TV SOUND FROM YOUR FM RECEIVER

JUNE 1957

Radio-Electronics

TELEVISION · SERVICING · HIGH FIDELITY

HUGO GERNSBACK, Editor

Add a Tuning Eye To the TV Receiver

•

Home Constructed Automatic Shutoff For Record Players

•

Easily Built Signal Generator For Color TV

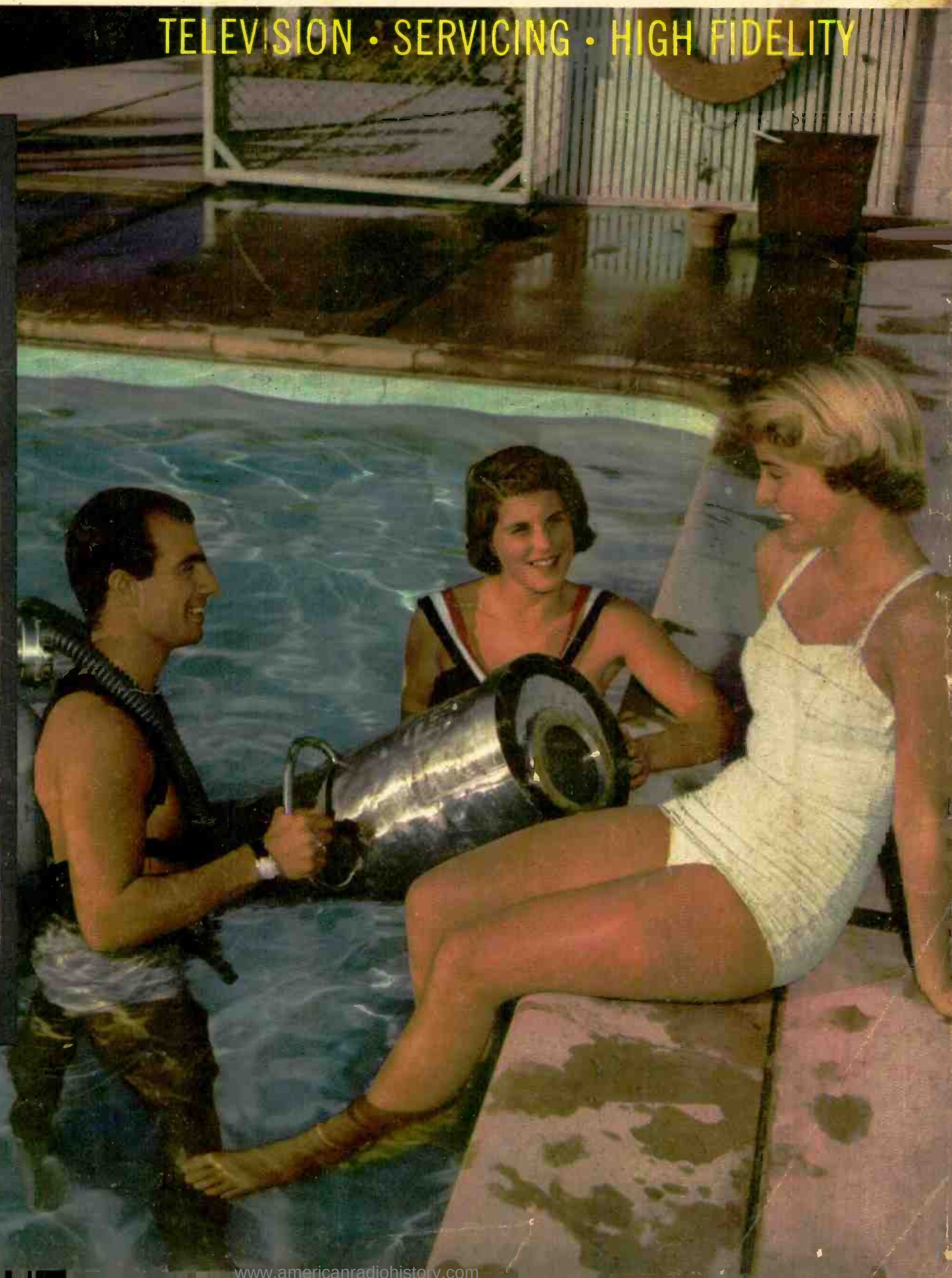
•

Smallest Yet Transistor Radio Operates Speaker

•

New TV Camera Works Under Water

(See page 59)



35c U.S. and Canada

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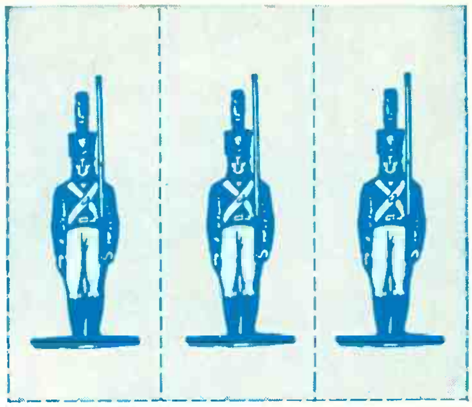
performance matched test equipment

for black and white

and ALL COLOR TV TESTING



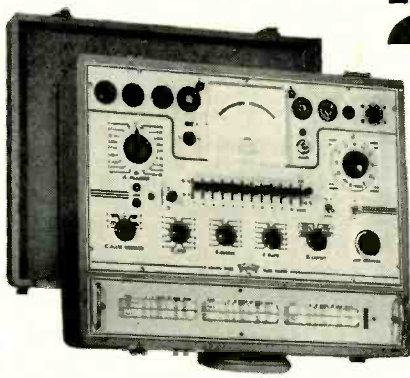
basic! fundamental! essential!

1

MODEL 631
VOM-VTVM

two in one tester for 100% service—VOM covers 90% of your usage, battery operated VTVM available for the other 10% when you need it. **$64.50**

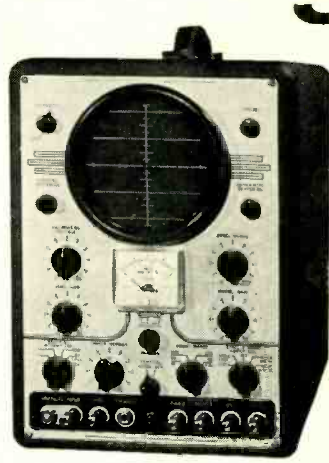
2



MODEL 3423

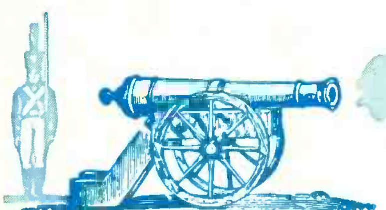
four in one—mutual conductance tube tester, transistor tester, germanium diode tester, selenium rectifier tester —checks for accuracy as circuit demands depending on the tolerance of the circuit. The patented circuit for the tube testing employs actual signal (4KC) for grid and DC bias voltage making it independent of line voltage hum. It also has a complete coverage of all tube types—six plate voltages (including 0-10 variable). Micromhos scales read 0-1,800, 0-6,000, 0-18,000 and 0-36,000. Leakage measured directly on meter 0-10 megohms. **$199.50**

3



MODEL 3441-A

three in one scope—oscilloscope, peak-to-peak meter, audio oscillator — essential for more than 50% of your Black and White Servicing—all Color Servicing. 10 mv sensitivity. 4.5 mc bandwidth. **$249.50**



TRIPLETT

These three units provide the ideal basis for the complete servicemen's test setup for black and white *and* color TV. You will want to consider also Model 3438 Dot Generator, Model 3439 Color Bar Generator, Model 3434-A Sweep Generator and other Triplett units.

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • BLUFFTON, OHIO

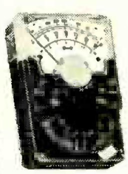
BURTON BROWNE ADVERTISING

631
Combination V-O-M—VTVM

630-NA
For Best Testing Around the Lab, Production Line or Bench

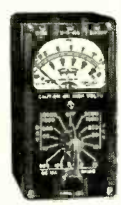
630
The Popular All-Purpose V-O-M

630-A
A Good Lab and Production Line V-O-M

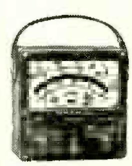


310
The Smallest Complete V-O-M with Switch

630-T
For Telephone Service



666-HH
Medium Size for Field Testing



625-NA
The First V-O-M with 10,000 Ohms/Volt AC

666-R
Medium Size with 630 Features

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Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I send to build many circuits common to Radio and Television. With my Servicing Course you build the modern Radio shown at left. You build a Multitester and use it to help make $10, $15 a week fixing sets in spare time while training. All equipment is yours to keep. Coupon below will bring book of important facts. It shows other equipment you build.

You Practice BROADCASTING with Kits I Send You

As part of my Communications Course I send you parts to build low-power Broadcasting Transmitter at left. Use it to get practical experience. You put this station "on the air" . . . perform procedures demanded of broadcasting station operators. An FCC Commercial Operator's License can be your ticket to a bright future. My Communications Course trains you to get your license. Mail coupon. Book shows other equipment you build for practical experience.

I Will Train You at Home in Spare Time to be a RADIO-TELEVISION Technician

TELEVISION

Making Jobs, Prosperity

25 million homes have Television sets now. Thousands more sold every week. Trained men needed to make, install, service TV sets. About 200 television stations on the air. Hundreds more being built. Good job opportunities here for qualified technicians, operators, etc.

J. E. SMITH, President
National Radio Institute
Washington, D. C.
Our 40th Year

America's Fast Growing Industry Offers You Good Pay, Success

Training PLUS opportunity is the PERFECT COMBINATION for job security, advancement. When times are good, the trained man makes the BETTER PAY, gets PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure you and your family more of the better things of life. Radio is bigger than ever with over 3,000 broadcasting stations and more than 115 MILLION sets in use, and Television is moving ahead fast.

N.R.I. Training Leads to Good Jobs Like These

I TRAINED THESE MEN

"I have progressed very rapidly. My present position is Studio Supervisor with KEDD Television, Wichita."—Elmer Frewaldt, 3026 Stadium, Wichita, Kans.

"Fix sets part time in my shop. Made about $500 first three months of the year. Could have more but this is about all I can handle."—Frank Borer, Lorain, Ohio.

"I've come a long way in Radio and Television since graduating. Have my own business on Main Street."—Joe Travers, Asbury Park, New Jersey.

"I didn't know a thing about Radio. Now have a good job as Studio Engineer at KMMJ."—Bill Delzell, Central City, Nebraska.

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. SERVICING: Home and Auto Radios, Television Receivers, FM Radios, P.A. Systems. IN RADIO PLANTS: Design Assistant, Technician, Tester, Serviceman, Service Manager. SHIP AND HARBOR RADIO: Chief Operator, Radio-Telephone Operator. GOVERNMENT RADIO: Operator in Army, Navy, Marine Corps, Forestry Service Dispatcher, Airways Radio Operator. AVIATION RADIO: Transmitter Technician, Receiver Technician, Airport Transmitter Operator. TELEVISION: Pick-up Operator, Television Technician, Remote Control Operator.

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

My training is practical, complete; is backed by 40 years of success training men at home. My well-illustrated lessons give you basic principles you need and my skillfully developed kits of parts "bring to life" things you learn from the lessons. I start sending you special booklets the day you enroll, that show you how to fix sets. Multitester you build with my parts helps you discover and correct set troubles, helps you make money fixing neighbors' sets in spare time while training. Many make $10, $15 a week extra this way.

Mail Coupon — Find Out What Radio-Television Offer You

Act now to get more of the good things of life. I send actual lesson to prove NRI home training is practical, thorough. My 64-page book "How to be a Success in Radio-Television" shows what my graduates are doing and earning. It gives important facts about your opportunities in Radio-Television. Take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mail coupon now to: J. E. SMITH, President, Dept. 7-FF, National Radio Institute, Washington 9, D. C. Our 40th year.

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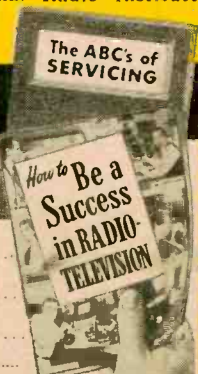

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Address...

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

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JUNE, 1957

Radio-Electronics

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

ON THE COVER

(More on page 59)

TV camera takes to the water in a California swimming pool for a demonstration of underwater television.

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We prepare you for a long list of job opportunities. Thousands of TV and Radio receivers are being sold every day—more than ever before. And, now, Color TV is here. Applications of Electronics in industry—AUTOMATION—are growing in tremendous strides. The whole field is alive—opening up new, important jobs rapidly. National Schools complete training program qualifies you in all phases of the industry.

YOU EARN WHILE YOU LEARN

Many students pay for their entire training—and more—with spare time earning. We'll show you how you can, too! Early in your course you receive material that shows you how to earn extra money servicing TV and Radio receivers, appliances, etc., for friends and acquaintances.

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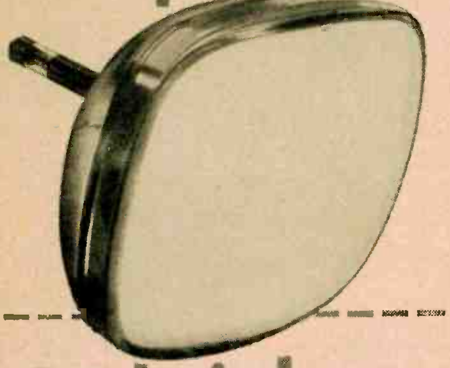

FOR A **brighter profit picture**

Keep your customers sold on *you!* Use the exact same tubes leading *independent* set makers specify. Tell your supplier you'd rather have Tung-Sol Tubes.

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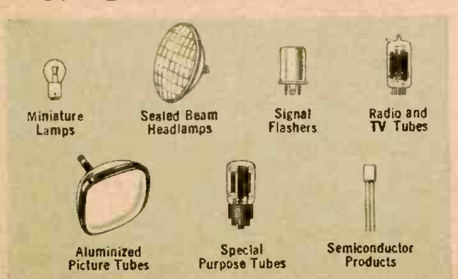
PICTURE TUBES

RECEIVING TUBES



News Briefs

MAIL SORTING by electronics is a future necessity, the Institute of Radio Engineers was told by a Canadian Post Office engineer, A Barszezewski. Otherwise, with the present increase in mail, a large enough volume is in sight in the foreseeable future to employ the entire population of the United States and Canada to do nothing but sort the mail of the two countries!

In a prototype system already tried out experimentally in Canada, letters are marked by a simple binary code arrived at by taking certain letters of street and town names. For example, a post office with two words in its name is coded by using the first and last letters of the two words. The code is automatically translated to the binary code used on the letters by a coding typewriter, and typed in an invisible ink that glows under ultra-violet light and activates a photocell. In sorting, letters on a conveyor can be gated down different chutes according to their coding. The invisible coding permits using the system on postcards.

WORLD'S FIRST RADIO to be offered for public sale was presented to the Henry Ford Museum by Hugo Gernsback, who first advertised the set for sale in *Scientific American*, Jan. 13, 1906. It was called the TELIMCO, a contraction of *The Electro Importing Co.*, Gernsback's pioneer wireless firm.

The radio (or wireless) of that day differed vastly from present sets and consisted of a transmitter and receiver. Transmission was by spark, and the receiver operated a relay that rang a doorbell to give the dots and dashes of the International Morse Code. Total price of the two units was $7.50 (later raised to $10). The set presented to the museum was a modern replica, built by Hugo Gernsback, using as many 1906 parts as could be obtained. Mr. Gernsback made the presentation at a special meeting sponsored by the Henry Ford Museum, the Michigan Institute of Radio Engineers and the American Radio Relay League.

INSECT-sized electronic circuits are the goal of micro-miniaturization, Dr. Cledo Brunetti of printed-circuit and miniaturization fame told the Institute of Radio Engineers at its recent convention. This can be achieved, he said, by "doing a strip-tease act on present equipment and components." "Miniature" components are mostly insulation and air, and even in a tiny transistor the ratio of volume of active element to that of the case is extremely small. To the active part of a resistor is added first connecting leads, then an insulating cover many times the size of the active portion. Can we, he asked, create circuits out of only the active materials first, then put the entire circuit in an insulating block?

Other approaches which might contribute to micro-miniaturization, Dr. Brunetti believed, were new fabrication techniques, new materials and possibly discovery and application of new physical phenomena.

ELECTRONIC INTERFERENCE resulting from widespread use of electrical and electronic equipment is impairing the operation of America's modern defense systems. Brig. Gen. E. F. Cook, commanding officer, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., gave this warning in an address at the opening session of a two-day Radio-Interference Reduc-

Hugo Gernsback, editor-in-chief of RADIO-ELECTRONICS, presents first home radio marketed in the world to Ronald A. Shelley, executive director of Henry Ford Museum, Dearborn, Michigan.

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EASIEST TO BUILD because KNIGHT-KIT "Step-and-Check" instruction manuals are marvels of clarity—it's just like having a good instructor at your side!

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★ Deluxe custom hi-fi styling
★ AFC and Flywheel tuning
★ Printed circuit—easy wiring

The best-looking, best-performing tuner kit your money can buy. Covers 88 to 108 mc; features AFC (with special disabling circuit); pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; illuminated lucite pointer. Sensitivity is 10 microvolts for 20 db of quieting across entire band. Ideal for use with Knight-Kit 20-Watt Amplifier or any amplifier with phono-tuner switch. 13 x 8 x 4". Complete, ready for easy assembly. Shpg. wt., 12 lbs.
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tion Conference at the Museum of Science and Industry, Chicago.

The conference, sponsored by the Signal Corps Engineering Laboratories, is conducted by the Armour Research Foundation of the Illinois Institute of Technology.

General Cook said the great increase of applied electronics, "with a multitude of specific equipments clamoring for bits of crowded [electro-magnetic] spectrum demands attention of design and development engineers so that spurious emanations as well as responses of receiving systems do not "wantonly consume that most critical of resources, the electromagnetic spectrum."

TWO NEW TV STATIONS, both in Louisiana and noncommercial, appear on our roster:

KLSE, Monroe, La. 13
WYES, New Orleans, La. 8

One station changed its channel:

KTVI, St. Louis, Mo. 2
(formerly 36)

Another changed its call letters:

WANE-TV, Ft. Wayne, Ind. 15
(formerly WINT)

These new developments bring the total of operating stations in the United States and its territories to 499 (405 vhf and 94 uhf), of which 25 are noncommercial (6 uhf).

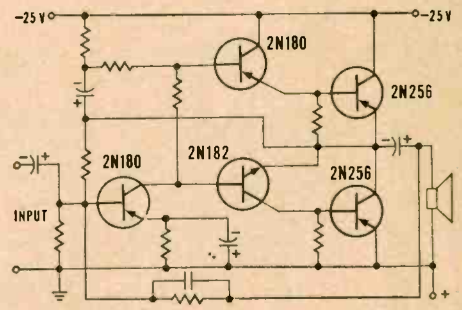
EXPANDING FM RADIO was seen by members of the National Association of Radio & Television Broadcasters at their 35th annual convention in Chicago. Fred Rabell, KSON-FM, San Diego, said the FM listener comes from the ranks of TV viewers. This optimistic thinking in the FM field was supported by a discussion which showed that competition for FM licensing existed in some areas. Los Angeles is a typical example. Leonard Ashbach, president of Majestic International, reported that the FM set is moving into the living room and pushing the TV into the bedroom, den and other parts of the house.

The growing popularity of FM sets was attributed to the general use of musical backgrounds and few commercials. A warning pointed out that the reason for FM radio's appeal in such areas as Los Angeles is that many of its listeners are fugitives from commercials and if more commercials are sold on FM, the listening audience would not be so large.

CREVASSE DETECTOR for locating camouflaged Arctic canyons has been developed by Army engineers at the Engineer Research & Development Laboratories, Fort Belvoir, Va., and the Southwest Research Institute of San Antonio, Tex. The device creates a low-frequency electromagnetic field which is distorted by the presence of a crevasse.

The unit consists of four electrodes placed at approximately 20-foot intervals. Its work horse is the Weasel, an over-snow vehicle. It moves three elec-

Transistorized
6-Watt Hi-Fi



New experimental all-transistor hi-fi amplifier delivers 6 watts with: ±1.5 db response from 30-15,000 cps, less than 1% harmonic and 2.5% intermodulation distortion, noise level 74 db down. Simple circuit features: pre-driver, driver, and final amplifier using low-cost CBS 2N256 power transistors . . . negative feedback . . . complementary-symmetry driver . . . direct coupling . . . economical power supply.

CBS alloy-junction germanium power transistors 2N255 (6-volt) and 2N256 (12-volt) are useful also in many other economical amplifiers . . . fixed or mobile . . . with up to 10 watts output Class B push-pull. Second Edition of CBS Power Transistor Applications, Bulletin PA-16, helps put them to work. Free, it gives complete data and circuits. Pick it up with your 2N255 and 2N256 transistors at your CBS Tube distributor's — today.

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You Have More TO SELL WITH A *Winegard*

The more sound selling facts you can put before a customer, the more chance you have of closing a sale! And the Winegard Color'Ceptor gives you selling points nc other antenna can offer . . . exclusive buying appeals that clinch 9 out of 10 sales!

They See the Gold and They're Sold

The gold-anodized finish of the Color'Ceptor gives it a rich, quality appearance not found in any other antenna. When you show the Color'Ceptor alongside competitive models, the Color'Ceptor is so distinctive, so *finished-looking* that it is invariably selected by your customers. Gold-anodizing has a practical sales advantage, too. It provides immunity to corrosion—prevents deterioration in performance.

If the Winegard Color'Ceptor won't bring in a station you want to see . . . nothing will! Proof of performance was dramatically illustrated when Robert Seybold of Dunkirk, New York—using a Winegard Antenna—broke all long-distance reception records in 1956 (see Radio-Electronics Magazine Jan. '57). Equipped with optional signal-boosting Power-Pack and patented "Electro-Lens"* focusing, the Color-'Ceptor is second to none for long distance reception and clear, watchable pictures in both black-and-white and color!

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The Winegard Authorized-Dealer decal (pictured above) is proving a real business-builder for every dealer who displays it. Heavily promoted in Winegard's national advertising, the decal tells the world that "here's the place to buy the gold-anodized Color'Ceptor."

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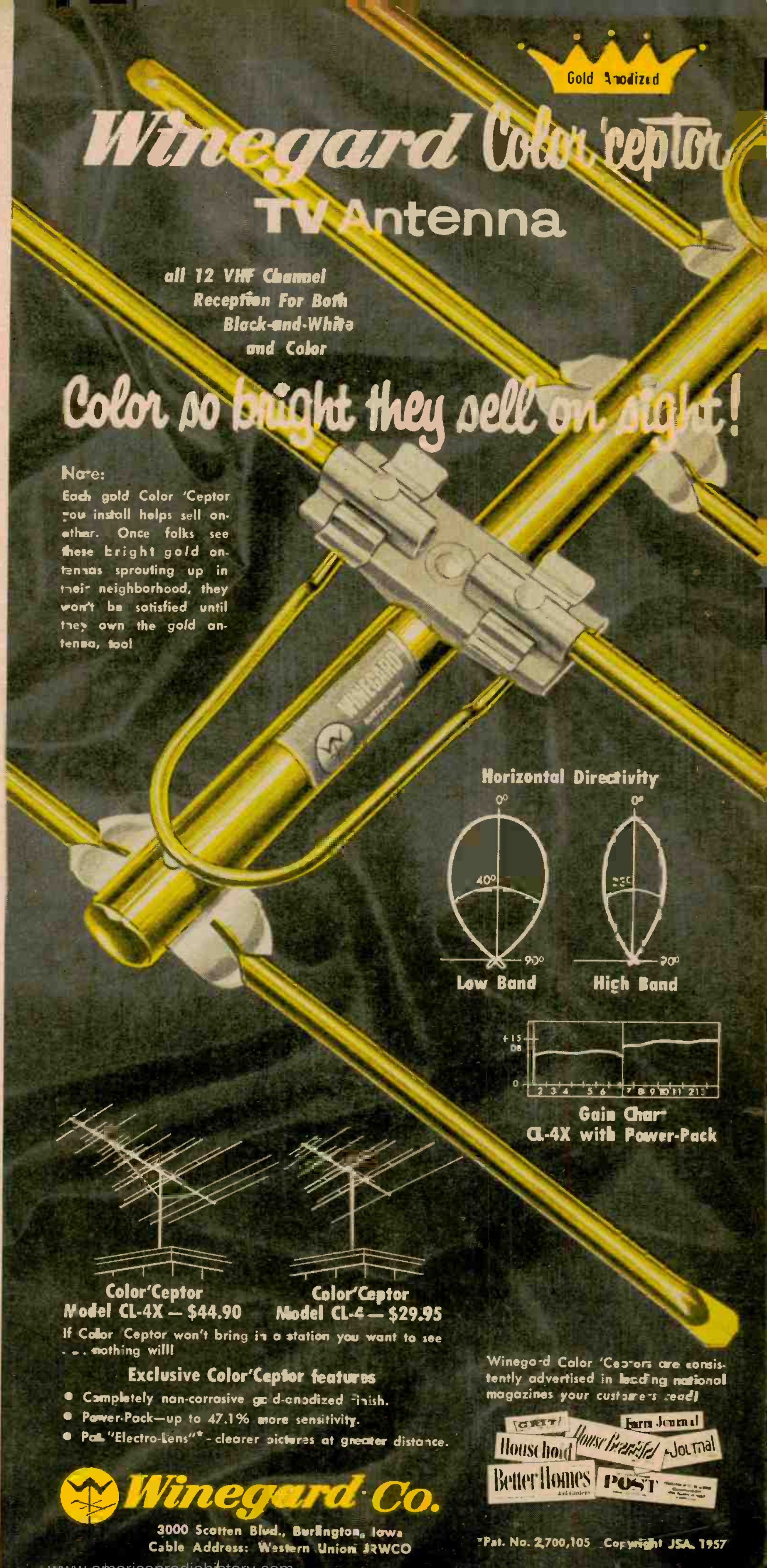

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trodes in the form of disk-shaped sleds and itself acts as the fourth electrode.

In operation the driver keeps an eye on a recorder as the Weasel moves over the snow. When the search head, pushed ahead of the vehicle, reaches a crevasse, the dielectric difference in the air in the crevasse and and the surrounding area causes a noticeable indication.

In tests covering more than 100 miles of the Greenland Ice Cap, the detector located all known creavasses and a number of new ones.

Calendar of Events

National Telemetering Conference, May 27–29, Hotel Cortez, El Paso, Tex.
1st Annual Conference on Production Techniques, June 6–7, Willard Hotel, Washington, D. C.
National Technical Career Conference and Exposition, June 8–12, Sherman Hotel, Chicago.
2nd RETMA Symposium on Applied Reliability, June 10–11, Hotel Syracuse, Syracuse, New York.
National Convention on Military Electronics, June 17–19, Sheraton Park Hotel, Washington, D. C.
British IRE Convention, June 27–July 1, University of Cambridge, England.

FM RADIO RADIATION is being checked by RETMA to determine whether foreign-made receivers comply with limits specified by the FCC for domestic manufacturers. Also concerned with the increasing rate of foreign tube imports, RETMA is gathering statistical information on the number of tubes being brought in from foreign countries.

ONE MILLION TV SETS are foreseen in Japan by the end of this year, according to a survey by Kyodo news agency. This means one set to each 90 persons.

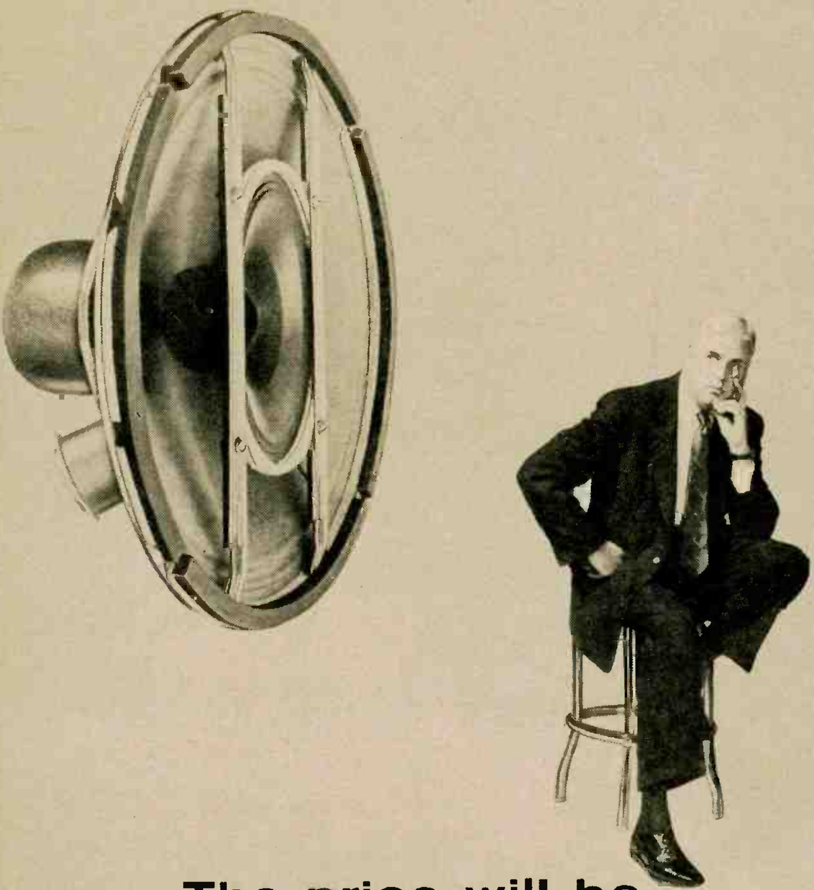
The big growth in TV receivers is expected to follow the expansion of microwave facilities and the establishment of six new Government-sponsored stations in April, two more during the summer and eight others scheduled for later in the year. Forty additional applications are on file with the Postal Ministry (licensing agency in Japan) by private firms.

The high price of receivers is still a major factor in retarding general popularity of television in Japan, as the present price of $200 for a 14-inch set represents six months' take-home pay to a factory worker.

TELEVISION TAX to support television maintenance districts was proposed in a bill introduced in the Nevada Assembly.

Introduced by White Pine County where a community antenna system is planned it would provide for a TV maintenance district to be set up upon a petition of the local county commissioners by a majority of registered voters.

The commissioners would appoint three trustees if the petitions did not specify them. Then the commissioners could tax TV set owners for the support of the district. END



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Prentice Harrison, Lewes, Delaware	1st	27 weeks
Francis W. Bartley, Danbury, Conn.	2nd	15 weeks
Herbert W. Clay, Phoenix, Ariz.	2nd	22 weeks
Thomas J. Bingham, Finley, N. Dak.	2nd	9 weeks

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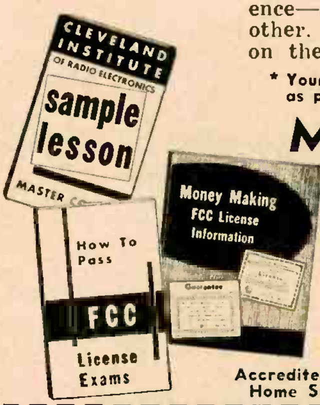

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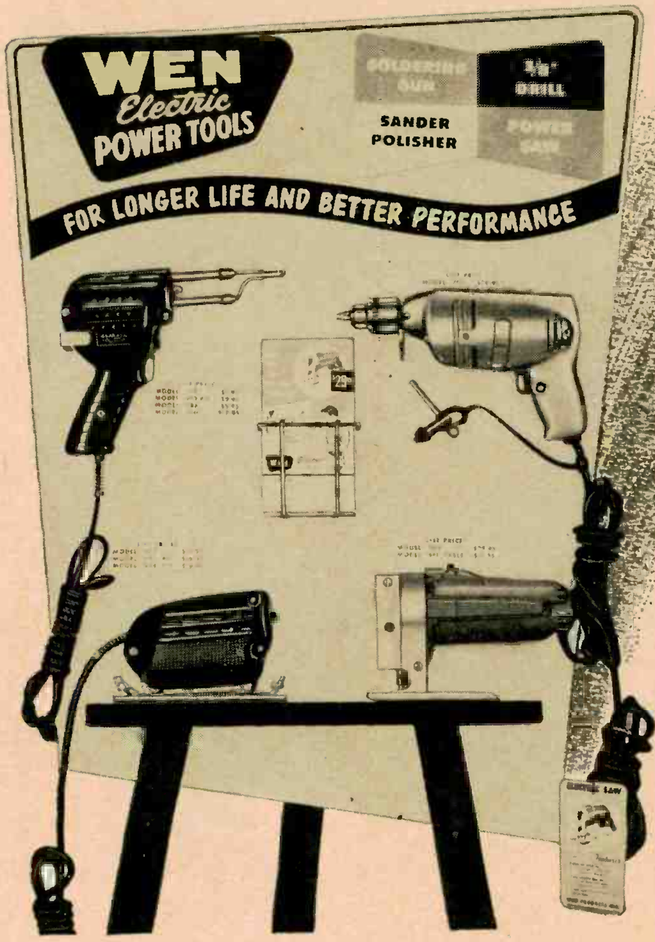

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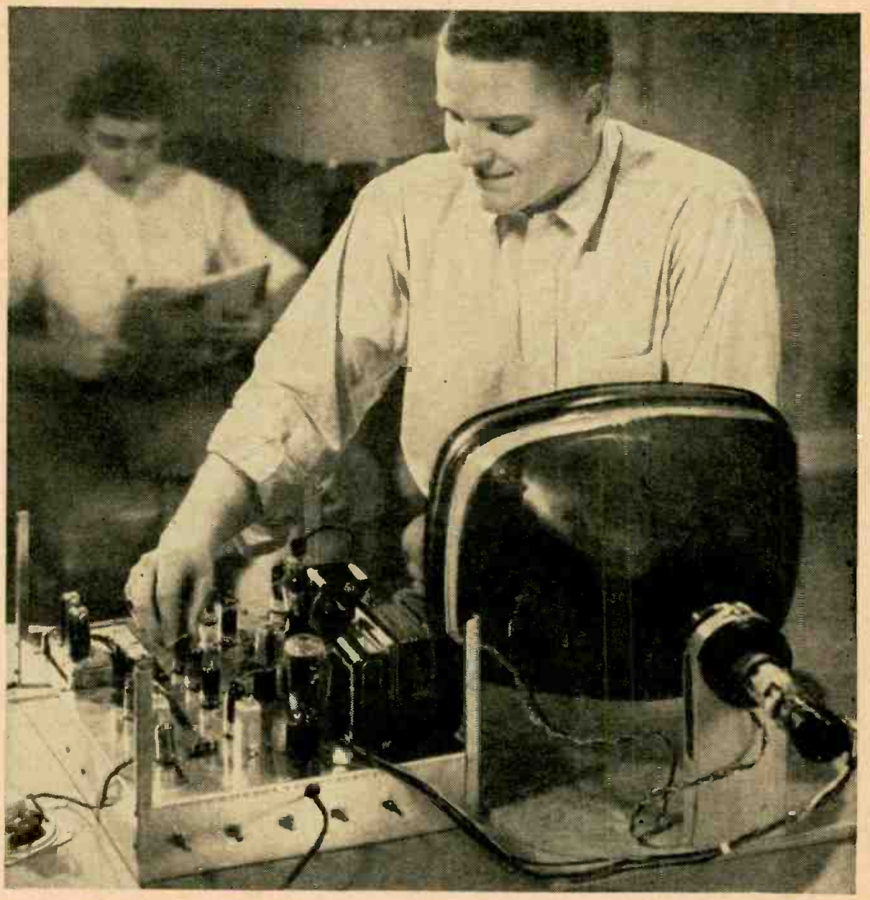

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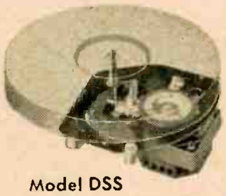

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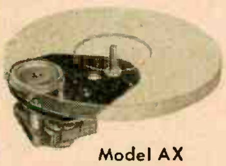

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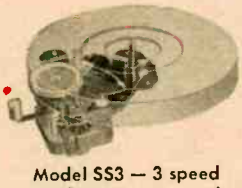

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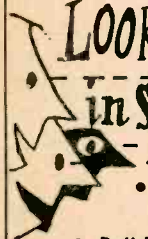

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Correspondence

IN STEWART'S CORNER

Dear Editor:

Concerning Mr. A. H. Stewart's letter in your April issue, I would like to say that he is definitely not the only one who feels as he does.

Mr. Stewart's comments concerning diplomacy are certainly well taken. TV service, whether performed on a full- or part-time basis, should be based on quality service and customer goodwill.

The trouble with many technicians is their attitude upon starting a job. Instead of thinking "How much service can I give this customer?" they think "How much can I charge this customer?" A reputation for quality workmanship, pleasant customer relations and reasonable pricing is far more valuable than a license hanging on the wall to gather dust. We should all remember that there is a big difference between being in business and being a businessman.

Dayton, Ohio ARTHUR BRISCOE

"WRONG QUIZ" WRONG?

Dear Editor:

In your February issue I think I have found an error. It occurs in the "Wrong Quiz," problem 5. You list the correct answer as D.

If you consider a cathode-to-heater short where the cathode returns to ground, you will have a complete circuit and current will flow. The tubes before the shorted stage will be brighter than normal. The remaining tubes will not be lit. EDWARD SULZBACH

Philadelphia, Pa.

(We agree that if such a cathode-to-heater short did occur in the next to the last tube of the series string only one tube would be out. But if the short were near the ground end of the filament, it would light and the tube that was out would not be the bad one. If the short were at the other end of the filament, *two* tubes would be out, thus not fitting the statement.)—*Editor*

CUSTOMER RELATIONS

Dear Editor:

In answer to Mr. A. H. Stewart's April letter, "A TV Owner Comments," why didn't he call an ethical shop in the first place? An ethical shop would have made good its guarantee.

From Mr. Stewart's letter, I assume that the set was working at the time the bill was presented, as it would be difficult to collect if the set were acting up at that time.

That the set failed again does not

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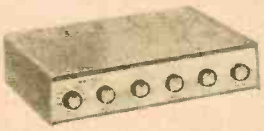

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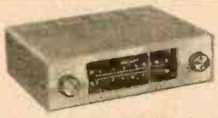

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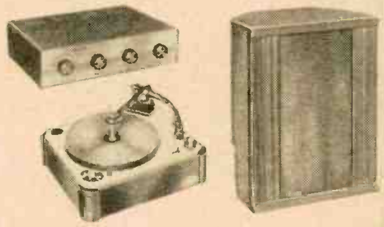

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necessarily mean the shop was incompetent nor does it prove the part-timer better qualified than the shop. The set could have given trouble later because an intermittent set can easily fool shop test equipment. Possibly the condition of the circuit parts at the time the part-timer worked on the set was such that it was easier to locate faulty intermittent parts. The part-timer may have had the luck of being there just at the right time—when the set was showing up the bad parts!

Many good full-time technicians, like our part-timer, are lost to our service industry because most of the public can not tell a good from a bad shop. Certainly, Mr. Stewart would not have called that shop if he knew it was not an ethical one. Good technicians give up, too, because they cannot stand the unjust accusations leveled at them. For example, sometimes the customer does not even give an ethical shop the courtesy of informing it when his set is not working properly. He accuses the shop behind its back without giving it a chance to make its work good.

I feel the injustices to both customer and qualified technician can be corrected. A service organization should be created in each locality. The members in good standing and their ethics should be published periodically in the paper, along with the statement, "Any customer who is using a member and is not entirely satisfied with work performed or feels the bill excessive should write to the Investigating Committee that will investigate this matter to his full satisfaction." If the complaint is found to be a case of dishonesty, the service technician must be dropped from the organization! If it is not dishonesty, then he must fix the set again at no charge.

Please comment on this plan. To my amazement, several well established shops in this areas have turned it down!

MELVIN COHEN
Suburban Television
Hudson Falls, N.Y.

DUB TECHNICIANS

Dear Editor:

The comments of Mr. A. H. Stewart in the April issue (perhaps inadvertently, but nevertheless vividly) go a long way in support of the view that there are all too many "dubs" masquerading as TV technicians! The mere fact that they are full-time "dubs" rather than the part-time variety emphasizes the problem and brings home, concretely, the desperate need for legislation separating the sheep from the goats.

Mr. Stewart's complaint of high-handed methods and browbeating are not peculiar to full-time TV technicians any more than freckles are. I dare say we have technicians well versed in etiquette and the social graces. His lone experience in this regard proves only that he met the other kind. If Mr. Stewart prefers part-timers, that's his business. But when he suggests that all

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ELECTRONICS' FUTURE CAN BE YOUR FUTURE

You can't keep up with the tremendous changes in the electronic industries. What's predicted for next year becomes outdated in a few months! All phases of the electronic industries are experiencing phenomenal growth. There are thousands of career openings, big ones. Industry can't find *enough* trained manpower to fill them in manufacturing, testing, servicing, broadcasting and telecasting.

TAKE TV FOR EXAMPLE!

Four hundred and six stations are on the air! Many more are building or in the plans stage: 38,000,000 sets are in use. Color TV is just starting to really come alive! This same phenomenal growth picture is repeated in every phase of business employing electronics—crime prevention, aeronautics, firefighting, communications, to name but a few. CREI has the plan to keep you moving upward, to help you assume your rightful place!

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The big companies know CREI men have what it takes! CREI grads are at work in America's biggest corporations, in positions ranging from technicians to engineers to top management. Companies such as Canadian Broadcasting Corp., Douglas Aircraft Co., Glenn L. Martin Co., All-American Cables and Radio, Inc., Federal Electric Corp., U.S. Information Agency (Voice of America), and United Air Lines, are now paying for CREI training for their own technical staffs. Our placement bureau has more requests for CREI-trained men than we can presently supply.

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HE'S WITH STEWART

Dear Editor:

In answer to A. H. Stewart of Bloomington, Ill., please assure him that he is not alone.

RENO DAIGLE
Lowell, Mass.

DO-IT-YOURSELFER VIEWPOINT

Dear Editor:

There is too much griping about "yourselfers." After all, we are all guilty at one time or another. Ever try to check the ignition on your car or install an electric outlet in your home? But to relate my experience:

Some shops here know I'm studying radio and television; those that know are helpful and polite. But if they don't know, boy, are they hostile when I ask for a capacitor or resistor I'm short of! One shop put me through the third degree when I asked for an electrolytic. I paid list price for it, so what I was going to do with it was my own business.

In my regular job, which takes me around the county quite a bit, I stop in some of the shops for a few moments and find that most of the regulars are swell fellows. When I inquire about "do-it-yourselfers," most of them agree with me that the set is the customer's property and what he does with it is his business.

Most of the pros who get annoyed, I believe, do so because it takes a lot more brains and knowledge to cope with the results of untrained hands in a TV set. But doesn't that sign outside the door say "TV Servicing"? No distinction about the type of trouble, whether due to natural wear, an act of God or the hands of the owner. Besides, the customer knows he must have snafued something, so he is usually willing to pay. But don't ridicule him—that's murder (to your business), the word-of-mouth kind.

By the way, your magazine is a must every month. Think your scheme for better marked diagrams and plans is going to be swell.

P. DEAN SOMMERVILLE
Marshfield, Wis.

DIMENSION DILEMMA

Dear Editor:

In recent times some manufacturers of batteries for standard penlights are so length. Some bayonet-cap penlights cannot be turned off when assembled with the longer batteries. With some screw-cap penlights, short batteries cause rattling and bulb failure through shock. Must we shop for flashlight batteries with a vernier caliper?

JOSEPH F. HAUBER
Minneapolis, Minn.
END

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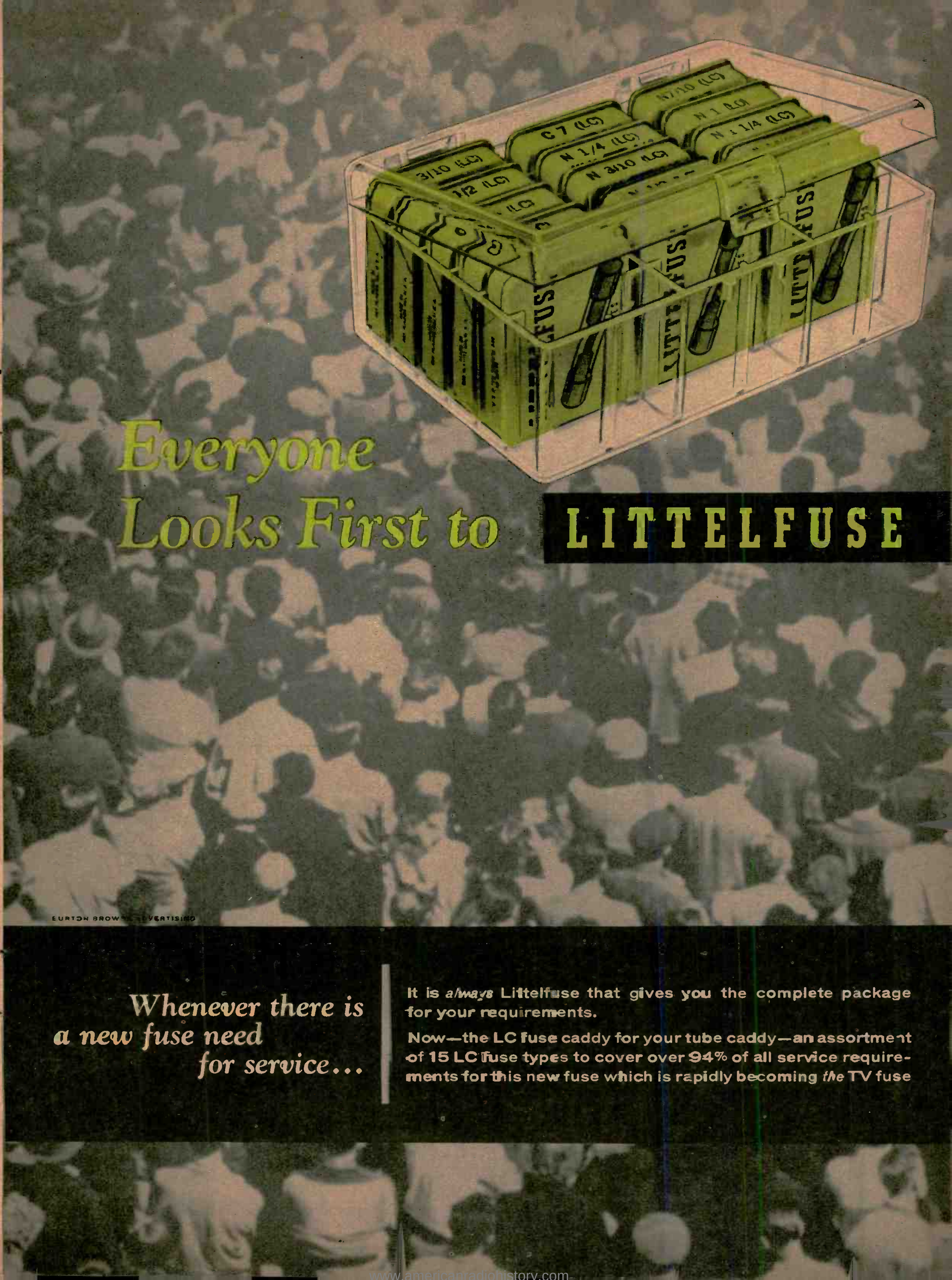
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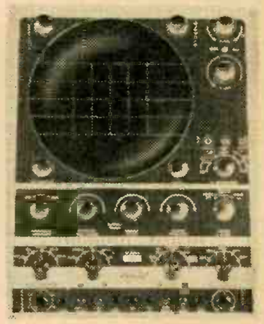

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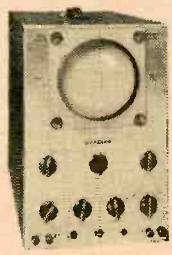

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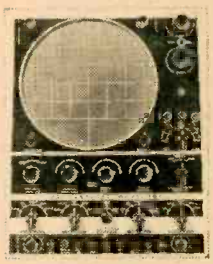

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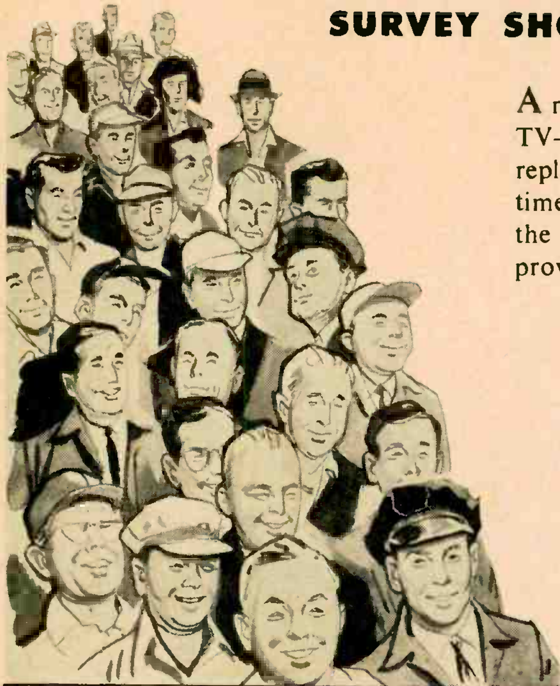
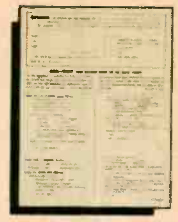


A recent Howard W. Sams survey among the nation's TV-Radio Service Technicians produced over 10,000 replies to an all-inclusive questionnaire. These men took time out to answer over 100 separate questions. Among the many valuable facts disclosed, the following will prove most significant to every Service Technician:



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COMPLETE Tube Placement Charts
Both top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

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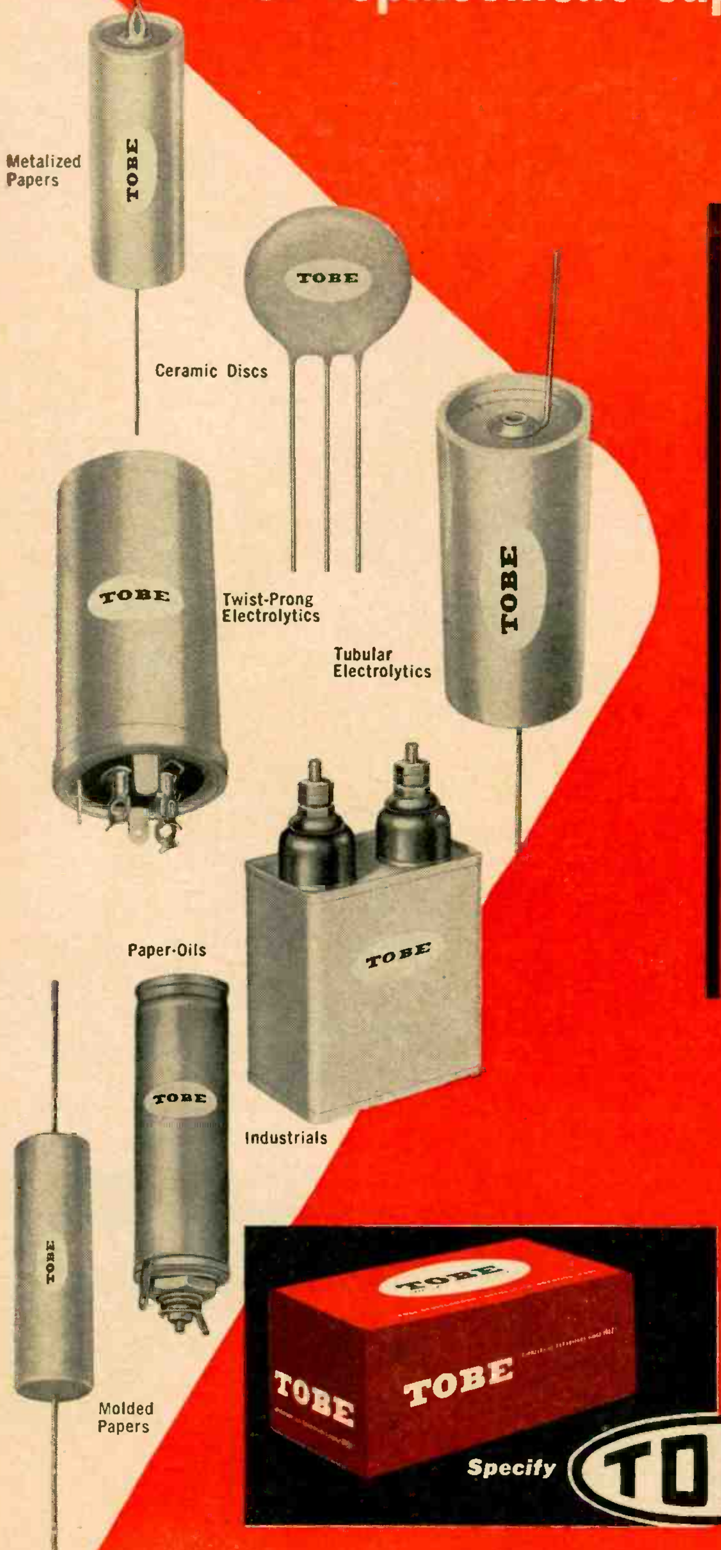

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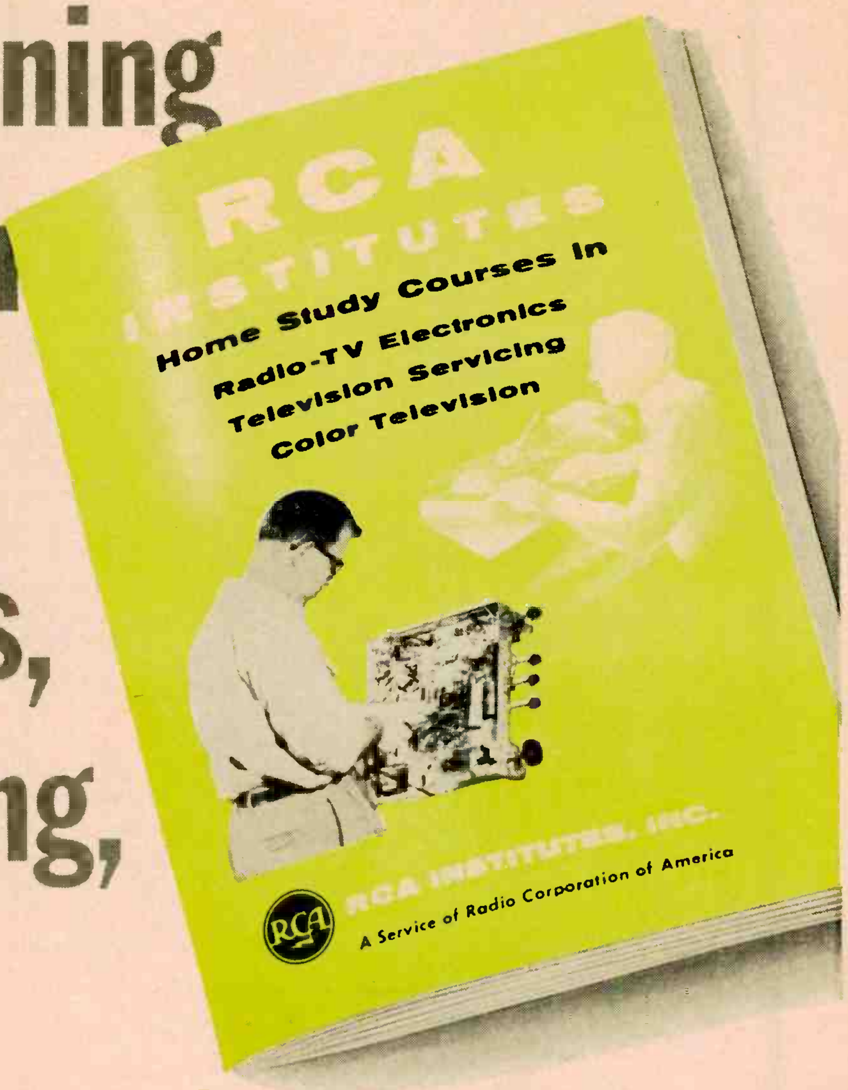

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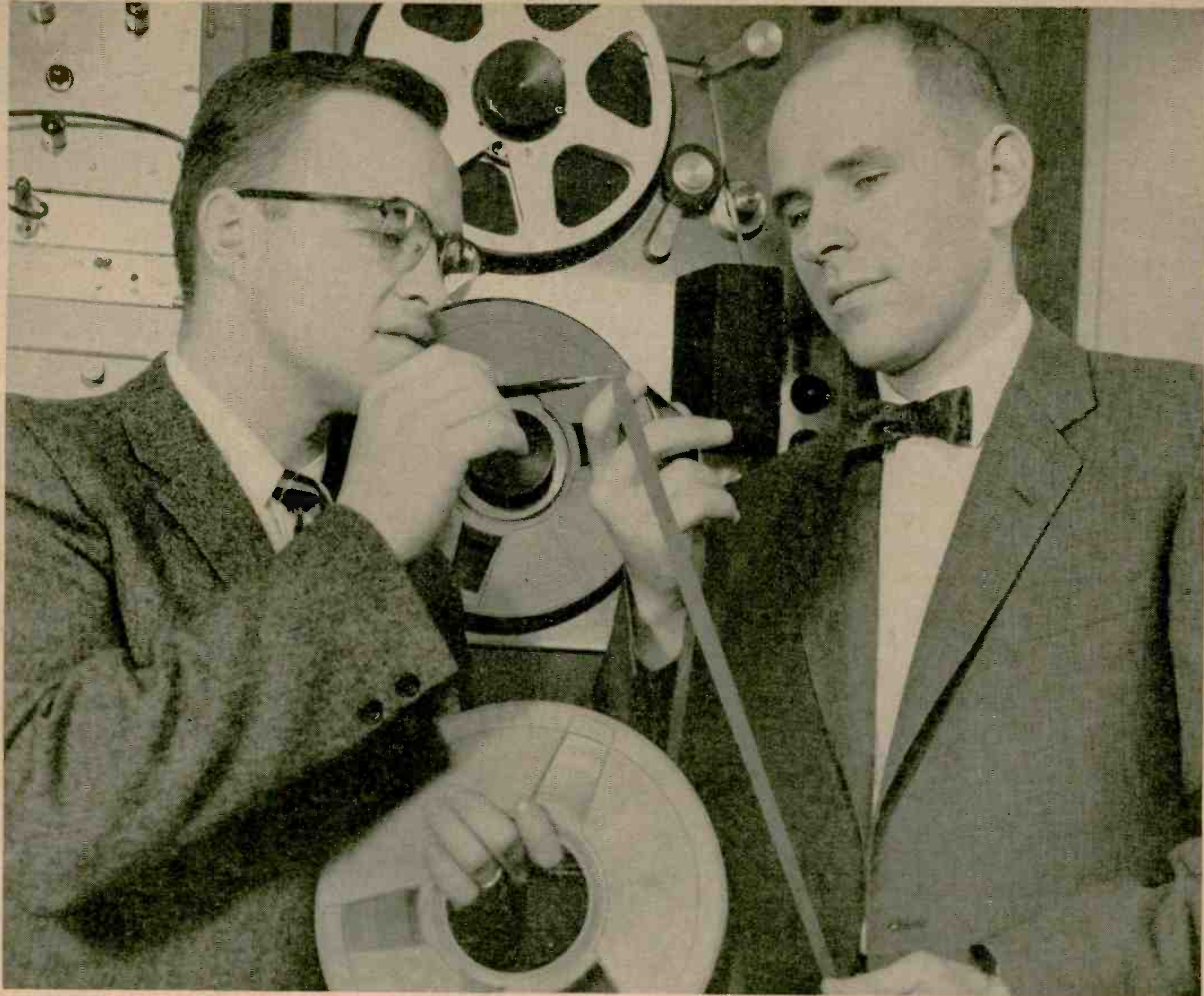

Bell Laboratories researchers Henry S. McDonald, Dr. Eng. from Johns Hopkins, and Max V. Mathews, Sc.D. from M.I.T., examine magnetic tape used in new research technique. Voice waves are converted into sequences of numbers by periodic sampling of amplitudes, 8000 samples per second. General purpose electronic computers act on these numbers as a proposed transmitting device might.

