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RADIO & TELEVISION NEWS

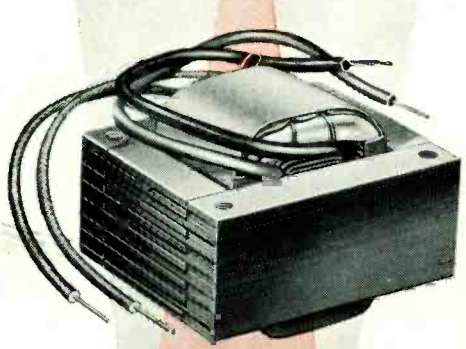
JULY
1955
35 CENTS
In U. S. and Canada

World's Leading Electronics Magazine

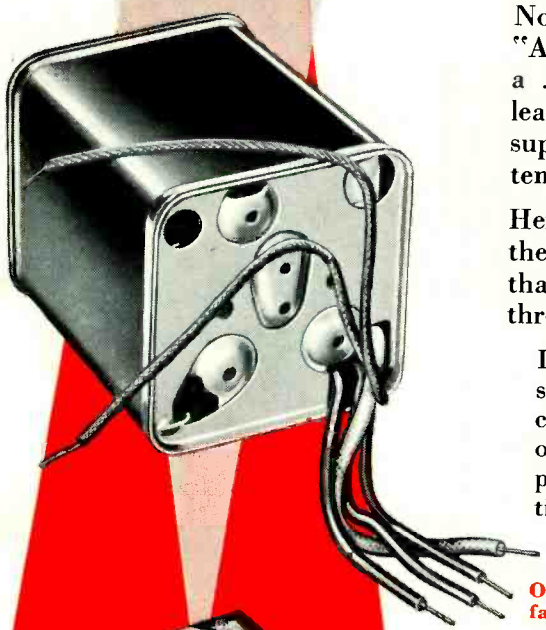
IN THIS ISSUE

from DELCO RADIO...

High-Quality
POWER TRANSFORMERS
for Car Radios



UNCASED MODEL 6055, ABOVE
BELOW, CASED MODEL 6060.



This is the newly developed package for Delco transformers and other electronics parts . . . brighter, stronger, easier-to-find.

Developed by Delco Radio and General Motors electronics specialists, and built under a strict quality control, Delco Universal Vibrator transformers have the kind of built-in customer satisfaction that can do a lot for your business.

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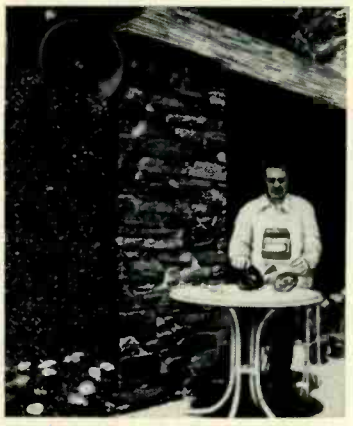

COVER PHOTO: Sound technician uses a Phaostron "555" multimeter to check speakers in an outdoor public address installation. Service hints on this are given on page 112.

(Ektachrome by Peter J. Samerjan)

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DEPARTMENTS

WILLIAM B. ZIFF (1898-1953) FOUNDER
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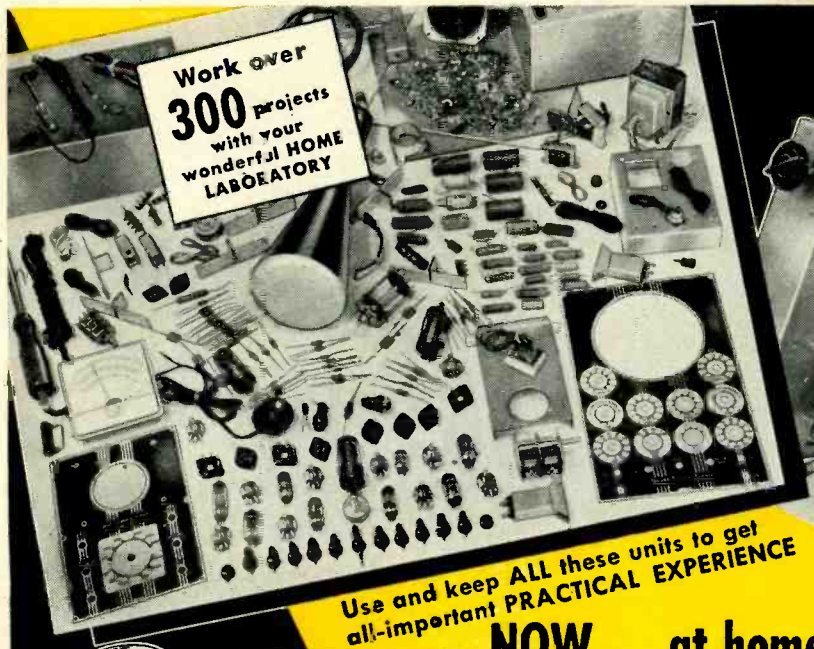

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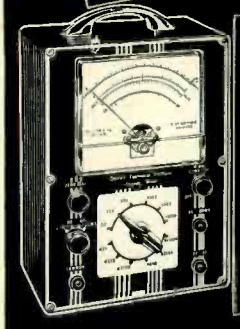

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Inset pictorial diagram on transparent styrene base. (See insert.) Mount parts to follow pattern—using handy "snap in" fasteners. Eliminates wiring errors. Tops for speedy circuit changes . . . for providing maximum circuit experience in minimum time. Build and operate scores of interesting projects — such as the electronic circuit shown below.

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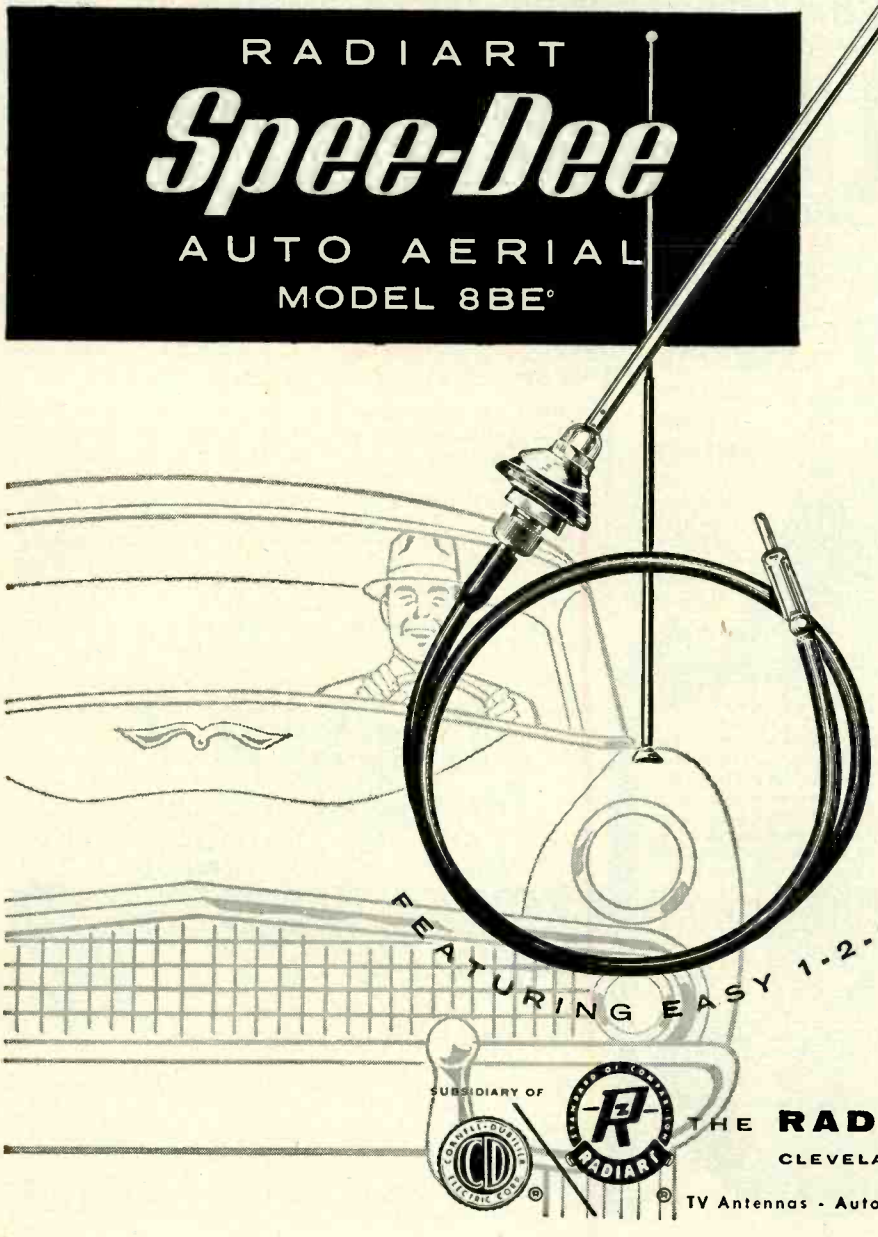

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3. Just tighten assembly . . . plug lead-in into radio.

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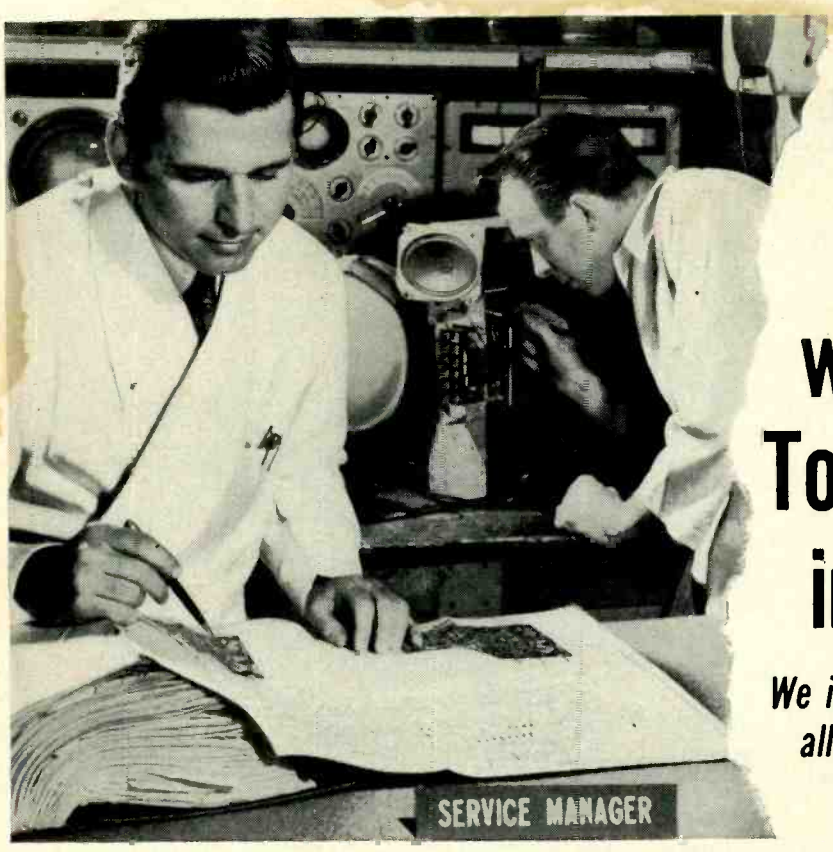

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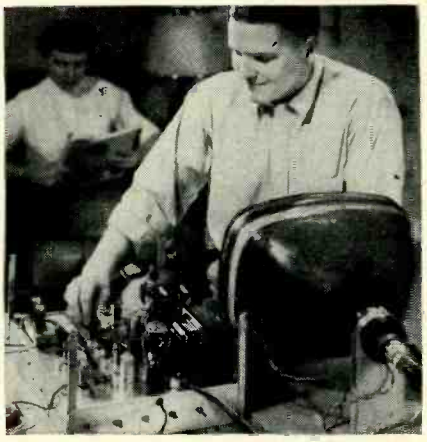

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For the RECORD

BY THE EDITOR

THE FLAT AGE

COMPONENTS for all forms of electronic instruments have undergone a great change in recent years. The trend toward "flatness" may be readily seen by scanning the pages of catalogues from the parts jobbers. The ceramic disc capacitor is one result of flat design. Tubes, especially those for hearing aids, are flat and shortened to tiny dimensions.

Even circuitry has undergone considerable change. The *Motorola* and *Walsco* TV chassis reflect the trend toward flatness of construction that simplifies troubleshooting and saves time since connections to components are reached without searching and picking through a maze of wiring.

Printed-circuit techniques have become widely accepted—even by the novice. A leading kit manufacturer now supplies compact flat boards on which is etched the wiring for critical circuits. Mistakes are prevented and proper dressing of connecting leads result from utilizing these flat assemblies. Another manufacturer is merchandising a complete line of interstage coupling units, called "Couplates," which include all of the necessary resistors and capacitors for various coupling requirements in a single flat assembly.

We would, of course, be remiss if we did not call attention to the possibilities opened up by transistors in the trend toward flatness. Their small size, low power requirements, and small heat dissipation permit the design of more and more compact electronic circuitry for hearing aids, portable radio and TV receivers, tape recorders, and the like.

Electrostatic loudspeakers are now on the market. These flat disc-shaped reproducers have only recently achieved popularity. Further development may lead to units capable of good, clean bass response from small, flat assemblies which can be hung on a wall or mounted in any convenient manner.

Magnetic tape is now flatter than ever. New base materials, having greater strength, permit reduction of thickness and allow more tape footage per reel. Audio amplifiers have been flattened and redesigned for shelf-type installations or for drawer dimensions. And pocket-sized AM and FM receivers, wire and tape recorders, and other electronic gear have been developed. All of these designs reflect the trend toward compact, flat assemblies.

The universal acceptance of big-screen television on direct-view picture tube phosphors has been established. Projection TV, on the other hand, has not shared in the popularity for home methods of producing acceptable pictures. The principal objection was the "metallic" effect produced by light-ray diffractions of the glass viewing screen.

At least one laboratory has recently shown great progress in further developing projection TV for the home. Radically new viewing screens are being studied and more economical circuitry is reviving interest in the future possibilities for large-screen projection in the home on "movie-type" screens. The so-called "picture on the wall" television screen has also received widespread publicity although such a screen is not yet commercially available. In this system, a flat screen is connected to the TV receiver by means of a cable, and the picture is formed on the screen electronically. It is even within the realm of possibility that an electrostatic speaker can be combined with a viewing screen to form a single, flat entertainment medium. This will include monochrome and color TV (regular reception or from pre-recorded tapes), slide film, and movie film.

The audio will be provided by the regular TV signals, from magnetic tape or film, or from hi-fi record albums. Reproducers (loudspeaker systems), if not a part of the picture screen, will be mounted within a wall or back of the screen. High fidelity will be achieved through a "new look" in flat electrostatic speakers or even more advanced types of cones.

Wide-angle viewing will simplify seating arrangements, and widely dispersed sound will enhance the effect of audio reproduction in the living room. Stereophonic reproduction will lend added realism and the practically complete elimination of noise and distortion will greatly reduce listener fatigue. Remote control will permit the major components of any system to be located out of sight, if desirable, thus contributing considerably to better room decor.

Such a composite system for providing our home entertainment is felt, by many, to be just around the corner. Most of the ingredients are well established. A few need more research and development if they are to fit economically into the picture—color TV, that is! . . . . . O.R.

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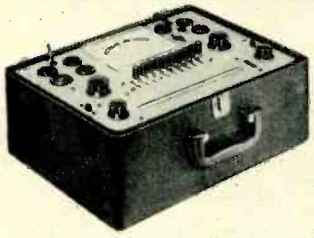

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Expertly engineered, low-cost tube tester. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures, pilot lamps. Tests cover new 600 ma. series-string types. Checks for emission, shorts, open elements, heater continuity. 4½" meter with "Good-Replace" scale. Fast-operating roll chart. Universal socket pin selectors to test tubes with new base arrangements. Blank socket for future use. Choice of 14 fil. voltages from .75 to 117 v. Includes all parts, dark green metal case, gray panel, wire, solder. 9 x 4 x 10". For 110-120 v., 50-60 cy. AC. 14 lbs.

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83 FX 142. As above but in fabrikoid covered portable case, 6½ x 14½ x 10½". Shpg. wt., 15 lbs. Only..**$34.75**

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Quality 20,000 ohm/volt VOM with 4½" meter; ± 2% full scale accuracy; 1% multipliers; single switch selects: 6 DC ranges—0.2.5-10-50-250-1000-5000 at 20,00 ohms/volt; 6 AC ranges—0.25-10-50-250-1000-5000 at 5000 ohms/volt; 3 resistance ranges—0-2000-200,000 ohms and 0-200 meg. 4 DC current ranges—0-10-100 ma. and 0-1-10 amps. Complete with bakelite case (6¾ x 5¼ x 3¾"), all parts, 4' test leads, batteries, wire and solder.

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83 F 145. Knight RF Signal Generator Kit. Only..**$19.75**

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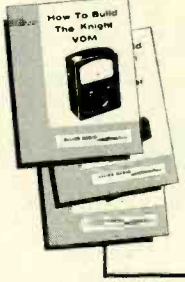
83 FX 137. Knight Audio Generator Kit. Only....**$31.50**



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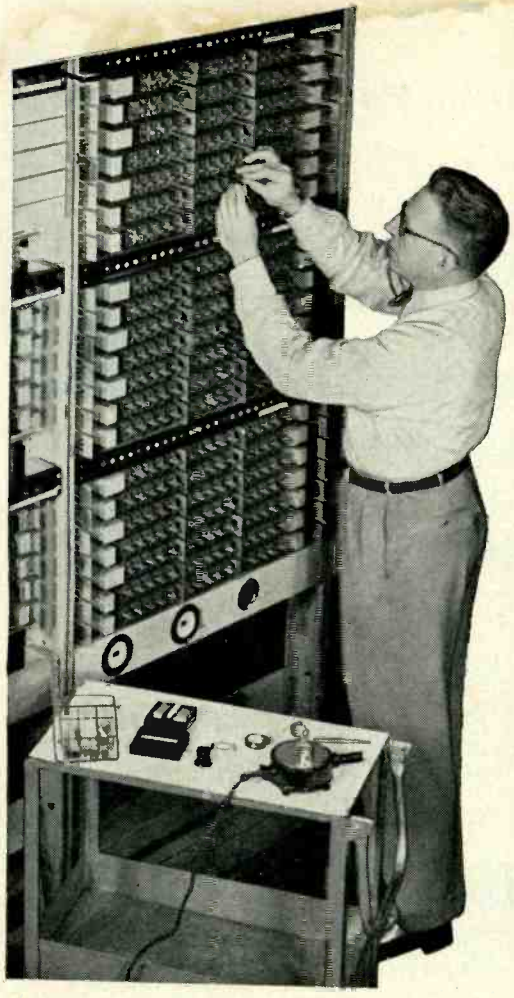
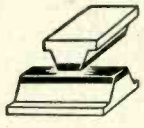


He's "fingerprinting" a relay contact

Bell Laboratories microchemists have perfected an ingenious new technique for "fingerprinting" relay contacts, the tiny switches on which a dial telephone system critically depends.

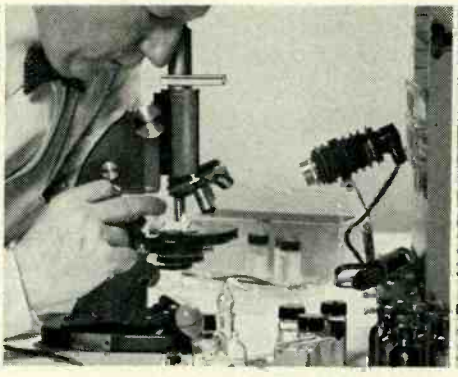
Using a portable test set, a chemist makes a plastic print of a contact. On-the-spot examination of the print with a microscope and chemical reagents quickly reveals the effects, if any, of arcing, friction, dust or corrosive vapors. While the chemist studies the print, urgently needed contacts continue in service. Findings point the way to improve relay performance.

This is another example of how Bell Telephone Laboratories research helps to keep your telephone system the world's best.

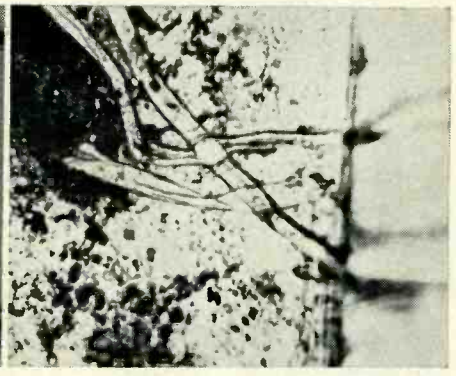


Above, Bell Laboratories microchemist applies plastic disc in heated clamp to relay contact. Imprint reveals contours of surface and picks up contaminants, if any. Part of portable test set is shown on table. Contacts, shown in small sketches, are of precious metal fused to base metal.

Preparing disc for microscopic examination. On-the-spot examination may reveal acid, alkali, sulfur, soot or other polluting agents peculiar to an area.



A microscopic look at disc often provides lead to nature of trouble. Unlike actual contact, print can be examined with transmitted light and high magnification.



Here the plastic disc has picked up microscopic lint that insulates contact, stops current. (Picture enlarged 200 times.) Traces of contaminants are identified in microgram quantities. Inert plastic resists test chemicals that would damage contact.

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Improving telephone service for America provides careers for creative men in scientific and technical fields

Week after week
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Quality products through *ADVANCED-ENGINEERING*

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PICKERING models 220/240 cartridges

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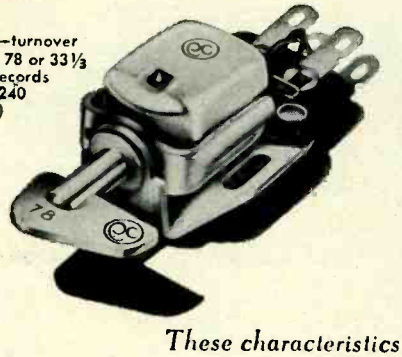
. . . they are sold separately for all standard arms or mounted back-to-back to make up the famous PICKERING 260 TURNOVER PICKUP.

MODEL 220—for 78 rpm records diamond or sapphire stylus

MODEL 240—for 33⅓ and 45 rpm records diamond stylus only



MODEL 260—turnover cartridge for 78 or 33⅓ and 45 rpm records (the 220 and 240 back-to-back)

The 220 and 240 are engineered to maximize performance. By comparison they are without equal . . .

The **220** *and* **240** *are*

Lighter— 5½ grams

Smaller—⅝ by ¾ by ⅜ inches

The **220** *and* **240** *have*

Highest Output—30 millivolts/10cm/sec.

More Compliance with Less Tracking Force

Lower Overall Distortion

Less Moving Mass

Wider Frequency Response

Mu-Metal Shielding for Less Hum

These characteristics have real meaning to those who understand that maximum performance depends upon components which meet professional standards. If you want the best that high fidelity can offer, ask your dealer to demonstrate the 220, 240 and 260 Pickering cartridges . . .

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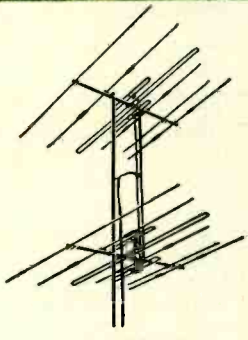

NEW!
Narrow-space stacking!

Channel Master's RAINBOW and SUPER RAINBOW can now be stacked only 60" apart. These new, extremely efficient, 2-stage, impedance-matching stacking rods permit easier installations with an absolute minimum sacrifice of gain.

model no. 331-7

Champion Rainbow 330 series
Super Rainbow 331 series
Challenger Rainbow 332 series

Warm weather is profit weather!

The weather's warmer! Days are longer! *This* is the time of year to go after that gold mine in your own backyard: the replacement of the antennas in your area that are damaged, worn, and obsolete.

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Other Patents Pending

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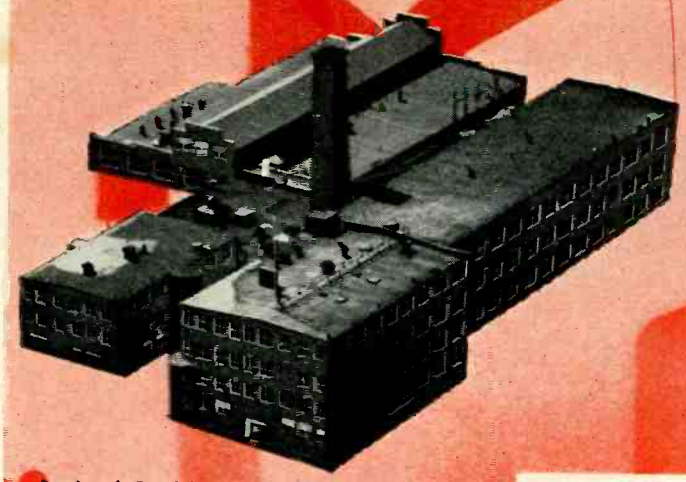

Raytheon's Receiving Tube Plant No. 1 — Newton, Mass.

Raytheon's Microwave and Power Tube Plant No. 1 Waltham, Mass.

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In TUBES and SEMICONDUCTORS

Raytheon's Research Center Waltham, Mass.

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RAYTHEON has more than 1,000,000 square feet devoted exclusively to the manufacture of Raytheon quality tubes and semiconductors.

RAYTHEON employs over 500 engineers and scientists who work exclusively in the electron tube and semiconductor fields.

RAYTHEON has had 33 years' experience in the manufacture of electron tubes.

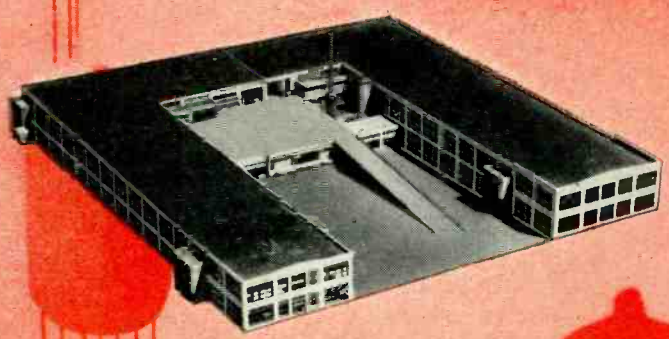
RAYTHEON has made tubes of every type of construction — Standard Glass, "G", GT, Bantal, Lock In, Metal, Miniature and Subminiature Tubes.

RAYTHEON Receiving and Cathode Ray Tube Operations have produced more than a third of a billion tubes and semiconductors.

RAYTHEON perfected the first practical rectifier tube types (BA and BH) to eliminate the need for "B" batteries to operate home radios. This revolutionized the design of home radio sets. Raytheon later developed the cold cathode rectifier tube for auto radios and has produced more of these tubes than all other companies combined.

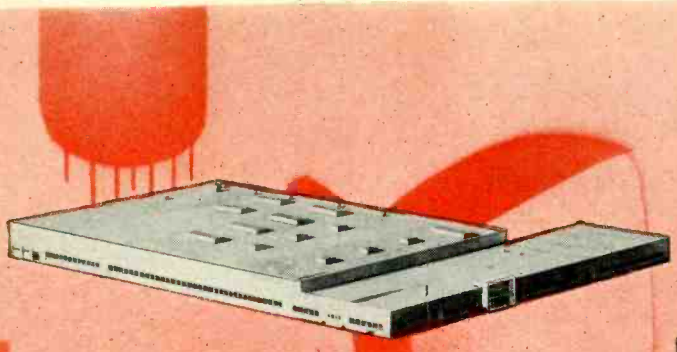
RAYTHEON developed the famous 4-pillar construction that strengthened internal structure resulting in sturdier tube design.

RAYTHEON developed and was first to mass-produce the octal button stem receiving tube — today's most imitated construction for premium TV performance. Raytheon was first to make millions of these tubes as far back as 1946. These tubes featured a planar button stem and 8 straight leads (8-pillar) which go directly into a standard octal base. Raytheon's Patent Numbers 2310237, 2321600 and 2340879 apply to this invention.

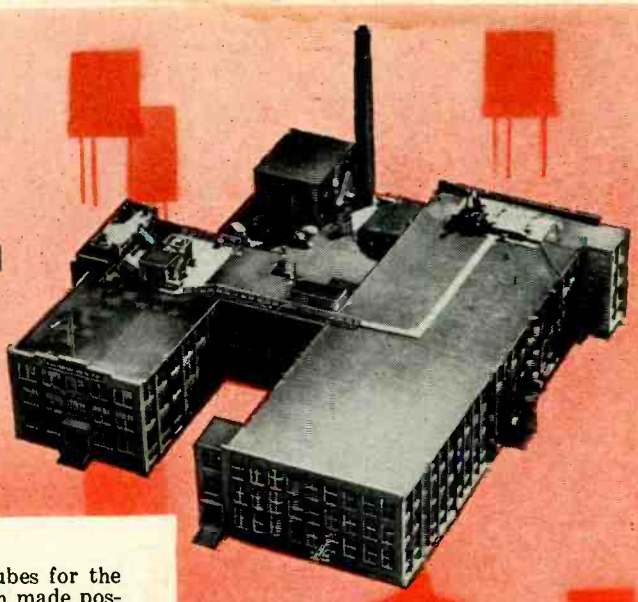


Raytheon's Semiconductor Plant No. 2 and Raytheon's Special Tube Plant No. 2 Boston, Mass.

Raytheon's Cathode Ray Tube Plant Quincy, Mass.



Raytheon's Receiving Tube Plant
No. 2 — Quincy, Mass.



Raytheon's Semiconductor Plant
Newton, Mass.
(Being Assigned to Semiconductor
Division Starting Dec. 1, 1955)

RAYTHEON developed and first mass-produced subminiature tubes for the hearing aid industry — the forerunners of the fuse tubes which made possible the famous proximity fuses of World War II. There are more commercial Raytheon subminiature tubes in use today than all other makes combined.

RAYTHEON developed a method of mass producing magnetrons (the power tube that is the heart of radar) early in World War II, that broke a serious bottleneck, and continues to produce more magnetrons than all other manufacturers combined.

RAYTHEON is the largest producer of klystrons and has manufactured more than all other companies combined.

RAYTHEON was the first commercial producer of Transistors — the "mighty mite" — a Raytheon achievement that revolutionized the hearing aid industry.

RAYTHEON first commercially produced fusion-alloy RF Transistors, expected to revolutionize the portable radio, auto radio and computer industries.

RAYTHEON has produced many more transistors than all other manufacturers combined — nearly 2,000,000 in use.

TODAY, RAYTHEON makes Receiving and Picture Tubes, Reliable Miniature and Subminiature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes and Microwave Tubes.

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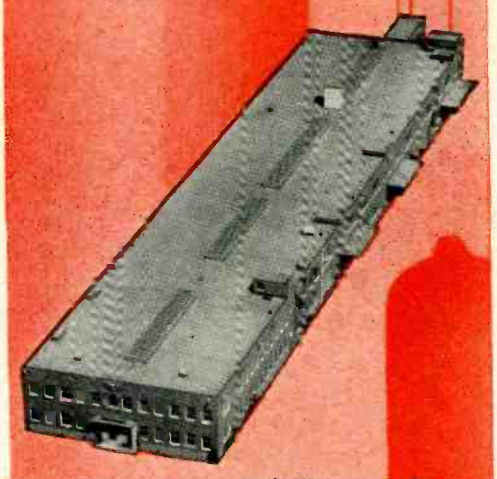

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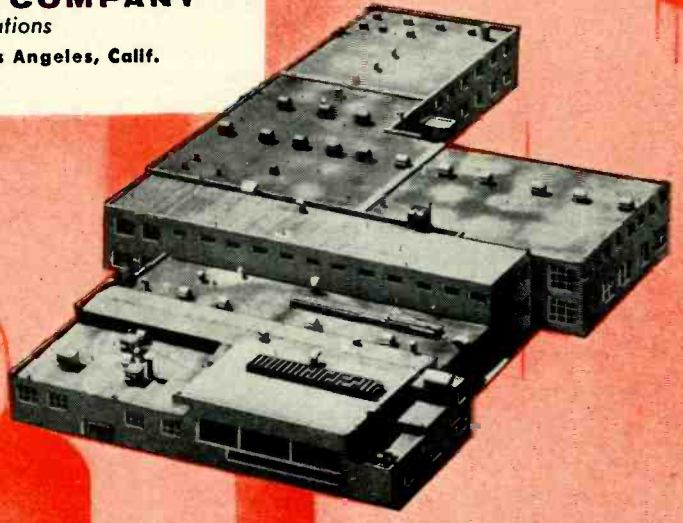

Raytheon's Special Tube Plant No. 1
Newton, Mass.

Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

WAVERING UPSTAIRS TV, under the Congressional microscope for months, also found itself on the Commission's examination table during the late Spring months. Determined to find some way to spur ultra-high acceptance, the FCC issued a proposal which would authorize co-channel u.h.f. booster stations to go on the air and serve to fill in the shadow areas of the mother station.

Pointing out that it was deeply concerned with the snarled high-band situation, the Commission declared that this new move could help to ". . . insure the fullest development of the television industry's potentialities in line with the needs and desires of the American public and the abilities and ingenuity of the American broadcasters."

Emphasizing that there are . . . "substantial obstacles presently hindering the bringing of a first television service to many small communities, as well as the expanding of multiple, competing services in larger economic and population centers . . ." the Commission said that the trouble lay in the failure of the u.h.f. station to become fully integrated with stations now on the air. This, they said, has hampered the development of an economically-sound, nationwide TV service.

Comparing the very-high and ultra-high channels, the FCC explained that the . . . "signals from u.h.f. transmitters have less tendency to fill in areas which are not in direct line-of-sight with the transmitting antenna. Consequently, there are areas which, although lying within the area that would normally be served by a u.h.f. station, are effectively shadowed by intervening terrain, and are thereby deprived of service."

The proposed amplifying transmitters or boosters, they felt, would be one means of providing coverage in such shadow areas. These slaves would operate on the same channel as the base transmitter and be dependent on the mother station for the generation of carrier frequencies and modulation.

Many have been experimenting with booster operation for years and thus were able to submit extensive data on this phase of operation. Some had even forwarded detailed survey analyses before the proposal was formally issued.

In one such report, covering plans for low-powered television, it was revealed that three systems have been developed. One, called an "on-channel" booster, features use of highly directional receiving and retransmitting antennas, so positioned that there is no feedback. In this setup, a high-gain, broadband a.g.c.-controlled amplifier with a 6-megacycle bandwidth serves as a preamplifier. This unit, it was said, requires an input signal of less than 1 millivolt-per-meter. Two more system amplifiers are also necessary, the report continued. One is a high-gain broadband unit with sufficient gain (50 to 80 db, depending on number of stages) to amplify an input signal on the order of 6 millivolts (across 50 ohms) to 20 watts visual peak power; aural power in the same ratio as the received signal. The second unit is a single stage, also broadband, but linear, which can be driven by the 20-watt amplifier, to amplify simultaneously visual and aural signals. Output here is 150 watts peak.

Receiving antennas required were described as colinear (4 x 4) with a power gain of 23 db. As a transmitting antenna, a 16 x 2 (32-element) colinear, with a power gain of 17 db, was said to be ideal for the purpose.

The second system offered was an "off-channel" satellite, with a crystal-controlled translator to shift the original signal, without demodulation, to a new frequency; any channel from 2 to 83 can be shifted. This arrangement, it was noted, could serve to provide improved coverage within the normal service contours of the originating station and also in the fringe signal areas. It was assumed, the report added, that translation would take into account existing unused allocations.

The third system featured a complete low-powered broadcasting station which could be programmed locally, off-the-air, or *via* a network signal. This equipment, it was noted, would be particularly useful for the establishment of a TV service in communities of 50,000 population or less, where a television facility would not be otherwise practical.

ELSEWHERE, the u.h.f. issue was the target of a roaring attack by Madame Commissioner Frieda Hennock. In a sizzling letter to the chairman of the Senate Interstate and Foreign Com-

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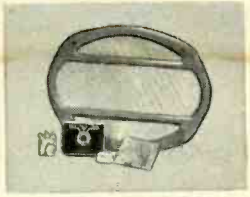

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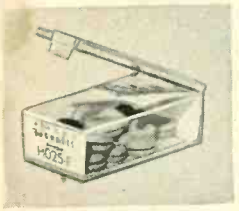

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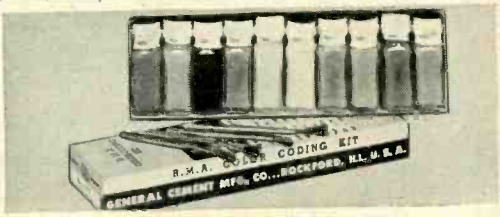

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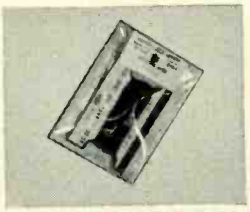

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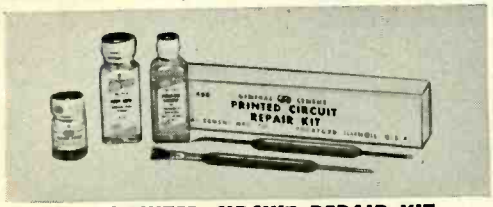

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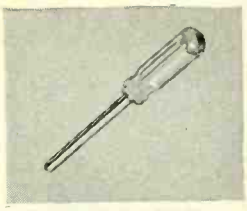

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merce Committee, Senator Warren Magnuson, she said that the government should begin telling prospective TV set buyers that they are being short-changed if their sets are not equipped to pick up all bands.

Charging that industry is saturating the market place with incompatible sets, she told the Senator that . . . "unless your committee takes action to halt this deluge . . . the monopolistic pattern will take hold permanently and thereby thwart the Congressional objective of a nationwide competitive TV system."

Noting that the public, still kept in the dark, continues to buy the standard-band receivers at a rate of over a half-million a month, the Commissioner reported that this adds up . . . "to destruction of 85 per-cent of television."

TOLL TV also found itself in the midst of a furious tug-of-war, with thousands telling the Commission that they should OK the new service, and many thousands strongly denouncing the plan.

A number of business groups told the Commission that they felt the pay-see idea was a good one. According to the National Small Business Men's Association, coin-code TV, which they tagged as an electronic delivery system, has substantial potentials in our economy. . . "not only as the basis of a wholly new and badly needed service in its own right, but . . . as a means of increasing the scope and usefulness of the present TV service."

