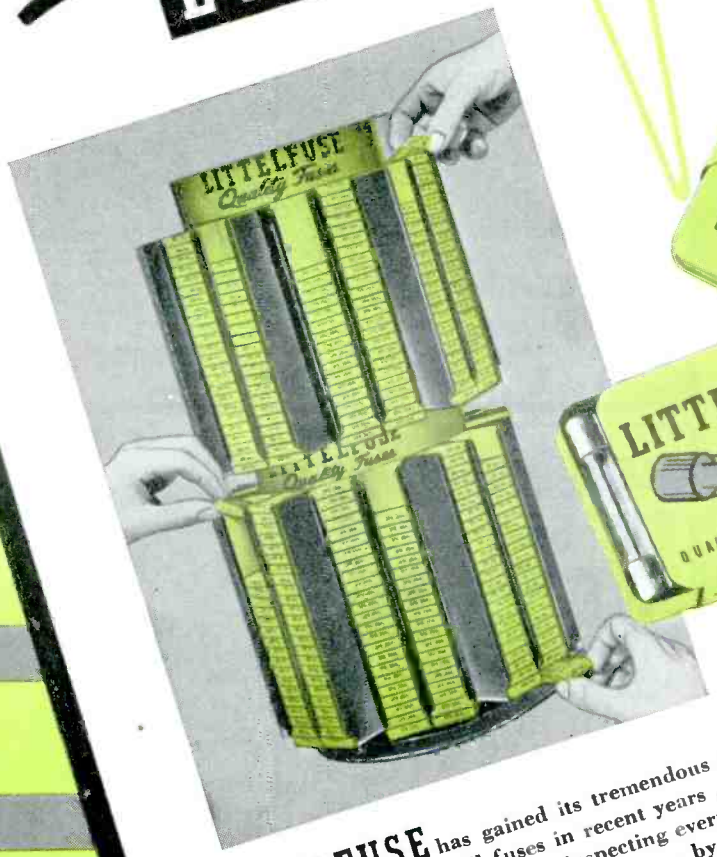

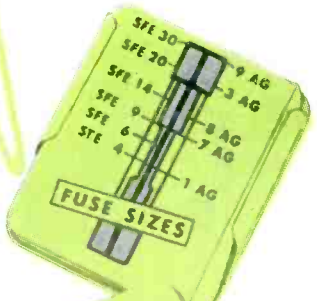

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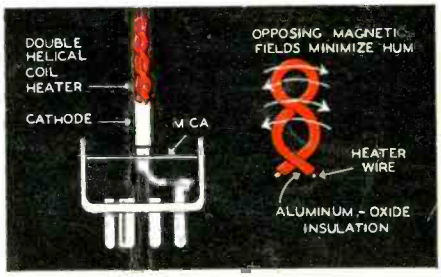

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