They send real voices on imaginary journeys

In their quest for better telephone service, Bell Laboratories researchers must explore many new devices proposed for the transmission of speech signals. For example, apparatus can be made to transmit speech in the form of pulses. But researchers must always answer the crucial question: how would a voice sent through a proposed device sound to the listener?

In the past it often has been necessary to construct costly apparatus to find out. Now the researchers have devised a way to make a high-speed electronic computer perfectly imitate the behavior of the device, no matter how complicated it may be. The answer is obtained without building any apparatus at all.

The researchers set up a "program" to be followed by the computer. Actual voice waves are converted into a sequence of numbers by sampling the waves 8000 times per second. Numbers and program are then fed into the computer which performs the calculations and "writes out" a new sequence of numbers. This new sequence is converted back into real speech. Listeners hear exactly how well the non-existent device could transmit a real voice.

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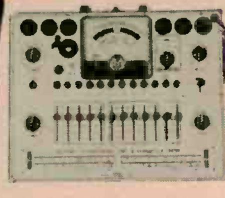

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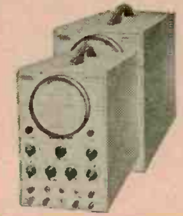

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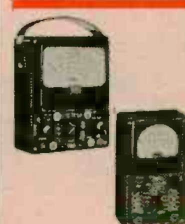

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TRANSISTOR GROWTH

... What Is the Future of the Transistor? ...

THE transistor, less than 10 years old, has now emerged from its swaddling clothes. Marvelous instrument that it is, much work still remains to be done in research laboratories before it will be near perfection and can be fully mass produced.

Many transistor manufacturing problems are still in flux. They are chiefly chemical, metallurgical and mechanical—and, more important, they hinge on process control. Yet constant progress is being made in every direction of transistor manufacture and it appears that within a few years the main difficulties that now delay mass production and full automation will have been overcome.

From the above it will be readily understood why transistors are not in all new radios or TV sets. For one thing, only a modest number of transistors are now being made, compared to tubes.

Secondly, the transistor is still expensive, higher in price than vacuum tubes. Third, high-frequency transistors have only recently made their appearance outside the laboratory.

While a number of transistor pocket radios are now manufactured, these are still expensive and may be termed a quasi-luxury article. As for transistor television sets, about which readers frequently ask, there certainly is no need for them now. Transistors are chiefly in demand where space saving and weight are big factors—as in hearing aids, pocket radios, etc. But for the present, space saving in TV sets is pointless because of the comparatively huge size of our picture tubes. Once flat picture-on-the-wall television is a commercial reality, then transistors in TV sets will be a must, but probably not before.

Generally speaking, transistors are following a cycle parallel to our early tube trend. Old-timers well remember such first tubes as the VT1, VT2, 201, WD11, WD12, 201A, 199 and others.

These tubes—produced some before and most during the early Twenties—were in vogue about 10 years before they were replaced with more efficient models. The early tubes, too, were not fully mass-produced immediately, not for lack of machinery but for lack of multimillion-unit demand, and chiefly for lack of know-how. In other words, humans had to be trained in the complexities of vacuum-tube manufacture—always a most difficult and usually slow process.

So with transistors which, due to their minuteness, are in a way more difficult to construct than vacuum tubes. Their manufacture may be compared to that of ladies' precision, dime-size watches. The micro-fine parts today are usually assembled by women, mainly because they are more nimble-fingered and more adaptable for this tedious type of work.

We recently had an interesting talk with Dr. Alan Glover, general manager of the RCA transistor plant. We learned, among other things, that at present there is no longer a bottleneck in transistor production. The industry, he feels, can keep in step with any transistor demand. Mechanization and automation, as far as transistor manufacture is concerned, are no longer serious problems. The chief problem is teaching and breaking in new operatives, the learning cycle—process control, as it is called.

While the industry as a whole does not give out figures on rejects (defective units), we were told that the percentage today is becoming more and more moderate. This is particularly true of those types which have been manufactured for a few years.

As for high-frequency transistors, every year sees at least a several-fold increase in maximum frequency. Here it is where invention and research are most intense. It was thus in high-frequency vacuum tubes, too. The RCA drift transistor and the Philco surface-barrier transistor are high-frequency types that prove the point in the evolution toward ever-higher maximums.

To understand better the present trends in transistor manufacture, a few statistics regarding their sales may be of interest.

Sales of transistors in the United States during 1956 were around 13 million. Spokesmen for the industry cite the following forecasts: 1957—26 million, 1958—59 million, 1959—125 million.

How does this compare with vacuum-tube sales? In 1956, the industry sold over 464 million tubes.

This brings up once more the inevitable question so often asked and answered by us on this page a number of times. We for one do not believe for a moment that the transistor will ever supplant the vacuum tube, any more than television will ever supplant radio.

Both the vacuum tube and the transistor are here to stay. Both have their own uses and their own fields in which they are indispensable. This is true despite the fact that the future day may arrive when some types of transistors will sell for 10 cents apiece.

What about the more distant future? *What comes after the present-day transistor?* To us it appears that it will be a *radioactive transistor*, i.e., an *atomic transistor*. The reason? A radioactive type of transistor will supply its own electric energy and needs no outside current supply or battery. Atomic batteries are already on the market—the atomic transistor consequently is a logical combination which is bound to follow. —*H.G.*

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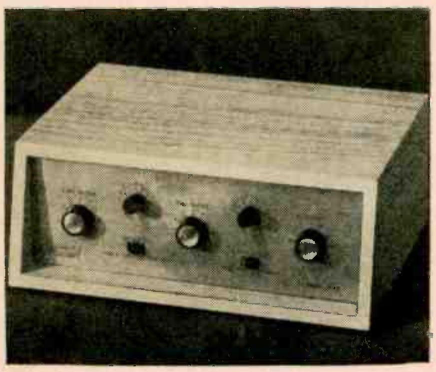
MULTICHANNEL

MULTICHANNEL AMPLIFICATION

by ROBERT F. SCOTT
TECHNICAL EDITOR

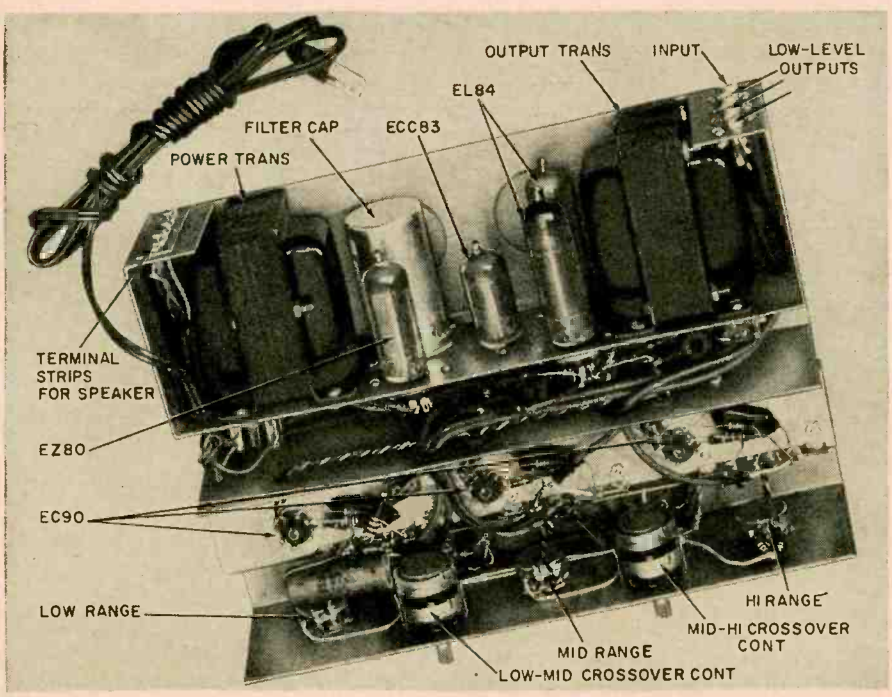
Electronic crossovers and two-channel amplifiers

Above—Heathkit Electronic Crossover.



Left—Colbert 3-CFD.

Below—Underchassis view of the Colbert 3-CFD (with callouts).



FOR years many music lovers and high-fidelity fans have used a single power amplifier to feed multiple-channel speaker systems through a dividing or crossover network. With hi-fi systems growing more elaborate and performance requirements becoming stricter, many fans have found that intermodulation distortion is lower and reproduction cleaner with better definition when the program material is split into channels at some low-level point and fed to separate amplifiers driving individual speaker systems. Usually, the crossover networks are placed between the preamplifier or control unit and the amplifiers.

Until a short time ago, with the exception of one or two "custom" manufacturers, such multichannel systems were home-made or built to order. Several manufacturers are now making amplifiers and low-level crossover networks for multiple-channel amplifiers. Other firms are beginning to incorporate twin-channel amplifier systems in some of their radios and phonographs. Some of these units are described in this article. Others will be covered as material is made available.

Colbert 3-CFD

This is a three-channel electronic frequency divider made by Colbert Laboratories. It is designed for use in either a two- or three-channel system. In a two-channel system, the crossover point is variable from 160 to 3,000 cycles. Crossovers are variable from 160 to 1,500 and 750 to 6,000 cycles when the unit is a part of a three-channel system.

Each channel (Fig. 1) has its own level control and is provided with a low-level high-impedance output circuit. The unit has a built-in 10-watt Ultra-Linear type amplifier that can be switched into the circuit to feed the tweeter in a two-way system or the tweeter or mid-range speaker in a three-way arrangement.

Crossover networks

There are two variable crossover networks in the 3-CFD. Each is controlled by a ganged potentiometer. The LOW–MID control varies the crossover frequency from 160 to 3,000 cycles and is used when the unit is a part of a two-way system. This control has a range of 160 to 1,500 cycles when it is used in a three-channel system.

The MID–HIGH crossover control—used only with three-channel systems—is fed from the high-frequency output of the LOW–MID control and has a range of 700 to 6,000 cycles.

Each crossover network consists of L type high- and low-pass filters in parallel. The resistive component in each is a section of the ganged potentiometer. The high-pass filter in each crossover network consists of a .01-μf capacitor in the series element and a shunt element consisting of a 250,000-ohm potentiometer and a 6,800-ohm

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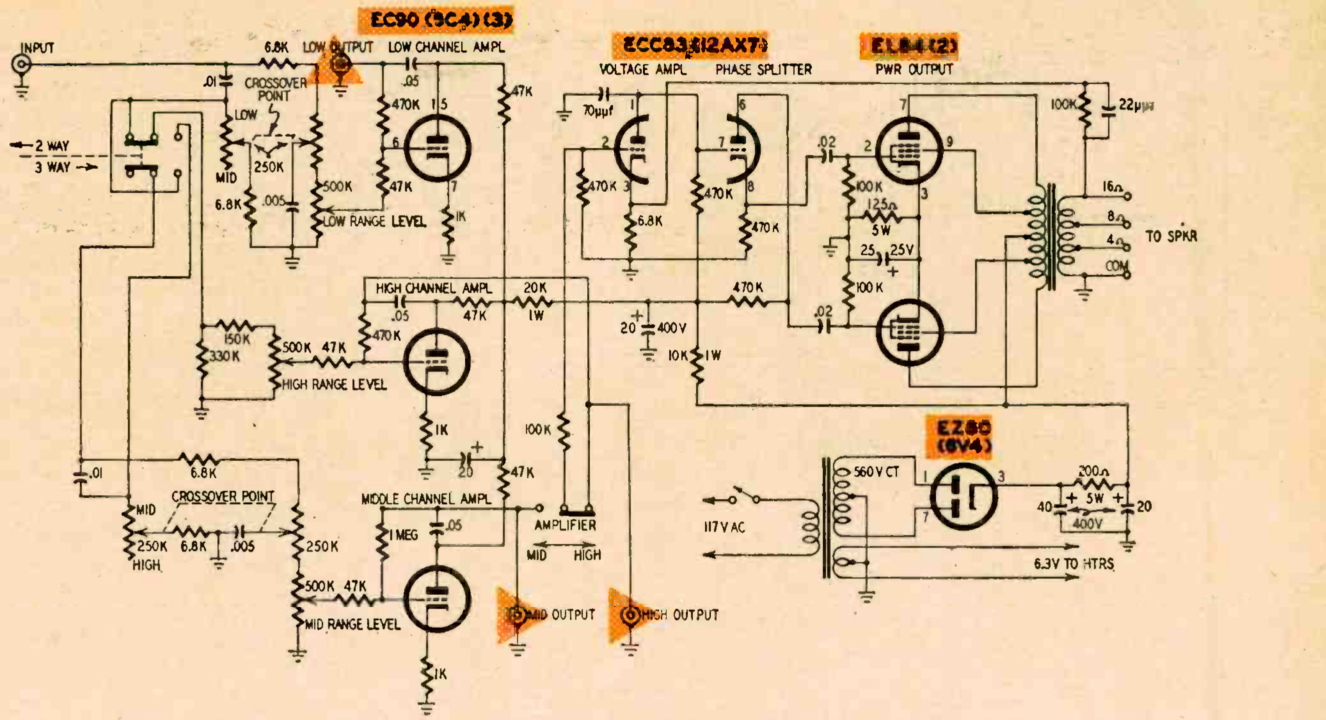

Fig. 1—Schematic of the Colbert 3-CFD, a three-channel frequency divider.

fixed resistor in series to ground. Output is taken from the junction of the .01-μf capacitor and the top of the shunt resistor. The low-pass filter has its series element composed of a 6,800-ohm resistor and 250,000-ohm potentiometer in series. Its shunt element is a .005-μf capacitor between ground and the arm of the variable series element.

When either control is set to its lowest crossover point (the LOW position for the LOW–MID control and MID position for the MID–HIGH control), the network circuit resistance is maximum in the low- and high-pass filters. Similarly, the crossover point is highest with minimum resistance in the circuit. The approximate crossover points for different positions of the controls are given in the table.

The voltage amplifiers in the low-, middle- and high-frequency channels are EF90's with plate–grid feedback to provide sharper cutoff slopes and minimize peaking (see "Feedback Filters for Two-Channel Amplifiers," by Crowhurst, *Audio*, October, 1954). These stages give unity gain between input and respective output terminals.

Position	Approximate Crossover Frequencies		
	Two-way	Three-way	
	Low–Mid	Low–Mid	Mid–High
0	160 (Low)	160 (Low)	700 (Mid)
1	175	175	800
2	185	185	900
3	200	200	1,000
4	220	220	1,250
5	250	250	1,500
6	300	300	2,000
7	400	400	2,500
8	800	650	3,300
9	2,000	1,000	4,500
10	3,000 (Mid)	1,500 (Mid)	6,000 (High)

The power amplifier uses a Williamson type front end driving push-pull EL84's in an Ultra-Linear circuit. The input is 1 volt for a 10-watt output. Response rolls off sharply below 100 cycles to protect the tweeter against damaging lows and is flat within 1 db from 100 to 30,000 cycles.

Heathkit XO-1

This is a two-channel electronic crossover network to be inserted between a program source and the input for the power amplifiers for low and high frequencies. Crossover points at 100, 200, 400, 700, 1,200 and 3,500 cycles are selected by two calibrated switches on the panel. Each channel (see Fig. 2), fed through a level control, features a two-stage feedback amplifier with a gain of 1 and a cathode-follower output. The normal input is 2 volts (rms) or less and the maximum is 5 (rms).

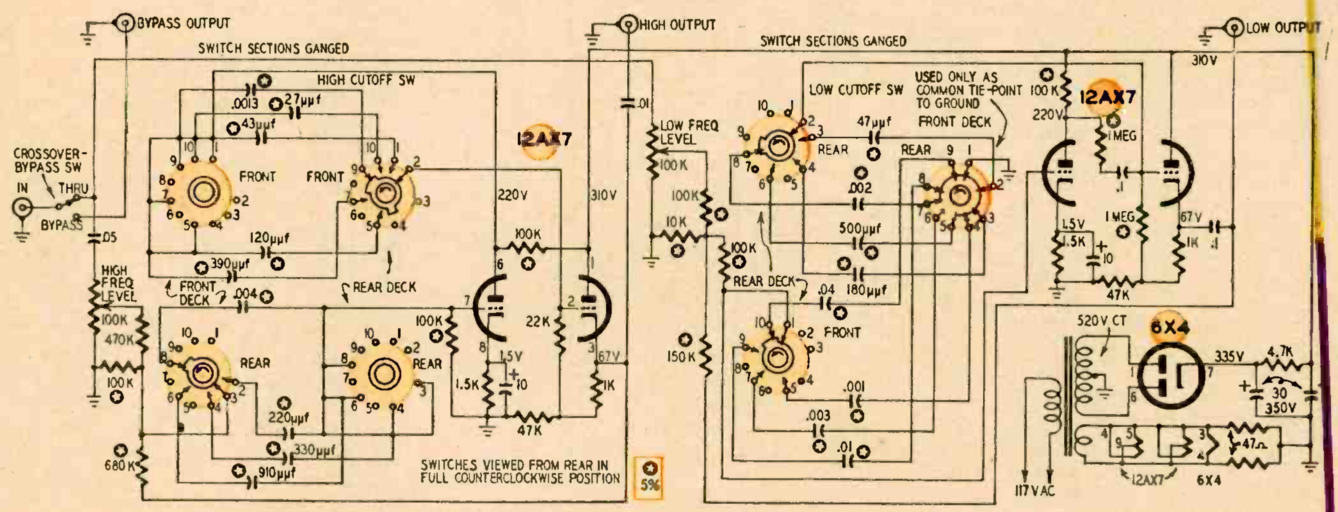

Fig. 2—Schematic of the Heathkit X01, electronic crossover.

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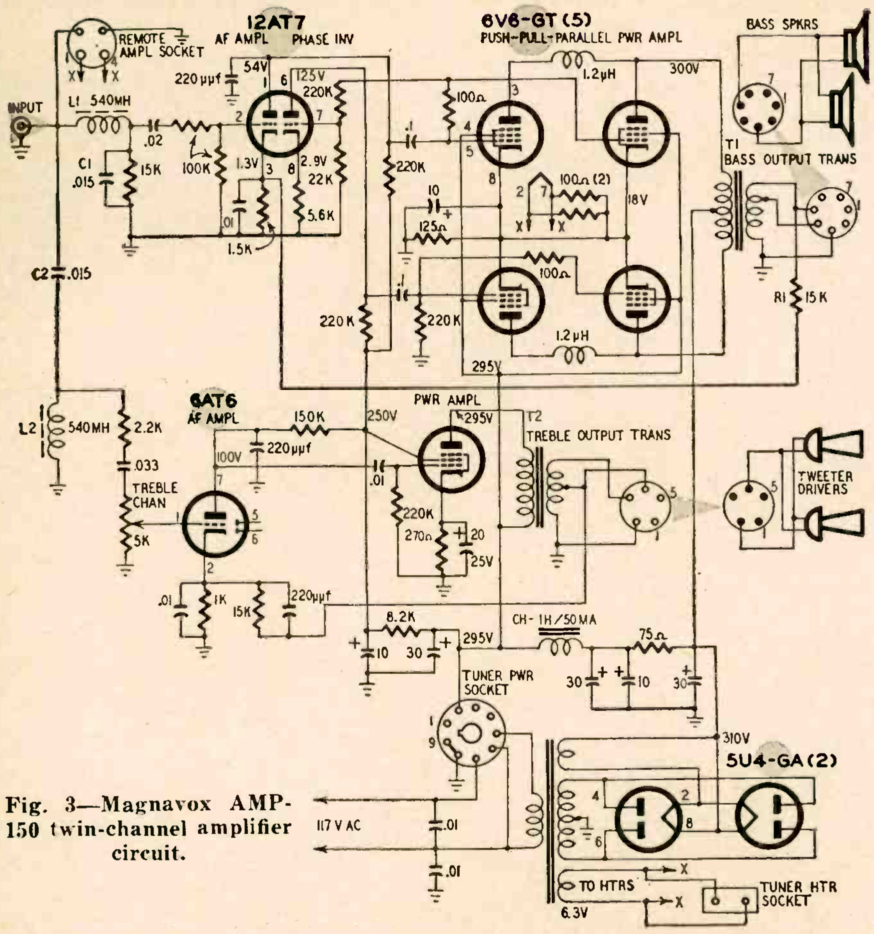

Fig. 3—Magnavox AMP-150 twin-channel amplifier circuit.

The frequency response of the low-frequency channel is ±1.2 db from 10 cycles to the cutoff frequency, and the high-frequency channel has response within 1.2 db from the crossover to 20,000 cycles. The rolloffs have a slope of approximately 12 db per octave. The manual on the XO-1 shows how it can be used with conventional high-level crossover networks when assembling three- and four-way systems.

In a simple three-way system the output of the high-frequency amplifier goes directly to the mid-range speaker and to the tweeter through a series capacitor. A more elaborate system employing a special low-frequency enclosure such as an air coupler would use the XO-1 to cross over at around 100 cycles and a conventional network operating at around 2,000 cycles to connect the high-frequency amplifier to the tweeter and mid-range speakers.

In a four-way system, you can set the XO-1 to cross over at around 700 cycles and use a 200-cycle conventional network to split the output of the low-frequency amplifier into two channels. Signals above 700 cycles can be separated at the output of the high-frequency amplifier with a simple series capacitor or a regular network crossing over at about 3,500 cycles. Another arrangement is to feed signals above 700 cycles to the high-frequency channel and split the output into three channels with a three-way dividing network or a two-way with the super-tweeter connected to the tweeter through a simple blocking capacitor.

For articles on designing your own networks to match the characteristics of your speakers, we recommend the Crowhurst articles "Loudspeaker Crossover Design"* and "Three-Way Crossover Design" in July, 1952, and January, 1957, RADIO-ELECTRONICS.

Magnavox two-channel amplifiers

Magnavox has recently introduced two multiple-channel amplifiers, the AMP-148 and AMP-150, to its line of wide-range reproducing equipment. These use L-C crossover networks as compared to the R-C types in the other equipment described here. The circuit of the AMP-150 is shown in Fig. 3. This amplifier has a 2,000-cycle fixed-crossover network feeding a single 6V6, 3-watt treble channel and a push-pull parallel 6V6 bass amplifier delivering 22 watts. The input impedance is 5,000 ohms. The AMP-148 is a higher-powered version using push-pull 6V6's in the high-frequency channel and six 6V6's in push-pull parallel in the bass channel.

Referring to Fig. 3, the input signal is applied to the parallel low- and high-pass filters consisting of L1–C1 and L2–C2, respectively. The output of the low-pass filter is fed through a 12AT7 voltage amplifier and phase inverter to the push-pull parallel 6V6's. The coupling capacitors are comparatively large (0.1 μf) to provide good low-frequency response. Feedback from the 16-ohm secondary of output transformer T1 is applied through R1 to the cathode of the af amplifier.

The high-pass circuit feeds the 6AT6 treble af amplifier that drives the single 6V6 in the output stage. Negative voltage feedback is taken from the secondary of T2 and applied to the cathode of the 6AT6. The interstage coupling capacitors have been reduced to one-tenth the value of those in the low-frequency channel to minimize hum, and roll off the lows that come through the simple high-pass filter in the input circuit.

The AMP-150 is used in two equipment models. One has 12- and 15-inch 8-ohm speakers in parallel as woofers and a pair of 16-ohm horn type tweeters in parallel. The other model has a single 16-ohm horn tweeter and a pair of 6-ohm 12-inch woofers.

White Beta-Tron

This twin-channel system (Fig. 4) has a built-in 10-watt Ultra-Linear type amplifier and a special 5-inch

*The material in this article also appears in the book "High-Fidelity," Gernsback Library No. 48.

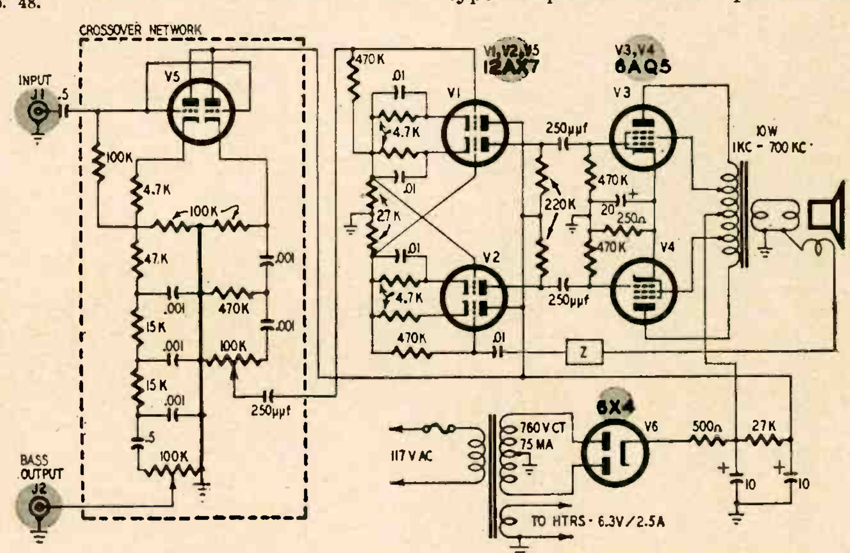

Fig. 4—Circuit of the White Beta-Tron dual-amplifier system.

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cone type tweeter is used for the treble channel. Any existing amplifier can be used as the bass channel. The input signal, from a preamplifier or other program source, is applied to a 12AX7 dual cathode follower with the grids fed in parallel. V1-a feeds a three-stage R-C type low-pass filter terminating in a BASS LEVEL control and an output jack. V1-b feeds a two-stage high-pass network. The two networks cross over at 3,000 cycles with a slope of 18 db per octave.

The signal developed across the TREBLE LEVEL control is coupled to the input grid of a cross-coupled phase splitter through a 250-μμf capacitor. This circuit was introduced by J. N. Van Scoyoc and popularized in the Marshall Golden Ear and White Powrtron amplifiers. The phase splitter feeds the push-pull output stage through 250-μμf coupling capacitors. These greatly attenuate high-amplitude signals from about 1,000 cycles down which may pass through the filter and damage the tweeter or cause intermodulation distortion.

The amplifier uses motional feedback—a type of negative feedback whose voltage is obtained from a coil on the voice-coil form rather than from the voice-coil winding itself. (See "Feedback from the Voice Coil," by Crowhurst, in the October, 1956, issue of RADIO-ELECTRONICS.) A phase-correcting network (Z) is inserted in the feedback loop to insure proper operation of the circuit.

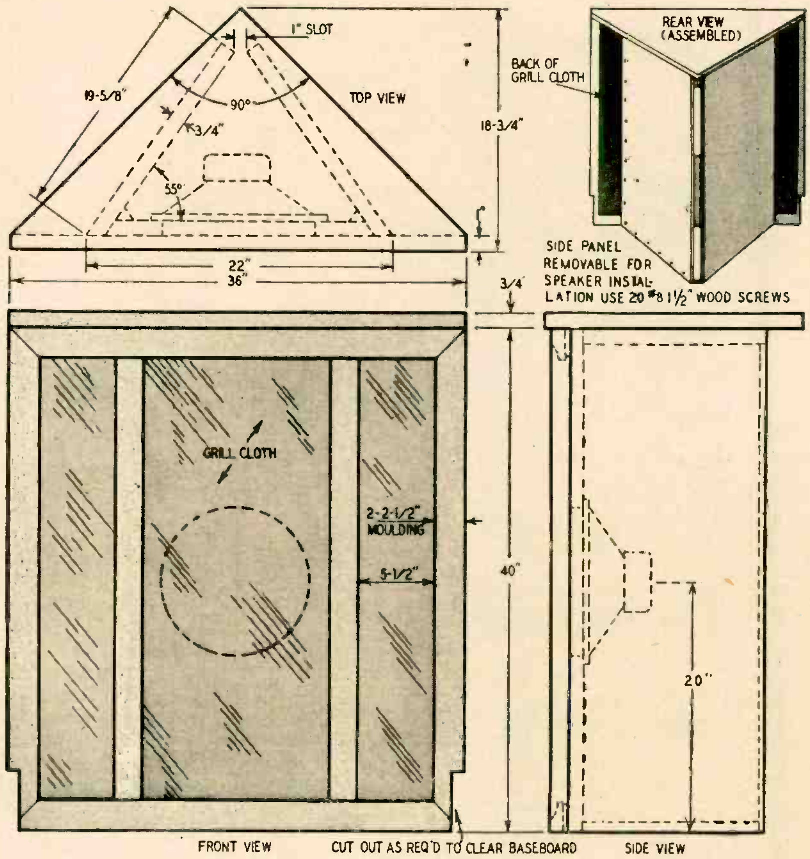
Operational notes

When using a two- or three-way system with a single amplifier, we generally select a fixed-frequency divider network crossing over at a point recommended by the speaker manufacturer or estimated from the woofer and tweeter characteristics. Very often the best crossover point depends on the type of enclosure used for the woofer and it may be quite different from that previously determined. In cases like this, we may go through a lot of expensive and time-consuming experiments with other speakers, networks and enclosures before we are satisfied. This assumes, of course, that your networks are not variable like the University N-1, N-2A and N-2B.

While checking a 3-CFD over a period of several weeks, we found that with almost any conceivable combination of speakers, baffles and enclosures, in two- and three-way systems, it was possible to adjust the crossover points and levels to the best listening point in just a few hours of serious experimenting. Although we have not tested the XO-1 and Van-Amp (see "Developments in Audio Circuits," in the February, 1956, issue of RADIO-ELECTRONICS), we feel that these and any similar electronic divider networks with instantly variable crossovers will become quite popular—particularly with hi-fi fans who are not using matched speakers and enclosures. END

a true CORNER SPEAKER

The room walls have an important part in horn-loaded corner enclosures



MANY of the horn-loaded loudspeaker enclosures described today are the so-called "corner-less corner" type that perform well in almost any location along a wall. The basic corner horn-loaded enclosure uses the 90° angle formed by the walls of a room as the walls of the horn. This design makes use of corner space not normally used and therefore does not fill valuable wall space.

The construction of one true corner enclosure of this type is illustrated in the figure (courtesy Racon Electric Co.). Intended to be built of ¾-inch lumber, it is designed for both 12- and 15-inch speakers and provides good bass response.

This enclosure is easy to build and does not require any special skill. With a little care and patience, you can make one just like it.

First step is the front panel. This is a simple framework made from 2-inch molding. The grille cloth is fastened to the back of this frame. Next the main body of the enclosure is built. Use three boards to form a 55°, 55°, 70° triangle. The sides do not meet at the rear and leave a 1-inch slot. The top and bottom of this triangle are closed. One of the side panels is fastened with woodscrews so it can be removed for installing the speaker. The other side and the speaker mounting board are fastened firmly to top and bottom of the triangle with No. 8 1½-inch wood screws and a liberal application of a good wood glue.

For a 12-inch speaker cut a 10½-inch hole in the front panel, for a 15-inch speaker a 13½-inch hole. The speaker must be centered on the panel. Tee nuts and round-head machine screws are used to anchor the speaker to the mounting board. Use lock washers to prevent vibration from loosening the speaker.

The top is cut to fit the front frame, with a 90° angle in the rear to fit in a corner. END

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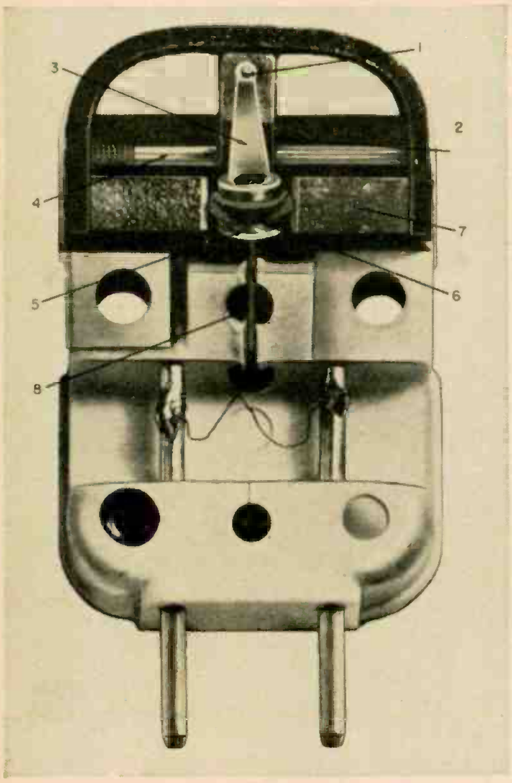
modern phonograph cartridges



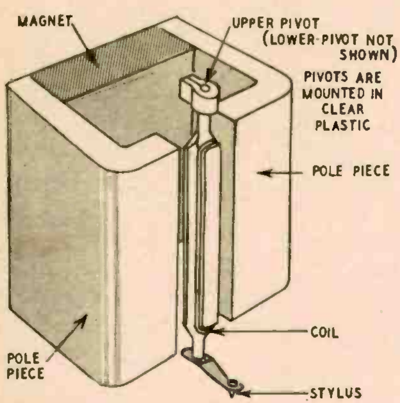
Part III:
A discussion of moving-coil magnetic cartridges

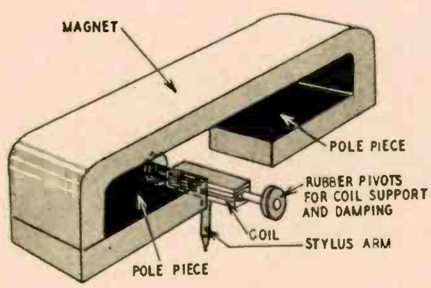
By JULIAN D. HIRSCH

Fig. 1 (above left)—Fairchild 225-A cartridge: 1, diamond stylus; 2, center beam support; 3 aluminum stylus arm; 4, Micradjust screw; 5, moving-coil wound on nylon bobbin; 6, silicone rubber damping ring; 7, Alnico V magnet; 8, Mylar vane anchors coil bobbin to base.

Fig. 2 (below left)—Electro-Sonic's internal construction.

Fig. 3 (below)—Construction of Leak dynamic pickup.





IN the first article of this series, we pointed out that all phonograph cartridges can be classified into one of two categories—velocity-responding and amplitude-responding. All magnetic cartridges are of the velocity-responding type. They are further broken down into variable-reluctance and moving-coil types. A number of variable-reluctance cartridges were described in the preceding articles. This article will cover the moving-coil or "dynamic" cartridges.

As the name implies, a moving-coil cartridge uses a small coil of wire suspended in a fixed magnetic field. The motion of the stylus as it follows the groove modulation causes the coil to move in the magnetic field, inducing a voltage directly proportional to the velocity of the stylus motion.

Until a few years ago moving-coil cartridges were too expensive for home use and were found only in broadcasting stations and recording studios. New manufacturing processes and the expanding market for high-fidelity equipment have brought their price within reach of the average audiophile. As a result, an increasingly large proportion of home hi-fi installations incorporate moving-coil cartridges.

Among the advantages of these cartridges are extended high-frequency response due to the very low moving mass of a small coil which does not contain any iron or other magnetic material, and low hum pickup due to the use of low-impedance coils having relatively few turns of wire. Some disadvantages are low output, sometimes requiring a stepup transformer between the cartridge and the preamplifier; more delicate construction than variable-reluctance cartridges and the fact that the stylus cannot be replaced by the user. Virtually all these cartridges have diamond styli, and the entire cartridge must be returned to the manufacturer when stylus replacement is needed.

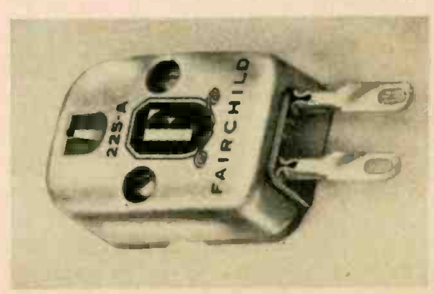
In the following paragraphs several representative types of moving-coil cartridges will be described.

Fairchild 225-A

Fairchild was the first in this country to market a high-quality moving-coil cartridge for home use. Their model 225-A is widely used in present day hi-fi systems. Fairchild cartridges employ a unique "wigwag" coil mounting. This is illustrated in Fig. 1, which shows the internal construction of the Fairchild Micradjust model 225-A. One end of the coil is mounted on a Mylar cantilever vane and the stylus and stylus arm are attached to the other end. The coil is positioned between the pole pieces of a powerful magnet. Lateral motion of the stylus causes the coil to "wigwag" in the magnetic field, inducing a voltage in it. A ring of a rubberlike material surrounds the coil and keeps it in the correct position between the magnetic pole pieces. This ring also provides damping of the stylus and coil motion.

The 225-A has a novel means of positioning the moving coil and adjusting the damping. A micrometer adjusting screw, accessible from the side of the cartridge during manufacture, changes the spacing between the magnet poles. This varies the pressure on the damping ring and allows critical adjustment of the damping after assembling the cartridge.

Unlike earlier Fairchild cartridges, the 225-A does not have an appreciable magnetic attraction to a steel turntable. This is avoided by providing a high-



Fairchild 225-A Micradjust cartridge.

permeability magnetic-flux return path between the outside ends of the magnet structure. The flux is retained within this magnetic circuit instead of attracting the cartridge to a steel turntable.

The Fairchild 225-A has a relatively high output for a moving-coil cartridge —approximately 5 to 6 millivolts at normal recording velocities. Its nominal impedance is only 200 ohms and the terminating resistance is quite non-critical. Its mounting dimensions will match any standard American tone arm. For use with preamplifiers having exceptionally low gain, a stepup transformer is provided, increasing the cartridge's output to over 25 mv. When the transformer (model 235) is used, its secondary should be terminated in 47,000 ohms.

Electro-Sonic cartridges

The Electro-Sonic (ESL) cartridges are based on a Danish design, the Ortofon, which is very popular in Europe. Three models are available—the Soloist, Concert and Professional. The Soloist is sufficiently rugged to be used in the better record changers. The Concert has a higher lateral stylus compliance and lower moving mass, which extends its response at both ends of the spectrum. Due to its relatively delicate construction, the Concert series is recommended only for quality transcription type tone arms. The Professional is similar to the Concert in performance but is quite different physically and must be used with its own specially designed arm. The Professional is actually the Danish Ortofon pickup.

The mechanical design of the ESL cartridges is radically different from that of any other moving-coil cartridge currently available. It is actually a very small D'Arsonval meter movement. The moving coil is wound on a relatively long, narrow form pivoted at its upper and lower ends in a rubber-like damping material. The coil is located between the pole pieces of a powerful magnet. At the end of a short stylus shoe attached to the lower end of the moving-coil structure is the jeweled stylus.

Lateral motion of the stylus causes a rotary motion of the coil about its vertical axis. The voltage induced in the coil by this motion is proportional to its angular velocity and therefore to the lateral stylus velocity.

Fig. two shows the internal construction of this ESL cartridge and clearly shows its similarity to an ordinary D'Arsonval meter movement. Since the coil is pivoted at both ends, it is impossible for vertical stylus motion to cause any rotation or other movement of the coil in the magnetic field. For this reason it is completely insensitive to the vertical components of stylus motion which can cause unpleasant distortion if they are reproduced.

Some of the electrical characteristics, as well as the mechanical design of the ESL cartridges, are unusual. The impedance of the moving coil is only 1.5 ohms and is essentially resistive. For this reason it is entirely non-critical as to termination. The value of the load resistance or capacitance connected across the cartridge has no effect on its output or frequency response. Its output voltage is also very low—approximately 1 to 2 mv. Since many preamplifiers do not have sufficient gain to drive a power amplifier to full output with only 1 mv of input signal, a stepup transformer is available which will deliver approximately 15 mv to the preamplifier. The low impedance of the cartridge makes it virtually immune to induced hum pickup and the preamplifier's gain can frequently be advanced beyond its normal setting without objectionable hum levels. The transformer is not necessary in such cases. In fact, the cartridge looks very much like a short circuit to the preamplifier input terminals.

The Soloist series has an effective moving mass of 2 milligrams. The Concert and Professional cartridges have an effective moving mass of 1 milligram. The high-frequency armature resonance of the Soloist cartridge when playing vinyl records is in the vicinity of 15,000 cycles. The lower moving mass of the Concert and Professional cartridges raises their resonant frequency to approximately 25,000 cycles.

Soloist and Concert cartridges will fit practically any standard American tone arm. Typical tracking forces required are 5–7 grams for the Soloist, 3–5 grams for the Concert and 2–3 grams for the Professional series. The magnetic structure of the ESL cartridges is oriented so that the external field does not cause any appreciable attraction to a steel turntable.

Leak dynamic pickup

The Leak dynamic pickup is imported from England by British Industries, Inc. It is sold only as a unit with its own tone arm and stepup transformer. Pickup heads are available with 1- or 2.5-mil styli and plug into the arm. This cartridge is available only with diamond styli.

The internal construction of the Leak pickup is shown in Fig. 3. The coil is wound on a long narrow form which lies parallel to the record surface. It is mounted between the pole pieces of a magnet and is supported at its ends by pivots of a rubberlike material which also provides damping.

The stylus is coupled to the coil by a short, stiff arm. Lateral stylus motion causes a rotation of the coil in the magnetic field, inducing a voltage proportional to the stylus velocity. The vertical compliance of the Leak pickup is relatively low. However, vertical stylus motion cannot produce any appreciable electrical output from the cartridge, since such motion does not alter the symmetry of the coil with respect to the pole pieces.

The pickup is provided with a stepup transformer. The coil impedance of the cartridge is approximately 6 ohms at 1,000 cycles. The output of the transformer is as high as 50–100 mv when playing LP records.

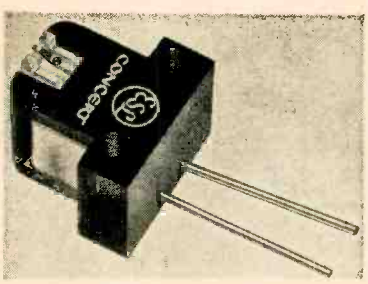
The rated tracking force for the Leak pickup is 2–3 grams for LP records. The high-frequency resonance on vinyl records is stated to be approximately 21,000 cycles and the low-frequency resonance of its arm is about 20 cycles. The orientation of the magnet is such that a strong attraction is exerted between the pickup and a steel turntable unless a spacer of at least ⅛ inch is placed between the record and turntable.

Connoisseur Mark II pickup

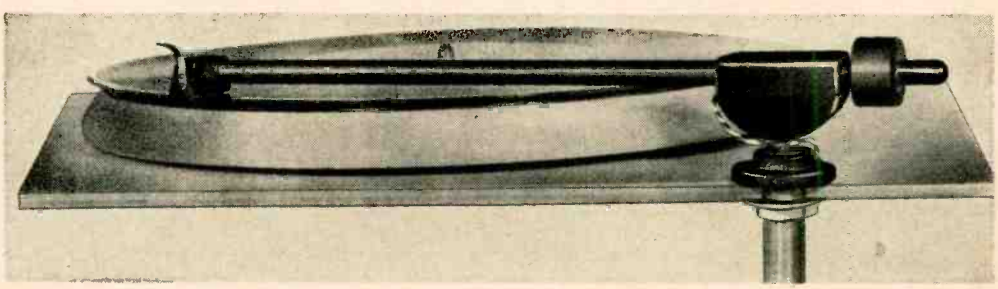
A relatively new moving-coil cartridge (at least in this country) is the Connoisseur Mark II. Like the Leak, it is imported from Britain and must be used with its integral tone arm.

Unfortunately, the details of its internal construction were not available in time for inclusion in this article. The manufacturer's specifications state that its coil impedance is 400 ohms at 1,000 cycles, suggesting that it has many more turns than any of the other moving-coil cartridges we have described. Its output voltage is high and no transformer is needed.

The moving mass of its stylus assembly is stated to be 4 milligrams. The recommended tracking force for the stylus is 6 grams. TO BE CONTINUED



Electro-Sonic cartridge, Concert series.



Leak Dynamic Pickup complete with arm and plug-in head.

Syncopation by Automation

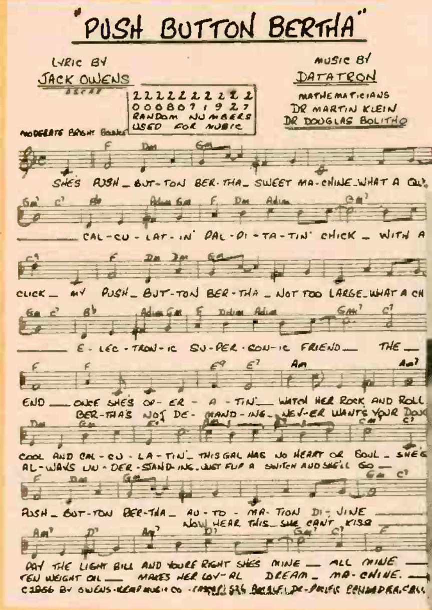


Fig. 1 — Musical score of a song by a composer called Datatron.

ALWAC, digital computer built by Logistics Research Corp.

By DR. MARTIN L. KLEIN

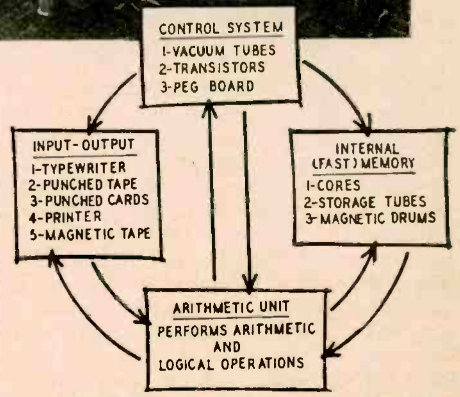


Fig. 2—Operational parts of electronic digital computer.

THE words "electronic digital computer" immediately conjure up a picture of a forbidding, heartless device. Those of us who design computing machinery know this isn't true. Computing machines have very human characteristics. They hate to get to work on a cold morning (we call this "sleeping sickness"). Occasionally, for unexplainable reasons, they don't work the same problem the same way twice (we say, then, that the machine has the flu). I have become personally attached to them and find computers very human—even human enough to write popular music.

Last spring we set out to prove that if human beings could write "popular music" of poor quality at the rate of a song an hour, we could write it just as bad with a computing machine, but faster. So we educated (literally taught a machine) in less than a month to write popular music at the rate of more than 4,000 popular songs an hour. You may think this was purely a stunt, but the outcome was extraordinary, even for the extraordinary music business.

One of the songs composed by the machine was played for Jack Owens, a nationally known composer and member of ASCAP, the major league of the songwriting business. Owens, the composer of "Cynthia," "The Hut Sut Song" and "How Soon," was so taken with the melody that he promptly sat down and wrote lyrics for it. In less than a week, five recordings were out and a month later it was introduced on the ABC network. Its name? In honor of the machine that wrote it—the Datatron Digital Computer—Owens named it "Push Button Bertha." If all this seems hard to believe, Fig. 1 shows the final product as given to the artists that perform it. In fact there has been one problem in connection with the whole effort. The Library of Congress refuses to issue a copyright because they have never been confronted with a piece of music written by a machine instead of a person.

Computer theory

Writing music on a computing machine is an education in computer electronics and, with the digital computer playing a progressively larger part in our daily lives. it seems worth discussing. The machine used was Datatron, but any digital computer could do the job. In fact, most computers are similar. The basic organization of a computer is shown in Fig. 2.

Computers must be given instructions on each and every step they take. This set of instructions, presented in the correct order, is written by the machine user and is called the "program."

The various instructions (there are over 100 in some computers) are punched onto *Hollerith cards*, in the form of numbers. Thus to add we might punch the number 23, to subtract 43, to multiply 56 and so on. The machine interprets these numbers and sets up the circuits to perform the required operations. Instruction cards and data from which the operations will be performed are stored in the internal memory of the machine, a magnetic-core storage unit or magnetic drum.

Magnetic cores are the most useful internal memory. Ferrite cores strung on planes, they can retain either positive or negative magnetization by virtue of their hysteresis curve. To change the state of a core, we simultaneously pulse a vertical and horizontal line, putting half the magnetization current in the vertical line and half in the horizontal. Only that core through which both lines pass receives sufficient magnetic flux to change its magnetization. The core remains indefinitely in the state into which it was magnetized. To read the core, the two lines are pulsed again with a current in the reverse direction. The core changes state, emitting a pulse on the sense line that winds through each and every core. Thus, if the core had been previously reversed in state, a pulse would be emitted. If it had not been reversed, no pulse would be emitted. So the output of a core memory is either a pulse or no pulse, depending on the state of core being pulsed. These pulses represent 1 and no pulse represents 0.

If we can arrange a number system to work with only 1 and 0, we can record numbers in a memory core. Such a number system does exist. It is standard for almost all digital computers and called the binary code. Table 1 shows some ordinary (decimal) numbers written in binary form. Computer engineers are extremely proficient and can write these binary numbers much as we can write numbers like 1, .023, 127 and 15.

Table I—Binary equivalents of decimal numbers.

Decimal number	*Binary number*
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010

These numbers are particularly easy to do arithmetic with. Suppose we wish to halve a number inside the computer. These arithmetic operations are performed in what is called the arithmetic unit of the machine, also sometimes referred to as the "main frame." To do arithmetic, use is made of a circuit familiar to electronic technicians, called a flip-flop (Fig. 3). It consists of two tubes, dc-coupled between themselves, with circuit values arranged so that, when one tube is conducting, the other tube is cut off. To change state—say the V1 is conducting—a negative pulse placed on the grid of V1 will momentarily cause the plate current to cease. The plate rises to supply voltage, causing the grid of V2 to rise. V2 starts conducting and its plate voltage drops. This drop at V2 causes the grid of V1 to be held down and thus the states have reversed. Now V2 conducts and V1 does not. As a result we say that when V2 is not conducting, its state is 1; when it is conducting, its state is 0.

Suppose (see Fig. 4), we cascade several of these flip-flops through capacitors so that only the changes

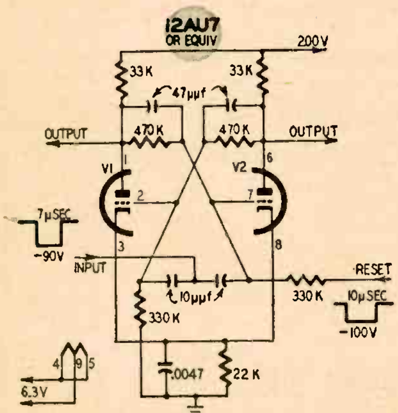


Fig. 3—Schematic of a flip-flop.

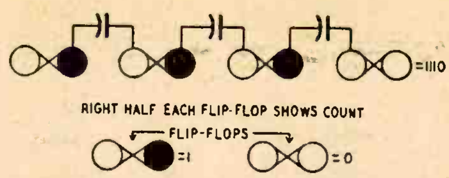


Fig. 4—Cascade of flip-flops.

are fed forward. We see that we can accumulate counts, or add, in binary with such an arrangement. As a matter of fact, we can halve numbers by inserting between flip-flops what is called an "and" gate. The diagram for this is shown in Fig. 5. Here we use the state of the flip-flop to enable a two-grid tube to conduct or not conduct. We can arrange this circuitry so that, when the previous state is 1, the clock pulse from an oscillator is fed to the next stage.

Referring to Table I, suppose we wish to halve the number 6. In binary, this would be 110. Let us suppose these states exist in Fig. 6. When the clock pulse comes through, we will change the states to 011, which is binary for 3, half the number we started out with.

Essentially this is how a computer operates. All that remains is to find a way of getting the answers back. Ordinarily this is done by printing out the core memory. Equipment exists to print on paper what is in the core memory, after converting it back to ordinary decimal numbers. Some machines allow the user to put the result on magnetic tape, punch cards or paper tape instead. As an idea of the speed of operation, the numbers 1,243,546,567, and 8,357,647,899 can be added in less than 8 microseconds, multiplied in 180 microseconds, printed on paper in less than 1 second and punched on paper tape in less than 1/10 second. Machines operating at 10 times these speeds are now in design.

With this brief excursion into the operation of the machine, we can show its applications. Writing music is, surprisingly, typical of the way computers are used in business, engineering and what are ordinarily thought of as more mundane applications.

Operating plan

Since each and every instruction has to be given to the computer, we had to educate the machine. Planning steps to program the computer led to a study of what goes into popular music. A study of the top 100 pop songs over a period of a year was conducted. These were selected from a weekly listing in *Variety*. There was a surprising similarity between the musical patterns of songs that reach this magic "top 10." You can notice this if you listen to them on the radio. The similarity is often so great, that it sounds as if the same piece of music had been written over and over.

These similarities boiled down to a set of rules:

1. There are between 35 and 60 different notes in a popular song.
2. A popular song has the following pattern: part A, which runs 8 measures and contains about 18 to 25 notes, part A, repeated, part B, which contains 8 measures and between 17 and 35 notes; part A, again repeated.
3. If five notes move successively in an upward direction, the sixth note is downward and vice versa.

To these simple observations, we added some rules set down by Mozart which constitute the art of writing melodies:

4. Never skip more than six notes between successive notes.
5. The first note in part A is ordinarily not the second, fourth or flatted fifth note in a scale.
6. Notes with flats next move down a tone, notes with sharps next move up a tone.

Since the computer cannot read notes, it was necessary to translate the notes into numbers. This is done by people who arrange music anyway, so we borrowed the number pattern they ordinarily use (Fig. 7). The notes correspond to the tones in the key of C and we added a few extras (not shown) for

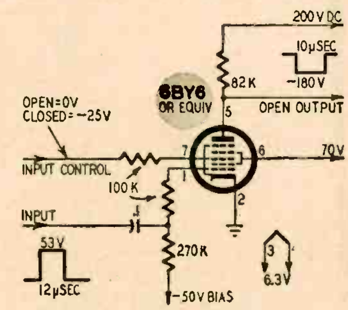


Fig. 5—An "and" gate circuit.

variety in the music. By referring to this figure, the rules mentioned can be translated into a relationship between numbers. For example, if the first note in the song is a C (the machine recognizes this as 1), the second cannot be a B (7) or C (8). Rule 4 tells us this (we must not skip more than six notes between notes). As another example, we know that the first note in part A cannot be D (2) because of rule 5.

These rules were programmed into the computer. This constituted its musical education. All that remained was to inspire it and give it freedom in selecting notes within the framework of rules established for good popular music writing practice. We did this by using a random-number table. Such a table consists simply of a series of unrelated numbers, in this case, the digits 0 through 9. Anyone can make up such a table with fairly good randomness. All you have to do is take the last four members out of a telephone directory. These numbers are assigned more or less randomly since the directory is an alphabetical listing and who gets what number is a matter of chance. We used a table made up by the National Bureau of Standards. They have used a computer to get a table of six-digit random numbers such as 815436, 987252, 462089 and so on. These random numbers were

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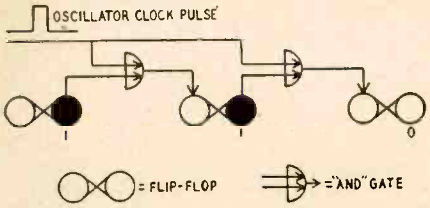


Fig. 6—Designers schematic of "and" gates and flip-flops.

Fig. 7 (right)—Musical symbols and their computer equivalents.

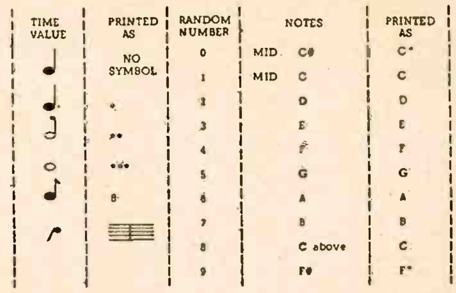
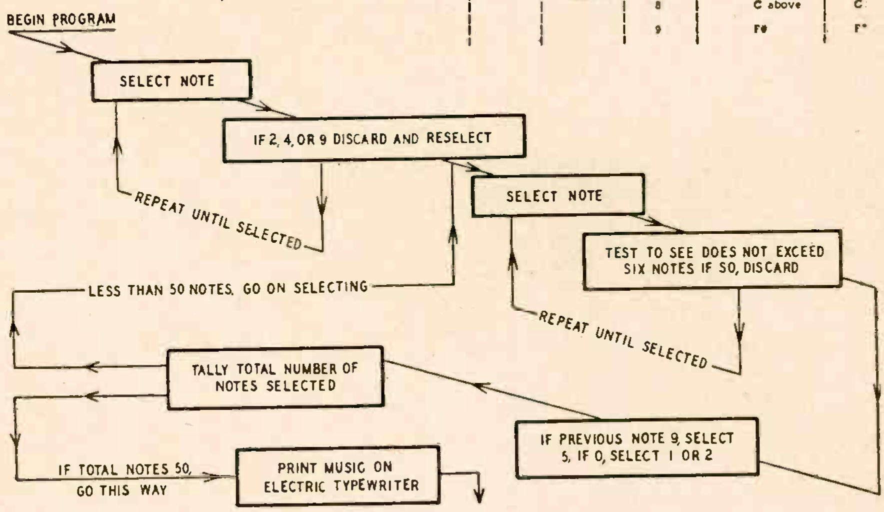


Fig. 8 (below) Flow chart for writing music.



placed into the internal memory of our computer. Using the numbers and the rules set forth, the machine set to work composing music. The essential steps follow:

1. Select a random number from the memory, between 0 and 9, and place it in the arithmetic part of the computer.
2. Test the number (which represents a note of music) against the set of rules previously mentioned.
3. If the number selected conforms to all rules, retain it in another part of the internal machine memory.
4. After all the notes are selected, constituting a song, print them out, using an electric typewriter which receives its information from the memory of the computer.

The result is, not notes, but a series of numbers and symbols representing music. This is how the Datatron computer types out the music to "Push Button Bertha":

/C/F*DA/G8C:8C:F"G/C*AF8G8/
G***/DEF"G/ABC:B8C:8/C:*B8C:8/
D*C/F*DA/G8C:8C:F"G/C*AF8G8/
G***/DEF"G/ABC:B8C:8/C:*A*/
F***/A**C8CD/FE*/B**C:8EF"/
G***/

Anyone with a knowledge of music can translate the numbers directly into musical notation.

Flow charts

One step remains to complete the picture of operating a computing machine. How does the programmer or machine operator know what instructions to put down and in what order? This is partly technical training, partly skill and partly system. System is the hardest part and computer programmers have developed one known as flow charts. Fig. 8 shows the flow chart for programming the machine to write music. All of the rules mentioned are shown in this flow chart (and a few others essential to machine operation) and the sequence of operation. This is essentially an organization of what to do and when. At this point, the programmer is not concerned with details of the program, only with the overall "logic." He must see that he has accounted for all steps to be performed.

In some steps, arrows point in two directions. This is known as a branch. The machine makes a test of some sort and, according to the results, decides which further set of instructions to follow. Such a step in a computer is an instruction called *transfer on zero*. The machine will test a number and if it is a zero, it will follow one set of instructions. If it's not zero, it will follow a second set of instructions. This is important as it gives a human capability to a computing machine, the capability of deciding what to do under different circumstances.

Notice that some arrows point back around a box. This is called a loop. It allows the machine to repeat a certain step over and over until it completes a sequence of events and then to progress with the rest of the instructions. This important property allows a machine to correct itself, much as a feedback loop works in a conventional amplifier. Prof. Norbert Wiener, the inventor of cybernetics, asserts that human beings perform much like a comupting machine: We think in binary code whether we know it or not. We work with feedback loops correcting our own errors.

It is interesting to note the results of writing music with a computer. Considerable interest was shown by reviewers. One was quite concerned with the effects on human songwriters. (So far there have been none of consequence.) He did point out that the computer could write at such an incredible rate and with such good quality that the entire music-writing profession was in great difficulty. We doubt that this is true. However, a preliminary effort is now under way to get a computer to write orchestral music. Early results written for a string quartette appear very promising. Here the computer is in its true realm. It will be possible to write orchestrations for full orchestra on a computer in less than a minute. It takes a human arranger almost three days to arrange a piece of popular music for an orchestra.