Urging the Commission to give early approval to this new technique, the association said that such authorization should help everyone.

Television, continued the association's plea for subscription-TV, is a major factor in our way of life; it has created billions of dollars worth of new wealth in receivers, stations, service, and programming, and still the industry is in its infancy. But, they emphasized, even though the Commission has allocated spectrum space for more stations, some 1500 more, few are being built; that, said the business group, indicates that something is wrong. Something, they added, is missing in the economics of the TV industry, and subscription TV . . . "represents a fresh approach to this vital economic basis of television."

Declaring that the best interests of small business is their business, the association said that they heartily . . . "resent any crass attempt on the part of a single self-interest group to carry the banner of 'small business' in their undynamic parade against progress."

If the new plan has the potentials . . . "of making more TV stations economically supportable, especially in the smaller towns and cities . . ." then said the association brief . . . "it certainly will help all business, large or small . . . More importantly, it will answer a growing and obvious public demand for more and better TV service."

Also writing in support of pay-TV, a

(*Continued on page* 101)

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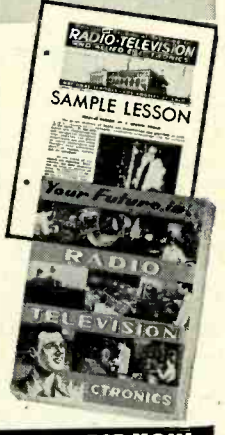

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14. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.

15. Blank pin or locating key on each tube is shown on placement chart.

16. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

17. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.

18. Series filament strings are schematically presented for quick reference.

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21. All parts are keyed to the photos and schematics for quick reference.

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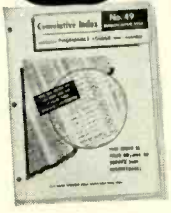

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Within the INDUSTRY

JOHN V. ZUCKERMAN is the new manager of personel and plant services at *Ampex Corporation*, Redwood City, California manufacturer of magnetic tape recorders.

For the past five years Mr. Zuckerman has been conducting audio-visual work and personnel management for the Air Force and Army. He was associated with Stanford University for four years, in 1947 and 1948 as director of the audio-visual aids and radio training programs, and in 1949 and 1950 in personnel work.

During World War II, he served with the OSS and the Armed Forces Radio Service. He holds graduate degrees from Stanford.

* * *

TELEVISION ACCESSORIES CO. has moved to Scottsdale, Arizona from Arlington, Va. The new address is Box 368 . . . **L & M ASSOCIATES**, sales and engineering representatives, have opened new offices at 253 Boulevard, Hasbrouck Heights, New Jersey . . . **OLSON RADIO WAREHOUSE, INC.** of Akron, Ohio has opened a new store at 423 W. Michigan Street in Milwaukee, Wisconsin. The company now has warehouses and stores in Chicago, Cleveland, Akron, Pittsburgh, and Milwaukee.

* * *

EDMOND SHERMAN, formerly chief engineer for *Tele-King Corporation*, has joined *Transitron, Inc.* of New York City in a similar capacity.

He has also served as project engineer on equipment for *Hazeltine Electronics Corporation*, as project and chief engineer for leading manufacturers of government electronic equipment, and commercial radio and television receiver makers.

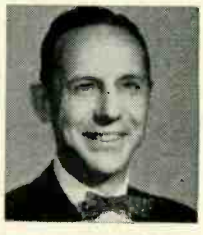
Mr. Sherman holds his degree in electrical engineering from New York University.

* * *

DAYSTROM, INC. has merged with **WESTON ELECTRICAL INSTRUMENT CORP.** which will be operated as a wholly-owned subsidiary. **WESTON** operations will be continued under the same management and the company's name will be retained on its products . . . **MAG-ELECTRIC PRODUCTS, INC.** of Hawthorne, California, manufacturer of magnetic amplifiers, regulated power supplies, transformers, etc., has acquired all of the assets of **MAG-ELECTRIC NETWORKS, INC.** manufacturer of radar components, etc. . . . **METROPOLITAN SOUND SYSTEMS, INC.** has been formed at 216 W. 14th Street, New York 11, N. Y., as a successor to **SOUND SYSTEMS, INC.** . . . **WESTERN UNION TELEGRAPH COMPANY** has acquired a one-third interest in **MICROWAVE ASSOCIATES, INC.** of Boston . . . **ELGIN NATIONAL WATCH COMPANY** has become the nation's largest manufacturer of high precision relay switches with the purchase of **ADVANCE ELECTRIC & RELAY CO.** of Burbank, California. The firm purchased **NEOMATIC, INC.**, Los Angeles relay company, last October and two months ago purchased **AMERICAN MICROPHONE CO.** of Pasadena.

* * *

ROBERT B. DAVISON has been appointed distributor sales manager of *Cannon Electric Company* of Los Angeles.



He joins the firm with a wide background in sales and jobber organization. With the exception of two periods spent in the military service, he has engaged in selling and manufacturers' jobbing activities in hardware and electrical products. Most recently he was sales manager for *Pacific Electricord* in Los Angeles.

Mr. Davison will make his headquarters at the company's Los Angeles plant.

* * *

WILLIAM R. McQUISTON is the new sales manager for *Electronic Engineering Company of California*. He has been with the firm for the past six years . . . *Rola Company, Inc.* has advanced **E. C. SLAUGHENHAUPT** to the post of vice-president in charge of manufacturing and promoted **KENNETH E. PHILLIPS** to the position of vice-president and director of purchases . . . **N. L. JOCHEM**, who has been with *Gates Radio Company* for the past twelve years, has been upped to the position of director of engineering . . . **ALFRED E. BOURASSA** is the new merchandising coordinator at *CBS-Hytron* of Danvers, Mass. . . . *Radio Condenser Company* has appointed **ALBERT G. SHAFER** to the post of vice-president in charge of its Western Division. He will be in charge of the company's plants in Watseka and Hoopeston, Illinois. He has been with the firm 24 years . . . Magnetic Recording Industry Association, a trade group made up persons and companies engaged in the manufacture of magnetic recording equipment and media, has

Write your Own Ticket

L. C. Lane, B.S., M.A.
President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

Use your experience in radio to step into a higher paying television job by studying AT HOME in your SPARE TIME.

The fabulous television industry has seen many booms — in building of broadcasting stations, manufacture of black and white VHF sets, and sale of these sets to millions of families — *but the biggest booms are yet to come.*

From my experience in the radio-television-electronics field and my contacts in high places, I can tell you that past TV booms will look small compared to the booms that will come with construction of new VHF and UHF stations and perfection of low-cost color television sets.

These developments are just around the corner. If YOU want to be in on the ground floor for the jobs that will be created, *now* is the time to do it. You can keep your present job and study one of my two NEW courses — FM and Television Technician Course — TV Cameraman and Studio Course.

These Courses — especially prepared for home study — will train you for top-paying jobs in the ever-expanding radio-television-electronics industry. You'll be able to write your own ticket to get a better pay job or set up your own business.

VETERANS!

My School fully approved to train Veterans under new Korean G.I. Bill. Write discharge date on coupon.

FREE FCC COACHING COURSE

Important for BETTER PAY JOBS requiring FCC License. You get this training AT HOME and AT NO EXTRA COST. Top TV jobs go to FCC-licensed technicians.

EARN while you LEARN

Almost from the very start you can earn extra money while learning, repairing Radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week ... pay for their entire training from spare time earnings ... start their own profitable service business.

EXPERT FM-TV TECHNICAL TRAINING

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. YOU CAN SAVE MONTHS OF TIME. My FM-TV Technician Course completes your training by providing a thorough background in Frequency Modulation and Television Theory and Practice.

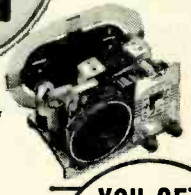
You "Learn by Doing", working with parts and equipment I send you. Six large kits of FM and TV parts are given to you as part of the course. You build and keep a professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch).

Upon completion of your training you may — if you desire — take two weeks of shop training at my associate resident school in New York City AT NO EXTRA COST!

Super-Het Radio Receiver

C-W Telephone Transmitter

RF Signal Generator



Combination Voltmeter-Ammeter-Ohmmeter

Public Address System

PRACTICAL TV CAMERAMAN AND STUDIO COURSE

My TV Cameraman and Studio Course is designed to train TV Studio Technicians and TV Cameramen, urgently needed today by Television Broadcasting Stations throughout the nation.

New TV Stations are now mushrooming throughout the country. Men who can work as Audio Technicians, TV Cameramen, Microphone Boom Operators, Monitor Operators, Turntable Operators, Control Room Technicians can write their own tickets.

I will train you for an exciting high pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups.

Available if you want it . . . one week of actual work with studio equipment & TV Cameras at my associate resident school in New York City.

This course is a MUST for those who wish to increase their technical knowledge of television operations.

TRAINING FOR BEGINNERS

My Radio-FM-Television Technician Course is especially prepared for men with no previous experience or training. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

Two weeks of intensive shop practice at my associate resident school is also included with this Course.

Radio Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

MAIL THIS COUPON TODAY!
NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President — Dept. T-7
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name_____ Age____

Address_____

City_____ Zone____ State____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Technician Course

VETERANS! Write discharge date _____

named **KENNETH R. ARVEDON** to the post of executive secretary with offices at 135 East 44th Street, New York City . . . **JOHN E. BOYLE** has been appointed to the newly-created post of director of business planning for the *Brown Instruments Division* of *Minneapolis-Honeywell Regulator Company* . . . *James Vibrapowr Co.* has announced the election of **P. T. McCAULEY** as secretary-treasurer of the firm. He was formerly associated with *Motorola, Inc.* . . . **EDWARD F. SHAVER** is the new sales promotion manager at *Jensen Manufacturing Company*. He will be in charge of sales promotion and advertising activities for the company . . . **S. R. MEACHAM** has been appointed assistant commercial sales manager for *Aircraft Radio Corporation* of Boonton, N. J. He was formerly with *Bendix* . . . *TelAutograph Corporation* has named **R. G. LEITNER** to the post of chief engineer . . . **HILTON A. LEVONIAN** is vice-president in charge of consulting engineering at *The Kuljian Corporation*.

* * *

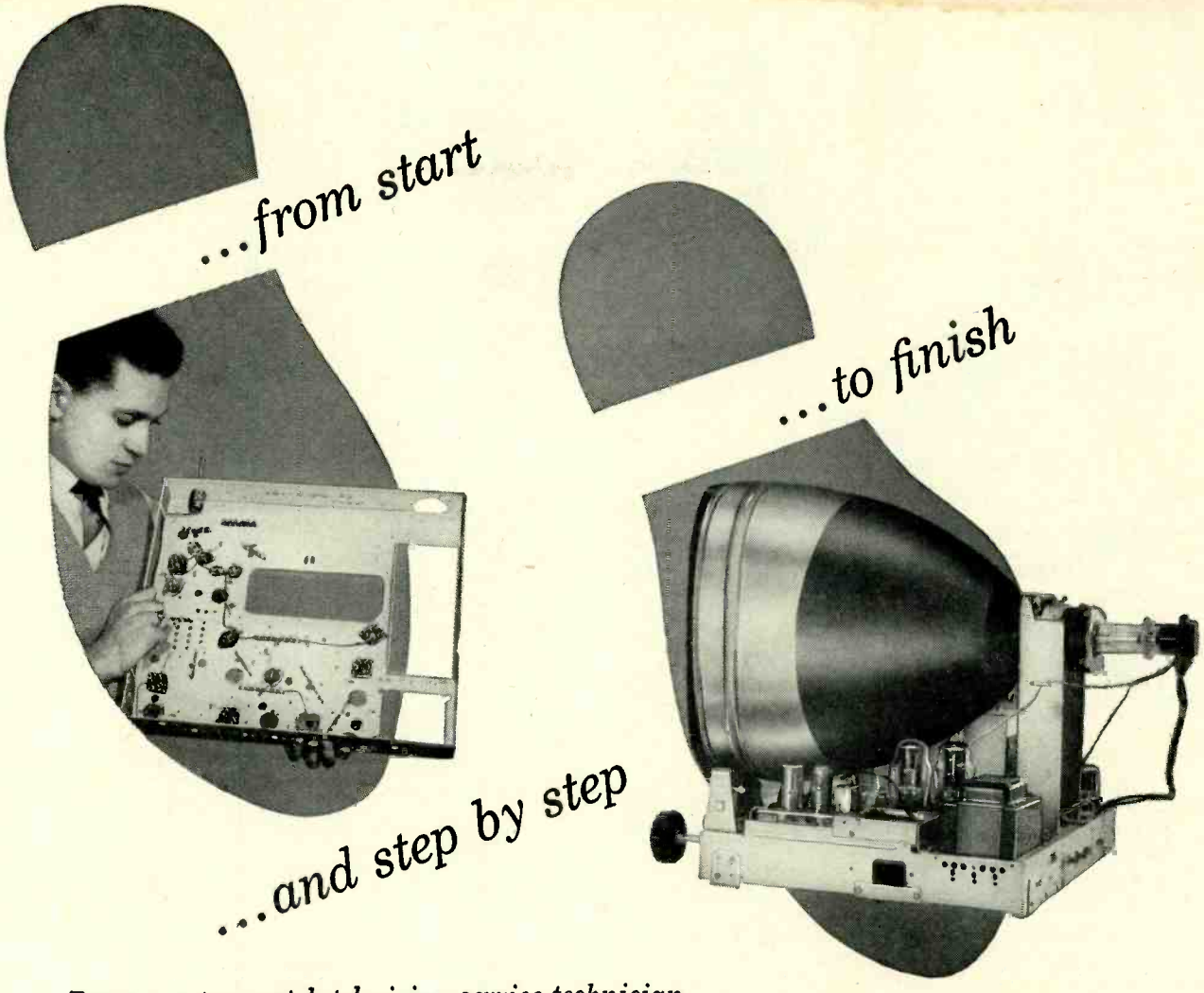
R. F. WILLETT is the new general manager of *Empire Coil Company, Inc.*, of New Rochelle, N. Y., flyback and transformer manufacturing subsidiary of *Storer Broadcasting Company*.

He started with *General Electric Company* as a student engineer upon his graduation from Rutgers in 1937 and spent five years with the firm working through design engineering, central office sales, to district office sales. Since leaving *G-E* in 1942, he has been active in the electronics manufacturing field in sales and application engineering, advertising, and management. For the past three years he was plant manager at *Essex Electronics* and prior to that spent five years as sales and application engineer with the *F. W. Sickles Co.*

* * *

RADIO RECEPTOR CO., INC. has taken a five-year lease on the entire premises of the newly completed $750,000 factory building at 80 N. 5th Street in Brooklyn. It will be occupied by the Engineering Products Division of the firm . . . New headquarters for **ELECTRONICS CORPORATION OF AMERICA** will be occupied late this year at One Memorial Drive in Cambridge, Mass. The building provides 208,000 square feet of floor space and will house the firm's laboratories, administration, and sales offices. The company has another plant in Cambridge which will be retained . . . A 100 per-cent increase in plant area for the manufacture of fractional horsepower motors, dynamotors, etc., has been announced by **MOTORDYNE, INC.** of Monrovia, California. Over 14,000 square feet have been added to the firm's plant at 2661 S. Myrtle Ave. . . . **PURNELL ELECTRONICS** has recently acquired additional floor

(*Continued on page* 129)



Become a top-notch television service technician

Now . . . RCA INSTITUTES offers modern TV KIT with Comprehensive Television Servicing Course

START to build with a TV Kit developed by one of America's foremost radio-tv schools—RCA Institutes. LEARN with simple step-by-step instruction how to build a modern, large-screen receiver. TEST each stage, *as you build*, and see how it works. Learn how "trouble-shooting" is applied. FINISH your Home Study Course ready and able to service all make and model sets!

Easy-to-follow instructions are planned and prepared for you through the efforts of RCA Institutes' instructors, engineers at RCA Laboratories, and training specialists of the RCA Service Company.

The RCA Institutes' TV Kit utilizes up-to-date circuits including:

- *Synchro-Guide horizontal automatic frequency control circuit.*
- *Horizontal magnetic reaction scanning.*
- *Latest deflection circuits.*
- *FM sound discriminator.*
- *High-gain, low-noise cascode tuner.*

Join the many thousands who have been successfully trained by RCA Institutes for a good job (or business of their own) in television servicing.

BASIC KNOWLEDGE OF RADIO NECESSARY
NO NEED FOR PREVIOUS TV TRAINING

FREE BOOKLET! MAIL COUPON NOW.

RCA INSTITUTES, INC., Home Study Dept. NK-7-55
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With no obligation on my part, please send me a copy of your booklet on the TV Servicing Home Study Course and Kit. I understand no salesman will call.

Name:_____ (Please print)

Address:_____

City:_____ Zone:_____ State:_____

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

LAFAYETTE'S SPECTACULAR MONEY SAVERS

A BUY OF A LIFETIME

PORTABLE ELECTRONIC MEGAPHONE and AMPLIFIER SYSTEM

COST U.S. NAVY ~~$1850.00~~ YOURS FOR ONLY $89.50

- Powerful 20 watt amplifier!
- Pistol grip dynamic megophone!

All Units BRAND NEW and GUARANTEED

A complete portable 20 watt amplifier system at a fraction of its original cost! Quality is unquestionable—designed and built for the U. S. Navy! Use on fishing boats—pleasure craft—traffic control—parking lots—day camps—carnivals—sports events—life saving stations—any place where handling large crowds; or reaching large audiences is necessary. Unit operates from self contained rechargeable batteries—no power line connections necessary. May be set up permanently when used with charging rack. System consists of a 20 watt 6 tube amplifier—in a waterproof portable metal case, an electronic megaphone, a battery charger power unit that operates on 110 volts AC/DC and on 12, 24, 48, or 96 Volts DC, 3 cell 6 volts storage battery, tubes, cables, plugs and 30 page instruction and diagram book. Overall size complete 15½"x13"x12". Shpg. wt. 88 lbs.

ELECTRONIC MEGAPHONE SYSTEM.....Net 89.50

Argonne TRANSISTOR TRANSFORMERS

AT LAST A COMPLETE LINE OF QUALITY TRANSFORMERS FOR EVERY TRANSISTOR APPLICATION AT A PRACTICAL PRICE!

2.75 each Lots of 10 Assorted

2.95 Singly, each

- Nickel-Steel and Silicon Steel Laminations
- Wound on Nylon Bobbins
- Mylar Outer Wrap
- Color Coded Leads

Have you been experimenting with transistor circuits? And have you been forced to make-do with compromise transformers or improvised units? And have you had to pay from $6.00 to $12.00 for them? The Argonne line brings you a wide variety for experimentation as well as for replacement. Efficiently designed to meet the needs of miniaturization and engineered to provide more power handling capacity and improved frequency response with minimum distortion. All are nickel-steel laminations except asterisk which are silicon steel. Average net weight 1¼ oz. average shipping wt. 4 ozs.

Argonne Number	Type	Impedance Primary Ohms	Impedance Secondary Ohms	Unbalanced Current Pri. D.C. MA	D.C. Resistance Pri. Ohms	D.C. Resistance Sec. Ohms	Overall Size
AR-100	Input	200,000	1,000	.0	3600	90	1"x¾"x¾"
AR-101	Input	100,000	3,000 CT	.5	3600	60	1"x¾"x¾"
AR-102	Input	100,000	1,500 CT	.5	3600	40	1"x¾"x¾"
AR-103	Driver	20,000	2,000 CT	1.	400	50	1"x¾"x¾"
AR-104	Driver	20,000	1,000	.0	400	50	¾"x⅝"x⅝"
AR-105	Driver	20,000	400	1.	600	30	1"x¾"x¾"
AR-106	Driver	16,000	4,000	1.	620	350	¾"x⅝"x⅝"
AR-107	Driver	15,000	200	1.5	1000	20	1"x¾"x¾"
AR-108	Driver	10,000	3,000 CT	.0	200	100	¾"x⅝"x⅝"
AR-109	Driver	10,000	2,000 CT	.0	500	50	¾"x⅝"x⅝"
AR-110	Output	10,000	25	2.	600	2.5	¾"x⅝"x⅝"
AR-111	Output	5,000	100	1.	600	10	¾"x⅝"x⅝"
AR-112	Output	3,500	200	1.	120	25	1"x¾"x¾"
AR-113*	Driver	3,000 CT	1,000	9.	100	60	¾"x⅝"x⅝"
AR-114	Output	2,500	11	10.	50	.1	¾"x⅝"x⅝"
AR-115	Input	2,000 CT	8,000 CT	.0	150	660	1"x¾"x¾"
AR-116	Output	2,000	200	4.	120	20	1"x¾"x¾"
AR-117	Output	500 CT	30	.0	20	1.5	¾"x⅝"x⅝"
AR-118	Output	500 CT	16	.0	20	1.5	¾"x⅝"x⅝"
AR-119	Output	500 CT	3.2	.0	20	.3	¾"x⅝"x⅝"
AR-120*	Output	400 CT	11	1.	20	.9	¾"x⅝"x⅝"
AR-121*	Output	300 CT	3.2	.0	20	.25	¾"x⅝"x⅝"
AR-122*	Output	250 CT	3.2	.0	11	.3	1"x¾"x¾"
AR-123	Input	200	2,000 CT	2.	11	50	1"x¾"x¾"
AR-124*	Output	200 CT	16	.0	20	1.3	¾"x⅝"x⅝"
AR-125	Input	3	4,000	.0	.14	50	¾"x⅝"x⅝"

Masco CASCADIAN TV BOOSTER

Reg. Price ~~$42.50~~

SALE 9.95

Biggest Booster Buy Ever!

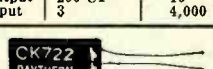
Famous Masco Cascode Booster!!

- Three tuned circuits—cascode!
- Golden Grid 6BZ7 Plus 6J6 Plus rectifier!
- 35 db gain (56 times!) average on all channels!

A sensational new tunable VHF booster utilizing a special low-noise circuit. Employs the new Golden Grid 6BZ7 tube so well known for its use in cascode circuits. Field pioneer and specifically designed for new low noise-high gain front ends. Brings superior reception to older type receivers. Single knob control for utmost simplicity of operation. Signal strength is increased at least 56 times—35 db!—average on all channels. Rack and pinion permeability for precision stability. Automatically switched on and off by TV set. Uses cross-neutralized 6J6 and 6BZ7 tubes for maximum gain and bandwidth. U/L approved. For 110 volts AC. Wt. 5 lbs.

Masco TVB-53. In lots of 3, Net 9.45 Singly, ea. 9.95

RAYTHEON TRANSISTORS QUANTITIES LIMITED



Actual Size

TYPE CK-722

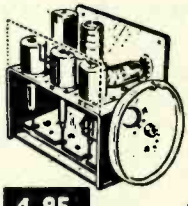
SP-92—In lots of 10, each.... 2.25
Singly, each.....2.45

TYPE CK-721 3.60

SP-93—In lots of 10, each.....3.95
Singly, each.....3.95

SALE! RADIO RECEPTOR UHF CAVITUNER

Complete with 6 AF4, 6BZ7 and IN82



4.95

Tunes all UHF channels 14-82. Most advanced engineering, three cavities, two used as bandpass pre-selector, one controlling local oscillator. Features frequency stability, uniformly broad bandwidth, high selectivity, low noise, high gain. Completely shielded. Ideal for building convertors, etc. Size 3½" H x 4¾" W x 1⅝" D. Shpg. Wt. 4½ lbs.

TL-26...Lots of 3, ea. 4.45
Singly, ea. 4.95

High Output Dynamic Microphone

List Price ~~$47.00~~ **$12.95**

High quality Dynamic microphone exceptionally fine for Public address recording, etc. Flat response 60-10,000 cps. Impedance 40,000 ±15% at 1,000 cps. output level —55 db. Die cast metal case equipped with 6 ft. of shielded cable. Shpg. wt. 3 lbs.

PA-19—in lots of 3 ..... 12.45
singly, ea. 12.95

TOP QUALITY CRYSTAL MICROPHONE

COMPARE IT WITH ANY MIKE AT 2 to 3 TIMES THE PRICE

A quality crystal Microphone for PA systems, house recorders, etc. Frequency response 30 to 10,000 cycles. Output level —52 db. Provides ample output for use with low gain amplifiers. Complete with 5 ft. of shielded cable. Shpg. wt. 3½ lbs. **$3.95**

PA-24—in lots of 3 .... 4.25
singly, each 4.25

LAPEL MICROPHONE

- REGULAR $16.00 VALUE!
- FULL —55 db. OUTPUT LEVEL!
- IDEAL GENERAL PURPOSE MIKE!

2.95

Specially engineered crystal Microphone. Attaches to lapel. Only 1⅝" in diameter. Exceptional frequency response. Output level —55 db. chrome plated case and clip for attaching to lapel. Includes 5 ft. of shielded cable. Shpg. wt. 1 lb.

PA-18 ..... 2.95

Lafayette Greatest Tape Buy Ever!

1200 FT. REEL
Genuine Plastic Base
RECORDING TAPE
Shpg. Wt. 14 oz.

$1.89 per roll plus postage
(COD's accepted)

LAFAYETTE made a terrific deal with one of the leading manufacturers of recording tape to supply us with their regular tape which sells for almost twice our price. WE GUARANTEE ABSOLUTE SATISFACTION OR YOUR MONEY BACK. The finest, professional-quality recording tape obtainable. Highest performance for thousands of playings. Red Oxide Base in a smooth, uniform coating; greater signal strength; with maximum fidelity; uniform frequency response from 40-15,000 cps.

In lots of 10 rolls - 1.75 ea

LAFAYETTE EXCLUSIVE! DYNAMIC EAR PHONE

A new lightweight plastic ear phone especially imported by Lafayette to bring you the high quality of a dynamic ear phone with the ease and comfort of an almost weightless unit—at a price less than half that of any comparable unit. Fits right into ear. Excellent sensitivity of 65 db. Ideal for use with miniature sets, hearing aids, transcribing, etc. DC resistance 2000 ohms, impedance 5000 ohms at 1000 cycles. Complete with 3 ft. plastic covered cord.

MS-72.....Net 1.95

LOW IMPEDANCE MODEL FOR SILENT LISTENING OR VIEWING

Will replace speaker on any radio set or T.V for silent listening, by direct connection to secondary of output transformer. Impedance 8 ohms.

MS-100.....Net 1.95

BINOCULARS NEVER BEFORE AT THIS PRICE

IMPORTED DIRECT

Prism-Coated Lenses

- All-Metal Construction
- Individual Focus
- Leather Case & Straps

F-86 —8X.25 I.F.....Net 17.45
F-105—8X.30 I.F.....Net 18.25
F-15 —7X.35 I.F.....Net 19.95
F-103—7X.50 I.F.....Net 21.95
F-117—10X.35 C.F.....Net 23.95
F-104—12X.50 I.F.....Net 32.50
F-118—16X.50 C.F.....Net 34.95

with order, Add 10% Fed. Tax

FREE send for it — RADIO CATALOG

GET LAFAYETTE'S NEW CATALOG PACKED WITH THE LARGEST SELECTION OF QUALITY ELECTRONICS EQUIPMENT AT BARGAIN PRICES.

Lafayette Radio

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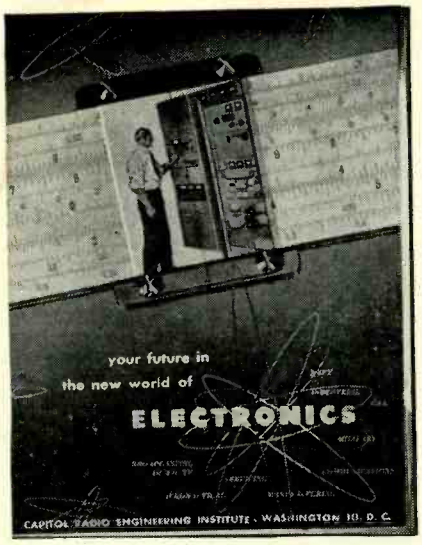
Remit by Check or Money Order. Include sufficient money for Postage. We Refund unused amounts.



The data that Launched Thousands of Careers is yours FREE to show

HOW YOU CAN BE SUCCESSFUL IN RADIO-TV-ELECTRONICS

Send for Your Booklet Today!

YOU CAN plod along for years, getting a paltry increase now and then, enjoying little security, finding your work dull and drab.

Then something happens. Things look up. You become more confident. Your earnings rise. You feel more important.

"Luck," some may say.

"Contacts," others may suggest.

But in your heart, you will know the answer: "Training." And it all may have started the moment you filled out a coupon requesting a copy of a free booklet named "Your Future in the New World of Electronics." From this data you get knowledge of where you stand in Electronics. Tremendous expansion leaves this gigantic industry pleading for trained men. Top manufacturers sold billions of dollars worth of electronic merchandise in 1954. By 1960, the radio-electronics industry should do no less than 10 billion dollars per year, not counting military orders.

Today there are over 97,000 radio-equipped police cars; an even larger number of taxis are radio equipped (at least 87,000); 32,000 civilian planes have radio; 35,000 American ships have radio.

Today there are over 120,000,000 radios in use. There are 36,000,000 TV sets and 428 TV stations in operation. Color TV is coming into its own. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts, trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

"Your Future in the New World of Electronics" shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

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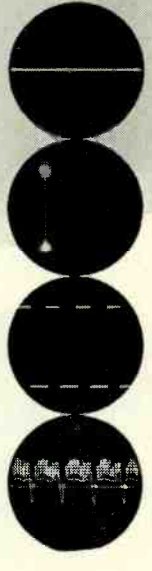

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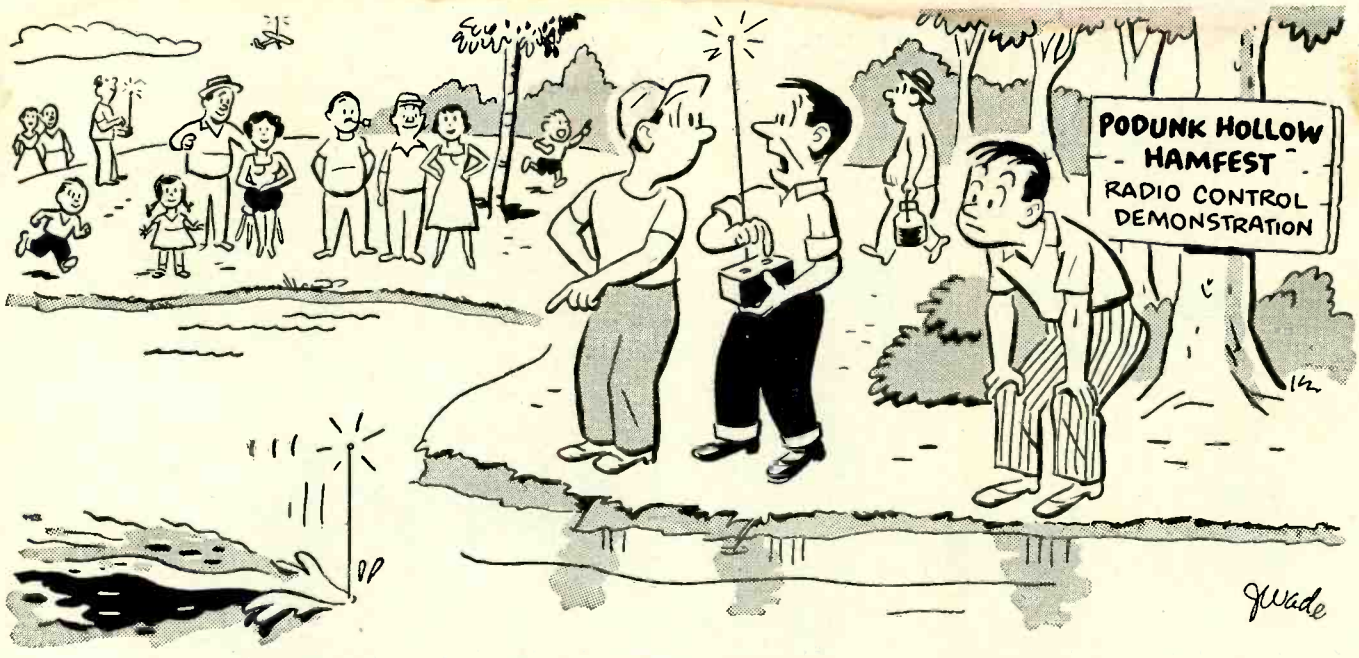

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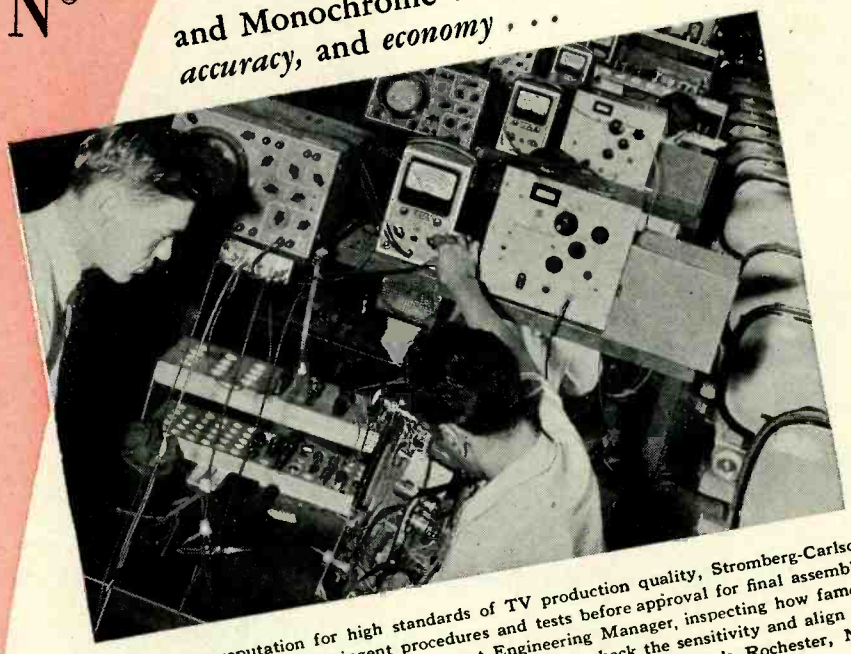

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"AUDAR"

By **CHARLES P. COX, JR.**

Fig. 1. Front view of the author's "Audar" unit. It is housed in a 7½" x 7¾" x 15" steel cabinet with carrying handle.

Details on a unique, short-distance detection and ranging system which is suitable for small boats or private planes.

SINCE World War II, considerable interest has been displayed among both professional researchers and amateur experimenters alike, in electronic circuits suitable for detection and ranging of distant objects. In this connection, the author recently suggested a modified version of the circuit herein described to the Department of Army, Signal Corps Engineering Laboratories as a means of short distance radar for possible military use.

The photographs and circuits accompanying this article represent the author's original workable model of this device which has been nicknamed "Audar." This title was selected as a contraction of the phrase, "*au*todyne *d*etection *a*nd *r*anging." The carrier frequency of approximately 500 megacycles was chosen as a compromise between the desire for the shortest possible wavelength with the resultant small antenna dimensions and the economy and practicability of construction afforded by conventional tubes and associated components. This model proved that the circuit design was workable and could be adapted to much higher frequencies, if desired.

Theory of Operation

Those readers who are old enough to recall the earlier days of amateur radio communication will remember the autodyne circuit as a regenerative detector which is so adjusted as to be in a slightly oscillating condition. Such a detector can demodulate and amplify tremendously such frequencies which are within a small percentage of the oscillating frequency of the detector. Thus, the incoming frequency is made to beat with the local detector frequency and the resultant audio beat note is heard in the phones or speaker. This arrangement, while not satisfactory for carrier frequencies modulated by voice or music, was utilized for many years for reception of code signals due to its efficiency and simplicity.

Audar depends upon the oscillating detector to produce a carrier frequency which emanates from a directional antenna. This carrier is frequency modulated at a constant rate of 60 cycles-per-second over a total deviation range of about 25 megacycles bandwidth. The carrier is directed to the target from whence it is reflected back to the antenna, received by the detector, and beat with the local oscillator frequency. Since the oscillator frequency is frequency modulated at a constant rate, the incoming frequency will at all times differ from the local oscillator frequency by a degree proportional to the distance existing between the antenna and the target. Therefore, a beat or heterodyne frequency is produced which is proportional to the distance ranged. If this beat frequency is amplified and converted to power so that a speaker cone can be actuated, it is found that the audible tone goes down as the ranged distance decreases and goes up as this distance increases.

In this circuit, it will be noted in Fig. 3 that a power amplifier stage and speaker have been incorporated in the design of the instrument for audible perception of the distance being ranged. In addition, Fig. 4 indicates a circuit which is not unlike the conventional type of cycle-counter which we call the beat-frequency indicator circuit. The microammeter of this circuit indicates, visually, the distance ranged and may be calibrated in terms of "feet" if so desired.

Construction Hints

As it was deemed at the outset, the model was to be somewhat portable in spite of its dependence upon the 117 volt power line, so it was decided to house it in a 7½" x 7¾" x 15" steel cabinet with handle as shown in the photograph of Fig. 1.