The computer is fast becoming a definite part of our daily lives. Some day we may expect it not only to write music, translate foreign languages (a Russian-English translator already exists), investigate the Bible for duplications (some work has been done along that line), and as the columnist Matt Winstock puts it, "How can it miss? It writes its own music, then types out a favorable criticism of it!" What next! END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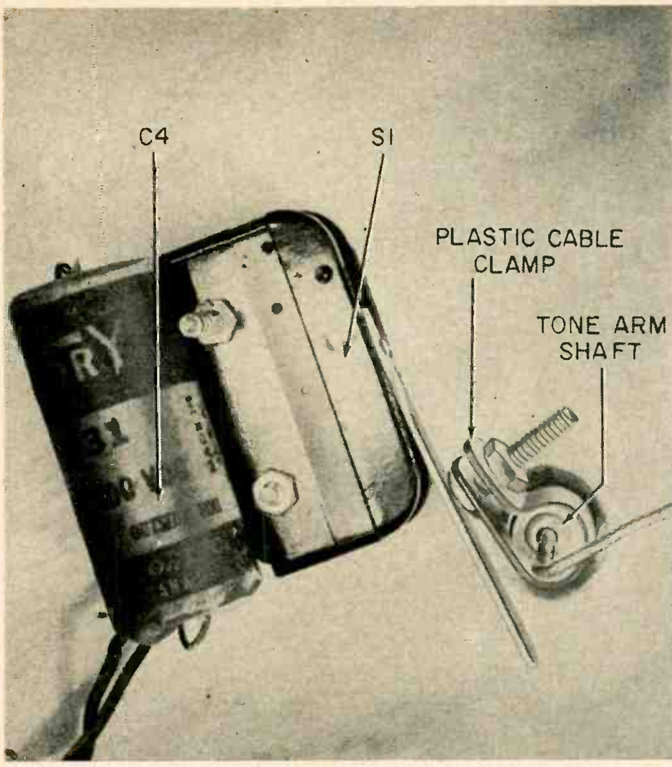

Fig. 1—Detail of trip mechanism. Screw head actuates the switch.

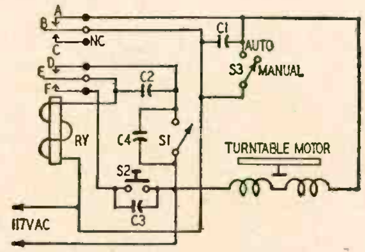

Fig. 2—How the relay and switch are wired.

Automatic Phono Shutoff for LP's

By NORMAN V. BECKER

An important current trend in hi-fi is the use of single-play record players in home music systems. These may be obtained as integrated units or may be assembled by the audiophile from the many excellent turntables and tone arms presently available. The latter choice allows greater freedom in selecting components and gives more opportunity to express personal preferences. However, it does pose one problem: that of automatic shutoff.

This was of no particular concern to the writer—whose home-built turntable consists of a Thorens E53N transcription motor and a Livingston Universal tone arm—until a new LP stylus was ground to a nub by accidentally allowing the turntable to revolve all night. So a circuit was devised to prevent such future tragedies. It is built around a ratchet impulse relay, which closes one set of contacts on the one actuation and another on the next.

Fig. 1 shows a lever type Microswitch mounted close to the tone arm's feedthrough bushing. This bushing rotates with the lateral motion of the arm; therefore this seemed a likely place to attach a tripping mechanism. A plastic cable clamp is slipped around the bushing and held tightly in place by a bolt and nut. The head of the bolt contacts the Microswitch lever when the tone arm has swung into the last record groove. Shutoff sequence is then:

The relay coil is energized and contact A–B (Fig. 2) opens to shut off the motor. At the same instant D–E also opens, removing current from the relay coil and preventing S1 from having any further immediate effect. (Otherwise tone-arm motion caused by the final eccentric record groove would continue to make and break S1 as the turntable *attempted* to halt.) The motor will remain off after the pickup is lifted from the record and returned to its arm rest.

In the off position relay contacts are now in these positions: B–C and E–F. By momentarily pressing S2, current is restored to the relay coil, and its "impulse-ratchet" action returns the contacts to their original positions. This turns the motor on and resets the device for another shutoff cycle. S2 is mounted in the motor board just above the relay, and is not visible in the photos.

S3 is included to disable the automatic stop, when necessary. It was the original motor switch. A few of the extended-play 45-rpm records are recorded so far into center that they trip the relay before musical material is completed. But if your record playing is limited mainly to LP's, this system is nearly foolproof. All capacitors are 0.5-µf 400-volt units and are connected in parallel with all switch contacts to eliminate "pops."

The Microswitch trip is adjusted by placing the tone arm in the last groove of a recording and rotating the cable clamp until it just actuates the lever. This is detected by a faint "click" of the switch. Do not tighten the cable clamp permanently until you have tried several recordings—preferably of different makes and playing time. When an optimum tripping position has been determined, very carefully tighten the clamp. Slippage during the tightening process can upset the tripping index.

Tripping mechanisms for tone arms whose bushings do not extend through the motor board may be prepared by extending the Microswitch lever with a strip of phosphor-bronze spring stock. It should be long enough to come through the motor board and contact the tone arm at a point near its mounting base (Fig. 3). The index can be adjusted easily by bending this extension for proper contact with the arm.

The type of relay used in this cir-

S1—snap-action switch (Minneapolis-Honeywell MS BZ-2RW80, Acro RD-LW-80, or equivalent)
S2—momentary pushbutton switch, normally open, 1 amp, 125 volts (Spemco H & H 1157-A or equivalent)
S3—switch, spst toggle, 1 amp, 125 volts
Ry—rachet-impulse relay (Guardian RC-100-GR)
S3—spot toggle switch, 1 amp, 125 volts
C1, 2, 3, 4—0.5-µf 400-volt paper

Fig. 3—Mechanism for pickups whose bushings do not extend through motor board.

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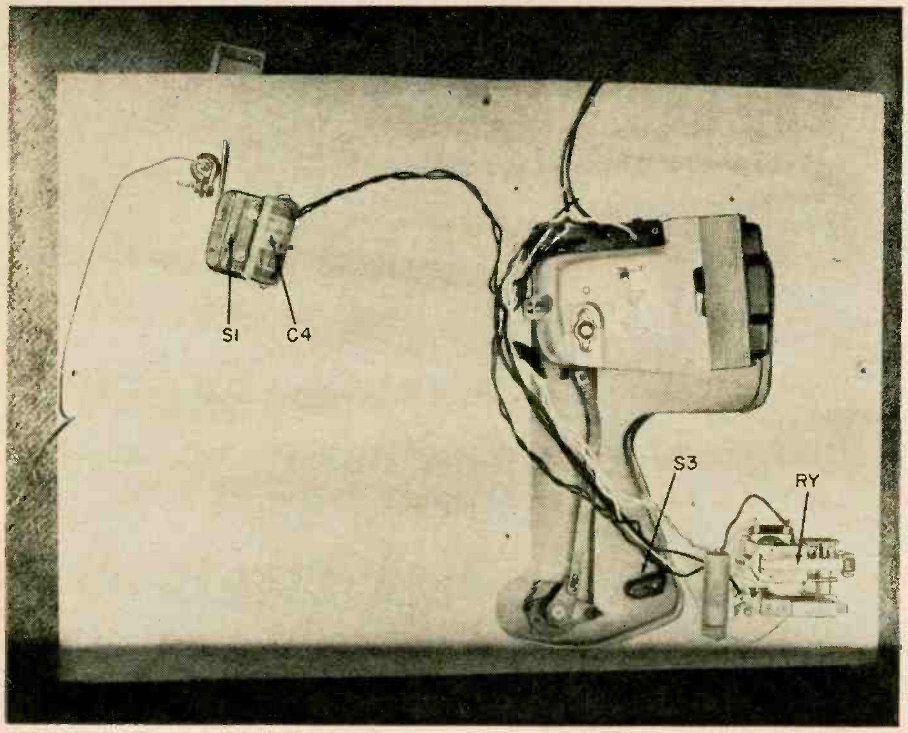

Fig. 4—Underside of motor board, showing the shutoff components. The capacitor seen to the left of the relay is C2.

cuit makes a fairly loud "clack" when energized, due to its rather complex mechanical action. For this reason, it should be installed on rubber shock mounts to absorb as much noise and shock as possible. Although the writer mounted it on the motor board (Fig. 4), perhaps a more desirable place would be somewhere else in the phono cabinet where shock effects would be better isolated from the pickup.

Professional type tone arms which are usually employed on home-assembled players are precision devices designed to have utmost freedom of vertical and lateral movement. To give the low record wear and fine tone quality of which they are capable, they must be properly installed, and no appreciable amount of mechanical drag can be imposed upon them. Ordinary shutoff trip mechanisms, therefore, might offer enough lateral opposition to cause groove skidding and severe record and stylus damage.

The method of automatic shutoff described here will not in any way impair the operation of fine phonograph equipment. Tone-arm pressure required to actuate this device is so negligible that it cannot be "felt" by a reproducer stylus. END

DON'T LET THEM FOOL YOU

This tube may look like new, but it's substandard—masquerading as new and unused. For the past 18 months RADIO-ELECTRONICS has been conducting a campaign to combat this fraudulent practice. We have no objection to anyone selling or advertising used or substandard tubes—PROVIDED THEY ARE SO LABELED OR ADVERTISED. But we are old-fashioned enough to think that when you see a mail order ad which offers "guaranteed tubes" or even just "tubes," you should expect that the ad means brand-new, unused tubes, even if it doesn't specifically say so.

Unfortunately this is not the case in some magazines, where ads of this type can mean used tubes, seconds, rejects, etc., as well as new tubes, depending on what the advertiser has in stock.

To be certain that RADIO-ELECTRONICS readers are not fooled, we do not accept this type of advertising—but insist that ads specify exactly what the tubes are—new and unused, or used tubes, seconds, etc. This policy has been in effect since our January 1956 issue.

PHASING EARPHONES

When a pair of headphone units is connected in series or parallel to form a double headset, the two units should be connected in phase (both diaphragms move in and out in unison) to give the best efficiency and tone quality. To test a pair of ordinary magnetic headphones for diaphragm phase, you can unscrew the caps, connect the cord tips across a 1½-volt flashlight cell and note if the disc diaphragms move in and out together. If one disc moves in while the other moves out, the phones are out of phase. Reverse connections to one unit.

You cannot make this test with dynamic or crystal phones, which have sealed-in elements and diaphragms which cannot be seen.

To test these types for diaphragm-phase: Connect the phones to a sound source, such as a radio, record player or audio signal generator and turn up the volume so you can hear the signal plainly with the phones about 1 inch away from your ears. Now hold one phone unit in each hand, with both hands close together and about 1 inch away from one ear, as shown in the photo. While keeping your hands together, slowly move them back and forth so that you hear first one phone and then the other. If you find that the signal volume nearly vanishes when your ear is between the two phone units, they are out of phase. Reverse the connections to one unit and try it again. There is little change in volume when the ear is between the two units while they are moved back and forth. Both are now in phase.—*Art Trauffer*

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Tracking Hum-m-m and Noise In Magnetic Recorders

By JAMES A. McROBERTS

TAPE and wire recorders are not supposed to record hum or noise along with the desired sound. When they do, a troubleshooting job arises.

Hum or noise can be recorded by:

1. The recording amplifier output.
2. The erase winding and its bias supply.
3. The bias winding on the recording head, its supply or connections to the recording amplifier.

The supply from the recorder's bias oscillator should be a pure signal. The voltage frequency is above audibility range—30,000 cycles and up. If hum modulates the ultrasonic bias, it will appear like Fig. 1-a. When demodulated or recorded, it will be like Fig. 1-b. A noise modulation may appear like Fig. 1-c for the portion indicated. The right-hand part of Fig. 1-c is normal, an unmodulated rf wave. When the wave of Fig. 1-c is demodulated, it appears like Fig. 1-d—noise on the left, and a straight line on the scope.

To troubleshoot a recorder, a scope is connected across the bias-oscillator tank coil, the recorder amplifier output, the bias-head winding and the erase-head winding in succession. The connection is directly to the deflection plates unless the scope has a wide-band vertical amplifier. The waveforms will appear like Figs. 1-a and 1-c. The normal is the right side of Fig. 1-c. Temporarily disconnect the recording amplifier and short out the bias winding while checking the erase winding. Short out or open the erase winding while testing the bias for noise, etc. If the windings are connected in parallel, either erase or bias winding can be opened; if in series, one can be shorted out with a jumper while testing the other. Try to have all other parts not operating while testing a particular one. The noise may interact. Thus, a corroded erase winding will indicate noise while the scope is connected to the bias on the recorder head. It will not do this if it is temporarily cut out of the circuit. Similarly, open the circuits to the erase and bias windings while checking across the bias-oscillator tank coil. Disable the bias oscillator while testing the recorder output to the recording head. (Pull the tube if a separate tube is used or use an electrolytic capacitor across the tank coil if possible.)

Fig. 2 shows typical connections to a combination head. Erase winding is on one leg of the magnetic structure while the record and bias windings are on another leg. Deactivate all but the winding being checked. With a separate erase head (see Fig. 3) interaction from the same magnetic structure is avoided, but any noise in the bias will affect the other head unless that winding is disabled. The recording amplifier should be disconnected here too—on the side toward the recorder amplifier from the capacitor feeding the bias into the single coil.

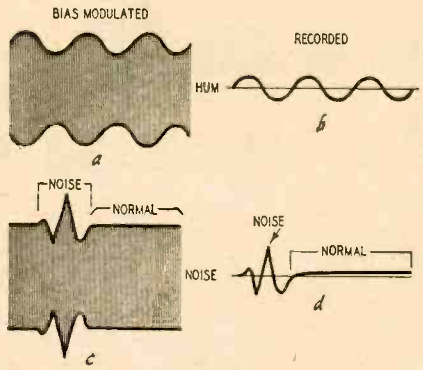

Fig. 1—Recorder waveforms: a—Hum modulated, b—hum recorded, c—noise modulated, d—noise recorded.

It may not be convenient to use the deflection plate input to the scope. A demodulator probe will demodulate the bias waveform and recover any modulation. A simple detector may be rigged up like Fig. 4-a if the demodulator probe is not available. Note that the demodulator circuit must be closed by a resistor if one is not present in the scope input or the probe. Almost any handy value from about 10,000 to 50,000 ohms will do.

In lieu of a scope a probe can be used with a headset as seen in Fig. 4-b. The headset furnishes its own dc path for the demodulating crystal's load. If the phones are crystal, shunt them with a resistor like that for the scope rig of Fig. 4-a, or use a commercial demodulator probe if one is available.

No sound should be heard on the phones if the bias waveform is pure. Similarly a straight line appears on the scope when used with a probe or the crystal detector rig of Fig. 4-a. Noise and hum will appear like their demodulated outputs (see Figs. 1-b and 1-d) or will be heard in the headset. Successive testing localizes the trouble. Then substitution as in ordinary radio repair work will finish the job. END

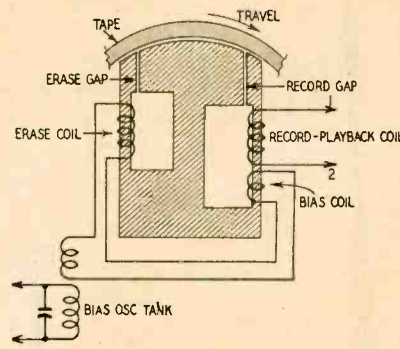

Fig. 2—Typical combination magnetic recorder head.

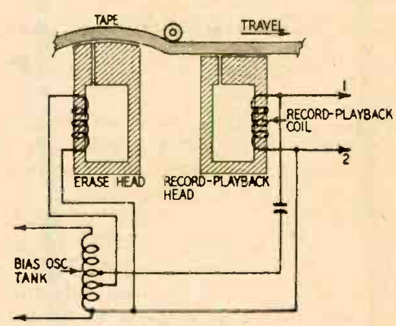

Fig. 3—Connection to separate erase head.

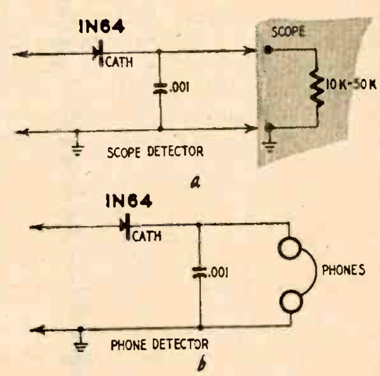

Fig. 4-a—Detector circuit to substitute for demodulator probe, b—headphone detector eliminates need for scope.

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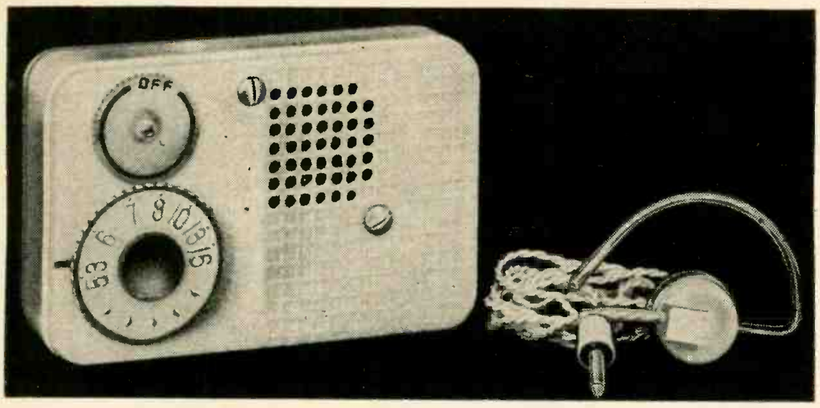
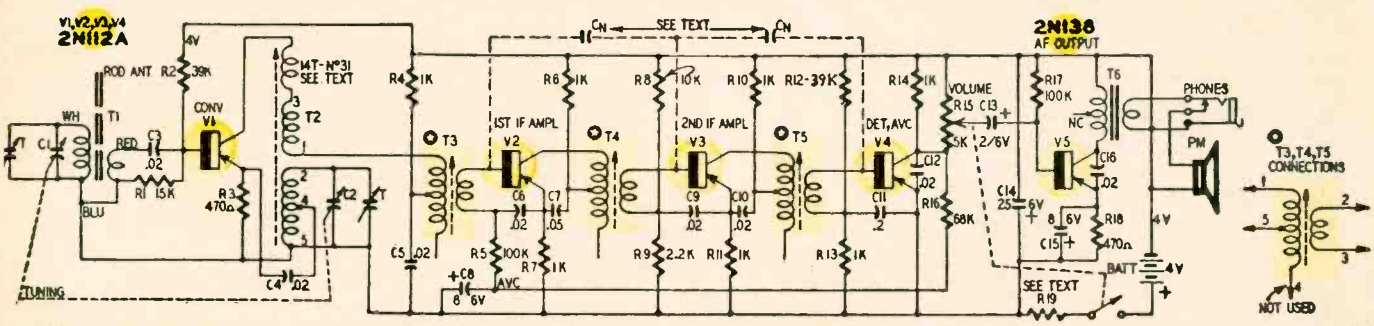


By I. QUEEN

This 5-transistor set may also be used with an earpiece

pocket radio operates speaker



R1—15,000 ohms
R2, 12—39,000 ohms
R3, 18—470 ohms
R4, 6, 7, 10, 11, 13, 14—1,000 ohms
R5, 17—100,000 ohms
R8—10,000 ohms
R9—2,200 ohms
R15—pot, 5,000 ohms with switch and dial (Lafayette VC-48)
All resistors preferably ¼ watt
R16—68,000 ohms
C1, 2—ganged tuning capacitor (Lafayette MS-270)
C3, 4, 5, 6, 9, 10, 12, 16—.02-µf flat ceramic
C7—.05-µf flat ceramic
C8, 15—8-µf 6-volt electrolytic
C11—0.2-µf flat ceramic
C13—2-µf 6-volt electrolytic
C14—25-µf 6-volt electrolytic
J—jack, 3-terminal (Lafayette MS-282 or equivalent)
T1—flat antenna coil (Lafayette MS-329)
T2—oscillator coil, modified, see text (Lafayette MS-265)
T3, 4, 5—if transformers (Lafayette MS-340 or equivalent)
T6—DOT 17 (UTC)
V1, 2, 3, 4—2N112A
V5—2N138
Sockets (5) for transistors
Speaker (Argonne AR-95)
Battery (RCA VS-308 or equivalent)
Dial for C1, 2 (Lafayette KN-24)
Plastic case (Lafayette MS-302)
Bakelite board, see text
Hardware

Fig. 1—Complete circuit of the shirt-pocket receiver.

IN the July, 1956, issue we described a radio *tuner* that would operate without an external antenna while carried inside a shirt pocket.

Since that time a number of readers inquired about the possibility of adding an amplifier and speaker. This was not practical due to lack of space. Recently new and smaller components have appeared on the market, and the home constructor can now build a complete radio receiver *with speaker*. It has the same general features as the earlier pocket set: high gain, selectivity, low battery drain, etc., but is smaller. On many local stations (10–15 miles) the sound is audible as far as 10–15 feet from the speaker in a quiet room. For distant reception or private listening, an earpiece jack is available. While in use it automatically cuts out the speaker. Battery drain varies with signal strength, from about 7.5 ma at low volume to about 10 ma at full output.

Before going into construction details, we will say a few words about this project. Parts specified here (or their equivalents) have not been designed expressly for this radio, so some modifications have been made. These few changes are easily made by anyone with a few tools, a little care and patience. A small soldering pencil (about 20 watts), screwdriver, small round and flat files, saw and drill are needed. If you like "do it yourself," this is for you. The photos show the neat and attractive case that houses the completed radio.

Five p-n-p type transistors are used in this radio. The five stages are: converter, two if's, power detector and audio output. The set is powered by a 4-volt mercury battery. Fig. 1 shows the receiver's circuitry.

Construction details

The entire receiver except for battery and antenna is mounted on a plastic chassis. It may be 1/16-inch-thick bakelite or any other easily machined material. Holes are drilled to accommodate the transformers, sockets and other components as shown in Fig. 2. It is suggested that you cut the chassis as shown by the dotted lines. This leaves room for T1, the speaker and battery.

For T3, 4 and 5 start with a ¼-inch round hole and file until you have an opening large enough for the transformers. It will be approximately ⅜ inch square. For transistor sockets drill two or three holes ⅛ inch in diameter, then join and enlarge them by filing. It is better if these holes are not too large, so file a little at a time then test. For leads which pass through the chassis, drill 1/16-inch holes.

Antenna T1 is slightly too long to fit into the case, so about ⅛ inch must be removed. Do this by chipping away *a little at a time* with a cutting plier. Take a little of the core material from each end but *don't touch the winding itself*.

Threaded spacers about 13/64 inch long (they can be sawed or filed down from a longer length) and 6-32 screws hold the speaker to the chassis. Only two screws, *diagonally opposite*, are needed. Screws pass into the spacers from each end. The rear screws (B in Fig. 3) hold the speaker to the chassis. Screws are passed through the case from the front (see photo) to hold the entire assembly.

The metal spacers are "sweated" or soldered to the speaker (points A in Fig. 3.) To do this, proceed as follows: Cut the spacers to correct length. Pass 6-32 screws through the front of the

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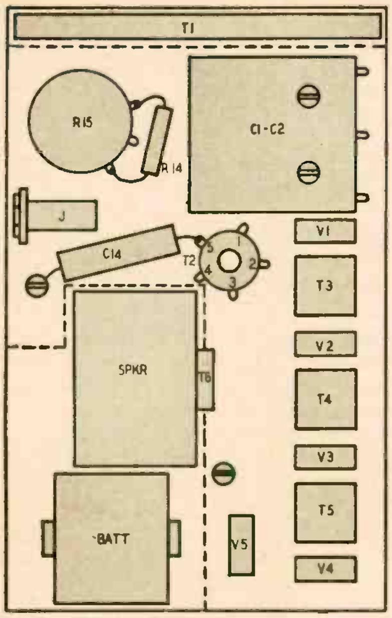


Fig. 2—Parts layout on the chassis board indicating holes cut in chassis.

speaker and tighten the spacers on them. The speaker frame is already drilled for holes, but these will have to be slightly enlarged to accommodate 6-32 screws. Now apply heat and solder at points A so that the spacers remain firmly in place after the screws are withdrawn. When the set is finished, these screws will be used to hold the chassis and speaker in the case.

With the chassis fastened in place inside the case, there will be approximately 8/32 inch between the case and the chassis to allow for socket pins, transformer terminals and other parts that extend below the chassis. Most capacitors and resistors are also within this space.

Oscillator transformer T2 must be modified as follows. Use No. 32 or finer enameled wire and add 14 turns to the collector winding. *Direction is important.* Solder one end of the wire to terminal 3, then wind *counterclockwise* while holding the form so the terminals point toward you. Preferably, the added turns are put on after the coil is inserted into its 3/16-inch mounting hole in the chassis (see Fig. 4). Then, the added turns being wound on the *under* side, the coil tends to remain in place. A few drops of polystyrene cement also help. The other end of the wire is soldered to the V1 collector.

The plastic case measures 4⅛ x 2⅝ x 1⅛ inches and is available in either yellow or maroon. A small amount of work must be done on it. Note that it comes with two holes on the front. The larger one is used for the tuning capacitor. I found it advisable to extend this hole about ⅛ inch upward. This permits mounting the tuning capacitor nearer to T1, saving space. The capacitor itself is mounted directly on the chassis, held by the two small screws supplied with it. Approximately 3/16 inch should be cut off its shaft.

The plastic case carries a threaded mounting stud that is not needed and should be removed. The metal insert is drilled out *carefully* and the plastic material around it melted off with a soldering iron.

The front of the case must be drilled so the speaker sound can come through. See the front-view photo. The case has a pattern of indented squares, and it is easy to drill through each square as required. Do this carefully without leaning on the drill during the process, to avoid chipping or cracking the plastic.

One more bit of work must be done on the case. This is drilling a hole through the side for an earpiece jack. The jack is mounted on a small angle bracket screwed to the chassis. This permits lifting out the chassis at any time without unsoldering leads.

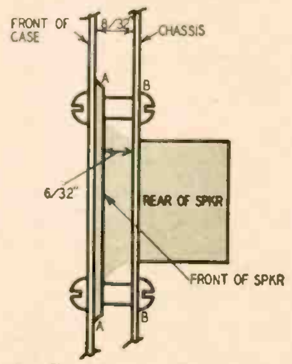


Fig. 3—Speaker mounting method.

It is wise to check each component before you mount it. For example, you may wish to test the continuity of each if transformer. Once you finish the wiring it will not be easy to remove and replace a defective part.

There is much less to be said about the wiring than the mechanical work. Simply follow the schematic carefully, using leads as short as possible. It is strongly recommended that you use ¼-watt resistors, at least for the if strip. Between each if transformer and the adjacent socket there is space for one ¼-watt resistor, and others may be placed close by. These small resistors will be found only in the larger supply houses. Although space can be found for larger and more common ½-watters, your work will be considerably eased by using ¼-watt units.

Practically all the smaller parts such

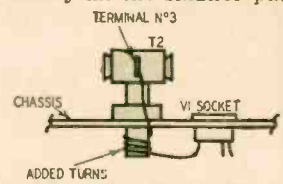


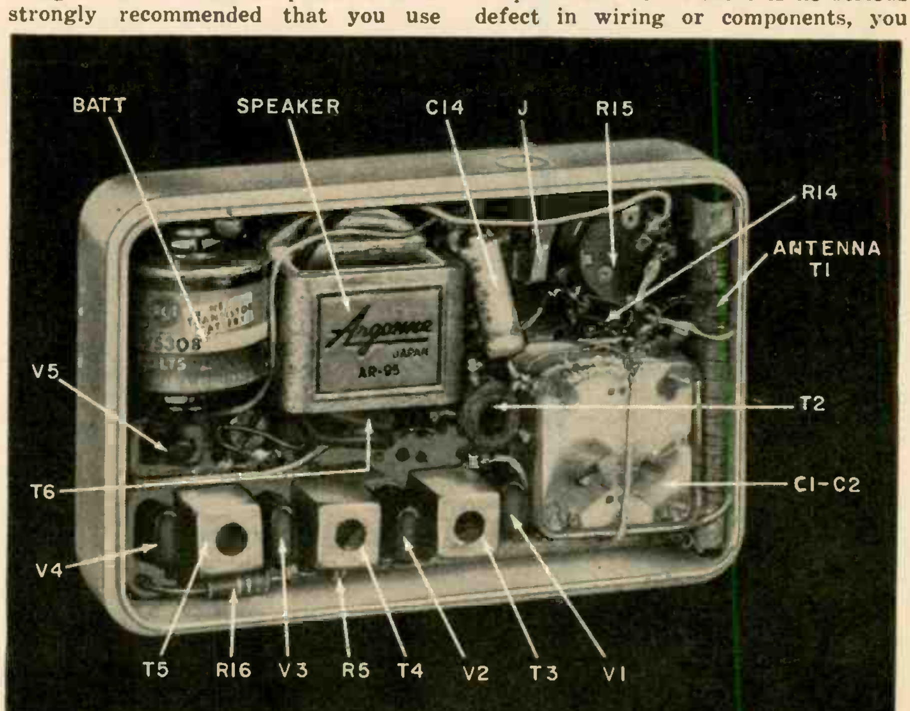
Fig. 4—Mounting the oscillator coil.

as capacitors and resistors are below chassis. Exceptions are the avc resistors, R5 and R16; filter capacitor C14 and resistor R14. Two capacitors, C6 and C9, stand upright against the side of an if transformer.

T6 is a tiny transformer, called DOT-17 made by UTC. This is tiny enough to fit next to the speaker magnet. Its center tap is unused.

Follow the usual rules for wiring a transistor device. Don't solder near a transistor, because of possible damage. Better remove the transistor until the soldering is done. Don't apply too much heat or mechanical pressure to any components. Be specially careful of the if transformers. These have very fine, easily broken leads from the interior to the terminal posts. Take your time in assembling and wiring the set because an error is not easily corrected.

After the assembly and wiring are completed, you are ready for alignment. The first step is to tune the if strip for 455 kc. If there is no serious defect in wiring or components, you



Inside view showing compact layout.

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should be able to pick up an if signal coupled loosely to T1. The low side of the generator goes to the tap (blue lead) and the high side to the red lead. Then tune each if transformer core, starting with T5 and working back. Tune each for maximum output. A voltmeter across R14 will serve as an indicator or you can listen to the speaker sound (if the generator is modulated). In many cases, the output from an if generator can be picked up by the if strip without a physical connection between them. Just bring the if lead close to the if strip input.

Since the if amplifier picks up random electric noise as well as radio signals, you can also adjust the strip for maximum response from a fluorescent lamp. A continuous static noise will be heard near most lamps.

To tune the converter, set the antenna trimmer (on the dual capacitor) to approximately mid-setting and tune the frequency dial for some local station near 600 kc. Adjust the oscillator core for maximum response on that station. An alternative method is to place the set near a fluorescent lamp or other noise field and tune the oscillator core for maximum response. This assures maximum sensitivity at this part of the dial, regardless of actual calibration. In tuning the oscillator core, set it rather deeply into the core so it can affect the added turns.

After adjusting the low-frequency end of the dial, tune the set to some station near 1400 kc and set the antenna trimmer (on the variable capacitor) for maximum response.

No neutralization has been found necessary in this set. If your if strip howls or whistles on every station, try adding a 56-μμf ceramic capacitor between the base of one if transistor and the next. In the diagram they are shown as C_n in dotted lines. Also try adding a resistor (R19) of about 33 ohms or more in series with the positive battery lead. A larger value for C14 may also help. In any case it is a good idea to try different transistors for V1. Some may not oscillate very strongly at the low voltage. Try interchanging your transistors to get the best one in this socket.

For the specified output transformer you can use any other that is small enough to fit which matches 2,000 ohms to 10 ohms. For example, a transformer may be purchased with the speaker (the combination being known as SK-62) for a good match. Although this transformer is much larger than the DOT type, space could probably be found alongside the speaker.

The battery used (and shown in the photo) is an RCA VS-308. A direct replacement is a Mallory TR-113R. The only difference is that the RCA unit is equipped with snap fasteners whereas the Mallory will require some sort of mounting bracket. Or you may prefer to use three type N dry cells: insulated, taped and soldered together to form a 4½-volt battery. END

L-C-R-coupled transistor circuits

Impedance coupling provides compromise between cost and efficiency

By JAMES E. PUGH, JR.

THE use of L-C-R coupling (sometimes called impedance, or choke, coupling) in transistor circuits offers some interesting possibilities for experimenters.

This coupling method is more efficient than resistance coupling, but at a greater cost. On the other hand, it is cheaper than transformer coupling, but less efficient. Therefore both efficiency and cost are between resistance and transformer coupling.

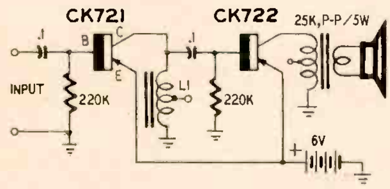

Fig. 1—Schematic diagram of two-stage L-C-R-coupled transistor amplifier.

The coupling methods described below have been used with vacuum tubes for many years. This article shows how they can be used to advantage with transistors. Fig. 1 is a two-stage, single-ended transistor amplifier using L-C-R coupling.

An inductance in the collector circuit provides a high impedance at audio frequencies and a low dc resistance, keeping the dc loss in the load at a minimum while presenting a suitable load at audio frequencies.

An inductance of about 2 to 5 henries is satisfactory for this purpose. The one used here is the primary of a center-tapped output transformer (Merit A-2937 or equivalent.) The secondary is not used and its leads may be clipped off short. This transformer was selected

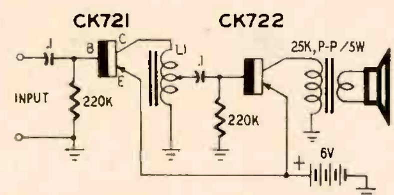

Fig. 2—The two-stage amplifier with improved impedance match between stages.

because it provides a satisfactory inductance value, its cost is low and it is usable in all three circuits to be described.

The chief disadvantage of the circuit in Fig. 1 is that impedance match between stages is not optimum. The high output impedance of the first stage is heavily loaded by the low input impedance of the second stage, thereby decreasing gain. (This is also a disadvantage with resistance-coupled transistors, but not with transformer coupling.) However very good results can be obtained in spite of the mismatched impedances.

It is possible to correct mismatched impedances by tapping the base connection of the second stage down from the collector. This results in an autotransformer as the coupling element (Fig. 2). (Inductance L1 in Fig. 1 may also be regarded as an autotransformer with an impedance ratio of 1 to 1.) Inductance L1 in Fig. 2 is the primary of a center-tapped output transformer and will improve the impedance match. It will not correct it completely because the impedance ratio is not optimum. The impedance ratio at the two taps (top and center) is 4 to 1. The impedance ratio should be about 20 to 1 for optimum coupling

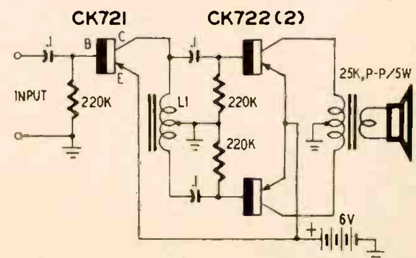

Fig. 3—Schematic diagram of push-pull L-C-R-coupled transistor amplifier.

between the two stages, but this would require a special inductance tapped at a 4.5-to-1 turns ratio. This was not done because the aim was to obtain best results using only standard parts.

Many times it is desirable to operate transistors in push-pull. The circuit of Fig. 3 shows how this can be done with L-C-R coupling.

This circuit takes advantage of the fact that, if current is made to flow in one half of L1, an equal current will be induced in the other half. There will be a phase difference of 180° between the two ends of the winding, the required condition for push-pull operation. The first transistor drives one half of L1, and in turn each half of the same winding drives a transistor to give push-pull operation.

This circuit has the same mismatched impedance condition as in Fig. 1. This could be corrected by the method used in Fig. 2, but here too it was desirable to obtain good results using only standard components and at minimum cost.

The collector current in each transistor should be about 1 ma. If it is far from this value the base resistors may have to be changed slightly for best results. The exact value depends on the individual characteristics of each transistor and should be determined by the cut-and-try method. END

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RADIO PILL . . .

transmits from inside you . . .

By ERIC LESLIE

A "RADIO PILL," an encapsulated FM transmitter that can be swallowed and is used to "telemeter" information from the digestive tract, was demonstrated April 8 at the Rockefeller Institute in New York City. Its action was explained by Dr. Vladimir K. Zworykin, affiliate in biophysics in the Medical Electronics Center of the Rockefeller Institute and honorary vice president of RCA, who had been active in the early stages of its design.

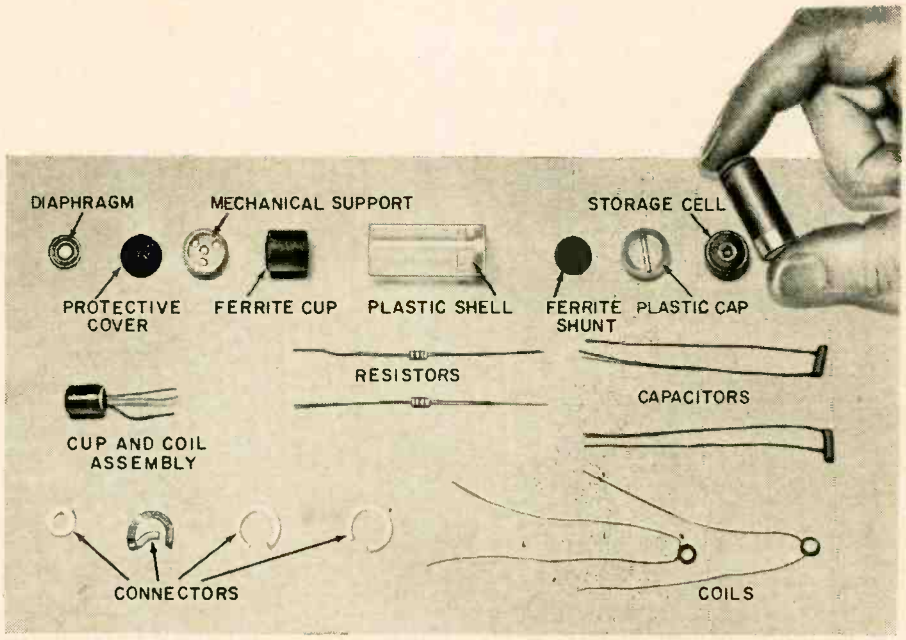
A "radio pill" offers the medical man many possibilities since it causes no discomfort to the patient and thus can make measurements under more normal conditions than older tools. It can easily penetrate such areas as the right side of the colon, hitherto almost inaccessible to study. Present models (only three were in existence at the time of the demonstration) have been used to measure pressure. Temperature measurements are also possible, and it is expected that means will be devised to measure acidity in the gastrointestinal tract.

The transmitter consists of a ferrite cup core, two coils, two resistors, two capacitors, a transistor and a small rechargeable 1.5-volt cell in a plastic capsule 1⅛ inches long and 0.4 inch in diameter. Operation is at approximately 1 mc, and the signal is receivable for a foot or two outside the body. The unit is frequency-modulated by a disc-shaped magnetic shunt, which changes the inductance of the core as it moves closer and farther away. Since frequency modulation is used, changes in amplitude caused by the unit moving nearer to or away from the body's surface create no reception problems.

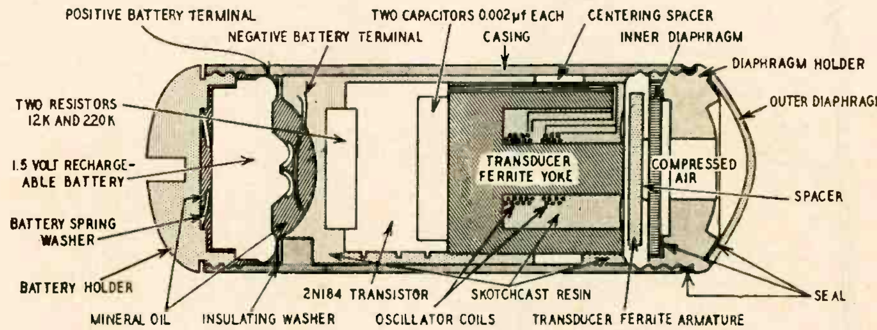
The pressure transducer consists of a rubber diaphragm (a metal diaphragm was used in the first model, shown in exploded form in the photograph) to which the magnetic shunt is attached. As pressure is increased, the diaphragm is bent inward, forcing the shunt nearer to the core and lowering the transmitter's frequency. A second diaphragm is provided at the end of the tube, for mechanical protection. The space between the two is filled with air, under enough pressure to make the whole space act as a piston, transmitting the pressure from one diaphragm to the other without significant loss.

The idea of such a pill was conceived by John T. Farrar of the Rockefeller Institute and its design worked out by Dr. Zworykin. The development work was done by a team of engineers of RCA's Commercial Electronics Products Division in Camden, N. J.

A remarkable feature of the apparatus is that it was constructed from available miniature components. Even the battery was found on the market.



These components all go together to make up the 0.4-inch-diameter, 1⅛-inch-long "Radio Pill" (upper right) that "telemeters" information from the digestive tract.

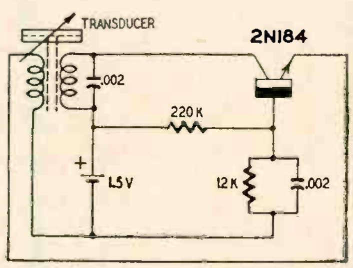


Cross-section diagram of the capsule containing the FM transmitter.

The constructors did not have time to get special components made for the job and had to rely on standard parts. With specially made components, an even smaller capsule could be built.

In its present stage of development, the radio pill must be considered an experimental technique but one which holds important implications for future medical research. The pill's practical uses will be evaluated following laboratory tests and experiments which will be conducted jointly by RCA, the Rockefeller Institute and the Veterans Administration.

Studies involving use of the radio pill, for the time being at least, are being carried out in the New York Veterans Hospital with the patient under continuous observation. Preliminary testing has taken place during the last year. END



Circuit of the tiny transmitter.

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TV SOUND TUNER

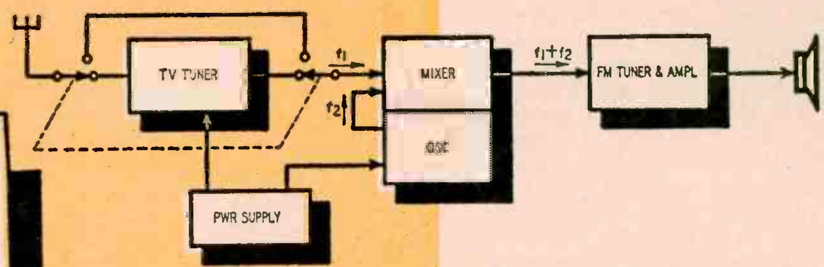
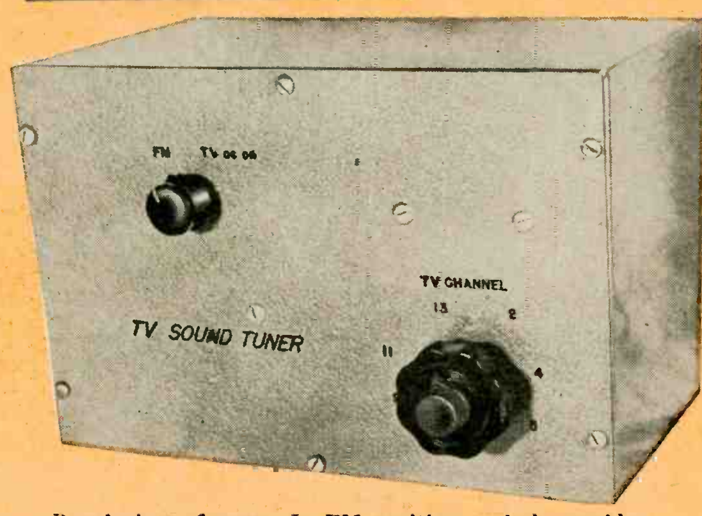


Fig. 1—Block diagram shows plan of the TV sound tuner system.

Improve your TV sound with the help of your FM receiver

By RICHARD GRAHAM

IT'S no secret to the serious audiophile that the audio quality of most TV receivers leaves much to be desired. TV has attracted and brought into our home via this medium many live performances by name artists and performers in both the popular and classical fields. This rich source of quality audio performances which might ordinarily be tape-recorded for future enjoyment is often marred by the poor audio performance of the TV receiver. Even feeding the audio signal directly from the FM discriminator in the TV set into a high-quality audio amplifier and speaker system often results in a 60-cycle vertical sync buzz and a 15,750-cycle horizontal sync whistle.



Panel view of tuner. In FM position, switch provides feedthrough to FM tuner from antenna input.

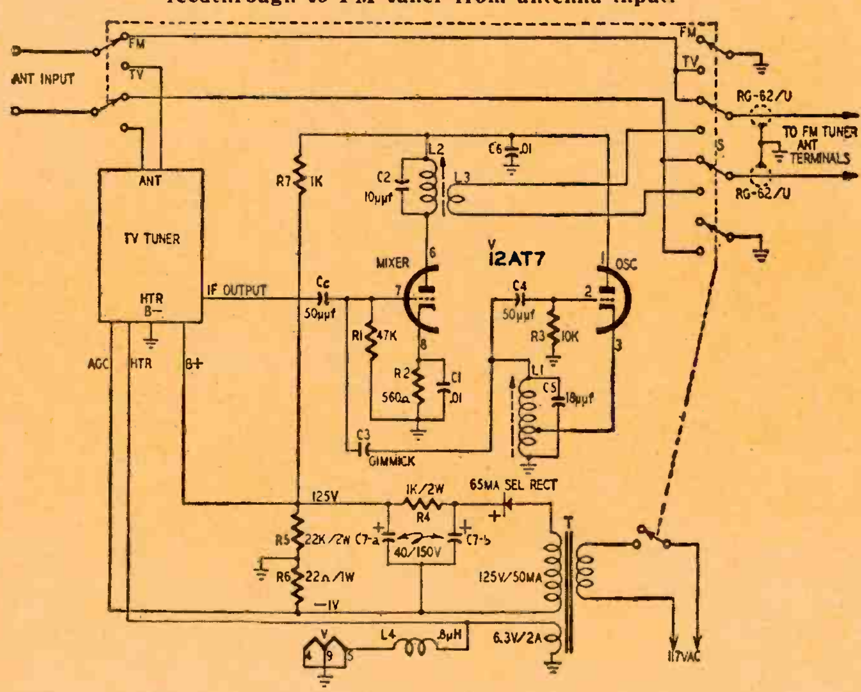


Fig. 2—Schematic diagram of the TV sound tuner. The switch is shown in the FM position.

R1—47,000 ohms, ½ watt
R2—560 ohms, ½ watt
R3—10,000 ohms, ½ watt
R4—1,000 ohms, 2 watts
R5—22,000 ohms, 2 watts
R6—22 ohms, 1 watt
R7—1,000 ohms, ½ watt
C1—.01 μf, ceramic
C2—10 μμf, ceramic
C3—Gimmick (two pieces of hookup wire twisted together for length of ½ inch)
C4—50 μμf, ceramic
C5—18 μμf, ceramic
C6—.01 μf, ceramic
C7—40-40 μf, 150 volts, electrolytic
Cc—Coupling capacitor, approximately 120 μμf (used only if not already in tuner)
SEL RECT—Selenium rectifier, 65 ma
T—Power transformer, secondary 125 volts @ 50 ma, 6.3 volts @ 2 amps (Stancor PA8421)
S—8-pole 2-position rotary switch (7 poles used)
V—12AT7
9-pin miniature socket and shield
L1—*For 21-mc tuners:* 4 turns of No. 20 wire spaced ½ inch long, tapped at 1¾ turns from ground end. Coil form: ¾-inch diameter (Cambridge-Thermionic LS3 slug-tuned or equivalent)
For 41-mc tuners: 5½ turns of No. 20 wire spaced ½ inch long, tapped at 2 turns from ground end. Coil form: ¾-inch diameter (Cambridge-Thermionic LS3 slug-tuned or equivalent)
L2—5 turns of No. 20 wire spaced ½ inch long. Coil form: ⅜ inch long, ⅜-inch diameter (Cambridge-Thermionic LS3 slug-tuned or equivalent)
L3—2 turns of hookup wire over L2
L4—Filament choke, 0.8 μh (J. W. Miller 6175 or equivalent)
TV tuner, any type with 21- or 41-mc output
Cabinet
Bracket
Line cord
Length of RG-62/U coaxial cable
Length of 300-ohm lead-in

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Fortunately this problem isn't really a difficult one to solve if one already has an FM tuner. Since the sound portion of TV transmission is FM, all that is necessary is the FM tuner and a means of converting the TV frequencies to one within its tuning range. This can be done by feeding the output of a TV tuner into a converter stage to change the TV tuner output frequency to one somewhere in the 88–108-mc FM band. The frequency mixing that takes place in the TV sound tuner discussed in this article is identical to that which takes place in the front end of any superhet receiver. In effect, we are using the FM tuner as an if amplifier. A block diagram of the TV sound tuner is shown in Fig. 1.

The TV tuner can be practically any type. (Some experimentation may be required when using tuners having a low-impedance link output. In some cases the link can be eliminated by tapping directly from the plate of the mixer through a coupling capacitor.) The winding of oscillator coil L1 (Fig. 2) depends on whether a 21- or 41-mc TV tuner is used; data are given in the parts lists for both types. The 21-mc type will probably be preferred by the builder since it is readily available, at very reasonable prices.

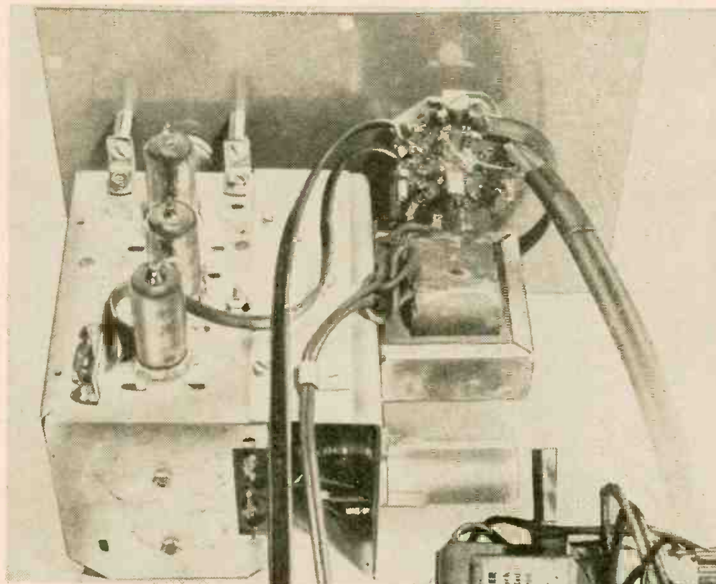
The circuitry

The converter portion of the TV sound tuner consists of a single 12AT7. One half of this double triode functions as a mixer and the other as a fixed-frequency oscillator. The output of the TV tuner is fed through capacitor C_c to the mixer grid. The oscillator output is also fed to this grid through C3. These two signals are mixed to produce a new frequency which, in this case, is chosen to be the *sum* of the TV tuner output and the TV sound tuner oscillator frequencies.

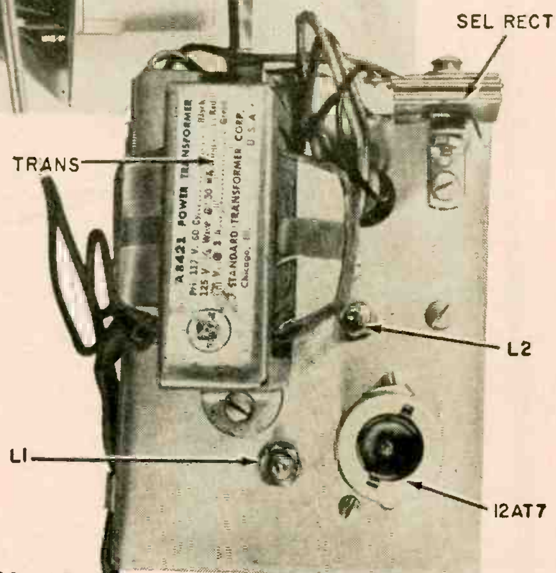
Coil L2 and capacitor C2 in the mixer plate circuit resonate to this sum frequency. A link (L3) around L2 is connected to the FM tuner antenna terminals. Thus this newly produced sum frequency is fed into the FM tuner and, if the FM tuner is set to this sum frequency, TV sound can be received. The particular channel received is selected by the TV tuner channel-selector switch.

For example: If we use a TV tuner with a 21-mc output, the oscillator in the TV sound tuner must be at 69 mc to produce an output of 90 mc into the FM tuner. The point selected on the FM tuner to receive TV sound is arbitrary —just pick an empty spot on the FM dial where no other station is received. The oscillator frequency on the TV sound tuner can be varied by adjusting L1 to vary the output frequency to the FM receiver.

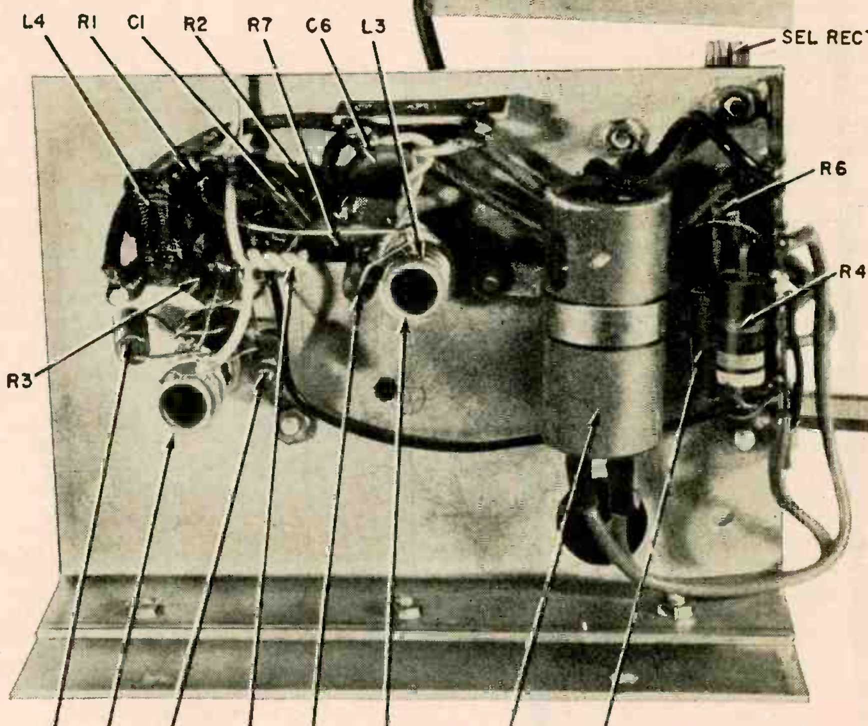
The rotary switch S performs three functions: It transfers the antenna to either the TV sound tuner or the FM tuner. When the TV sound tuner is used, the unused contacts of the antenna changeover portion of switch S are



TV sound tuner circuit is mounted on L bracket bolted to chassis of TV tuner.



Top view of bracket shows major components.



Underside of bracket contains coils, wiring and minor components.

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grounded. This prevents reradiation of the TV sound tuner output through the capacitance of the switch contacts and the antenna. Rotary switch S also turns the TV sound tuner on when placed in the TV position.

The power supply is a standard transformer-fed half-wave selenium rectifier circuit. A small negative voltage of about 1 volt is developed across resistor R6 by the current drawn through it by the TV tuner and bleeder resistor R5. This is applied to the agc lead on the tuner. The voltage may vary slightly according to the current requirements of the tuner. The current through R5 stabilizes this bias voltage against variations due to different tuners.

Aligning the tuner

No special tools or instruments are required for alignment. First set the TV tuner on a channel known to be in use. Next set the FM tuner dial on an unused frequency between 89 and 107 mc.

Now you adjust the oscillator frequency by turning the screw on L1 until the channel selected is heard. The last step is to adjust L2 for maximum signal out, or minimum noise in the speaker. This adjustment is broad.

The TV sound tuner was constructed on an L-shaped bracket fastened with self-tapping screws to the edge of the TV tuner. No specific dimensions are given since sizes and shapes of TV tuners vary considerably. The L-shaped chassis is used because it permits short, direct leads between the TV tuner output leads and the 12AT7 mixer-oscillator. In general all leads associated with the 12AT7 should be kept short. Long leads on the oscillator section invite frequency instability among other things. Therefore, keep these leads short and rigid.

The unit is housed in an aluminum utility box for shielding as well as appearance. The oscillator in the TV sound tuner can conceivably cause interference to neighboring TV receivers. Arrange the TV sound tuner oscillator frequency (the difference between the FM tuner frequency setting and the TV tuner output frequency) to fall on an unused TV channel in your area.

The output of the TV sound tuner is fed to the FM tuner through a pair of RG-62/U coaxial cables. Effectively, these cables are in series, thus preserving a reasonable impedance match with only a small loss in signal. One can also use a shielded 300-ohm cable if it is available. It is desirable to use a shielded output cable because of the radiation possibilities. END

THREE CHEERS

—L. R. Davis

A toast is due that customer,
He's rare, there is no doubt of it;
Who, when his set is brought to shop,
Has kept his fingers out of it!

Selenium Diode Voltage Regulators

By J. R. GNESSIN

A VERY interesting application of selenium rectifiers is to provide voltage regulation, especially for nominal 1.5-volt filaments which actually operate on 1.35 volts. This voltage can be obtained from local ac sources and kept within exceedingly fine limits with selenium rectifiers.

A surplus stepdown transformer supplies 10 volts ac center-tapped, from a local 117-volt source, as shown in the figure. A full-wave selenium rectifier REC1 (International Rectifier Corp., JD-508G or similar) provides two rectified voltages, one of which is used for control while the other provides the actual output voltage. An output regulator diode REC2 (IRC JD-500G or similar) regulates the actual output to 1.35 volts dc at 0.5 ampere within narrow limits.

Why? When the bottom of T1 secondary is negative, the electrons flow from the bottom of the winding, against the arrow direction of the rectifier REC1 to point B and ground. It can be seen that current at ground will flow through output bleeder R2 (and the external load) up to "+" output terminal. Some of the current will flow from ground against the arrow of REC2 up to "+". Here the two currents will combine, heading back toward the transformer. The currents again divide, part going through the filter choke to T, completing the circuit, while part goes up through R1 back to REC1 up against the arrow of the rectifier to the top of T, completing the circuit through the transformer winding. While it is true that the last division of current will find a lower resistance path through the filter choke than through R1, yet it can be seen that the path through R1 is toward a point of greater potential, overcoming voltage drop across R1.

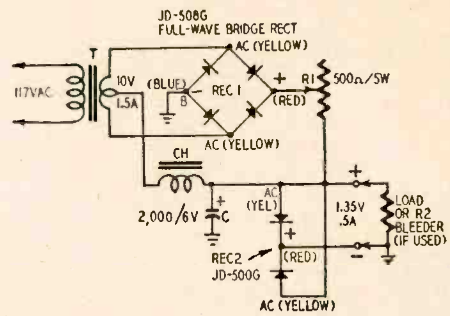
On the next half-cycle the top of T secondary is negative, permitting the electrons to flow from the top of the winding, against the arrow of the rectifier to point B, thence to ground, on through the external load and output bleeder R2, part dividing to go up through REC2, combining at point "+", again dividing to go through the filter choke to transformer as well as up through R1 and down against the arrow of rectifier JD-508G to the bottom of transformer T, completing the circuit and cycle.

REC1 thus rectifies the full voltage across T and also the voltage from center tap to ends. In effect it provides dual full-wave rectification, with output in the form of a voltage divider with approximately 5 volts from top of R1 to ground and approximately 2.5 from positive output terminal to ground, if rectifier REC2 were not in the circuit.

REC2 is the voltage regulator. As hooked up into the output circuit it loads the circuit, pulling the voltage down from approximately 2.5 to about 1.35 dc. The exact voltage at the output is determined by setting of R1 in the following manner:

The resistance of the voltage regulator varies inversely as the voltage across its terminals. The polarity will not change, since this is filtered dc. The amplitude might change as occasioned by fluctuating line voltage or load changes. To resist these voltage changes the voltage-regulator resistance goes up sharply as the voltage across it goes down and vice versa.

Resistor R1 together with rectifier REC2 forms a voltage divider from



T1—Stepdown transformer, line to 10 volts, center-tapped. (Not critical, 6.3- and 5-volt filament windings of power transformer can be used—for low currents a single 6.3-volt center-tapped winding.)
R1—500-ohm 5-watt pot
R2—Load. (If bleeder is used, resistance should be 5 times as high as load.)
C—2,000-μf 6-volt electrolytic
CH—Filter choke. Primary of old power transformer or other low-resistance inductor.
REC1—Full-wave bridge rectifier, ac input 26 volts max., dc output 0–20 volts @ 700 ma (IRC JD-508G or equivalent)
REC2—Full-wave rectifier, ac input 26 volts max., dc output (diodes in parallel) 800 ma (IRC JD-500G or equivalent)

The regulator circuits

the 5-volt point to ground. R1 is set so the voltage at the output, under load, is exactly 1.35 (or whatever is required). Under quiescent conditions this will fall into the center of the regulating range of REC2.

Whatever the cause, if the voltage across the voltage regulator increases above 1.35 (or whatever voltage setting made) the resistance of the regulator decreases. This increases the current flow through it to such a value that the increased voltage drop across the filter choke and R1 bring the voltage across the regulator back to 1.35 volts. If the voltage across the regulator drops, the resistance across it increases, reducing the current through it, and the voltage drop across the filter choke and R1 and raising the voltage across the regulator.

In this manner, accurate output voltage of 1.35 can be safely connected to filament circuits, etc. with assurance that negligible output voltage changes will result despite normal line and load changes. END

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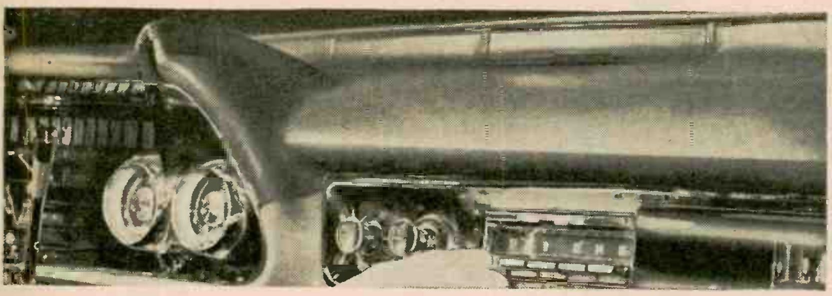
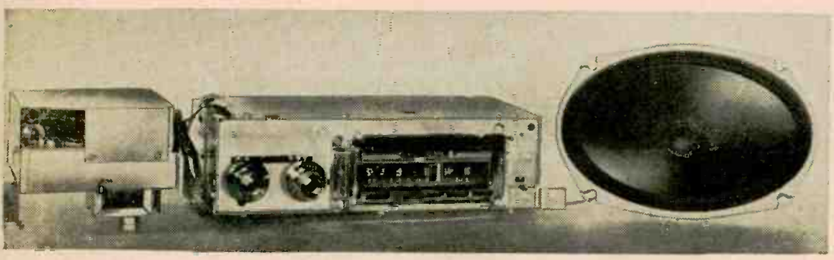
what's new?

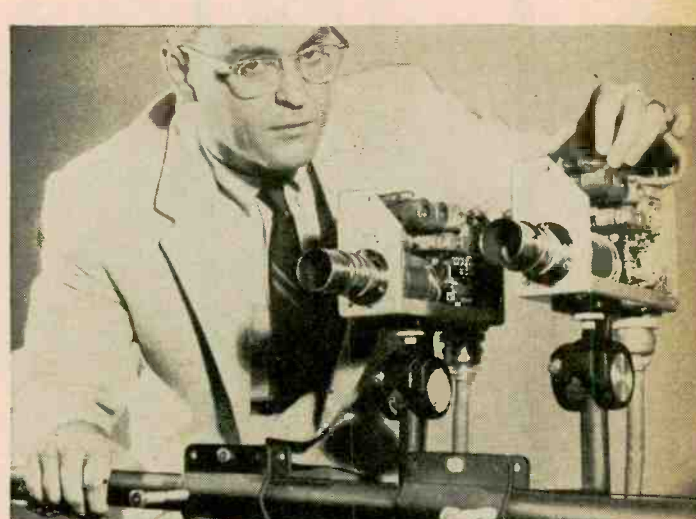
ZAUBERSCHALTER is the German name for this novel method of remote control. Squeezing the rubber bulb forces air through an ultrasonic whistle. This is picked up by a microphone at the receiver, and made to actuate a relay to turn the set on and off. It has a range of at least 20 feet and, of course, no external wiring is needed.

13-TRANSISTOR auto radio made for the Cadillac El Dorado Brougham by Delco Radio has 3 germanium diodes as well as its 13 transistors. It requires no warmup time and, since no vibrator is used, vibrator buzz is eliminated. Total current drain



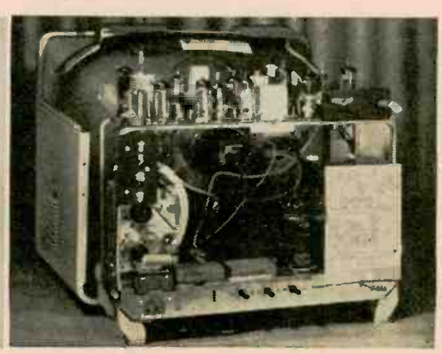
of the set is 0.6 ampere. The radio is built in three sections. Other transistor models are being made for Chevrolet and Pontiac. These radios are all designed to provide the long trouble-free life and reliability characteristic of transistor equipment.





THREE-DIMENSIONAL TV has been presented from ABC network station KABC-TV, Hollywood, on ***Adventure . . . Tomorrow***, first commercial telecast in 3-D. Two cameras are used simultaneously. The right camera has a reversed scan and the image is electronically split. Both cameras are focused on the same point and spaced 10 inches apart. They are panned as a single unit, held rigidly on a bar. Two pictures appear side by side on the TV screen, and the viewer superimposes them with the help of a small mirror held edge-on to his nose. The system was developed by Dr. Martin L. Klein (with cameras in photo) and Harry C. Morgan. The cameras, built by Kintel Corp. of San Diego, are standard broadcast quality. Vidicon tubes are used in the small cameras instead of the larger image orthicon.

CONTRIBUTIONS TO 110° TUBE progress by RCA and Sylvania are shown below. Both will present TV receiver lines featuring the 110° picture tube for 1958. The photo at the left shows the new RCA 21-inch 110° picture tube. A 110° deflection yoke is in position on the $1\frac{1}{8}$-inch-diameter neck. The glass-button base eliminated any possibility of loose base-pin connections. To the right is a photo of the Sylvania S-110 chassis designed for the 110° picture tubes. Service is simplified by the slide-back chassis. The new design takes 50% less space than do old models. This is possible as the 110° tubes are as much as $5\frac{1}{2}$ inches shorter than the 90° tubes.



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BUILD a versatile probe set

Part I: Construction and application of direct, alignment, isolation and high-frequency probes

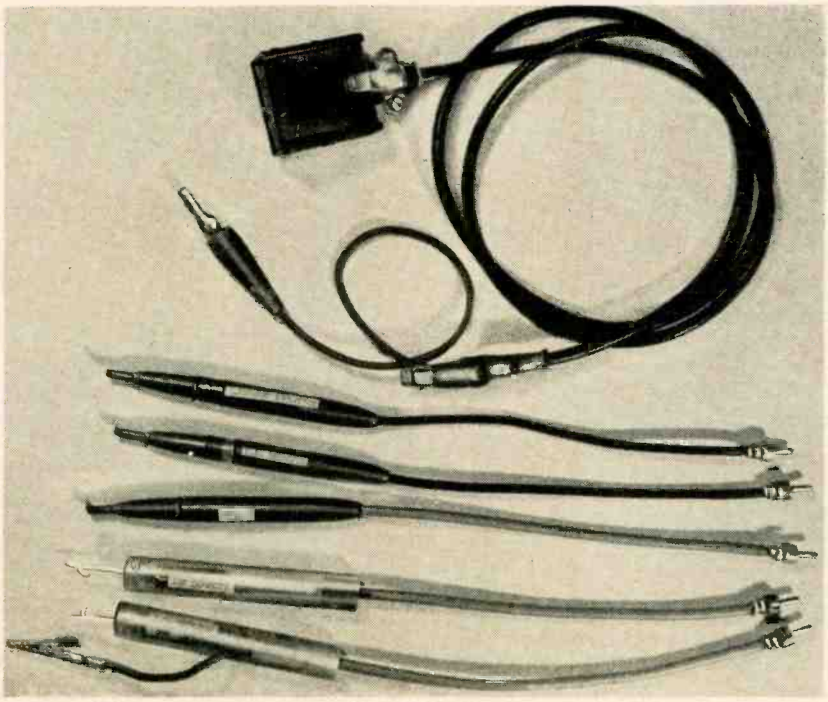

Fig. 2—The scope cable and the five probes described in article.

By EARL T. HANSEN

MANY service technicians who have a fine scope have never bothered to obtain the set of probes necessary for its proper and complete use. Others have probes but are often uncertain as to which one to use for the particular circuit to be analyzed. This article describes the construction and use of five oscilloscope probes which meet practically all requirements for servicing modern electronic equipment. The cost of materials for the set is $7–14 depending on whether the probe blanks are purchased or assembled by the builder.

The original probe set used E-Z-Hook probe blanks; however, two types were duplicated using readily available materials to prove the feasibility of home construction of the entire set. Fig. 1 shows construction details. Polystyrene, bakelite or similar plastic may be used for the barrel and end plugs. A ¾-inch length of ½-inch plastic rod is drilled for a snug fit of the shielded cable and cemented flush in one end of a 4-inch length of ⅝-inch od tubing. A 7/16-inch length of ½-inch rod is drilled to clear a 6-32 machine screw. It will be easier if the rod is drilled before it is cut to size. This piece is held in the probe with two small self-tapping sheet-metal screws. The holes for these should be drilled at this time. The tip is made of steel wire. A medium-sized paper clip seems ideal; the wire is stiff and solders easily. The exact dimensions of the tip are not critical. The hooked portion is extremely useful when the probe is to be left connected to a circuit under test for any length of time. The slot in the 6-32 screw must be cleaned out with a hacksaw to assure easy soldering, and the wire tips soldered to the screw before placing in the plastic end.

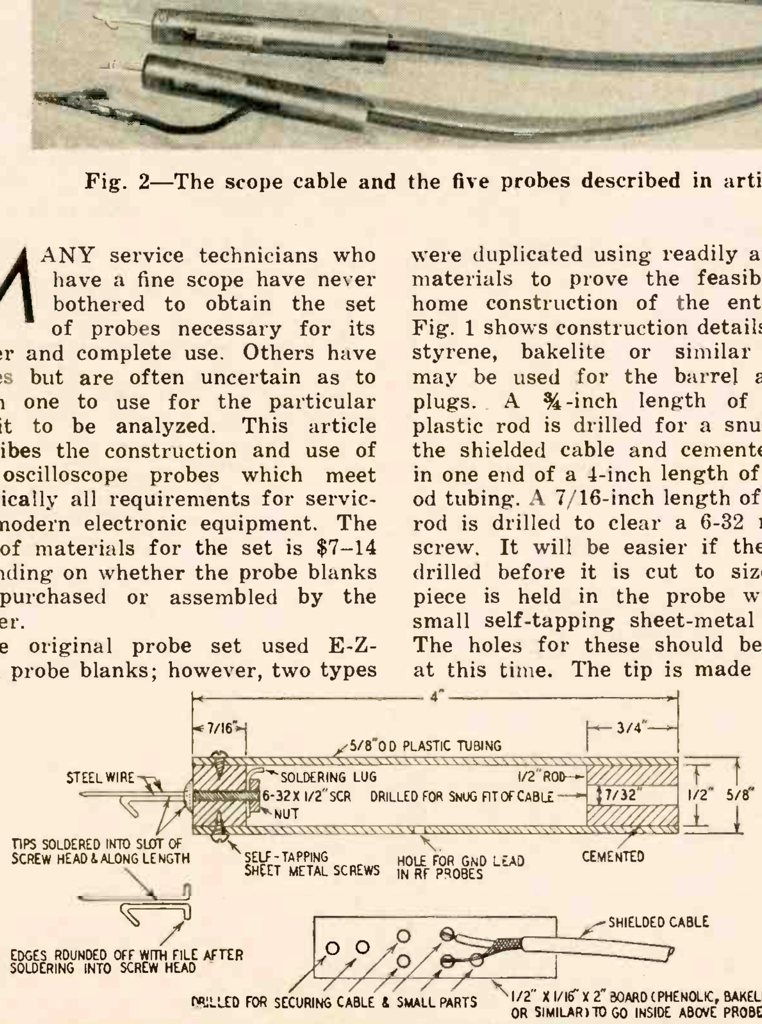

Fig. 1—Construction details for building the probe blank.

Components and the shielded cable are fastened to a 1/16 inch thick, ½ inch wide strip of phenolic insulating board, Bakelite or other material that would resist the soldering heat. A length of about 2 inches would do. A shorter strip can be used in the probes which have fewer internal parts. Holes are drilled in the strip at convenient spots to facilitate parts mounting. The shielded cable should extend as far toward the front of this probe as possible and still leave space for other parts. This minimizes the amount of unshielded wiring.

For convenience one cable is used for all five probes. The cable consists of a 3½-foot length of RG-62/U coaxial line. RG-62/U has a partial air dielectric which helps to reduce the capacitance to 13.5 $\mu\mu f$ per foot. Other types of shielded wire or cable may have sev-

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eral times this capacitance and therefore should not be used. In addition, this cable is very flexible and easily worked.

One end of the cable is connected to the scope vertical input terminals directly or with a shielded plug suitable for the scope to be used (Fig. 2, at head of article). The other end is soldered and taped to a female cable ...

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6-57

scope gain is seldom necessary and because of scope input and cable capacitance, high-impedance circuits are loaded down and high-frequency components are attenuated, giving a distorted presentation. The use of this probe should be limited to low-level audio, checking ripple in plate supply voltages, auto radio vibrators and similar low-level or low-impedance circuits. Peak-to-peak ac currents can be observed by connecting the scope across a low-value resistance (1 ohm) with this resistance placed in series with the circuit to be checked. An example would be where the resistor is placed in series with the low side of a yoke coil and the linear sawtooth current of a properly operating deflection circuit can be observed on the scope. Capacitance loading with this type of probe will be from 55 to 125 $\mu\mu f$, depending on scope input capacitance.

Alignment isolation probe

This probe (Fig. 4) has one important use—connection to the video detector load circuit for alignment and if response curve observation. Resistor R has a multiple purpose. First, it serves as an rf filter to prevent the intermediate frequency which may pass

...le direct probe.

...nt isolation probe.

...or from reaching ... radiated or fed ...urve distortion or ... R and the cable ...ope input capaci- ... network which ... frequencies above ...s has the effect of ...ers on the response ... response curve in- ...ow-frequency com- ...is not altered by ..., because of the ...ction, 15,750-cycle ...nized.

... may wonder about ... probes. Shielding ..., weight and input ...obe and has proven unnecessary in TV signal tracing. The unshielded leads and parts within the probe are only about 2 inches long and no unwanted signals have been picked up. However, the free-floating probe tip will pick up horizontal pulses and

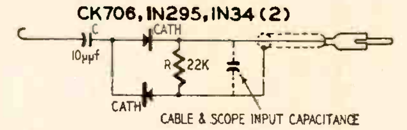


Fig. 6—The high-frequency probe.

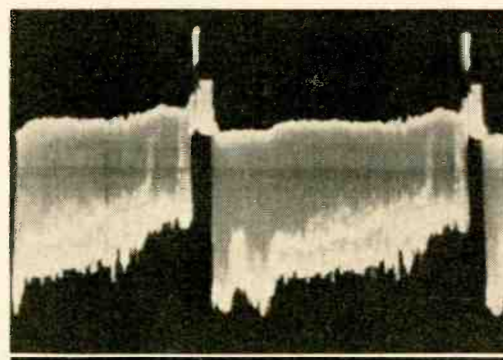
Materials for probe set

Fig. 4
R—100,000 ohms

Fig. 6
R—22,000 ohms
C—10 $\mu\mu f$
D—CK706, IN295, IN34 crystal diodes or equivalent, see text

Miscellaneous (Cable and hardware listed below includes that needed for Part 2)

3½-ft RG-62U coaxial cable
4-ft microphone cable, Beldon 8401 or equivalent
1-ft test lead wire
5 male phono plugs
Cable type female phono connector
Shielded connector to fit vertical input terminal on scope
2 alligator clips
5 probe blanks, EZ-Hook or similar type, or if it is desired to construct the probe blanks:
- 2 12-inch lengths ⅝-inch outside diam, ½-inch inside diam polystyrene tubing
- 12-inch length ½-inch polystyrene rod
- piece phenolic board, 1/16 x ½ x 12 inches
- 5 brass ½-inch oval-head machine screws, 6-32, nuts and lugs
- 5 paper clips
- 10 self-tapping sheet-metal screws, 3/16-inch



...deo distor- ...e when de- ...robe of in- ...nd width is ...nal tracing ... of TV re- ...er.

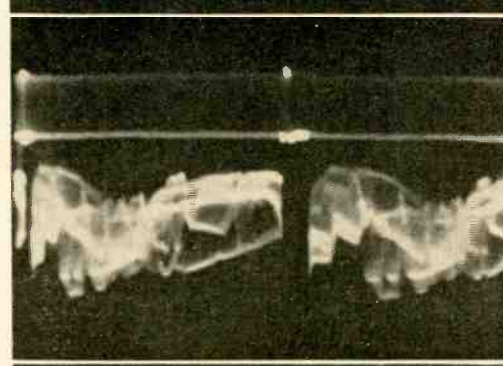


Fig. 7—Video signal as seen with high-frequency detector probe at second if stage.

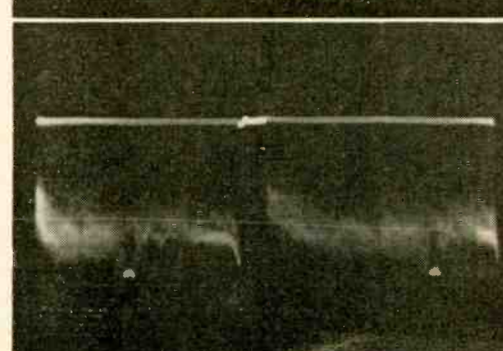


Fig. 8—Video signal with severe sync pulse clipping. High-frequency detector probe on plate of third video if stage.

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a little hum but this disappears when the probe contacts the circuit under test. There would be very little sense in shielding the probe tip if the circuit under test was relatively unshielded and free to pick up stray signals. Most video amplifier, if and sync circuits are not extremely high impedance and therefore do not generally pick up unwanted signals. If unwanted signals are present in any circuit, they were there before the probe was connected.

High-frequency detector probe

The term high frequency applies to the modulated signal or audio output and not to the rf to be demodulated. This probe is designed primarily for signal tracing and analysis in the video if section of TV sets. An attempt to signal trace in an if strip with a conventional detector or demodulator probe presents a picture similar to that of Fig. 5, with the horizontal portion of the signal apparently depressed and irregular. It is difficult to determine from this presentation whether hum or sync distortion is present. The conventional probe is not designed to pass the demodulated video signal without this distortion; it is designed primarly for alignment and general signal tracing, as is the low-frequency detector probe to be described later.

The high-frequency detector probe (Fig. 6) is a voltage-doubler type, designed to give maximum output with adequate bandwidth. C is low in capacitance to reduce loading on the circuit under test. The value of R is a compromise between output amplitude and output bandwidth (modulated-signal frequency response). The output bandwidth with the component values shown in Fig. 6 is dc to approximately 100 kc, adequate to display the horizontal sync pulses at the correct amplitude. The crystals used (1N295, CK706 or 1N34) must be small enough to fit in the probe assembly; those used in the original model are about the size of a ½-watt resistor. Any crystals having similar size and electrical characteristics may be used. Somewhat larger types may be used if homemade probes are used. Electrical characteristics are not critical, those with a higher inverse voltage rating being preferable.

Fig. 7 shows how the video signal appears when the high-frequency probe is used to check the signal in the 21- or 41-mc video if section of present TV receivers. Note how easily hum modulation or sync clipping (Fig. 8) could be seen if it were present. In good signal areas it is possible to get a usable signal right off the output of the tuner or the grid of the first if tube. It may be necessary to short out the tuner agc voltage to get additional signal at this point.

The probe can be connected to grids and plates progressively down the if strip to check stage-by-stage gain and signal quality. Checks in this manner are normally made with the scope horizontal sweep at 30 cycles, synchronized to the line frequency. This allows hum modulation and vertical sync troubles to be more easily identified. If the scope sweep is changed to 7,875 cycles to observe the individual sync pulses, you will note that the front and back porches are not visible and the pulse tips somewhat pointed or rounded off. The exact shape of the horizontal sync pulses could be seen more closely by decreasing the value of R. This is not recommended, however, as it would increase the loading of the circuit under test and decrease the output amplitude of the probe. It is actually not necessary since we are concerned more with the relative amplitude of the pulses, not their exact shape.

This probe has excellent 60-cycle ac rejection and therefore can be used to check for rf interference on filament and other power supply leads. If rf were present in these circuits, the modulation component would show up on the scope.

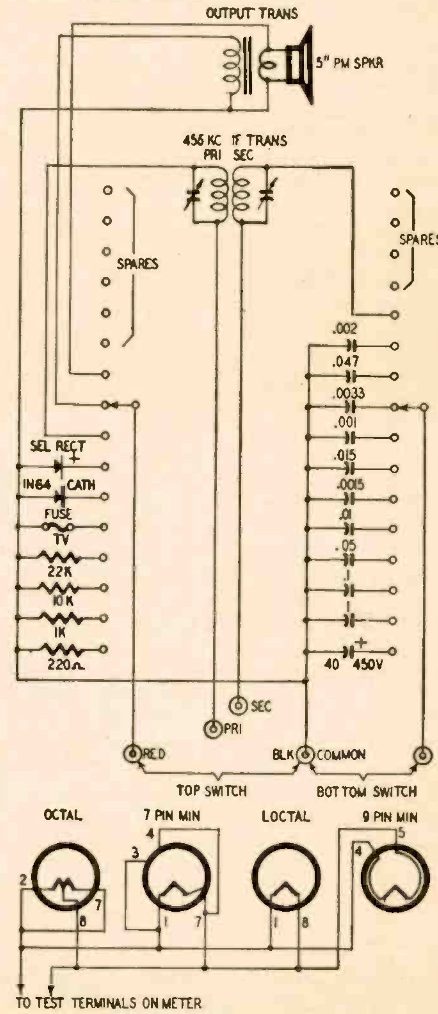
Another important use for this probe is signal tracing in the chrominance section of color receivers ahead of the synchronous demodulators. The color burst signal shows up as a pulse similar to horizontal sync pulses, with other demodulated subcarrier information interspersed. To observe this the scope should be swept at 7,867 cycles, synchronized by lightly coupling the external sync lead of the scope to the "hot" lead of the horizontal yoke coil.

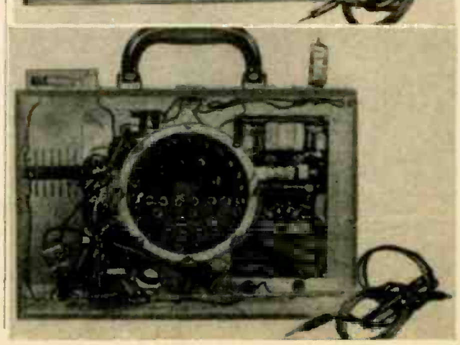
To check for hum on the chroma signal the scope sweep is 30 cycles. Therefore with the aid of this probe the scope need not be a wide-band model to signal-trace in the chroma section of a modern color set. However if a wide-band scope (response to 4 mc) is used, it is far more desirable to use the low-capacitance probe (to be described later) for signal checking in the chroma circuits. Use caution in high-level demodulation circuits where the chroma voltages may exceed the ratings of the crystals in the probe. As a rule, do not go beyond the grid of the demodulator driver with this type of probe, unless the coupling to the probe tip is reduced by adding a 2-$\mu\mu$f capacitor in series with the probe tip and the circuit under test.

The high-frequency probe is not satisfactory for signal tracing in radios because of the relatively low if (455 kc). Much of this signal would be passed by this probe rather than demodulated, thus distorting the output or causing regeneration. The probe should not be used on rf above the video if range (46 mc) because the probe cable could become resonant, producing erratic indications. Because the upper-frequency limit of this probe is 46 mc, it is not necessary to use a short ground lead. However, if the builder prefers to include a separate short ground lead, it could certainly do no harm. This probe may be labeled a video rf probe, which would be more descriptive of its actual use. TO BE CONTINUED

HANDY TESTER

Here is a versatile instrument for testing radio and TV sets. It is a substitution box containing components likely to give trouble. A multimeter is used for voltage, resistance and continuity checks. Four tube sockets provide rapid heater continuity tests.—*Alvin J. Showers.*





Synchronized Color Subcarrier Signal Generator

Instrument produces 3.58-mc signal synchronized with horizontal and vertical sweep frequencies

By EDWARD K. NOVAK

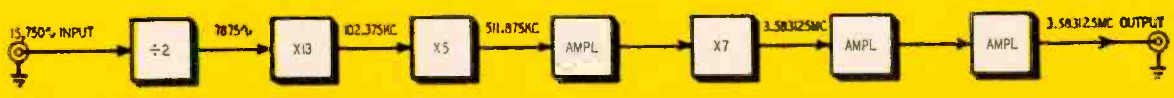


Fig. 1—Frequency multiplication from horizontal to subcarrier frequencies.

IN color television signal-generating equipment, the usual method of obtaining the 3.58-mc color subcarrier is to use a crystal oscillator operating at the color subcarrier frequency. Since this signal must be exactly synchronized with the horizontal and vertical scanning frequencies, frequency dividers and automatic frequency control circuits are used to divide down the output of the crystal oscillator for use as synchronizing signals for the scanning signal generators.

In some applications requiring a color subcarrier synchronized with the horizontal and vertical scanning signals, a perfectly satisfactory method of obtaining this result without the cost and complexity of crystal oscillators, frequency dividers and afc circuits is one using the reverse process: multiplying up from the usually already available and stable horizontal scanning frequency signal to the color subcarrier frequency. The signal generator to be described here produces a 10-volt output signal at 3.58 mc, synchronized with the 15,750-cycle horizontal scanning signal, using only eight tubes, conventional components and simple circuitry.

The color subcarrier must be an odd multiple of half the line scanning frequency, or, as specified by the NTSC, 455/2 times the line scanning frequency. The horizontal sync signal usually available, whether from a standard sync signal generator or an off-the-air sync signal via a television receiver, is nominally 15,750 cycles. Thus, to obtain the 455/2 multiple of 15,750, this equipment first divides by 2, then multiplies successively by 13, 5 and 7 ($15,750 \div 2 \times 13 \times 5 \times 7 = 15,750 \times 455/2 = 3,583,125$). The multiplying factors given (Fig. 1) are the only possible submultiples of 455. The order in which the factors are multiplied is not necessarily the only one that will produce the same result. However, it permits standard, readily avail-

Parts for subcarrier signal generator

Resistors: 2—47, 2—68, 3—100, 1—1,000, 3—4,700, 1—18,000, 1—22,000, 3—33,000, 2—47,000, 3—100,000, 2—220,000, 2—330,000, 2—470,000 ohms, 3—1 megohm, ½ watt.

Capacitors: 2—10, 2—50, 3—100, 1—150, 1—200, 5—500, 2—700 μμf; 9—.001, 1—.005, 2—.01, 1—0.1 μf; 2—5-50 μμf, trimmer.

Miscellaneous: 1—12AU7, 3—6AU6, 4—6AG7, tubes; 1—9-pin miniature, 3—7-pin miniature, 4—octal, sockets; 1—shield for V4; 2—jacks (input and output); 1—length of 75-ohm coax; 1—chassis.

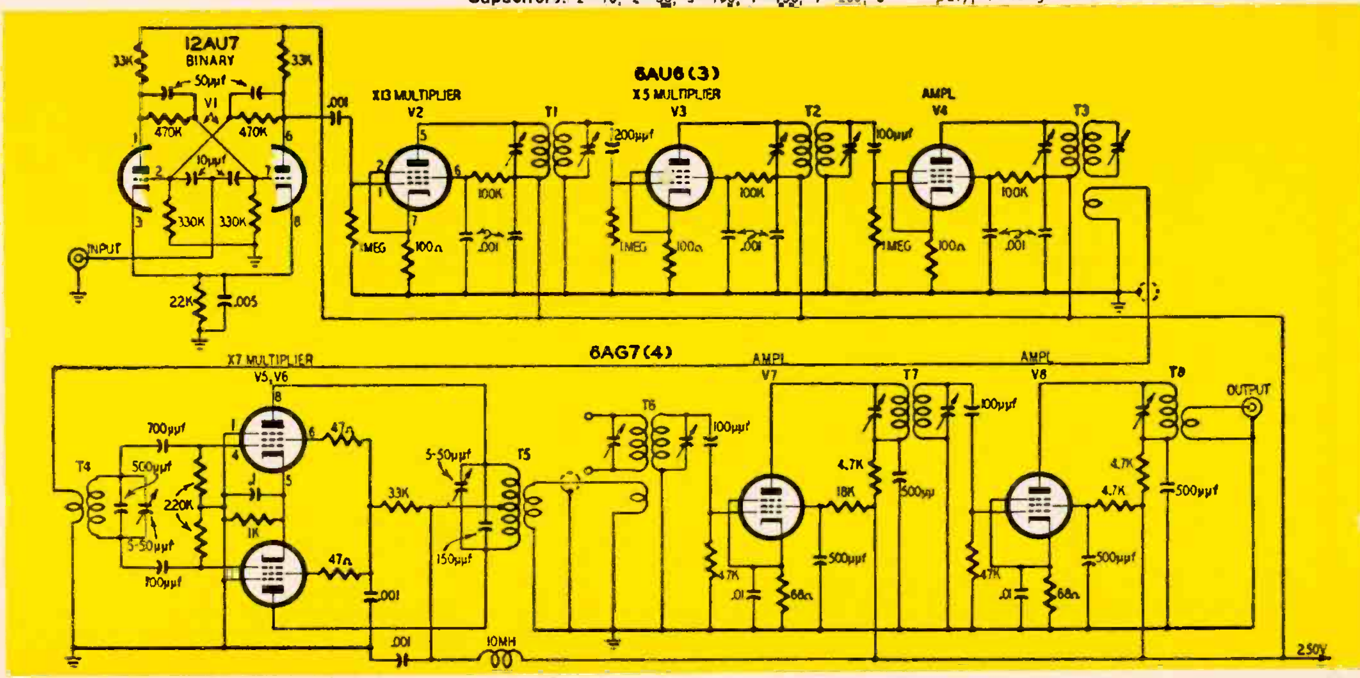


Fig. 2—Schematic diagram of the synchronized color subcarrier signal generator. Transformer data given in table.

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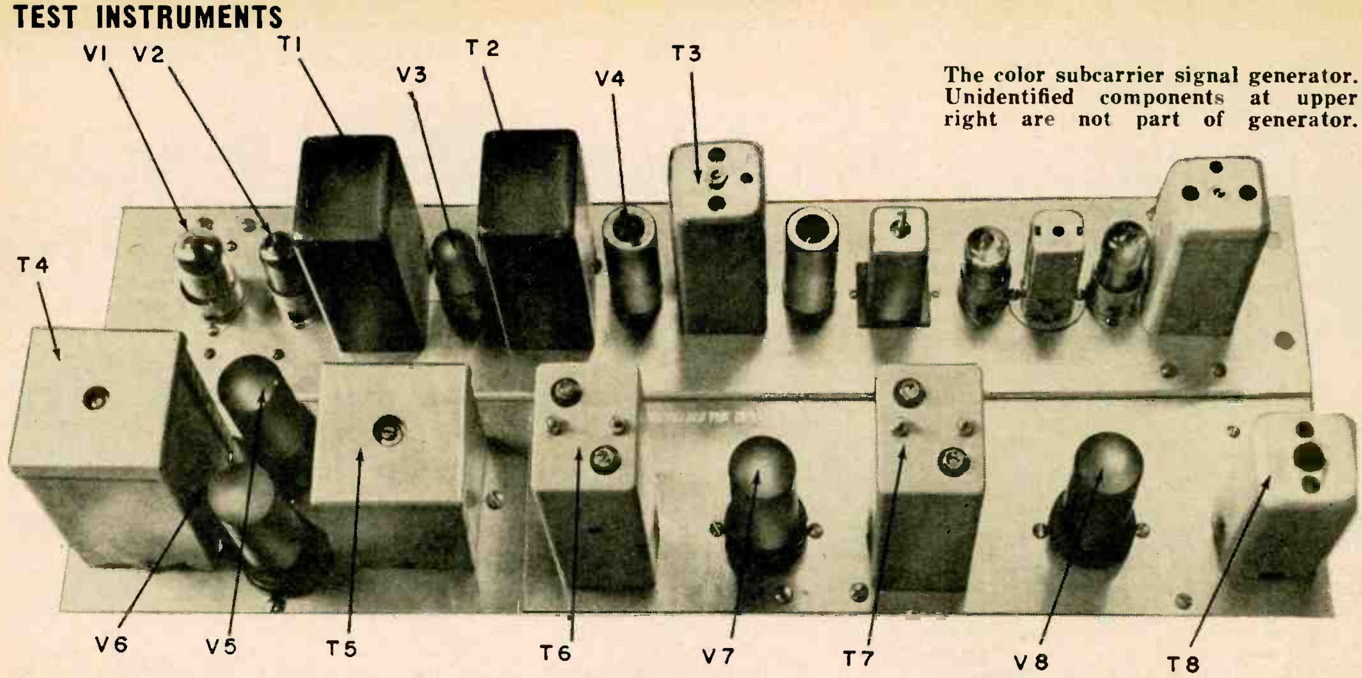

The color subcarrier signal generator. Unidentified components at upper right are not part of generator.

able rf transformers to be used with only slight modifications.

Circuit description

The input stage of the unit (Fig. 2) consists of a conventional binary scaler. The horizontal sync or blanking signal is brought into the unit through a coaxial cable and its amplitude should be 50 to 100 volts peak to peak. The square-shaped input pulses are differentiated by the short-time-constant grid circuit resulting in positive and negative pulses at the leading and trailing edges, respectively, of the input signal. Since this scaler will switch only on negative input pulses, and two negative pulses are required for one complete cycle of operation, the output frequency of the binary is one-half the input frequency. The output of the divider is 120–150 volts peak at 7,875 cycles.

Since the output of the binary is a large-amplitude square wave and consequently rich in odd harmonics, no difficulties are experienced in operating the first multiplier at the 13th harmonic of the input frequency. The output of this stage is 15 volts peak to peak at 102.375 kc. T1 is a standard receiver type 455-kc if input transformer, padded down to the proper frequency with mica capacitors.

The output of the ×13 multiplier (V2 stage) is applied directly to the input of the ×5 stage (V3). Since this multiplier operates with a waveform almost sine wave in shape, therefore low in harmonic content, the efficiency is low; however, sufficient harmonic signal output is available to drive the succeeding amplifier stage. Transformers T2 and T3 are standard 455-kc if units. T2 is changed only in trimmer adjustment; T3 is modified slightly by adding a simple five-turn link coupling winding. The original secondary on T3 is not used.

The 511.875-kc output of the ×5 multiplier is coupled through an amplifier and a short length of 75-ohm coaxial cable to the push-pull ×7 (V5, V6) multiplier. Push-pull and link-coupled operation reduces the tendency of the circuit to pass other harmonics of the driving signal frequency. The output of this stage is about 35 volts peak to peak at 3.583,125 mc. T4 and T5 are simple single-layer-wound rf transformers. Winding data are given in the table.

To clean up the waveform and provide a low-impedance output of sufficient amplitude, two stages of rf amplification follow the last multiplier stage. The output of the unit is a 7–10-volt sine wave into a 75-ohm coaxial cable at 3.583125 mc. Transformers T6 and T7 are padded-down 5-mc rf units obtained from war-surplus equipment. However, standard 4.5-mc television if transformers were also tried and found satisfactory. A discarded 455-kc if shielded can and coil form were used to construct output transformer T8.

TRANSFORMER DATA

T-1	Receiving type (455-kc if) padded down to 102 kc.
T2	Same as T1—tuned to 511 kc.
T3	Same as T2—5-turn link added.*
T4	1-inch diameter form: primary, 1 layer No. 28 enameled wire closewound—4 turns**; secondary, 144 turns. Secondary inductance, 200 μh.
T5	1-inch diameter form: primary, 1 layer No. 28 enameled wire closewound—72 turns center-tapped; secondary, 4 turns.** Primary inductance, 100 μh.
T6	4.5-mc TV type transformer tuned to 3.58 mc. Add 5-turn link.*
T7	Same as T6 but no link.
T8	1/2-inch diameter form: primary, 1 layer No. 28 enameled wire closewound—90 turns; secondary, 26 turns.** Primary inductance, 36 μh.

* Link winding spaced 1/2 inch from main winding.

** Link winding spaced 1/8 inch from main winding.

All link windings wound on same core as main winding.

Circuit adjustment

To adjust the unit apply power and driving signal and connect a low-capacitance oscilloscope probe to the grid of V2. A 7,875-cycle square wave with a slight indication of the 15,750-cycle fundamental component riding the square wave will be seen. With the probe on the plate of V2 a sine wave having a low- and a higher-frequency component should be seen if transformer T1 is tuned approximately to 102 kc. Adjust this waveform with the primary circuit trimmer on T1 so that exactly 13 cycles of the high-frequency component fall within 1 cycle of the lower frequency.

Similarly, with the oscilloscope probe connected to the plate of V3, tune the next stage by adjusting T2 so that 5 cycles fall within 1 cycle of the lower-frequency component that appears at that point. With the probe on the grid of V5 or V6, readjust the primaries and secondaries of T1, T2, T3 and T4 for maximum signal. Then adjust the output of the 3.58-mc multiplier in the same manner as the previous multipliers. Tune the final two stages for maximum output.

Due to the cascade operation of rf amplifiers at the same frequency in the last two stages there may be some tendency to oscillate. This condition can be minimized by taking the usual precautions necessary for good rf design and layout.

The final check consists of looking at the oscilloscope presentation of both the input and output on the same trace, using a simple resistive adding circuit. If the unit is properly locked in, the two signals will remain stationary with respect to each other when the oscilloscope is adjusted to sweep at half the value of the horizontal frequency. END

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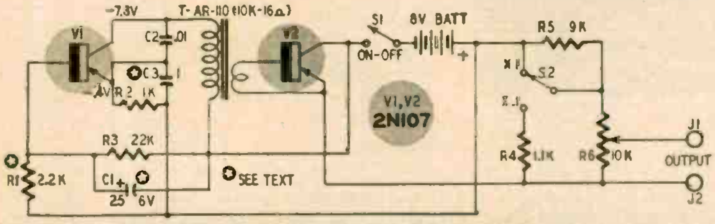
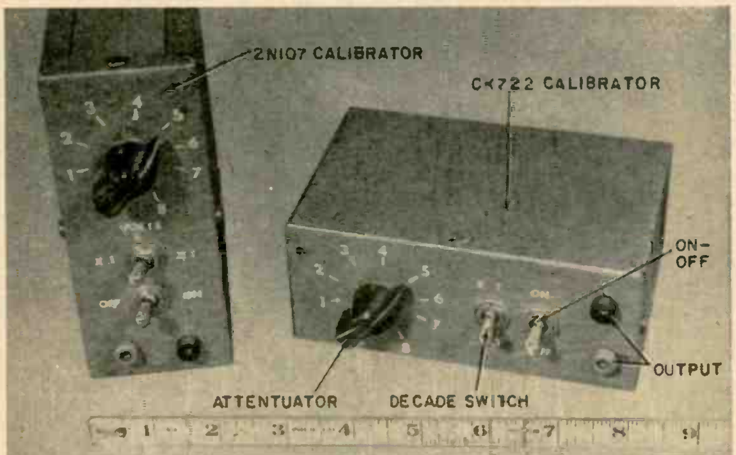
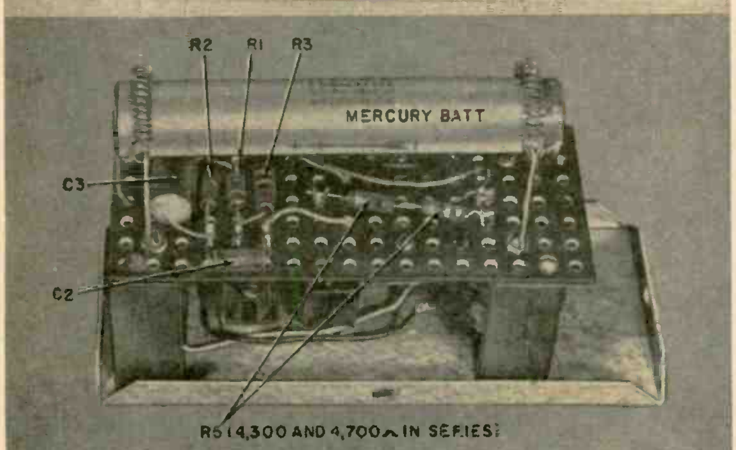
Transistorized Oscilloscope Calibrator

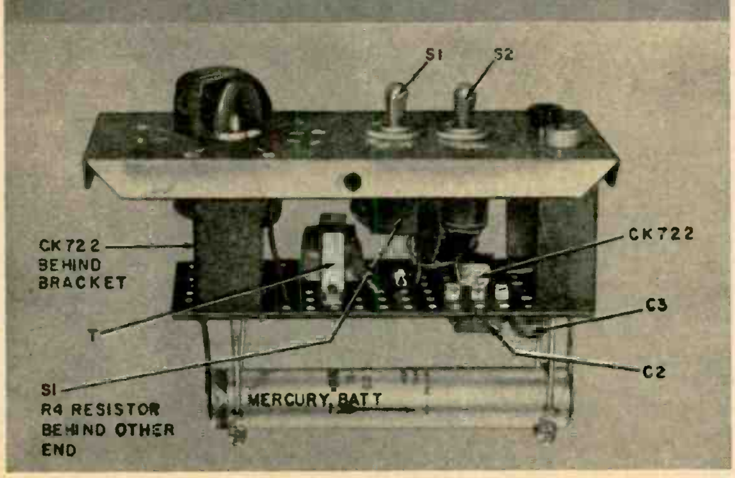


By EDWIN BOHR

Fig. 1—Oscilloscope calibrator circuit.







Top — The two units mentioned in the article; middle and bottom — internal construction of the calibrator.

THIS transistorized calibrator supplies a square wave of definite amplitude, making your oscilloscope a wide-range electronic voltmeter for measuring amplifier gain, small ac voltages, plus TV and other complex waveforms. The calibrator is exceedingly accurate, very rugged and miniature in size.

Parts list for schematic at left

C1—25-µf 6-volt electrolytic (Barco P6-25)	T—10,000 to 16 ohms (Argonne AR-110)
C2—.01 µf, 200 volts	V1, 2—2N107
C3—1.0 µf, 200 volts	J1, 2—pin jacks
R1—2,200 ohms	BATT—8-volt mercury (Mallory TR136R)
R2—1,000 ohms	Case—ICA 3797
R3—22,000 ohms	Knob
R4—1,100 ohms, 5%	Terminal board
R5—9,000 ohms, 5%, or 4,700- and 4,300-ohms 5% in series	Decals
R6—pot, 10,000 ohms (Ohmite CU-1031)	Miscellaneous hardware
All resistors ½ watt	To build using CK722 transistors substitute:
S1—Spst toggle	R1—3,300 ohms
S2—Spdt toggle	C1—omit
	C3—0.25 µf, 200 volts

Vacuum tubes are at a disadvantage in many instruments. It is here that they will be most rapidly displaced by transistors. We see this happening in portable receivers and automobile radios. Our prediction is test equipment will be next.

Our calibrator is a case in point. It is far more accurate than a vacuum-tube unit, weighs less, costs less, is miniature in size and does not have a dangling power cord. If necessary, just pick it up and toss it in your tool kit; it is self-powered and rugged.

You're worried about battery life? Why? The one battery in this calibrator should last about 2 years with normal use.

Circuit details

The circuit (Fig. 1) is split into two distinct functions. One transistor generates a 1,000-cycle sine wave. The other, driven by the oscillator, behaves like a high-speed on–off switch, interrupting a highly accurate voltage standard. This action produces extremely accurate square waves.

Actually, the waves are not exactly square, but this does not detract from the calibrator's usefulness. Fig. 2 shows a typical waveshape from the calibra-

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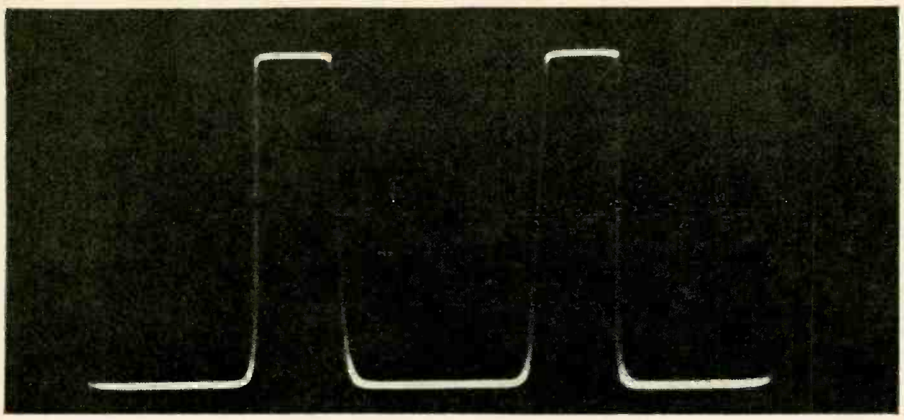

Fig. 2—Calibrator's square wave output.

tor, using type 2N107 transistors.

The oscillator is stabilized against temperature effects and inherently adjusts to sine-wave output. For these reasons frequency stability is good. You can expect the frequency to drift no more than 2% under ambient conditions. For the component values given, the frequency will be approximately 1,000 cycles. The exact frequency can be adjusted by changing the value of the .01-μf capacitor (C2).

Many transistor circuits are plagued by transistor leakage currents. This calibrator has built-in immunity to these effects. This trouble usually stems from poor circuit design that places large resistances in the base-to-emitter return path. The only resistance between the base and emitter of the switch transistor is the transformer winding resistance. This resistance is only 2.5 ohms. Consequently, the quiescent drop across the 10,000-ohm potentiometer is not more than a few millivolts.

The overall accuracy of the calibrating square wave is very good—at least the equal of any of the commercial or kit-built calibrators—with a full-scale accuracy of 2%.

The low output impedance of the calibrator is another advantage. More load can be placed across its output without affecting the accuracy of the square-wave amplitude.

Design considerations

Even though careful consideration is given to circuit design, troubles sometimes arise when transistor devices are built in quantity. This is doubly true for circuits using dollar-variety transistors.

To show what can happen, we built two of these calibrators. One used G-E 2N107 transistors and the other used Raytheon CK722's. Otherwise, there were no differences in the proposed components.

Fig. 1 is the circuit using 2N107's. When using CK722's, change R1 to 3,300 ohms, omit C1 and reduce C3 to 0.25 μf. It is essentially immune to changes in transistor parameters. When CK722's were used with all components exactly as in Fig. 1, there was improvement in performance. The 2N107 calibrator gives a better square wave than the CK722 unit. This is a minor point since it does not affect the accuracy of either calibrator.

The modifications to the 2N107 calibrator essentially increased the feedback of the oscillator. The added bypass capacitor (C1) decreased losses in the base circuit. Increasing emitter capacitor C3 to 1 μf provided a more favorable impedance match.

Building two of these calibrators, using different transistors, provided an interesting look into any difficulty that others might experience with the circuit.

Construction

The calibrator is built in an ICA 3797 switch case which features welded steel construction and a removable front panel. Because of the great rigidity of its design, the case is ideally suited for miniature portable test equipment that must undergo a rough-and-tumble existence.

The two calibrators were given somewhat different panel treatments–see the photographs. The panel of the CK722 was decaled horizontally and the 2N107 calibrator vertically.

Some explanation of the decade-switch resistors is necessary. The specified values are 9,000 and 1,100 ohms. These are not standard values. To make the 9,000-ohm resistor, connect a 4,300-ohm and 4,700-ohm resistor in series. Both should have a 5% tolerance. The mathematically correct value of 1,100 ohms is shown on the diagram, but a standard 1,100-ohm 5% resistor is suitable.

A high-grade 10,000-ohm potentiometer, an Ohmite CU 1031, is used for the attenuator. This potentiometer, made for industrial and laboratory use, has fairly tight tolerances for both total resistance and linearity. However, it costs more than twice as much as a replacement control. A radio-replacement control, because of its looser tolerance, may require some changes in the decade resistor values. This will be pointed out in the calibration section.

In short, use the best 10,000-ohm *linear* potentiometer available. The Ohmite CU 1031 is preferred, a wire-wound control is second and an ordinary linear control last.

For reference, several voltage points are indicated on the diagram. These measurements are from the positive side of the battery to the appropriate test point. The readings are dc and should be taken with a 20,000-ohms-per-volt meter.

Calibration

Because this device is inherently self-calibrating, this procedure could not be much easier. With the decade switch in the × 1 position, rotate the attenuator to its extreme clockwise position. The output is then exactly 8 volts peak to peak. Connect the calibrator to the vertical deflection terminals of an oscilloscope and set the scope gain for 8 divisions of deflection. This represents 8 volts. Now rotate the attenuator until the deflection is only 7 divisions, then 6 divisions, etc., marking these divisions on the attenuator dial.

At zero and maximum rotation, there are a few degrees where the moving contact is completely shorted to either end of the potentiometer. This makes the dial look non linear between 0 and 1, and between 7 and 8. Actually, it is not. We placed our 0 and 8 decals at the absolute extremes of rotation, so the knob could be taken off and replaced without disturbing its calibration.

Now, check the calibration of the decade switch. It reduces the output by a factor of 10. To do this, again set the attenuator to maximum output, but this time, adjust the scope for 10 divisions of deflection. Now flip the decade switch to × 0.1 and the deflection should decrease to 1 division.

If it does not decrease the output by exactly 10, shunt the 1,000-ohm resistor to *decrease* the output or shunt the 9,000-ohm resistor to *increase* the output. Shunts, 10 times larger than the resistors they are placed across, will produce, approximately, a 10% change. Shunting the 9,000-ohm resistor with 100,000 ohms, for example, would increase the output a little less than 1 division in 10. A 200,000-ohm resistor produces only half as much change.

Leads to the mercury battery are soldered in place. To do this, first scrape each end of the battery and *quickly* tin each area with solder. *Do not use too much heat.* Then solder pretinned leads to the battery. Observe the correct polarity. It is indicated on the battery jacket.

The calibrator is now ready for operation. Use it in the usual manner for calibrating your oscilloscope screen. It is also very useful for feeding accurate signals into audio amplifiers and audio preamps for determining gain and overload levels. It is useful wherever a fixed-frequency audio generator is necessary. END

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Putting a tuning indicator on an intercarrier TV set poses difficult problems. This ingenious solution will be useful to set owner and technician

A TV TUNING INDICATOR

By W. E. LIDDELL*

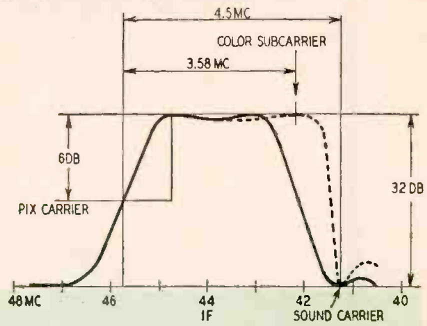

Fig. 1—Typical if responses for monochrome and color TV receivers.

TELEVISION receivers commonly have two tuning controls. The coarse or channel selector and the fine-tuning adjustment which covers a predetermined portion of the selected channel. With the fine-tuning control correctly adjusted, you have the best picture and sound.

Many people ignore the fine tuning and are satisfied with a picture of poor quality although their receivers are capable of better performance.

We felt that some reference or guide point should be provided to help the viewer in adjusting the fine tuning. This device would have to be positive, inexpensive and easily maintained. This article describes such a device and discusses the problems of designing it.

Television receivers are classified as intercarrier or separate-sound receivers. Each type presents completely different tuning problems which must be considered individually. In a separate sound receiver the sound is separated from the picture at a point between the mixer stage and video detector and both are amplified independently. From this point the audio is handled as in conventional FM receivers.

As the sound if is never more than 200 kc wide, the viewer must tune for the best sound and accept the accompanying picture. A tuning reference device for this type of receiver can be a discriminator null indicator, or — if there is a separate audio agc voltage — an electron-ray type tuning indicator can be employed. However, the separate-sound receiver has several major disadvantages which cause continuous tuning readjustment. With a narrow sound carrier the presence or absence of sound is an excellent tuning reference.

*Canadian Radio Manufacturing Corp., Toronto (a paper read at the IRE Canadian Convention, Toronto, October, 1956).

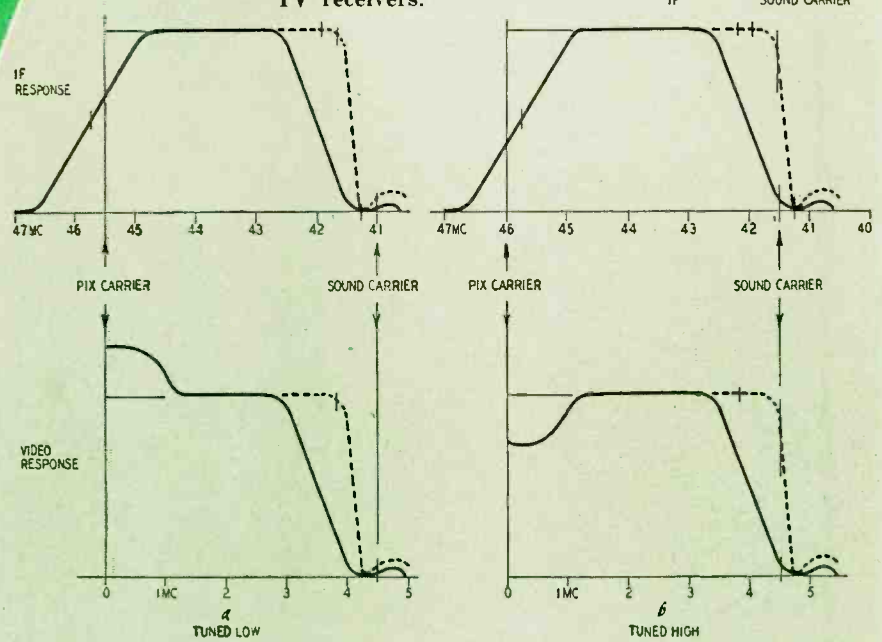

Fig. 2—Effects of mistuning on typical if curves, and resulting video response.

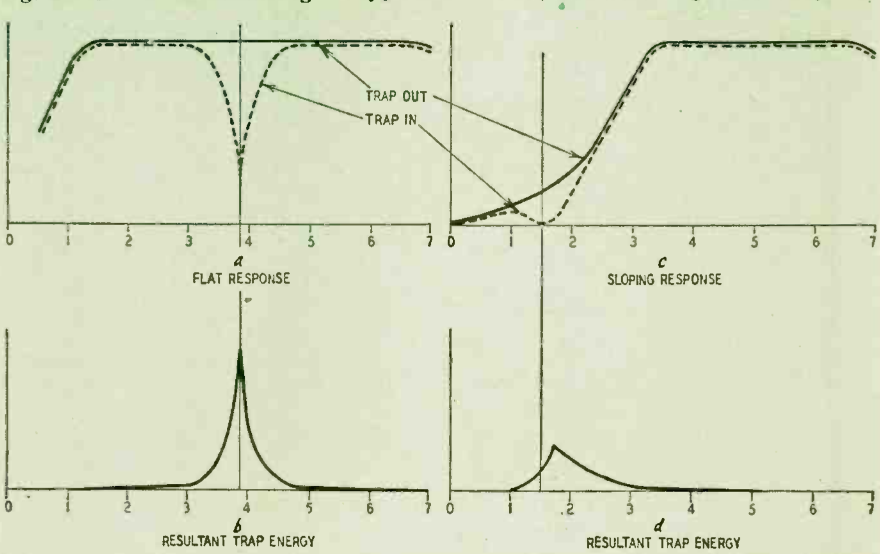

Fig. 3—Typical trap energy contents recovered from flat and sloping response.

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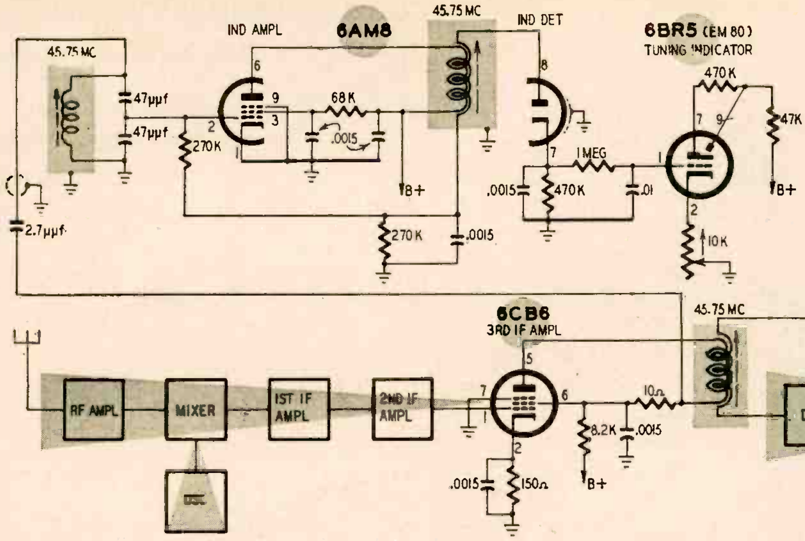

Fig. 4—Schematic of tuning indicator for intercarrier TV receiver.

In an intercarrier system the sound carrier is amplified with the picture carrier in the same if amplifier. At the video second detector the two carriers are heterodyned, producing a new carrier equal to their difference and containing the FM sound information which is picked off and detected. As both picture and sound carriers are accurately spaced by 4.5 mc at the transmitter, the beat frequency will always be constant and independent of the fine-tuning control. With this system the viewer may tune for the best picture and still have good sound in spite of any receiver alignment inaccuracies or temperature drift. The problem of proper tuning still remains, as in the intercarrier set both picture and sound responses are extremely broad, leaving no sharply defined references.

With a strong signal a point can be located where picture resolution is nearly optimum. Tune past this point and visible sound bars appear and picture "breakup" starts. This position is progressively more difficult to find as the received signal decreases in strength.

Fig. 1 shows a representative if response curve for good-definition black-and-white reception, with the dotted curve indicating the additional response necessary to accommodate the narrow 3.58-mc subcarrier in a color receiver.

With the receiver correctly tuned, both picture and sound carriers will locate themselves at their correct intermediate frequencies. A 26-db sound attenuation relative to the picture carrier is necessary for best intercarrier sound operation. The picture carrier has been purposely placed 6 db below the peak of the response as this corresponds with 100% modulation at all low video frequencies in a single-sideband system. Following detection, the upper sideband remnant may be added to the full lower sideband to make up a flat video response.

Consider what happens when a receiver is tuned so that carrier frequencies are lower than the correct ones, as seen in Fig. 2-a. The sound carrier has moved beyond the trap setting and, depending on the amount of mistuning, the sound quieting sensitivity becomes increasingly poor. At some intermediate point the sound frequency may rise on the trap re-entrant which will, if of sufficient amplitude, introduce visible 4.5-mc grain into the picture. Simultaneously the video carrier has increased in amplitude, causing overmodulation at the low-frequency or black levels with accompanying high-frequency or detail loss. In receivers with the sound takeoff point located in the plate circuit of the video amplifier, this additional signal in local areas could cause the stage to cut off on peaks, causing a sync buzz in the sound.