On the rear of the front panel were mounted three sheet metal chassis, 6¾" wide by 6½" deep, which are duly supported by triangular brackets as shown in the photograph of Fig. 2. On these chassis were mounted the various components of each of the three sections of the instrument. The bottom chassis supports the power

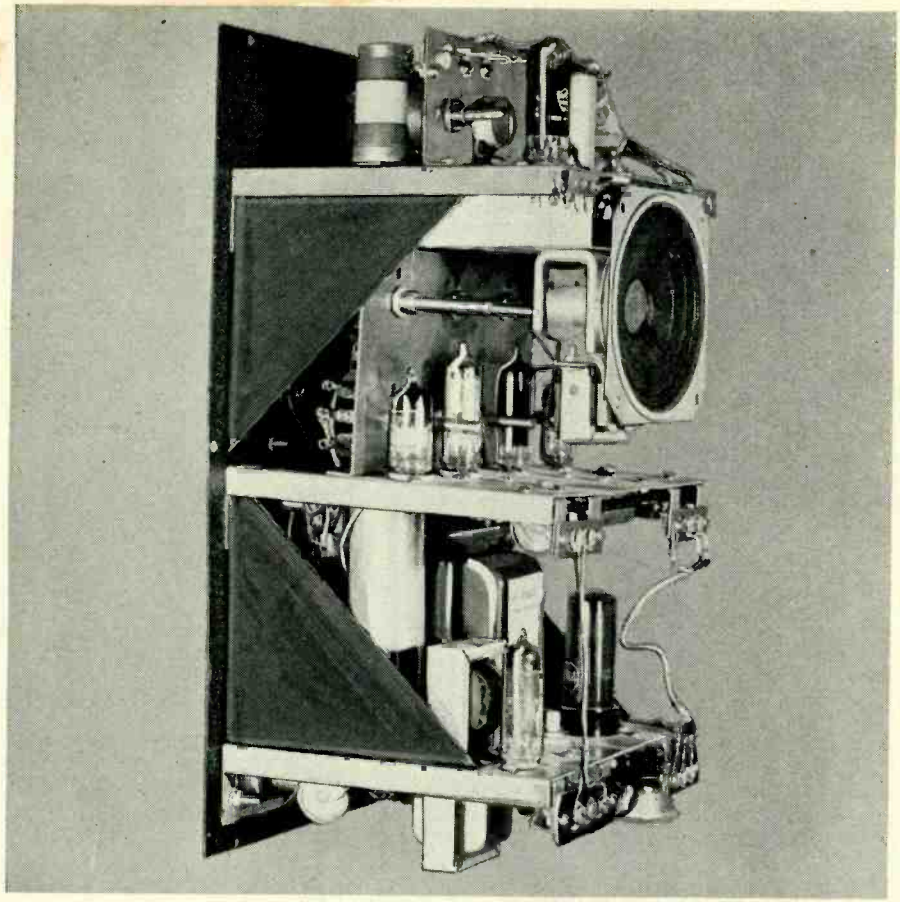
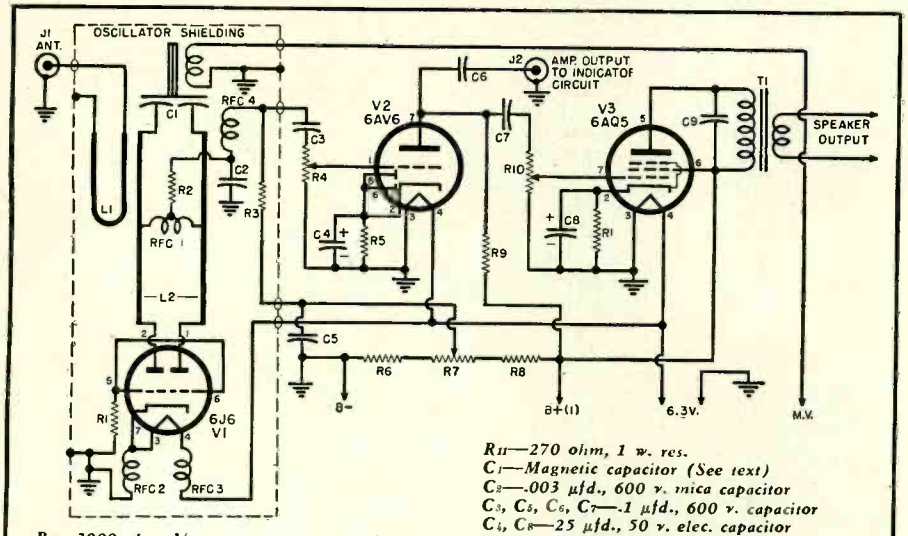


Fig. 2. Rear view of instrument showing how chassis are stacked. From top to bottom, oscillator-modulator-beat frequency amplifier; beat frequency indicator; and power supply

supply; the middle one—the beat frequency indicator, and the top chassis supports the oscillator, modulator unit, and beat frequency amplifier. The volume control, R_{10} of Fig. 3, is mounted under the middle chassis with the shaft protruding through the front panel and connected to the power amplifier stage on the top chassis by means of shielded cable. Range switch, S_1 of Fig. 4, is likewise mounted on the front panel along with the meter, power switch, and pilot light assembly. All other controls are mounted either on the individual chassis decks or on sub-panels which can be seen mounted on the two upper chassis decks in Fig. 2. The antenna is introduced by means of the coaxial connector, J_1, mounted above the meter on the panel.

Fig. 3. The r.f. oscillator and beat frequency amplifier circuit and parts list.



R_1—3900 ohm, ½ w. res.
R_2—2200 ohm, 1 w. res.
R_3—47,000 ohm, ½ w. res.
R_4—500,000 ohm pot (Beat Frequency Limit Control)
R_5—2700 ohm, 1 w. res.
R_6, R_8—47,000 ohm, 1 w. res.
R_7—50,000 ohm pot (Regeneration Control)
R_9—100,000 ohm, 1 w. res.
R_{10}—100,000 ohm pot (Audio Volume Control)
R_{11}—270 ohm, 1 w. res.
C_1—Magnetic capacitor (See text)
C_2—.003 μfd., 600 v. mica capacitor
C_3, C_5, C_6, C_7—.1 μfd., 600 v. capacitor
C_4, C_8—25 μfd., 50 v. elec. capacitor
C_9—.002 μfd., 600 v. mica capacitor
L_1—Antenna coupling loop (See text)
L_2—Plate line inductance (See text)
J_1—R.f. jack (AN-SO-239)
J_2—Shielded phono jack
RFC_1, RFC_2, RFC_3—U.h.f. choke (See text)
RFC_4—10 mhy. r.f. choke
T_1—Audio output trans. 5000 ohms to v. c.
V_1—6J6 tube
V_2—6AV6 tube
V_3—6AQ5 tube

It should be noted that the oscillator wiring, shown in Fig. 3, is to be kept as short as possible and should be mechanically strong for stability. L_2 consists of a half-wave plate line made from two parallel #10 AWG tinned copper conductors spaced ⅜" apart and each 3½" long. L_1 is a hairpin loop of #10 AWG wire about ⅜" wide and 1½" long and spaced about ⅜" from, and parallel to the open-end or capacitive end of L_2. Spacing of the hairpin loop, in relation to L_2, will be somewhat critical and will depend, to some extent, upon the antenna design.

The oscillator, after assembly and wiring, was shielded by means of an aluminum channel-type of chassis about 3" wide, 6½" long, and 1¼" deep. The speaker is bolted to the aluminum chassis and aligns with a 4" hole cut in the rear panel of the cabinet. RFC_1 is an air wound r.f. choke consisting of 19 turns of #20 AWG enameled copper wire with an inside diameter of 3/16" and a finished length of ⅞". This choke is connected to the mid-point of the plate lines as shown in Fig. 3. RFC_2 and RFC_3 are likewise air wound r.f. chokes consisting of 12 turns of #20 AWG enameled copper wire, 3/16" i.d. by ¾" long. C_1 in Fig. 3 is a magnetically-activated variable capacitor used in the APN-1, altimeter and readily available as a war-surplus item for a few dollars.

The power supply, shown in Fig. 5, was designed to furnish 200 volts by adjustment of R_3, with a degree of freedom from line voltage fluctuation, to the oscillator-amplifier section. Voltage regulation in the beat frequency indicator section of Fig. 4 is maintained by the 0A2 voltage regulator tube.

The antenna design may vary according to the individual preference of the builder and, indeed, the instrument could be utilized as a means of testing various antenna designs. The author used the helical, the yagi, and the folded dipole with reflector at various times in experimentation. Best results should be obtained when the antenna and transmission line are both designed for about 72 ohms impedance and the antenna is made as directional as possible at 500 megacycles.

Adjustment and Operation

The approximate mean carrier frequency of the completed unit can be

checked by disconnecting the energizing lead to C_1 and adjustment of R_7 of Fig. 3 to a point where oscillation is just begun, as indicated by a slight grid current drain of the 6J6. This current should not exceed 5 milliamperes with the antenna connected. Lecher wires will now indicate the approximate carrier frequency which should lie somewhere between 450 and 500 megacycles.

C_1 can now be re-energized and its amplitude and the resultant deviation of carrier frequency adjusted by means of R_1 of Fig. 5. Deviation can be checked by means of Lecher wires, by measuring the average a.c. voltage developed across C_1 at any given setting of R_1. By substituting a d.c. voltage of like magnitude to C_1 with the Audar unit oscillating, the resultant frequency can thus be determined and the difference between this frequency, and the average mean carrier frequency, multiplied by a factor of 2 will indicate the total carrier deviation frequency for a particular setting of R_1.

If the antenna is aimed at a target, say 100 feet away, and R_1 of Fig. 5 is adjusted for a total frequency deviation of 25 megacycles (12.5 megacycles either side of the mean carrier frequency), then by use of the following formula:

$$F_b = 3 \times 10^9 \times \frac{2D}{186{,}000 \times 5280}$$

where: F_b = beat frequency in cycles to the speaker or beat frequency indicator, and D = distance to the target in feet.
then:

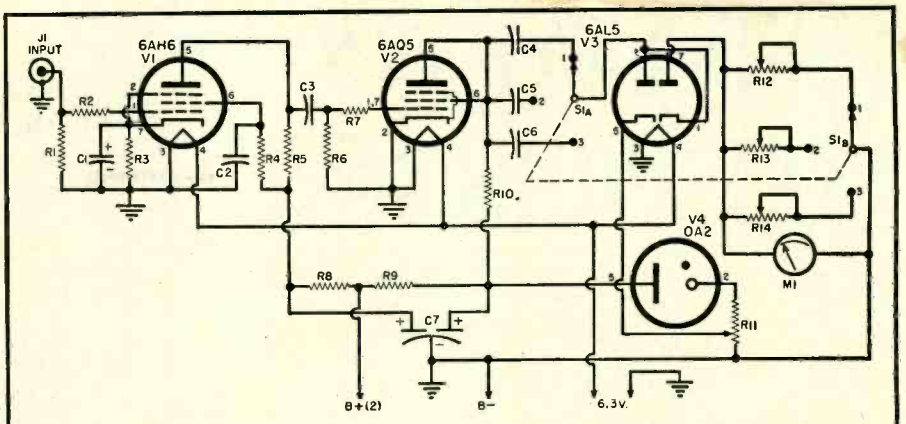
$$F_b = 3 \times 1{,}000{,}000{,}000 \times \frac{2 \times 100}{186{,}000 \times 5280}$$

or:

$$F_b = 3 \times 1{,}000{,}000{,}000 \times .0000002 =$$
$$3 \times 200, \text{ or } F_b = 600 \text{ cycles}$$

This would indicate that a beat frequency of 600 cycles would be heard in the speaker when the instrument was ranging a target 100 feet from the antenna. If the distance is increased to 200 feet, then the frequency will increase to 1200 cycles; whereas, if the distance is made 50 feet then, the beat frequency will be about 300 cycles.

The beat frequency indicator circuit of Fig. 4 can be properly calibrated by means of an audio frequency signal generator. However, it should be noted that should the indicator needle deflect with the input disconnected or a continuous deflection be noted irrespective of input frequency, the wiring should be checked for possible cause of oscillation between stages or stray pickup of 60-cycle hum from the filament supply or power supply. Range switch S_1 of Fig. 4, when in position 1, should read exactly full-scale at 500 cycles input frequency, provided that input voltage is of an amplitude of 1 volt or more and less than 200 volts. The meter scale reading on range position 1 is calibrated by means of meter shunt, R_{12}. Position 2 has a full-scale indication range of 5000 cycles and is calibrated by means of R_{13}; whereas,



R_1, R_7—220,000 ohm, ½ w. res.
R_2, R_6—100,000 ohm, ½ w. res.
R_3—680 ohm, 1 w. res.
R_4—470,000 ohm, ½ w. res.
R_5—150,000 ohm, 1 w. res.
R_8—2200 ohm, 5 w. wirewound res.
R_9—5000 ohm, 5 w. wirewound res.
R_{10}—2700 ohm, 1 w. res.
R_{11}—200 ohm, 2 w. wirewound pot
R_{12}, R_{13}, R_{14}—500 ohm, 2 w. wirewound pot
C_1—16 µfd., 50 v. elec. capacitor
C_2, C_3—.1 µfd., 600 v. capacitor
C_4—.04 µfd., 600 v. capacitor
C_5—.004 µfd., 500 v. mica capacitor
C_6—.0004 µfd., 500 v. mica capacitor
C_7—20/20 µfd., 250 v. elec. capacitor
J_1—Shielded phono jack
S_1—D.p. 3-pos. switch (Range)
M_1—0-100 d.c. microammeter
V_1—6AH6 tube
V_2—6AQ5 tube
V_3—6AL5 tube
V_4—0A2 tube

Fig. 4. Schematic diagram and parts list covering the beat frequency indicator.

position 3 should indicate full scale at 50,000 cycles and may be calibrated by R_{14}. Thus, as long as a carrier frequency deviation of 25 megacycles is maintained, the distance measurable by position 1 of the range switch is from 0 to 83.3 feet; for position 2, ranging distance is from 0 to 833.3 feet; for position 3, ranging distance is from 0 to 8333.3 feet.

The instrument was found to be accurate to well within 10% on all ranges. The maximum range seemed to extend to about 2500 feet over water or flat terrain, provided the target had a flat area facing the antenna which was in excess of at least one square foot. This distance increased to about 3500 feet when used for ranging planes in the air.

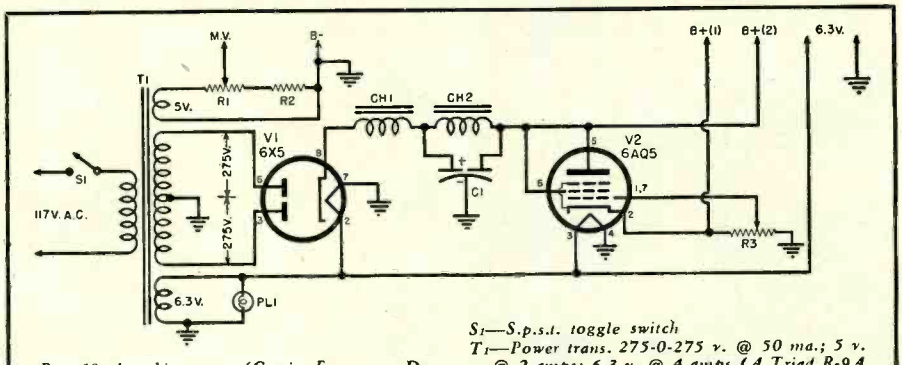
Possible Uses

This instrument, it would seem, would be of particular interest to the small boat owner who could utilize the ability of the instrument to penetrate fog and darkness to discern shore lines, channel buoys, other craft, and similar obstructions.

With a suitable vibrator-type power supply the instrument could be used by small planes as an economical but accurate absolute altimeter. With the large area of the ground as a target, it would seem that the upper altitude limit would be extended to about 5000 feet or more. In fact, the Audar unit favors, in theory of operation, the absolute altimeter but is simpler, more economical to construct and operate, and uses but a single antenna for both transmission and reception of the frequency-modulated signal.

Other than the uses previously described, the construction of this unique instrument makes an interesting project for the technician who enjoys experimenting with an electronic device whose uses are limited only by the range of the imagination. -30-

Fig. 5. Circuit diagram and parts list for building the power supply for unit.



R_1—68 ohm, ½ w. pot (Carrier Frequency Deviation Control)
R_2—20 ohm, 1 w. wirewound res. (Carrier Frequency Deviation Control)
R_3—50,000 ohm wirewound pot (Regulated Voltage Amplitude Control)
C_1—8/8 µfd., 600 v. elec. capacitor
CH_1, CH_2—30 hy., 50 ma. filter choke
PL_1—6.3 v., 300 ma. pilot light
S_1—S.p.s.t. toggle switch
T_1—Power trans. 275-0-275 v. @ 50 ma.; 5 v. @ 2 amps; 6.3 v. @ 4 amps (A Triad R-9A could be used although its 6.3 volt winding is underrated. Since the high-voltage secondary is considerably overrated, this transformer should work satisfactorily. The author used the Stancor PC 8410 in this construction)
V_1—6X5 tube
V_2—6AQ5 tube

1955 EMERSON TEST POINTS

Fig. 1. The Emerson model 1106 side-tuned TV receiver, using the new 1955 chassis.

By **HAROLD BERNSTEIN**
Service Manager
Emerson Radio & Phonograph Corp.

These new chassis have some unique features; using the provided test points will insure rapid servicing.

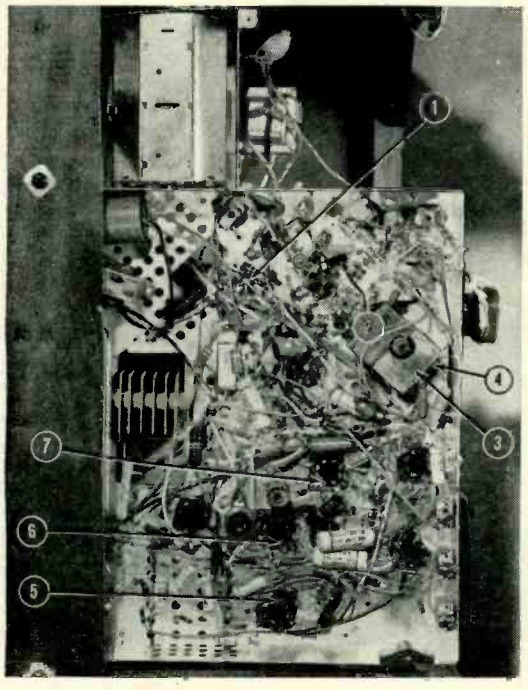
EMERSON'S new side-tuned chassis 120245-D, 120255-F, 120256-F, and 120259-F used in Models 1130D, 1106H, J, 1106L, N, 1104F, J, and 1114D, F, utilize an extremely high efficiency horizontal deflection system and high-voltage supply. A filtered "B+" supply of only 125 volts is needed to energize the horizontal sweep and develop about 350 volts of "B+" boost which is then used to insure adequate sweep and high voltage. This low operating voltage can be supplied by a single selenium rectifier and an a.c. input of between 105 and 125 volts. The model 1130 using chassis 120245-D is an a.c.-d.c. model.

The rest of the circuitry used in these chassis is fairly conventional except for the use of a sound reflex circuit and a low-voltage deflection system. By taking the 4.5-mc. intercarrier sound beat from the output of the video detector and feeding it back to the second i.f. stage where it is amplified and fed directly to the sound limiter, a sound i.f. amplifier tube is saved without any change in over-all performance. This is accomplished simply by using two resonant circuits in the grid circuit and two resonant circuits in the plate circuit of the second i.f. stage. One plate and grid circuit is made resonant at about 44 mc., while the other plate and grid circuit resonates at 4.5 mc. This stage will, therefore, amplify 40-mc. signals as well as 4.5-mc. signals without any interaction between the two.

Few test points are needed on the top side of the chassis in these sets since one section of the bottom of the cabinet is removable, as shown in Fig. 2, making approximately 90 per-cent of the components and all of the tube sockets (except for the tuner) accessible. Therefore, aside from a tuner test point (which indicates if the r.f. oscillator is working and should measure −1 to −5 volts), a "B+" test point (125 volts on one side of the brightness control), and a horizontal oscillator alignment point, all others are accessible from the bottom of the chassis while it is still mounted in the cabinet. Table 1 indicates the various test points and their uses.

In the event that a heater of one tube should open up in a group of tubes whose heaters are connected in series, the heaters of all tubes are extinguished. Therefore, irrespective of which tube heater fails, picture and sound are lost and a new simple approach must be made to locate the defective tube. Tube substitution is one method, but this is slow. Following are simple quick checks which can be made by the technician in the home. Two methods are given—one from the top of the chassis and one from the bottom of the chassis.

To locate open heaters from the top of the chassis, use an ohmmeter or continuity checker. The ohmmeter should be set to a low scale and no more than a 3-volt battery used in the continuity checker. This is important



← Fig. 2. The bottom view of a new Emerson side-tuned TV receiver with one section of the bottom of the cabinet removed. The test points indicated are listed in Table 1.

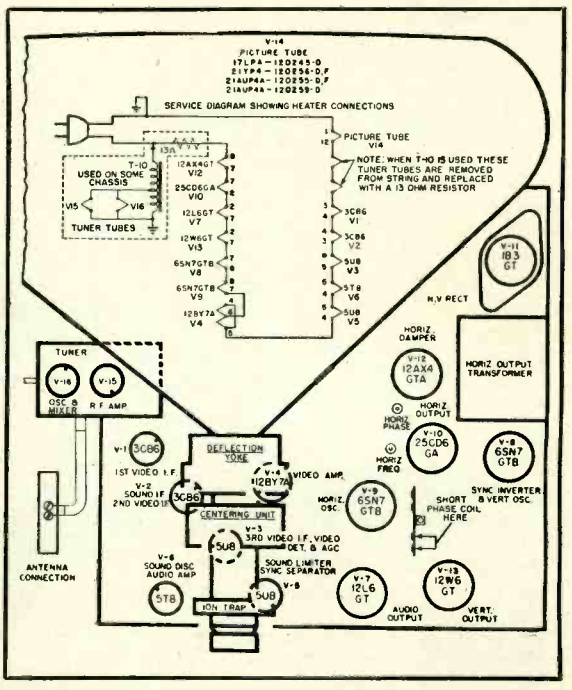


Fig. 3. Tube and parts layout of the top of the Emerson chassis. The heater wiring diagram for all of the series tubes is shown in the picture-tube outline. →

especially when checking for continuity or resistance across a 3-volt tube such as the 3CB6. A simple inexpensive continuity checker can be made with a 3-volt battery in series with a #40 pilot light bulb.

Refer to the tube location diagram, Fig. 3, and remove V_5 (5U8, sound limiter and sync separator). Check continuity between pins 4 and 5 of the 5U8. If OK, then rest the a.c. plug on the chassis, making sure a good electrical contact is made with both prongs. Check continuity between the 5U8 tube socket hole 5 and the chassis (with the 5U8 tube removed). If OK, then tubes V_6, V_3, V_2, V_1, V_{14}, and the tuner tubes (if part of the series string), are good. If not, then the trouble lies in one of these tubes.

If the continuity check in the previous paragraph showed good, check continuity between 5U8 (V_5) tube socket hole 4 and the chassis (with the 5U8 tube removed). If OK, then the trouble should have been found in the previous check. If not OK, then the trouble lies in one of the following: V_4, V_9, V_8, V_{13}, V_7, V_{10}, V_{12}, the 13-ohm heater resistor if used, or the line to the a.c. plug.

The trouble could be further isolated to the exact tube by using the previous procedure on the string of 5 or 7 tubes which tested open. *Note:* When looking at the top of a tube socket, be sure to count pin numbers in a counterclockwise direction from the keyway or wide pin-spacing reference point.

To locate an open heater from the bottom of the chassis, use an a.c. voltmeter set for 150 volts or more. Starting with V_{12} (12AX4), check the heater pins of each tube (keep low side of meter to chassis and turn chassis "on" with power supplied to set). When you get to a tube which reads 117 volts a.c. on one side and zero on the other, you have located the defective tube. *Note:* Since one side of the chassis is connected to the a.c. line, it would be best to polarize the a.c. plug properly

(*Continued on page* 105)

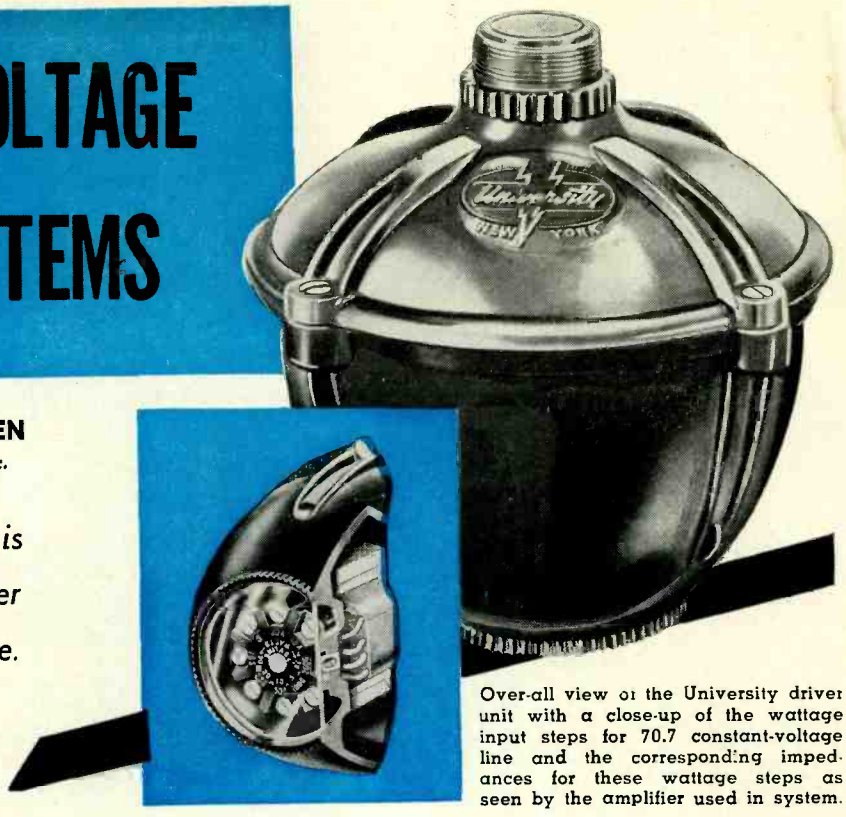
Table 1. Procedure for servicing the new Emerson side-tuned TV receivers via the use of the test points shown in Fig. 2.

TEST POINT	NORMAL READING	SYMPTOMS	CIRCUITS INVOLVED	TEST PROCEDURE
Tuner test point (top of chassis).	—1 v. to —5 v.	Weak or no picture. No sound.	R.F. oscillator.	Grid conduction of the mixer due to the oscillator voltage develops this voltage which varies from channel to channel. Check other channels, if OK, change oscillator strip of affected channel; if not, check voltage to the tuner. This should be 115 volts. If it is much lower, disconnect the "B+" input to the tuner and measure the "B+" again. If OK, then there is a short in the tuner. If still low, check the power supply.
Power supply 125-volt point (junction of filter choke and 120-ohm resistor). "1" on Fig. 2	125 v.	No sound, no raster.	Power supply.	Check fuse, 5-ohm surge resistor, and rectifier. If fuse keeps popping, check "B+" points for shorts. Disconnect electrolytic filter capacitors and reconnect one at a time.
		Small raster, weak picture, low brightness.	Power supply or circuits which it feeds.	Resistance from 125-volt point to chassis should be 16,000 ohms. If lower, find which feedline has a short. In the event that the short appears only when the set is on, disconnect all leads from the 125-volt point and add one at a time until the voltage is materially reduced.
A.G.C., pin 1 of V_3, 5U8. "2" on Fig. 2.	—.8 v. to —6 v., depends on signal strength.	Weak or no picture. No sound. Raster OK.	I.F. circuits.	If a.g.c. is over 10 volts negative, an i.f. stage is probably oscillating. If a.g.c. measures high on a weak signal, then an i.f. stage may be regenerative. Check the dress of components near detector, the alignment of the i.f. stages, and the screen bypass capacitors.
		Picture bend, buzz in audio, video overload, or weak picture and sound in strong signal area.	Tuner, i.f. circuits, or a.g.c. circuit.	For severe picture overload, check components in the a.g.c. circuit. If picture and sound are weak where they should be strong, then the signal is not getting through the tuner or i.f. circuits. Voltage and resistance readings on tuner and i.f. stages (i.f. coils included) should indicate the trouble.
Sound limiter, pin 2 of V_5, 5U8. "3" on Fig. 2	—2 v. to —18 v., depends on signal area.	No sound, picture and raster OK.	Sound limiter and reflex sound transformers.	Good reading means audio is getting to this point. If reading is low on a strong channel, then trouble is due to alignment or reflex transformers. If reading is normal but varies from channel to channel and is lower on unused channels, the trouble is in the following stages. Check pin 9 of V_6 (44 v.) and pin 3 of V_7 (105 v.)
Sync separator, pin 9 of V_5, 5U8. "4" on Fig. 2	—12 v. to —30 v. depends on setting of contrast control.	Poor or no vertical and horizontal sync. Picture and sound OK.	Sync separator and video amplifier.	If the reading is OK, the trouble may be due to severe video overload (r.f., i.f., or video amplifier), or to defective sync phase inverter circuit. If the reading is incorrect, check components between plate of video amplifier and grid of sync separator.
Vertical oscillator, pin 1 of V_8, 6SN7. "5" on Fig. 2	—9 v. to —14 v.	No vertical sweep, insufficient vertical sweep, and/or vertical fold-over.	Vertical multivibrator.	If the reading is OK, check the electrolytic capacitor from the cathode of the vertical output tube to the chassis. Check also, the .1 μfd. capacitor in the grid circuit and the vertical output tube and the vertical winding in the deflection yoke. In the event that the reading is incorrect, check the "B+" at pin 2 of V_8 (10 v. to 70 v. depending on size control setting), "B+" at pin 3 of V_{13} (118 v.), and the .01 μfd., .001 μfd., and .0047 μfd. capacitors in the circuit of V_{13}.
Horizontal oscillator, pin 5 of 25CD6 GA. "6" on Fig. 2	—20 v. to —30 v.	No high voltage (no raster) due to defective horizontal oscillator.	Horizontal oscillator, horizontal control tube, "B+" circuits.	If the voltages check, then the trouble is due to high voltage and not to the horizontal oscillator. In the event that the voltages are not OK, check the oscillator or boost circuits.
Pin 4 of 6SN7, V_9. "7" on Fig. 2	—50 v. to —60 v.			

CONSTANT-VOLTAGE SOUND SYSTEMS

By **ABRAHAM B. COHEN**
University Loudspeakers, Inc.

Method of sound distribution that is most practical for multi-loudspeaker installations of practically any type.



Over-all view of the University driver unit with a close-up of the wattage input steps for 70.7 constant-voltage line and the corresponding impedances for these wattage steps as seen by the amplifier used in system.

THE constant-voltage distribution system has been widely used by public utilities because of its inherent advantages for power distribution work. The audio field, taking its cue from the utilities, may now realize for itself the many benefits to be derived from the "70.7 constant-voltage" audio power distribution system. The advantages of this method are: (*a*) Elimination of impedance matching of the load to the line; (*b*) Ease of adding or removing a section of the load without resetting master gain controls; (*c*) Ability to proportion the individual sound outlets to fit specific local needs without upsetting other local outlets; (*d*) Reduction of audio power losses in attenuators by eliminating individual speaker branch attenuators in favor of vari-tapped constant-voltage transformers; (*e*) Simplicity of choosing amplifier equipment through standardized power output ratings on a constant-voltage basis; and (*f*) Reduction of overload failures of sound units when "power matched" to a constant voltage line system.

These benefits stem from the fact that if the line voltage of the distribution network is maintained constant then the various speakers that are added to the line may be considered in terms of rated watts, rather than in rated impedances. The loudspeakers used with this type of system need to be designated in wattage input steps to the unit for the 70.7 constant-voltage line feeding it. This is analogous to power type of equipment being rated in input watts for the power line voltage of 110 (constant) volts. Fig. 1 illustrates such a sound driver designed to operate at full efficiency not only on the constant-voltage system but likewise on constant-impedance systems if necessary.

It will be observed that the terminal board designations are given on a *wattage* basis for the 70.7-volt line. This simply means that when connected to the 20-watt tap, the driver unit receives 20 watts; or when connected to the 5-watt tap, it takes 5 watts of audio power. The sound output will naturally be in proportion to the power input. Accordingly, then, it becomes a simple matter to get the necessary sound power from such a unit by simply tapping into the right *power* rating terminals, from the 70-volt line. It will be observed, however, that these same terminals are also rated in terms of input impedance across the 70-volt line which produces the indicated power. We will have more to say concerning these alternate ratings later, but first let us see what we may do by simply using the wattage ratings of such a unit for the constant-voltage system.

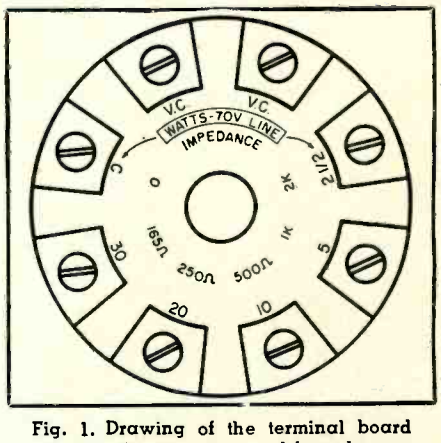


Fig. 1. Drawing of the terminal board showing the wattages and impedances.

Planning a sound system is very much like laying out a lighting system. In problems of illumination, one determines by experience or by photo-measurements how much light is needed in given areas and how that light is to be distributed. Then appropriate light sources are installed. Similarly, for sound systems, one makes a survey of the sound needs by means of sound survey meters, or by experience, or by the use of available tables and literature, and a plan for the sound distribution is developed that calls for specific sound powers to be delivered in given areas.

Fig. 2 illustrates a small plant installation requiring three different levels of sound coverage as determined by the noise considerations of the various areas and the size of these respective areas. The busy office may require 1 watt of audio power, the stockroom 10 watts, and the factory area 30 watts. The project now becomes one of determining the means by which these different values of audio power may be obtained. If the amplifier were a 70-volt constant-voltage type, then with the type of driver unit illustrated, one would simply choose the proper wattage tap on the input terminal board and the installation would be complete. As simple as this procedure seems to be on paper, it is not in any way oversimplified. The design of the driver unit and its integral "power matching" transformer makes the use of this system as simple as it sounds. Although the transformer is rated in wattage, it must present to the amplifier some very definite impedance. The actual impedance that the constant-voltage amplifier will see will be the speaker impedance modified by the step-up ratio of the transformer. Fig. 4 gives, in tabulated form, the primary

impedances of the transformer for the secondary impedance load of 16 ohms (which is the speaker voice coil impedance). These primary impedances are the impedances that the constant-voltage amplifier actually sees, and the power that the amplifier will deliver into each of these taps will readily be derived from Ohm's law as shown in the tabulation. Thus, although the user of this driver unit on a constant-voltage system doesn't have to know what the impedance of the tap is from which he expects a certain power input to the driver, yet the designer of the unit takes it into account.

Since the constant-voltage amplifier maintains its output at a constant 70.7 volts irrespective of the impedance it sees, one may indiscriminately run up and down these transformer taps, selecting whatever power input to the speaker best suits the acoustical conditions without upsetting any amplifier operating characteristics. One may now plant loudspeakers in any location, one after the other, simply by plugging them in (like an appliance) across the 70.7 constant-voltage line without upsetting previously installed speaker inputs. Furthermore, each loudspeaker may be adjusted to give the desired loudness without upsetting the loudness adjustment of the other components. There is, of course, a practical limit to the number of speakers that may be put across one amplifier. This limit is naturally fixed by the total power capabilities of the amplifier. Thus for a 100-watt amplifier, any number of speakers may be installed provided that the total power drawn by all of them does not exceed 100 watts.

The real value of this constant-voltage system cannot be fully appreciated, however, until one examines a typical installation of the constant-impedance, rather than the constant-voltage, type. The constant-impedance installation is, of course, the type where the total impedance of the speaker system installation must match the amplifier impedance for maximum power output. Let us assume that we have two 16-ohm impedance speakers to be installed in two different locations requiring different power inputs, but both operating from the same amplifier. If the output impedance of this amplifier is 8 ohms, then we may arrange the two speakers in a parallel circuit giving a resultant load impedance of 8 ohms which will match the amplifiers, as shown in Fig. 3. Now if on this constant-impedance system one of these speakers is to be operated at a lower power than the other, then an attenuator will have to be put in this speaker branch as illustrated.

If 5 watts is to be fed into the unattenuated 16-ohm speaker, then the gain of the amplifier will have to be set so that the line voltage developed is close to 9 volts. But now, how about the speaker that only requires 1 watt of input power? In order to reduce its input power to 1 watt, the attenuator in its circuit must be turned down until the voltage across the driver unit is 4 volts (even though the input to the attenuator still sees the 9 volts of the line). If the attenuator is matched in impedance to the speaker, then this 16-ohm pad must be receiving a full 5-watts input. But if it delivers only 1 watt *to* the speaker, then 4 watts of audio power must be burned up in the attenuator. This is the price that must be paid in amplifier power for level control by means of attenuators.

It will, of course, be realized that this case is also an oversimplification of fact, for actually in a complex multi-speaker installation of many branches, these attenuator power losses may add up to a value that will make the initial power amplifier equipment large and expensive simply to handle the attenuator losses. In the simple illustrative problem just discussed, the two-speaker installation requiring a total of 6 watts of audio would draw only 6 watts from the constant-voltage amplifier, but would draw 10 watts of amplifier power from the constant-impedance type of amplifier for the same speaker power input.

Impedance matching serves only one purpose in life: to get maximum power from a system. If we have a system where impedance mismatch does not upset the power relationship, then there is no problem about impedance match. If the amplifier used in the system is of the constant-voltage type where the power delivered to the load is simply a function of the load impedance and not the impedance match, then we can throw away our problems of load matching. This is exactly what the 70-volt system accomplishes. The loudspeaker itself is always across the full secondary of the transformer as shown in Fig. 4, but the primary is tapped so that when the 70-volt line is connected to a given section of the primary winding, the amplifier will see a given impedance, and will deliver to that tap a corresponding electrical power. Thus, it will be observed that if the full primary is put across the line, the voltage to the secondary is stepped down the most, giving a low power input to the speaker. As the line is connected to smaller sections of the primary of the transformer, the voltage step-down to the secondary is decreased, developing more voltage on the primary and consequently delivering more power to the loudspeaker.

However, since in setting these wattage ratings for the convenience of the user of the 70.7-volt system it has been necessary to definitely use the concept of impedance in the design of the unit, we might just as well take full advantage of the impedance ratings of the various sections of the constant-voltage transformer for applications where the 70.7-volt system is not available, but where instead the constant-impedance system is in use. For instance, ten such units, of the type illustrated in Fig. 4, may be connected in parallel across their 165 ohm input taps giving a total resultant impedance of 16.5 ohms.

This will, of course, match commercial power amplifier output ratings of 16 ohms. In this case, however, the power that each unit will receive will be dependent upon the gain setting of the power amplifier. If this main power amplifier has sufficient reserve power, then any power from zero watts up to the rated unit input power of 30 watts may be applied to each unit when so connected. The fact is that on a constant-impedance basis the power input to the unit is continually variable, depending entirely upon the gain setting of the amplifier no matter what impedance tap is used on the unit.