Fig. 2-b illustrates the effects of tuning too high in frequency. As the higher sideband remnant is attenuated, there is serious loss of low frequencies, resulting in smear and eventually loss of sync pulse information. The sound carrier has moved rapidly up the high-frequency side of the video response, introducing low-frequency sound bars in the picture due to slope detection of the FM carrier at the video second detector. Mistuning in this direction is more serious as picture quality deteriorates rapidly. In a color receiver correct demodulation of the double-sideband subcarrier as well as sound and picture carriers must be performed. The slightest attenuation or phase displacement of this carrier or its sidebands will have detrimental effects on picture hue.

A simple tuning indicator giving an accurate presentation would definitely be an asset to both of these intercarrier type receivers.

A conventional electron-ray indicator run by agc voltage is useless due to the single-sideband method of reception. The eye would respond to the maximum signal level, presenting a difficult problem in interpolating from the correct 6-db-down video carrier.

The 4.5-mc sound carrier, by virtue of constant heterodyning through use of the intercarrier system, is very broad and cannot be used.

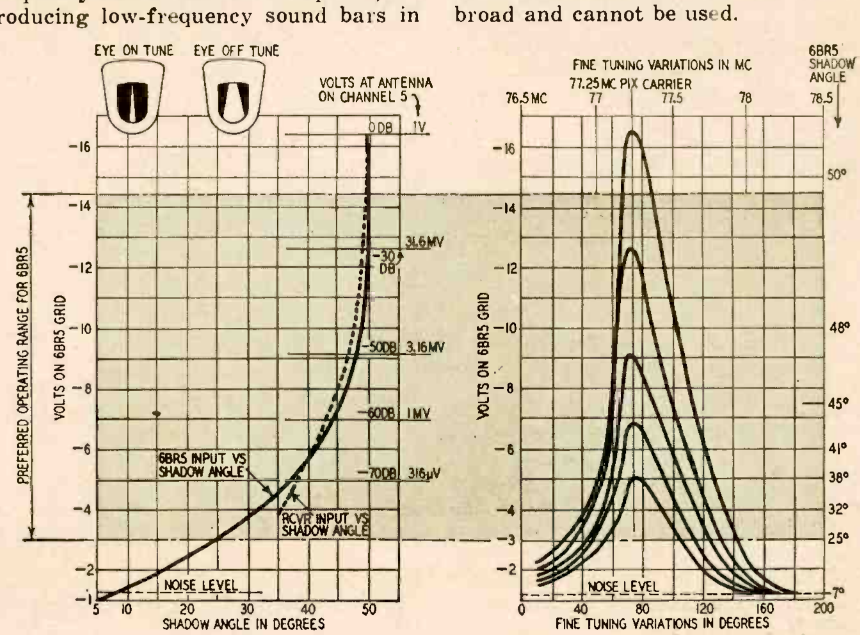

Fig. 5-a—Detector output configurations for antenna input signals; b—relative shadow-angle change.

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We find the TV signal to be composed of two carriers containing a maximum of energy in the proximity of each carrier. Sampling either of these through use of a resonant circuit established and locates the carrier position accurately.

Initial attempts to recover the energy absorbed by the sound trap, when tuned to or near the received carrier, produced an interesting problem. The resonant current peak, recovered from the trap, did not correspond with the null seen on the if response curve.

Fig. 3-a shows a typical flat response curve with and without an absorption trap acting upon it. Fig. 3-b shows the absorption or voltage difference between these two curves. Note that under this condition the peak of the recovered image corresponds with the bottom of the trapped hole.

In Figs. 3-c and 3-d a different effect is seen. Here we are trapping on a slope and, to produce the resultant curve shown by the dotted lines, we must absorb more energy from the higher side of the slope, resulting in high trap currents beyond the corresponding null point on the recovered curve. Attempts to reshape by amplifying the desired portion of this curve were discouraging because the predominantly asymmetrical curve sides made the tuning approaches broad on one side and sharp on the other. Further, the recovered signal is very small, requiring several stages of amplification.

By series coupling into the plate lead of the third if stage and tuning to the picture carrier, an acceptable circuit evolved (Fig. 4). The response curve is not as steep here and it becomes possible to produce a nearly symmetrical output curve through a correct choice of Q and coupling parameters in the plate transformer of the 6AM8 amplifier. The video carrier is not affected by this method of coupling if proper component placement and shielding are maintained.

The 6BR5 tuning indicator is used because of its large indicating area and high sensitivity. An input signal of 12 volts produces a shadow angle change of nearly 50°. In spite of excellent receiver agc control, some shadow angle variations exist under changing signal conditions. This can be compensated for by operating the 6BR5 above the knee. Shadow angle changes of less than 5° through a 60-db antenna signal change were possible. However, in production it was found desirable to compensate for the tube tolerances by placing a potentiometer in the cathode. In this case it was found necessary to operate below the knee and to add a sliding grid-bias loop to keep the on-tune shadow angle constant. If the indicator is used to show *relative* signal strength, this loop may be omitted. However, under weak signal conditions, the eye will open rather wide and its light may be distracting to the viewer.

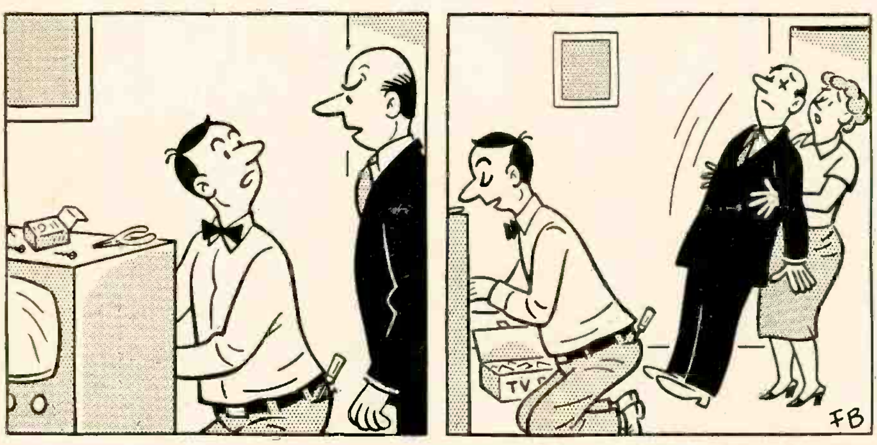
Fig. 5-b shows the detector output configurations for antenna input signals ranging from 300 μv to 1 volt peak to peak. Fig. 5-a shows the relatively small shadow angle change in comparison.

Aligning the indicator chassis is simple with no test equipment required. By observing a strong local station, for which the correct tuning position has been visually determined, the two coil adjustments may be tuned using the tuning indicator tube as a peak detector.

This indicator is an extremely sensitive device, capable of presenting accurate carrier references down to a level of minimum picture discernibility. Therefore, in extreme fringe areas, it may be desirable to detune to a point higher on the receiver's response curve for maximum contrast or sync stability.

A commercial use of this device can be seen in several Phillips black-and-white monochrome receivers. A typical set is shown in the photo.

We believe that the use of this tuning indicator will enable the average viewer to have the best sound and picture performance which his receiver can produce. END



Suggested by Garbis Kallayan, Alexandria, Egypt

"You've got a partial failure of the cathode-ray tube, a fused activated coil and a bad correction central mechanism."
"What does that mean?"
"Oh, about $50."

COVER FEATURE

Underwater Television Camera

A STAINLESS steel cylinder with a small window in one end—as shown on our cover this month—is lowered into a swimming pool. Inside the container is a new type of television camera, a special version of the Hancock Vicon IV developed by the HEC Corp., Redwood City, Calif. In a near-by house a group of electronics experts watch an underwater swimming demonstration photographed by the new camera via a closed-circuit TV system as a practical demonstration of underwater TV.

The extreme sensitivity of the camera is made possible by a high-gain preamplifier. For most applications no additional lighting is needed.

The complete unit weighs 95 pounds. Once underwater its weight drops to 12 pounds due to the buoyancy of the water. Connected to the viewing screen by a long flexible cable, the camera is easily maneuvered by a diver or can be lowered by a crane.

Remote controls permit selection of lenses, adjustment in *f* steps of the lens opening and focus control from the viewing site. An intercommunications system permits divers to keep in touch with control personnel.

One valuable application of the camera is in offshore oil drilling operations. The camera can also be towed underwater for a close look at trawls, nets and an inspection of canals. Dams, spillways, turbine blades, irrigation canals and ship hulls can also be checked.

A tape recording may be made of the televised picture for a permanent record for later reference. This makes possible underwater photography without film.

The equipment was developed by the HEC Corp., Redwood City, Calif., for the Department of the Interior, Fish and Wild Life Service, for underwater exploration of marine life, and the Navy's Bureau of Ships for hull inspection and salvage operations.

A 500-foot cable connects the camera to its associated controls and monitoring equipment. It can be easily removed from its watertight casing with only a screwdriver and a small wrench.

As the camera is compatible with American television standards it can be used for television broadcasting as well as closed-circuit systems. The camera signal may be transmitted over wire, cable or microwave. END

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TV Service CLINIC

conducted by

JERRY KASS

THE most conventional electronic circuit carried over from radio to television servicing is the low-voltage power supply. There have been changes in power supply circuitry in recent years but these changes, such as controlled warmup time heater strings and the widespread use of selenium rectifiers, are the result of general technical advances and would have occurred regardless of television. The low-voltage power supply feeds every circuit in a television receiver with the exception of those few using germanium or silicon diodes. Indirectly, even the high-voltage power supply is dependent upon the low-voltage supply for proper operation.

While heater circuitry varies considerably in TV set designs, the B-supply circuitry is fairly well stabilized with only a few types used in more than 95% of TV receivers in the last few years. The most common circuit, of course, is the ageless transformer type full-wave rectifier and pi filter. Fig. 1

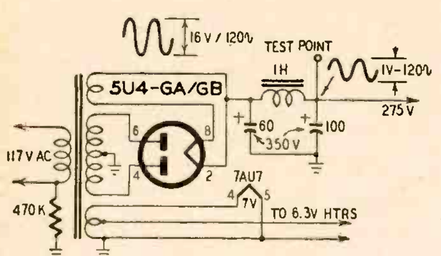

Fig. 1—Power supply of G-E *S* line TV receivers.

shows this arrangement used in the 1956 *S* line of G-E receivers. The manufacturer specifies a 120-cycle hum voltage of 16 at the filament of the 5U4. However, voltages of up to 20 can be expected. Of far greater importance is the hum voltage at the power supply test point. Here it should read about 1 volt, with readings above a few volts seriously affecting receiver performance.

To reduce the weight, size and cost of television receivers, the most commonly used low-voltage power supply consists of a voltage-doubler circuit using two selenium rectifiers with conventional filtering. Fig. 2 shows such a circuit used in the Crosley chassis 483 and 484. This circuit compares favorably with that of Fig. 1, having a 60-cycle hum voltage of 18 peak to peak at a point comparable with the filament of the rectifier. At the power supply output, the hum voltage is generally 1 volt or less.

Perhaps the simplest type of practical low-voltage power supply is the full-wave voltage doubler. Such a circuit is shown in Fig. 3 and is used in the Motorola chassis TS-534. Two 350-ma selenium rectifiers are used with a special plug-in wirewound 7.5-ohm fusing resistor. The 50-ohm loudspeaker field coil is used as a choke in the low-voltage filter circuit.

While the half-wave circuit in Fig. 2 normally has a greater ripple voltage than the Fig. 3 full-wave circuit, it is used far more often for two reasons: the ripple or hum of the half-wave circuit is still well within tolerable limits; one side of the power line becomes the common, ground or B-minus side of the power supply, producing less voltage stress between the heater and cathode of some tubes when the heaters are connected in series across the ac line.

Power supply troubleshooting

As in most circuits, a stage completely inoperative is far easier to service than one operating poorly. Thus, a no-picture no-sound condition with B plus missing is a comparatively simple service job. Assuming that the heater voltage is normal and all tubes are lit, measure the dc output of the power supply filter. If no B plus appears at this point, measure the ac applied to the rectifier elements. Should ac appear here, the trouble is usually an open filter choke or resistor or a shorted

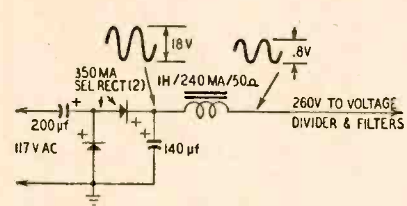

Fig. 2—A half-wave voltage-doubler power supply used in Crosley 483 chassis.

filter capacitor or bleeder resistor. If no ac is measured at the rectifier elements, the solution is simple: follow the ac line back to the power line plug.

A condition of low B plus (caused by other than low line voltage) becomes somewhat more complicated since this trouble can be the result of a defective power supply component or any other component connected between the B-plus line and ground or B minus. While replacing a rectifier tube is the quickest check, the safest test, should there be a short in the B-plus circuit, is to open the B-plus lead feeding the various branch lines. If the B-plus voltage increases significantly or rises above normal, reconnect the branch B circuits one at a time while constantly monitoring the B-plus voltage. Any branch line that causes the normal B-plus voltage to drop significantly should be further isolated. This would include removing tubes one at a time from the circuits fed by the troublesome B-plus branch line. In a case of series-string heaters, replace the removed tube with a dummy tube having all pins clipped except for the heater leads.

If all tubes are OK, open all plate and screen decoupling capacitors between B plus and ground, check for obvious wiring shorts and open any resistors that might be used as bleeders.

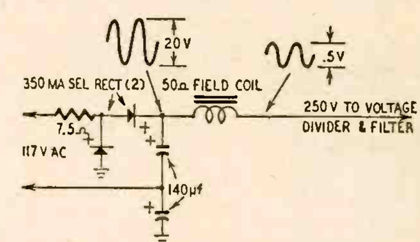

Fig. 3—Full-wave voltage-doubler supply found in Motorola chassis TS-534.

Where there is a dead short, or almost so, an ohmmeter can be used to expedite the search. However, in most cases of partial shorts, opening leads and testing by direct substitution is the most practical method in the long run.

Should disconnecting the power supply from the rest of the television receiver fail to restore normal B plus, this is no positive evidence that the basic trouble is in the power supply. It is very possible that some defective circuit external to the power supply has caused heavy B current flow which damaged the rectifier tube or selenium rectifiers. Thus, replace the low-voltage rectifier and check the electrolytic capacitors for leakage. If their resistance is high and they do not heat up when voltage is applied, shunt them with known-good units. In some cases resistors that were subjected to overheating might have to be replaced.

Finally, when the low-voltage power supply voltage is restored to normal, connect the main B-plus lead to the B lines of the set while constantly monitoring the B voltage. If B voltage drops sharply below normal at any

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given test point, open the B circuit immediately and proceed to check the individual B branch circuits as outlined above. (Many schematics have B-plus distribution diagrams.) As a safety measure, you might even insert a ½- or 1-amp fuse in series with the B-plus line in case of serious trouble.

Where the audio amplifier tube is used as a voltage divider in the B-plus distribution, consider the stages feeding the cathode circuit of the audio tube as branches of a B-plus line and use the circuit-elimination procedure if the low B voltage (audio output cathode voltage) is considerably below par.

A low B-plus voltage can produce almost any conceivable effect. The most common are weak sound and video, poor sync, and narrow raster width and height. Where the B-plus trouble is isolated to a particular stage, the trouble may be more pointedly related such as in the case of blooming or the complete loss of vertical sync.

Hum (not buzz) in the sound, video or raster presents no particular problem, being often caused by defective electrolytics. Complete procedures for correcting this trouble have been discussed in past TV Clinics. In case of lamination buzz, loosen the mounting nuts that hold the transformer to the chassis and then tighten the transformer bolts. In some cases you can apply shellac to loose laminations.

Picture smear

A particularly troublesome case of picture smear has come into the shop on a Packard-Bell 88S1 chassis. I have checked all components from the video detector circuit to the input of the picture tube, and all appear good. On the possibility that the trouble is not in the response of the video amplifier, but in the alignment, I used a sweep generator and oscilloscope and carefully aligned the if amplifier. The smear persisted and I am at a loss as to how to clear up the picture.

It seems almost a certainty that the trouble is in the video amplifier but my checks reveal nothing. I would appreciate any suggestions.—F. R., Tulsa, Okla.

The frequency response of a video amplifier is generally obtained by a careful selection of component values. In many cases of picture smear no component actually goes "bad," but simply changes in value, sometimes still remaining within its tolerance rating. Thus, replace the video detector and video amplifier as well as any component that is off value by more than 10%.

A certain amount of picture smear is common in circuits using vertical retrace blanking of the type found in this chassis (Fig. 4). The smear can often be eliminated or greatly reduced by grounding the picture-tube control grid. Then, remove the 470-μμf capacitor and 470,000-ohm resistor that couple the blanking circuit to the grid. In place of these connect a .01-μf capacitor from the same retrace-blanking takeoff point to the first anode. To stabilize the circuit insert an isolating resistor of approximately 1 megohm between the screen grid and the boosted B-plus circuit.

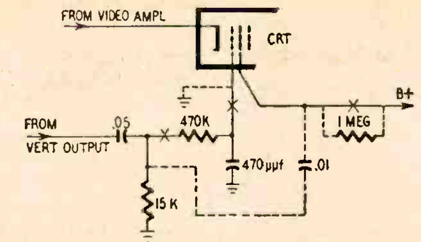

Fig. 4 — Packard-Bell vertical retrace blanking circuit indicating modifications to reduce smear.

Some additional improvement can be had by moving the 0.1-μf coupling capacitor between the plate of the video amplifier and the picture-tube cathode at least ½ inch from the chassis. Also, the yellow cathode lead must be clear of other leads and as far away from the chassis as possible. As an added precaution remove the 56-μμf capacitor from the sync takeoff circuit and increase the value of the resistor feeding this capacitor from 10,000 ohms to about 20,000 or 30,000 ohms.

Sync buzz

In a Philco TV-300 chassis there is a moderate sync buzz that simply cannot be removed. I have a schematic of the set and have checked all possibilities of trouble that I know of. All rf, if, sync and audio tubes have been replaced and the if amplifier and ratio detector aligned. On the possibility of overloading in the if amplifier, a bias box was used. However, even over a wide variation in bias the sync buzz varied only very slightly. Nothing seems to help, and I would appreciate any suggestions you can give.—A. P., Minneapolis, Minn.

If all the standard troubleshooting procedures have failed to eliminate the sync buzz, an old trick to cure this may be tried. It consists of eliminating the cathode bias used on the sound amplifier (Fig. 5) and substituting grid-leak bias. There is no need to remove any components—just short the cathode of the 6AU6 sound if amplifier to ground. Then, insert the grid-leak components. A good combination to start with is a capacitor of about 100 μμf and a resistor of about 100,000 ohms. The change in bias is quick and simple and will almost surely improve the sync buzz condition. It is possible that the values given in Fig. 5 may not be optimum for every set. Thus, start with these and then try varying the capacitor and resistance values slightly.

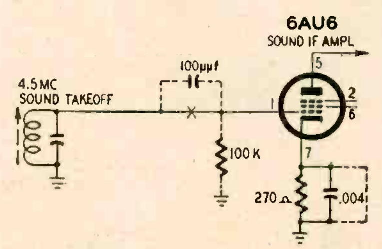

Fig. 5—Eliminating sync buzz in a Philco TV-300.

White flashes

I have a Pacific Mercury receiver, chassis 150. This set is extremely sensitive to vibration. Whenever the set is jarred, even by someone walking across the room, white flashes appear across the face of the picture tube as straight white lines. As far as I can determine, the flashes are not accompanied by audible arcing. I have looked over the entire high-voltage circuit and cannot find the source of arcing. Everything seems to be mounted firmly, and I have shortened all wiring in the high-voltage circuit. In areas where the solder joints were pointed, I rounded them off and covered them with high-voltage dope or insulation.

No arcing is visible even in a darkened room and, with no arcing being heard, it has become almost impossible to locate the source of the trouble. All connections in the horizontal output circuit have also been checked with no results.—T. L., Columbus, Ohio.

The symptoms you describe are not too common but bear the characteristics of being static voltage flashes. This has occurred on several of these sets and similar units using high-voltage transformers with a Tinnerman nut (Speed Nut) at the end of the long bolt through the center of the transformer that holds the core and terminal strip together. While not coming in contact with any part of the high-voltage circuit, this bolt and nut build up a strong static charge that arcs from the nut to the metal trapdoor on the bottom of the cabinet, generally when the set is jarred. The flash seen is often mistaken for a loose connection in the antenna circuit. Of course, this possibility must always be checked.

The solution is to cover the nut with a small strip of vinyl tape, as is done by some manufacturers. In this set the tape or insulation may be applied through the trapdoor without removing the chassis from the cabinet. END

Next Month's TV Service Clinic offers Hints on How to Handle Printed-Circuit Boards.

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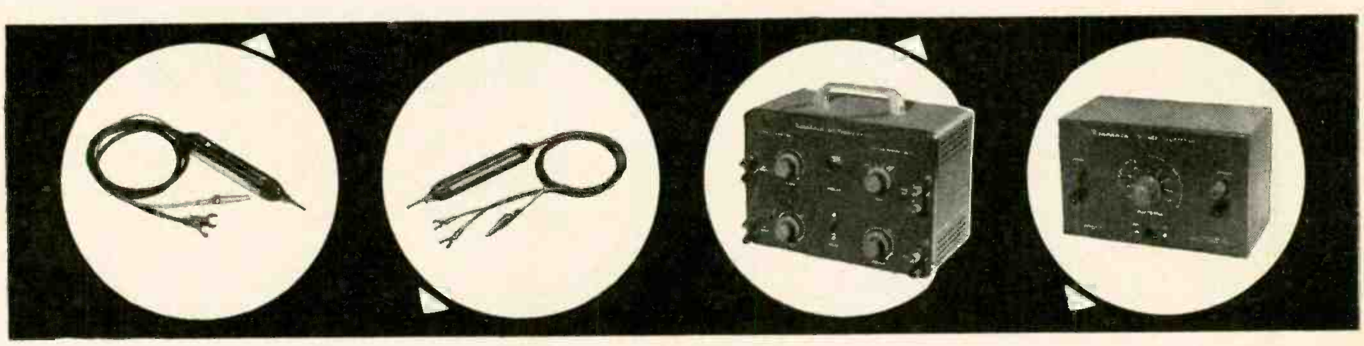

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Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

Shpg. Wt. 6 Lbs.

ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimenter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 Lbs.

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CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- * *Brand new circuit for extended frequency response and added stability.*
- * *Ten accurate ranges from 0-.01 to 0-300 volts.*
- * *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.95

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

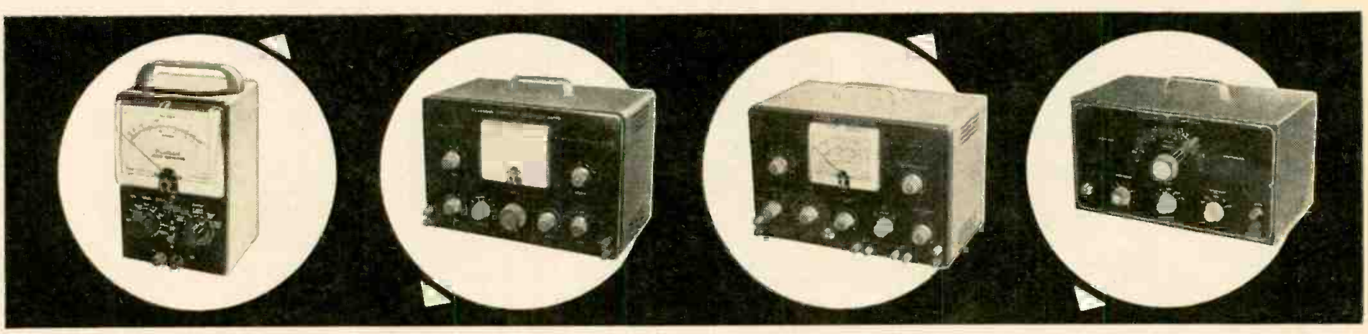
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$49.95

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

www.americanradiohistory.com

HEATHKIT

Audio Generator Kit

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1 $5.50 Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

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

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8 $29.50 Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1 $16.50 Shpg. Wt. 3 Lbs.

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1 $19.50 Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3 $35.50 Shpg. Wt. 17 Lbs.

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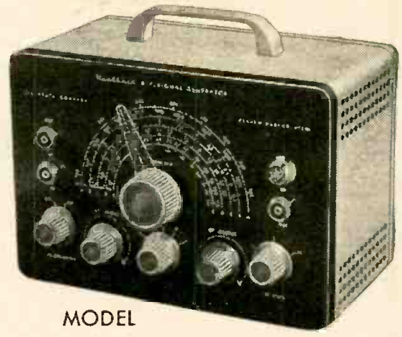
BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*



MODEL SG-8

$19.50 Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

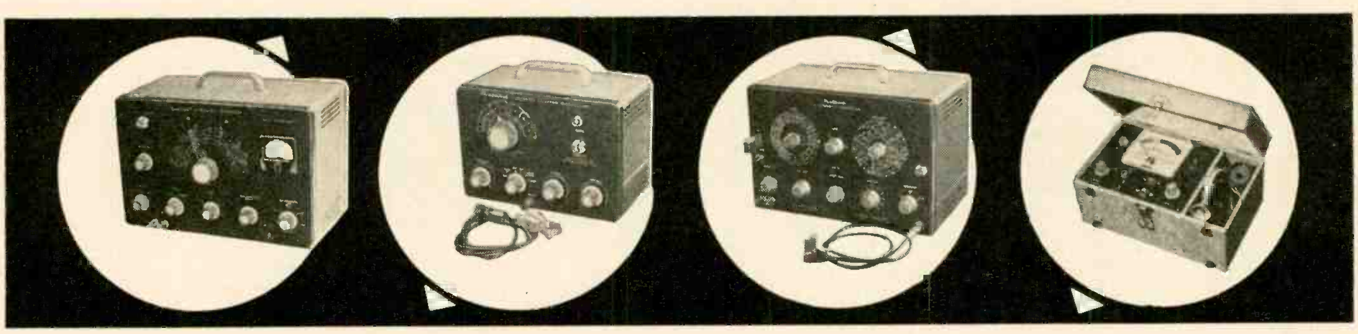
This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1 **$48.95** Shpg. Wt. 16 Lbs.

HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

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



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2 **$22.50** Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

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

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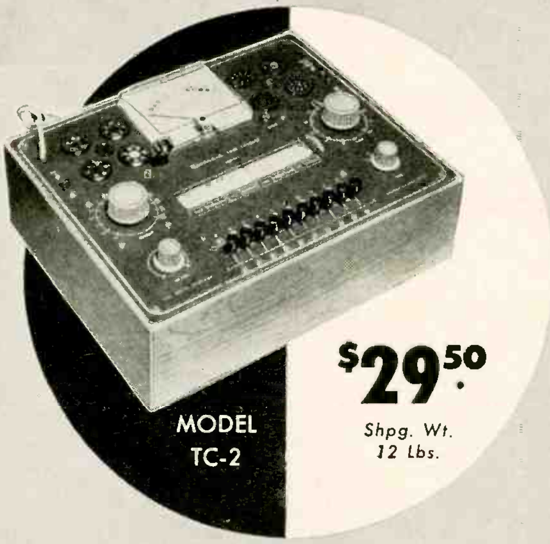
HEATHKIT

Tube Checker Kit



MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

* *Attractive counter-style cabinet.*
* *Wiring-harness simplifies assembly.*
* *Large 4½" meter with two-color "good-bad" scale.*
* *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

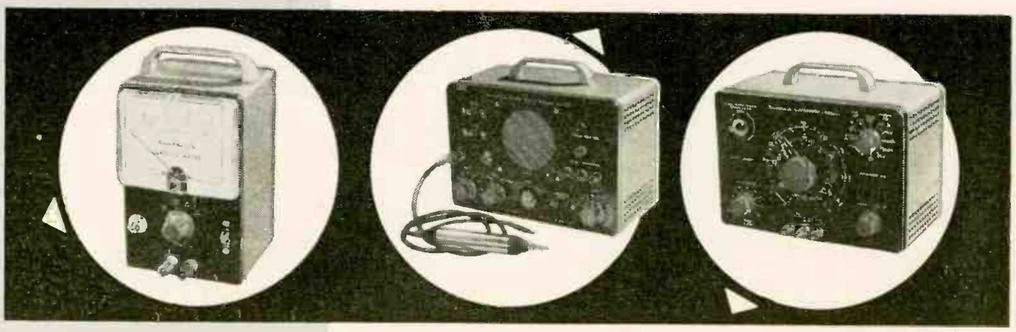
HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.



HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

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PIONEER DESIGN . . .

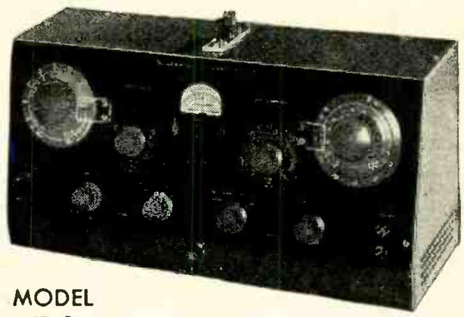
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

HEATHKIT "Q" METER KIT

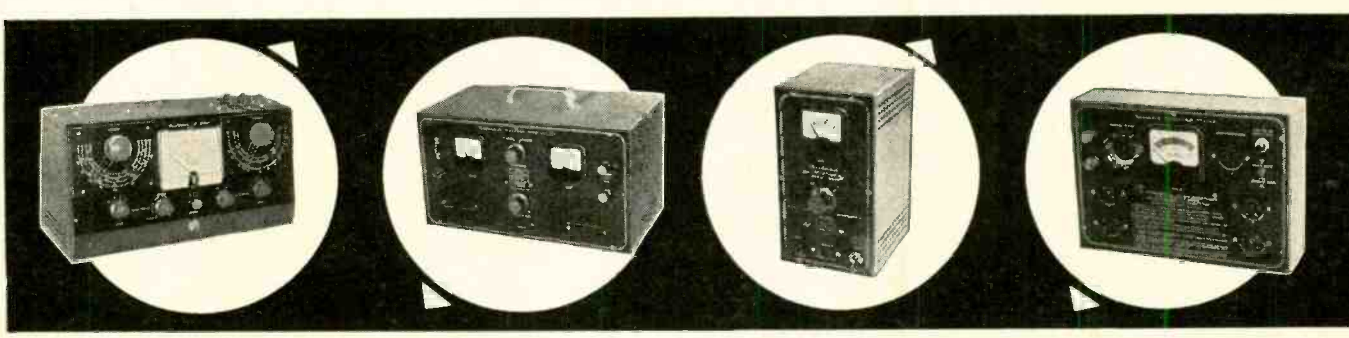
The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

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

HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1 **$16.50** *Shpg. Wt. 9 Lbs.*



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4 **$31.50** *Shpg. Wt. 17 Lbs.*

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1 **$14.50** *Shpg. Wt. 6 Lbs.*

www.americanradiohistory.com

HEATHKIT DX-100 PHONE AND CW

Transmitter Kit

$189.50

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

MODEL DX-100

Shpg. Wt. 107 Lbs.

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

MODEL AR-3

$29.95

INCLUDING NEW EXCISE TAX

(Less Cabinet)

Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95

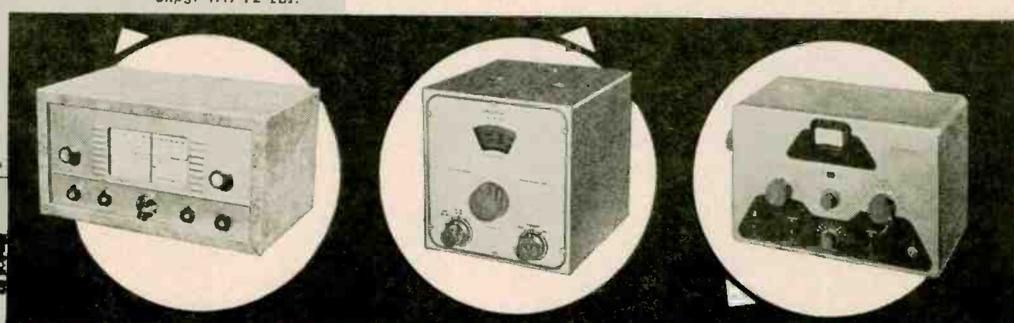
HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1

$19.50

Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 20, MICH.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20

$35.95

Shpg. Wt. 18 lbs.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quqlity equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

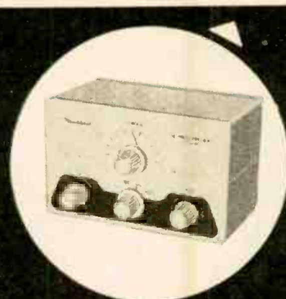
$14.50 *Shpg. Wt. 2 Lbs.*

HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95 *Shpg. Wt. 3 Lbs.*



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50 *Shpg. Wt. 4 Lbs.*

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95 *Shpg. Wt. 4 Lbs.*

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HEATHKIT BROADCAST BAND Receiver Kit

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX‡

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A . . . . $4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

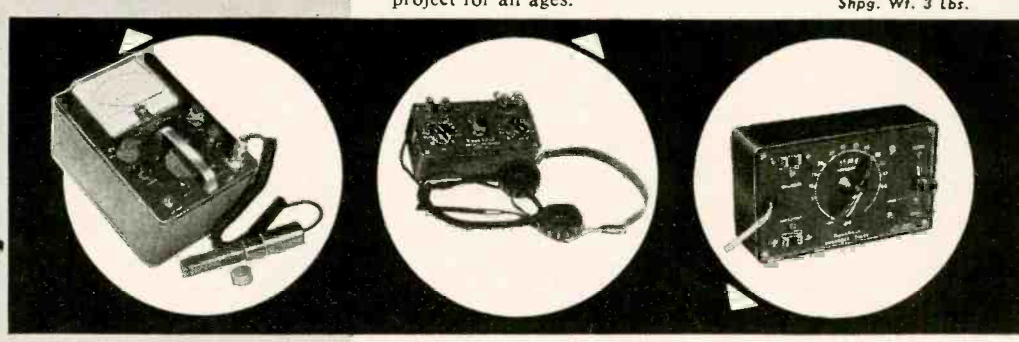
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.



- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

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COMPREHENSIVE INSTRUCTIONS . . .

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

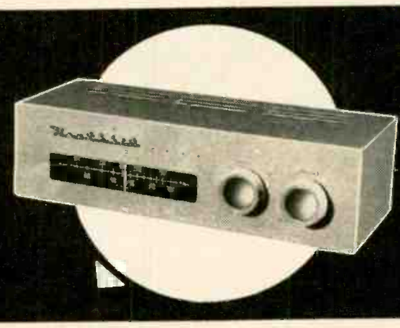
$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A **$25.95** INCLUDING NEW EXCISE TAX (With Cabinet) Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1 **$25.95** INCLUDING NEW EXCISE TAX (With Cabinet) Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1 **$18.95** Shpg. Wt. 6 Lbs.

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HEATHKIT ADVANCED-DESIGN *HIGH FIDELITY*

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only........ $49.75

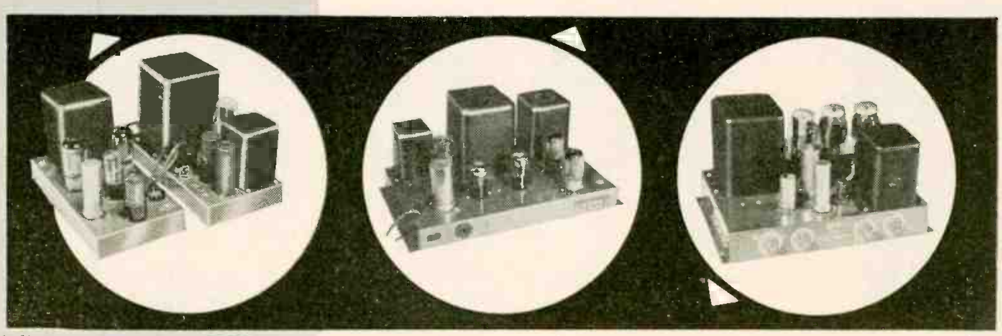
MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only............ $69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only....... $39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only.............. $59.50



HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 Lbs.

MODEL A-7D
$17.95
INCLUDING NEW EXCISE TAX

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. $19.95‡

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency response of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

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All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,

HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending

SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95 *Shpg. Wt. 80 Lbs.*

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95 *Shpg. Wt. 30 Lbs.*

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

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ORDER BLANK

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QUANTITY	ITEM	MODEL NO.	PRICE

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UNUSUAL OCCURRENCES

More evidence that anything can happen in TV servicing, and often does!

GROUND WAVES

While making a routine service call for a TV service company I encountered a ghost that wasn't a ghost.

Two receivers were connected to the same antenna through a commercial isolation unit. One of the sets, in the first floor living room, showed clear ghost-free pictures on each of Philadelphia's three channels—3, 6, and 10.

The other set, in the basement playroom, was ghosting pretty badly on channel 3.

The customer told me I was the fifth man sent from the company on this trouble. I had had no advance information of any unusual problem connected with this call. Originally, the customer informed me, the sets had been connected directly to the transmission line. On the fourth call, the isolation unit had been installed, without good results.

The idea of if trouble occurred to me. Close examination of the picture showed a *trailing* ghost, not a *leading* one. Temporarily, at least, I ruled this possibility out.

I began to disconnect the isolation box to try direct connection for observation of any difference in results. With the antenna disconnected, a clear ghost-free channel 3 presented itself!

The answer was then suddenly obvious. The channel 3 transmitter was only a couple miles distant at most. The ground wave, entering the basement but not the first floor above, was being picked up by the 2 or 3 feet of lead-in between set and isolation box. The signal coming in from the antenna was the ghost!

Shielded lead from set to box provided the answer. A switch to disconnect the antenna for channel 3 operation would have also served.—*H. R. Holtz*

NO BRIGHTNESS

I was asked to check a new Admiral chassis 21F1 for no brightness. I tried the 1B3 and found I could draw a small arc from the plate cap, indicating oscillation in the horizontal section. I changed the 6BQ6, 6W4, 6SN7 horizontal oscillator and sync inverter, and the 6AL5 sync discharge tube. There was no improvement.

I removed the chassis and measured the high voltage—6,000 on the second anode. I measured the voltages on the horizontal tubes and found that they were not as high as they should have been. The oscilloscope indicated nearly perfect waveforms. I removed the high-voltage cage, checked and replaced the high-voltage capacitor, the yoke, and high-voltage transformer. I made continuity checks of the width and linearity coils, and checked and substituted in frustration for every component in the horizontal section—all to no avail.

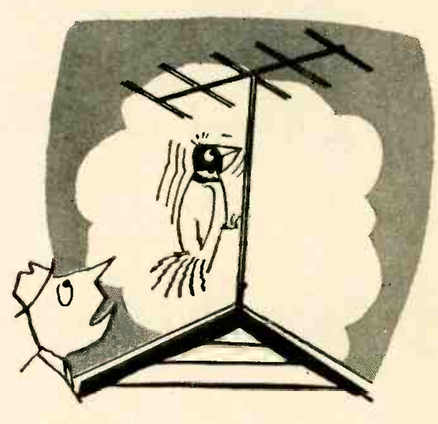
I switched my attack to the if section and to my surprise I got no video signal from the 6AC7 plate. I tried the agc tube and again found irregularities in the scope waveform and pin voltages. These irregularities led me back to the width coil. I had no width coil to substitute so I disconnected one of its leads—behold brightness! The width coil was the culprit. A new coil was substituted and everything was fine.—*William L. Fields*

UNUSUAL RINGING

The exasperated wife of a well-known local doctor called me in to check her television set, recently installed by another service technician. She told me that he had given up, frankly telling her his experience didn't cover the sort of trouble she was having.

It seems her TV set rang like a telephone early every morning. At first they had thought that it was the phone. But every time they answered it, sleepily, no one was on the line. Since theirs was a new house, she thought that the carpenters might have nailed a phone up in the wall in back of the TV set. The doctor noticed it was not his phone ringing, it must be another, somewhere in his TV set. Checking the set, I found no phone and no phone line other than his regular phone drop that came into his house.

The set was a Zenith and the manufacturer had installed no bells on that particular model. The chassis checked out perfectly, the set operated very well. The investigation extended over a week since the only time the set would ring was in the very early morning around daybreak, and I usually didn't get up that early. Peculiarly enough, the set was never on at the time it rang. In desperation, I set up a watch during the early morning hours to pinpoint the source of the sound. When it finally appeared it seemed to come from the set. But on closer investigation it seemed to emanate from the wall directly in back of the set. The rings were of odd length and short duration. Since we didn't want to tear out the doctor's new wall, we went outdoors to check the other side. It was then that the apparent source of the sound shifted upward. but the only unusual aspect of the antenna installation was a bird sitting on the antenna arms.



Had we been qualified bird watchers, we would probably immediately have noticed that he was a male woodpecker, hammering away on the aluminum. The din was terrific! The antenna was a ground installation with a V bracket mounted against the house approximately at the location of the TV set on the other side of the wall. The bird had either been trying to impress his ladylove with the racket or just plain didn't know any better. The doctor's wife reported that he got discouraged in another week and that the antenna seems to perform just as well with the holes in it.—*Philip Whitney*

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UNUSUAL OSCILLOSCOPE PATTERN

I have often thought of trying to feed in television sweep voltages at the horizontal and vertical input terminals and a video signal at the intensity control of my oscilloscope to see if I could produce a television picture. Like most technicians I do not have much time for such experimenting and I never have actually tried to see if it would work. Until this week the only television pictures I had seen were properly confined to a TV screen and my scope produced only useful waveshape or crazy-quilt designs.

This week, however, using the scope to trouble-shoot an Emerson model 700 TV set for loss of sync and having just made a connection at the grid of the horizontal control tube, I looked back at my scope to make the switch from 60 to 15,750 cycles. I saw a green "Liberace" grinning at me from the screen!

After pinching myself, checking to see that it was not a reflection from the TV screen and calling my partner to convince me that I was not seeing things, I found I very definitely had an excellent TV picture on my oscilloscope. Incidentally, the picture on the television set was rolling while that on the scope was locked in perfectly. The scope picture was in positive phase, had good detail, plenty of contrast and fairly good linearity. The scope horizontal sweep corresponded to the picture vertical sweep so the picture was on its side.

I called several other shops in town, but none of them had ever run into such a thing. In fact, some of the technicians were so surprised that they came over to see it for themselves. The thing that mystified us all was the apparent modulation of the scope beam when the only input to the scope was at the vertical terminals through an ordinary frequency-compensated probe.

Studying and checking of the schematic and waveshapes showed how the picture got on the scope, and how it surely must be possible to get the same results using any scope and any television set having the pulse-width (Synchroguide) type of horizontal afc and a slightly weak sync circuit. I figured it out this way:

At the grid of the horizontal control tube two voltages are combined, a sawtooth waveshape coupled from the horizontal discharge network and a horizontal sync pulse from the sync separator stage. In this particular set, some of the video signal was riding through the sync stages with the sync pulses. This video signal, compressed, appeared to contain the complete picture signal from light to dark. Since the sync pulses at this point combine with and ride on the peak of the sawtooth, the video information was located on the slope of the sawtooth. At a scope sweep frequency of 15,750 cycles, this video appeared as a ripple or ragged edge on the sawtooth. When the scope sweep was changed to 60 cycles however, the sawteeth appeared as vertical lines (of a raster). The video signal between the sync pulses then added to or subtracted from the speed of the vertical sweep on the oscilloscope and effectively "speed-modulated" the beam trace to produce the intensity variations of the picture.

I was a little skeptical that repairing the set might cause me to lose my scope picture. However, after completing the repair I found that it did not. I believe that this portion of the video signal riding through the sync stages is common in many television sets, and since it is too low to disturb the operation of the sweep oscillators, it may even be allowable in the design of some sets. Certainly it could occur due to changes in component values or aging of tubes in the clipper and sync amplifier stages. After realizing how common the possibility of obtaining a television picture on a scope screen could be, I wonder why I have never heard or read of it before.

The experience of finding a picture on my oscilloscope screen was exciting and naturally I wanted to impress my wife with my discovery. After looking calmly at the green picture for a few minutes she really dampened my enthusiasm: "It's a pretty good picture all right, but where's the sound?"—*L. H. Wilson*

THERMAL CUTOUT

One of the most unusual service experiences I ever had was with a G–E model 12C105 TV receiver. This set, like many G–E's, has a thermal cutout in the power circuit that feeds the series filaments.

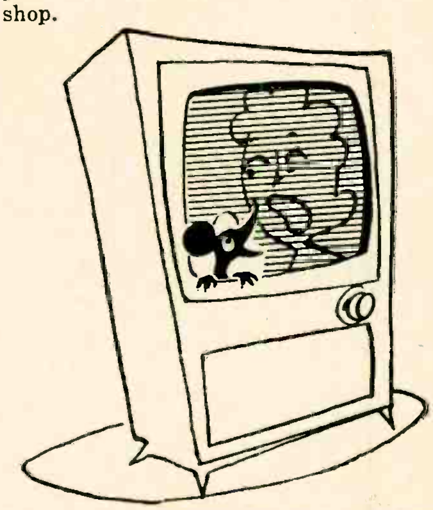
My first call found the set dead. I took off the back, plugged in my "cheater," and allowed the set to warm up. Everything acted normal and, thinking this might be one of those pesky intermittents, I performed the usual tube banging, made some voltage measurements, and replaced a doubtful 6BG6. I told the owner to let it play as long as it would and to call me when it quit.

The call came about 10 days later. This time I took the chassis to the shop and put a Variac on it to raise the line voltage until something popped. Something did pop, but was the last thing I suspected. The interlock ac input socket arced over and the thermal cutout opened. After letting it cool, I again applied about 117 volts—another arcover and cutout. Replacement of the ac input interlock socket cured this trouble.—*D. L. Weaver*

MICE IN TV SETS

Mice and small rats can find their way into, and make their homes in, some of the strangest places. For instance, the inside of a television receiver. Whenever small openings can be found leading into the underside of a chassis, they prefer to make this their habitat, rather than upon the slightly cooler topside. Occasionally, I imagine, some are electrocuted or shocked, but the vast majority seem to be right at home among the jumble of wires and components.

When called upon to service defective receivers that show evidence of these small rodents, such as small pieces of paper, rags, and other foreign materials, you will find that they usually do not respond to standard home-call procedures and have to be taken to the shop.



I have found that much time can be saved in servicing these sets by following this set of rules:

1. Clean set thoroughly of all foreign materials, with a small brush or damp cloth.
2. Check all fuses in the set.
3. Make a careful visual inspection of all the less-rigid noninsulated wires to see if they have been moved, possibly causing a short circuit.
4. Check all insulated wires for chewed-through insulation.
5. Most important, make a continuity check of all inductances wound with very small wire, such as peaking, width, linearity, and horizontal oscillator coils.

Normally, these checks will give you the key to the problem, if caused by these pests.

Unnecessary callbacks can be reduced by closing all ports of entry. Seal all small openings with tape, mesh wire, or wire-cloth. But make sure that plenty of air can circulate in and about the set. Determine how the rodents entered the room. Sometimes moving the set to another location or by moving adjacent objects away from the set, will cut off the path of entry.

Similar difficulties will sometimes be caused by members of the insect family. Again the same rules apply. Just use a finer screening.

And most important, after the set has been returned, *do not—under any circumstances—tell the owner that she had mice in her TV set!—William Shope*

END

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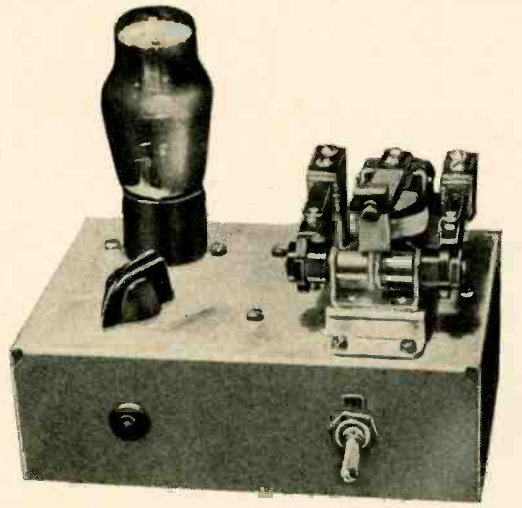
SQUELCH THAT BLURB

Commercial killer is triggered by flashlight

By A. A. SCHULKE

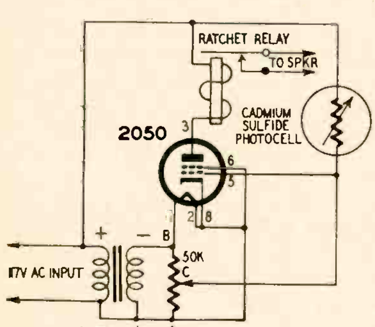


The light-sensitive unit — photocell is held in place by rubber grommet.

MOST of us are fairly reasonable folks and are willing to accept a certain amount of advertising in exchange for favorite TV programs. In many cases this trade is easy to make—the ads are even interesting. Unfortunately, however, some advertising is downright objectionable.

Probably the most aggravating are those sponsors who employ drill-sergeant-voiced announcers and pound their messages across by sheer volume; the long, interminable ads so diabolically worded that you think they are going to stop with the next sentence—but never do; and the string of "free-loaders" who contribute nothing but a series of five or six ads during a break between programs you "paid" to watch. These are the ones this "commercial killer" was designed to eliminate. With just a simple flick of a flashlight, the TV set is silenced and the sound remains off until another flick of the flashlight restores it.

The operation of the device is remarkably simple and it uses an almost irreducible minimum of parts. The entire unit may be easily built on a 4 x 6 x 2-inch deep chassis and can be made still smaller if desired.



1—50,000-ohm potentiometer; 1—chassis, approximately 4 x 6 x 2 inches deep; 1—2050; 1—octal socket; 1—filament transformer, 6.3 volts at 1 ampere; 1—ratchet relay, 115 volts ac (Guardian RC-100-GR or equivalent); 1—crystal photocell, RCA 6694-A or equivalent.

Fig. 1—The light-sensitive circuit.

The circuit is shown in Fig. 1 and operates directly from the power line. When the plate is negative, the thyratron cannot conduct; when it is positive, the tube can conduct whenever the bias on the grid is such that it will permit it to do so.

The transformer is connected so that whenever the plate is positive, the secondary will be negative at point B and positive at A. Since the electron flow through the resistor will be from B to A at this time, point C will be more negative than A and a negative bias will be applied to the grid. This bias is easily set by the position of contact C. When C is near B the tube has maximum bias and will not conduct. But as C is moved toward A the bias decreases until the tube conducts whenever the plate is positive. The position of this contact is adjusted between these limits so that the tube will not fire until a light of predetermined intensity falls on the photocell.

When light strikes the photocell, the current passed by the cell flows through the resistor from A to C and opposes the current normally flowing in the opposite direction. This decreases the grid bias, the tube conducts and the relay is energized. Since the relay is energized only when the tube conducts, an impulse type ratchet relay was selected for this application. One flash of light on the photocell provides a current pulse to the relay and opens a set of contacts. These contacts then remain open until the next impulse closes them.

The photocell selected for this merits special mention because it made possible the simplification of this device to only five components. This is the new cadmium sulfide crystal photocell and has really remarkable output for its size. Physically, it is a tiny cylinder measuring less than ¼ inch in diameter and ½ inch in length. It requires no socket and can be easily mounted by pushing it through a rubber grommet in the chassis. It has a maximum voltage rating of 200 and despite its small sensitive area (less than 1/32 x 1/32 inch), will produce a 300-μa output at 90 volts with 100 foot-candles of illumination. The average two-cell flashlight at 15 feet produces about 10 foot-candles. With the crystal photocell connected as shown in Fig. 1, it has an output of about 15 μa—more than enough to operate the tube.

The construction of the unit is fairly straightforward and parts placement is not critical. There is one possible source of difficulty. If the transformer is not wound with polarities as shown, the tube will conduct each time the plate is positive and the bias control will have no effect. Reversing the secondary connections of the transformer will correct this.

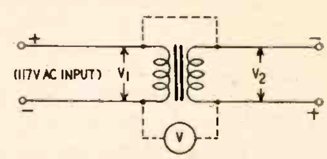


Fig. 2—Testing transformer polarities—those shown in diagram are additive. Top dashed lines are the connection.

Transformers with the polarities shown in Fig. 1 are called *additive* and, if a voltmeter is available, this can be easily checked by connecting the transformer as shown in Fig. 2. If the polarities are correct, the voltmeter will read the *sum* of the primary and secondary voltages. If not, the voltmeter will read the *difference* between them.

It is desirable to connect the relay contacts in series with one of the wires to the speaker voice coil. This will silence the speaker completely when the contacts are open. The two wires from the relay contacts may also be connected across the speaker terminals with small battery clips. This method will reduce the volume considerably but will not completely eliminate the sound. END

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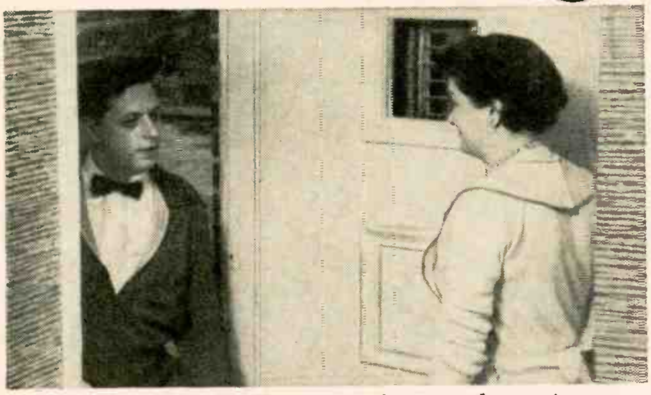

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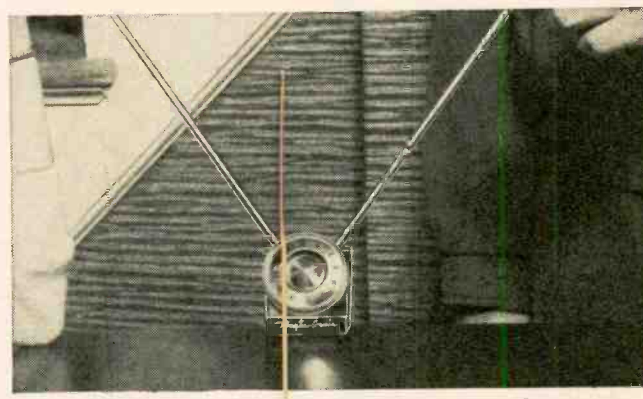

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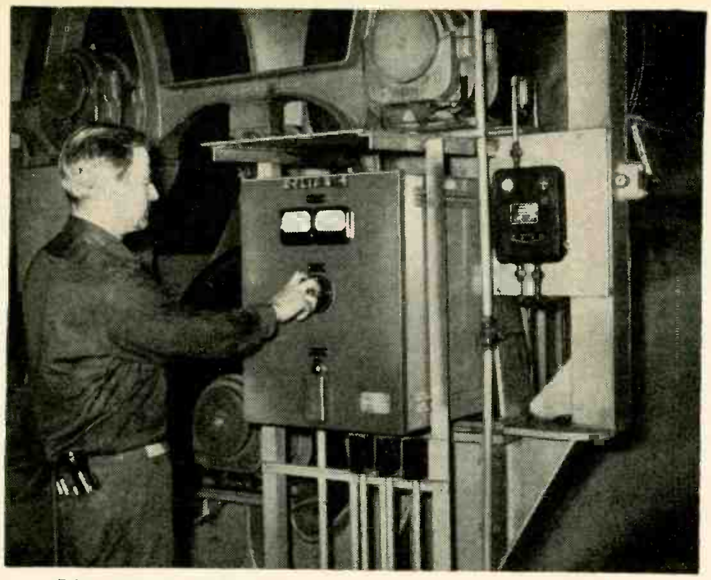

Line-speed control box

Those factory jobs are not as hard as they may look, and they do pay off

industrial service call

By GUY SLAUGHTER

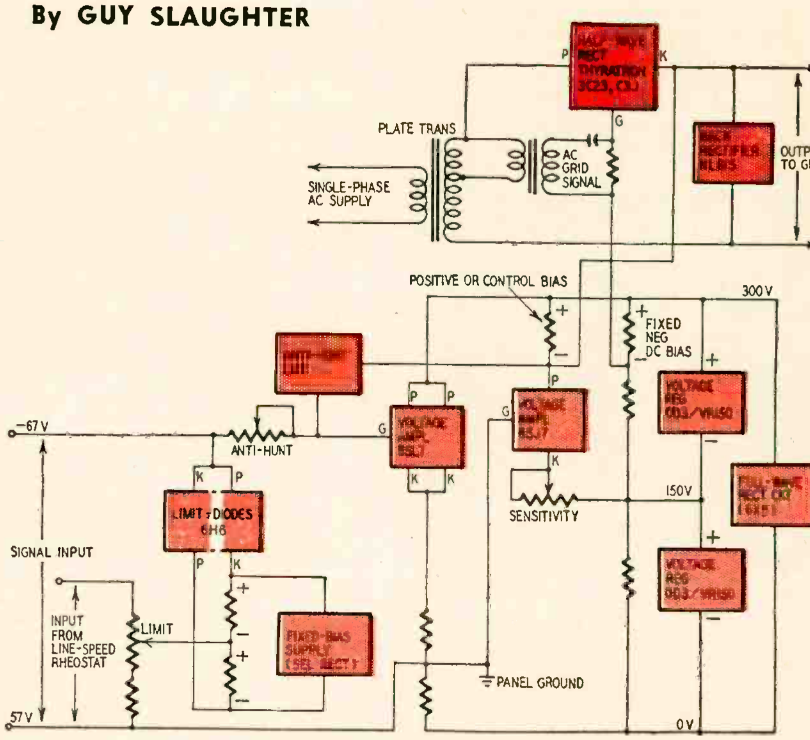

Fig. 1—Thyratron control and dc amplifier found in many types of industrial equipment.

"YOU'RE as bad as the others," the telephone rumbled in my ear. The caller was an old friend who works as an electrical troubleshooter in a small factory near by. "This is supposed to be the electronic age," he went on bitterly. "But when a plant like ours runs into trouble with our electronic gear, we're out of luck."

"It can't be that bad," I said, defensively. "Have you changed tubes?"

"Sure I've changed tubes. You think I'm a schnook? I've checked everything I can think of, and the thing still won't work."

"Call the manufacturer, he can probably suggest just what's wrong, and . . ."

"Nuts," the phone snapped. "I've talked to them three times long distance. They say they can send an engineer out next week, period."

"Great," I said. "A real big help."

"We'll have to shut down and send everybody home if we don't get this control working. That's why I called you. I figured maybe you could help us out."

"I'd like to, but . . ."

"Sure," he said, cutting me off. "But! You're like all the rest. You electronic guys are always bragging about the future of the field. Well, believe me, buddy, it's not going to *have* any future if you don't help us when we need it."

"Okay," I said, making up my mind. "I'm convinced. Tell me how to get there and I'll see what I can do. But don't be too optimistic. I'm a radio–TV man, not an industrial engineer."

"You know about tubes and capacitors and stuff." My friend sounded happier now. "That's what this gear is made of."

★ ★ ★

The plant proved to be a smallish place as factories go, typical of thousands dotting the larger cities across the country. And its problem was also typical as I learned later. This particular plant makes paper products, especially paper toweling. A few years ago it allowed itself to be sold some electronic equipment as thousands of other small plants have before and since. Now that the equipment has been used a while, it is beginning to give trouble. The maintenance budget couldn't afford an electronic technician on a full-time basis, and when they needed service they couldn't get it. Up to now they had been lucky. My friend the plant electrician had located and repaired the defects that had occurred. This time he was stumped.

"It's the line-speed control," he explained, meeting me at the plant entrance and escorting me through the building. His nickname is Moon, and he's a tall, slender guy with an earnest face. "I'm sure glad you could come."