Take, for example, an amplifier that has a 500-ohm output for a long line distribution, such a line may be loaded down with four of these units con-

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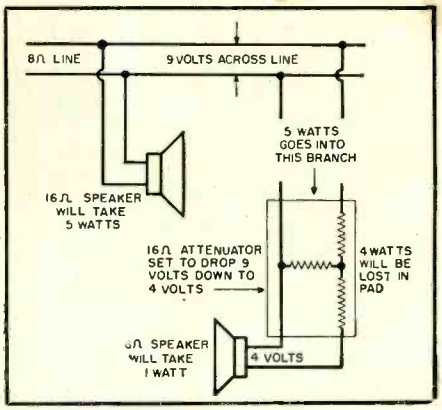


Fig. 3. In constant-impedance type systems, changes in speaker operating power are usually obtained by means of constant-resistance attenuators which waste audio power and do not convert it into sound.

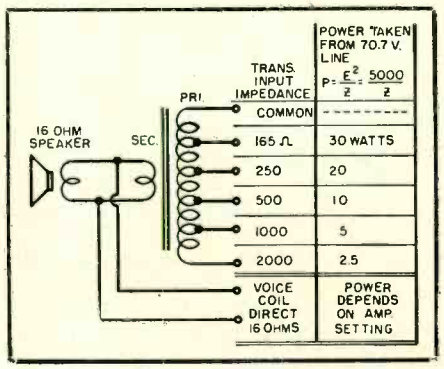


Fig. 4. The power delivered to the loudspeaker from the 70.7 constant-voltage system is determined by the transformer input impedance as seen by the line. The user of the system simply picks the desired power, transformer does the rest.

Fig. 2. In planning a sound-system installation, the size of the area to be covered and the level of the background noise along with the reverberant conditions of the room will determine the amount of audio power required in each of the areas.

OFFICE	STOCK ROOM
FAIRLY BUSY 30' X 50' X 20' NEEDS 1 WATT	NOISY AND BUSY ACTIVITY 30' X 100' X 20' NEEDS 10 WATTS OF AUDIO
FACTORY	
NOISY AND HEAVY INDUSTRIAL 60' X 150' X 30' REQUIRES 30 WATTS OF AUDIO	

SERVICING WITHOUT METERS

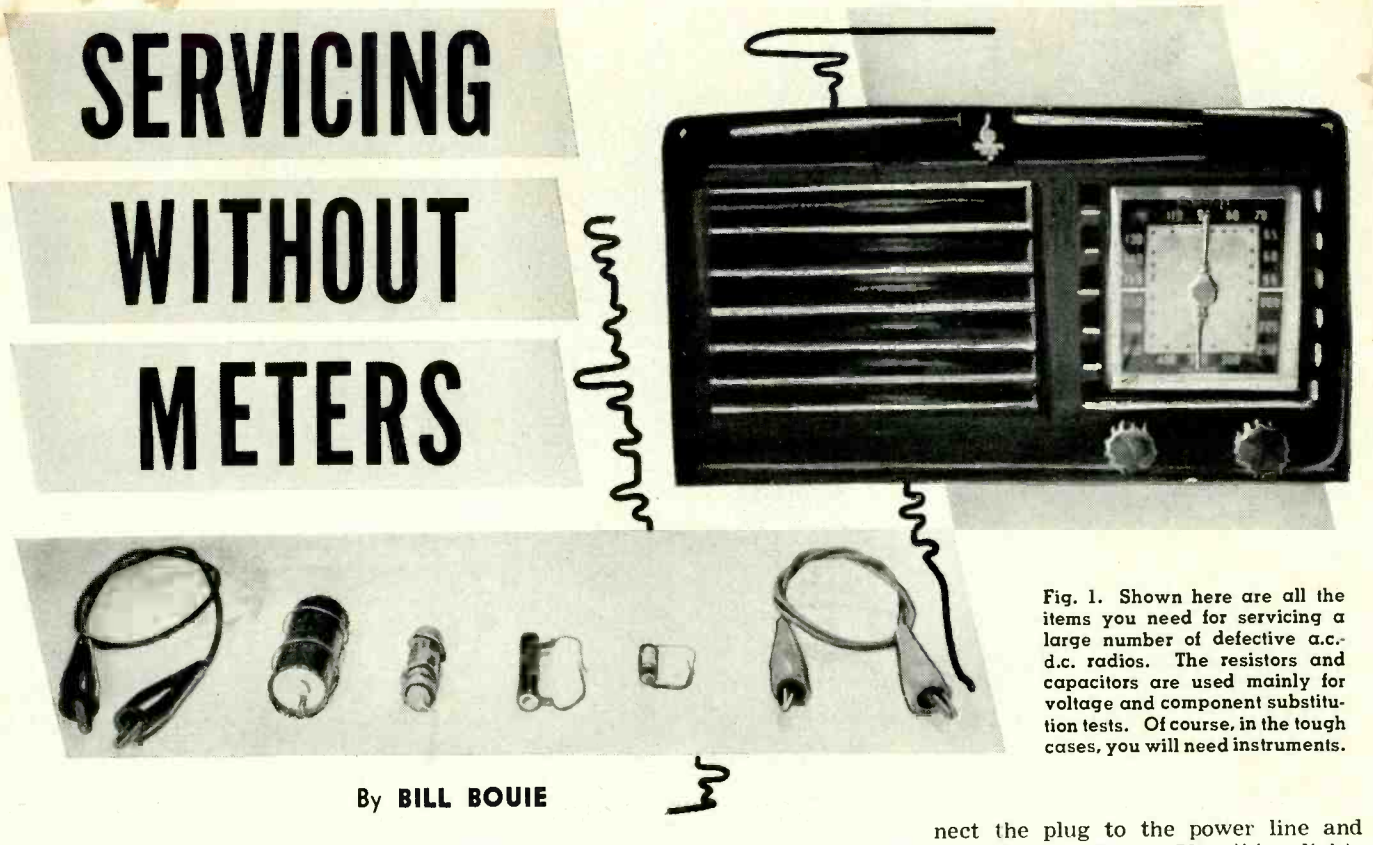


Fig. 1. Shown here are all the items you need for servicing a large number of defective a.c.-d.c. radios. The resistors and capacitors are used mainly for voltage and component substitution tests. Of course, in the tough cases, you will need instruments.

By **BILL BOUIE**

You can make a.c.-d.c. radio servicing pay if you use faster methods. Here's one approach that has worked.

MANY TV service technicians have neglected the servicing of small radios because they feel that the payment for such jobs does not warrant the time expended. The same amount of time put in on a TV repair will bring in more money. These are cold business facts—and the service technician is justified, if he hasn't already discovered that servicing radios can be so fast that such business is profitable. If you have a set in the shop now, get it out on the workbench, because we are going to show you how you can make any number of checks and tests to isolate the defect without any meters or conventional test equipment at all.

The items shown in Fig. 1 are all you will require to make systematic checks from the input to the output of the set, including the power supply. Three basic test routines can be used.

The items shown in Fig. 1 are probably in your parts cabinet right now. From left to right, they are a black test lead, 12 to 18 inches long, with alligator clips on both ends; an 8 to 10 μfd., 450-volt electrolytic capacitor; a .02 μfd., 400 to 600-volt paper or mica capacitor; a wirewound 150-ohm, 2-watt resistor; a 150,000-ohm carbon, 1-watt resistor; and a red test lead similar to the black one. Make sure that the parts are in good condition, especially the filter capacitor. In the way of tools, you'll need a soldering iron, side-cutting pliers, and a screwdriver. Lay out these items on the workbench and we are ready to begin.

We'll assume that your defective set is a five-tube a.c.-d.c. radio. Since television has become top entertainment in the average home, many of these faithful little radios are left to collect dust after they become inoperative. In most cases, only a simple defect has developed which can be easily corrected, and the set restored to useful operation again. The circuit of a conventional five-tube superheterodyne receiver is shown in the schematic diagram of Fig. 2. Either standard octal-base or pin-type tubes are indicated for use in corresponding stages. A rectifier tube is used, but conditions are similar if a selenium rectifier is found instead.

EDITOR'S NOTE: *The author does not wish to imply that servicing via test equipment is an obsolete technique. He does, however, point out that there are many simple shortcuts that can be taken in diagnosing troubles. Proper test equipment should be used as a follow-up to make sure the repair is permanent.*

Before any tests are attempted, a preliminary inspection should be made to discover possible symptoms indicating the source of trouble. Many times such a routine inspection immediately finds the fault. However, even these simple checks should be done in some sort of order because we are now interested in saving as much time as possible. Before you remove the chassis, check the line plug and connecting cable for loose or broken connections. Remove the back from the set and check the antenna connections. Connect the plug to the power line and turn the switch on. If nothing lights up, you probably have a dead tube. If a set of tubes is available, try replacing tubes to restore operation. Otherwise, pull the chassis from the cabinet and turn it bottom side up. With the set turned on, connect your test leads to the 150-ohm resistor and apply it across the heater terminals on each tube base in turn. The heaters of tubes in a.c.-d.c. sets are all wired in series and if one burns out the whole string goes dead. Jumping the terminals of the burned-out heater with the resistor completes the circuit and the other tubes will light.

Your first suspect is the rectifier tube with the output tube usually next, since more power is consumed in the heaters of these tubes than by the others. When the rectifier heater burns out, the pilot light usually burns out, too, and will require replacement.

The next test is made on the power supply to find out if operating voltages are present. This test can be made in two ways. One way is to connect your two test leads to the 150-ohm resistor, and connect the free end of the black lead to "B—". (Note that "B—" here is not the same as chassis ground. To reduce the shock hazard in these circuits, "B—" is floated above ground by capacitor C_2 and resistor R_2 in Fig. 2.) The red lead is then touched momentarily to a high-voltage point, such as the junction of C_{11} and R_{10}. If voltage is present, the momentary contact causes a spark, and a "pop" is heard in the speaker, caused by the sudden change of current in the circuit. Don't hold this contact longer than a moment, or some other component may be damaged by the shorting of the power supply.

The second method of testing for voltage is made with the 8-μfd. filter capacitor. Connect the test leads to the capacitor terminals observing polarity (red to "+", black to "—"). With the black lead connected to "B—", connect the red lead directly to the high-voltage point and wait a few seconds for the test capacitor to take a charge. Then disconnect the red lead and immediately touch it to the black lead, shorting the test capacitor. A fat spark indicates that operating voltage is present at the point of contact in the circuit.

Using either of these two test methods, any point in the power supply can be tested for operating potentials. After a little experience, the size of the spark obtained will indicate expected relative values of voltage at different points in the circuit.

Suppose no spark was obtained when the test was made on the input filter capacitor, C_{11}. The trouble could be in C_{11} or in the rectifier tube. Disconnect the positive lead of C_{11} and connect your test filter capacitor as a substitute. If voltage is available now, C_{11} is bad and should be replaced. If still no voltage is obtained, then attention is directed to the rectifier tube. Similar tests are made on the other filter capacitors, C_{12} and C_{13}. Suspected filter resistors, R_{10} and R_{11}, are checked by shunting them with your 150-ohm test resistor, one at a time. If no voltage seems to be coming into the set, check the switch by shorting a test lead across its terminals (always assuming, of course, that you are not plugged into a dead power line). An examination of the circuit in Fig. 2 will readily indicate other points in the power supply at which to make a jumper test.

A check on the loudspeaker normally comes next. However, the spark test for voltage may have produced audible clicks or pops in the speaker, indicating that this unit is operating. An additional test of speaker operation can be made by connecting your 0.02 μfd. test capacitor from the a.c. line or a heater prong on one of the tube sockets to the plate or grid of the output tube. A hum should be heard

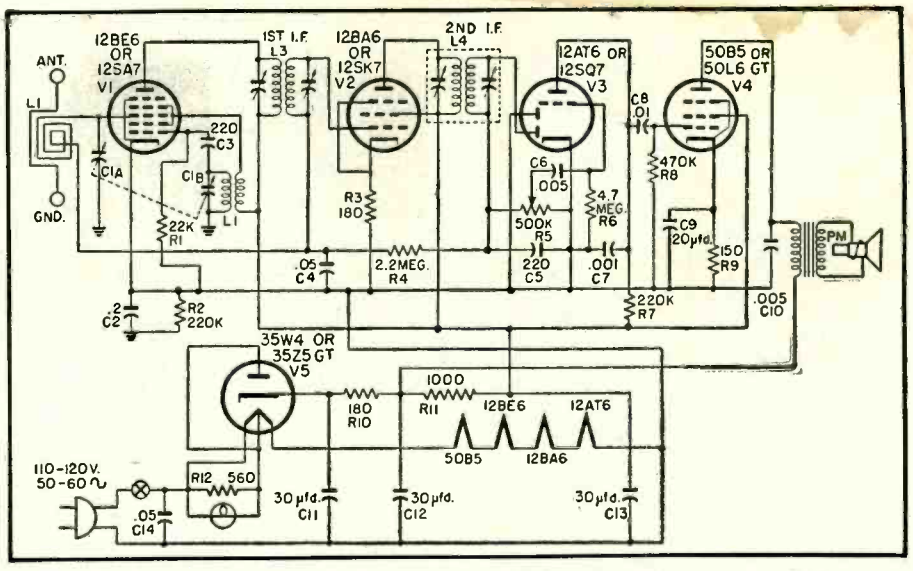


Fig. 2. Complete schematic diagram of a typical a.c.-d.c. radio receiver. This is a conventional 5-tube set using regular wiring and a vacuum tube rectifier.

if the speaker is operating OK. In this test you are picking up the 60-cycle power line hum and feeding it through to the speaker. The hum will be louder if the output tube can be used to amplify the signal by feeding it into the grid of this stage. Press the speaker cone lightly for a test on the voice coil connections. Examine the rim of the cone for secure mounting to the speaker frame.

Stage-By-Stage Tests

You can now turn your attention to a stage-by-stage test. Use either the 150-ohm test resistor or the test filter capacitor to check for voltages at the plates and screen grids of the tubes, working back from output to input. As you do this, listen for clicks in the speaker upon initial contact with the test lead. This will give you a general idea of the ability of the stage to pass a signal. The plate of the detector-audio stage, V_3, normally operates with less voltage than the other tubes, but once again, a little experience will tell you the normal voltage indication to expect from this stage.

A signal test can be made on each stage to determine whether it is operating. Connecting a test lead to the grid of the i.f. tube and tapping the other end of the lead against the chassis produces clicks in the speaker if this and all following stages are operating. This test produces similar results when made from the signal grid of the mixer tube or from the antenna terminal connecting to the tuning capacitor.

This test method can be used on the audio grids as well to produce a hum in the speaker. For a better test on the audio stages, you can pick up a hum signal from the a.c. line or from a tube heater and couple it through your .02-μfd. test capacitor to the plates and control grids of these stages in turn. As you work back from the plate of the output tube, the hum in the speaker will increase with the increased amplification of each audio tube.

When the faulty stage has been found, the component substitution test is made to isolate the defective part. For this test, use the .02-μfd. capacitor and the 150,000-ohm test resistor.

(*Continued on page* 127)

Fig. 3. Using the 150-ohm wirewound resistor to check for voltage in the power supply. Momentary contact will produce a spark if voltage is present at test point.

Fig. 4. Shunting a filter capacitor with the 8-μfd. electrolytic testing unit. To check for a shorted capacitor, disconnect one of the terminals of the suspect.

Fig. 5. To test the speaker, feed a hum signal from the heater line to the primary of the output transformer through the .02 μfd. paper testing capacitor.

TEST INSTRUMENTS NEED CALIBRATION

By **WALTER H. BUCHSBAUM**
Television Consultant
RADIO & TELEVISION NEWS

Why not stop "second guessing" your meters and calibrate them, now that you have time on your hands. Accurate-reading instruments save time.

THE summer months are usually marked by a slump in radio and TV service work and afford the alert technician an opportunity to attend to some of the chores neglected during the busy part of the year. Organizing the bookkeeping, restocking the parts shelves, and similar activities often wait for the summer months and many service technicians also look after their test equipment and tools at that time. Calibrating the various test instruments is another important job for the slack season.

This article deals with the check and calibration work which the average service shop can do, without investing in expensive precision test equipment.

Basically all the instruments in the service shop can be divided into two types: the generating equipment and the measuring equipment. Into the first classification fall signal generators, sweep generators, oscillators, square-wave and pulse generators, and even test receivers which provide a test signal from a station. Measuring devices are all kinds of meters, tube testers, and oscilloscopes.

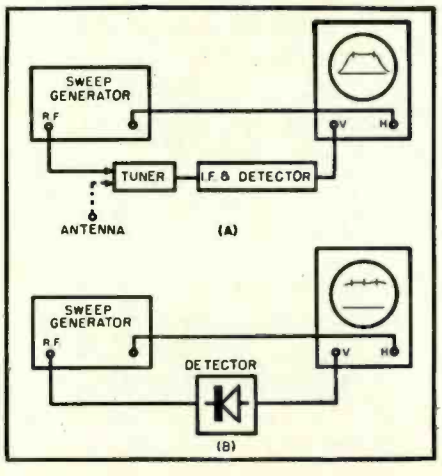
In the course of ordinary trouble-shooting these two types of instruments are generally used to measure or test each other's performance. Thus, the output of the sweep generator is eventually displayed on the oscilloscope. The test set-up illustrated in Fig. 1A can be changed by removing the TV receiver and connecting directly to a detector as shown in Fig. 1B. In this manner, the oscilloscope display is an indication of the sweep generator performance and output flatness. This can be used for calibrating other generators, as will be explained later. The oscilloscope itself is subject to calibration and it may be necessary to calibrate it before it can serve as a standard of comparison.

This illustrates the fundamental requirement of any calibration procedure, and that is that some kind of standard, a known, accurate value of an electric parameter, must be used against which the other instruments can be compared. A standard for frequency and one for voltage, current, or resistance is required for the test equipment found in radio and TV service shops.

Calibration Standards

Frequency standards for the calibration of extremely accurate devices are usually called "secondary" standards, such as the type TS-173 frequency meter used by the Armed Services. Receivers tuned to station WWV, the government-owned radio station which transmits code signals at accurately fixed frequencies, are also used as standards. For radio and TV work the broadcast stations themselves serve as frequency standards, since their accuracy is the ultimate required from home receivers. In addition to those station signals, intermediate frequencies are also needed and these can usually be checked by comparison with crystal oscillators.

Fig. 1. Two methods for developing the output signal of a sweep frequency generator on an oscilloscope. The method shown in (A) is used for frequency calibration of markers.



Accurate voltage or current sources are not quite so easily available. One of the simplest is batteries and neon bulbs or other gas-filled tubes. The accuracy of the battery voltage is unfortunately dependent on the age and the state of charge, but gas-filled tubes are remarkably uniform in their firing voltages. In order to permit a variety of calibrations to be performed with the voltage standards, a set of accurate resistors is required. These resistors will also come in handy for the calibration of the resistance and current ranges. For this reason we recommend a set of 2-watt, film-type resistors having an accuracy of 1%. Suitable values are 100 ohms, 900 ohms, 9000 ohms, and 90,000 ohms. These values can be combined to provide a great variety of standard voltages.

Frequency Calibration

When a sweep generator has an r.f. marker available, it should be calibrated first and then it can be used in conjunction with the oscilloscope to help calibrate other signal sources.

To check the calibration on a TV station, connect the sweep generator as shown in Fig. 1A. Tune the TV set to a local channel; tune the sweep generator to the same channel and observe the scope presentation. In order to see the station sound and video carriers as illustrated in Fig. 2, it may be necessary to reduce the sweep generator output and increase the oscilloscope gain. Now, tune the r.f. marker generator until the marker pip coincides with the station video carrier.

Having followed thus far, the technician now probably finds that the marker generator dial indicates a frequency other than that of the video carrier. It may be possible to shift the frequency dial to correct the error, but this may throw off other frequency bands. The simplest method is to first

note down each dial reading and the actual frequency, and then decide after the entire unit has been calibrated how the correction should be made. In some generators there is an internal or external trimming adjustment which permits accurate calibration. Other units allow for calibration by a shift in the frequency indicating mechanism. In either event, the manufacturer's instructions should be carefully followed.

After the individual station signals have been fully utilized, it may be possible to get lower frequencies directly from the marker signal by using the principle of harmonics. For example, the *RCA* WR-39 TV calibrator has crystal calibration available at 2.5 mc. and .25 mc. which can be utilized in the following manner: Assume that channel 4 is available and the setup of Fig. 1A is used. First, set the r.f. marker at the video carrier of channel 4, 67.25 mc. Next, turn on the .25 mc. crystal and vary the crystal adjustment control until the marker and crystal oscillator signals zero beat. (In the *RCA* WR-39, a speaker is provided; earphones can be used with other units.) Once the .25 mc. crystal oscillator has been calibrated, the various i.f. frequencies can be checked by first zero beating with the 2.5 mc., and then with the .25 mc. crystal for final accuracy.

Other signal generators not having built-in crystal oscillators can be calibrated in the same manner if an additional generator is used as the intermediate or transfer oscillator. Many of the r.f. generators used for radio work operate at 250 kc. and this is then mixed with the station carrier marker. Since the relative signal amplitudes of the various generators will probably not be known in advance, some adjustment must be tried in the event that zero beats are not readily obtainable. If the signal is too weak, the audio section of the TV set can be used as an indication of zero beating by connecting the two signals directly to the top of the volume control. Other methods of calibration are also possible, especially where accurate equipment is readily available.

A word should be said here about the use of calibration charts or graphs. Fig. 3A is a portion of a typical calibration chart, and Fig. 3B, a typical graph. The former is preferable when the same frequencies are always used, as in radio and TV servicing, while the latter is more suitable for experimental work. A graph requires careful reference and interpretation, while the chart immediately tells the exact frequency at a glance.

Practice has shown that for service shop operation, the chart should always be kept next to the generator and in an easily visible spot. Some technicians simply type or letter the chart, paste it to the top or side of the generator, and forget about it. In less than three months the chart is usually illegible, torn, and dirty. A much better solution is to sandwich the paper between two sheets of transparent plastic and fasten this to the generator with strong wire. One really elegant service technician uses surplus military map cases for this purpose.

Voltage Calibration

As previous articles in RADIO & TELEVISION NEWS have pointed out, the oscilloscope is a voltage indicating device and can be used as a voltmeter. It is especially useful for a.c., but can be calibrated with d.c. Usually, the vertical axis is used for voltage indication and this is calibrated simply by connecting a voltage of known amplitude to the vertical scope terminals. Most of the voltage standards are d.c. When a d.c. voltage is applied to the oscilloscope terminals, the base line will jump up or down by a certain amount. This corresponds to the applied d.c. potential. To calibrate the oscilloscope, therefore, simply connect a battery to the scope with a means for rapidly interrupting the circuit. A transmitting key or switch, as shown in Fig. 4, is sufficient. The resultant scope presentation is shown in Fig. 5, the separation between lines represents the applied calibrating voltage. If a 1.5-volt battery is used for this, adjust the vertical scope amplifier until the separation between scope traces is 15 divisions, then the scope is set for .1 volt per division. If the lines are separated by 3 divisions, then the scope is calibrated for 1 volt per 2 divisions. The other ranges can be calibrated in a similar manner, using larger voltage sources such as gas tubes.

Regulated power supplies usually use a gas tube as the voltage reference because this tube has the characteristic of maintaining a fixed voltage across itself. As an example, refer to the circuit of Fig. 6, which shows a VR105 connected for calibration purposes. This tube conducts and glows when the voltage across it exceeds 105 volts. Any increase in input voltage results in an increase of current through the tube, but the voltage across the tube remains constant over the range of current from about 5 to 30 milliamperes.

Knowing that the voltage across the tube is 105 volts, we can calibrate a d.c. meter against it or else use it as a voltage standard for the oscilloscope. It is only necessary to rig up a circuit like that in Fig. 6, using the "B+" from a TV set as a source, for example, and adjust the variable series resistor until the VR tube glows. Then we know that the firing voltage is present. A voltage divider made up of the 1% precision resistors shown in Fig. 6 will allow suitable fractions of the total calibration voltage to be available.

In addition to the VR105, regulating tubes are also available for 150 and 75 volts, and a simple neon bulb like the NE-51 provides a voltage drop of 51 volts. Furthermore, it is possible to connect several VR tubes in series, and use a much higher voltage. The accuracy of the VR tube method of calibration probably does not exceed ±2%, but this is sufficient for most service applications.

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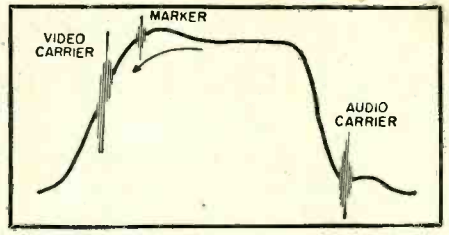
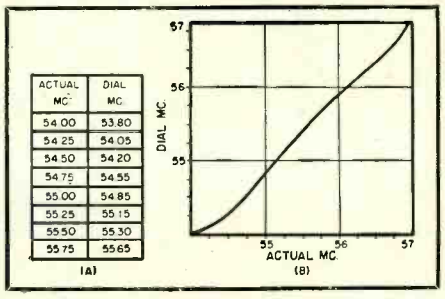


Fig. 2. Scope trace using a sweep generator and a TV receiver tuned to an active channel. Note marker signal.



ACTUAL MC	DIAL MC
54.00	53.80
54.25	54.05
54.50	54.20
54.75	54.55
55.00	54.85
55.25	55.15
55.50	55.30
55.75	55.65

Fig. 3. Two forms of calibration references are shown here. (A) is a table which is direct reading and lists the most frequently used settings; (B) is a graph requiring interpolation for specific values.

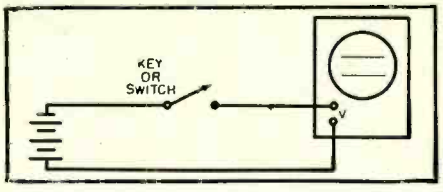


Fig. 4. Setup for voltage calibration of an a.c. oscilloscope using an interrupted direct current source.

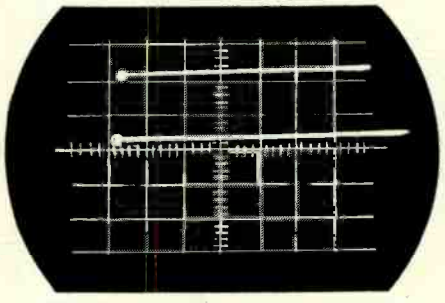


Fig. 5. Actual scope presentation showing voltage calibration lines.

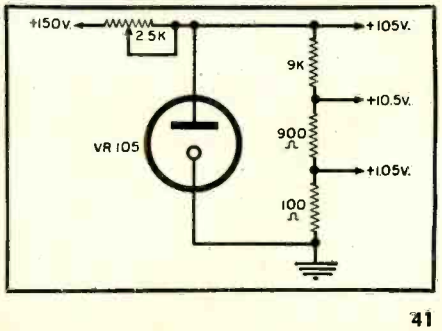


Fig. 6. Voltage divider across a VR tube serves as source for three accurate d.c. calibrating voltages.

PORTABLE TV PICTURE

Fig. 1. The substitute picture tube assembly shown here in use with a conventional-type horizontal chassis whose CRT is bolted to the receiver cabinet front.

By **JOHN T. JANS**

Build this picture tube substitute using the new 5AXP4 tube, invaluable for servicing vertical chassis TV sets.

WITH the trend toward larger picture tubes and smaller chassis, more manufacturers are mounting the picture tube on the cabinet. When the picture tube is so mounted and the receiver needs shop service, the technician is faced with the unenviable decision of carrying the entire receiver, cabinet and all, to the shop or dismantling the receiver in the customer's home and carrying the parts piecemeal. Most service technicians grit their teeth, remove the chassis, focus coil, yoke support, yoke, and picture tube, and when the set is repaired, replace these parts one by one. Usually, the dissassembly, subsequent reassembly, and adjustment takes at least twenty minutes. This time is completely unproductive and, coupled with the risk of damage to the yoke and picture tube, makes the shop repair of a receiver with a cabinet-mounted picture tube more expensive than necessary.

Since the 5AXP4 receiver check tube was introduced by *Sylvania,* the service technician has had a simple solution to the problem of the cabinet-mounted picture tube. With the 5AXP4 receiver check tube the technician need remove only the chassis and leave the picture tube and its components in the cabinet without changing their adjustment. Once back in the shop, the receiver is connected to the socket and yoke adapter of the 5AXP4 and the receiver can be operated on the bench.

For convenience, speed, and safety, the *Sylvania* 5AXP4 tube can be mounted in the enclosure shown in Fig. 1 and the yoke connected as shown in Fig. 2. A 70 degree yoke similar to the *Ram* "Y7OF14/43" or *Stancor* "DY9A" is used. A 12-pin socket on the 5AXP4 is wired directly to a 12-pin plug, pin-for-pin. Two other leads ending in alligator clips, shown in Fig. 1, are for high voltage for the tube—one for the anode connector, the other for grounding the box.

The yoke, socket adapter, and high-voltage leads are about four feet long, so the 5AXP4 tube and its enclosure can be left on a shelf above the service bench out of the way. The long leads will not affect the yoke operation and the slight reduction of horizontal resolution caused by the long socket leads will be too small to see on the five-inch tube.

The dimensions and layout for the tube and yoke enclosure are shown in Fig. 3.

Alligator clips on the yoke leads enable the service technician to connect quickly to the scan output circuits of the receiver. In most cases where the picture tube is cabinet mounted, the yoke and focus assembly is plugged into the chassis—the alligator clips can connect to this chassis socket. When most of the receivers serviced are of one make or type, an adapter plug and the exact yoke replacement can be used to plug directly into the chassis. In a few instances the yoke is wired directly to the chassis. When this is the case, the best expedient is to cut the yoke leads at a convenient spot and connect the alligator clips to the bare ends of the wires on the chassis. This situation happens infrequently and the cutting and repairing of the cut leads is still much faster than the disassembly of the yoke and picture tube.

There is no external coating on the 5AXP4 and consequently, on receivers

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Fig. 2. Suggested universal yoke circuit for the picture tube assembly. The leads from the yoke should be four feet long.

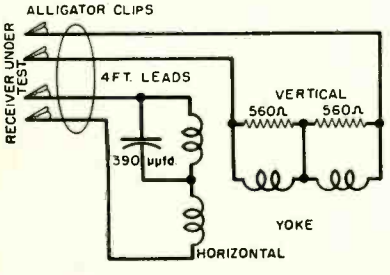
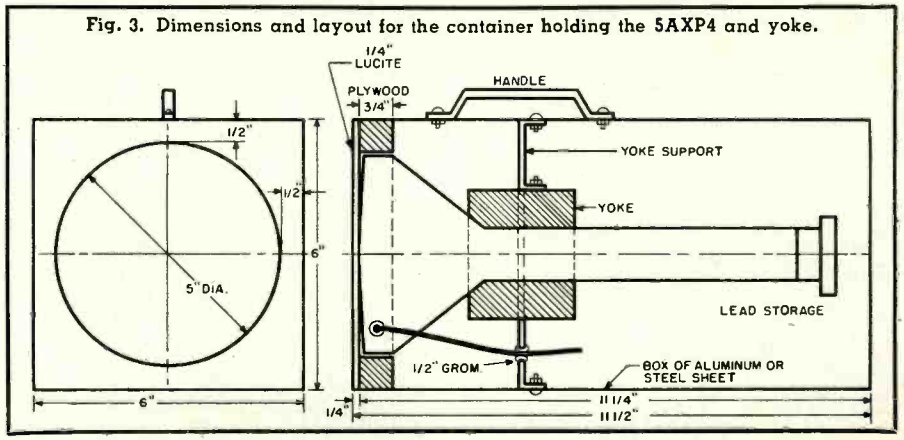
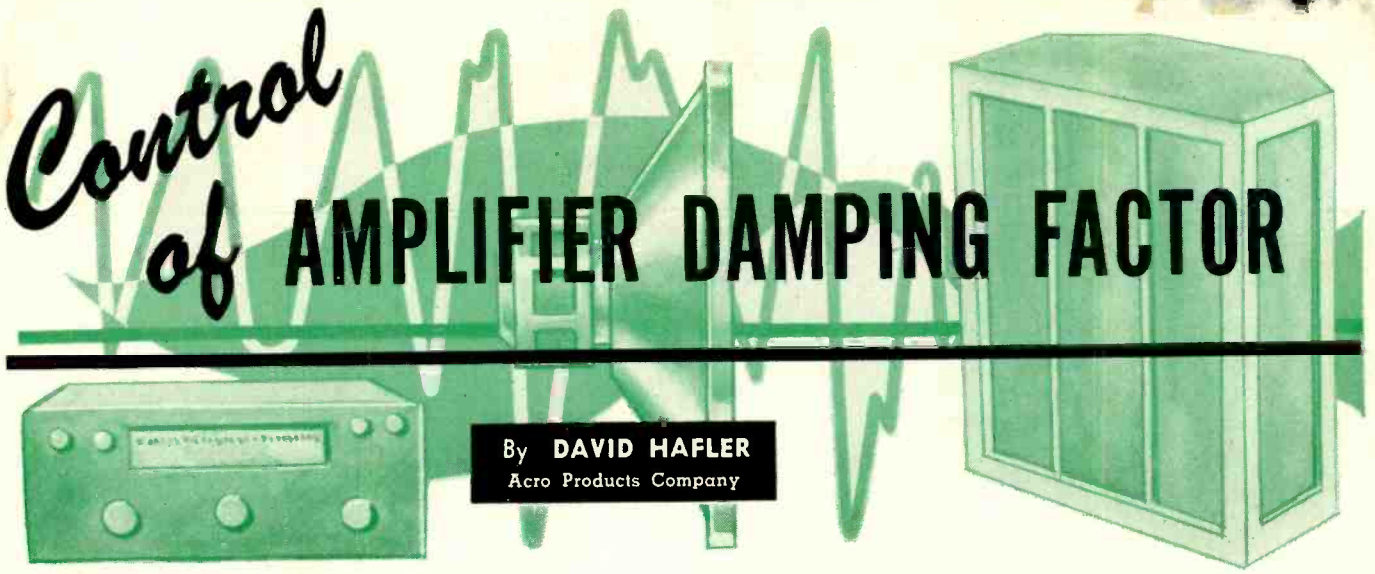


Fig. 3. Dimensions and layout for the container holding the 5AXP4 and yoke.



Control of AMPLIFIER DAMPING FACTOR



By **DAVID HAFLER**
Acro Products Company

Is variable damping a "must"? Here are some pros and cons on this currently "hot" audiophile topic.

THE damping factor of an amplifier is defined as the ratio of nominal load impedance to actual output impedance. The nominal load impedance is the value of impedance in which the amplifier should be terminated for normal operation. For example, the 16-ohm output on an amplifier should normally be terminated in a 16-ohm speaker or other load. Other values of load impedance will generally degrade performance. However, the actual output impedance of the amplifier is unrelated to this nominal impedance and the 16-ohm output tap of an amplifier could represent any measured impedance from −16 ohms to +160 ohms.

It is simple to measure the output impedance of an amplifier. A signal voltage is introduced at the input and the output voltage is measured with no load on the amplifier (keeping the signal level below the overload point). Then a variable resistor is put across the output and varied until the output voltage has dropped to one-half of its unloaded value. The measured d.c. resistance of the variable resistor which drops the output to half voltage is equal to the output impedance of the amplifier. If the voltage rises when the load is introduced, the output impedance is negative; and a 2 to 1 change in voltage gives the resistor value which is equal to the negative impedance.

Obviously, a zero output impedance cannot be measured by this approach. Therefore, a zero impedance is determined as the condition where the connection of any value of load produces no change in output voltage.

Since the damping factor of an amplifier is equal to the nominal load impedance divided by the output impedance, the damping factor can be changed by controlling the output impedance. Thus, varying the output impedance gives variable damping. The damping factor can be made unity by making the output impedance equal to the load impedance. It can be made infinite by making the output impedance zero. Likewise, it can be made negative by making the output impedance negative.

Until recently the damping factor of an amplifier was an incidental resultant of the design. Triodes without feedback had damping factors in the range of 2 to 4. Tetrode amplifiers had damping factors of 1 to 10 (depending on the amount of feedback used). More recent designs using triodes with feedback or "Ultra-Linear" stages with feedback have had damping factors ranging from 10 to 30. It was generally felt that higher damping factors were more effective than lower ones, but design was aimed more at obtaining low distortion and similar attributes than at achieving a specific degree of damping.

Now, however, the latest fad in amplifier design is to provide means of controlling the damping factor through control of the amplifier's output impedance. Variable damping is appearing on more and more commercial amplifiers, and the advertising claims for it herald it as a tremendous advance and an absolute necessity for the audio enthusiast. Amazingly, these claims are inconsistent since some recommend high damping factors, others lower ones; and even the negative damping factor is extolled. It is well worth while examining the reasons for variable damping, the means by which it is done, and its results. In this way, perhaps, the role of variable damping in amplifier design will be better understood.

Why Variable Damping?

Even though variable damping is a feature of *amplifier* design, its function has nothing to do with amplifier performance. Variable damping is introduced for the purpose of obtaining better *loudspeaker* performance. It is widely appreciated that the performance of a loudspeaker is influenced by the impedance of the source from which it is driven. Variable damping makes it possible to optimize the source for any given loudspeaker.

Unfortunately, it is difficult to determine what comprises the proper source impedance for a loudspeaker. There are three basic schools of thought on this subject, and their opinions are incompatible and contradictory.

School A claims that a speaker should be *critically damped*. Depending on the speaker system being used, this is generally attained when the speaker is almost matched to the amplifier and the damping factor is approximately 1 or 2. A range of variable damping from 1 to 10 would take care of almost all systems if critical damping were the only consideration.

School B claims that the speaker should be matched in impedance at frequency extremes. Most loudspeakers exhibit a substantial rise in impedance at low and high frequencies. If a constant voltage amplifier, one with a zero output impedance, were used, the power into the speaker would decrease (because it takes increased voltage to maintain constant power across an increased impedance). Conversely, a high impedance source, which would match the speaker impedance at high and low frequencies, would make for flatter power output. It is necessary to get output impedances as high as 10 times the nominal impedance (damping factor of .1) to follow the practices of this school.

School C believes in the need for an infinite damping factor, or at least as high a damping factor as possible, obtained by a source impedance which approaches zero. The reasoning behind this school of thought is that a zero impedance will short circuit the back e.m.f. due to spurious speaker motions and thus produce cone motions more closely following the amplifier output. This of course would provide less distortion and superior transient response

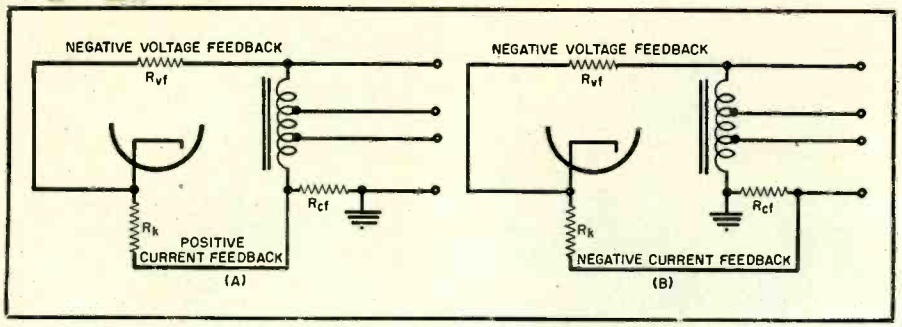


Fig. 1. The use of current feedback for damping factor control. Refer to article.

as well as making the output of the amplifier independent of impedance variations in the speaker.

A subgroup of "School C" believes in carrying the output impedance into the negative region to the point where the d.c. resistance of the speaker voice coil is cancelled out. In this way the total circuit impedance, including amplifier and speaker, is approximately zero; and the speaker cone is rigidly coupled to the amplifier. This represents the ultimate in damping, past which one cannot go.

How It Is Done

Variable damping is accomplished through the manipulation of feedback around the output stage. Normally, a high grade power amplifier has negative voltage feedback which lowers its output impedance. It is also possible to increase the output impedance by using positive voltage feedback, but this is basically an unstable mode of operation. It is practical, however, to use current feedback; and the effect of current feedback on output impedance is inverse to that of voltage feedback—positive current feedback decreases output impedance, while negative current feedback increases it. It is useful, therefore, to combine voltage and current feedback to obtain a wide range of impedance control.

Fig. 1 illustrates how voltage and current feedback can be combined to obtain any desired output impedance and damping factor. In Fig. 1A negative voltage feedback is combined with positive current feedback to lower the output impedance and to increase the damping factor. In Fig. 1B the combination of negative voltage and negative current feedback increases the output impedance and reduces the damping factor.

In each case, R_k is the cathode resistor of the stage to which feedback is taken. R_{vf} and R_k form a voltage divider which controls the proportion of negative voltage feedback. R_{cf} is a resistor in series with the load. The current through the load and through R_{cf} produces a voltage across R_{cf} which is fed back to furnish *current proportional* feedback. R_{cf} must be made small or too much of the load power will be dissipated in it. Because it is small, it must be introduced in series with R_k or else its shunting effect would change operating conditions of the stage biased by R_k.

The larger R_{cf} is, the more current feedback there is. Also, changes in the load will produce current changes in R_{cf} and change in the current feedback. Therefore, such changes as shifting to a speaker of different output impedance brings about a change in output impedance and a corresponding change in damping factor, because of the change in the ratio of voltage and current feedback.

For those who are interested in experimenting with variable damping, it can readily be added to an "Ultra-Linear" Williamson-type circuit by using a .5 ohm rheostat for R_{cf}. This can consist of a 1-ohm resistor and a 1-ohm rheostat or potentiometer in parallel. If a wirewound control without a parallel resistor is used, poor contact at some points of rotation of the slider arm would make the effective resistance increase and cause big changes in current feedback. This effect is minimized by having a fixed resistor in parallel.

The circuit gives an approximate range of control of output impedances (on the 16-ohm nominal output) from -12 ohms to $+1$ ohm if the current feedback is positive and $+1$ ohm to $+15$ ohms if the current feedback is negative. The total possible damping factor variation is from about -1.3 to $+1$ and including infinity in this range. If a loudspeaker load is connected to the amplifier, its impedance variations might cause even more current feedback, thus extending the range of control. Unfortunately, large proportions of current feedback may cause instability and oscillations. The experimenter is warned that a wide-band a.c. v.t.v.m. or scope should be kept connected across the amplifier output when adjusting the damping in order to avoid instability which could damage the speaker system should too much current feedback be used. In particular, the use of *positive* current feedback can easily lead to instability irrespective of the amount of voltage feedback. Negative current feedback adds to the total negative feedback; and if instability is a problem, a reduction of the negative *voltage* feedback can be made (by doubling the value of R_{vf}, for example) to keep the total feedback within the range of satisfactory stability. Many circuits use ganged controls to vary both R_{cf} and R_{vf} simultaneously so as not to change the total amount of negative feedback. For the purpose of this article it was felt that such variants are of minor pertinence; and, therefore, they are not discussed. Of far greater importance are the end results of using current feedback to vary the damping of the amplifier.

Effects of Variable Damping

The use of current feedback for damping factor control influences the performance of both amplifier and loudspeaker. The effect on amplifier performance is generally ignored in presentation of information on variable damping because the effects on speaker performance are more obvious. However, some mention of what happens to amplifier performance is justified since we are interested in the over-all amplifier-speaker combination rather than one alone.

1. *Amplifier performance:* Irrespective of whether feedback is of the voltage or current proportional type, it influences the amplifier distortion. Therefore, the addition of positive current feedback to an amplifier will increase its distortion; while adding negative current feedback will reduce the amplifier distortion.

As mentioned, the use of positive current feedback will lead to instability if the output impedance is made too negative. Instability can also arise when too much negative current feedback is added to the amplifier. These problems appear superficially unimportant because the amplifier can always be checked for stability before it is put into service. Unfortunately, however, there is no certainty that laboratory stability will mean stability under home listening conditions.

The reason for this is that the current feedback varies when the load impedance is changed. Connection of a loudspeaker will give a different proportion of current feedback than will be obtained with a resistor. Connection of a multiple speaker system with crossover network will cause drastic changes in feedback at the crossover frequency where impedance changes always occur.

Even if variations in load impedance do not cause instability, they cause changes in frequency response. Obviously, when the feedback changes, the gain changes; and if this is a different effect at different frequencies (as happens on complex loads), then there is frequency discrimination.

2. *Loudspeaker performance:* When current through the load is fed back through the amplifier, any non-linearities in load current are applied again to the load as part of the driving signal. Thus if a speaker has non-linear voice coil excursion, a non-linear driving signal will be applied to the speaker when current feedback is being used. This signal may either correct for the original non-linearity or it may add to it, depending on phase relationships. It has been claimed that positive current feedback provides a phase relationship which reduces loudspeaker distortion by this type of cancellation of some of the distortion components. However, as shown in Table 1, there

is no clear-cut reduction in distortion as the damping is increased, nor is there much difference in distortion when the damping is decreased with current feedback. Apparently, the effect of variable damping on distortion is dependent on the type of speaker used, its baffling, and similar variables which make it difficult to generalize.

One experiment which can be readily attempted with limited equipment indicates that under some conditions positive current feedback *increases* speaker distortion while negative current feedback *decreases* it. When a signal is fed into the loudspeaker, smother its output by putting a heavy cardboard across the orifice of the baffle. This places an air load on the cone which changes the linearity of the voice coil motion. A corrective signal should be in such phase that the amplifier delivers more output and pushes the speaker harder to overcome the smothering. Either more positive feedback or less negative feedback would furnish the correct compensating signal.

At most frequencies where this experiment is tried, the speaker impedance increases, the current through R_{cf} is decreased, and the current feedback is decreased. Positive current feedback causes a reduction in gain and does not correct for the smothering effect; while negative current feedback causes the speaker to be driven harder, thus correcting the effect. At the bass resonance frequency, however, the speaker impedance is decreased by the extra air load; and the correction effect is reversed. Therefore, this particular type of speaker non-linearity is affected differently by different types of current feedback depending on the frequencies at which testing is done. It is probably possible to pick frequencies and test conditions which can tip the scales in any direction desired by the experimenter.

Although the effects of different damping factors on speaker distortion are not conclusive, the effects on frequency response are quite certain. The response of the speaker-amplifier combination increases with increases in impedance when the damping factor is low (and source impedance is high), and decreases with increases in impedance when the damping factor is high (and source impedance low). The response follows the impedance curve with low damping and is inverse to the impedance curve with high damping. Which is the more desirable response curve?

Evidently, if speakers are designed to operate with a low-impedance source, this is the best condition to use. If the speaker manufacturer sets his response specifications by observing a fixed voltage across the voice coil at various frequencies, the amplifier with zero source impedance (infinite damping factor) would duplicate the manufacturer's test conditions. In this case a higher source impedance would cause response peaks at impedance peaks, such as the bass resonant

Frequency	Amplifier Impedance —5 ohms D.F. = —3.2	Amplifier Impedance 0 ohms D.F. = ∝	Amplifier Impedance 50 ohms D.F. = .32
50 cps	15 %	20 %	18 %
100 cps	8.2%	5.2%	4.8%
500 cps	.8%	2.3%	3.0%
5000 cps	2.0%	1.8%	1.9%

Table 1. Loudspeaker harmonic distortion for various damping factors. Measurements made at absolute sound pressure at 500 cps of 94 db. Sound pressures at other frequencies are obtainable by reference to the response curves shown in Fig. 2 below.

frequency; while a negative source impedance would cause a loss in response at impedance peaks. The correct response curve for a speaker will be obtained only if the speaker is operated as intended by its manufacturer.

Fig. 2 shows the response curve of a 12-inch loudspeaker in the medium price category (near $30.00). These curves, taken with various damping factors, show that the frequency response is intimately related to the source impedance. With high damping factors (low source impedance), there is a definite loss of bass and treble response. Experiments were also carried out with better quality speakers, and it appears that the effects of different damping factors are diminished with better grades of loudspeakers.

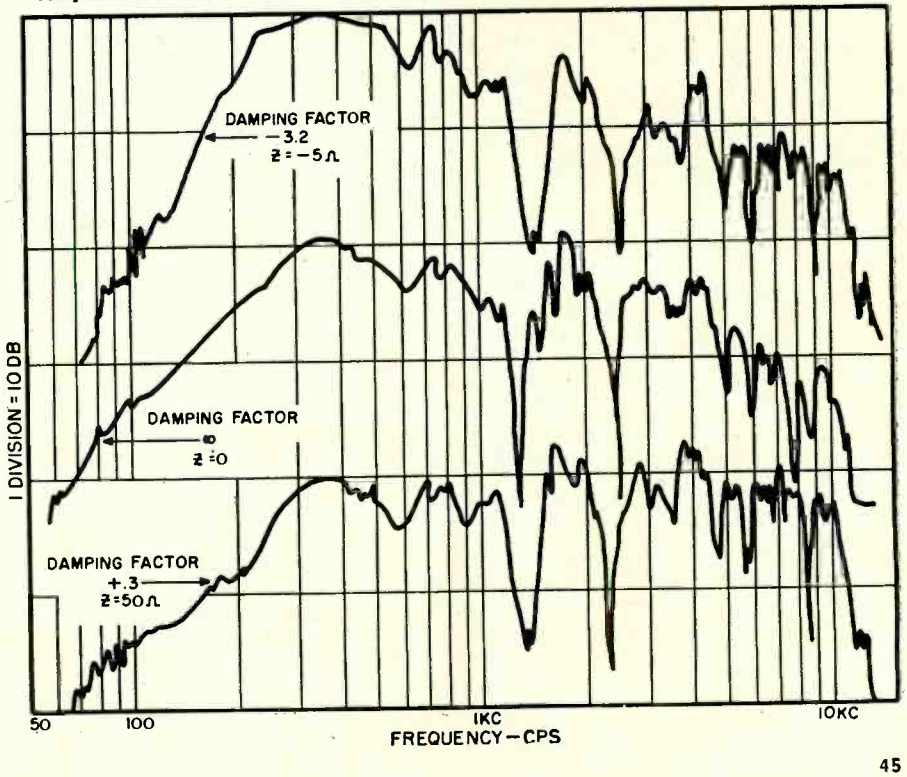
The higher the quality of the loudspeaker system (including baffle), the smoother and less variable is the impedance characteristic of the system. With less impedance variation in the speaker system, there will be less changes in frequency response as the damping is changed.

The same situation holds for speaker damping. Better grades of speakers with more efficient and larger magnet structures will generally be critically damped with a damping factor in the range of 1 to 4. Low cost, inefficient speakers may have so much d.c. resistance that a negative source impedance is necessary to bring the total circuit impedance in the range where the back e.m.f. generated by the voice coil is effectively short circuited. Therefore, except with the poorest types of systems, moderately low source impedances will supply sufficient damping to nullify overshoot and boom which are spuriously generated by underdamped systems. Damping factor control over the range of 1 to 10 would cover the possibility of obtaining critical damping of most better grade speaker systems. Increases in damping factor past the condition of critical damping will have practically no effect on the damping of the system. The impedance contributed by the amplifier after passing a damping factor of 10 is so small compared to that contributed by the speaker that damping is unaffected by further reduction of amplifier source impedance.

Thus, after eliminating poor grade speakers, it appears that any damping factor of 10 or more will serve to provide satisfactory speaker damping. However, speaker response will depend on the damping factor used. The best

(*Continued on page* 66)

Fig. 2. Frequency response with variation in damping factor. For a more accurate comparison of these responses, these three curves should be superimposed by user.



The new RCA 21-inch round color TV picture tube is shown here in comparison with the old 15-inch tube. The receiver with the larger tube actually uses fewer receiving tubes than the set with the 15-inch tube.

COLOR TV BROUGHT UP TO DATE

By **HARRY E. THOMAS**

The cost of color sets is coming down, due in part to the great strides in tube reduction described here.

THE rapid progress in color TV receiver circuitry within the last year is particularly evident in the tube economies seen in the latest models. For example, the reduction in tube count in *RCA's* latest receiver, described in the March issue of RADIO & TELEVISION NEWS, is accompanied by improved performance, although this set uses only 28 tube envelopes instead of the 39 tubes used in their original 15-inch set. Other manufacturers have likewise reduced their over-all tube count. Also, in attaining general improvement in color reproduction, all models now use stabilized color phase circuits and employ improved picture-tube circuits. Tuning and color controls have also reached high degrees of flexibility equalling the convenience standards existing in present monochrome receivers.

Color picture tubes themselves have likewise shown remarkable improvements, among which are large size color screens of up to 250 square inches using a light, round, metal tube blank; an adjustable magnetic field equalizer affecting the whole picture-tube screen irrespective of extraneous magnetic fields; a shorter, more efficient electron gun; and temperature-compensated components within the picture tube itself.

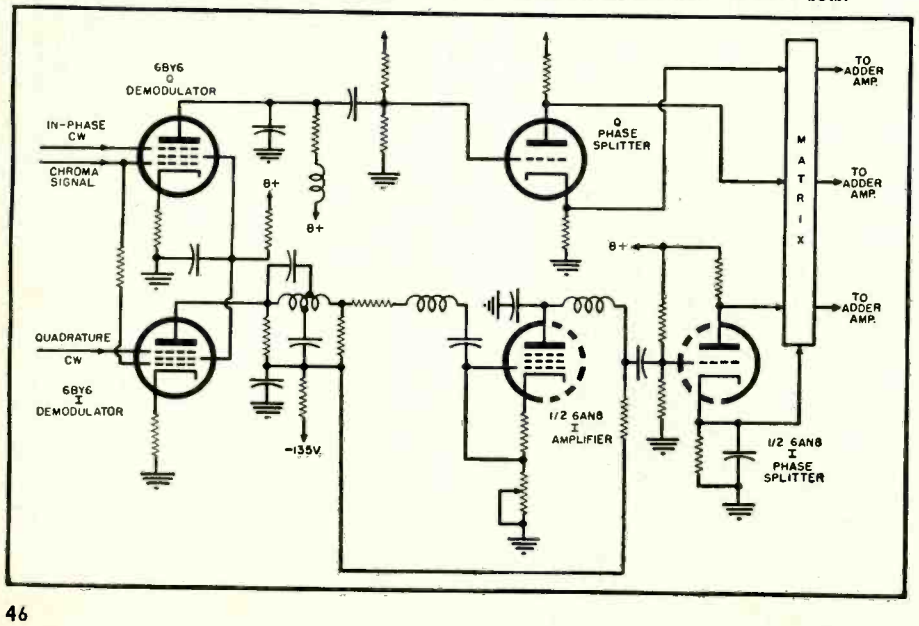
In summarizing, the most important contribution to receiver circuitry is the development of high level demodulation. Two triode demodulators (in one envelope) plus a suitable transformer and coupling networks handle large enough signals to directly drive the grids of the picture tube. This results in savings over old-style circuitry of one demodulator tube, three adder tubes, three amplifiers, three restorer diodes, a phase splitter, and a phase inverter. Even when using double section tubes in old circuits, this results in a saving of six tube envelopes. This type of demodulation provides improved linearity, better maintenance of stability, and assures color processing which is independent of tube characteristics.

Further comparison of low level and high level demodulation systems is particularly interesting in that two types of low level systems have been used—one involving pentodes and one using double diodes. Figs. 1 and 2 show two early pentode circuits where the chrominance signal in both cases is applied to the demodulator control grid while the in-phase and quadrature c.w. gating signals are applied to the respective suppressors. Note in Fig. 2 that the demodulator is a 6AS6 tube whose suppressor characteristic is specifically tailored for gating applications.

Fig. 3 shows double diodes employed as gating tubes in the demodulator circuits of a difference color TV receiver. These circuits also require additional amplification between the demodulators and the picture-tube grids. The circuits of Figs. 2 and 3 combine matrixing steps within the demodulator and amplifier circuits, thus eliminating adder, phase splitting, and inverter tubes which are necessary in the *I* and *Q* signal system of Fig. 1. Fig. 4 is a schematic of the high level triode demodulators used in the new *RCA* receiver.

Another improvement and saving involves the convergence system. With suitable magnetic coupling directly from the horizontal and vertical output amplifier circuits, it is possible to elim-

Fig. 1. A pentode low level demodulator circuit of the type used in early color receivers. Note the matrix section and the adder tubes, not used in later sets.



inate one amplifier tube. This system is a low level one, quite different from the original circuitry used with the 15-inch color tube in the "CT100" receiver, where convergence voltages were applied to focus electrodes at the picture tube.

By using selenium rectifiers, as is becoming common practice in heavy duty power supplies, a net reduction of four tubes is attained over the total receiver tube count of the older models.

Other circuit improvements resulting in tube savings are: (1) the elimination of a quadrature amplifier by suitable phasing obtained in the coupling networks linking the subcarrier oscillator and the demodulator (see Fig. 4); (2) the inclusion of the chroma bandpass filter as an amplifier coupling network leading to the demodulator circuits; (3) the elimination of a focus rectifier tube and associated components due to improvements in the electron gun of the picture tube; (4) the reduction of two tubes in the sound amplifier system by economies in multiple section tube envelopes; (5) the use of a simple diode as a burst gate instead of employing a burst amplifier stage; and (6) the reduction of tubes in miscellaneous circuits throughout the receiver such as vertical deflection (½ tube), color sync and a.f.c. (½ tube), picture i.f. (1 tube), and luminance channel (1 tube).

Table 1 offers an interesting comparison of these economies by giving a breakdown of the tube complements of the original 15-inch color-tube receiver circuitry as presented by *RCA* in the "CT100," which was a production version of the original 15-inch receiver designed by them in 1953; the present *RCA* 21-inch color-tube circuitry; the *CBS-Columbia* model 205; the *Motorola* model TS-902; and an interim design by *G-E*.

Picture Tube Developments

It is interesting to note that the picture tube developments paralleling the circuit advances were covered in two steps—the first embodied in the development of 19-inch picture tubes, and the second in the additional advances incorporated in the 21-inch model.

Following the first 15-inch picture tube which had obvious drawbacks, both *RCA* and *CBS* started on a development program for a 19-inch tube. Three advances that resulted from this work were the process of photographically depositing color phosphors directly on the picture-tube face plates, the use of a curved shadow mask which serves also as a template in the photographic process, and the inclusion of internal pole pieces for exact convergence of the individual beams plus auxiliary pole pieces for additional correction of the position of the blue beam. Also, the 19-inch tube uses low level dynamic convergence with electromagnetic correction coils placed directly above the color guns and on the neck of the tube.

The 21-inch tube is the latest one developed by *RCA*, which has discontinued production of the 19-inch model. This tube uses a color equalizer consisting of a sectionalized magnetic field produced by adjustable permanent magnets positioned around the front rim of the tube. The individual magnet adjustments give selective control of fields over the face of the tube and compensate for unwanted fields when setting up for color purity.

An improved shorter electron gun is used in the 21-inch tube, requiring two-thirds the focussing voltage used in the longer 19-inch tube. The mask has an indexing system affording self-alignment and exactly correct mask-to-phosphor screen spacing. This refinement in design does not require undue precision in manufacture. The mask itself is thermally self-compensated and maintains indexing at all operating temperatures. Loss of register between apertures and phosphor dots is thus eliminated.

The relatively high voltage and power requirements of color picture tubes led to the development of several special tubes which appear in the output systems of current color TV receivers. Among these is the 6CB5 horizontal sweep output tube which delivers nearly 1 milliampere at 27,000 volts as required for the three color tube electron guns. This tube is in effect a heavy duty 6CD6G.

Increased picture-tube voltages and beam currents led to the development of two high-voltage rectifiers: the 3A3 in an octal base, and the 3A2 in a miniature base. Precise regulation of the picture tube's ultor (highest electrode) potential is obtained by the use of several new tube types: the 6BD4, 6BK4, and 6BU5 are grid-controlled, shunt-regulator tubes whose cap connection

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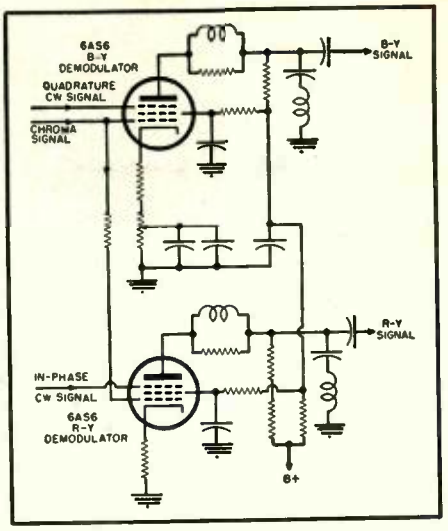


Fig. 2. The circuit shown here is a pentode low level demodulator whose output is a set of B-Y and R-Y difference signals.

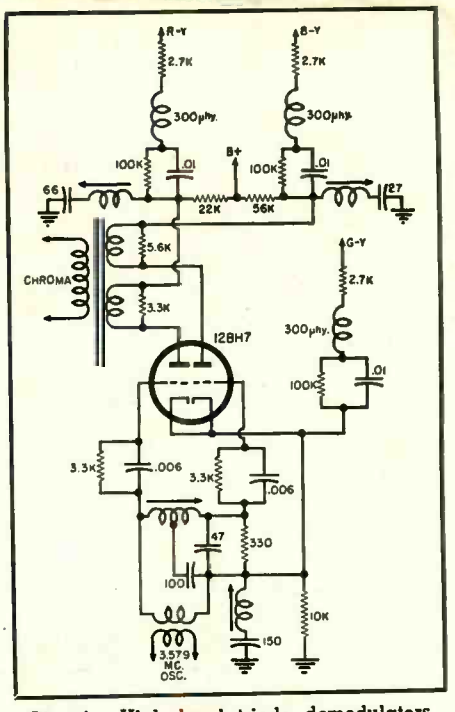


Fig. 4. High level triode demodulators used in the new RCA 21-inch tube set.

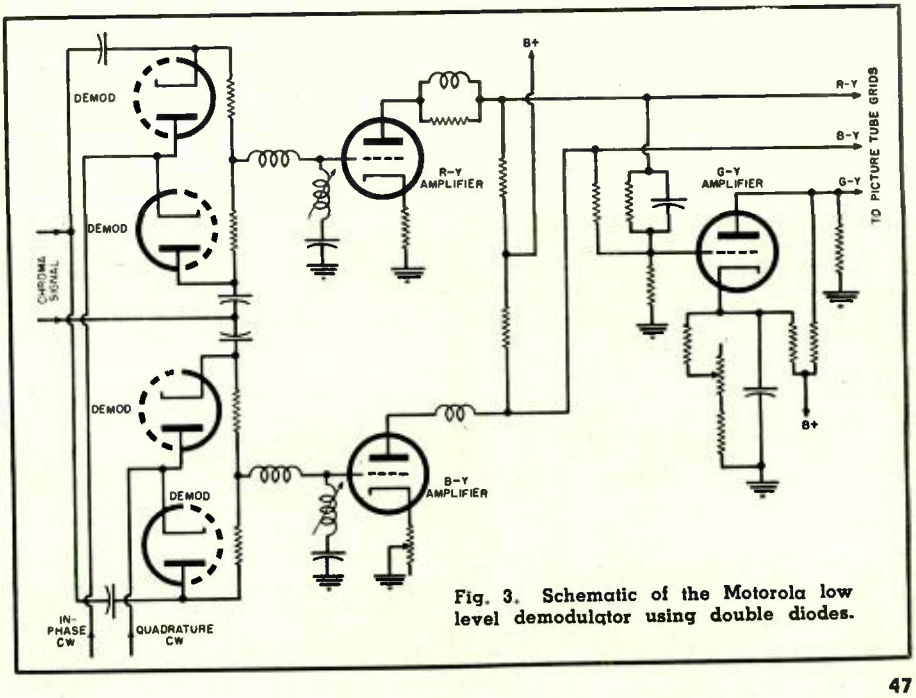


Fig. 3. Schematic of the Motorola low level demodulator using double diodes.

Over-all view of the compressor and its associated power supply (right). Device is very compact

HAM PHONE COMPRESSOR

By **ALLAN M. FERRES,** ex-W2CST

Add this effective unit to your present ham transmitter and obtain up to 20 db of compression at low distortion.

VOLUME compressors increase the effective range of voice transmitters. Almost all commercial radio equipment and many amateur radio stations include them to good advantage. As a compressor can keep the average percentage of modulation high, the carrier power of the transmitter is used more efficiently, resulting in a louder signal at the distant receiver. They are especially valuable when used with a "phone patch," where a wide range of voice levels is encountered.

A recent project involved building a compressor which could be added to a factory-built amateur transmitter. Although many excellent compressors have been described in technical publications over the past few years, none of them fully met the requirements. The unit described here has proven to be very satisfactory and has these advantages:

1. Up to 20 db of compression can be obtained with less than 3% distortion.
2. No audio transformers are required.
3. The plate current requirements are small and constant, so that a simple power supply can be used.
4. Short attack time has been combined with thump elimination.
5. It can be added to any transmitter using a high-impedance microphone without disturbing the wiring of the transmitter itself.

A compressor is an audio amplifier with an automatic gain control, the gain being reduced as the signal into it increases. Although there are many ways of accomplishing an automatic control of gain, the method similar to that used in radio- and intermediate-frequency amplifiers is perhaps the most satisfactory. In this system, the output of the amplifier is rectified and the resulting d.c., which varies with the amplitude of the signal, is used to increase the negative bias on the amplifier, thus reducing the gain. Fig. 3 is a graph showing the relationship of the input to the output voltages of a normal amplifier and this unit with a compression characteristic. Curve "A" represents a normal amplifier, that is, the gain is a constant, and the output voltage increases linearly with the input voltage. Curve "B" shows the result of automatic gain control. The gain is constant up to point "C," called the "breakaway" point, and then as the input signal increases, the gain becomes less, so that the output voltage, follows curve "B." As the input is increased from —44 db to —5 db, the output increases from —38 to —19 db; a 39 db input change is reduced to a 19 db change, that is, a 20 db compression. Because the amplitude of the output voltage does not vary as widely as the input voltage, the average level of modulation can be made higher with less danger of over-modulation.

This unit is designed so that the gain characteristic goes into limiting if the input is accidentally increased above —5 db, preventing the output from exceeding —18 db irrespective of the input voltage.

A major problem in the design of automatic gain control amplifiers is to prevent the d.c. control voltage from appearing at the output of the amplifier as a disturbing thump. The usual method of thump elimination is the use of a push-pull controlled stage, the

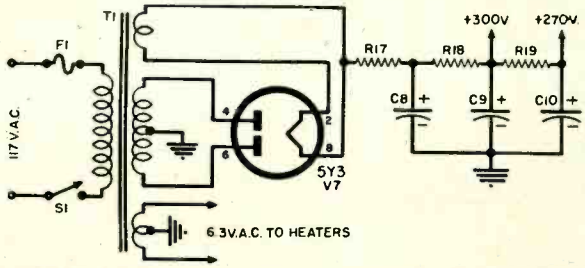


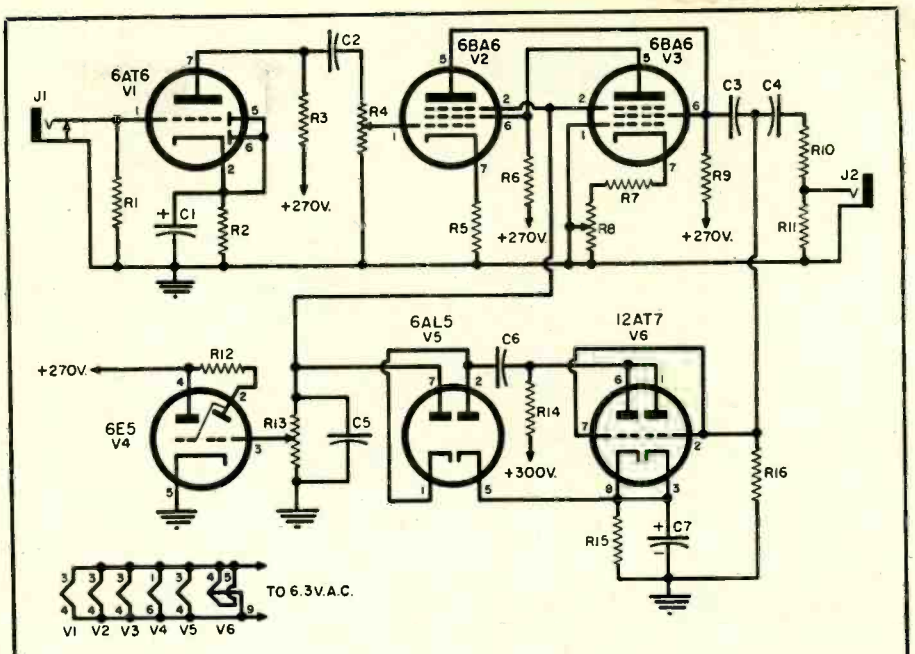
Fig. 1. Schematic diagram of power supply unit. As shown in the photo above, right, it is constructed on a separate chassis base.

R_{17}—220 ohm, 1 w. res.
R_{18}—5000 ohm, 5 w. wirewound res.
R_{19}—2500 ohm, 5 w. wirewound res.
C_8, C_9, C_{10}—30 µfd., 450 v. elec. capacitor
F_1—1 amp fuse
T_1—Power trans. 325-0-325 @ 40 ma.; 5 v. @ 2 amps; 6.3 v. @ 2 amps. (Stancor PC8406 or equiv.)
S_1—S.p.s.t. switch
V_7—5Y3GT tube

control voltage being balanced out in the output transformer. In order to save the cost of a transformer, a modification of the circuit suggested by Mr. A. Nelson Butz ("Surgeless Volume Expander," *Electronics*, September, 1946) was used. The gain-reducing d.c. control voltage is applied to the suppressor grid of a pentode tube. When the suppressor grid of a pentode is made more negative, the plate voltage rises and the screen voltage decreases. This rise in plate voltage would appear in the output of the amplifier as a thump. In this circuit, the control voltage is also fed to the suppressor grid of a dummy tube. Its plate is connected to the screen grid of the amplifier tube, and its screen is connected to the amplifier plate. By proper choice of plate, screen, and cathode resistors, the plate and screen voltage changes can be made to cancel each other and the effect of the control voltage on the output signal is eliminated.

The wiring diagram of the compressor is shown in Fig. 2 with the power supply diagrammed in Fig. 1. V_1 is a 6AT6 preamplifier stage for use with a crystal microphone. V_2, a 6BA6, is the gain-controlled amplifier, and V_3, also a 6BA6, is the dummy tube described previously. R_8 in the cathode circuit of V_3 is a balance control to adjust for any difference in characteristics of the two 6BA6's. The output of the gain-controlled tube is fed to the output jack, J_2, through C_3, C_4, and the voltage divider R_{10} and R_{11}. This voltage divider is necessary to reduce the output of the compressor unit to a level comparable to a crystal microphone in order to prevent overloading the high gain input stage of the transmitter.

V_6, a 12AT7 with the two triode sections connected in parallel, is used as a side amplifier feeding V_5, a 6AL5 connected in a voltage-doubler circuit. The cathode on pin 5 of the 6AL5 is connected to the cathode of the 12AT7 to provide a positive 2.2 volt delay bias. This bias and the gain of the 12AT7 stage sets the "breakaway" point "C" of Fig. 3. The d.c. output of the rectifier is filtered by R_{13} and C_5. R_{13}, a one-megohm pot, is also used to adjust the operating point of the electron-ray tube, V_4.



R_1—1 megohm, ½ w. res.
R_2—3900 ohm, ½ w. res.
R_3—270,000 ohm, ½ w. res.
R_4—500,000 ohm audio taper pot
R_5—1100 ohm, ½ w. res.
R_6, R_9—47,000 ohm, 2 w. res. (matched, see text)
R_7, R_{15}—820 ohm, ½ w. res.
R_8—500 ohm wirewound pot
R_{10}—390,000 ohm, ½ w. res.
R_{11}—100,000 ohm, ½ w. res.
R_{13}—1 megohm, ½ w. res. (included in "Magic Eye" assembly)
R_{14}—1 megohm audio taper pot
R_{15}—47,000 ohm, 2 w. res.
R_{16}—470,000 ohm, ½ w. res.
C_1, C_7—25 μfd., 25 v. elec. capacitor
C_2, C_4—.001 μfd., 600 v. capacitor
C_3—.01 μfd., 600 v. capacitor
C_5—.25 μfd., 200 v. capacitor (see text)
C_6—.05 μfd., 600 v. capacitor
J_1—Closed-circuit phone jack
J_2—Open-circuit phone jack
1—Magic Eye assembly for 6E5 (Amphenol #58-MEA6)
V_1—6AT6 tube
V_2, V_3—6BA6 tube
V_4—6E5 tube
V_5—6AL5 tube
V_6—12AT7 tube

Fig. 2. Complete schematic of ham phone compressor for use with any transmitter.

The power supply consists of a 40-ma./650-volt power transformer, a 5Y3GT rectifier, and the *RC* filter made up of R_{17}, R_{18}, R_{19}, and C_8, C_9, and C_{10}. As the plate current requirements are only 3 milliamps at 300 volts and 12 milliamps at 270 volts, and as the plate currents do not vary during operation,

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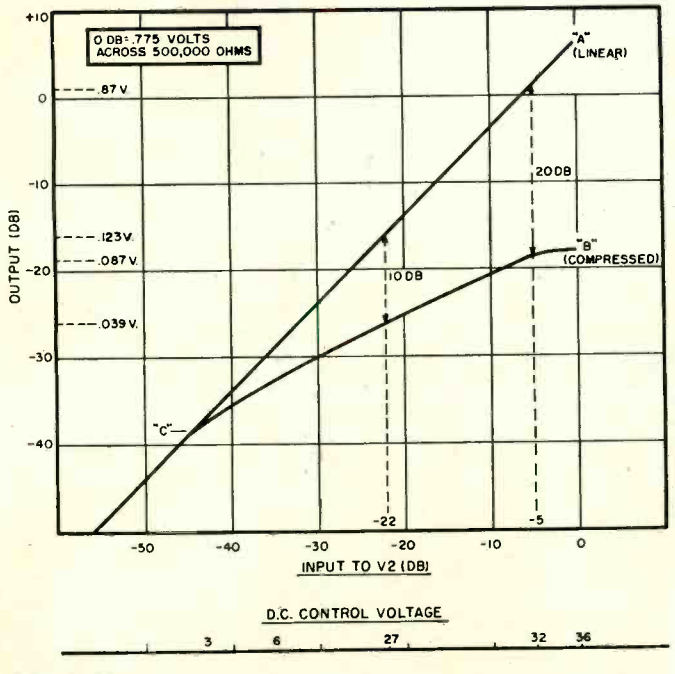
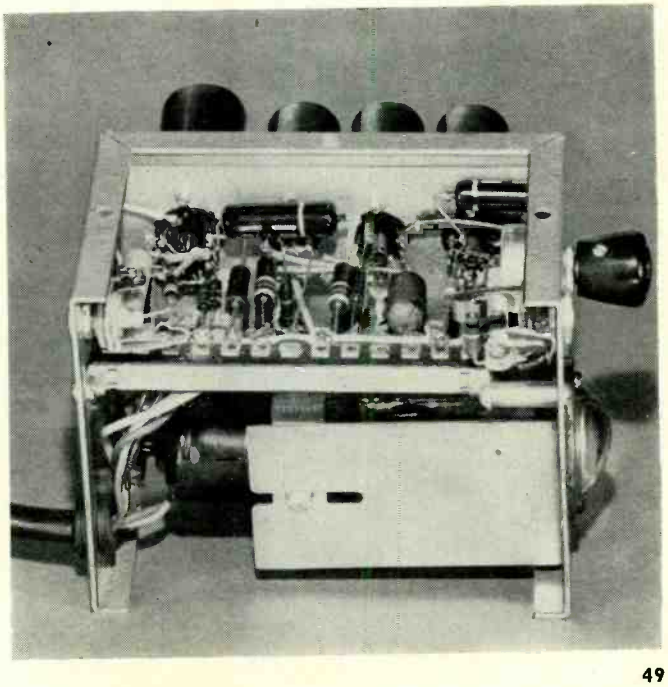
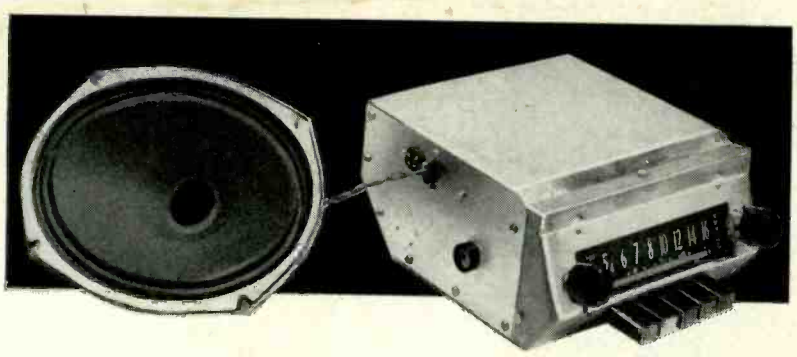
Fig. 3. Gain characteristics of compressor. Refer to article.