"I've worked on some industrial equipment," I said, "but what the devil's a line-speed control?"

"We drive our paper-rolling line with electric motors fed by generators. We control the speed of the line drive motors by varying the outputs of the generators. The electronic line-speed control is a gadget to maintain line speed at a preset level by varying the dc excitation of the generator fields."

"I suppose there's some sort of feedback loop between the motors and the electronic control?"

"A tachometer generator," Moon said. "It's driven by one of the line motors so its output varies with line speed and feeds the electronic regulator."

"But something's loused up now?"

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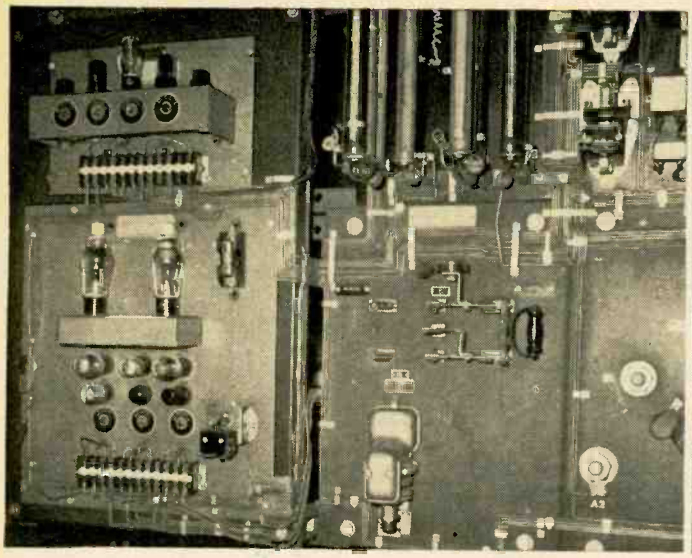
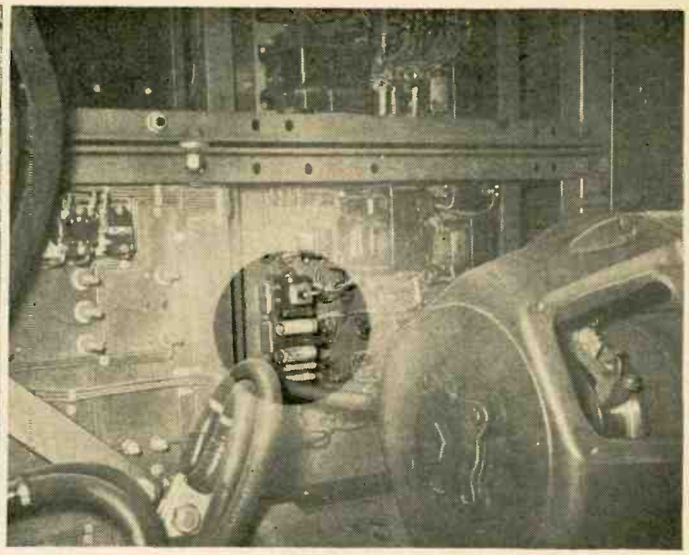


Electronic parts layout of line-speed control



The defective power supply

"That's for sure," Moon said. "The line speed wanders all over. It's set for about 400 feet a minute but it's varying from 250 to better than 500."

"Does it hunt?" I wanted to know. "That is, vary up and down rapidly?"

"No, just drifts around between those limits. So the paper tension keeps changing in the line. Sometimes the paper tears and sometimes it throws so much slack it wrinkles. Either way we can't make a good product."

It should have worked

We arrived in the control basement and Moon showed me the equipment. A steel cabinet maybe 12 x 8 x 6 feet housed the gear. Inside was a good-sized generator; several ropelike bunches of high-current bus cables and, mounted neatly on panels, subpanels and chassis, the electronic gear I had come to repair.

Like most industrial equipment it was built in sectional units, with the various components neatly wired to tie strips. The units were connected and interconnected by wiring harnesses, cables and screw type terminal blocks. Unlike some industrial apparatus, it had a schematic and interconnection booklet accompanying it, furnished by the manufacturer.

"I'm not familiar with this gear," I told Moon, after scanning the drawing (Fig. 1) for a few minutes. "But it's a common control circuit. Your generator fields are fed by that pair of thyratrons, and their output is controlled by a dc amplifier." I jerked a thumb at one of the panels containing a 6SL7, a 6SJ7, anti-hunt circuits, power supply and a pair of VR tubes. "Evidently your line-speed control rheostat upstairs adjusts the bias applied to the input stage of the dc amplifier. The tach generator on the drive motor also supplies a signal voltage to this stage. Whenever the line speeds up too much the tach generator voltage, or signal voltage, exceeds the bias voltage and the dc amplifier acts to reduce the output of the thyratrons feeding the generator fields. The motors upstairs then receive less excitation and slow down; the tach generator output voltage falls and drops the signal voltage back to the value of the bias voltage. If the line speed drops below the preset level, the reverse occurs and, ultimately, the line speed is brought back to normal."

"Yeah," Moon said. "But it's not working."

"Okay," I countered. "So let's find out why. You got a multimeter?"

He had one and knew how to use it. So we started checking out the apparatus. We began upstairs with the line-speed preset rheostat. Its resistance was normal, but there was high-resistance leakage to ground in the cable connecting it to the gear below. We ran a temporary line and disconnected the leaky cable. Line speed was still erratic.

"I believe it's a little better," Moon said, his tone showing his disappointment. "But it's still not good enough."

"Okay, let's keep going. Where's that tach generator?"

Moon pointed it out, and we hung a voltmeter across its leads. Its output voltage followed line speed faithfully as far as we could tell, so we went back downstairs to the electronic panels. Moon had already changed all the tubes, but we changed them again, including the thyratrons. The trouble still persisted. So we shut the line down, turned off the equipment and started checking the electronic portion of the control, schematic in hand.

The thyratron circuit proved to be conventional for industrial installations. A grid-controlled rectifier furnished current to the highly inductive load on the positive half-cycle of the ac swing. The other tube of the pair, a straight mercury-vapor diode, was hooked up as a back rectifier (what we'd call a damper in TV) to pass the self-induced current generated by the collapsing field of the load, during the other half-cycle. The current fed to the generator field is, therefore, proportional to the percentage of the ac half-cycle during which the grid-controlled rectifier was in a conducting state.

The grid-controlled thyratron circuit

(*Continued on page* 84)

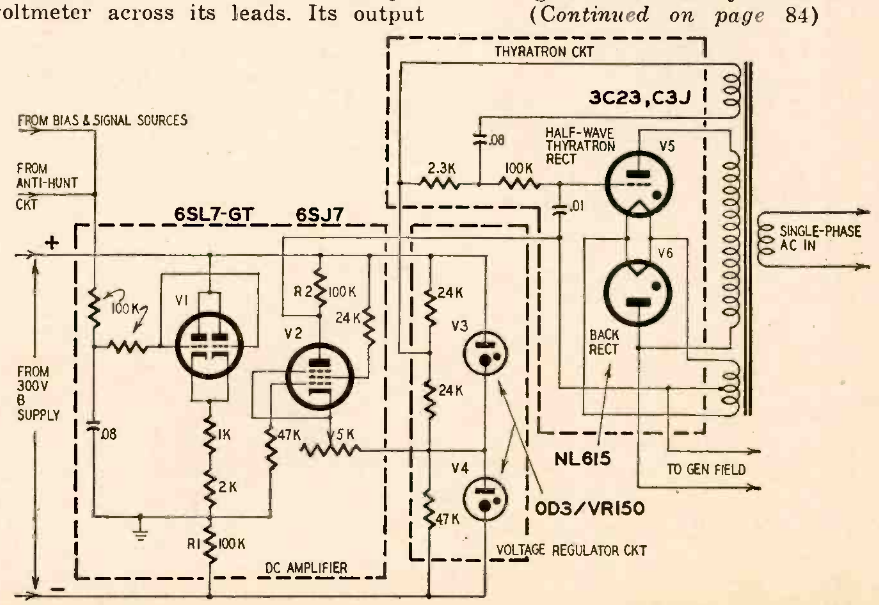


Fig. 2—Simplified diagram of the thyratron power supply and control circuit.

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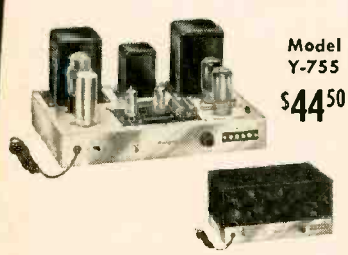

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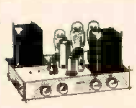

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ELECTRONICS

(*Continued from page* 82)

was of the "ac rider, dc bias" type. The grid is continuously fed ac of the proper phase and amplitude to keep the tube conducting during the entire positive half-cycle, but the dc bias impressed on the grid is varied by the output of a dc amplifier and is of the proper amplitude and polarity to override the ac grid voltage and cut the tube off when the proper signal voltage is fed to the amplifier. Circuit constants are chosen so that relatively small changes in dc bias voltage are sufficient to vary the thyratrons' output between zero and several amperes of current.

The dc amplifier itself (Fig. 2) is a bit different from conventional amplifiers as radio–TV men know them: the change in voltage drop across the plate load resistor (R2) of V2 becomes the dc control voltage which is applied to the grid circuit of the thyratron. The grid circuit of V2 returns to a voltage divider in the cathode circuit of V1, a 6SL7 voltage amplifier with both its triode sections in parallel for greater plate current swing. The net result is that a variation in plate current through V1, flowing through a 100,000-ohm cathode resistor, R1, produces a proportional variation in V2's grid-to-cathode potential and therefore varies the effective grid bias of that tube within wide limits. Such a dc amplifier is conventional design in industrial equipment and may be found in almost any type of apparatus, from beta-ray gauges to temperature controls.

Continuing the search

"So far so good," I told Moon. "Everything normal back to here. That leaves the grid circuit of the 6SL7 and the anti-hunt control. I've got a hunch the anti-hunt is okay."

"What makes you think so?" Moon wanted to know.

"The way that line speed drifts around," I said. "Generally, trouble in anti-hunt stages shows up as a rapid flutter in the controlled voltage or current. So let's look over this input section."

The grid circuit of the 6SL7 was a mess of wiring and R-C networks on the panel, a maze of lines and symbols on the schematic. Sorted out, the maze proved to be three different inputs plus an anti-hunt circuit. One input fed the grid an adjustable bias voltage from the line-speed preset rheostat upstairs; the second fed a signal voltage from the tach generator and the third fed a *fixed* bias voltage from an external source we hadn't yet seen. This fixed bias set the operating point of the tube. About this point the speed-determining bias and the signal voltage from the tach generator varied. The fixed bias was supposed to be 1.9 volts negative. Actually, it read 0 volts.

"Somewhere there's another power supply, but I don't see it on these panels. Let's start looking around."

"There's one on the other side," Moon said. "Up above the generator." He led the way around the cabinet, swung another pair of doors open. "That it?"

It proved to be a small selenium rectifier type power supply laid out on a vertical panel. One of its filters had given up the ghost and taken a series resistor with it. We replaced these components, fired up the panel and started the line. It came up to normal speed and stayed there. There was no sign of erratic control.

"Hot dog," Moon said, his usually serious face beaming. "It's working."

"Yeah," I said. "It's always so simple after you find it. Well, I guess that's that."

"Not quite," Moon said. "There's something you've still got to do for me."

"Like what?"

"Don't rush me. I got to make a speech first." He dragged a beatup pipe out of his pocket and stuck it in his teeth. "You guys in the electronics field have got to assume some of the responsibility for solving the service problems of the smaller industries. That's our only salvation."

"Easier said than done," I objected. "We don't even know what your problems are."

"Sure you do," Moon contradicted me. "Service on our gear. And I've got the answer. If you radio–TV men would familiarize yourselves with the basics of industrial electronics and then call on the small plants in your home cities and leave your names and addresses with the plant managers, it would be a good thing for everybody."

"You could look up the radio–TV service technicians in your phone book when you needed help," I pointed out.

"I tried that," Moon said bitterly. "I called several before I got hold of you. Most of them aren't interested. But they're passing up a good thing if they only knew it. For instance, how much do you think you are going to bill us for?"

I mentioned a fee, a respectable one, I thought, covering time spent and distance traveled.

Moon grinned. "Multiply it by five," he said. "We needed your help and we're glad to pay for it. We'll need you again some time, and we want to be sure you'll come back."

"For that kind of money I'll just stay here," I said.

"Like I was saying," he went on. "You get the radio–TV boys to register with the small industries around the country, and industrial electronics will grow. But if you don't, we'll all go back to electromechanical controls the plant electricians can service. I know what I'm talking about."

"I suppose you're right," I said. "Now what was it you wanted me to do for you?"

"Spread the word," Moon said, waggling his pipe under my nose. "Tell as many of the boys as you can reach what I've just told you."

I promised I would do just that for him.

And now I have. . . . END

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Silicon Junction Diodes

New semiconductors feature low reverse current and high stability

By NATHANIEL RHITA

THERE are two types of semiconductor contacts: the point and the junction. Early transistors used point contacts. Later, the junction types appeared and soon replaced the older types. A junction type is far more stable than a point contact which may be damaged by mechanical shock and is more susceptible to random changes in characteristics. Also, the junction type is more efficient and operates at lower voltage.

In the matter of semiconductor material, we also find two possibilities—either germanium or silicon is useful. Most present-day transistors and diodes are made of germanium. Silicon is more difficult to process because of its high melting point. By the same token, silicon is less susceptible to the adverse effects of higher temperatures. For example, the upper temperature limit of a germanium transistor may vary between 50°–85°C, depending upon its type and manufacturing process. Compare this with a silicon transistor which can operate safely even at 150°C.

There is another important consideration, besides safety, to be taken into account. The reverse current through a semiconductor junction contact rises rapidly with temperature. In many transistors the cutoff is about 1 μa at 20°C and nearly doubles for every 20° rise in temperature. This problem of reverse current is especially serious in a *diode*. The perfect rectifier should show *zero* resistance in the conducting direction; the resistance should be *infinite* in the direction of reverse current flow. Yet most crystal diodes now in use have a back resistance of 0.5 megohms or less. Even a "high-back-resistance" diode like the 1N54 has a reverse resistance of only 1.4 megohms at 10 volts. If used in a high-impedance circuit, this value is woefully small and it makes the crystal a poor competitor to the tube in this respect.

Recently developed diodes have combined the features of *silicon* diodes and *junction* contacts. They are now available at prices within the reach of experimenters. These diodes function safely at 150°C and their reverse current is amazingly low. A typical diode will pass *less than .01 μa* at 10 volts in the reverse direction. This is a resistance of one billion ohms. Besides, the junction contact means high stability and immunity from mechanical and aging effects.

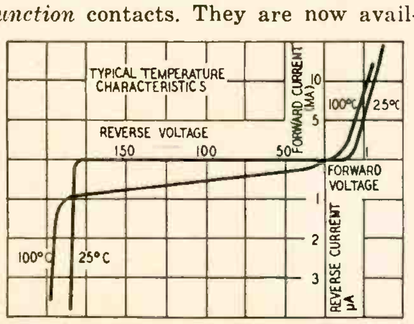

Fig. 1—Temperature characteristics of the 1N433 silicon junction diode.

Typical characteristics of silicon junction diodes are listed below; these are Raytheon types:

Diode	Continuous inverse voltage	Average rectified current *(ma)*
1N300	12	40
1N301	60	35
1N302	215	25
1N303	110	30
1N432	35	60
1N433	135	50
1N434	170	45
1N460	85	40

The maximum inverse current (at 10 volts) of all types is .01 μa, except for the 1N432 (.005 μa) and the 1N300 (.001 μa). This compares with 10 μa for a 1N81 diode, formerly considered a high-back-resistance diode. The inverse voltages listed above are continuous values. Peak values are somewhat higher.

Fig. 1 is a typical graph of a 1N433 silicon junction sealed diode. The horizontal portion of the curve denotes very high (more than 1,000 megohms)—resistance in reverse direction. Even at 100°C the characteristic is still excellent. This feature is lost if more than 175 volts is applied in the reverse direction, at which point "breakdown" occurs. This is not destructive in itself, but it may lead to excessive dissipation which may ruin the diode.

All diodes listed above are only about ¼ inch high and wide. Their two leads may be soldered directly into a circuit or they may be clipped and inserted into a socket.

To summarize, the new diodes have the following features:

1. Safe operation at high temperature
2. Extremely low reverse current
3. High stability
4. Tiny size

The data are impressive, but how do the new diodes compare with conventional types in a practical circuit? I tried a pair of 1N433 diodes to see how they might improve the "Transistor DC Transformer" described in the December, 1955, issue. A modified schematic is shown in Fig. 2. The transistor is used as an audio oscillator, with the af stepped up and then rectified. The original article mentioned the problem of poor diode action. These rectifiers permitted considerable reverse current which lowered the available output. Since the generator puts out a current in microamps, the loss of a small current might seriously affect the available voltage.

Replacement with silicon junction diodes made an amazing improvement! Whereas the original circuit was able to ignite a neon lamp only after considerable coaxing, the circuit of Fig. 2

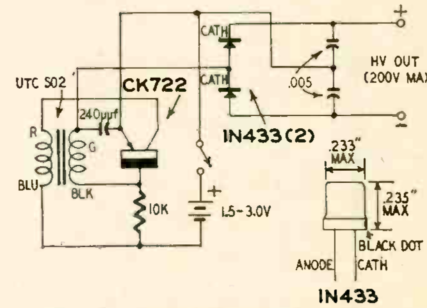

Fig. 2—Modified audio oscillator.

does it easily. There is no need to select diodes or to use only new penlight cells. Furthermore, where it required *two* cells to ignite a lamp across the output terminals, a *single cell* can now do it. The no-load voltage which was 70 or 80, now reaches a peak of nearly 200! With a drain of 35 μa, the output voltage is about 90.

This improvement has made it possible to add features to the high-voltage generator (Fig. 3). Generator

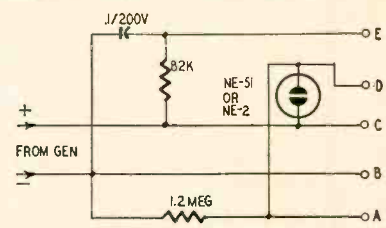

Fig. 3—Features added to oscillator.

output terminals B and C provide nearly 200 volts, depending upon load. Terminals C and D are across the neon lamp, therefore their voltage is regulated so long as the lamp remains lit. This voltage will remain within a few volts of 60 (up to a drain of 40 μa or more) so long as the lamp is not extinguished.

Terminals B and E are filtered leads. The R-C network removes practically all of the ac component (from the oscillator). A pair of phones across these leads shows hardly a trace of audio. A blocking capacitor must be used in series with the phones. END

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Superior's New Model TW-11
STANDARD PROFESSIONAL

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- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
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- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus **it is impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

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

EXTRAORDINARY FEATURE

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

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

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TUBE TESTER

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- The Professional Serviceman, who needs an extra Tube Tester for outside calls.
- The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

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

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

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

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

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

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

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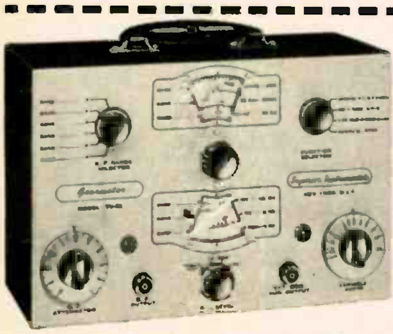

Superior's New
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A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

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

7 Signal Generators in One!

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

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

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

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

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

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

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

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

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Superior's New
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PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C.R. Tubes and nothing else.

Tests ALL magnetically deflected tubes...in the set...out of the set...in the carton!!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (Ion trap need not be on tube). Throw switch up for quality test...read direct on Good-Bad scale. Throw switch down for all leakage tests.

Model TV-40 C.R.T. Tube Tester comes absolutely complete — nothing else to buy. Housed in round cornered, molded bakelite case. Only

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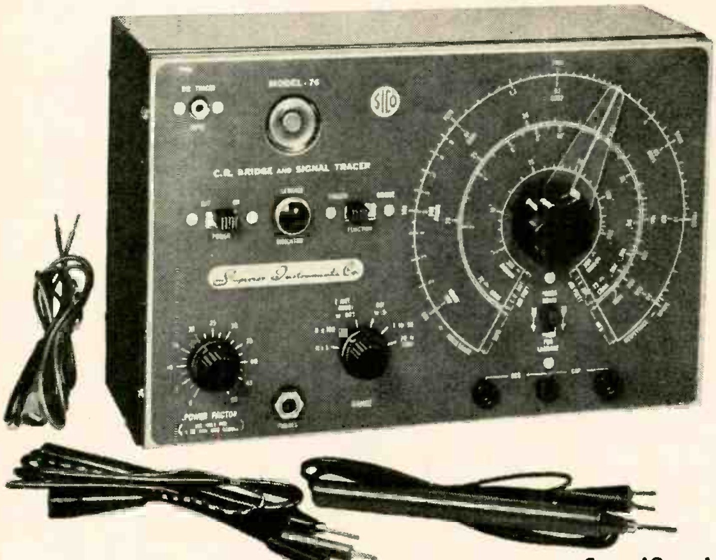
Superior's New Model 76



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CONDENSER BRIDGE
with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A
RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms

IT'S A
SIGNAL TRACER
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A
TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

Specifications

✓CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✓RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

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A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✓TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy.
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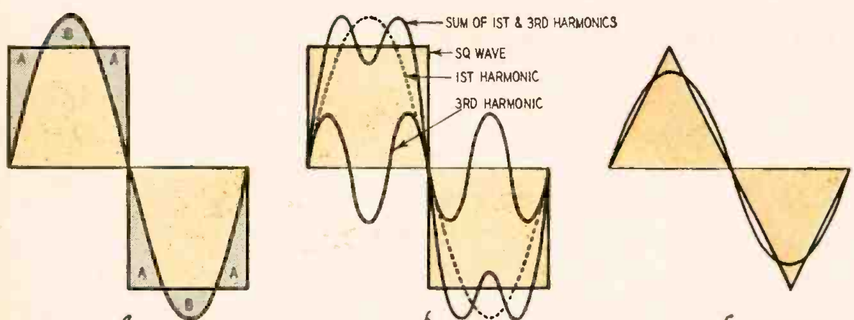
$$y = f(x) = A_0 + A_1 \sin x + B_1 \cos x + A_2 \sin 2x + B_2$$

Harmonic Analysis MADE EASY

Analyze harmonics without higher mathematics

By ARNOLD R. SHULMAN



a — SQ WAVE SHOWING SINE WAVE (1ST HARMONIC) WHICH BEST APPROXIMATES ORIGINAL SQ WAVE

b — SQ WAVE 1ST HARMONIC & 3RD HARMONIC. THE 3RD HARMONIC IS THE SINE WAVE 3 TIMES THE FREQ OF THE 1ST HARMONIC. THIS SINE WAVE WHEN ADDED TO THE 1ST HARMONIC WILL BEST APPROXIMATE THE ORIGINAL SQ WAVE

c — SAWTOOTH WAVE SHOWING SINE WAVE (1ST HARMONIC) WHICH BEST APPROXIMATES THE ORIGINAL SAWTOOTH WAVE

Fig. 1—Waveforms and their sine-wave approximates.

MOST of us, while watching a waveform on an oscilloscope, have wished we could measure the harmonic content. Many of us know that the harmonic content of any wave can be determined by Fourier analysis. The trouble is that Fourier analysis requires a knowledge of higher mathematics. Fortunately there is a method for determining the harmonic content of a wave without using higher mathematics.

Sine waves have been adopted in engineering as the fundamental waveform. Sinusoidal voltage is the only voltage waveform such that, when applied to a resistance, inductance or capacitance, the current will have the same waveform. By using the sine wave as a reference, a waveform can be analyzed into a number of sine waves of different frequencies. This is Fourier analysis.

These sine waves of different frequencies are called the first harmonic or fundamental, second harmonic, third harmonic, etc.

Fig. 1-a shows a square wave. It doesn't look anything like a sine wave, but the figure shows that a sine wave can be drawn to approximate it. The sine wave that will best approximate this square wave will have a definite phase and magnitude with respect to it. This best-fitting sine wave is the first harmonic. If the square wave is to be applied to a circuit, its effects may be calculated by assuming that the first-harmonic sine wave was applied and by doing the calculations based on that waveform.

Practically all formulas used in electrical engineering are based on sine waves. Most instruments are calibrated for them—a square wave would cause the average multimeter to read 11% high. The ability to approximate any wave with sine waves is extremely important.

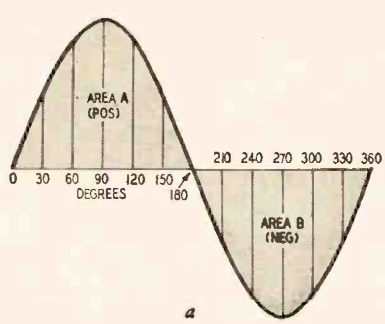
Actually the first harmonic is a poor approximation of the square wave. The shaded areas A are not included, and area B is outside the square wave. The next step is to find a sine wave of another frequency which, when added to the first harmonic, will more closely approximate the square wave, adding to the areas marked A and subtracting from the areas marked B. The third harmonic (a sine wave three times the frequency of the first harmonic) will do that (see Fig. 1-b). If appropriate higher harmonics were found and added to the first and third, a closer approximation would be found.

It is evident that the first harmonic is a good approximation of the sawtooth wave in Fig. 1-c. It could be used in many calculations without introducing a significant error. However, Fourier analysis permits *any* continually periodic waveform to be represented and measured.

Graphic analysis

The graphical procedure which follows is a close approximation to the accurate mathematical solution (see

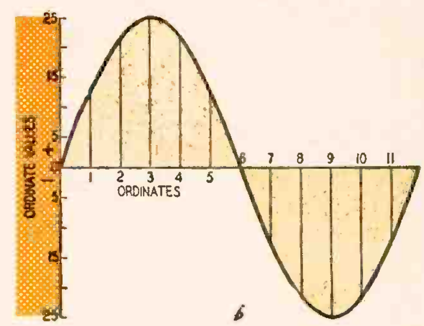
Fig. 2—Sine waves with their ordinates and ordinate values charted.



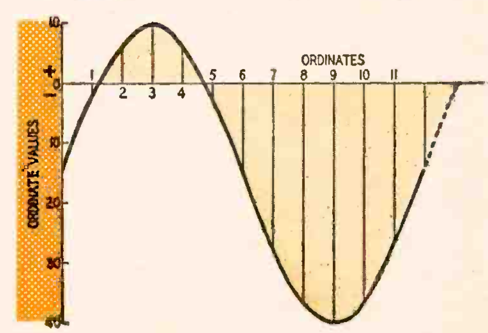
a

ORDINATE	VALUE
0	0
1	+ 12
2	+ 21
3	+ 25
4	+ 21
5	+ 12
6	0
7	− 12
8	− 21
9	− 25
10	− 21
11	− 12
SUM OF ORDINATE VALUES	0
AVERAGE ORDINATE	0

c



b



ORDINATE	VALUE
0	−15
1	−3
2	+6
3	+10
4	+6
5	−3
6	−15
7	−26
8	−36
9	−40
10	−36
11	−26
SUM OF ORDINATE VALUES	−178
AVERAGE VALUE = 1/12 SUM OF ORDINATES	−14.8

e

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$\cos 2x + A_3 \sin 3x + B_3 \cos 3x + \cdots A_n \sin nx + B_n \cos nx$

equation at the head of this article). It is particularly important because in most practical situations it is necessary to find only a few harmonics. The higher-frequency components are usually so small that they have little effect.

The first term of the equation is A_0, the dc component of the wave. Fourier analysis can of course be used to analyze a waveform with no dc component, such as the sine wave of Fig. 2-a. In this wave, a voltage (or a current, if you like) starts from zero and reaches a positive maximum in 90°, one-quarter of a cycle. In the next quarter it drops to zero and in the third starts in the other direction and reaches a maximum. In the last quarter it drops to zero and is ready to start all over again.

To analyze the wave, we set up a number of *ordinates*, evenly spaced along the cycle, to give us its value at the instants the ordinates represent. (We say "value" because the curves may represent voltage or current.) In our examples ordinates are placed every 30°, giving 12 ordinates a cycle. For greater accuracy more ordinates—say one every 10°—could be set up, but every 30° is enough for most waveshapes.

We number our ordinates from 0 to 11 (ordinate 12 is ordinate 0 since it starts the cycle again). The table, Fig. 2-c, is then made. To find the average ordinate, representing the dc value of the wave, we add all the values and divide by the number of ordinates. In this case, the average value is zero, as is the case with all symetrical ac sine waves.

Fig. 2-d shows a wave of exactly the same shape as 2-a or 2-b, but with a different zero axis. Most of this wave is negative. Fig. 2-e shows that the dc component of the wave is −14.8. This is the value a dc meter would indicate. The next step is to determine the magnitude of the first harmonic. Mathematically this is represented by $A_1 \sin x + B_1 \cos x$ where

$$A_1 = \frac{1}{\pi}\int_0^{2\pi} y \sin x \, dx$$

$$\text{and } B_1 = \frac{1}{\pi}\int_0^{2\pi} y \cos x \, dx$$

Graphically this means, to find A_1, take the sum of the ordinates each multiplied by the sine of the angle at which it occurs, and divide by half the number of ordinates used. To find B, take the sum of each ordinate multiplied by the cosine of the angle at which it occurs, and divide by half the number of ordinates used.

Let us work with the square wave of Fig. 3-a. The 360° are divided into 12 intervals and the ordinate length determined. The table (Fig. 3-b) is then made. Next the respective ordinate values are placed end to end in a *vector polygon* (see Fig. 3-c) with each ordinate placed at the angle it appears in the cycle. This takes care of the multiplication by the sines and cosines of the respective angles at which the ordinates occur.

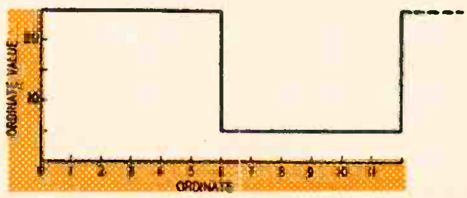
Computing resultant vectors

The *resultant vector* Z, drawn from the point of origin to the end of the last of the ordinates, gives the total value of all the vectors and can be analyzed in terms of its component vectors. The sum of the ordinate (vertical) values of these is equal to the vertical value of the resultant. The sum of the abscissa (horizontal) values of the vectors is equal to the horizontal value of the resultant. Each vector value in the table (Fig. 3-b) times the sine of its respective angle gives the ordinate value (A_1) and each of them multiplied by the cosines of their respective values gives the abscissa value (B_1).

If the vectors do not terminate at a point on the line OB of Fig. 3-c, this displacement is found by drawing a line from the origin (O) to the terminating point and measuring the angle between the two lines clockwise from OB. This angle is the phase displacement in degrees from the origin (Fig. 3-d).

The second and third harmonics are found by drawing graphs similar to those of Figs. 3-b and 3-c. Since the second harmonic is twice the frequency of the first, it will go through 60° while the first harmonic goes through 30°. Thus the ordinates are drawn at a 60° angle to each other, as in Fig. 4. The third harmonic is *three* times the frequency and the quantities are 90° apart, as in Fig. 5. Measuring our resultants, we find that the first harmonic vector is 74.6 units long, making its value 12.4 (1/6 of 74.6). The second harmonic is zero, and the third harmonic is 1/6 of 20, or about 3.3, in phase with the first harmonic.

So far we have dealt with positive



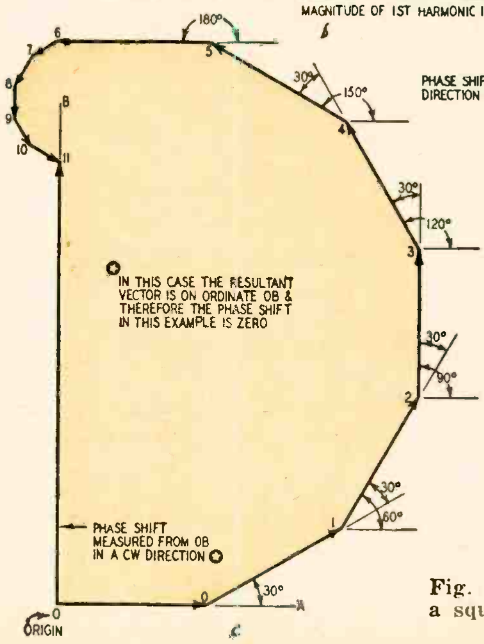
a

ORDINATE	ORDINATE VALUE	ANGLE (DEGREES)	SINE ANGLE	COSINE ANGLE	ORDINATE VALUE TIMES SINE ANGLE	ORDINATE VALUE TIMES COSINE ANGLE
0	25	0	0	+ 1	0	+ 25
1	25	30	+ .5	+ .866	+ 12.5	+ 21.6
2	25	60	+ .866	+ .5	+ 21.6	+ 12.5
3	25	90	+ 1.	0	+ 25.	0
4	25	120	+ .866	− .5	+ 21.6	− 12.5
5	25	150	+ .5	− .866	+ 12.5	− 21.6
6	25	180	0	− 1.	0	− 25.
7	5	210	− .5	− .866	− 2.5	− 4.3
8	5	240	− .866	− .5	− 4.3	− 2.5
9	5	270	− 1.	0	− 5.	0
10	5	300	− .866	+ .5	− 4.3	+ 2.5
11	5	330	− .5	+ .866	− 2.5	+ 4.3
				SUM	+ 74.6	0
				1/6 SUM	+ 12.4	0

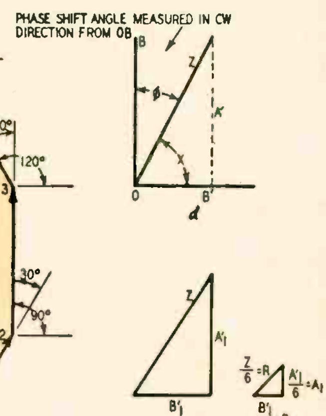
12 | 200
16.7 AC OR DC VALUE

MAGNITUDE OF 1ST HARMONIC 12.4 WITH NO PHASE SHIFT

b



c



d
e

Fig. 3—Vector diagram of a square wave and method of construction.

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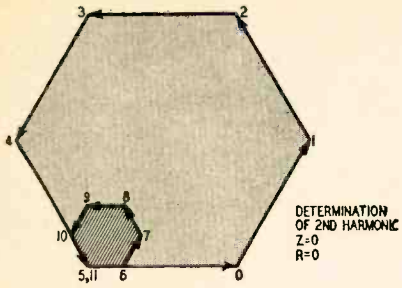


Fig. 4—Vector diagram of a square wave's second harmonic.

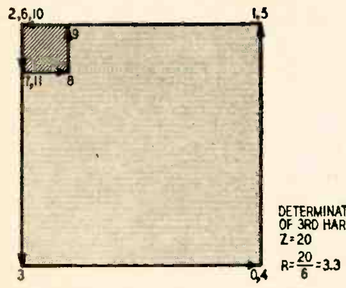


Fig. 5—Vector diagram of a square wave's third harmonic.

quantities only—all our ordinates have been measured *up* from the base line. In actual work true ac forms appear on *both* sides of the zero axis. The same method will work, only the vector additions are more difficult. For example take a combination of fundamental and second harmonics. To be sure we get the right wave, we can draw a sine wave (first harmonic) (dashed lines of Fig. 6) and another of twice the frequency (second harmonic) (dotted lines). Then we add the two together at a large number of points, and draw the resultant (solid line).

Now as seen from Table I, a number of our quantities are negative—measured *downward* from the axis. Note that when a negative quantity is added, the angle and distance are the same as for a positive quantity, but the line is drawn *backward.* Thus a 210° quantity, instead of being drawn down and to the left at an angle of 30° from the horizontal, is drawn *up* and to the right.

Drawing the vector polygon for the first and second harmonics of the wave, we find that the amplitude (peak) of the first harmonic is 10 and the second 5. Had we started out with a single complex wave like the solid line of Fig. 6, we would now be able to draw the two waves of which it is composed.

In drawing sine waves like the first and second harmonics in Fig. 6—or any combination of harmonics in any wave the reader may analyze—the *unit circles* of Fig. 7 are useful. The first circle is drawn with a radius of 10, that of the first-harmonic peak value. The second has a radius of 5, the second-harmonic peak. The circles are divided into 30° segments, and the base of the sine wave is laid out at the same level as the center of the circle. The circle is divided into 12 sections, one for each ordinate, 30° apart. Then a horizontal projection from the 30° point on the circle to the 30° ordinate will give the correct amplitude (height) for that point. The other ordinates are similarly handled and the points connected for a sine wave.

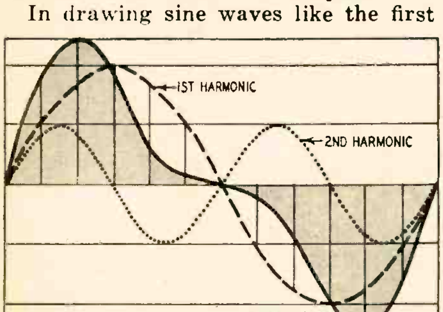


Fig. 6—Fundamental, second harmonic and resultant.

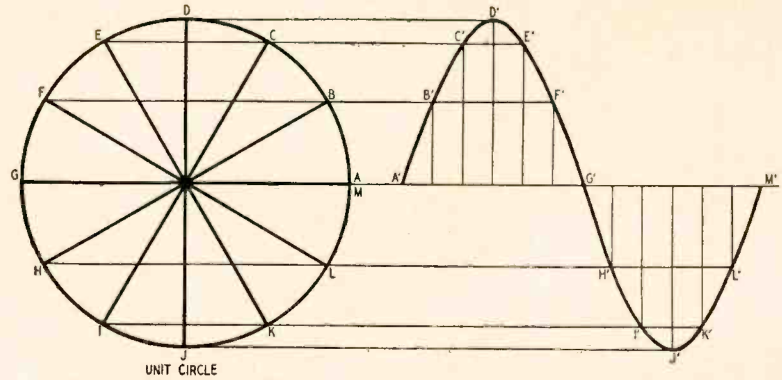


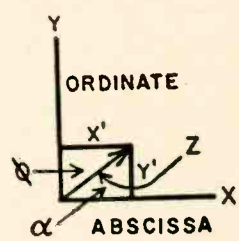
Fig. 7—A unit circle used to construct a sine-wave drawing.

Computing components arithmetically

Table I shows how the components of a wave may be determined arithme-

TABLE I—DETERMINING COMPONENTS OF WAVEFORM
(Values Taken From Figs. 3, 4 and 5)

Component	Ordinates	Values	
Dc	0	25	Dc component = 1/12 total = 200/12 = 16.67
	1	25	
	2	25	
	3	25	
	4	25	
	5	25	
	6	25	
	7	5	
	8	5	
	9	5	
	10	5	
	11	5	
	Total 200		



	Ordinate Operation	Ordinate Values	Total Values	Multiply Values by	Product	
1st Harmonic	+0−6	+25−25	0	+1	0	Resolve Abscissa and Ordinate for Resultant
	+1+11−5−7	+25+5−25−5	0	+0.866	0	$Z=\sqrt{x^2+y^2}=\sqrt{0^2+74.6^2}$
	+2+10−4−8	+25+5−25−5	0	+0.5	0	$Z = 74.6 \quad 1/6\,Z = 12.4$
				Abscissa	0	$\tan\alpha = \frac{x}{y} = \frac{0}{74.8} = \infty$
	+3−9	+25−5	+20	+1	+20	$\alpha = 90° \quad \phi = 0°$
	+1+5−7−11	+25+25−5−5	+40	+0.5	+20	
	+2+4−8−10	+25+25−5−5	+40	+0.866	+34.8	
				Ordinate	+74.6	
2nd Harmonic	+0+6−3−9	+25+5−25−5	0	+1	0	Resolve Abscissa and Ordinate for Resultant
	+1+5+7+11 −2−4−8−10	+25+25+5+5 −25−25−5−5	0	+0.5	0	$Z=\sqrt{x^2+y^2}=\sqrt{0^2+0^2}$
				Abscissa	0	$Z = 0$
	+1+2−4−5+7 +8−10−11	+25+25−25−25 +5+5−5−5	0	+0.866	0	$\tan\alpha = \frac{x}{y} = 0$
				Ordinate	0	$\alpha = 0$
3rd Harmonic	+0+4+8−2−6 −10	+25+25+5−25 −25−5	0	+1	0	Resolve Abscissa and Ordinate for Resultant
				Abscissa	0	$Z=\sqrt{x^2+y^2}=\sqrt{0^2+20^2}$
	+1+5+9−3−7 −11	+25+25+5−25 −5−5	+20	+1	+20	$Z = 20 \quad 1/6\,Z = \frac{20}{6}$, $\frac{20}{6} = 3.33$
				Ordinate	+20	$\tan\alpha = \frac{x}{y} = \frac{0}{20} = \infty$
						$\alpha = 270°$

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tically, without drawing any figures. It is derived from Figs. 3, 4, and 5. First the dc component is found by adding the ordinates and dividing by 12. In the case of our square wave, it comes to 16.7. This is the value a dc meter would read. To find the alternating component, each value is multiplied by the sine and cosine of its angle to find a resultant value and the phase shift. The resultant is divided by half the number of ordinates used to find the amplitude of the component. This is actually what we have been doing in the diagrams. For example, a line 10 units long at an angle of 30° to the horizontal will be found to have risen 5 units.

The end of the line will be 5 units above a point 8.66 units from its origin, the 8.66 being measured along the abscissa. The sine of the 30° angle is 0.5 and the cosine 0.866.

It can be seen from Fig. 3 that vector 0 is entirely in the horizontal direction and does not contribute any vertical component to the resultant vector Z. Vector 1 has a vertical component equal to the ordinate value of the wave (at 30°) times the sine of 30°. Vector 1 has a horizontal component equal to the ordinate value of the wave (at 30°) times cosine 30°. We can find the vertical and horizontal components in the resultant vector by simply adding the vertical and horizontal components of each of the respective component vectors in turn.

When adding horizontal components a vector moving toward the right on the graph has a positive value; to the left a negative value. With vertical components a vector moving up has a positive value; down a negative value. A chart to simplify this procedure is shown in Table I. The values used are from Figs. 3, 4 and 5.

When we have added all the horizontal components together, we have the horizontal component of the resultant Z. (In this example it is zero.) Then we add the vertical components together to find the resultant vertical component (74.6). The next step is to find the magnitude of the resultant from its horizontal and vertical components.

In our example the vertical component was 74.6 and the horizontal component was zero. The magnitude $Z = \sqrt{x^2 + y^2} = 74.6$. The angle that the resultant makes with the horizontal is $\tan \theta = \frac{y}{x}$ but the phase shift is measured from the vertical (OB of Fig. 3) therefore $\tan O = \frac{x}{y}$. We have determined the phase shift and what remains is to determine the amplitude of the first harmonic. This is done by taking one-sixth the resultant Z: $1/6Z = \frac{74.6}{6} = 12.4$. With this explanation it should be easy to follow Table I to determine the amplitude and phase of the various harmonics, without having to draw a figure. END

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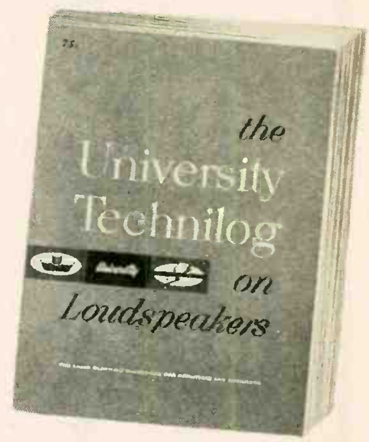

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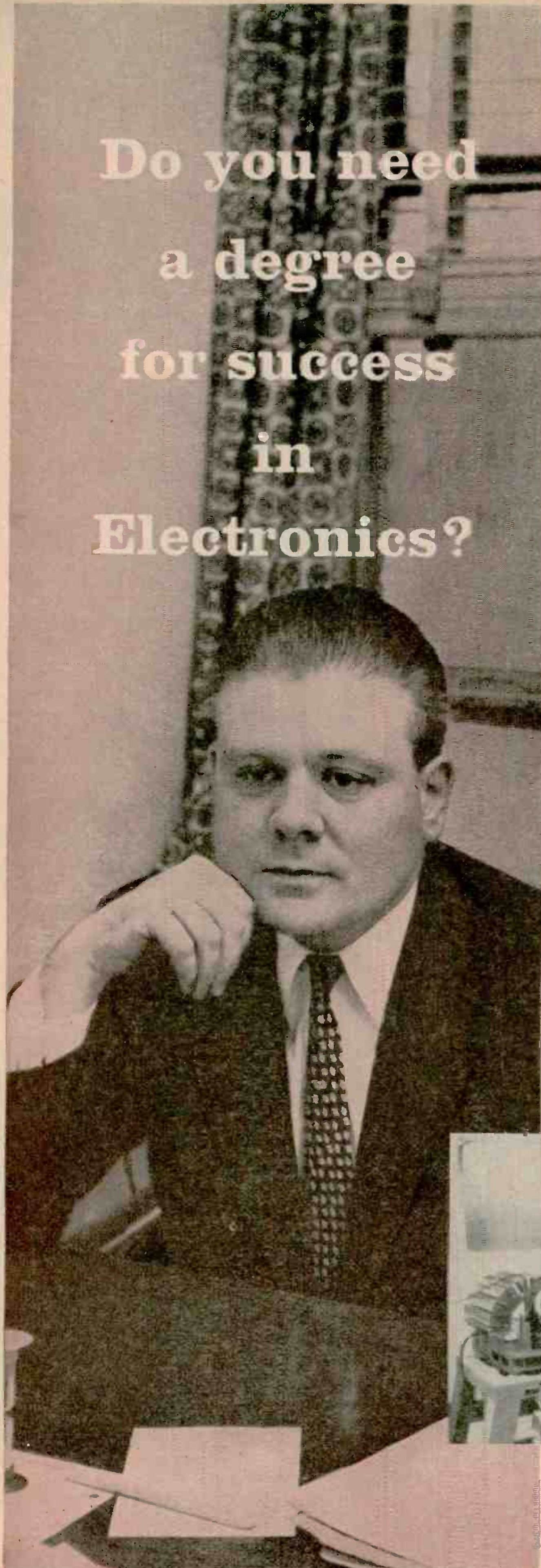

"Not necessarily," says Dick Brani, Instructor in Project Sage at IBM—Kingston, New York. "Oh, sure—I'm aware of my limitations to design electronic equipment—that's the big advantage of a formal degree. But I am qualified to maintain it. The point is . . . there are many management positions in IBM for men like myself, and I'm convinced that comparable positions elsewhere would probably require an engineering degree."

Some years ago, IBM took the initiative with respect to technical training within its own organization. It realized, even then, that a great number of intelligent and capable men were falling by the wayside because they lacked 4 years of college engineering. Statistics indicated that because of financial difficulty or improper high-school preparation, close to 50% of the potential engineers in the country became lost in the educational shuffle. While some people ignored or bemoaned the fact, IBM did something about it. Consequently, men like Dick Brani now enjoy satisfying, more rewarding work than ever before.

Great Interest in Mathematics. While Dick was attending high school, his principal academic interest was mathematics. And, like many other young men of that time, Dick was realistic about his future. He decided his best bet might be business accounting. When Dick graduated, he accepted a position with a New York banking firm. It was not until he entered the Army that he had the opportunity to pursue a more advanced form of mathematics—an A.S.T.P. training program at Lehigh University. This all-too-brief experience convinced Dick that he should make his career in a field related to electrical technology.

Postwar Education. Discharged with the rank of Staff Sergeant, Dick returned home to marry a girl he had met at Lehigh. During this period, he successfully supported

Dick trouble shooting Magnetic Drum Frame.

He studies computer pluggable unit.

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his family selling various lines of food. In the evening, however, Dick continued his study of radio, TV, and electronics at the Allentown Branch of the Temple Institute. In two years' time, he graduated and secured an F.C.C. license—his technical career began to take shape.

IBM Looks Especially Good. Glancing through an issue of *Time Magazine* one evening, Dick happened to read an article about Thomas J. Watson, Jr., the president of IBM. The story emphasized Mr. Watson's great faith in the future of electronic computers . . . the wonderful promise it holds for the ambitious, intelligent young man. Later, Dick spotted a classified ad describing IBM's association with Project Sage. That was all Dick Brani needed.

Asked to Become an Instructor. Three-quarters of the way through his nine-month computer systems course, Dick was invited to remain at Kingston as an instructor. "It was like a bolt out of the blue," he recalls. "I knew I'd enjoy teaching, but I always thought it was out of the question. I accepted all right. I can't tell you how much I've enjoyed helping these fellows and watching them grow within the organization. Right now, there's a fellow in my class whose education is limited to correspondence school. He's in the top third of his class, and has a real future with IBM—all because he has the native talent and is willing to work."

What Does Dick Brani Teach? "Actually, I teach three separate courses in field engineering. One is computer systems testing, which is for the more advanced student. It lasts for 33 weeks—a long time, perhaps, but it's well worth it. Another is a program of 24 weeks' duration that deals with computer input-output units. Finally, I teach a course in computer units displays. This also lasts for 24 weeks. Each one of these courses is an education in itself." Experience has shown that IBM's educational programing is most successful. Men accepted receive their training with no strings attached. Upon graduation the road to success is wide open in *all* divisions of the corporation.

Computer Analyzes All Air Traffic. "This computer is really fantastic. It contains approximately 1,000,000 parts, and it's housed in a building 4 stories tall. Information is filtered in from Texas towers, picket ships, reconnaissance planes—even ground observers. Every object in the sky is analyzed. Then it checks each object against available traffic data and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against a 'baddie.' Only authorized personnel can make that decision."

What About Dick's Future? "Well, right now, I'm doing work that most technicians couldn't touch with a ten-foot pole. I guess it's a matter of approach, but I know of few companies other than IBM where technicians are actually doing engineering work. Both kinds of companies will get the job done, but IBM prefers to think in terms of the man, encouraging him to grow into more responsibility. You might say that IBM gets more out of the man. In the final analysis, it seems a lot more efficient from the corporation's and employee's viewpoint. Personnel policy at all levels—management, engineering, or technical—is the same. The future is wide open."

Just recently, Dick bought a home in Saugerties, near Kingston, where his wife Betty and their three children, David, 9, Sharon, 7, and Paul, 3, enjoy a pleasant, contented life together. Occasionally, in the summertime, Dick plays softball with his co-workers. But his family is—and always will be—his predominant interest.

What About You? Permanent opportunities in the nationally important Project Sage program are still growing. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, valued at many thousands of dollars as a Computer Systems Engineer. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training as a Computer Units Field Engineer, with opportunity to assume full engineering responsibility. *Assignment in area of your choice.* Every channel of advancement in the entire company is open. All the customary benefits and more. For more information, please write to: Nelson O. Heyer, Dept. 3106, IBM, Kingston, New York. You'll receive a prompt reply.

Dick explains computer logic to a Systems Class.

At the Operating Console.

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HAYDN: ***Symphony 103 (Drum Roll)***
Symphony 104 (London)
Scherchen and Vienna Symphony Orchestra
Westminster XWN-18327

I recently complained of the way one conductor submerged the drums in the Drum Roll symphony. This recording does the drums in both symphonies complete justice (and some may say "and then some"). Both of these are delightful as music and the very clean. Beautifully defined recording with big drums at their best.

MOZART: ***Concerto for Bassoon in B Flat (K191)***
Concerto for Clarinet (K622)
Rodzinski and Vienna State Opera Orchestra
Westminster WXN-18287

There are no better examples of Mozart's scores of concertos for various instruments. With a bassoonist in the family, I am especially interested in that instrument. This particular instrument has a rather individual tone and is played with the necessary virtuosity. The clarinet concerto is quite a favorite and does the instrument proud. Together the two sides offer good test material for the mid-bass and mid-high ranges, as well as very pleasant music.

SURINACH: ***Sinfonietta Flamenca***
TURINA: ***Sinfonia Sevellana***
Winograd and Philharmonia Orchestra of Hamburg
MGM E-3435

Surinach especially gives the percussion section plenty of work which it performs well, and the recordist has recorded with fairly spectacular effect. Not as engaging as the same composer's very amusing *Madrid 1890*, but not at all hard to take as music and gratifying as to sound. Turina's work is more DeBussy—and De Falla-like and causes no pain whatsoever. The two works represent two generations of modern Spanish composers and present a fine sound-picture of the progress of music in Spain in this century.

DVORAK: ***Symphonic Variations (Op. 73)***
Scherzo Capriccioso (Op. 66)
Winograd and Philharmonia Orchestra of Hamburg
MGM E-3438

The *Scherzo* is one of Dvorak's most popular shorter works and makes a good demonstration piece what with plenty of drums and high-highs, plus some spectacular peaks (which, however, may overdrive some pickups). The *Variations* are less well known but make good listening. The recording is live and provides a fine sound.

HOVHANNES: ***Saint Vartan Symphony***
Surinach conducting MGM Chamber Orchestra
MGM E-3453

The music of Hovhannes is absolutely individual and unique. It has a color nobody else has even remotely approached. In it Western modernism, Near-Eastern modalities and preclassical musical forms combine in a remarkable and exotic blend. It does not take any great tolerance to be emotionally affected by it, intellectually impressed by the virtuosity of the writing and aurally impressed by the unusual sound. If you do not know Hovhannes, you should and this is a good example.

HAYDN: *Symphony No. 33*
Symphony No. 46
Winograd conducting Philharmonia of Hamburg
MGM E-3436

These are among the best of Haydn's middle or transition period. Not played as often as the London symphonies, they are pleasant to listen to and this recording is one of the best from this orchestra—clean, well defined and balanced, and with a nice liveness.

BIZET: *Carmen Suites 1 and 2*
L'Arlésienne Suites 1 and 2
Rodzinski and Philharmonic Symphony of London Westminster XWN-18230

Here on one record is the most popular of Bizet's music in orchestral versions. The fine recording does complete justice to the more spectacular moments without losing balance. It is another extremely fine demonstrator of how high-fidelity reproduction enhances music. Portions of it present demonstration material with plenty of big drums, cymbals, triangles, tambourines, sharp peaks, dynamic contrasts and a high degree of presence. One of the most satisfying records for hi-fi listening I know of.

Symphonic Dances
Hollywood Bowl Orchestra conducted by Slatkin
Capitol P-83-69

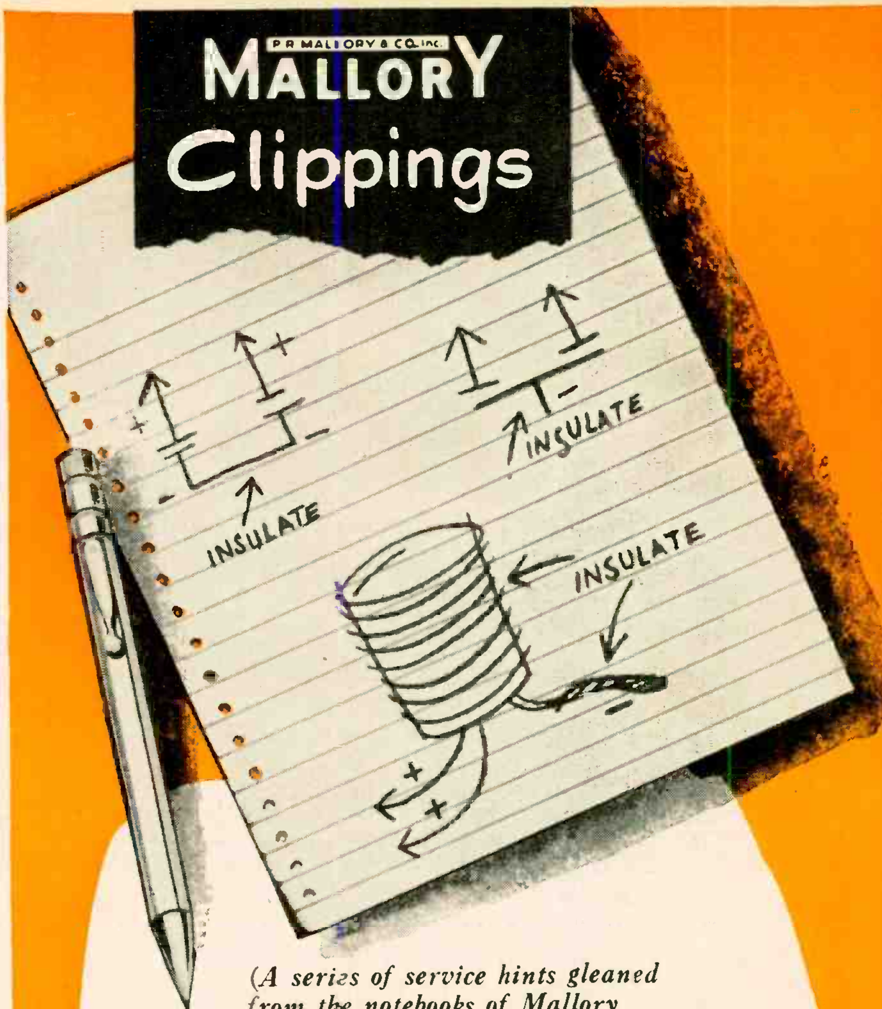
Dealers in hi-fi could do far worse than put in a standing order for the entire series of these potpourris by the Hollywood Bowl Orchestra. There are better demonstration records, but for the run of the mill hi-fi customer these will do nicely. The entire series would make a spectacular background sound for a hi-fi emporium. This particular one presents an excellent assortment of various effects—good basses in the *Waltz* from *Sleeping Beauty;* trap drums in the *Galop* from the *Comedians;* triangles and cymbals in Grieg's *Norwegian Dance No. 2;* soft delicate chording in Ravel's *Pavane;* a spectacular overall sound and both tapped and rolled tambourine in Gliere's *Sailor's Dance;* flutes, brass and a big climax in Bizet's *Farandole;* a sharp, damped drum in Massenet's *Navarraise;* pizzicato strings in the *Pizzicato Polka;* and a fine spectacular finish in the *Sabre Dance* and *Bacchanale.* The bass is not overwhelming, the big drum is soft, the balance is excellent. This is very live, with a big echo; as a result, definition is not tops but presence is high.

BERLIOZ: *Overtures, Roman Carnival, Corsair, Rob Roy*
Boult conducting Philharmonic Promenade Orchestra
Westminster W-LAB 7051

Berlioz was one of the greatest masters of orchestration. To appreciate this mastery, top-quality reproduction and definition are necessary. These works aren't the best examples of his skill, but check what you hear against the timed notes; if you can hear all the effects your system should pass for definition. Very lovely sound throughout, extremely clean and well-defined, with very fine presence, and just live enough for a well-furnished living room. There are some good drums, a first-class string bass, fine brasses and some high highs. *Roman Carnival* is well known; the other two less frequently heard. All three are pleasant music. A fine example of top level contemporary recording style in a very superior pressing.

Honky-Tonk in Hi-Fi
Westminster WP-6033

Some years ago we had a *Spectrotune* recording of some of the immediate predecessors of the jukebox. This presentation of nickelodeons, including the *Seeburg Orchestral Piano,* the *Orchestron,* the *Nelso-Wiggin Orchestron,* the *Link Piano* and the *Wurlitzer Pianino,* from the Deansboro, N. J., collection, presents instruments in far better condition and with a faithfulness that will take you right back to the speakeasy.



(A series of service hints gleaned from the notebooks of Mallory design and application engineers)

Once in a while, on some special service job, you're apt to need a *non-polarized* capacitor. Here's a way to make temporary repairs until you can get down to your distributor's for a Mallory replacement.

Use a common negative dual capacitor, each section having the *same* voltage rating and *twice* the capacity rating as the unit being replaced. Use the two positive leads *only*—don't connect the negative lead (or the can) to anything, just insulate them well!

Assuming sufficient physical space, the same thing can be done with two single capacitors—by connecting the negative leads together and insulating them, and the cans, carefully. Use the two positive leads.

Of course, for an exact replacement or temporary repairs such as above, you ought to use Mallory FP Capacitors. They're tougher, longer lived, and plenty dependable—but, you probably know that from experience. See your Mallory Distributor today—lay in a working replacement stock.