Under chassis view of the compressor showing parts layout.





Over-all view of RCA's experimental transistor auto radio. It can be used with either 6 or 12 volt auto battery systems. Nine transistors are incorporated.

ALL-TRANSISTOR AUTOMOBILE RECEIVER

"Dead-battery blues" may be a thing of the past with the development of a transistor auto radio.

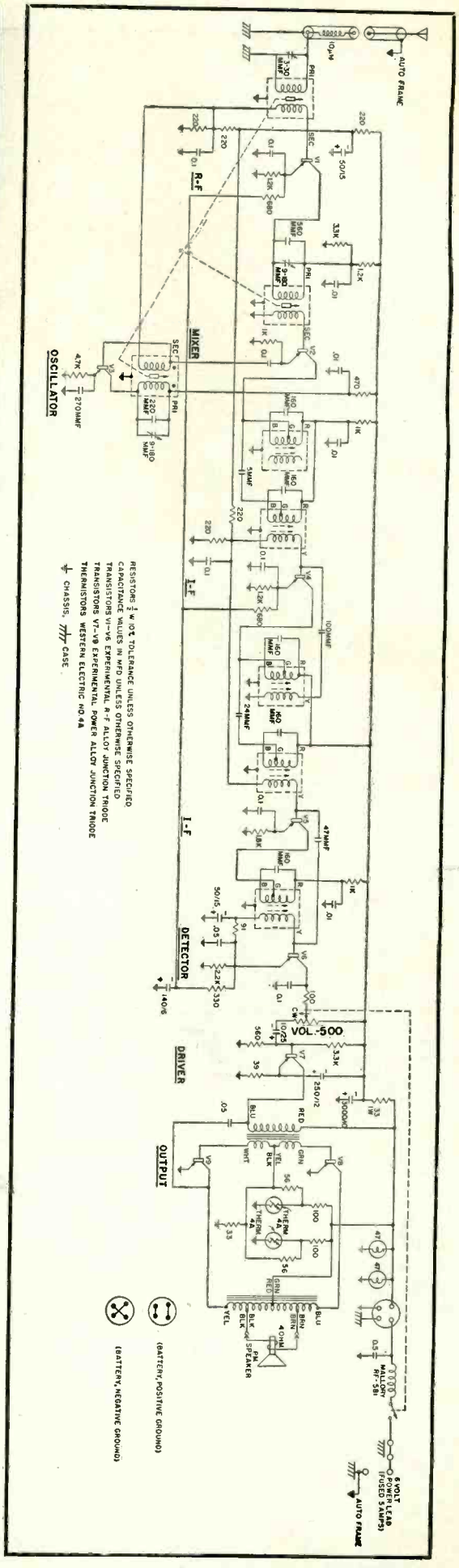
A TRANSISTORIZED automobile radio that operates directly from a 6-volt car battery and requires only about one-tenth the power used by a conventional car radio has been introduced on an experimental basis by scientists from the David Sarnoff Research Center of *Radio Corporation of America* in Princeton, New Jersey.

The new radio, employing nine transistors in place of tubes, is said to be equal in performance to standard car radios. Emphasizing its low power consumption, the scientists pointed out that more than half of the current required by the radio was used to light the dial pilot bulbs.

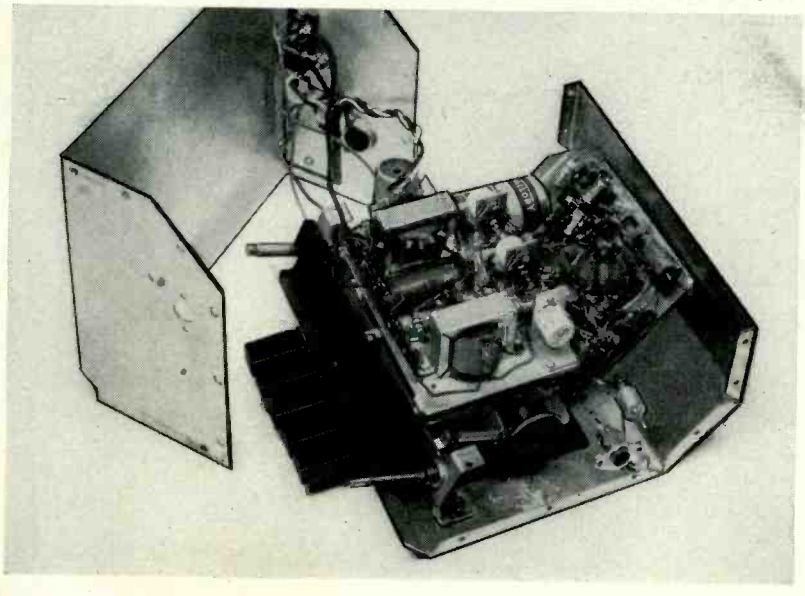
The radio has been tested with a 6-volt battery as its power source. It is also adaptable to installation in automobiles with 12-volt batteries. With a 12-volt supply, the power output of the radio would be more than doubled since it is not limited by the capabilities of the transistors used in the circuit.

While the new receiver resembles present car radios in external appearance, it requires no vibrator, power transformer, or rectifier. It is also also said to perform satisfactorily at temperatures as low as —40 degrees F and as high as 176 degrees F. —30—

Schematic diagram of RCA's experimental transistorized automobile receiver. ➡



Internal view. The problem of parts heating is eliminated by use of transistors.



TRANSISTOR DIP OSCILLATOR

By RUFUS P. TURNER, K6AI

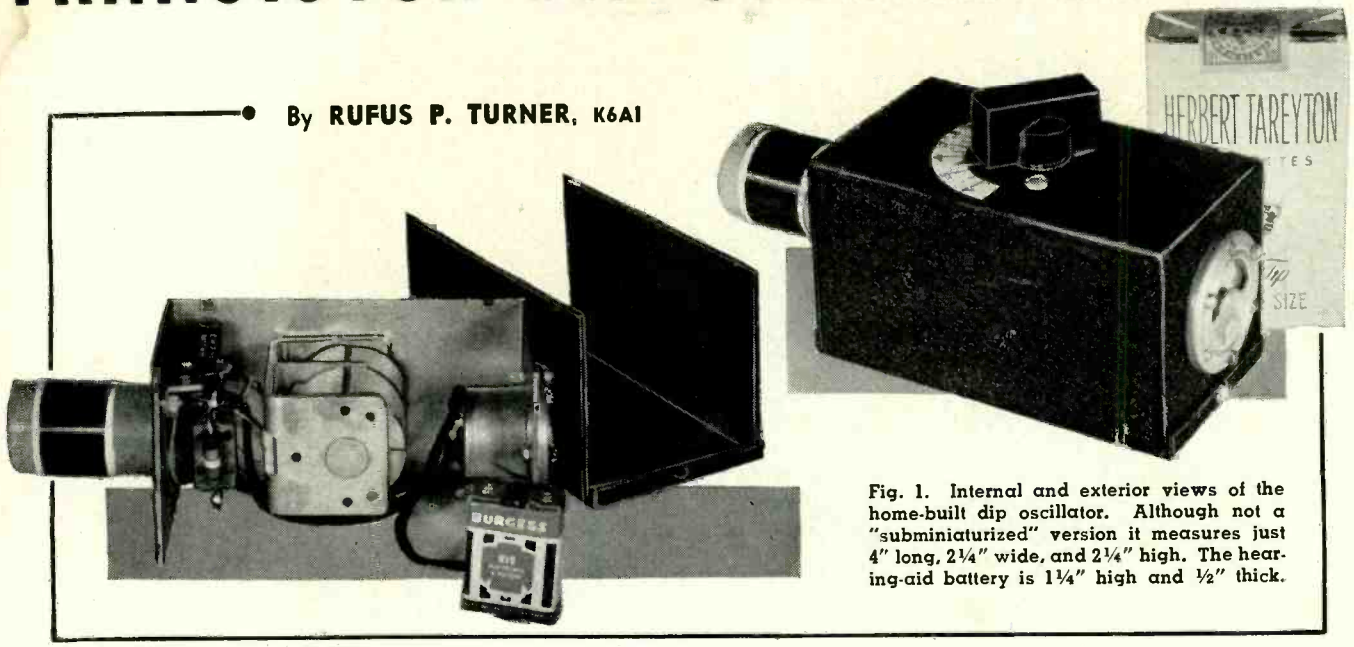


Fig. 1. Internal and exterior views of the home-built dip oscillator. Although not a "subminiaturized" version it measures just 4" long, 2¼" wide, and 2¼" high. The hearing-aid battery is 1¼" high and ½" thick.

Details on a compact unit that covers from 350-1700 kc. with plug-in coil. It can also be used as an oscillator.

THE vigorous oscillating ability of the CK722 junction transistor immediately suggests its use in several low-voltage instruments and test gadgets. Among the possibilities is a transistorized version of the well-known grid-dip oscillator.

In this case, the term *grid*-dip hardly would be appropriate, inasmuch as there is no grid. A more exact term would be *collector-dip*, since it is the collector current in this transistor oscillator that dips as the circuit is tuned.

Advantages afforded by the transistor in the dip circuit are extremely small size and lightness of weight, low current drain, simplicity, and complete isolation from the power line. Particular advantages afforded by the junction-type transistor are high efficiency, low-voltage requirements, and single miniature battery operation.

The single disadvantage is the restricted frequency range of the junction transistor. This author has been unable to obtain suitable oscillation at frequencies higher than 1700 kc., using the CK722. Such r.f. transistors as the CK760 and CK761 are intended for higher frequencies but the price is somewhat higher. The instrument described in this article is nonetheless interesting, however, being entirely practical and dependable at broadcast and i. f. frequencies as well as at low frequencies. Further refinements in transistor construction, as exemplified by the new *Raytheon* CK760, now permit higher-frequency operation, and the same type of dip oscillator is useful at the additional frequencies now covered by conventional grid-dip meters and at reduced voltages.

Constructional details of the transistor dip oscillator are shown in photos of Fig. 1. The circuit diagram is given in Fig. 2.

The entire instrument is self-contained in a small metal radio utility box 4 in. long, 2¼ in. wide, and 2¼ in. high. A 4-contact tube socket in the front end of the box receives plug-in coils. A 1-inch-diameter, 0-1 d. c. milliammeter is mounted in the rear end.

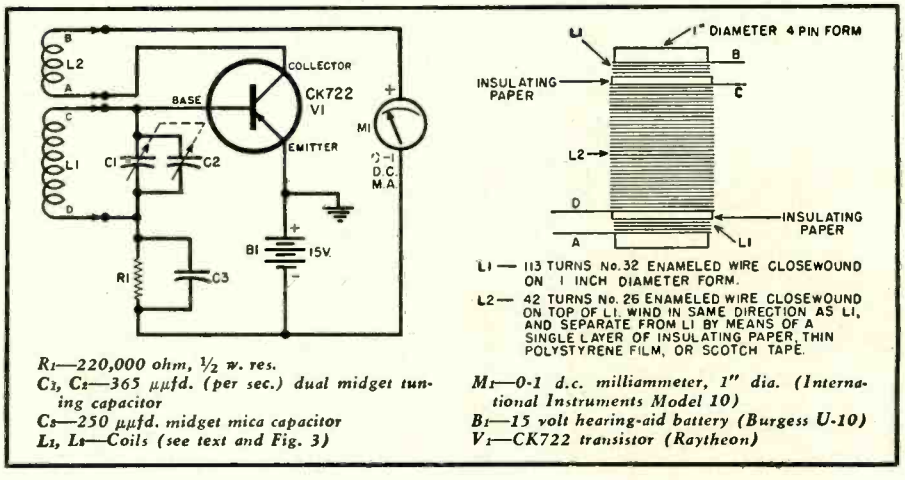
In the complete circuit diagram of Fig. 2 a "tickler coil" feedback circuit is employed with the transistor connected in a grounded-emitter arrangement. Tuning is accomplished with a midget 365-$\mu\mu$fd. dual capacitor with its two stator sections connected in parallel. The surplus tuning capacitor used in the author's instrument has unequal sections, but its total capacitance is approximately equal to the 730 $\mu\mu$fd. obtainable with the more conventional unit specified.

The d. c. power is supplied by a small 15-volt hearing aid battery (*Burgess* U-10), visible in the photograph. This battery is 1¼ in. high, 15/16 in. wide, and ½ in. thick. The total current drain (out of dip) is 0.4 ma. At dip, the current drops to 0.3 ma. on close coupling to the external circuit under test, and to a somewhat higher value on loose coupling. In order to save space, no battery switch has been provided. Instead, removing the coil from its socket automatically disconnects the battery through tickler coil L_2.

Only one coil combination (L_1-L_2) has been provided for the instrument shown. With the specified tuning capacitor, it covers the range 350 to 1700 kc. Both L_1 and L_2 are wound on the same 1-inch-diameter, 4-pin coil form (*National* XR-1). L_1 first is wound on the form and consists of 113 turns of

(*Continued on page* 85)

Fig. 2. Complete schematic and coil winding data chart for the dip oscillator.



R_1—220,000 ohm, ½ w. res.
C_1, C_2—365 $\mu\mu$fd. (per sec.) dual midget tuning capacitor
C_3—250 $\mu\mu$fd. midget mica capacitor
L_1, L_2—Coils (see text and Fig. 3)
M_1—0-1 d.c. milliammeter, 1" dia. (International Instruments Model 10)
B_1—15 volt hearing-aid battery (Burgess U-10)
V_1—CK722 transistor (Raytheon)

FLYBACK TRANSFORMERS

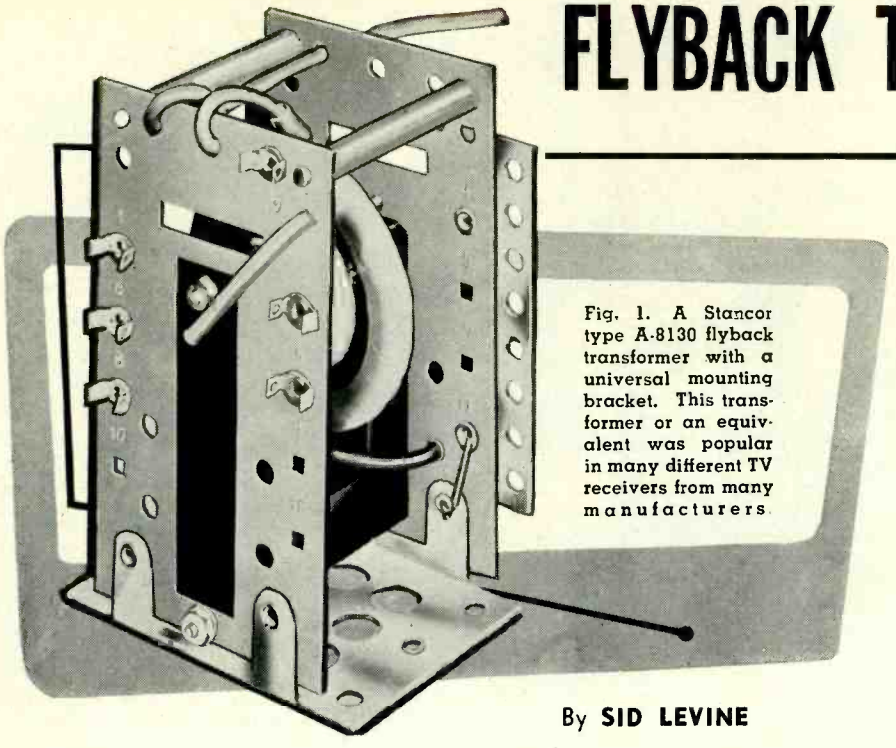


Fig. 1. A Stancor type A-8130 flyback transformer with a universal mounting bracket. This transformer or an equivalent was popular in many different TV receivers from many manufacturers.

By **SID LEVINE**

Although they are well built and well designed, they are subject to certain troubles—recognizing these faults can make your servicing job faster and surer.

FAR too often, service technicians spend valuable troubleshooting time checking every component in the horizontal sweep and high-voltage circuits until they finally realize something might be wrong with the flyback transformer. Even though these transformers have been widely used within the last decade, their whys and wherefores still remain a mystery to many service technicians. The purpose of this article is not to go too deeply into the theory of the operation of the flyback transformer, but to show how to quickly check and, in some cases, repair them.

The use of the flyback transformer in the television receiver is two-fold. It provides the electromagnetic current to sweep electrons across the full width of the picture tube and also the high voltage that is needed to pull the electrons down the neck of the picture tube and onto the face. An additional by-product of the flyback circuit is the boost voltage, the high "B+" voltage that is applied to the plate of the horizontal output tube. It is the interdependence of these separate functions that makes troubleshooting of the flyback transformer more difficult than, say, a video i.f. transformer. By a careful analysis of the causes and effects of the troubles originating in flyback transformers, we can learn to handle these circuits more quickly and thus more profitably.

A typical flyback circuit is shown in Fig. 2. The horizontal output tube amplifies the trapezoidal voltage which is obtained from the horizontal oscillator circuit. This amplified voltage is fed into the primary of the transformer between terminals 1 (the bottom) and 2, and is coupled through the transformer to the output (terminals 4 to 6) where it is applied to the plate of the damper and the horizontal windings of the deflection yoke. When this voltage enters the yoke, it generates the proper saw-tooth of current that is needed to sweep the electron beam in the picture tube.

When the voltage across the input drops to zero during the retrace time, oscillations are generated in the flyback. To squelch these oscillations, which appear as vertical striations in the picture, the horizontal damper tube is used. This tube is essentially a rectifier and a large "B+" potential appears at its cathode. This large "B+" voltage (larger than the "B+" supply of the set) is called the boost voltage and is supplied to the plate of the horizontal output tube after being filtered through the horizonal linearity coil and its two capacitors.

The sharp pulse supplied by the horizontal output tube to the primary winding of the transformer is stepped up through the tertiary winding from terminals 2 to 3, and applied to the plate of the high-voltage rectifier tube. There, this pulse is rectified and filtered by the 500 micromicrofarad capacitor and applied through a current-limiting resistor to the high-voltage cap of the picture tube.

The width control is a variable coil which places a small inductive load on the output of the transformer.

A brief description of the construction of flyback transformers will aid in understanding the possible troubles to which they are subject. The typical bottom-mounted flyback transformer is wound in three sections; the first or "A" winding is the secondary or sweep output, the second or "B" winding is the primary or input from the horizontal output amplifier, and the third is the tertiary which is the high-voltage winding to the high-voltage rectifier tube.

Fig. 3 is a typical flyback transformer showing the various windings and their leads. The "A" winding is the first to be wound. It starts from the paper tube form. The "B" winding starts on top of the "A" winding. The tertiary starts at the finish of the "B" winding.

After the transformer has been wound on the paper tube, it is then impregnated in a hot wax or varnish bath to remove the air and furnish greater dielectric strength between wires. When it has cooled, after sufficient impregnation time, a wax "tire" is placed around the rim of the tertiary to prevent breakdown and arcing from this high r.f. voltage point. The windings are then placed on a core of ferrite material, after the proper air gap has been set (usually with tape) between cores to prevent core saturation. It is next mounted, and the taps are brought out to their proper terminal lugs and soldered (see Fig. 1). Then the high-voltage rectifier filament winding is added.

Troubles

There are three common troubles to which flyback transformers are subject in the field: shorts, insulation breakdowns, and "opens." Each one of these troubles will be discussed in detail as to their causes, effects, troubleshooting procedures, and repair.

Shorts occur less frequently in the field than breakdowns and "opens" but, because of their nature, are difficult to spot. A short can occur from one wire to another in any one of the three windings, or from one winding to another. Poor insulation on the wire used in the windings can cause a short from turn-to-turn or layer-to-layer. Most wires used today have a heavy coating of "Formex" with a nylon or silk jacket, but even with these precautions, fraying occurs in the winding of the transformer or in the spooling of the wire. When a short occurs between windings, it is usually due to poor quality or an insufficient amount of tape separating the sections. This type of short is first caused by a breakdown between the sections through the tape.

Remember, one shorted turn of a coil may greatly reduce the "*Q*" of the coil. If a great deal of energy is dissipated in one or more shorted turns, the output will be reduced considerably. Thus, if a short occurs in the tertiary, not only will the high voltage suffer, but energy will be drawn away from the "A" winding and result in lowered sweep output. To check for shorts with an accurate ohmmeter, check the resistance of the windings as compared to the manufacturer's specifications which many times are found on the TV receiver schematic. As a general guide, the resistance of the primary between the bottom and terminal 2 in Fig. 2 will be between 30 and 40 ohms, the tertiary between terminals 2 and 3 should measure between 180 and 350 ohms, and the secondaries are on the order of 3 to 10 ohms between consecutive terminals. However, an ohm or two lower than the actual manufacturer's specification could indicate trouble. In many cases, particularly in the tertiary, the reduced resistance due to a short will be very pronounced.

Another method of testing for shorts is to check waveforms with the aid of an oscilloscope. To do this, however, you must be thoroughly familiar with the wave amplitude, under normal conditions, of the input to the deflection yoke and the boost voltage.

Still another way of checking for shorts is to feed r.f. voltage into the primary winding of the flyback transformer and see if you can pull a spark off terminal 3, the high-voltage rectifier plate cap. A convenient source for the r.f. is the output of a working flyback (terminal 3). Feed this into the primary of the suspected transformer and see if you can pull a spark off the one in question.

A short from the primary to the secondary of the transformer acts as a short across the damper tube. In the circuit of Fig. 2, any measurable resistance from the plate to the cathode of the damper can usually be attributed to a primary-to-secondary short

In addition to these methods for finding shorts, there are numerous commercial flyback testers. These generally contain a source of r.f. voltage which is fed into the primary; the inductance or "*Q*" of the secondaries or tertiary usually determines the meter reading. A shorted turn will impair the "*Q*" of a coil appreciably. In addition, these instruments are generally useful for determining open windings.

Whenever high r.f. and d.c. potentials are applied in surges to a component, breakdowns can occur. The flyback transformer is no exception. Breakdowns are the most prevalent of flyback troubles.

The causes for breakdowns are numerous. When the transformer is being wound, one wire may slip from its layer and come down on the outside next to a wire of a layer much closer to the core. This would place a wire of a high r.f. potential close to one of much lower r.f. This trouble, slipped turns, is the biggest cause of breakdowns. Low breakdown strength of the insulating tape between windings and insufficient impregnation of the windings are other causes of breakdowns. Sometimes, a transformer is wound with the edges of the windings close to or even touching the edges of the core, causing a breakdown to the core. The high-voltage rectifier tube gets its filament voltage from the r.f. that is picked up by a loop of wire close to the tertiary. This filament wire carries from 12,000 to 16,000 volts d.c., and if it is positioned too close to the rim of the tertiary, breakdown may occur. A poor quality of wax or insufficient amount of wax "tire" on the rim of the tertiary may cause arcing.

A visual check of the transformer while in operation will usually show up most breakdowns. Arcing, sputtering, and even smoking are self-explanatory. Sometimes, when the windings have broken down to the core, arcing takes place from the core through the phenolic board to the metal bottom mount. When the filament lead breaks down to the tertiary rim, the insulation of the filament wire will be charred and the bare wire exposed.

The biggest cause of open leads is mishandling. Carelessness when installing a flyback transformer during a replacement, for example, can result in broken wires. Don't jerk leads or bend the phenolic boards. Try not to have any sharp objects come in contact with the tertiary rim where a slight nick in the wax may cut several layers of winding. Some tertiaries are wound with number 40 wire, approximately the size of a human hair.

Cold-soldered joints at the terminal lugs will act the same as open windings. These generally result from improperly cleaning the "Formex" or enamel coating from the ends of the wires that are to be soldered to the terminals.

To attach the high-voltage plate lead to the extremely thin wire of the tertiary, it is first necessary to strengthen this wire with one that is heavier. Sometimes, a slight pressure on the heavier wire can snap its connection to the lighter wire even though both are taped down to the tertiary rim before the wax "tire" is applied.

The operational effect of a break in a winding or a cold-soldered joint depends on where the break occurs. If there is an open in the primary winding, there will be no high voltage, sweep, or boost. This can be quickly checked with a simple ohmmeter reading across the primary. An open tertiary will not prevent horizontal sweep or boost voltage and there may even be high voltage due to the inductive coupling of the r.f. pulse through the windings.

When the transformer is open at terminal 6 (see Fig. 2), the flyback circuit is completely inoperative since there is no complete path back to the "B+" through the transformer secondary. The flyback can be open at

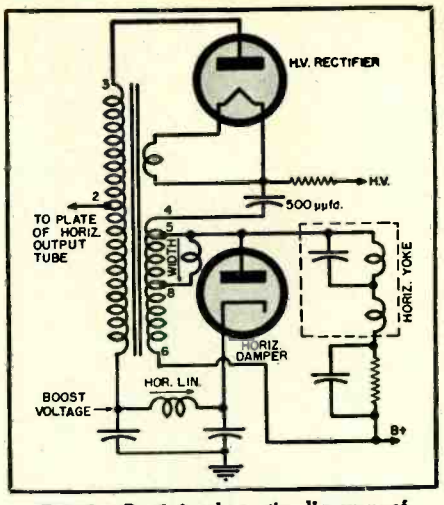


Fig. 2. Partial schematic diagram of a typical flyback transformer circuit.

terminal 4 but still have continuity from 5 through 6, and it will continue to operate but with slightly lower high-voltage output. If it is open at terminal 8, but there is continuity from 4 through 6, there will be high voltage and a wider sweep with no width control action.

Repair and Replacement

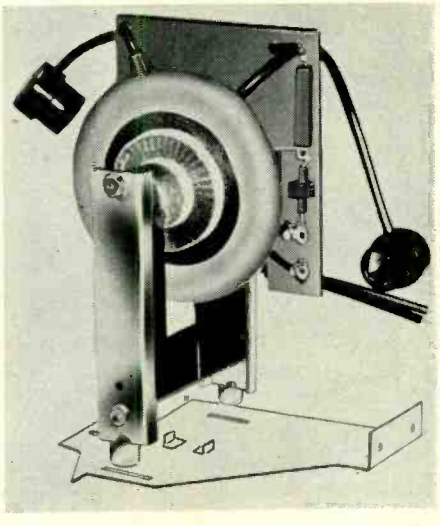
It was mentioned that shorts comprise a large percentage of flyback troubles, yet nothing can be done to repair them. However, there are some breakdown and "open" troubles that can be easily fixed to keep the flyback running satisfactorily.

When the edges of the transformer windings are pressed up against the sides of the core and are breaking down, the windings can be insulated from the core by taping them over at the point of breakdown with black vinyl electrical tape. If there is arcing from the rim of the tertiary, carefully tape over the portion of the rim where the arcing is taking place.

A common trouble is the breaking down of the high-voltage filament lead

(*Continued on page* 127)

Fig. 3. A recent flyback transformer model serving as an exact replacement for one used in certain Philco receivers. This one is manufactured by Stancor.



SELENIUM VOLTAGE DOUBLER

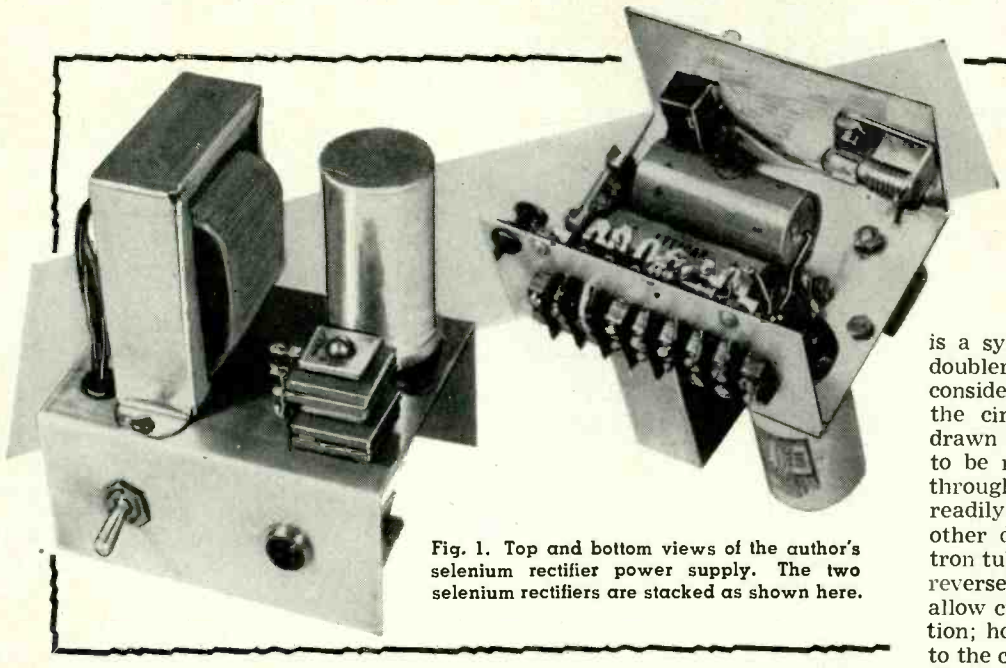


Fig. 1. Top and bottom views of the author's selenium rectifier power supply. The two selenium rectifiers are stacked as shown here.

By

HAROLD REED

Research and Engineering
U. S. Recording Company

A discussion of voltage doubler rectifier circuits and details on a compact selenium power supply of many uses.

VOLTAGE doubler rectifier circuits have been used extensively in electronics equipment. Their special advantage lies in their ability to supply a rectified, pulsating, direct current output voltage equal to approximately twice the peak voltage value of the input alternating current voltage. Or, more simply expressed, we obtain a d.c. voltage in the output of the rectifier which is two times higher than the a.c. voltage applied to the input, which is useful in the proper operation of electron tubes and other electronic apparatus.

A conventional type of voltage doubler circuit employing diodes is illustrated in Fig. 2A. It is shown using a power line isolation transformer. Direct operation from the 117 volt a.c. line with suitable tubes is possible; however, in many applications it is preferable to use the transformer, and definitely safer, too, inasmuch as the 117 volt supply line is then isolated from the chassis. Also, the same transformer, with low voltage windings, can furnish required filament voltages. We may explain the operation of this circuit as follows.

The 117 volt a.c. supply voltage is applied to the primary at points $P1$ and $P2$ of transformer T_1. Therefore, an a.c. voltage is induced in the secondary of this transformer. Suppose now, for purposes of this analysis, we assume that this induced voltage in the secondary winding results in point $S1$ being at a positive potential while $S2$ is negative with respect to point $S1$. The voltage at this instant is then impressed across tube V_1. Capacitor C_1 is in series with the secondary winding and the diode tube. The plate of V_1 is positive with respect to its cathode and so electrons flow from cathode to plate. This electron movement constitutes a current flow in the series circuit. Electrons leaving the top plate of C_1 flow around the circuit through tube V_1, accumulating on the bottom plate of this capacitor. Thus capacitor C_1 becomes charged to the peak alternating voltage of the transformer secondary, less the voltage drop across tube V_1.

When the alternating current cycle reverses, point $S1$ of the transformer secondary goes negative and there is no current flow through V_1. However, tube V_2 now conducts and the current flow in the other series circuit comprising V_2, the transformer secondary, and capacitor C_2, causes C_2 to charge to the peak alternating voltage during this half of the a.c. cycle. The total rectified d.c. voltage is applied to the load, R_L, between terminal Z and ground. This output is equal to the sum of the voltages on C_1 and C_2 which is about twice the peak a.c. voltage across the transformer secondary. V_1 and V_2 may be a single tube housing two diode sections.

The foregoing rectifier analysis concerning diode electron tubes was reviewed so that a clear understanding of voltage doubler action may be had, and so a comparison can be made between the tube diode circuit and that of the selenium rectifier now to be analyzed.

A selenium rectifier schematic as frequently diagrammed is shown in Fig. 2B. In this form it may appear confusing and difficult to understand. This is a symmetrical or full-wave voltage doubler similar to the tube circuit just considered. To simplify the discussion the circuit of Fig. 2B has been redrawn to appear as in Fig. 2C. It is to be remembered that current flows through a selenium rectifier cell more readily in one direction than in the other direction and although an electron tube may be non-conducting in the reverse direction a selenium cell does allow current flow in the reverse direction; however, it is small in comparison to the current amplitude in the forward direction.

In Fig. 2C, suppose at a certain time the alternating voltage wave is such that the upper end of the secondary of T_1 is positive with respect to the lower end. In this state SR_1 conducts, charging capacitor C_1 to the peak a.c. voltage, less the rectifier voltage drop which is approximately 5 volts. We may say SR_2 does not conduct during this time. During the following half cycle when the upper end of T_1 is negative and the lower end positive, rectifier SR_2 conducts, charging capacitor C_2, SR_1 being considered in the non-conducting state at this time. The rectified output voltage appears across points X and Y, Y being the ground side, and is equal to the sum of the voltages across capacitors C_1 and C_2 which sum is about equal to twice the peak a.c. voltage across the secondary of T_1 less the voltage drops across the rectifier cells, approximately 5 volts across each unit.

It will be observed from Fig. 2C that failure of either capacitor in the form of a short circuit can prove disastrous to the particular selenium unit in series with it by allowing the transformer potential to appear across it. In like manner, either capacitor can be ruined by a prolonged short across the series rectifier of the circuit.

The rectifier circuit of Fig. 2B was used to supply the required d.c. supply voltages to a 4 watt record player amplifier using a 12AT7 twin triode and 6V6 output tube. The selenium rectifiers were rated at 65 milliamperes each. The load imposed by this amplifier required a current flow of 42 milliamperes through the rectifier circuit at point X. With this current flow the d.c. supply voltages as indicated in the diagram were available. Sufficient filtering to smooth out the 120-cycle ripple frequency of the rectifier is pro-

vided by the filter section consisting of resistors R_1 and R_2 and capacitors C_{3A}, C_{3B}, and C_{3C}. In Fig. 1 this power supply is shown built up as a separate unit for general use. With filter resistors selected as required or variable controls used, a versatile utility unit can be constructed with output voltages as required. The component parts are assembled on a simple 3½ x 4½ x 2 inch chassis suitable for experimental applications.

The schematic circuit diagram given in Fig. 2D is similar to Fig. 2C but employs selenium rectifiers rated at 100 milliamperes each. This circuit provided supply voltages for a commercial hi-fi 10-watt amplifier consisting of a 12AX7 twin triode preamplifier, 12AX7 voltage amplifier and treble-bass tone control stage, 12AT7 voltage amplifier and phase splitter and push-pull 6V6 output stage. The d.c. supply voltage to the output stage was 290 volts. A voltage dropping resistor, R_1, is used in this circuit. This dropping resistor, either fixed or variable, could be used in the rectifier shown in Figs. 1 and 2B to obtain variable output voltage.

That this selenium rectifier circuit was capable of giving satisfactory results was proven by the fact that the hum and noise level in the above mentioned hi-fi amplifier was —55 db through the phono preamplifier input and —65 db through the tape-TV-tuner input. Distortion at 10 watts output was 1.5 %. Filtering was provided by the *RC* decoupling networks between the rectifier output and the individual amplifier stages.

Before closing this article we should consider the half-wave voltage doubler, a simplified diagram of which is given in Fig. 2E. In this analysis, consider first that the a.c. voltage across the secondary of T_1 is such that the lower end is positive. Rectifier SR_1 will then conduct, charging capacitor C_1 to the peak voltage of the a.c. potential across T_1 secondary winding. During the next half a.c. cycle across T_1 the upper half of the secondary winding goes positive. Rectifier SR_2 now conducts and capacitor C_2 charges up to the peak a.c. potential across T_1, plus the charge already across capacitor C_1. It is easy to see, then, that the sum of these two potentials applied across C_2 is equal to twice the peak a.c. voltage of the transformer secondary. This voltage is then applied to the load R_L between point Z and ground. Disadvantages of the half-wave voltage doubler are the lower frequency (60 cycles) ripple component and poorer voltage regulation.

There are, of course, other useful circuits such as the tripler and quadrupler arrangements and the interested reader is referred to the references below.

The selenium rectifier contributes to a compact, cool-operating, long-life power source and, when properly used, furnishes a very satisfactory means of obtaining a ripple-free, d.c. voltage supply.

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"Selenium Rectifier Handbook," Federal Telephone and Radio Co., Clifton, N. J.

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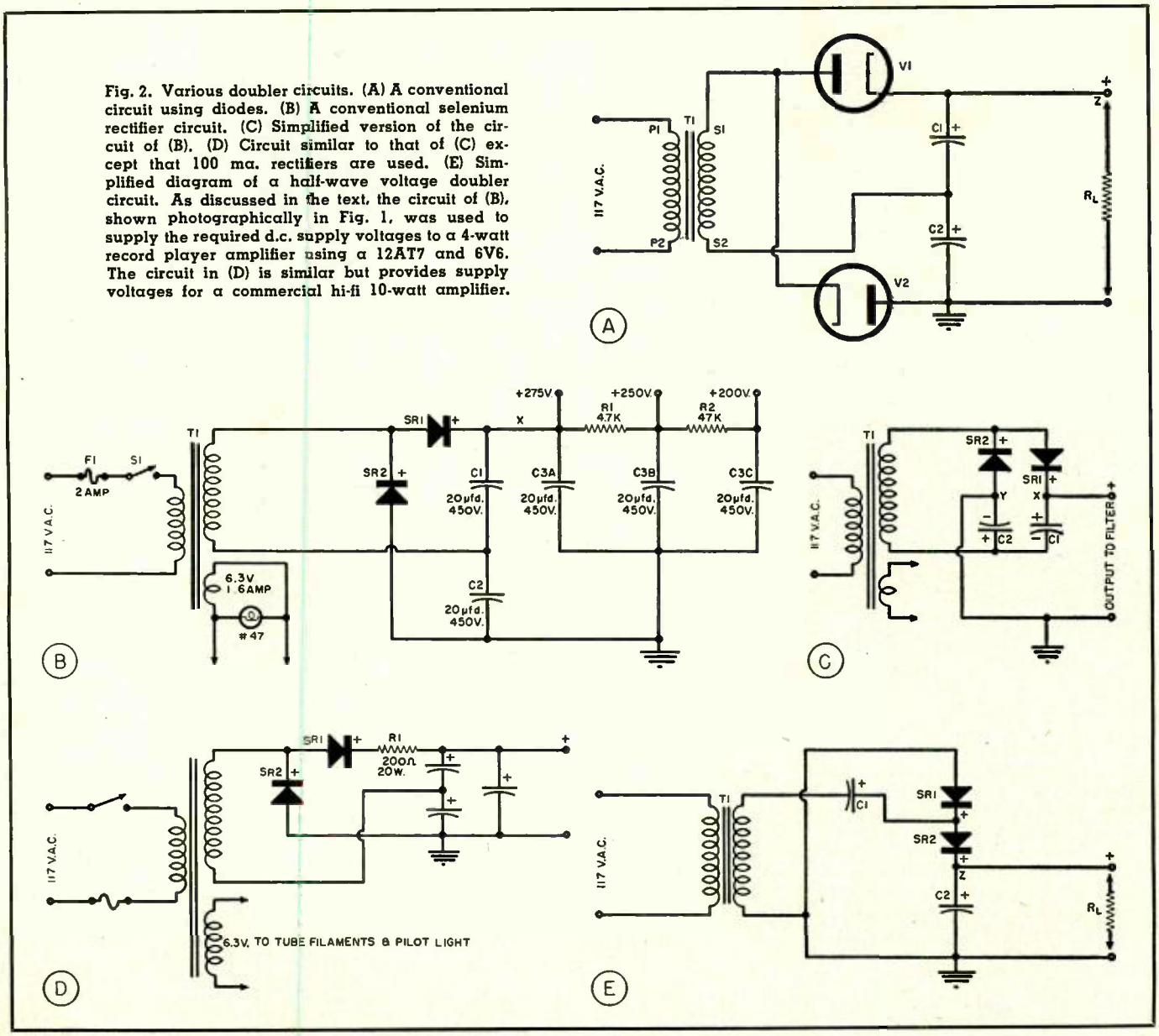
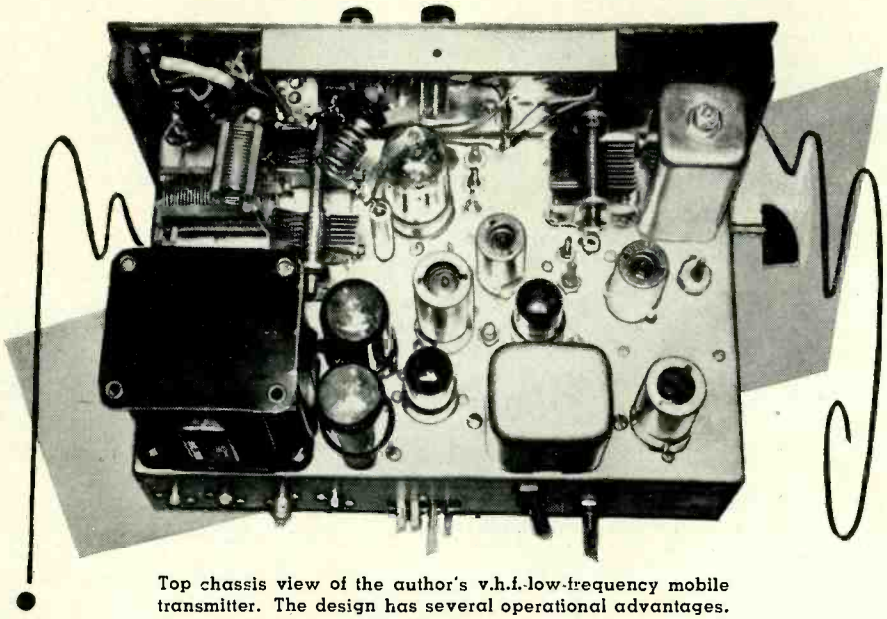


Fig. 2. Various doubler circuits. (A) A conventional circuit using diodes. (B) A conventional selenium rectifier circuit. (C) Simplified version of the circuit of (B). (D) Circuit similar to that of (C) except that 100 ma. rectifiers are used. (E) Simplified diagram of a half-wave voltage doubler circuit. As discussed in the text, the circuit of (B), shown photographically in Fig. 1, was used to supply the required d.c. supply voltages to a 4-watt record player amplifier using a 12AT7 and 6V6. The circuit in (D) is similar but provides supply voltages for a commercial hi-fi 10-watt amplifier.

COMBINATION V.H.F.-L.F. FINAL AMPLIFIER



Top chassis view of the author's v.h.f.-low-frequency mobile transmitter. The design has several operational advantages.

By **JACK NAJORK, W2HNH**

Two tank circuits in series permit operation of the same transmitter final on 3.5 or 144 mc. without coil changes.

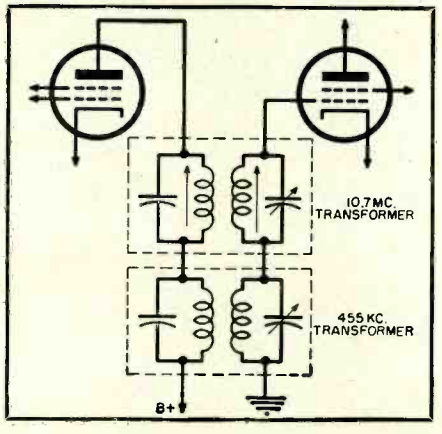
THE author recently designed and built a mobile rig ending up with the popular 2E26 as a final amplifier. Since this tube is a proven performer at 144 mc., and since we had more than a passing interest in this band, it was decided to use separate exciters for low-frequency and 144 mc. and employ the 2E26 as a combination v.h.f.-low frequency final amplifier. As finally evolved, the 2E26 plate circuit can be tuned to two meters or any of the low-frequency bands from 10- to 80-meters *without bandswitching or use of plug-in coils.*

Before covering the practical aspects of the circuit, it might be well to discuss briefly how such a design can be made to operate efficiently despite the popular contention that independent amplifier stages are required for optimum performance on v.h.f. and low-frequency amateur bands.

The usual textbook reasons advanced for the use of separate amplifiers are theoretically sound, *viz*: that the *L/C* ratios required in a tank circuit for low-frequency operation cannot be used with any degree of efficiency at v.h.f. and *vice versa*. Other design factors such as physical arrangement of components, lead lengths, etc., are also involved if v.h.f. operation is contemplated but, in general, the primary problem is simply one of maintaining proper tank circuit "*Q*" over the frequency spectrum to be covered. As an example, the generally accepted "*Q*" figure of 12 for a final amplifier tank circuit usually requires a tank capacity on the order of 100 $\mu\mu$fd. for 80-meter operation. If a tuning capacitor of, say, 125 $\mu\mu$fd. is used on this band, the designer soon finds that the minimum capacity for such a unit, together with stray wiring capacities, results in an extremely poor *L/C* ratio for 144 mc. operation. This is because the minimum total tank capacity will fall between 30 and 50 $\mu\mu$fd. whereas something like 10 $\mu\mu$fd. is called for on the two-meter band. How then, does one go about designing a tank circuit that will overcome this bugaboo?

The answer is quite simple and is based on a technique used by receiver design engineers who were faced with a similar problem in the design of a combination 10.7 mc.—455 kc. i.f. amplifier system for AM-FM radio receivers. They found that the 10.7 mc. transformers could be put *in series* with the 455 kc. transformers and the laws of reactances did the rest. The basic circuit is shown in Fig. 1. What could be easier? No bandswitching—no extra amplifier tubes—no additional power consumption! Feed a 455 kc. signal into the system and it passes through the 10.7 mc. transformer winding with negligible loss. Why? Because the inductance of the 10.7 mc. transformer looks almost like a piece of straight wire at 455 kc. Push through a 10.7 mc. signal and what happens? The 10.7 mc. transformers do their work and the relatively large capacitors hanging across the windings of the 455 kc. transformers look like good bypasses at 10.7 mc.

Fig. 1. Basic dual-frequency i.f. amplifier system on which design of the v.h.f.-l.f. final amplifier, described herein, is based.



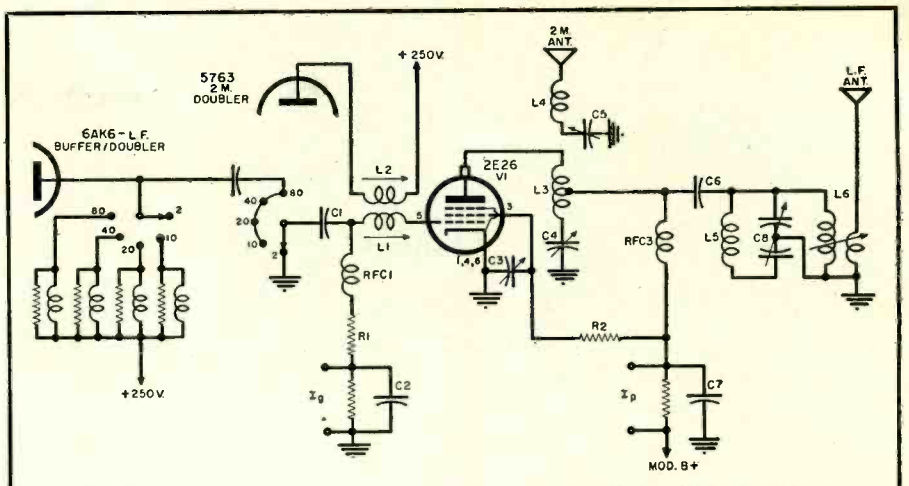
We did the same thing, with minor variations, in our 2E26 final amplifier and it works just as well as the dual i.f. systems. Separate exciters are used, one for v.h.f. and one for 10- to 80-meter operation. On the low frequency bands, capacity coupling is used between a 6AK6 buffer/doubler stage and the 2E26 grid. This low-frequency excitation flows through the two-meter grid circuit, L_1 in Fig. 2, which is permanently wired into the 2E26 directly at the socket. Since the reactance of L_1 is negligible at 28 mc. and lower, it has no effect on the low-frequency operation of the circuit. At the plate of the 2E26 we again feed through a permanently connected two-meter tank, L_3, which at low frequencies looks like a parasitic suppressor, and drives the low frequency tank circuit made up of L_5, L_6, and C_8. This latter circuit will be recognized as the all-band tank which tunes 10- through 80-meters with one rotation of the tuning capacitor. If desired, a pi network or switched coils can be used here with no change in circuit performance.

For two-meter operation, the coupling capacitor, C_1, is grounded by a section of the exciter bandswitch and becomes a bypass for the cold end of the two-meter grid coil, L_2. Two-meter drive is coupled into this coil by inductive coupling from the plate circuit of the 144 mc. driver stage, L_2. The two-meter plate tank is of the "series-tuned" variety. The plate inductance, L_3, is proportioned so that it resonates with a tuning capacity at C_4 of approximately 7 $\mu\mu$fd. This is equal to the output capacity of the 2E26, and the complete tank circuit then looks like a parallel-tuned circuit with the tuning capacitor C_4, and the output capacity of the 2E26 in series across the tank coil, L_3. L_3 is tapped at the r.f. center which is not necessarily the physical center of the coil. To find this point, fire up the rig on two meters and tune the tank to resonance. "B+" can be temporarily fed through a 144 mc. choke at any point on L_3. Experimentally tap L_3 with a small

screwdriver and a point will be found where contact does not cause detuning. Connect the "B+" lead at this particular point. The 144 mc. antenna coupling coil, L_4, is loosely coupled to the tank coil and is series-tuned in the usual manner.

Keeping the 2E26 neutralized for both v.h.f. and low-frequency operation poses a tough problem. The circuit was first neutralized at two meters by tuning out the screen inductance with a trimmer, C_3. An effective capacity of approximately 30 $\mu\mu$fd. tamed the 2E26 nicely on two meters but as was expected, this turned out to be insufficient capacity at the lower frequencies and the tube took off as a tuned-plate, tuned-grid oscillator. One method of taming unwanted oscillations of this type is to lower the impedance of either the grid or plate circuit to a point where the oscillation ceases. Since there was an excess of excitation available at the low frequencies, and since the buffer/doubler plate coils had to be damped for broadband operation anyway, the problem solved itself. Loading resistors across these coils reduced the grid circuit impedance enough to prevent tuned-plate, tuned-grid oscillations and simultaneously reduced grid drive to the 2E26 to the proper level. These resistors varied from 4700 ohms at 80 meters to 18,000 ohms at ten meters.

As is the case with all v.h.f. designs, some precautions must be taken with regard to lead lengths. The grid-cathode path with the exciter switch in the two-meter position must contain an absolute minimum of inductance, otherwise L_1 will have to be reduced to microscopic proportions to achieve grid circuit resonance at 144 mc. L_1, by itself, is but a small portion of the total resonant grid circuit at 144 mc., since the inductance of C_1, the switch inductance, and the cathode path to the switch ground point all form part of the total circuit which is shunted by the rather hefty input capacity of the 2E26. L_1 should be wired directly to the grid pin of the 2E26 with just sufficient room between the cold end of L_1 and the switch rotor to permit insertion of C_1. The two-meter ground connection at the switch should be made with copper strap rather than wire, in order to reduce the inductance to a minimum. All three cathode pins on the 2E26 should be grounded with short, heavy straps. If it is desired to keep the cathode above ground for keying purposes, disc type ceramic capacitors should be used to bypass all three cathode connections.



R_1—22,000 ohm, ½ w. res.
R_2—30,000 ohm, 5 w. wirewound res.
C_1—100 $\mu\mu$fd. midget mica capacitor
C_2, C_7—.001 μfd. disc ceramic capacitor
C_3—50 $\mu\mu$fd. ceramic trimmer
C_4—15 $\mu\mu$fd. double-spaced var. capacitor
C_5—25 $\mu\mu$fd. midget var. capacitor
C_6—.002 μfd., 1500 v. mica or ceramic capacitor
C_8—125/125 $\mu\mu$fd. var. capacitor
RFC1—144 mc. choke (Ohmite Z-144) or 27 t. #28 en., wound on 3/16" form
RFC3—2.5 mhy. choke
L_1—1 t. #18 tinned, wound on ¼" dia. brass-tuned form (See text)
L_2—4 t. #18 tinned, wound on ¼" dia. iron-tuned form. Center-to-center spacing of L_1-L_2 is ⅞"
L_3—6 t. #14 tinned. ⅜" o.d., ¾" long
L_4—2 t. #14 tinned. ½" o.d.
L_5—14 t. #3014 "Miniductor," 1" dia., 8 t. per inch
L_6—21 t. #3015 "Miniductor," 1" dia., 16 t. per inch.
V_1—2E26 tube

Fig. 2. Complete schematic of the author's v.h.f.-l.f. combination final amplifier.

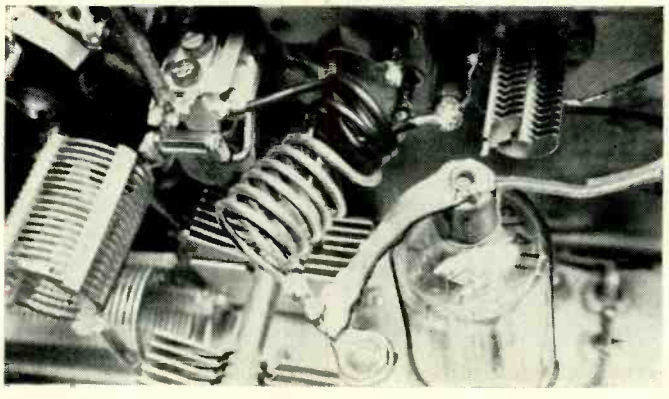
Adjustment of C_3, the screen neutralizing capacitor, will affect the input capacity of the 2E26, hence, L_1 should be retuned for maximum grid drive after C_3 has been adjusted for proper neutralization.

A grid-dip meter will greatly simplify v.h.f. tune-up and is almost a necessity for initial grid circuit adjustment. With the two-meter driver coil, L_2, shorted, L_1 is adjusted for resonance at the approximate operating frequency in the two-meter band. Since the tuning range of the brass slug in L_1 is rather limited, some physical alteration of this coil may be required, depending on individual layouts. When approximate resonance is indicated by the grid-dip meter, the two-meter exciter can be fired up and L_1 and L_2 tuned for maximum grid drive.

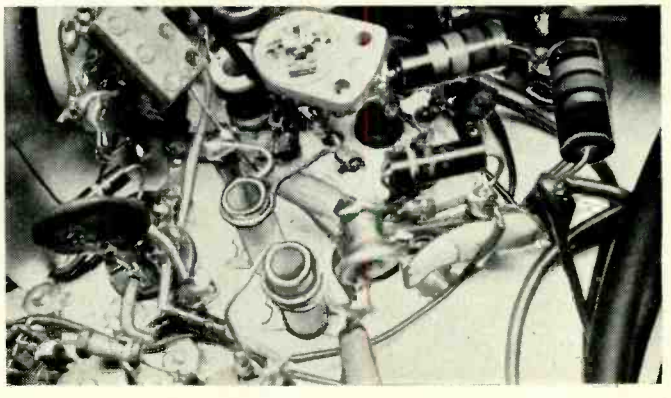
The two-meter exciter used with this circuit employs a 6BK7 36 mc. crystal oscillator-doubler, and a 5763 doubler to 144 mc. With 250 volts on the 5763 plate and screen, 2.5 ma. of grid current is obtained.

The low-frequency exciter uses a 6AK6 v.f.o. and a 6AK6 buffer/doubler. Plate voltage is permanently wired to both exciters and a section of the bandswitch applies heater voltage to the appropriate exciter as the bandswitch is shifted from v.h.f. to the low-frequency bands. Separate antenna relays are used in the v.h.f. and low-frequency output tanks, thus the shift from one range to the other can be made by simply flipping the bandswitch and tuning the appropriate tank circuit. Since C_4, the v.h.f. tuning capacitor, remains in the 2E26 plate circuit at all times, it can be set at mid-range and used as a low-frequency vernier when small shifts in frequency are made on these bands. -30-

Closeup view of 2E26 v.h.f. tank circuit with l.f. tank in background. Split section of twin-lead connected to the 2E26 is capacitor coupling to the neon bulb modulation indicator.



The 2E26 v.h.f. grid circuit. The 5763 plate coil is in foreground, coupled to 2E26 single-turn grid coil. The 2E26 screen neutralizing capacitor is slightly to the left of the socket.



AN "IMPROVED" SOUND SWITCH

By **LOUIS E. GARNER, JR.**

This versatile unit can serve as a secret lock, a noise alarm, transmitter control, or a commercial "killer".

Fig. 1. This easily-built sound switch features high gain and built-in delay.

SOUND-ACTUATED switches are not new, but most of the ones described in the past have been designed for specific, rather than for general, applications. Many of the earlier "sound switches" have been fairly insensitive, using a high output carbon microphone and, even then, requiring a sound source of fairly high intensity or very close to the mike for proper operation. In addition, most of the earlier sound-switch circuits have been limited to one of three modes of operation: (1) "pulsed", (2) "continuous", or (3) "locked in" operation.

The "pulsed" type units are fast acting, opening and closing a relay with every pulse in the sound. Such units are popular for operating model trains and similar "remote control" devices, where the pulsed output can be applied to a sequence or stepping relay. Where this type of sound switch is employed, the operator's choice of words or phrases determines the relay's stopping point and hence the type of operation obtained from the remote controlled device.

The "continuous" operation sound switch is similar to the "pulsed" type except that a short time delay is introduced in circuit operation. Instead of opening and closing on individual pulses, the relay is kept closed (or opened) as long as the sound intensity is kept above a given level. Shortly after the sound level drops, the relay opens.

"Locked in" sound switches generally incorporate a gas-filled tube (thyratron) which "fires" and closes a relay when the sound intensity reaches a predetermined level. The relay then remains closed until the unit is "reset" by a manual switch. This type of sound switch is useful in alarm applications.

Although the entire circuit, including its self-contained power supply, is assembled in a standard 4" x 5" x 6" box, the sound switch shown in Fig. 1 will, with but minor modification, take the place of any of the three basic sound-switch circuits in most applications. The unit shown uses a *crystal* microphone and has ample sensitivity for most uses.

With the "Sensitivity" control turned only part of the way up, the instrument may be operated easily with a normal speaking voice at a distance of 12 to 15 feet from the microphone. In fact, with full sensitivity, the faint click of its own relay is sufficient to initiate circuit operation.

The unusual versatility of the sound switch shown is obtained in two ways. First, its high sensitivity allows it to be used under extreme conditions. And, secondly, a unique "time delay" circuit permits its operation either at the short intervals of a "pulse" type circuit or at extremely long intervals. Only two components need to be changed to go from one type of operation to the other.

When maximum time delay is used, the relay may remain open for as long as 15 to 20 seconds (or more) after the application of an actuating signal. With this much time delay the instrument's operation is similar to that of a "locked in" circuit, but with an "automatic reset" feature.

Circuit Description

The complete schematic diagram for this "improved" sound switch is given in Fig. 2. Only two tubes are used in the amplifier and control circuits and both of these are miniature types. A single selenium rectifier is used in the power supply.

In operation, sound striking the microphone ("Mic.") is converted into an electrical audio signal and applied across potentiometer R_1. The setting of this control determines what portion of the available signal is applied to the amplifier and hence the sensitivity or gain of the instrument.

The audio signal is applied through coupling capacitor C_1 to the grid of the first amplifier stage, a pentode-connected 6AU6. Resistor R_2 serves both as a grid return resistor and as a bias resistor for this stage. Convection bias is used and the tube's cathode is returned to ground. Screen grid voltage for the 6AU6 is furnished through voltage dropping resistor R_4, bypassed by capacitor C_2.

Resistor R_3 serves as the plate load impedance for the first stage, with the amplified audio signal appearing across it applied through coupling capacitor C_3 to the grid of the second stage, half of a 12AT7 high-mu dual triode. R_5 serves as the grid return resistor. Conventional cathode bias is provided for this stage by cathode resistor R_7, bypassed by C_4, a tubular electrolytic capacitor.

The amplified signal appearing across plate load resistor R_6 is applied through coupling capacitor C_5 to the grid of the relay control stage, the second half of the 12AT7. R_8 serves as the grid return resistor.

Since both the cathode of the tube and the "cold" end of the grid resistor (R_8) are returned to ground, the only bias on the relay control stage is that provided by contact potential bias through R_8. This bias is fairly small and enough plate current flows through the relay (RL_1) to keep it closed.

When the amplitude of the audio signal appearing on the grid of the relay control stage becomes larger than the contact potential, the grid is driven

positive, and the grid-cathode circuit acts as a simple diode. The resulting grid current charges C_5, which, in turn, can only discharge through R_8. A large bias voltage is built up across R_8 as C_5 discharges. This bias is sufficient to reduce the plate current to the point where relay RL_1 drops out.

The relay then remains open until C_5 is almost completely discharged and the grid bias voltage drops to approximately its contact potential value. The time the relay remains open is determined partially by the amplitude of an applied signal and partially by the RC time constant of R_8 and C_5. Where a fairly strong actuating signal is used, the RC time constant is the essential factor.

Thus, the sound switch relay remains closed until a loud sound strikes the microphone. The relay then drops out and remains open for a period determined by the time constant of R_8 and C_5. This period may be made either short or long simply by varying the size of these two components. For longer periods, the size of either R_8 or C_5 (or both) may be increased. For shorter periods, the sizes of these components are reduced.

The level of the sound required to initiate operation depends on the setting of R_1, the "Sensitivity" control.

The relay operation described is like that employed in many industrial electronic control circuits and in alarm devices. Since the relay is normally held closed and opens on the application of a control signal, circuit operation is virtually assured since should the 12AT7 burn out or the relay coil open, the relay will then drop out. This is generally called "fail safe" operation.

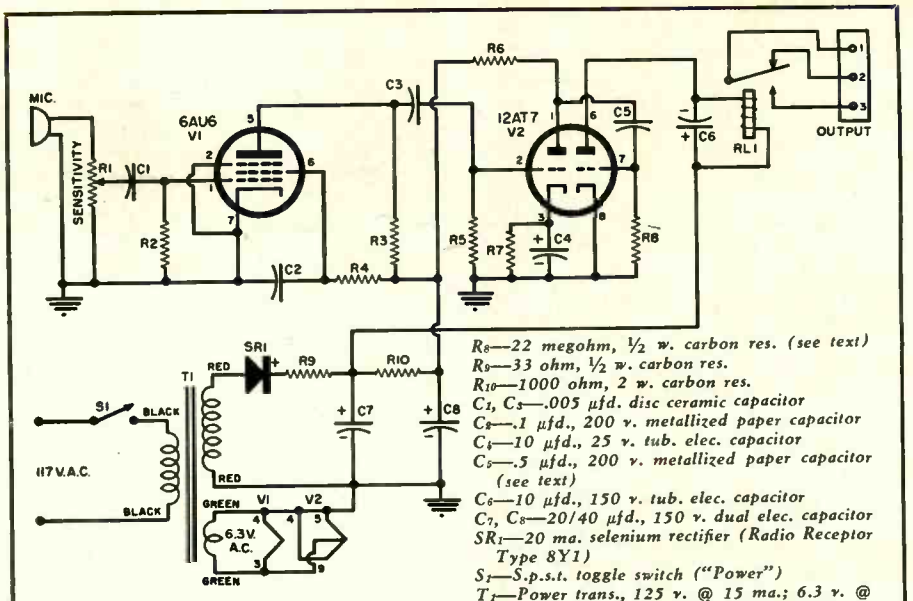
Capacitor C_6, across the relay, smooths any variations that may occur in relay current and helps insure positive operation. There is no tendency for the relay to "hum" or vibrate.

Although it is customary to use a.c.-d.c. power supplies in simple relay control circuits of this type, in the interests of safety and reliable operation, a straight a.c. power supply circuit has been employed. A small transformer (T_1) of the type used in audio preamplifiers furnishes both filament power and high voltage for the rectifier. A s.p.s.t. switch, S_1, in the primary circuit, serves as the "Off-On Power" switch.

A half-wave selenium rectifier, SR_1, furnishes d.c. power for the operation of the instrument. A conventional "pi" RC filter, consisting of resistor R_{10} and electrolytic capacitors C_7 and C_8, is used to remove ripple. Resistor R_9 serves to protect the selenium rectifier from current surges as C_7 charges when the unit is first turnd "on".

Construction Hints

Above and below chassis views of the completed instrument are given in Figs. 4 and 3, respectively. The unit is housed in a standard 4" x 5" x 6" "Minibox". A commercial aluminum chassis measuring 3" x 6⅛" x 1¼" is used, with approximately ¼" cut off its length so it fits within the "Minibox". If the builder prefers, he may bend a chassis from sheet stock.



R_1—2 megohm carbon pot ("Sensitivity")
R_2—10 megohm, ½ w. carbon res.
R_3—220,000 ohm, ½ w. carbon res. (see text)
R_4—270,000 ohm, ½ w. carbon res.
R_5—1 megohm, ½ w. carbon res.
R_6—47,000 ohm, ½ w. carbon res. (see text)
R_7—270 ohm, ½ w. carbon res.
R_8—22 megohm, ½ w. carbon res. (see text)
R_9—33 ohm, ½ w. carbon res.
R_{10}—1000 ohm, 2 w. carbon res.
C_1, C_3—.005 µfd. disc ceramic capacitor
C_2—.1 µfd., 200 v. metallized paper capacitor
C_4—10 µfd., 25 v. tub. elec. capacitor
C_5—.5 µfd., 200 v. metallized paper capacitor (see text)
C_6—10 µfd., 150 v. tub. elec. capacitor
C_7, C_8—20/40 µfd., 150 v. dual elec. capacitor
SR_1—20 ma. selenium rectifier (Radio Receptor Type 8Y1)
S_1—S.p.s.t. toggle switch ("Power")
T_1—Power trans., 125 v. @ 15 ma.; 6.3 v. @ .6 amp. (Stancor PS8415)
RL_1—5000 ohm s.p.d.t. plate relay (P. & B. Type LM-5)
Mic.—Crystal microphone cartridge (Shure type R7)
V_1—6AU6 tube
V_2—12AT7 tube

Fig. 2. Complete schematic diagram and parts list for the "improved" sound switch.

Neither layout nor wiring is especially critical. However, good wiring practice should be followed. The input and output circuits should be kept well separated to avoid feedback and oscillation, and the power supply components should be kept away from the input circuit to avoid hum pick-up. All connections should be as short and direct as possible.

In order to conserve space, disc ceramic capacitors were used for coupling the input and the second stage (C_1 and C_3). Metallized paper capacitors were used for the screen grid bypass (C_2) and for the "time delay" coupling capacitor (C_5).

Commercial decals were used to label the model. These were protected with two coats of clear acrylic plastic, sprayed on after the decals had dried.

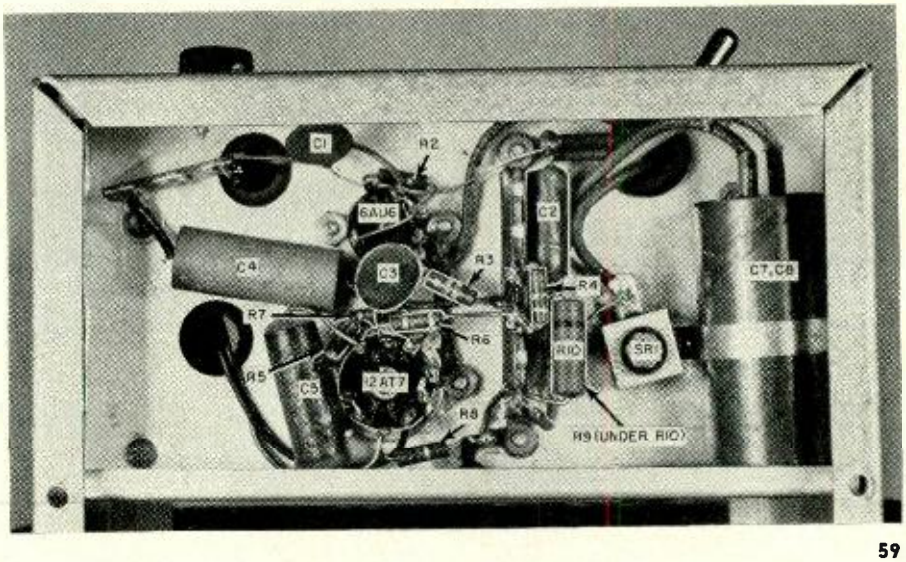
The microphone cartridge may be mounted by cutting a hole in the "Minibox" slightly smaller than the rubber support ring and forcing the "mike" into place. Special rubber-to-metal cement may be used if desired. See Fig. 5.

A pattern of small holes should be drilled in the back and top of the box cover to provide ventilation. Commercial louvers or "vent plugs" may be used instead, if preferred by the individual builder.

Circuit Modifications

A number of modifications in the basic circuit is possible, depending on the requirements of the individual builder. However, while circuit values are not critical, a certain amount of care should be exercised to avoid

Fig. 3. Under chassis view of the sound switch. Layout is not especially critical.



trouble. The average builder will probably find it best first to duplicate the circuit given in Fig. 2, and then, after checking the unit's operation, to make the desired modifications.

With the component values given in the parts list, the time delay is approximately 10 to 15 seconds. That is, the relay will remain open for this period of time after the actuating sound. To increase this time delay, increase the value of either C_5 or R_8 (or both). To reduce the time delay, decrease the value of these components. A "dual" time delay may be obtained by providing two capacitors (C_5) of different values, with a small switch to select the one to be used. A continuous control of time delay may be obtained by replacing R_8 with a potentiometer. However, the value of R_8 should not be dropped below 3 megohms.

The sound switch may be made sensitive only to certain tones by replacing plate load resistor R_3 by a parallel-tuned circuit adjusted to the desired frequency. A tuned circuit may also be used in place of R_6.

If desired, the instrument may be modified to use a "remote" microphone. Replace the "mike" connections with a closed-circuit jack and add a shielded lead and plug to the microphone cartridge.

Other possible modifications include replacing the relay (RL_1) with a different unit to obtain a greater number of contacts, using a control with a screwdriver slot instead of a knob for R_1, replacing the toggle switch with a key-type switch, or even combining the "Sensitivity" control and "Power" switch, and replacing the crystal mike cartridge with a magnetic unit. If desired, a PM loudspeaker and output transformer may be used in place of the crystal mike. Connect the primary winding of the audio transformer to the input of the instrument (across R_1), thus using it as a step-up unit.

Adjustment and Use

Two adjustments affect the senstivity of the sound switch—the setting of the "Sensitivity" control R_1 and the tension on the relay spring. For most work, the factory setting of the relay is satisfactory.

To use the sound switch, first connect the circuit to be controlled to the proper relay contacts to give the type of operation desired. Either "normally on" or "normally off" operation may be obtained, depending on the pair of relay contacts chosen. Turn the "Sensitivity" control to its minimum gain position.

After turning the unit on and allowing a few minutes warm-up, adjust the "Sensitivity" control so the relay opens with a sound of the desired level. The proper setting of this control will be such that the instrument does not respond to background noises, but operates instantly on the "control" sound. The position of the microphone with respect to the point at which the "control" sound originates will affect the setting of the "Sensitivity" control.

Applications

The possible applications of the "improved" sound switch are limited only by the ingenuity of the individual user. A few possible applications are listed and these should serve as a guide to the reader in working out applications of his own:

Voice controlled toys: By shortening the time constant of the time delay network (C_5-R_8) to the point where "pulse" type operation is obtained, the sound switch may be used to operate a sequence or stepping relay to control toys or models.

Commercial "killer" or radio-TV silencer: A piece of ordinary line cord may be used to connect the relay terminals across the coil leads of a radio or TV receiver. The "Sensitivity" control is adjusted so that the relay does not operate on normal program volume. When a commercial comes on, simply shout "Shaddup!" and the sound switch will do the rest . . . the commercial will be cut off for about 10 or 15 seconds . . . if this isn't long enough, extend the time by saying "Keep Quiet!" Used in this fashion, the sound switch is also handy for silencing a radio or TV set when you are called to the telephone. If the sound switch is placed near the phone bell, radio silencing may be made automatic.

Garage door opener: Mounted in a garage, with the relay contacts connected to a door opening motor, the sound switch may be used as a remote control for opening the garage doors. Adjust the "Sensitivity" control so the sound switch will respond only to an auto horn sounded a few feet away. Little sensitivity is required.

When you come home, drive up into the driveway until your car is only a few feet from the garage. Sound your horn and the sound switch will do the rest.

"Secret" lock: With the plate load resistors (R_3 and R_6) replaced by tuned circuits (at a selected audio frequency), and the relay contacts connected to control an electric lock release, you have a "secret" lock which may be operated. Adjust a small whistle to sound a note of the proper frequency.

"Noise" alarm: When a late party is planned, the sound switch may be connected to operate a light or buzzer and the "Sensitivity" control preset. As long as the party proceeds at a quiet pace, the neighbors will be happy and the sound switch will remain inoperative. Should the party become too boisterous, however, the sound switch will let you know so you can quiet things down and avoid tangling with the police.

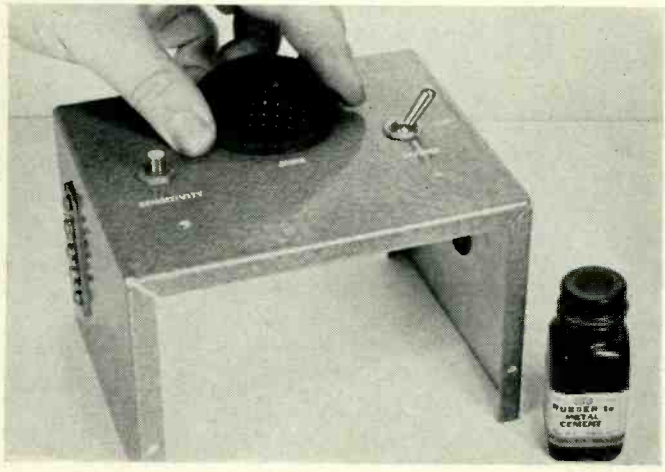
Tricks and stunts: The sound switch may be used to good advantage at parties or meetings . . . to turn a light off or on "on command", to operate a record player on command, and in similar applications.

Transmitter control: Hams will find the sound switch useful as a control on their phone transmitters. Instead of having a "push-to-talk" switch, use the sound switch (the same microphone may be used both for the sound switch and for the transmitter). The transmitter is turned from "standby" to "on" as soon as the operator starts talking.

Audio burglar alarm: If you live in a quiet neighborhood, you can connect the sound switch to an alarm bell and turn the "Sensitivity" control up just before you retire. If someone tries to "jimmy" a door or window, the sound of their efforts will operate the alarm. When used in this application, the sound switch should be placed near the outside entrance. —30—

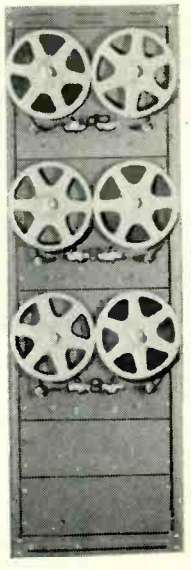
Fig. 4. Top chassis view with various parts identified.

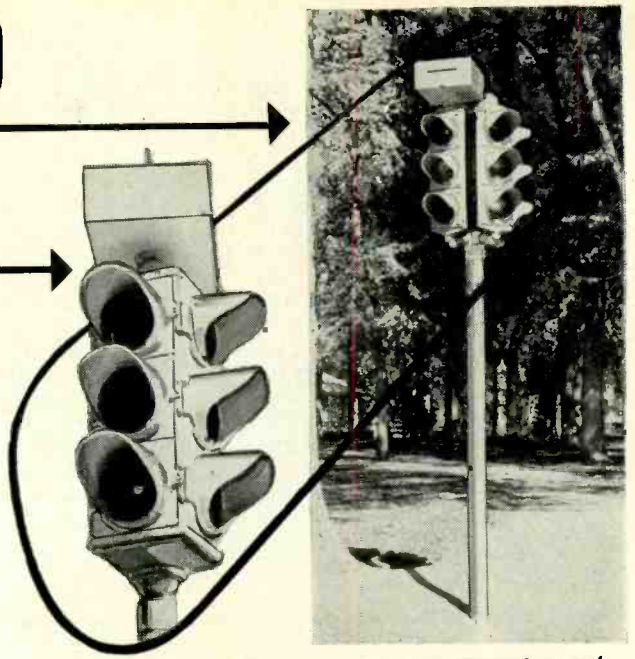
Fig. 5. One method of mounting the microphone cartridge.



RADIO-CONTROLLED TRAFFIC LIGHTS

By **NORMAN SKLAREWITZ**





Two views of the radio control equipment mounted on traffic signal and the three-tape system which provides the automatic cycling for control, as installed in Greeley, Colo.

First electronic system of its type now permits traffic signal patterns to be adjusted from a central point.