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Nelson-Wiggin obviously had the best arrangers and the several selections played on its orchestron display considerable virtuosity. There are all sorts of sounds useful for hi-fi testing or gratifying to the ear. Especially notable are the extremely rapid bursts on the xylophone of the Link piano which approach the limit of the ears' resolution and therefore present an extremely useful test for transient response, hangover, cabinet and speaker resonance, etc.

BACH: *Musical Offering*
Scherchen conducting Special Ensemble
Westminster XWN-18375

One of the all-time masterpieces and an incomparable test for definition. Parts of this contain the most involved counterpoint ever written and demand the best possible definition. The commentary details the work to provide guidance in checking the definition. Superb music, and the recording has a very fine tone quality, presents the instruments faithfully and with a high degree of presence.

HAYDN: *Symphonies Nos. 101 (Clock) and 102 in B Flat Major*
Scherchen conducting Vienna Symphony Orchestra
Westminster XWN-18326

Another in the series of Scherchen's readings of the London symphonies. Neither of these is as spectacular as the *Military* as to drums and high highs, though the *102nd* has plenty of kettledrums. They will yield on a first-class system a very opulent sound and, with a speaker system that provides a wide sound source, a very satisfying approximation of a live performance.

TOCH: *Symphony No. 3*
HINDEMITH: *Mathis der Maler*
Steinberg conducting Pittsburgh Symphony
Capitol P-8364

The *Toch* symphony, quite a sensation at its first performance a year ago by this orchestra, finds its first recording here and one that, so far as I can judge, does it justice. There is some quite remarkable sound here with some notable percussion effects and the sound of a "Hisser," a tank of compressed air whose release through a valve is provided for in the score. The music is rather like the background music for some ominous movie or TV—and no doubt will find wide use in those media. *Mathis der Maler* by Hindemith is "one of the cornerstones of modern music." I don't recommend this except to buffs of modern music, but those will find the recording well worth hearing.

Music of George Gershwin
Sandra Bianca, pianist, and Pro-Musica Orchestra of Hamburg conducted by Hans-Jurgen Walther
MGM 3E1 (three 12-inch LP's)

All of Gershwin's symphonic music, plus the three piano preludes. Some might prefer these performed by an American orchestra; on the other hand, I don't think the music suffers at the hands of this German one. Moreover, it is interesting to have a reading of it based on the scores and not conditioned by everyday living with jazz. Sandra Bianca, an American, does the piano work very competently. I like the album and the sound is excellent with good, though not overwhelming, drums; an excellent piano and a good assortment of high highs in the *Cuban Overture*.

Vistas D'Espana
Laurindo Almeida, Guitarist
Capitol P-8367

BACH: *Six Clavier Concerti after Vivaldi*
Sylvia Marlowe, Harpsichord
Capitol P-8361

I pair these for several reasons: first, they are as good recordings of the two instruments as I know of. The Marlowe is a closeup job which delivers the harpsichord into the room, with all its lovely bass, tinkling high highs, unique percussive qualities and transients. The more I hear these Marlowe recordings, the more I'd like to have a harpsichord. The Almeida records also gives us the guitar in its full glory, but complete with the various unintentional transients which (except in the hands of a Segovia) seems to be an inescapable concommitant of its marvelous capacities. Secondly, though they differ in appearance, they are essentially plucked string instruments and it is very interesting (as well as a good test of hi-fi quality) to hear how much they differ and in what respects. Finally, the music in both instances gives each instrument the fullest opportunity to reveal its versatility and special qualities—as well as the virtuosity of the performers.

WEIL, KURT: *Score for Johnny Johnson, Burgess Meredith and other soloists*
Samuel Matlowsky conducting orchestra
MGM E-3447

Most recordings of Broadway shows are atrocious—obviously tailored for the cheapest reproducing equipment, usually highly overcut, terribly balanced and intolerable on high fidelity unless the highs are rolled off at about 5,000 cycles. Here is one whose only fault is that it is cut at a higher level than symphonic recordings and may, therefore in one or two spots overdrive some pickups. The sound is first class, with an especially well-defined and pretty big bass, excellent reproduction of the voices, excellent presence and, all in all, quite comparable with the better classical recordings.

WAGNER: *Prelude, Good Friday Spell*
Siegfried Idyll
Prelude to Die Meistersinger
Steinberg and Pittsburgh Symphony
Capitol P-8363

About as much of Wagner as most of us want to hear at a sitting in a recording which does the extravagant music well in a big round, romantic sound. Especially good as an example of brasses well used, well played and recorded with a minimum of the stridency which so often overtakes brasses on records.

Nocturne
Carmen Dragon and Hollywood Bowl Orchestra
Capitol P-8363

This is the change of pace for ears soured or deafened by more spectacular hi-fi or for those who have just joined the "restful good music" club. Here are 10 of the most often played, such musical sentimentalities as: Massenet's *Elegie* and *Meditation*, Schuman's *Traumerei*, Brahm's *Cradle Song*, Wagner's *Evening Star*, etc., in suitably romantic renderings and an excellent recording.

Melachrino on Broadway
Melachrino Orchestra
RCA Victor LPM-1307

The Eyes of Love
Hugo Winterhalter Orchestra
RCA Victor LPM-1338

Tangos for Two
Harry Horlick and Orchestra
MGM E-3427

These will help relieve the shortage of pops suitable for demonstration. None is spectacular, but all are reasonably clean, despite being recorded at the high pop level, and present music likely to please. Melachrino and Winterhalter both belong to the "let the fiddles play in their top register school" and both present plenty of high-high shimmer. Winterhalter stresses the bowed and Melachrino the slapped bass, both with good beats. *Eyes of Love* has a dozen sentimental favorites like *With My Eyes Wide Open I'm Dreaming* and *I'll See You Again*, in dreamy arrangements; Melachrino devotes one side to tunes from *My Fair Lady* and the other to top hits of other Broadway shows. *Tangos for Two* presents 14 favorite tangos played with no progressive nonsense and a good beat for dancing. Pretty good bass, sharp trumpet and a nice overall sound, though it may overdrive some pickups. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*

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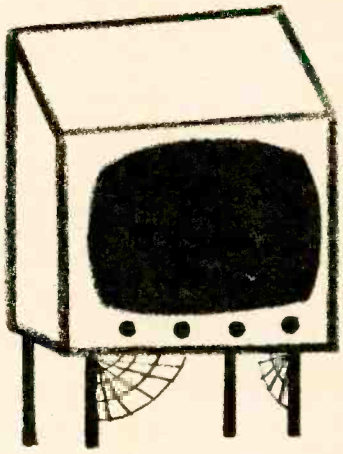
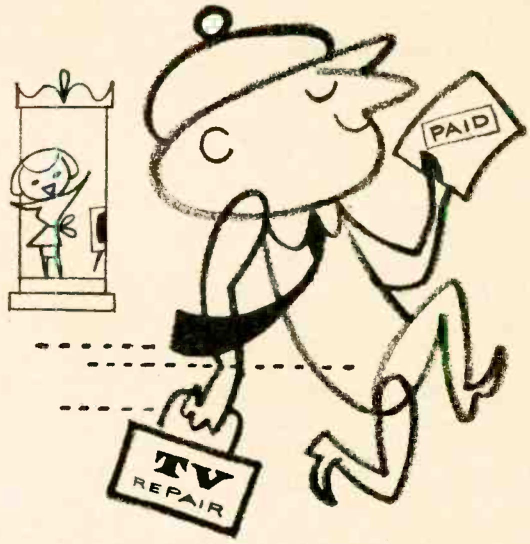
Reputation Builder #2: it pays to be prompt





- Only 51% of set-owners who wait 3 to 4 days for service are satisfied with the bill

- BUT . . . 69% of customers getting same-day service are satisfied with the bill

it pays to replace with Sprague Twist-Lok* Electrolytics

- Another way to build and hold a reputation is to insist on top quality replacement parts. Callbacks due to replacement failures not only cost you *money* . . . they also cost you customers! Replace with less than the best and you place your reputation at stake. In capacitors, the best is *Sprague.*

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- Get your copy of Sprague's latest radio and TV service catalog, C-455. Write Sprague Products Co., Distributors' Division of Sprague Electric Company, 81 Marshall Street, North Adams, Mass.

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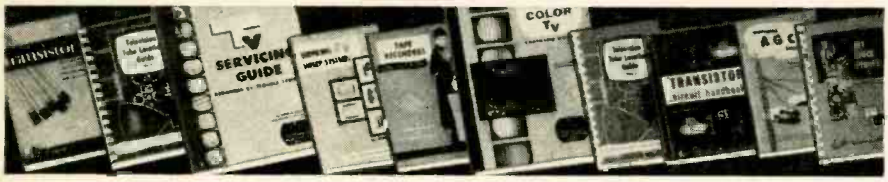

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TV Tube Location Guides. Shows tube positions and functions in hundreds of TV receiver models; helps locate faulty tube quickly; cuts trouble diagnosis and replacement time.
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Vol. 5. Covers receivers produced in 1953-1954. 200 pages; 5½ x 8½" **$2.00**

Color TV Training Manual. Prepares the service technician for Color TV work. Covers principles of the Color TV system; Color receiver circuits; installation and servicing of receivers. Includes color blocks outlining use of color test equipment. 260 pages; 8½ x 11"; 300 illustrations **$6.95**

Transistor Circuit Handbook. This authoritative book completely covers transistor types, construction, characteristics, wiring and testing techniques, basic circuits, circuit applications; includes reference charts, definitions; formulas. 430 pages; 6 x 9"; illustrated **$4.95**

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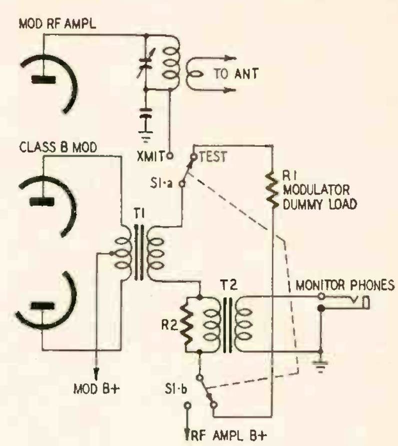
SIDE-TONE CIRCUIT

Most radio amateurs have, at one time or another, needed to monitor the modulator output of an AM transmitter. This usually occurs when a fellow ham reports distortion, hum or other types of audio troubles on the rf carrier. When troubleshooting the modulator, we are then faced with the problem of providing a dummy load to protect the modulation transformer during off-the-air tests.

The diagram shows the approach used by G5WW and described in *The Short Wave Magazine* (London, England). The side-tone signal for monitoring is reduced to a small fraction of the maximum available to avoid overloading the phones. The side-tone voltage is developed across R2 inserted in series with the B-plus side of the secondary of modulation transformer T1. A small audio interstage or output transformer T2 is bridged across R2 to isolate the phones from the B-plus circuit. Phones are plugged into the jack for monitoring while transmitting or testing the modulator alone.



The value of R2 is determined by the power output of the modulator and on the turns ratio of T2. Normally, you need not develop more than a few volts across R2. The wattage rating of R2 should be adequate to carry the current circulating in the secondary of T2.

Dummy load R1 should have a wattage rating equal to or greater than the maximum sine-wave output of the modulator and resistance approximately equal to the impedance of the modulated amplifier as found by dividing its plate voltage by plate current in amperes. For example, a 1-kw plate-modulated final amplifier may draw 400 ma at 2,500 volts. Its impedance as seen by the modulator is 2,500/0.4 or 6,250 ohms. Thus the modulator dummy load R1 should have a resistance in the range of 6,000 to 6,500 ohms and rating equal to the sine-wave output of the modulator—usually about 50% of the dc power input to the rf amplifier.

Power resistors are expensive and often unavailable in the desired wattage or resistance. A number of mail-order radio supply houses often list odd lots and assortments of high-wattage wirewound resistors at only a small fraction of their normal cost. A number of these can be selected and used in series, parallel or series-parallel to get the desired resistance and wattage at a great saving.

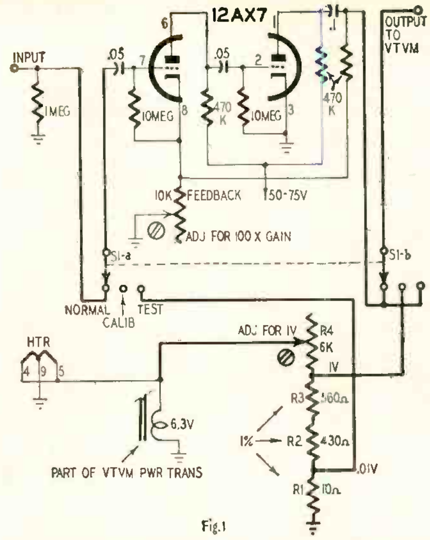


Fig. 1

REVAMPED MILVAMP

The Milvamp described in the December, 1955, issue is a clever and worthwhile accessory for the technician's vtvm. The self-calibrating feature that I've added simplifies initial adjustments and permits an instantaneous check on calibration.

Fig. 1 shows how I modified the instrument. I adapted the self-calibrating feature from the General Radio Sound-Level Meter described on page 121 of the April, 1953, issue of this magazine. The range control was replaced by a 1-megohm fixed resistor, and a double-pole 3-position switch and voltage divider were added. The voltage divider consists of precision resistors R1, R2, R3 and variable resistor R4.

With the switch set to CALIBRATE, R4 is adjusted for 1 or 1.5 volts on the vtvm. The switch is then thrown to TEST and the 10,000-ohm feedback control adjusted so the meter reads the same as in the calibrate position. This establishes the Milvamp's gain at 100. Now, switch to the NORMAL position and you are in business.

Fig. 2 is an experimental modification providing five voltage ranges by switching fixed resistors across the feedback control to vary the amplifier

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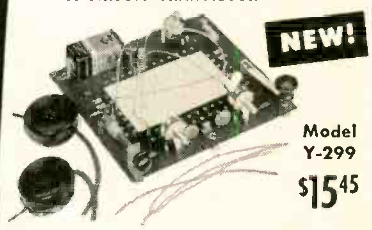

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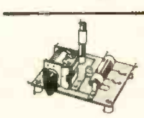
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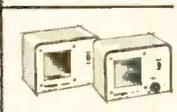
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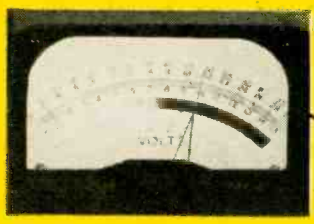
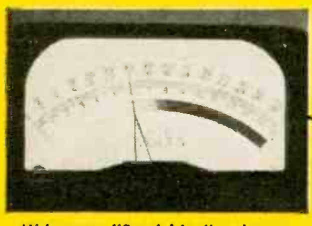
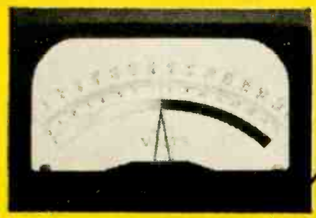


Low "fixed bias" point at −1 volt (bottom scale)



Mid-range "fixed bias" point at −3 volts (top scale)



High "fixed bias" point at −7.5 volts (bottom scale)

In determining the plate current (I_b) and Transconductance curves, grid bias is fixed at three points. These points, representing conditions of weak, average, and strong signals establish the nature of the plate current characteristic curve. The "fixed bias" points selected vary according to tube type.

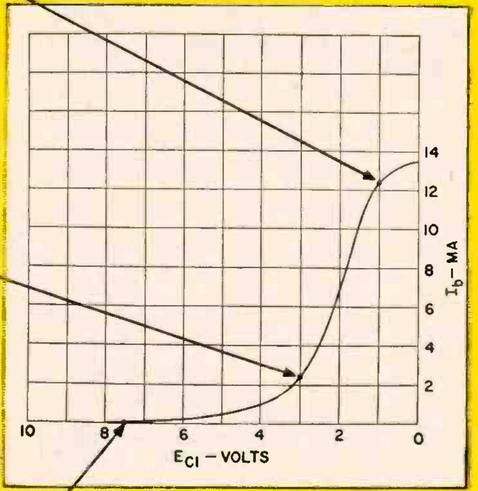


Plate current characteristics, shown on this typical test curve, are carefully controlled by the "fixed bias" test, assuring good performance and stable AGC functioning over a wide range of TV signal conditions.

Dynamic TV set conditions are set up in these test bridges making the "fixed bias" test a true measure of how the tube will perform in TV sets encountered by you in the field.

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for stable performance and service dependability

It has always been Sylvania's policy to search for new and better ways to test tubes under dynamic conditions for closer control over performance. The "fixed bias" test is typical of these techniques. It places a more stringent, realistic measure on the tube's ability to perform under varying circuit conditions.

By controlling the plate current characteristics and transconductance of IF amplifier tubes, the "fixed bias" test gives the serviceman an extra measure of dependability regardless of make, model, or age of the TV set serviced.

The range of stable operation is controlled, too, for smooth AGC action over wide variations in signal strength.

These are the same reasons that Sylvania IF types are the choice of leading TV set manufacturers, attested by the wide assortment of Sylvania original types listed among IF tubes now in popular use.

In addition to the "fixed bias" test many other electrical tests are performed on Sylvania IF amplifier types including stability during life. During life tests, close controls are placed on interelectrode leakage.

In every way, Sylvania IF amplifier types offer you maximum assurance of trouble-free service based on sound, newly developed testing methods. Specify Sylvania IF amplifier tubes in the new yellow and black carton.

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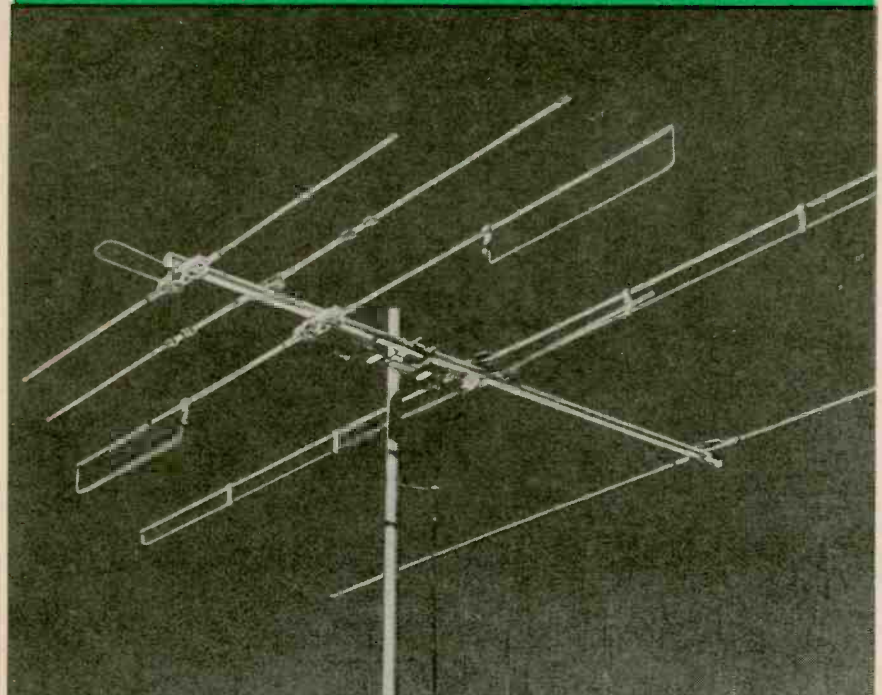

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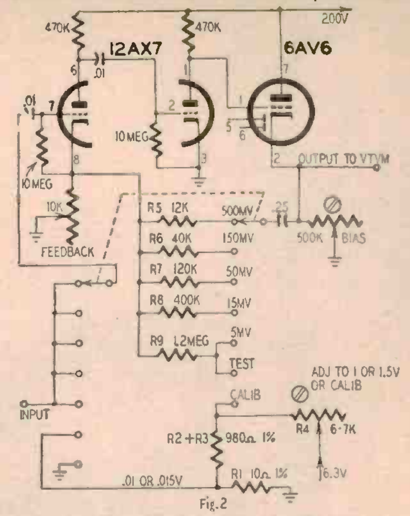


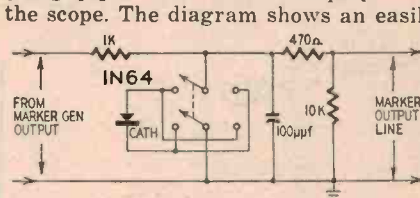
Fig. 2

gain. A direct-coupled 6AV6 cathode follower improves the high-frequency response and isolates the feedback network from the output circuit. The values of feedback resistors R5 through R9 may have to be determined experimentally. The bias control is set for maximum output as indicated on a scope connected to the output terminal.

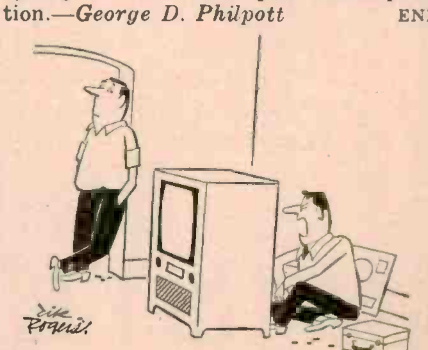
We suggest constructing a small power supply to deliver 6.3 volts ac and 150–200 volts dc for the circuit in Fig. 2. This improves performance and makes the Milvamp more useful with other test instruments.

POLARIZED MARKER PIPS

To minimize waveform distortion and simplify identification of markers, it is often desirable that a marker generator provide positive- or negative-going pips on the curve displayed on the scope. The diagram shows an easily



constructed addition to the output circuit of most marker generators to provide positive, negative and bipolar pips at the flip of a switch. The diode clips and removes the positive or negative peaks of the marker signal, depending on the switch setting. The switch is a dpdt lever, toggle or slide type with spring return to the open center position.—*George D. Philpott* END



"The symptoms are familiar. Loss of vertical sync, followed by the back accidentally falling off and three tubes changing sockets."

try This one

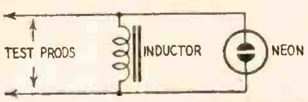
A HANDY KINK

In his article "Tracking Down an Intermittent" in the December, 1956, issue, Bob Middleton describes how he uses a heat lamp in localizing intermittents. I follow his procedure to locate the general area of the faulty component and then carry it one step further to pinpoint the trouble.

I take a sheet of asbestos paper like that used by heating and insulating crews and punch a ¾-inch hole in its center. Holding the sheet over the lamp. I can concentrate the heat on only one or two components at a time so the bad actor can be run down. With this method I can apply heat faster and more uniformly than by holding a hot soldering iron close to the suspected component.—*Joseph Lacey*

LOW-VOLTAGE NEON FLASHER

While it is generally considered that about 75 volts is needed to flash a neon bulb, it is possible to obtain a test flash with 1.5 volts by using the arrangement shown. The bulb flashes each time the test prod is lifted to break the circuit. The bulb element that flashes is the positive terminal.



Look around in your junkbox for any small iron-core inductor. If you have a horizontal blocking oscillator transformer, use the primary winding. If you want to make a vest-pocket tester, rewind the coil on a ¼x4-inch iron core.

The counter-emf of the coil steps up low voltages when the test prod is lifted from the low voltage circuit, causing the bulb to flash.—*Robert G. Middleton*

COMBINATION VTVM PROBE

Many popular electronic multimeters have separate probes or test leads for ac volts and resistance measurements and another set for dc voltage. Fig. 1

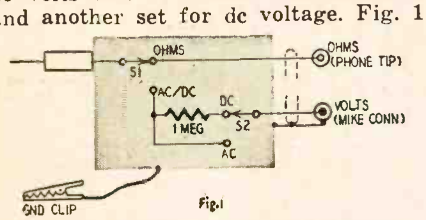
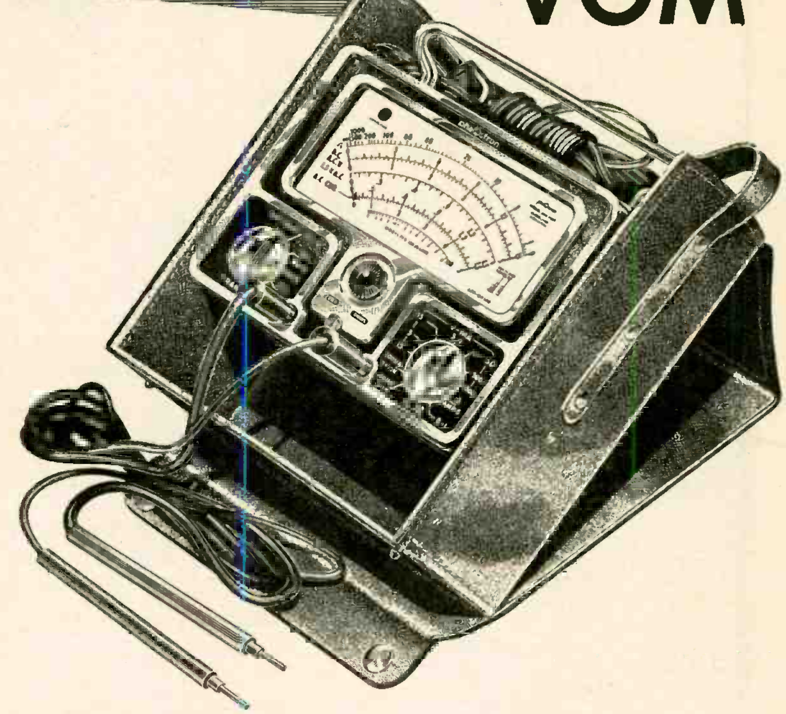


Fig.1

and the photo show how a dc/ac–ohms probe can be used for all measurements. Two built-in switches select the desired function. When S1 is set to OHMS, the circuit is completed straight through to the OHMS terminal on the

PHAOSTRON 666 VOM



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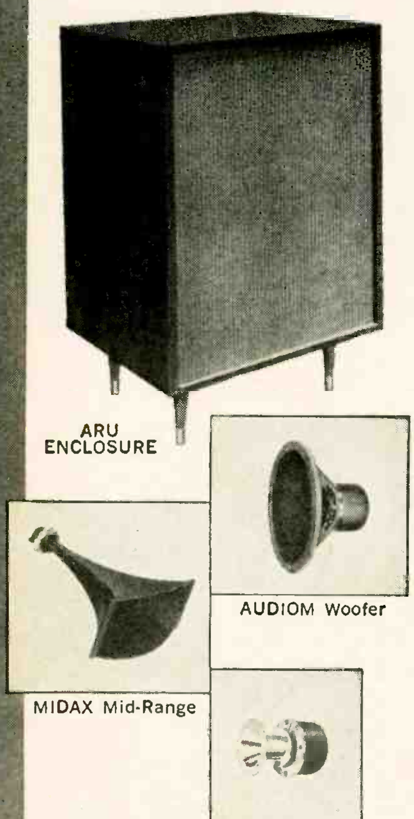

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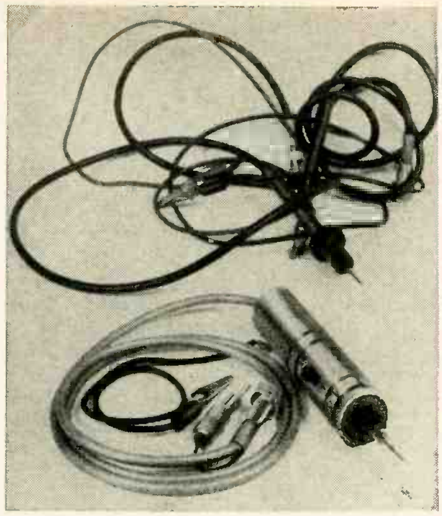


Combination probe compared with the mass of probes and cables it replaces.

meter. Switching to AC–DC connects the probe tip directly to the VOLTS terminal on the meter when S2 is on AC and through a 1-megohm resistor when measuring dc.

The housing is 1⅛-inch inside diameter aluminum tubing with machined plastic or fiberboard inserts in the ends.

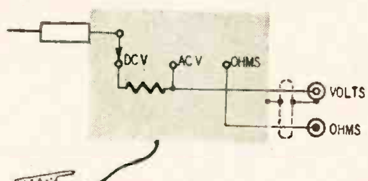


Fig. 2

The cable may be two-conductor shielded cable or two-conductor coax such as RG-22/U.—*Vincent Lavarone*

(Construction and operation can be simplified by replacing S1 and S2 with a three-position single-pole slide switch connected as in Fig. 2. The output connectors are selected to match those on your vtvm.—*Editor*)

PENICILLIN SYRINGES

My doctor saves empty disposable penicillin syringes for me. They are convenient containers and applicators for oil, contact cleaner and other service chemicals. The syringes take up very little space in the tool kit and are handy for forcing liquids into hard-to-reach spots.—*William Porter*

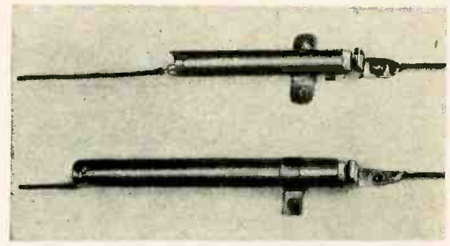
BATTERY HOLDERS

The design of these holders permits quick replacement of cells—simply pour out the old and slide in the new. The holders in the photo were designed for Eveready No. 912 penlight cells (or any other brand of the same size).

The short one is made from a 3½-inch length of ½-inch copper tubing and holds two cells (3 volts). The mounting bracket is a 1½ x ½ x 1/16-inch brass strip, with two ⅛-inch holes drilled through it soldered to the tube near one end. A lug is formed on one end of the tube to contact the negative terminal of the battery and hold them in. To do this, make two saw cuts about ¼ inch apart and then bend the lug inward.

For the positive contact, bend a metal strip (shaped like a question mark) from a piece of spring brass ⅜ x 1¾ inches and drill a ⅛-inch hole in it. Slide two cells into the tube and mount the parts, using three screws. The negative lead can be soldered anywhere on the tube or mounting bracket. Solder the positive lead to the spring contact.

The long holder contains three cells (4½ volts) and is made from a 5-inch length of ½-inch tubing. The tube is held by a cable clamp on one end and a screw through a ⅛-inch hole at the other.



When it is mounted on a metal chassis, insulate the spring contact from the chassis. You can have positive ground if you slide the batteries into the holder in the opposite to normal direction. If the contacts are made right, they will still make an excellent connection.—*Art Trauffer*

ERRATIC RECORD PLAYERS

Slippage in the friction-drive mechanism of rim-driven phono turntables often causes erratic and unsatisfactory performance in record players. If this condition cannot be corrected with normal service adjustments, paint liquid nonslip compound on the inner rim of the turntable, the edge of the rubber-tired drive wheel and on the metal shaft that engages and drives it. I use a compound prepared by General Cement for slipping dial belts and drive cords and find it works even better on phono drives. The stick type nonslip compound is not nearly as effective as the liquid on record players but it is very good for use on dial cords.—*Paul Ealk* END

"Reception is so bad here that we have to have this control to keep the snow from drifting."

Technicians' News

FEW TV LICENSES

Few television licenses have actually been issued after one year of TV licensing in Detroit—a total of only 135. Only 1,041 applications for examination have been filed, about 20% of those who are required to be licensed. Of this group 941 have taken tests, 333 have passed and 135 have paid the license fee and picked up their licenses.

The ordinance calls for all persons engaged in instaling, servicing, maintaining or repairing television equipment to have a license. The service dealer must be licensed or employ a licensed technician.

SERVICING TELERAMA

For three days at the Ritz-Carlton Hotel in Atlantic City, N. J., the service-industry Telerama, sponsored by the Council of Radio & Television Service Association of the Delaware Valley, took over. H. Harrison Neel and Reginald Cherrill, co-chairmen of the council, report that more than 300 turned out for the meeting. One came from as far as Winston-Salem, N. C.

The overall theme behind the meeting was "Let's Unite the Service Industry." This was the first extensive conference type meeting to be held in 3½ years. A similar meeting was proposed for next year.

A key day in the proceedings featured demonstrations of Raytheon's Radar Range, a feature of great interest to the wives. A talk by Dr. Walter Grattidge of G-E on high-temperature electronics followed. In the afternoon an address on material resources of electronics by H. W. Leverenz of RCA was followed by a presentation by the Hickok Electrical Instrument Co. of its new punched-card tube tester to end the day.

At the Telerama banquet Charles Settle, a council member, was toastmaster. Mr. G. Burns of G-E and Mr. Shipman of CBS-Hytron were among the speakers representing service-industry leaders.

LICENSING BILL PASSED

A bill calling for licensing of all TV service technicians, dealers and distributors has been passed by the Long Beach (N.Y.) City Council, making this community the first in Long Island to do so. The law went into effect May 1.

The city had hoped that the State Legislature would pass a licensing bill this session and had withheld action on its bill to allow the state to act.

Christopher Stratigos, president of the Radio & Television Guild of Long

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Model Y-703. Net, F.O.B. Chicago.... $6.75

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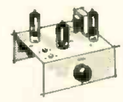
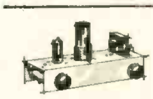
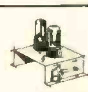


WIRELESS BROADCASTER KIT Y-705 $9.50

50 W/SEC. ELECTRONIC PHOTOFLASH KIT Y-244 $28.50



PHONO AMPLIFIER KIT Y-790 $8.95



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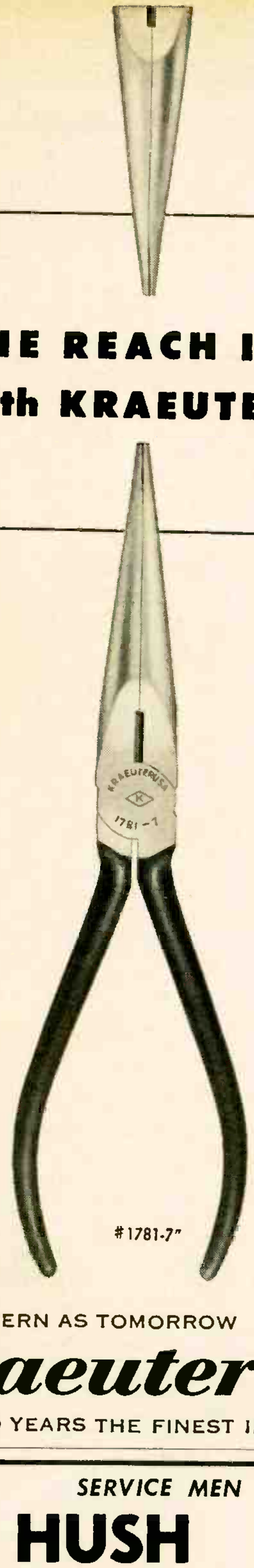

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Island, said he was satisfied with the bill. Originally designed to protect only the customer, the bill was amended after a request by the guild to include two representatives of the servicing industry on the administrative board. One would be from the selling and servicing field and one a service technician. The other three members will be a lawyer, a science teacher and an electrical engineer. All board members must be residents of Long Beach.

Oral and written examinations will be given to TV technicians applying for the annual license. The fee which will be set by the board cannot be more than $10.

The bill applies to all people engaged in selling, distributing or servicing TV equipment in Long Beach. A $5,000 bond will be required.

Licenses can be revoked for failing to leave a detailed bill, for fraudulent or misleading advertising or failing to give board members records of charges or overcharges upon request.

All violators are entitled to a hearing before the board. Licenses can be revoked only by a majority vote. Violators are also subject to court action with a maximum penalty of a $250 fine, 30 days in jail or both.

GUILD PRAISES AD BACKING

Manufacturers whose advertising favors the independent service technician are praised by the Radio & Television Guild of Long Island.

The guild resolved that letters be sent to P. R. Mallory, CBS-Hytron, Raytheon Manufacturing, Tung-Sol Electric, Sprague Electric and Westinghouse Electric, commending them for their ads favoring the independent service technician.

STATE LICENSING BILL

CSEA of California has presented its revised state licensing bill to the Senate Interim Committee on Licensing Business and Professions.

Under the bill, radio and TV technicians would be required to obtain state licenses to perform any services in connection with repairing, maintenance, installation or adjustment of radio or television receivers. People who have been working at full-time servicing for the last 12 months can qualify for the license without an examination, if satisfactory proof of this experience is shown. A $500 cash performance bond must be posted.

Licenses could be revoked for incompetence, deceit or dishonesty. A revoked or suspended license can be reissued if an applicant demonstrates his rehabilitation after a period of 1 year.

FRTSAP AWARD

Paul Wendel, former editor and publisher of *Service Management*, received the annual award of the Federation of Radio, Television Service Association

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of Pennsylvania in recognition of his service to the independent electronics service industry in 1956. The day of the award was designated "Paul Wendel Day" by the Harrisburg, Pa., American Legion Post.

OSCILLOSCOPE COURSE

The Associated Radio & Television Servicemen (ARTS) Chicago, Ill., is presenting a course on oscilloscopes. Classes, held once a month, are conducted with the cooperation of the Simpson Electric Co.

Participation was by written invitation to register. The class is now closed and is expected to run for about a year.

DRUGSTORE TUBE TESTERS

A new attitude toward drugstore tube testers has been adopted by many TV technicians. Instead of trying to fight those who are installing the devices, they are ordering testers that they will install and maintain in local supermarkets and drug stores.

This change in attitude is a result of surveys which showed that the majority of sales by these units occur during the hours that service shops are closed. For example, 33% of the sales take place on Sunday evenings.

A self-service tester in his shop also helps the service technician. The customer who tests his own tubes, only to find them all good, realizes that he must leave his set for bench repairs.

MINTSE REPORTS

The Minnesota Television Service Engineers, Inc. (MINTSE) is presenting classes at the University of Minnesota's Center for Continuation Study.

The classes held on May 27, 28 are designed for technical assistants, clerks, and secretaries. They will cover topics such as phychology of merchandising, telephone techniques, customer relations, and handling of related office and shop procedures.

Earlier in May three days of similar classes were held for service managers and service engineers.

250,000 TUBES SEIZED

The District Attorney's office of the Bronx, N. Y. seized 28 barrels containing a quarter million rejected tubes reported stolen from RCA's Woodbridge, N. J. plant. A basement raid at 40 Featherbed Lane, Bronx, N. Y., revealed the cache. Leonard Wachsman, owner of the Industrial Testing Laboratories, rented the basement. Mr. Wachsman said he bought the tubes not knowing they were stolen. He was held for concealing stolen property.

TV TECHNICIANS FINED

Two TV service technicians were convicted in Muscogee Superior Court in Columbus, Ga.

Robert L. Farris, Teletron TV Service, was fined $350 and placed on probation for 12 months. During his trial, expert witnesses testified that a TV set with only a bad fuse was taken to the shop and the owner billed for several tubes and other unnecessary parts.

Douglas A. Thomas, also of Teletron Service pleaded guilty and was fined $250 and put on probation for a period of 12 months.

Judge Thompson said that the public must be protected from TV repair practices like those the men were charged with. He went on to say that the leniency of the sentence was not a precedent and that future violations of this sort would probably be dealt with more severely.

RTA-PASADENA MEETS

The Radio Television Association–Pasadena, listened to insurance counselor Robert Lloyd discuss insurance programs for a small business at a recent meeting. He covered liability, property and life insurance needs of a TV service and sales organization.

A report of the meeting of the Board of Delegates of California Electronics Association was heard. Members were also told of activities to form all 10 service associations in Los Angeles County into a single organization.

TECHNICIAN BECOMES INVENTOR

A plan to eliminate effects of slow season TV servicing has turned radio and TV service technician Murray Barlowe of Bethpage, L. I., into an inventor, industrial consultant and radio manufacturer.

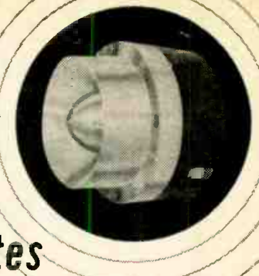
The new operations were adopted to end layoffs in slack seasons and insure having enough men on hand for the September service rush.

Some of the new activities are; devising an electronic mat weighing device to weigh *Fiberglas* as it is piled on a drum; develop an electronic glass level control for maintaining the level of molten glass in a furnace; develop electronic instruments for a heart and lung machine. Production of an all-transistor wrist radio is also scheduled to begin soon.

SYLVANIA COLOR COURSE

Sylvania Electric Products has set up a free 14-lesson course in color television repair. Correspondence lessons are obtainable through local Sylvania distributors. END

A commemorative stamp honoring Heinrich Rudolph Hertz, the first to create, detect and measure electromagnetic waves, has been issued by West Germany on the 100th anniversary of his birth on Feb. 22, 1857 in Hamburg.



notes and quotes

loudspeaker logic for the newcomer to **high fidelity**

PART I

advantages of a system made with components

The very best loudspeaker system — The Hartsfield

"High Fidelity" is a phrase invented by sound lovers who were determined to find a better way of reproducing music in their homes. They found equipment which would accomplish this in the small establishments of sound specialists who were making precision reproduction equipment primarily for the motion picture and broadcasting industries.

Today there are two kinds of high fidelity. The first kind is the music system assembled from specialist-built *components.* The second is the ordinary, packaged, complete radio-phonograph to which the term "high fidelity" is indiscriminately attached as a merchandising slogan. Since the second kind appropriates the words from the first, we shall call the original, component type, "true high fidelity".

The components in a true high fidelity system will consist of a loudspeaker system, power amplifier, preamplifier-control unit, and sound sources. The source components may be of any of the following: FM and AM radio tuners, record changer or player, tape machine, television chassis.

The advantages to owning a music system made up of components are: 1. You get better quality sound for less money. 2. You can balance the quality of components. 3. You can continue to improve upon your system. 4. The system you select will exactly match your individual needs.

JBL Signature loudspeakers are true high fidelity components made by James B. Lansing Sound, Inc., a manufacturing concern which devotes all of its energy and resources to making the very best loudspeakers possible. JBL Signature speakers are made with the care and precision usually associated only with the manufacture of scientific instruments. Components of this quality are only available for use with true high fidelity systems. They are demonstrated and sold by dealers who *specialize* in audio components. There is a JBL Signature speaker for every purpose. They range from the beautiful, small, Model D208 eight-inch extended range unit to the mighty Hartsfield, a complete speaker system built around JBL Signature Theater Speakers. Write for your free catalog and the name of the audio specialist in your community.

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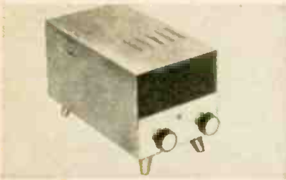

plifier. Flat response from 20–20,000 cycles. 1% distortion at 10 watts.—**David Bogen Co., Inc.,** Paramus, N. J.

AMPLIFIER KIT. *KT-120.* 60-watt, Ultra-Linear amplier kit. EF86 voltage amplifier, 6SN7-GTB phase inverter, push-pull EL34 output. Intermodulation

distortion 0.6% at 60 watts, 0.15% at 30 watts. 16–90,000 cycles at 60 watts; 2–220,000 cycles at 1 watt. 0.55 v. in for full output, 20-db feedback, hum 80 db below rated output. Remote switching and preamp power takeoff sockets. 6⅝ x 14 x 7 15/16 inches.—**Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33, N. Y.

RECORD PLAYER. *Garrard model T Mk II.* 4-speed single-record player. 4-pole shaded in-

duction surge motor. Belt-free drive, approved wiring, electric line cord and pickup cable ready to plug in. Starts and stops automatically. Cabinet 14¾ x 12½ inches; 3 inches above motor board; 2 1/6 inches below.—**Garrard Sales Corp.,** 80 Shore Rd., Port Washington, N. Y.

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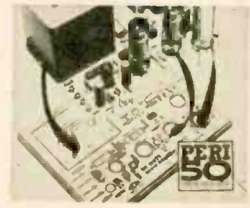

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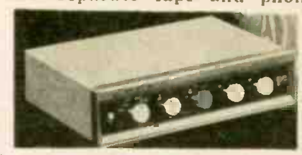

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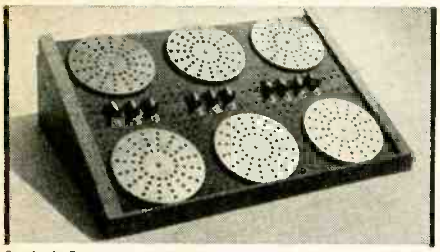

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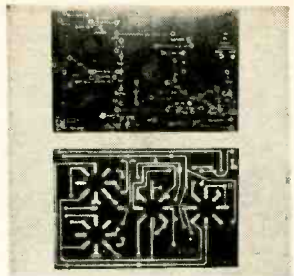

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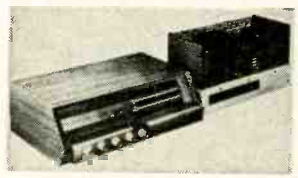

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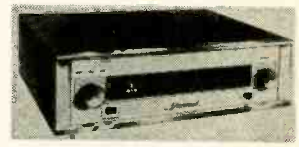

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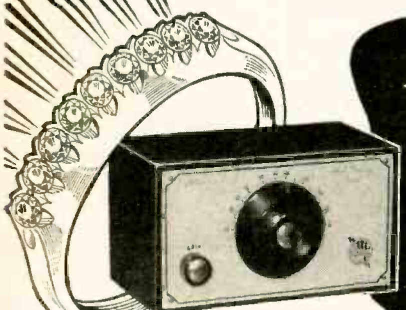

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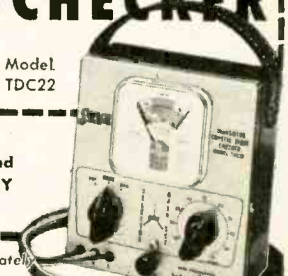

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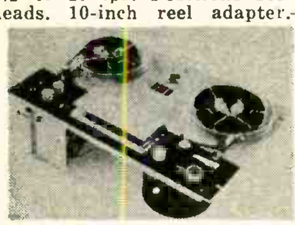

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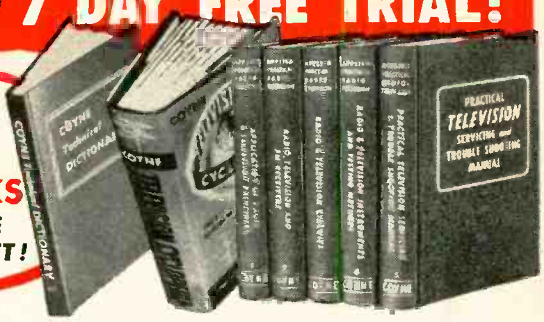

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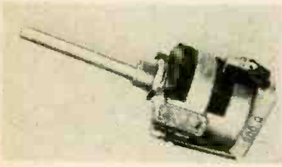

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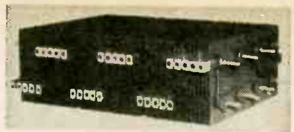

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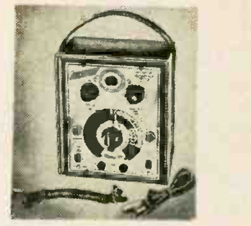

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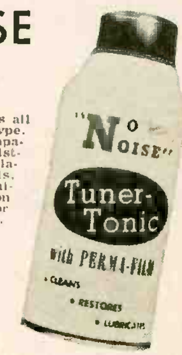

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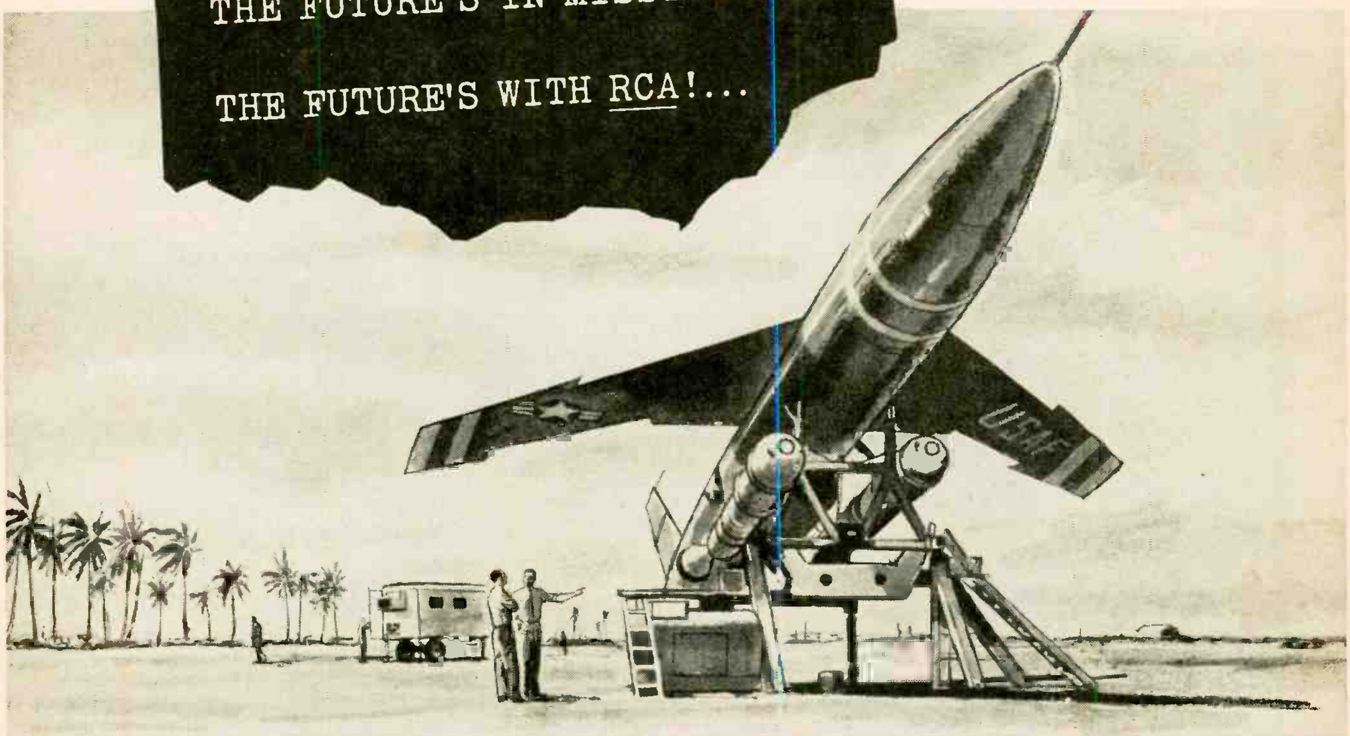

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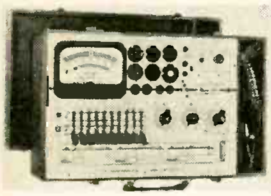
screen 12–160 volts dc; bias 0.1–100 volts dc; filament 0.1–119.9 volts ac; signal 0.22 volts.—**Hickok Electrical Instrument Co.**, 10531 Dupont Ave., Cleveland, Ohio.

TUBE AND TRANSISTOR TESTER. *Model 660.* Tests rf, af. power and tetrode transistors for I_{CBO}, gain, leakage; crystal diodes for forward and



reverse current; special circuitry for beam-current testing of popular TV picture tubes; emission tests modern TV and radio tubes.—**Precision Apparatus Co.**, 70-31 84th St., Glendale 27, N.Y.

TRANSISTOR RADIO KIT. *Knight.* 2-transistor-Battery-operated. Printed-circuit panel, simulated leather case, dynamic

earphone, built-in antenna.—**Allied Radio Corp.** 100 N. Western Ave., Chicago 80, Ill.

AMATEUR RECEIVER. *Model NC-109.* 4 bands cover 540 kc to 40 mc. S meter. Calibrated bandspread for 10, 11, 15, 20, 40 and 80 meters. 11-inch slide-rule

dial. Crystal filter and product detector for SSB and CW. 11 tubes. 16 13/16 x 10 x 10⅞ inches.—**National Co.**, 61 Sherman St., Malden, Mass.

HAM RECEIVER. *Model NC-188.* 4 bands cover 540 kc to 40 mc. 5 bandspread ranges for amateur bands. 11-inch slide-rule dial. S meter. Separate tun-

ing knobs for general coverage and bandspread. 16 13/16 x 10 x 10⅞ inches. 35 pounds.—**National Co.**, 61 Sherman St., Malden, Mass.

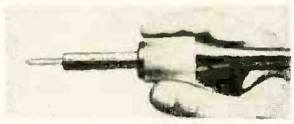
SOLDERING AID. *Solder-Matic* can be mounted on most electric soldering guns. Trigger feeds solder from spool through guide

tube to gun tip. One-hand operation.—**Atlas Manufacturing Co., Inc.**, 1126 S. Decatur St., Montgomery 6, Ala.

SOLDER DISPENSER. *Spyraline.* For applying solder in hard-to-get-at places. Stores in tool-

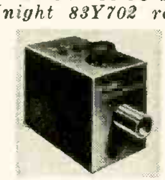
box. Eutectic ratio of 60% tin, 40% lead. Rosin, acid or solid-wire form.—**Rayline Inc.**, 307 Willis Ave., Mineola, N. Y.

SOLDERING PENCIL. *No. 248:* 50-watts; ¼-inch tip; 2 ounces. Ventilation design. Coated-copper tip. Nickel chromium and



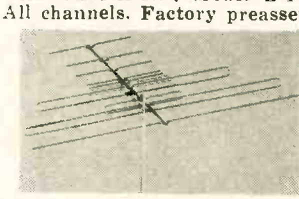
mica-wound element. Tip and element separate independently replaceable parts.—**Hexacon Electric Co.**, 186 W. Clay Ave., Roselle Park, N. J.

PHOTOELECTRONIC SYSTEM KIT. *Knight 83Y702 relay kit.*



Auto and trip operation. Range 250 feet. Parts, tubes, photocell and instructions. *Knight 83Y703 light source kit* includes sealed-beam bulb and infra-red filter.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

VHF ANTENNA. *Model Z-100.* All channels. Factory preassem-



bled. Designed for extra gain on high-band channels.—**Welco Manufacturing Co.**, Burlington, Iowa.

CW TRANSMITTER KIT. *Model DX-20.* CW only; for novice and advanced CW operators. Plate input 50 watts. 6DQ6A final amplifier, 6CL6 oscillator, 5U4GB rectifier. Bandswitching covers 80, 40, 20, 15, 11 and 10 meters. Built for crystal excitation, but vfo may also

be used. Pi network output circuit to match antenna impedances from 50–1,000 ohms. Access for crystal changing provided by pull-out plug. Includes all parts, schematic and step-by-step instructions.—**Heath Co.**, 305 Territorial Rd., Benton Harbor, Mich. END

All specifications given on these pages are from manufacturers' data.

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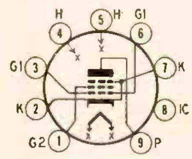
New Tubes & Semiconductors

We have a variety of new types this month—from a direct-reading indicator to a 110° vertical deflection tube to a phototransistor and a midget selenium diode.

6DB5, 12DB5

Nine-pin miniature beam-power pentodes designed for 110° vertical-deflection and audio amplifier use and announced by CBS, the 6DB5 and 12DB5 are intended for compact TV sets or equipment using printed circuitry.



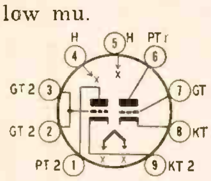
6DB5,12DB5

When pentode-connected in suitable circuits and operated from a 250-volt B supply, they will vertically deflect 110° picture tubes.

The 6DB5 and 12DB5 differ only in heater characteristics. The 12DB5 has a 600-ma heater with warmup control characteristics for series-string use. The 6DB5 has a 1.2-amp heater.

6-, 10-, 13DE7

In this Sylvania nine-pin miniature duo-triode with dissimilar sections, one section is intended for use as a vertical-deflection oscillator with medium mu. The other as a vertical-deflection amplifier with low mu.

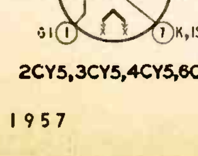


6DE7,10DE7,13DE7

The 10DE7 and 13DE7 are designed for series-string receivers and have controlled warmup, 600 and 450 ma, respectively. The 6DE7 requires 950 ma. All other specifications are identical.

2-, 3-, 4-, 6CY5

These sharp-cutoff tetrodes are particularly designed for if or uhf amplifiers in TV receiver tuners. Made by Sylvania, they are miniature seven-pin



2CY5,3CY5,4CY5,6CY5

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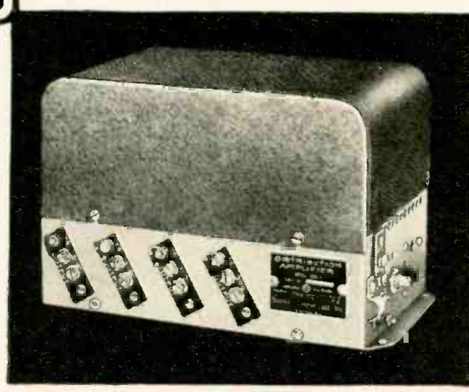

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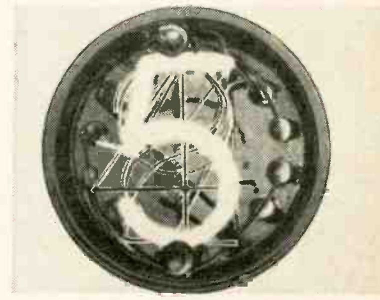
tubes that operate at a maximum plate voltage of 180.

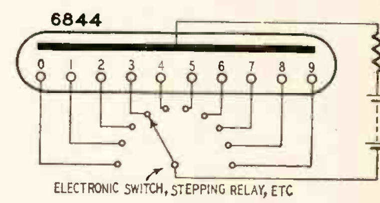
Identical except for heater characteristics, the 2CY5 has a 600-ma, the 3CY5 a 450-ma, the 4CY5 a 300-ma and the 6CY5 a 200-ma heater

6844 "Nixie" indicator

An all-electronic "read-out" tube mass-produced by the Burroughs Corp.'s Electronic Tube Division is a small low-cost electronic device which converts electronic pulses into readable



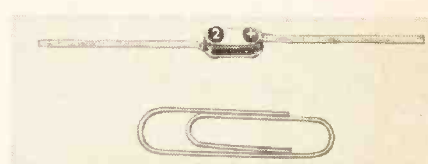
characters in the form of small glow-discharge tubes, like miniature neon signs. It contains all the digits. Any one can be selected and displayed in a common viewing area (see photo).



This numerical indicator tube can be triggered by beam-switching tubes or any suitable voltage source supplying approximately ¼ watt. A typical circuit is shown.

Dwarf selenium rectifier

This tiny selenium rectifier will handle 5 ma at 125 volts with a resistive load. A quarter the size of an ordinary paper clip, it weighs .015 ounce. Imported from West Germany by Radio Receptor, it is assembled in a black plastic body with flat pigtail leads.



Available only in half-wave units, several may be connected to form bridge, center-tap or doubler circuits.

GL-6942

A uhf transmitting tetrode announced by General Electric with a 1-kw TV output, the GL-6942 is designed for use as a power amplifier or oscillator in grounded-grid circuits with both grids maintained at rf ground potential. The anode is capable of dissipating 1½ kw. It is cooled by forced air. The

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radiator is an integral part of the anode.

Used as a class-B grounded-grid broad-band TV amplifier, it has a peak power output of 1 kw at 900 mc.

2N238/310

This Texas Instruments p-n-p germanium alloy-junction transistor is designed for low-power class-A audio applications. Although the 2N238/310 is designed for driver applications, it is also suitable for low-level class-A output circuits.

It is mounted in a metal case with a glass-to-metal hermetic seal between the case and leads.

At a temperature of 25°C ambient its absolute maximum ratings are: collector voltage, −20; dc supply voltage (for inductive load), −10; device dissipation (free air), 50 mw.

Phototransistor

This type 800 n-p-n grown germanium phototransistor is designed to replace phototubes in most applications. The added advantages are small size and reduced power demands. It is very sensitive to the relative position of light on the bar, making it useful in positioning controls, remote instrument calibration and similar directional applications.

At 25°C ambient temperature this unit's maximum ratings are: collector voltage referred to emitter, 20; collector current, 5 ma; collector dissipation, 65 mw.

It is mounted in a hermetically sealed metal case. The window on top of the unit is made of optical-quality glass. END

Thirty-Five Years Ago

In Gernsback Publications

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

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

In June, 1923, *Science and Invention* (formerly *Electrical Experimenter*)

Radio For Every Tenant.

The Phonofilm—Talking Movie, by Dr. Lee de Forest.

Hunting Trouble in the Radio Set, by H. Winfield Secor.

A "DX" Single Peanut Tube Receiver, by Major Douglas H. Nelles.

Radio for the Beginner—No. 16. Protection Against Lightning—by Armstrong Perry.

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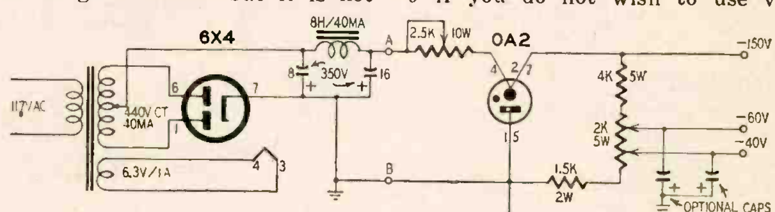
Question Box

AUDIO BIAS SUPPLY

Please print a diagram of a C-bias supply using a 6X4 rectifier and supplying 150, 60 and 40 volts negative.—J. H., Detroit, Mich.

You did not specify how the supply is to be used so we cannot be sure that this circuit is satisfactory. It will work out nicely in audio circuits that draw little or no grid current but it is not suitable for transmitters. If you want to use your bias supply in a transmitting rig, we suggest that you refer to circuits in *The Radio Amateur's Handbook* or give us more complete details on the application.



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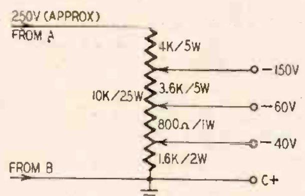

b

The circuit shown at *a* provides regulated voltages. The 2,500-ohm resistor should be set for 15 to 20 ma through the VR tube. A single 7,500-ohm adjustable resistor with two sliders might seem a logical choice instead of the three series-connected units but you may find that the 60- and 40-volt positions are too close together for proper adjustment unless you use a resistor of 100 watts or so.

Use the voltage-divider network at *b* if you do not wish to use voltage regulation. A 10,000-ohm resistor with three adjustable sliders is used for the bleeder and voltage divider. The approximate resistance between each tap and the wattage rating is shown so that you can make up the divider from separate resistors if you so desire. In this case, use the nearest RETMA values.

TURNTABLE NEUTRAL INDICATOR

The manufacturer of my phonograph turntable recommends throwing the speed control selector to neutral when the instrument is not in use. This prevents flat spots from developing on rubber-surfaced parts of the drive mechanism. I, and others in the family, frequently forget to throw the control to neutral after the last record. Is there any kind of reminder I can use to indicate positively when the player is inadvertently turned off without switching to neutral?—B. F., New Rochelle, N. Y.

You did not list the make and model number of the player or changer that you are using so we will show a basic method of connecting an indicator of the type you need. The indicator is a pilot lamp that glows only when the player's drive mechanism is engaged.

Most multiple-speed record players and turntables (and some tape recorders) have a clutch that must be disengaged or a neutral position on the speed selector that must be used when the equipment is not in use. Study the underside of the clutch or speed selector mechanism as you throw it in and out of neutral. You will probably find a pulley, cam, drive disc, lever, push rod or other moving part that is in one particular position only when the turntable is in neutral.

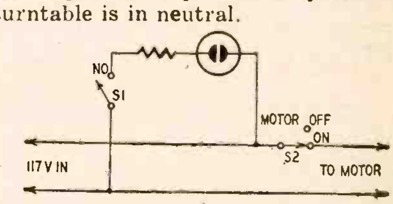

Fig. 1

You can install a switch (S1 on the diagrams) so its contacts are closed by the part of the mechanism you select for the job when the player is engaged. The switch is in series with a neon lamp and dropping resistor or a 115-volt pilot lamp across the ac line. Fig. 1 shows a simple installation where S1 is a sensitive normally open switch while S2 controls the motor. Fig. 2 is a

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	12QP4	10.50	24.75	17LP4	18.00
18.75	12UP4	15.00	37.00	19AP4A	24.00
20.75	14CP4	13.75	28.35	20CP4A	18.95
	15DP4	14.50	32.10	20CP4B*	21.95
33.75	16AP4	18.50	36.00	21AP4	25.00
32.20	16DP4A	15.25	29.75	21EP4A	20.15
23.50	16KP4	15.75	33.50	21EP4B*	23.25
27.20	16KP4A*	18.75	30.90	21FP4	21.15
33.75	16GP4	18.75	37.00	21MP4	26.25
31.50	16LP4A	15.25	29.75	21YP4	22.00
31.50	16WP4	15.25	100.00	24AP4	56.00 (6 mos. guar.)
23.50	17BP4	15.75			
27.50	17BP4B*	18.75	46.60	24CP4A*	38.00
			48.20	24DP4A*	39.00

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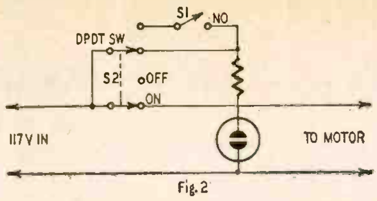

Fig. 2

more elaborate system in which the indicator is also a pilot lamp for the motor. This makes it impossible to leave the motor running with the turntable in neutral or possibly jammed. In this case the motor switch is replaced by a dpdt type of the same general size and shape as the original.

If the player is always visible, you can mount the indicator lamp close to the operating controls. If it is in a drawer or behind cabinet doors, you can use an indicator with a miniature or subminiature jeweled socket assembly mounted in a conspicuous place.

S1 may be a standard normally open snap-action type like those made by G-E, Unimax, Arco and others; a mercury switch or one made from spring-leaf contacts from a relay or telephone type lever switch. Snap-action switches are available with plunger, spring-leaf and roller type actuators. Select the type best suited for your particular equipment. END

CORRECTIONS

Mr. Montgomery has informed us that the output cathode resistor (R24) should have a 1-watt rating rather than ½ watt as specified in the parts list and assumed on the diagram of the Bookshelf Audio Amplifier described in the April issue. We thank Mr. Montgomery for calling this to our attention.

In the item "Atomic Power" on page 47 of the April issue, plutonium 147 was erroneously mentioned as the power source in the Elgin-Kidde nuclear battery. The element used is *promethium* 147. (Plutonium's weight is 239.)

The drawings for Figs. 1 and 3 were transposed in the article "Rhomboids for TV Reception" on page 86 of the May issue. The 2-wavelength 85-mc antenna has legs 23 feet long and requires an area at least 37 feet long and 27 feet wide for erection. The antenna for 680 mc is only 60 inches long and 39 inches wide.

Our thanks to Mr. Charles Lee Barron of Tallahassee, Fla., for pointing out the error.

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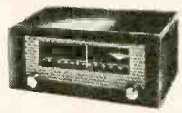

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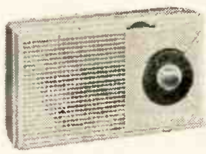

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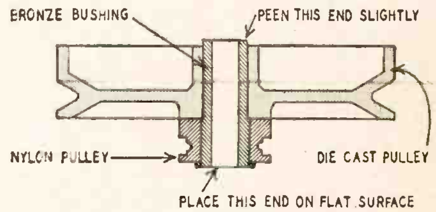
Technotes

7-TR-2, -3, -TRC-1 TAPE RECORDER

The winding direction of the motor windings in relation to the winding direction of the power transformer winding has a definite relation to hum. The residual hum level can sometimes be reduced by interchanging either the leads to the motor or the primary leads of the power transformer. Least hum does not always occur with leads connected according to the colors indicated on the schematic diagrams.



Several instances of insufficient tape-takeup tension have been found to be the result of a separation in the main drive pulley (see diagram). This is a dual unit in which the nylon pulley is held to the metal one by a bronze bushing. In the instances mentioned the bushing loosened in the metal pulley and moved endways slightly. This allowed the nylon pulley to slip on the bushing and resulted in insufficient tape-takeup tension.

If the nylon pulley shows any indication of being loose, the dual pulley assembly should be removed and the bushing tapped back into position. The pulley should then be placed on a flat surface and the small-diameter end peened slightly. This should hold the bushing tightly in place and prevent further slippage.—*RCA Radio & Victrola Service Tips*

HORIZONTAL OSCILLATORS

Horizontal oscillator circuits are somewhat critical with respect to tube characteristics; each time a 6SN7, 12AU7, etc., is replaced, the receiver should be adjusted. It may be necessary to reset certain controls in addition to the horizontal hold, which is the only one most technicians bother with. These adjustments are made originally at the factory but they should be rechecked for each tube replacement in the field.

A blocking oscillator circuit has a horizontal locking range and a waveform adjustment. The waveform adjustment is not normally affected by tube substitution but frequency adjustments are usually critical.

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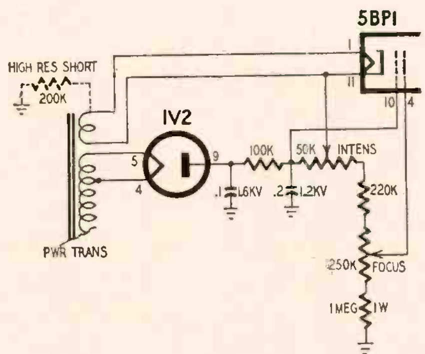
factory-adjustment controls are usually provided to accommodate normal tube variations. Besides the horizontal hold control one or two frequency adjustments and a horizontal drive control are generally included.

When a TV receiver is aligned in the factory, these adjustments are made to provide optimum performance for the particular tubes in the set. These factory adjustments should be checked when replacing a tube. If the horizontal hold control is not effective in bringing the picture into sync, readjust the frequency control. The horizontal frequency adjustment should be made so that the picture is in sync at the mid-position of the hold control.

With proper adjustment of the horizontal controls there is usually enough range in the hold control to accommodate reasonable changes in tube characteristics. Too many horizontal oscillator tubes are being replaced needlessly.—*Bruce Richards*

HEATH OSCILLOSCOPE OM-1

Gradual dimming and finally complete disappearance of the trace on the oscilloscope screen was found to be due to a high-resistance short (about 200,000 ohms) from the 5BPI heater winding (see diagram) of the power transformer to ground. Current drawn through this short loaded down the high-voltage supply until its output dropped from 1,050 volts to 700, not



sufficient for a trace. This situation was remedied by using a separate 6.3-volt C-R tube heater transformer with high insulation resistance (at least 1,500 volts, preferably 3,000). This extra transformer must be oriented so its magnetic field does not affect the C-R tube beam.—*Paul S. Lederer*

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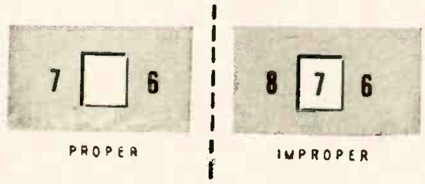
occur when a hole is drilled are practically eliminated.—*Harvey Muller*

WESTINGHOUSE H-827T21

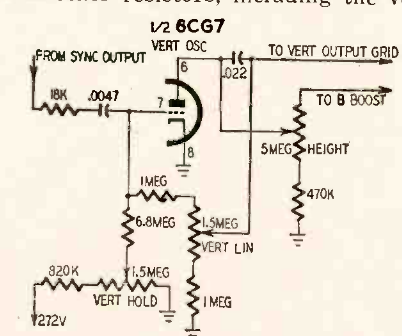
Some of these models using tuner V-12400-1 have come out with a dial that was made for some tuner other than the Sarkes Tarzian unit used in this series. Complaints of one or more channels coming in on the next lowest number on the high band is because of a neutral position between channels 6



and 7. To go from channel 6 to 7 in the Sarkes Tarzian tuner the channel switch is moved two clicks or notches instead of the usual one. In addition, some of these dials warp or change position, so don't dig into these sets until the dials are first checked. The correct dial will have a larger blank space between channels 6 and 7.—*G. P. Oberto*

VERTICAL ROLL IN RCA

In several cases where the complaint was vertical roll with no vertical hold control, the trouble was traced to an open 6.8-megohm resistor in the grid circuit of the vertical oscillator (see diagram). This resistor is in parallel with other resistors, including the ver-



tical linearity control, and it is easy to get a false reading with an ohmmeter. The trouble occurred on 1956 RCA printed-circuit chassis.—*J. E. Dow*

7-BX-10 PORTABLE RADIO

For improved shortwave reception the blue lead to the telescoping rod antenna must be dressed away from the case side. The side is metal and when the blue lead lies against it there is considerable signal absorption which is detrimental to shortwave reception. The lead should be taped to the plastic cover of the tuning unit.

It has been found necessary to add a 3-$\mu\mu$f capacitor across the secondary of the 16-meter oscillator coil. This capacitor is connected between terminals 5 and 10 of S1-C rear with the capacitor body near terminal 5. Adding this capacitor allows the oscillator adjustment of the 19-meter band to be made more easily.—*RCA Radio & Victrola Service Tips*

END

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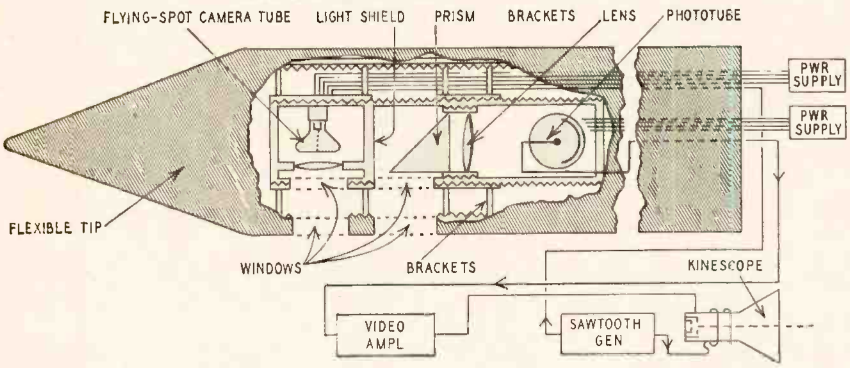
Patents

ENDOSCOPE

Patent No. 2,764,149

Edward Emanuel Sheldon, New York, N. Y.



This is a medical device for examining the interior of a human body. A tiny TV camera is built into a flexible tube that may be lowered into the body. Power for the instrument is fed through the tube. An air pump is also attached for the purpose of distending the part being examined, for example a stomach.

Details are shown in the figure. A flexible tip permits the endoscope to enter the body without damage. The heart of the device is a flying-spot tube, its beam controlled by deflection and power circuits (outside the body). As the flying spot sweeps over its target, it illuminates the examined organ through a window in the endoscope. Reflected light enters a second window, then passes through a prism and lens onto a photocell. The cell output is a video signal corresponding to the desired picture. It is amplified and fed to a receiving kinescope tube.

SPEECH VS MUSIC DISCRIMINATOR

Patent No. 2,761,897

Robert Clark Jones, Cambridge, Mass.

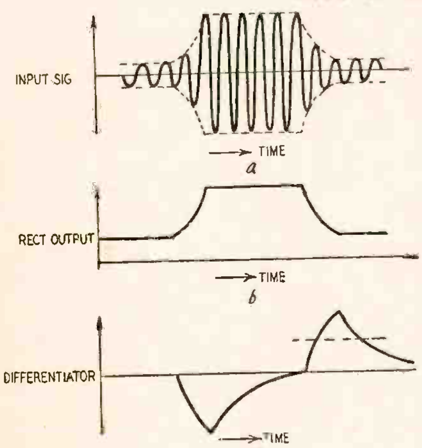


Fig. 1

This is the fundamental patent covering the speech–music discriminator described in this magazine under the name "Vocatrol."

Speech waveforms are far more complex than those of music, rising and falling much more rapidly. By detecting the *rate of change* of a waveform, this device differentiates between speech and music. It can automatically switch a program on or off; for example, mute a radio during commercials.

An understanding of the principle may be gained from Fig. 1. At *a* a speech waveform shows a characteristic rise and fall in amplitude. The wave is rectified at *b* then differentiated at *c*. Only the peak (see dotted line) is transmitted. If desired, both negative and positive peaks of the differentiated wave are passed by using a full-wave rectifier. The peaks correspond to the *rate of change* of the signal. Rapid changes (as in speech) give higher peaks.

The peak voltage is stored in capacitor C (Fig. 2). If many such peaks occur in a given interval, considerable charge collects in the capacitor. The

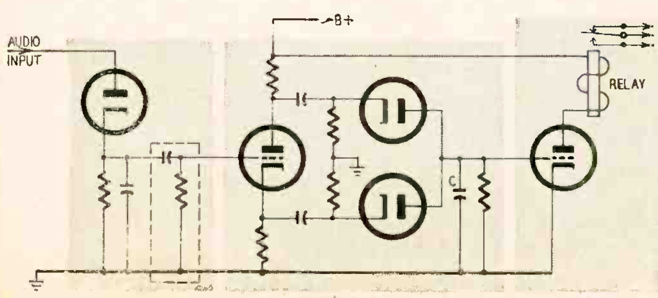


Fig. 2

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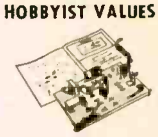
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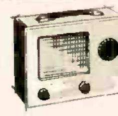
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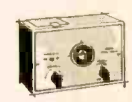
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potential actuates a relay to mute the program (which is obviously speech).

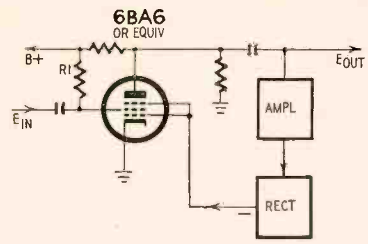
Practical circuits based on this invention appeared in this magazine in August, 1955, and September, 1956. A simple circuit improvement appears in the Correspondence column in the February, 1957, issue.

AUDIO COMPRESSOR

Patent No. 2,766,331

William P. Birkemeier, Cedar Rapids, Iowa (Assigned to Collins Radio Co., Cedar Rapids)

This circuit delivers nearly constant output, even when the input varies over a wide range. The first and third grids are tied together and



used to control gain. The screen becomes the input element, as shown in the diagram.

E_{out} is amplified, then rectified. This provides the control potential which varies tube gain. The greater the output the less the gain, so that nearly constant output is maintained.

DIRECT-COUPLED AMPLIFIER

Patent No. 2,768,250

Edward J. Stachura, Arlington, Va. (May be manufactured or used by and for U. S. Government without royalty payment)

This push-pull amplifier uses a novel cross-connection of grids and cathodes. It is capable of higher gain than conventional hookups. Two stages may be directly-coupled so both dc and ac components are transmitted.

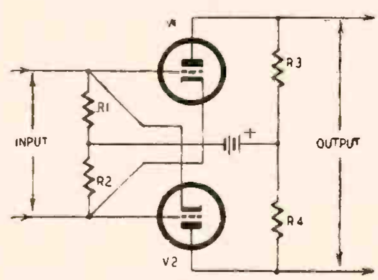


Fig. 1

The plate current of each triode flows through the plate load, battery, an input resistor and back to the cathode. (See Fig. 1.) For example, V1 passes current through R3 and R2. Some degeneration occurs because the cathode resistor R2 generates a voltage drop that opposes the input. However, the inventor finds that this loss is more than overcome because the *full signal* energizes each tube. In a conventional amplifier only 50% is utilized.

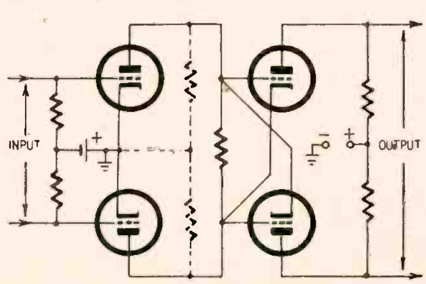


Fig. 2

With zero signal, both input and output terminals show no difference in potential. This makes it convenient to couple two stages directly as in Fig. 2. The dotted resistors represent the internal resistance of each triode. END

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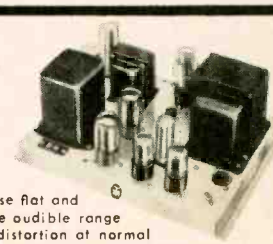

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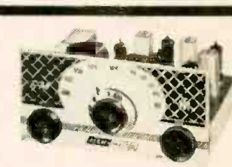

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Business and People

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uses it to show Rohn products firsthand. The trailer is available to distributors and dealers for open houses, anniversaries and other special events.

Heath Co., a subsidiary of Daystrom, Inc., is building a new plant in South St. Joseph, Mich., on a 16-acre site. The plant is expected to be completed

late this year. The company will keep its Benton Harbor, Mich., address. An artist's conception of the new plant is shown.

Rek-O-Kut Co., Long Island City, N. Y., will begin operation in a new 25,000-square-foot plant in July. Expansion plans include a greater diversification in the manufacture of the present line of hi-fi components and recording equipment.

General Instrument Corp.. Elizabeth, N. J., acquired Radio Receptor Co., Brooklyn, N. Y., through the purchase of 80% of the latter's outstanding stock. This is General Instrument's third acquisition within a year.

ORRadio Industries, Opelika, Ala., designed a new self-merchandising "Money Maker Pack" dealer display for

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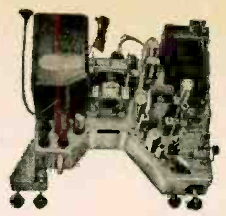

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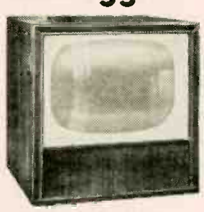

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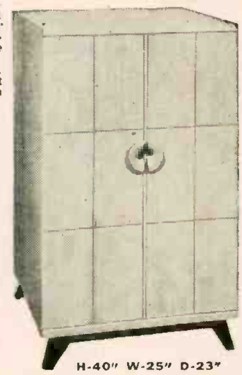

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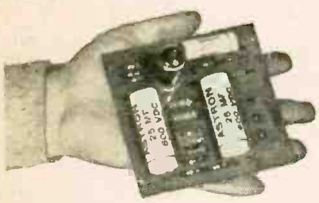

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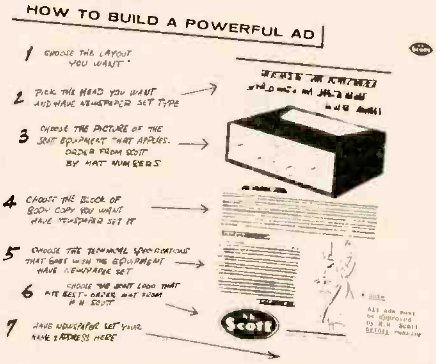
Hermon Hosmer Scott, Inc., Cambridge, Mass., stepped up its program of cooperative advertising with hi-fi dealers at the local level. The company



has prepared a kit which includes sample layouts and copy, radio scripts, mats, publicity stories, etc. One unit from the kit is shown above.

Sylvania Electric Products, New York, received the NATESA Friends of Service Management plaque for 1956. This is the sixth consecutive year Syl-

vania has won the award. Photo shows Robert Hester, NATESA president (left), presenting the plaque to Donald W. Gunn, general sales manager—electronic products of Sylvania. Officials of NATESA and Sylvania look on.

Allan W. Fritzche (left) was elected chairman of the board of General Industries Co., Elyria, Ohio. He had been president and general manager since 1943 and will continue as the chief ex-

ecutive officer. **William E. Foster** (right), vice president, succeeds him as president. All directors were re-elected. **H. E. Moon**, a director who has held various executive positions, was elected first vice president.

Victor H. Pomper (left), assistant general manager and a director of Hermon Hosmer Scott, Inc., Cambridge, Mass., was elected vice president of the company. He continues as a director.

Marvin Grossman (right), who joined the company in 1954, was appointed sales manager and will continue as advertising and sales promotion manager.

Obituaries

David T. Siegel, founder and president of Ohmite Manufacturing Co., Skokie, Ill., suddenly in Palm Beach.

Charles DeWitt White, publisher of White's Radio Log since 1925, at his home in Bronxville, N. Y., at the age of 75.

END

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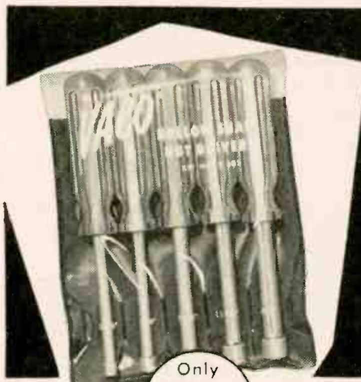

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technical Literature

NEW RETMA STANDARDS

RETMA has published two new standards for the Handbook: *RS-182, Class-A Variable Air Capacitors*, from Standards Proposal No. 501, reaffirms REC-106-A; *RS-183, Output Transformers for Radio Broadcast Receivers*, from Standards Proposal No. 502, reaffirms REC-124.

RETMA, Engineering Dept., 650 Salmon Tower, 11 W. 42 St., New York 36, N. Y. RS-182, 30¢; RS-183, 25¢.

METAL-FILM PRECISION RESISTORS

Comprehensive data on the construction, applications, characteristics, identification, tolerance and dimensions of metal-film precision resistors is found in the performance charts and graphs of *Catalog Data Bulletin B-3*.

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

GENERAL EQUIPMENT

A large and diverse line of precision measuring instruments, scientific apparatus, industrial test and control equipment is described and illustrated in an 8-page condensed catalog.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

RADIO AND TELEVISION TRAINING

This descriptive circular outlines a new 35-lesson *Practical Radio & Electronics Course* in detail and offers many other radio and TV servicing helps to the beginner.

Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.

HI-FI SUPPLIES

Catalog HF-250 offers the audiophile, hobbyist and experimenter an assortment of "do-it-yourself" speaker systems, cabinets, cabinet kits, components and hi-fi systems.

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

PHONOGRAPH NEEDLES

The importance of a diamond needle's grain orientation and how it can be accomplished with the proper shaping, finishing and setting is the subject of *Folder CL-45*. Ample space is provided on the back for imprinting.

Jensen Industries, Inc., 7333 W. Harrison St., Forest Park, Ill.

LOUDSPEAKER SYSTEMS

Each page of this brochure of speaker systems shows a photograph of a system, describes it in detail and lists its specifications. Five types are presented,

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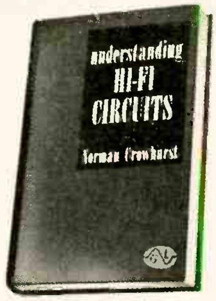

Now—this new book **UNDERSTANDING HI-FI CIRCUITS** by hi-fi expert Norman H. Crowhurst shows you the way to new pleasure—new profit in hi-fi enjoyment! Here at last is a book which tells you how to select **THE BEST HI-FI CIRCUITS FOR YOUR OWN TASTE—AND BUDGET!** Crammed full of the practical hints you want for better hi-fi performance, this big 224-page book analyzes special output stages, feedback and damping, inverter and driver stages, input stages, matching, equalization, speaker distribution and crossovers, loudness and volume controls, tone control and many other vital topics. Thoroughly illustrated—completely indexed.

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THESE BOOKS ALREADY PUBLISHED

To begin your membership you may select the new book UNDERSTANDING HI-FI CIRCUITS—or either of these two books previously published.

BASIC AUDIO COURSE. By Donald Carl Hoefler, RCA recording engineer—Covers audio-high fidelity fundamentals from the theory of sound to advanced recording techniques, including amplifiers, feedback, power supplies, distortion and noise, attenuators, loudspeaker systems and every other important audio unit. Shows why and how audio systems work.

MAINTAINING HI-FI EQUIPMENT. By Joseph Marshall—RADIO-ELECTRONICS widely-read hi-fi authority teaches you the techniques needed to recognize and repair hi-fi troubles. Covers acoustical and mechanical faults as well as electronic. A must for the professional hi-fi man or the audiophile who maintains his own equipment.

THESE BOOKS SET FOR FUTURE PUBLICATION

Here are some of the titles to be published one-at-a-time at regular intervals of about four months each in the months ahead. You will automatically receive a copy of each book for a 10-day FREE inspection as it comes off the press.

- HIGH-QUALITY AUDIO
- THE AUDIO DATA BOOK
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MAGNETIC TAPE

A new two-color, pocket-size booklet describes the characteristics of six magnetic recording tapes and how each should be used. Other topics include splicing, leader and timing tapes. A reference table that lists playing time of single- and dual-track tapes at 3¾ and 7½ inches per second in a variety of reel lengths is another valuable feature.

Minnesota Mining & Manufacturing Co., Dept. M7-56, 900 Bush St., St. Paul 6, Minn.

KITS

Audiophiles, experimenters, radio hams and service technicians will find this catalog of kits interesting. Four of the kits presented are new: the Legato speaker system, an impedance bridge, an automatic Conelrad alarm kit and an rf power meter.

Heath Co., Benton Harbor 20, Mich.

BATTERIES FOR PORTABLE RADIOS

A new 1957–58 portable-radio battery guide shows the manufacturer's numbers (adopted from the approved NEDA standard numbering system) and the numbers of seven other major battery makers. It has a section on transistor batteries, vacuum tube models and 100 standard type batteries. Details on the battery complement of more than 600 models of portable radios, covering 41 brands, are listed. The guide is in the form of a chart with a riveted hole for hanging on the wall, promoting customer self-service. A 1957 calendar adds to its usefulness.

Ray-O-Vac Co., Dept. 284, 212 E. Washington Ave., Madison, Wis.

HI-FI EQUIPMENT

The question: "Shall I buy a turntable or record changer?" is answered in a pocket-size booklet that breaks the problem down into eight basic differences between the two. The booklet also shows the manufacturer's entire line in full color.

Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, N. Y.

ALLIGATOR CLIPS

This manufacturer describes his three new 70 Series streamlined alligator clips, their complete specifications and the functional advantages of their use of cord-strain relief ears and meshing teeth in *Catalog Sheet No. 176*.

Mueller Electric Co., 1567Y E. 31 St., Cleveland 14, Ohio.

ELECTRONIC COMPONENTS

A very recent line of electronic components is highlighted in the 48 pages of *Catalog No. 571*. Transformers, (audio, power, pulse), filters and discriminators, toroids, magnetic ampli-

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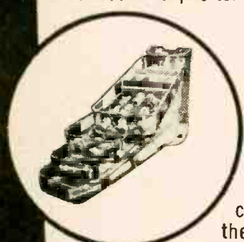

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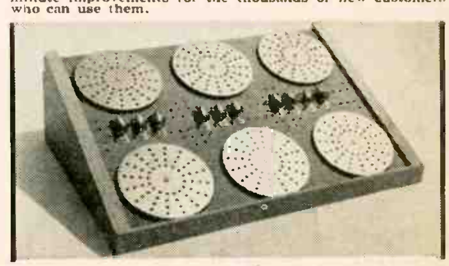

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fiers and ultrasonic components are all described and pictured in detail. The performance of many of these units is shown by the 128 graphs. Complete data on transformers for military and commercial applications is also included.

Freed Transformer Co., Inc., 1789P Weirfield St., Brooklyn 27, N. Y.

ELECTRONIC TEST INSTRUMENTS

Catalog S-57 (4 pages, 2 colors) on electronic test instrumentation, covers expanded-scale voltmeters and frequency meters, synchro testers, vtvm's, oscillators, resistance bridges, power supplies, wide-band amplifiers, WWV receivers and decade inductors.

Shasta Div., Beckman Instruments, Inc., P. O. Box 296, Station A, Richmond, Calif.

TUBE CURVE WORKSHEETS

Seven new types of tube curve worksheets, for the 6AU6 (pentode), 6AU6 (triode), 6CL6 (pentode), 6CL6 (triode), 12AY7, 5670 and 6080, have been added to this technical publisher's line. These curves, on 8½ x 11-inch pads of 20 sheets each, show plate, positive-grid and screen characteristics. A fresh sheet is available for each circuit design and can be torn off for filing.

Technical Publishing House, 4 Tyler Rd., Lexington 73, Mass., 1-99 Pads 89c each (sample sheet of any type sent on request).

WIRE AND TUBING

Bulletin No. T-257 features industrial and government specification hookup wire, lead wire and insulated tubing. It is accompanied by a suggested resale net-price sheet effective March 1, 1957.

Birnbach Radio Co., Inc., 145 Hudson St., New York 13, N. Y.

Any or all of these catalogs, bulletins or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

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THE FUND REACHES $12,239.27

HELP - FREDDIE-WALK FUND

Seven years ago this month, the Help-Freddie-Walk Fund was organized by RADIO-ELECTRONICS to aid little Freddie Thomason, who was born both armless and legless, by providing some measure of financial assistance for his father, a service technician of Magnolia, Ark. Since that time over $12,000 has been donated by thousands of our readers.

As we close this quarterly report on the activities of the fund, we are only a few days away from the deadline for paying income taxes, and we feel certain that this is the reason for such a small response to our last appeal.

However, if the fund is now 7 years old, Freddie is 7 years older himself. A normal, healthy youngster in all other respects, he is as active as an 8-year-old dependent upon artificial arms and legs can be. As he continues to grow at a normal rate, these appliances must grow proportionately if Freddie is to remain healthy emotionally and psychologically as well as physically.

For this reason we are renewing our appeal and asking our readers to dig down in their pockets and send us any amount they can spare. *No* amount is too small to receive our sincere thanks and acknowledgement and all donations are turned over to the Thomasons to help assure Freddie's future.

At this time we would like to make special mention of the donation received from "The folks at J. T. Hill Co." San Gabriel, Calif. Their accompanying letter reads in part: "You certainly must be a courageous little fellow and we know your mother and father are very proud of you."

Won't you mail us your contribution as soon as possible? *Make out all checks, money orders, etc., to Kiwanis Club of Magnolia, Ark.* Send all contributions to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS
154 West 14 Street
New York 11, N.Y.

RADIO-ELECTRONICS Contributions as of Jan. 10, 1957	$11,598.67
FAMILY CIRCLE Contributions	602.50
Harry L. Bailey, Pomeroy, Ohio	1.00
Joseph P. Bertucci, M.D., Ishpeming, Mich.	5.00
Boenecke Associates, Camden, N.J.	1.00
The Folks at J. T. Hill Company, San Gabriel, Calif.	13.00
Meridian TV Service, Washington, D. C.	4.00
William A. Mertens, Racine, Wis.	1.00
Louis Peck, Ketchikan, Alaska	5.00
Alexander Rys, Minneapolis, Minn.	.10
Fred A. Stickler, Long Beach, Calif.	6.00
E. F. Szajna, St. Clair Shores, Mich.	1.00
Vincent's Radio TV Service, Clio, Mich.	1.00
TOTAL CONTRIBUTIONS as of April 10, 1957	$12,239.27

OPPORTUNITY ADLETS

Rates—45c per word (including name, address and initials) Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for August issue must reach us before June 15, 1957.

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ELECTRONICS SURPRISE PACKAGE Real Scoop. Approximately 100 pounds. $9.95 F.O.B. Dayton, No C.O.D. remittance with order. ALPINE PRODUCTS, Dept. 5A, 2236 Hepburn Ave., Dayton 6, Ohio.

YOUR name, address, phone number on sets you service. Big roll of Gummed Labels ½" x 1¾" printed, mailed immediately $1. Airmailed $1.25. ALEXANDER, Box 474-A, Pomona, Calif.

ELECTRONICS-T.V.-RADIO. Sales-Service, 1956 sales $69,000. West Virginia, price $25,000. APPLE COMPANY, 1836 Euclid, Cleveland, Ohio.

NEW TG-34A Photoelectric Tape Code Practice Sets with manuals $24.95: New BC-645's, with original and Citizen's Band conversion schematics, data, $24.95. ENGINEERING ASSOCIATES, 428 Patterson Road, Dayton 9, Ohio.

20-50% DISCOUNTS on Hi-Fi, tape recorders, tape, accessories, photographic equipment, individual quotations only. No catalogs. Conmar Camera & Hi Fi, 121-07 237 Street; Rosedale 22-R, N.Y.

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30W. Motorola Mobile Phones, 150-162MC. Complete with all cables-antenna—WE41A Control unit—WE106A Selective ringer for Telephone Co. use. Present Crystals for WJ Band—FCC approved. FUSON, Box 990, Ft. Wayne, Ind.

DIAGRAMS FOR REPAIRING RADIOS $1. Television $2. Give make, Model. DIAGRAM SERVICE, Box 672-RE, Hartford 1, Conn.

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that Jack built.

This is the clatter
that came from the house
that Jack built.

For all was the matter
with the musical clatter,
that came from the house
that Jack built.

This was the platter?
Which made all the matter
with the musical clatter,
that came from the house
that Jack built.

Reviewing the data
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which made all the matter
with the musical clatter,
that came from the house
that Jack built.

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and the maiden who's
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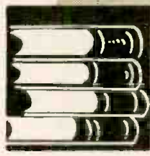

MANDL'S TELEVISION SERVICING, revised edition, by Matthew Mandl. Macmillan Co., New York, N. Y. 6½ x 9½ inches, 460 pages, $6.50.

Written for the service technician in an easy-to-read style, this edition will make a valuable reference volume. Fundamentals of both monochrome and color TV are reviewed. Each section of a TV receiver is discussed separately with particular attention to troubleshooting. Sections covering series filament circuits, transistor theory and servicing and printed-circuit theory and servicing are included. An index to common television troubles facilitates use of the book.—*LS*

PRINCIPLES OF COLOR TELEVISION by the Hazeltine Laboratories staff, edited by Knox McIlwain and Charles E. Dean. John Wiley & Sons, Inc., New York, N. Y. 9½ x 6 inches. 595 pages, $13.

A technical text offering the advanced technician, scientist and engineer a unified presentation of the design and theory of color television. After a background of basic principles and a discussion of the quantitative handling of color, the book presents features of transmitting, receiving and measuring equipment. A complete description of engineering design of receivers includes synchronization, rf, if, video amplifiers, and decoders. A study of FCC transmission standards, a glossary of terms and several appendices complete the text.—*LS*

REPAIRING TELEVISION RECEIVERS, by Cyrus Glickstein. John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N. Y. 5½ x 8½ inches, 206 pages. $4.40.

TV repair is not an easy business that can be explained in a few simple lessons. This book assumes a basic knowledge of TV theory and test instruments. From here it proceeds to a clear and complete discussion of troubleshooting and servicing short cuts. The method is simple and logical. First it shows how to locate the defective section, then the defective stage, finally the defective component. The author's "quick key check" can in many cases reveal the defective section with the aid of only a vtvm and screwdriver. Then test equipment can take over the search for the trouble.

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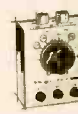

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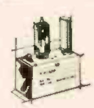

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cussed in separate chapters. Even experienced technicians will find helpful hints to speed up their work.—*IQ*

TRANSISTOR MANUAL. General Electric Co. 5½ x 8½, 61 pages, 50c.

This booklet describes transistors and circuits. Prepared like a tube manual, it is a handy and time-saving reference for hobbyists, technicians and engineers. It explains the construction of transistors and how they operate. Basic circuit design, meaning of symbols and applications are among the contents.

Among the listings found in the manual are RETMA types, replacements for latest transistor receivers and specifications for G-E types. A large number of circuits are given with complete parts lists. These include hi-fi amplifiers, power supplies and broadcast receivers.—*IQ*

PRACTICAL RADIO AND ELECTRONICS COURSE For Home Study, preparation directed by M. N. Beitman, Supreme Publications, 1760 Balsam Road, Highland Park, Ill., 8½ x 10½ inches, 268 pages, $3.95.

A complete discussion of radio and electronic fundamentals is presented for the beginner. There are numerous illustrations throughout chapters on what makes up a radio, circuits using resistors, properties of coils and transformers, vacuum tubes, rf amplifiers and electronic test equipment. This material is service-slanted and intended to lead to more advanced courses in electronic servicing.

An important feature of this book is the photographic identification of many components. In the chapter on capacitors, for example, the reader learns what they look like along with what they do. When he sees a radio chassis, he will be able to identify the different types of capacitors.—*LS*

HOW TO INSTALL AND SERVICE INTERCOMMUNICATION SYSTEMS, by Jack Darr. John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N.Y. (Cat. No. 189). 5½x8½ inches, 151 pages. $3.

An intercom is more than just an audio amplifier. If you try to build or service one, you may soon wish you knew more about selector and talk-listen switching, cabling and installation. This book covers the whole field including wired and wireless types. It illustrates commercial units from the simplest to the most complicated. It tells how to build your own. Special attention is given to wiring through walls, in basements and along towers. Also included are hints on servicing and testing, installing remote stations and other topics.—*IQ*

HANDBOOK OF INDUSTRIAL ELECTRONIC CONTROL CIRCUITS, by John Markus and Vin Zeluff. McGraw-Hill Book Co., New York. 352 pages. $8.75.

Over 300 electronic circuits and descriptions reprinted from recent issues of *Electronics* magazine. All circuits were selected for their particular value in the design of control devices and systems and are grouped in chapters according to the basic function or application. Each is complete with data on performance, operation, critical components and applications. END

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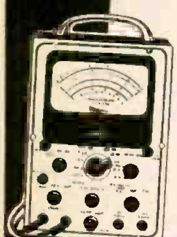

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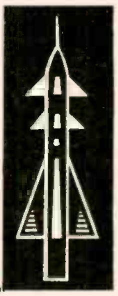

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930 ...... 1.50
954 ...... .40
955 ...... .40
956 ...... .35
957 ...... .35
958A ...... .35
991 ...... .25
CK1005 .. .35
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CK1028 .... 2.35
2051 ...... .65
5517 ...... 1.35
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5642 ...... 1.00
5646 ...... 4.35
5651 ...... 1.40
5654 ...... 1.40
5675 ...... 8.00
5676 ...... .85
5687 ...... 1.85
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5692 ...... 5.00
5693 ...... 4.75
5703WA .. 4.50
5718 ...... 2.00
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GT	6SN7, etc.	1.25
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Large G	5U4G, etc.	2.00

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SIZE	PER EACH
Ministacker	1½c
GT	.02

$10.00 Per Case of 1000 FOB NYC.

All cartons & stackers f. o. b. NYC

INVISIBLE INFRA-RED CL-2 LAMP $10.00

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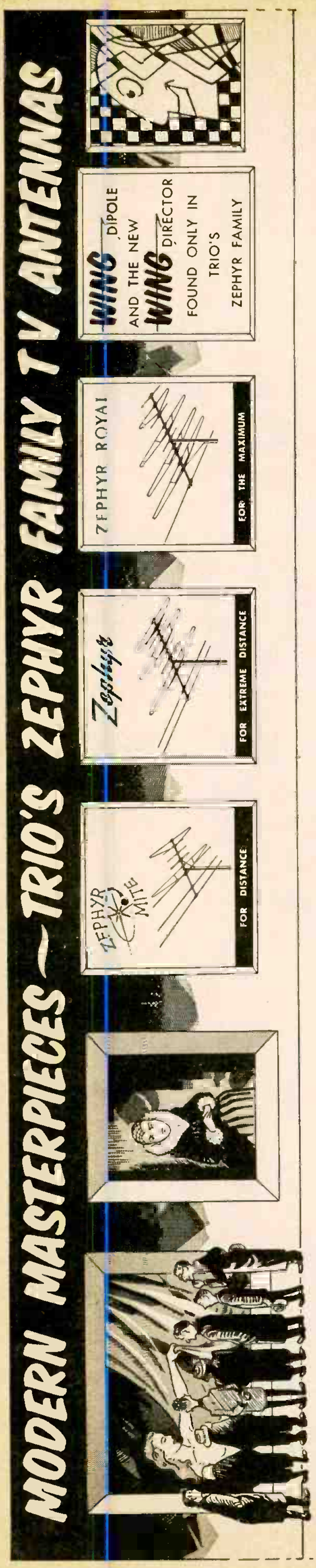

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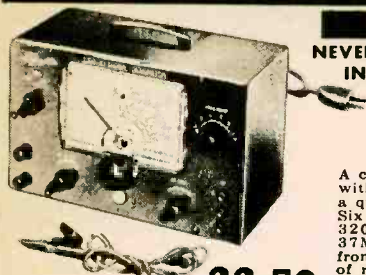

LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

22.50

A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR 22.50

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH

FULL SCALE RANGES

DC Volts: 0-10; 0-50; 0-500; 0-1000 Volts — **AC Volts:** 0-10; 0-50; 0-500; 0-1000 Volts—**DC Current:** 500 ua and 500 ma — **Resistance:** 0-10K; 0-1 Meg — **Decibels:** —20 to +22; +20 to 36 db (0 db — 0.775 V)—**Capacity:** 250 mmfd to .2 mfd—.005 mfd to 1 mfd—**Output Ranges:** 0-10; 0-50; 0-500; 0-1000 volts

8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A .... Complete 8.95

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

34.50

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001-.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¼"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 .... NET 34.50

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER

LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — **A.C. VOLTS:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — **RESISTANCE:** 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—**D.C. CURRENT:** 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — **DECIBEL:** —20 to +77 db (0 db—0.774V) — **CAPACITY:** .0001-.01; .005-.15 mfd — **INDUCTANCE:** 20-2000 millihenry —**OUTPUT RANGES:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

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

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

COMPLETELY WIRED AND TESTED

21.50

- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 .... NET 21.50

Lafayette Import Special! TRANSCRIPTION TYPE MANUAL PLAYER

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM

Complete Turntable and Tone Arm Assembly at the lowest price Ever for Such High Quality

24.50

Here is a new manual player for the audiophile who wants noiseless, "wow-free" and rumble-free reproduction of recorded music at nominal cost. All the important features of professional transcription players have been incorporated in this precision turntable. The lightweight pickup arm is an integral part of the mounting plate and requires no installation. Player is equipped with a heavy duty, 4-pole, 3-speed motor for 78, 45 and 33⅓ RPM records. An exclusive magnetic brake controlled by knob on the base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included with unit, checks speeds. Extremely smooth and quiet operation. No hum even with the most sensitive cartridges. Speed selector safety switch protects mechanism by making it necessary to pass through an OFF position when switching from one speed to another.

10" diameter, weighted cast turntable is supplied with a rubber traction mat for positive grip of record. Stylus pressure adjustment can be made easily and quickly with the conveniently located adjusting screw on the underside of the tone arm. Mounting plate is also equipped with pickup rest and ON-OFF switch. Dimensions of mounting plate: 12-15/16" left to right, and 10⅞" front to rear. Requires 2¾" clearance below motor board and 3" above. Supplied with AC line cord, two plug-in heads, output cable for connection to amplifier and 45 RPM adapter. For 105-120 volts, 60 cycle AC. Shpg. wt., 12 lbs. Less cartridge. (NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)

PK-160 Manual Player .... Net 24.50

PK-164. Same as above except equipped with genuine GE triple-play magnetic cartridge and dual diamond-sapphire styli .... Net 36.50

Wood base, cut out for PK-160 Manual Player. Top quality veneer attractively finished in mahogany or blonde (Specify).

PK-162. Shpg. wt., 5 lbs. .... Net 3.95

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PK-163. Shpg. wt., 1 lb. .... Net .95

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PK-300 TURNTABLE, PK-90 TONE ARM AND G.E. CARTRIDGE WITH GENUINE DIAMOND AND SAPPHIRE STYLI.

72.50

PK-300

ILLUMINATED BUILT-IN STROBOSCOPE & VIEWER

COMBINATION DEAL

PK-90

LATEST IMPROVED MODEL PK-300 TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-300 .... Net **49.50**

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 12" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-300 with matching finish. Shpg. wt., 2½ lbs.

PK-90 .... Net **15.95**

New!

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

14.95

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 .... Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000-16,000 CPS
HANDLES 20 WATTS OF POWER

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.

5.95 Net

HK-3 .... Net **5.95**

CROSSOVER NETWORK

- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

8.75

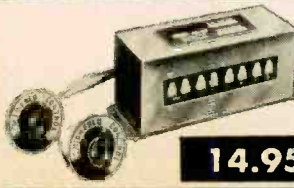
The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 .... Net **8.75**

3 WAY CROSSOVER NETWORK

Carefully designed and engineered to Lafayettes own specifications. Insertion loss is well below the acceptable minimum. Crossover is at 350 and 5000 cycles. Permits full enjoyment of any 3 way system. Properly balances woofer-mid range speaker and tweeter inputs. Complete with 2 continuously valuable "presence" and "brilliance" controls for tonal adjustment and full instructions. 8"L x 3¼"H x 2⅝"W. Shpg. wt., 7 lbs.

LN-3 .... Net **14.95**



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LAFAYETTE FM-AM TUNER KIT

Build Your Own Hi-Fi Tuner Kit and Save!

KT-100

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output: **FREQUENCY RESPONSE:** FM ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 kit, less cage .... Net **34.95**

ML-100—Metal cage for above, shpg. wt., 3 lbs. .... Net **5.00**

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Are Making Music In The World's Finest Amplifiers

POWER AMPLIFIER TYPES

6CA7/EL34 — Exceptionally linear high-power output pentode with low-voltage drive requirements. Up to 100 watts in push-pull.

EL84/6BQ5 — Unique AF power pentode combining high gain and linearity with 9-pin miniature construction. Up to 17 watts in push-pull.

VOLTAGE AMPLIFIER TYPES

EF86/6267 — High-gain pentode with exceptionally low hum, noise and microphonics.* Particularly suitable for pre-amplifier and input stages. Equivalent to the Z739 and the 5879.

ECC81/12AT7 — Medium-gain dual triode with low hum, noise and microphonics. Replaces the 12AT7 without circuit changes.

ECC82/12AU7 — Low-gain dual triode with low hum, noise and microphonics.* Replaces the 12AU7 without circuit changes.

ECC83/12AX7 — High-gain dual triode with low hum, noise and microphonics.* Replaces the 12AX7 without circuit changes.

ECC85/6AQ8 — High-gain dual triode for FM tuners, with shield between sections for reducing oscillator radiation.

RECTIFIER TYPES

EZ80/6V4 — Indirectly heated, full-wave rectifier with 6.3 v, 0.6 amp heater, 90 ma output capacity and 9-pin miniature construction.

EZ81/6AC4 — Indirectly heated, full-wave rectifier with 6.3 v, 1 amp heater, 150 ma output capacity and 9-pin miniature construction.

GZ34/5AR4 — Indirectly heated, full-wave rectifier with 5 v, 1.9 amp heater and 250 ma output capacity. Octal base. Replaces the 5U4G without circuit changes with the advantage of lower tube voltage drop because of the unipotential cathode.

*MAXIMUM LEVELS SPECIFIED AND GUARANTEED

INDICATOR TUBE TYPES

A complete line of subminiature, 9-pin miniature and octal-base types for AM and FM tuner and radio receiver applications.

High-fidelity authorities may not be in perfect agreement as to the "finest" amplifier design available today, but none of them will deny that at least 80% of the contenders for such a title utilize one or more of the new AMPEREX 'preferred" type audio tubes. Originally developed in the laboratories of Philips of the Netherlands and applications-researched by AMPEREX for the American electronics industry, these ultra-advanced tubes have by now thoroughly proven their reliability and unique design advantages in late models by the world's leading high-fidelity manufacturers. Sold by franchised distributors everywhere . . . available for off-the-shelf deliveries in any quantity.

Detailed data, as well as applications engineering assistance to manufacturers and professional designers, available from Semiconductor and Special Purpose Tube Division, Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, Long Island, N.Y.

ask Amperex

. . . about hi-fi tubes for hi-fi circuits

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SAM: *Looking for something?*

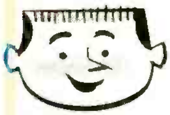
YOU: *That's right! I'm looking for a real all-purpose P. A. speaker and microphone combination. I want a combination that will stand up and do a top-quality job in any application.*

SAM: *The fact is that Electro-Voice has what is probably the handiest, most versatile P. A. speaker and microphone combination in the business.*

ELECTRO-VOICE CDP® SPEAKERS—*Compound Diffraction Projectors —are overwhelmingly superior to conventional P. A. horns because: CDP gives you two coaxially-mounted horns operating from a single diaphragm . . . a large one for lows, a small one for highs; 2½ additional octaves of sound reproduction plus dispersion through a solid 120° angle. CDP reaches more people more clearly. Two sizes to meet your needs.*

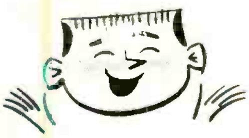
MODEL 848 CDP *handles the biggest jobs. 25 watts, 16 ohms. Response: 175-10,000 cps, crossover at 1000 cps. Sensitivity rating, 52 db. Size, 10½" x 20½" x 20". Wt., 12 lbs. List, $75.*

MODEL 847 CDP *for smaller areas. 12 watts, 16 ohms. Response: 250-10,000 cps, crossover at 1500 cps. Sensitivity rating, 51 db. Size, 11¾" x 7¾" x 10 7/32". Wt., 6½ lbs. List, $46.33.*

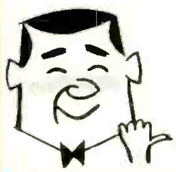


YOU: *Sounds great! But what about the all-around general-purpose microphone?*

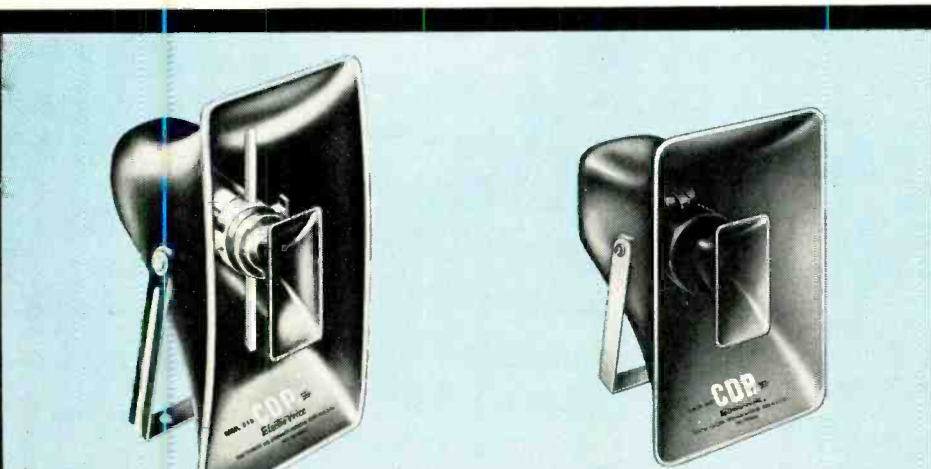
SAM: *Electro-Voice has the mike to do the job. In fact, the E-V Model 664 High-Fidelity Cardioid Dynamic is so good that Electro-Voice GUARANTEES it to outperform any other P. A. cardioid or your money back. Model 664 with unique E-V Variable D® gives you amazing versatility. It provides highly directional sound selectivity, smooth, peak-free response at all frequencies from 40 to 15,000 cps, no boominess. Exclusive, indestructible Acoustalloy diaphragm assures dependable, long-life operation indoors and outdoors. It lists for only $82.50 (less stand).*



YOU: *Looks like the answer to my problems.*



SAM: *It is! Send for Bulletin 195-76. It's a 24-page handbook with a lot of answers on public address problems. Cat. No. 126-76 will give you complete details on Electro-Voice P. A. and general-purpose microphones. Bulletin No. 246-76, "The A B C's of Microphones," is packed with facts about the different types of microphones and how they work. Send for them today!*



Model 848 CDP **Model 847 CDP**

Model 664

Electro-Voice®

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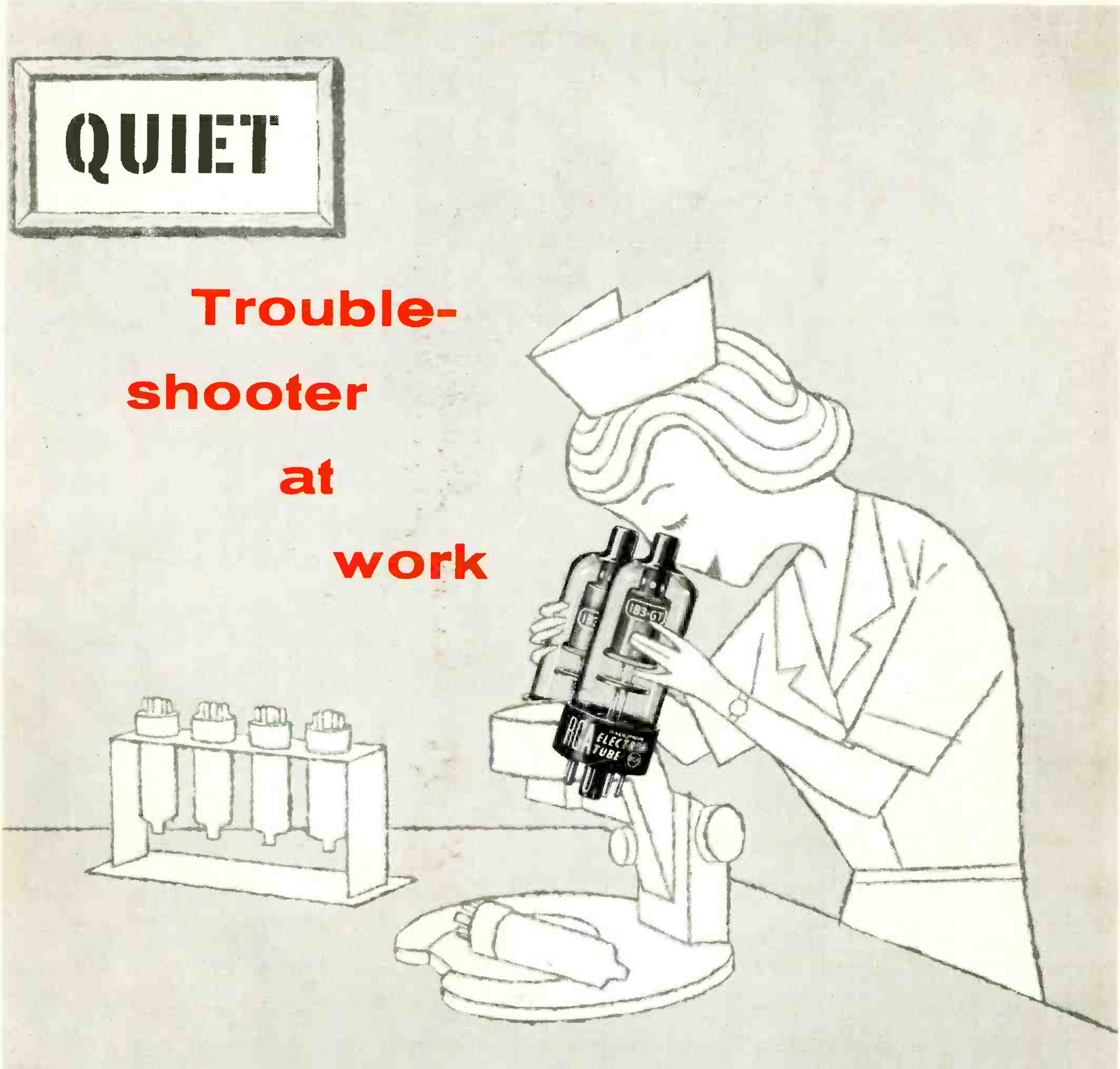
Trouble-shooter at work



Here's how Microscopic Inspection by RCA helps reduce costly callbacks...

A bad tube, or a potential trouble-maker—can it get by this gal? Not likely. She's part of the specially trained RCA group of inspectors whose important job it is to find trouble and help prevent it from happening *to you.*

RCA Quality-Control Procedures include MICROSCOPIC INSPECTION OF POPULAR TV RECEIVING TYPES! These types are closely examined for possible poor welds, weld splatter, bad crimps, damaged stems, improper assembly, and many other factors that can affect top quality, long-term performance. Though the tubes may pass all electrical tests, such defects could slip by and mean the difference between a profitable service call and a costly callback.

You gain valuable assurances from this *extra* care: (1) that popular TV receiving types shipped to RCA Tube Distributors have had the *extra* benefit of the MICROSCOPIC INSPECTION PROGRAM and (2) that you can always service your customers with the confidence that RCA TV Receiving Types are top quality replacement tubes.

When you order—tell your distributor "RCA only" and watch your profits grow.

RCA ®

RECEIVING TUBES

RADIO CORPORATION OF AMERICA

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