ELECTRONICS will take over the job of traffic control in a growing number of American cities this summer as a new engineering contribution toward speeding vehicle movement and saving lives. Conventional corner traffic lights will be activated by remote-control radio.

Greeley, Colorado, already has one system, designed by *Colorado Electronics Corporation,* in operation, and Chicago will get the world's most extensive network of radio-operated signals by summer. The equipment for the Windy City was designed and built by *General Electric.*

Both systems utilize existing stop-and-go lights but overcome the disadvantage of fixed time cycles. Tone signals transmitted from a central radio station to FM receivers mounted near the lights will re-time signals automatically as required by car movements and weather conditions.

The need for these new systems stems from the fact that street traffic changes its pattern a number of times each day. During the early morning rush hours, for example, cars roll into Chicago's "Loop" area at a tremendous volume. Yet intersection signals remain at constant timed cycles. The period of "go" for this southbound flow is the same as it is for traffic headed north although virtually no cars are moving in that direction.

Cars back up for blocks and drivers fuss and fume. The result of this condition is more than delays and inconvenience, engineers found. In order to "beat the lights," drivers make jackrabbit starts, cut in and out, and follow much too closely. Dozens of serious accidents along such busy thoroughfares as well as dented fenders and bent grilles underscored the need for some change.

Lloyd M. Johnson, Chicago's commissioner of streets, initiated a detailed survey of traffic conditions. The result was a recommendation that the number of intersections with traffic lights be increased by almost 1500 new signals.

The majority of these new lights could be equipped with conventional preset timing patterns. At about 450 corners, however, engineers said that the unbalanced traffic flow during the morning and evening rush hours called for a system that would permit variable time conditions. This could be done by interconnecting the lights by underground cable—a system used in heavily concentrated business centers. Cost, however, was a prohibitive $3,375,000!

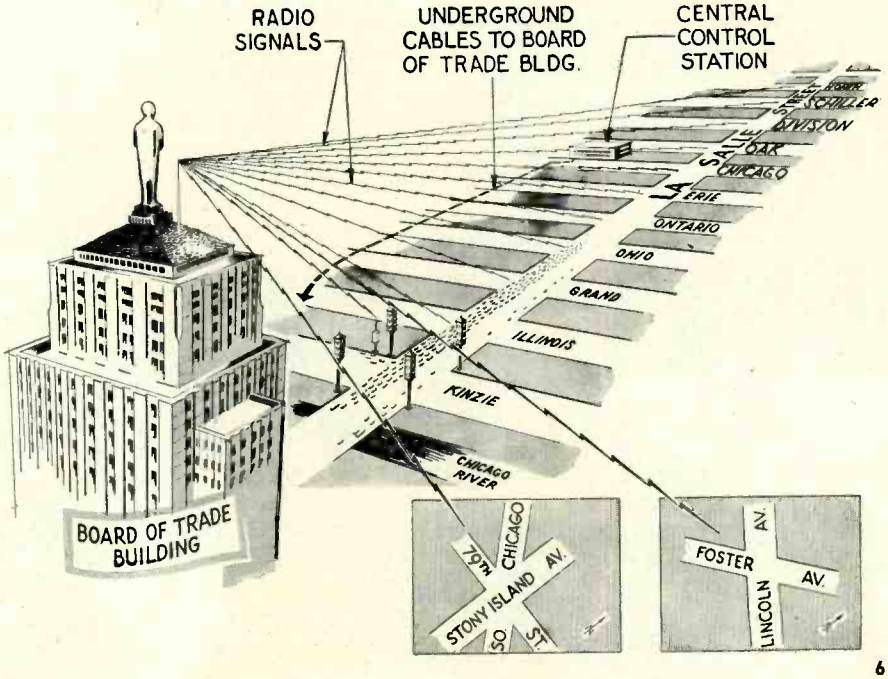
So another solution was sought and radio was it. Research and development of an entirely new idea in remote-controlled signals was undertaken by the city's associate traffic engineer, Ralph F. Michel, and *General Electric's* Charles L. Race.

A pilot network was subsequently designed with radio-controlled signals going at two different six-way intersections on the city's South and West Sides and along eleven intersections of La Salle Street which brings traffic directly into the Loop district from the Outer Drive.

The Central station for the Chicago system will be a *G-E* 34-W transmitter which will be located in the Board of Trade Building, one of the city's tallest

(*Continued on page* 106)

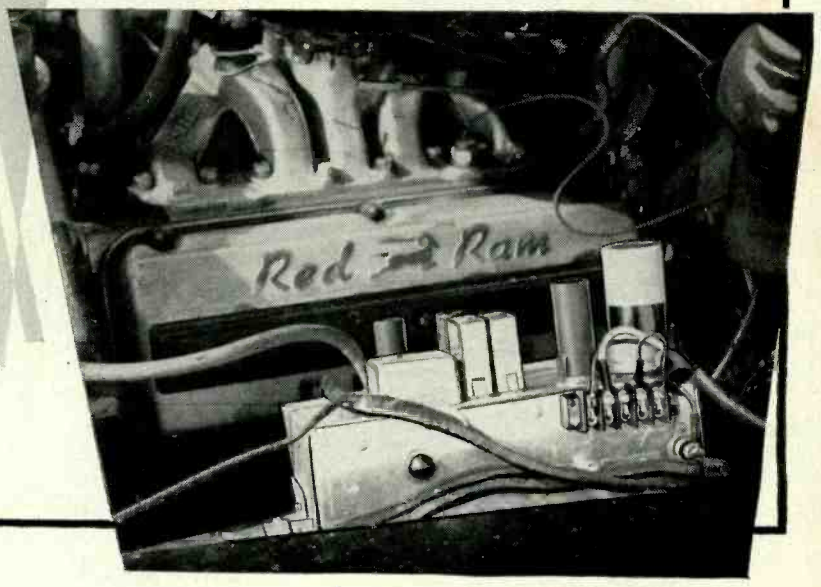
The new traffic control signal plan being set up in Chicago by General Electric.



ELECTRONIC IGNITION SYSTEM

By **HARRY W. LAWSON, JR.**

The electronic ignition unit installed in the author's V-8 Dodge. The chassis can be accommodated under most car hoods.



Step-up performance of your car without use of added coils or distributors by incorporating this simple circuit.

THE system to be described here can be considered more than a hot-rod novelty. Indeed it should be of interest to any Saturday mechanic on the lookout for smoother operation, better acceleration, and extremely long point life. Perhaps, first it would be well to lay some ground work about ignition systems in general.

To begin with, those of you who remember the struggling infancy of the automobile industry may recall the various methods of obtaining the required ignition voltage. Out of all the multitude of magneto and vibrator-coil designs, there emerged the single-coil interrupter type still in use today. The industry's reluctance to abandon this antiquated method stems mainly from the economics of long-standing practice.

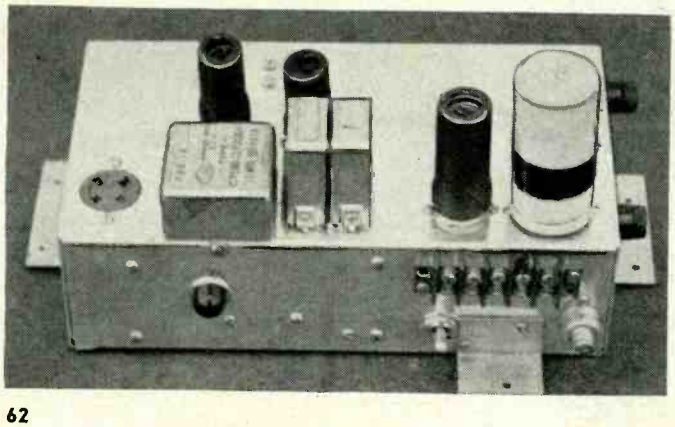
Let us first review the operation of the conventional ignition system used today along with its various innovations. Starting with fundamentals, it has long been established that the interruption of current through a coil produces a voltage induced in the coil proportional to the inductance of the coil and the rate of change of current in that coil.

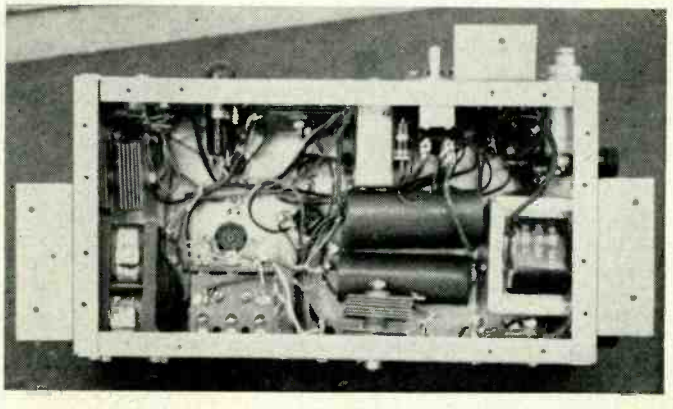
$$\text{Hence: } E_{ind.} = L\, di/dt$$

If we then place another winding on this coil (*i.e.*, a transformer), this second winding will have induced in it a voltage proportional to the first winding voltage multiplied by the turns ratio. Hence, with large ratios the right order of magnitude of ignition voltage will result in the second winding or secondary. This is all well and good except that it is a little rough on the contacts that do the interrupting. It will be apparent that the entire primary induced voltage (250 to 350 volts for an ordinary coil) appears across the points immediately on opening. With the small contact spacing present at the initial break, this voltage is sufficient to break down the gap and cause a destructive arc. In order to slow down the rate of rise of voltage across the points, a capacitor is shunted around them. Since the capacitor voltage cannot change instantaneously, the points have sufficient time to increase their gap above breakdown voltage. The result of all this is the ignition system used today, as shown in Fig. 2.

On closer examination of this circuit we will find that on opening of the points a series resonant circuit is present, consisting of the primary coil inductance and the distributor capacitor (*C*). With typical values of 5 to 15 millihenrys (open secondary) and .25 μfd. the opening of the points causes a sinusoidal rise of voltage for roughly one-quarter cycle of a 2000 to 3500 cps wave, assuming the spark plugs fire at approximately the peak of this wave. A plug firing appears as a secondary short circuit reflecting a decrease of primary inductance on the order of ten-to-one or .5 to 1.5 millihenrys. With this change of primary inductance the induced voltage and subsequent damped oscillations have now become shifted to the neighborhood of 10,000 cycles per second. Fig. 1 illustrates this point of operation. It should be mentioned that if the plug fails to fire at the top of the initial rise it is

Two views of the author's ignition system. It is ruggedly constructed throughout to withstand vibration and engine heat.





safe to assume that it will not fire at all.

First, take a look at some of the aspects of this system as described. True, it is simple and reliable, but it fails in many ways to meet the requirements of modern, high-speed engines. During the relatively slow initial voltage build-up, needed coil energy is expended through ground leakage paths in the high voltage wiring. This is aptly demonstrated by fouling a plug with as high as ten megohms shunt resistance. In addition, this slow build-up time, although of no consequence at low speeds, amounts to twenty-four crankshaft degrees at 4000 rpm. True, an attempt to correct this and the combustion rate is made by automatic distributor advance, but nonetheless the difference between the optimum and actual firing points increases with speed.

Of the most consequence however, is the inability of the present system to function at high engine speeds. The reason for this stems from the relatively slow rise time of the charging current in the coil, this time being proportional to the ratio of the coil primary inductance to the circuit resistance. Thus, in order for proper ignition voltage at high speed the closed point time or dwell time in seconds should be on the order of ten times the time constant L/R. This condition can be improved by the addition of another set of points whose function is solely that of increasing the dwell time in order that the charging current more nearly reaches its full value before break. On the author's V-8 *Dodge* this dual-point distributor is standard equipment as on all *Chrysler* V-8 engines.

Though the foregoing is only a partial coverage of the story it would be pertinent here to set down the requirements of an ideal ignition system: *a*. Good reliability; *b*. No speed limitation; *c*. Not affected by secondary loading; *d*. Elimination of points; *e*. No warm-up time; *f*. No supply voltage restriction; and *g*. Low cost and easy serviceability.

Although the system to be described does not eliminate points, it meets the other requirements. However, since the point current and voltage requirements are both reduced by a factor of fifty to one, point life is increased.

It can be seen from Fig. 1 that there is much to be gained by applying a fully charged capacitor directly across the coil at the desired instant of firing. The simplified schematic shown in Fig. 3 illustrates a circuit which will accomplish this. Capacitor C, which has become charged through the limiting resistor R, is suddenly switched across the coil by means of the thyratron. The resulting current and voltage waveforms for this circuit are shown in Fig. 4. This circuit has the disadvantage that the limiting resistor, R, is wasteful of plate current during thyratron conduction and limits the maximum firing rate by slowing up the capacitor recharging.

By replacing the limiting resistor by charging choke L_1, as shown in Fig. 5A, the efficiency of the circuit can be raised 100 per-cent. This is brought about by the utilization of the energy storage in this inductance during conduction. Since capacitor C is charged by both the power supply and the stored inductor energy, the resultant peak capacitor voltage is approximately twice the power supply voltage. Since the rate of firing has a wide frequency range, the selenium rectifier, *Rect.*$_1$, is used to hold the capacitor at full peak voltage before firing. Since the thyratron conducts for only one-half cycle, as soon as the tube extinguishes its plate voltage drops as shown in the Fig. 5B waveforms. This is due to the negative charge left on capacitor C. If the inverse diode *Rect.*$_2$ is added as per Fig. 5C, the other half cycle of the oscillation is completed and the firing capacitor is charged to twice power supply voltage, again from

(*Continued on page* 90)

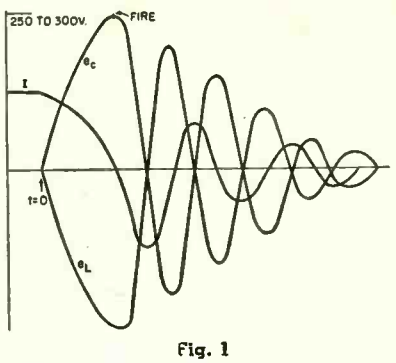


Fig. 1

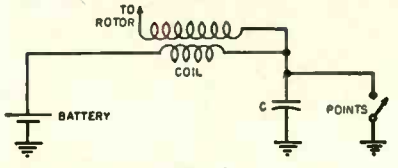


Fig. 2

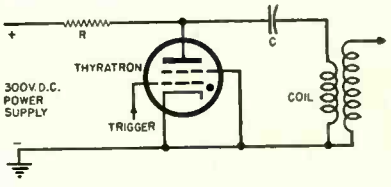


Fig. 3

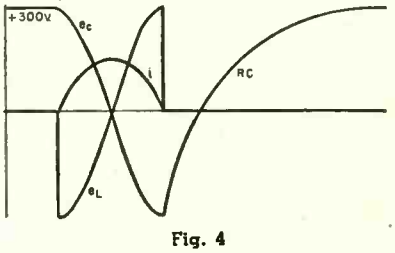


Fig. 4

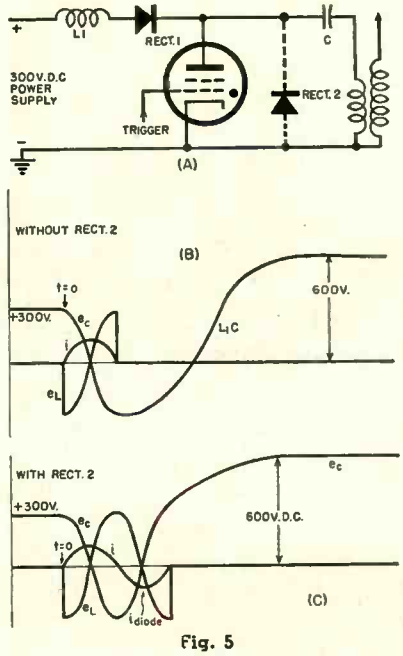
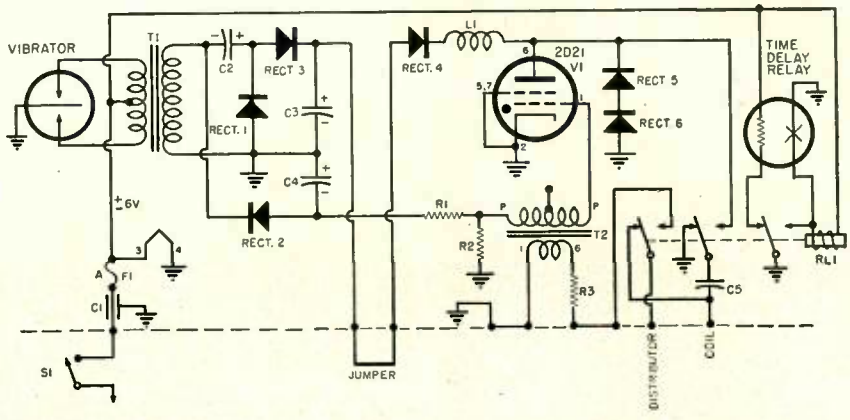
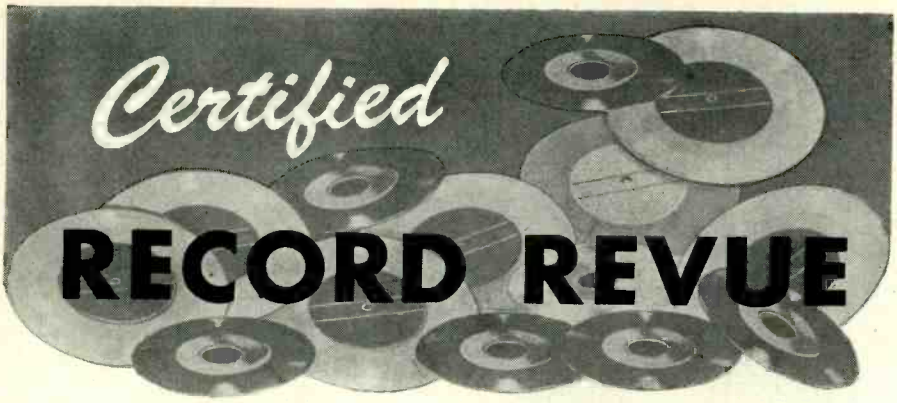


Fig. 5

Fig. 6. Complete diagram. Filament transformer is used as vibrator transformer.



R_1, R_2—100,000 ohm, ½ w. res.
R_3—51 ohm, 2 w. res.
C_1—.1 µfd., 600 v. capacitor (Sprague "Hy-pass")
C_2, C_3, C_4—40 µfd., 350 v. elec. capacitor
C_5—.5 µfd., 1000 v. oil-filled capacitor
F_1—4 amp fuse
RL_1—3-pole, d.t. relay, 6 v. d.c. coil, 5 amp contacts
S_1—S.p.s.t. disabling switch (remote)
Vibrator—4-prong standard vibrator
L_1—See text
Time Delay Relay—Miniature 15 sec. time delay relay, 6.3 v. (Amperite)
Rect. 1, Rect. 2, Rect. 3, Rect. 4, Rect. 5, Rect. 6—100 ma. selenium rectifier
T_1—Fil. trans., 6.3 v. @ 3 amp
T_2—Audio output trans. (Stancor A-3850)
V_1—2D21 thyratron



By **BERT WHYTE**

AS THE regular readers of this column know, I'm a creature of moods. Some months, I ain't mad at nobody; other months I'm loaded for bear and ready to eat raw meat! Of course, these "moods" or attitudes are merely my personal reflection on what is currently good, bad, or indifferent in the world of audio. Those of you who don't cotton to my ranting can stop reading right here . . . cause this month I'm *really* fuming!

You know, I have supported the audio-hi-fi movement ever since 5000 cycles was a big deal. Like many of my contemporaries, I'm pretty proud of the fact that the prognostications we made about the future of high quality music reproduction are at long last coming to fruition. Yessir, hi-fi is bigtime now . . . articles about it in *Life, Time, Newsweek,* etc., etc. Hi-fi is becoming (unfortunately from a philological viewpoint) a word in common usage . . . hi-fi shops and services burgeoning everywhere. You might say the musical millennium has arrived for certainly the public interest in good musie and high quality sound is one of the phenomena of this decade. I sincerely feel that this tremendous upsurge of interest in what is largely a cultural pursuit, is one of the saving graces that makes life bearable in the psychoneurotic political climate of this weary world. Feeling as I do about good music and hi-fi, I am acutely sensitive to influences and conditions which might have a deleterious effect on the public acceptance of this medium.

It is because of this that I call your attention to a situation which is rapidly becoming one of the greatest menaces to hi-fi sound. I refer to the insidious rise of "discount stores" as a source of hi-fi equipment. At first glance, one might raise the question . . . "what is so harmful about a discount house? After all, if I can save a few bucks on the equipment, what is wrong with that?" On the face of things, the answer to this seemingly would be . . . nothing! It is human nature asserting itself when we try to "get something for nothing," or we indulge in "Yankee horse trading" to save a few dollars. It is just as much a part of human nature to be suspicious . . . to beware the "pig in the poke" type of transaction. And well you might be suspicious! The sad plight of many people who "got a deal" attests to the basic fallacy of doing business with a discount house. Yessir, that "ten or fifteen or twenty per-cent off net" sounds mighty attractive, but if the average hi-fi buyer would take a good look at the background of his deal . . . I very much doubt that the discount would continue to be attractive. Let me give you a few illustrations of things which have happened to many discount-conscious buyers.

Not long ago a friend of mine walked into a shop in New York which is notorious for its cut-rate policies. My friend wanted to purchase a well-known preamp-equalizer, and after some of the usual haggling, he got his unit for about 17% off the net price. He was quite smugly satisfied with the "shrewd" deal he had made . . . satisfied until he opened his "poke" and took a look at the "pig" inside. Oh, he had a new unit all right. But the serial numbers of the thing were deliberately obliterated and no warranty card could be found. In other words, he had purchased a piece of bootleg equipment and if something turned out to be wrong with it . . . he was up the well-known creek. What is behind all this is that the shop was not an authorized dealer for this particular unit and had been buying stock from out-of-state "transhippers." Discount houses generally don't give a tinker's toot about service. Many do not maintain a service department at all and for the most part those who do, have them mostly as "window dressing" and they are totally inadequate. I hardly need say here that service facilities are important . . . as good and reliable as most hi-fi equipment is, things do go wrong!

Now we come to one of the most annoying aspects of doing business with a discount house, and that is a general lack or inadequacy of demonstration facilities, and the inexpert and poorly trained personnel. I will swear an affidavit that I was told the following in one of the big discount houses in downtown New York: "Demonstration? Phooey! Our men are trained to quickly discern whether the guy who walks into the store is a 'looker' or a 'buyer.' If he's a 'looker' we give him a fast brush . . . if he's a buyer, we get right down to the question of price, rarely do we have to demonstrate." And as Mr. Gobel would say, "so there you are!" I know the foregoing may seem incredible, but that is a pretty general state of affairs in the discount houses. Many of them have no facilities for A/B comparison, there is no consideration whatsoever of acoustic environment and much of what rarely does get demonstrated is improperly matched as to impedances, etc. When it comes to personnel, it's just short of murder! You can hear more pure balderdash and mis-information dispensed in one of these discount joints in five minutes than you can hear in a legitimate establishment in a year!

Sure, if you're real hep to the hi-fi, you *know* what equipment you want, etc. But consider the case of the average Joe who doesn't know much about the subject and must, perforce, depend on the supposedly "expert" advice he thinks he can get in the hi-fi salon. One of the most lamentable practices that has sprung up is the unthinking (and hardly ethical) person who goes to a legitimate dealer's showroom, gets courteous and expert attention from highly qualified hi-fi consultants, listens in comfort, and makes comparisons through the excellent (and expensive) switchboard setup, and then high-tails it to the discount house a few blocks away and makes his purchases. The net result of this kind of shenanigans is that many of the reputable dealers with big investments in stock and demonstration facilities and high salaried personnel, are finding themselves in very untenable positions. And it is really quite a dilemma! The hard, cold, inescapable fact is that hi-fi equipment cannot be properly sold to the average person unless there is considerable investment in plant and personnel. And with these investments, the reputable dealer cannot afford to compete with the two-bit discount houses.

Some dealers have faced up to the situation by getting out of the hi-fi business altogether or by dropping those lines which are being "footballed" around the discount houses. Which brings up the point that the manufacturers are hardly blameless in many cases, since they sell direct to the cut-price artists. In this they are sowing the seeds of their ultimate destruction. A few of the manufacturers "hungry" for a fast buck started all this foolishness and gradually others followed suit in self-defense. If the discount market ever got out of hand, it would be the downfall of the hi-fi market and movement as we know it today. A few of the really big powerful dealers recognize this, and are bringing pressure to bear on certain manufacturers, by threatening to drop their lines and by other actions. Unfortunately, the Fair Trade laws in this country are in such a confused mess, that no recourse can be found in them. It all boils down to this: either everybody is going to become a hi-fi expert (a highly improbable happenstance) and use discount houses or the *thinking* person will realize that he is better off enjoying the facilities and expert advice offered by the legitimate dealer. If the public continues to use the discounters . . . it means the end of the reputable hi-fi salons and hi-fi will have been dealt a body-blow from which it may never recover. Be sensible . . . no one ever got something for nothing. You get what you pay for, and in no business is this truer than in high fidelity.

Equipment Used this Month; *Electrosonic* Professional Series arm and cartridge, *Components Corporation* turntable, *McIntosh* C-8 preamp, two 30-watt *McIntosh* amplifiers, *Jensen* "Imperial" speaker, *Jim Lansing* D 34001 speaker system.

BIZET
SYMPHONY #1
PATRIE OVERTURE
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL1186. RIAA curve. Price $3.98.

This comes hard on the heels of the excellent versions by Cluytens and the Philharmonic Orchestra on *Angel*. In comparison, I think Ansermet is more astute than Cluytens in the symphony, while Cluytens is more spirited in the "Overture." Soundwise, the *London* is outstanding, with superb string tone and brilliant brass. The *Angel* is more subdued in over-all effect, but will find its adherents as well. Nice "live" acoustics in both recordings. The RIAA curve was improved with a slight bass boost. Quiet surfaces in my copy.

WALTON-SITWELL
FACADE
Dame Edith Sitwell and Peter Pears with The English Opera Group Ensemble conducted by Anthony Collins. London LL1133. RIAA curve. Price $3.98.

This is listed as an "entertainment" and I can assure you it qualifies as that! The recording here supplants the old one with Dr. Sitwell on an early *Columbia* and, cloaked in

(*Continued on page* 96)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine

Six months from today

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this-

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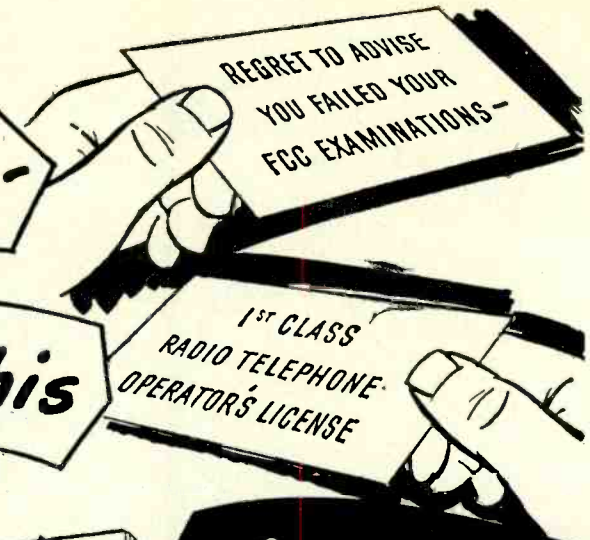

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Charles Ellis, Box 449, Charles City, Iowa	1st Class	28 Weeks
Omar Bibbs, 1320 E. 27th St., Kansas City, Mo.	1st Class	34 Weeks
Kenneth Rue, Dresser, Wisconsin	2nd Class	20 Weeks
B. L. Jordan, Seattle, Washington	1st Class	20 Weeks

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Charles E. Loomis, 4516 Genessee Ave., Dayton 6, Ohio

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Variable Damping

(*Continued from page 45*)

source impedance for a particular speaker must be specified by the manufacturer of that speaker, as the means for proper adjustment of frequency response through variable damping are beyond the capacity of any but a well equipped acoustics laboratory.

The author has questioned several speaker manufacturers and has found them amazingly (and amusingly) reluctant to comment on how their speakers should be operated. The consensus seems to be that modern speakers are expected to work properly with amplifiers of low positive source impedance (damping factors of 10 or more), and the manufacturers' specifications are set from a constant voltage source—the equivalent of a zero impedance source. Any departures from this conventional standard should be mentioned by the manufacturer in his directions for using the speaker.

Conclusion

Weighing the various pros and cons of variable damping, the author finds it difficult to justify variable damping except in the limited case of low grade speakers or situations where the speaker manufacturer intended a specific source impedance other than close to zero.

Speaker distortion may be affected for better or for worse through variable damping. Frequency response will generally be most suitable for a low source impedance. Therefore, a fixed, low source impedance, such as is normally obtained from amplifiers with appreciable negative voltage feedback, will provide close to optimum performance as well as insuring that the speaker is critically damped (or slightly overdamped).

On the other hand, the use of current feedback to provide variable damping introduces new problems which tend to degrade listening quality. When a multiple speaker system is used with a crossover network, the impedance-sensitivity of current feedback will cause frequency variations which cause rough and ragged reproduction at the crossover frequencies. If no crossover is used in a multiple system, the impedance variations in one part of the system cause current feedback changes which are reflected in changes in signal level to other units in the system. This again accentuates raggedness of frequency response.

The most serious drawback to the use of variable current feedback lies in the dangers of instability. This is particularly true where the feedback is positive. In order to minimize this difficulty, some designs introduce filters to confine the positive feedback to a limited frequency spectrum. However, this causes frequency unbalance similar to tone control action.

Listening tests under reasonably well controlled conditions indicate that, as theoretically expected, high output impedances lead to boomy and screechy sound quality, while negative impedances lead to a loss of bass. Extremes in either direction lead to veiled and indistinct sound quality. Undoubtedly, other experiments using different equipment could lead to different conclusions, but so far the author has found nothing to justify variable damping, while many factors indicate that it is undesirable.

EDITOR'S NOTE: *One thought that should not be overlooked is that many manufacturers have been including some form of variable damping in their new amplifiers at no additional cost to the consumer. Many individuals may find it quite interesting to experiment with this feature. In all cases, it can be cut out of the circuit if not desired.*

The measurements shown in Table 1 and Fig. 2 were made by Mr. Bruce DePalma, of M.I.T. Mr. DePalma also contributed many ideas on the subject of variable damping during the course of the discussions and tests on which this article are based. —30—

WYOMING HAMFEST

THE annual Wyoming Hamfest will be held at the South Fork Inn area, 18 miles west of Buffalo, Wyoming on Highway 16, on July 23rd and 24th. Cabins or camping sites will be available.

The Sheridan Radio Amateur League has prepared a full program that will include a banquet, a Wyoming "Trading Post," and valuable prizes.

Registration, including the banquet, is $3.50. Hams vacationing in the Yellowstone Park area are invited to join with the Wyoming hams in this get-together.

Register with W7QPP, 362 E. Loucks St., Sheridan, Wyoming, or contact any Wyoming ham for full details on this hamfest in the wide-open-spaces. A hearty welcome awaits attendees. —30—

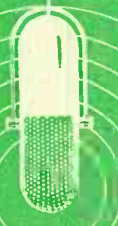
RETMA TEACHERS' COURSE

AS PART of its effort to increase the skills of practicing TV service technicians, the RETMA has announced that it is again offering a three-week teacher training seminar in advanced TV servicing techniques, beginning July 5th. The seminar is being offered by RETMA and the New York State Department of Education, in cooperation with the New York Trade School, N.Y.C.

This year's seminar will offer special advanced instruction in TV servicing to teachers of television courses in public and private schools in addition to those who conduct instruction for service organizations.

The course will include instruction on servicing all sections of TV receivers, in addition to antenna systems and TV accessories, customer relations, techniques of teaching, and the organization of a school workshop. Extensive laboratory work will be included.

Full details are available from Gilbert Weaver, Director of Training, The University of the State of New York, 227 E. Ninth St., New York 3, N. Y., upon request. —30—



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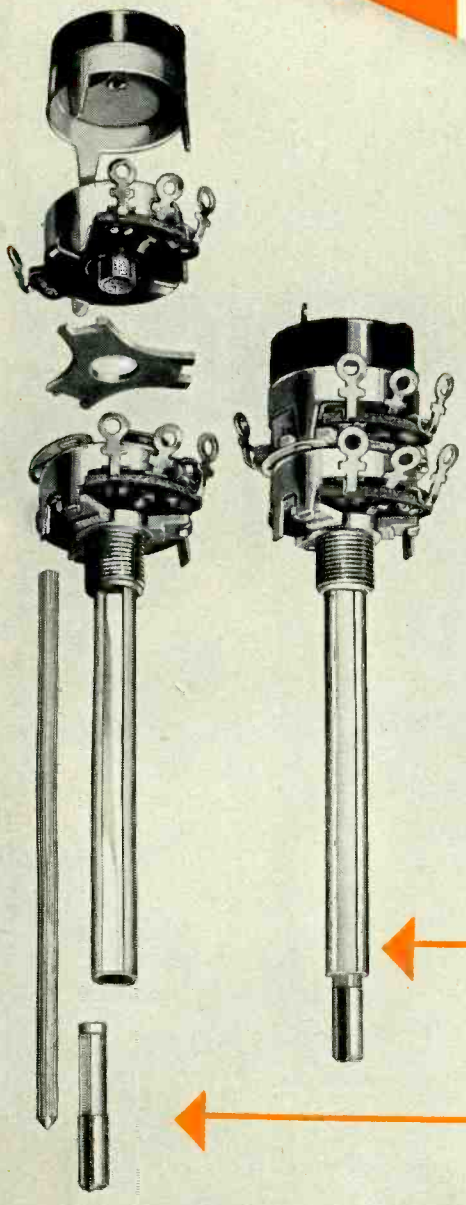

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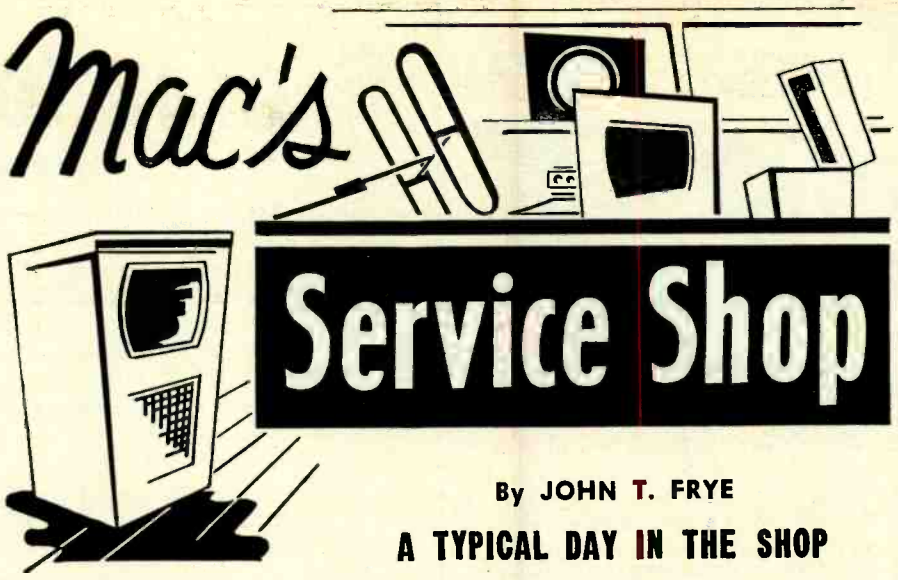

By JOHN T. FRYE

A TYPICAL DAY IN THE SHOP

A MAN who was just leaving the service shop politely held the door open for Barney to enter. The youth, at the age when he thought all forms of common courtesy were, at best, so much wasted motion, or, at worst, performed with an ulterior motive, looked suspiciously after the neatly dressed man as he carried a small tool box to his waiting car.

"Well, Mac," Barney greeted his boss, "did you finally get a set too tough for you and have to call in another technician for a consultation? Why didn't you call on me? I'm always available."

"That would be like a one-eyed man asking a blind man to lead him," Mac grunted. "That fellow is a technician all right, but he works on electric typewriters instead of radios. The on-off switch on Matilda's pride and joy finally wore out, and he came over to replace it."

"If that's all that was wrong, why didn't you do it yourself?"

"My mind started working in that direction, too," Mac admitted, "and then I brought myself up short. There I was right on the verge of doing what I criticize so severely in our customers: tinkering with something I knew little about and that I was not equipped to service; so I picked up the telephone and called the service department of the people who sold us the typewriter and asked them to send a repairman over to fix it. He came right away, and I'm certain I got a lot more useful information out of watching him work than the bill will total."

"How's that?"

"Well, I happen to know that the company manufacturing our electric typewriter also makes other expensive office equipment used all over the globe. Since they realize their service technicians represent the whole company and its products in the minds of many people, they give each fellow an intensive and thorough training before he is allowed to start work. It occurred to me that if I watched him at work here in our office, I probably could pick up some good pointers on how a professionally-trained technician worked to produce a good impression; then I might even try to graft some of these scientific methods on you."

"Trust a Scotchman to squeeze an education out of a service call," Barney said with a grin. "What did you learn?"

"You saw for yourself how neat and clean he was—and how courteous. He came in, introduced himself, removed his coat, opened his toolbox and took out a workcloth to place beneath the typewriter, put this in place, and went right to work. No time was lost in idle chatter. In that little toolbox he had exactly the right tool for every job, and I particularly noted the tools were clean and in excellent condition.

"Even though I promptly gave him my own diagnosis of the trouble, he politely made his own checks before starting to remove the switch. Two or three other times I offered him the benefit of my valuable advice—which invariably turned out bad. He received all this courteously, without comment, and then went right ahead to do the job the way it should be done; but he was careful not to mention or point up the fact that I was mistaken. That takes good discipline and will power to keep from showing a smart aleck how wrong he was!

"I kept trying to engage him in conversation on every subject from baseball to politics. He answered me each time politely and briefly, but he kept right on working. His movements were quick and sure but gentle. That typewriter was treated as though it were a priceless family heirloom. After the switch was installed, he worked it several times to be sure *it* was all right. Nothing was taken for granted. Next he cleaned and oiled the entire machine —not only the working parts but also the portions that had to do with the appearance of the typewriter. After that, in spite of the fact that Matilda and I both assured him there was nothing wrong with the typewriter except the bad switch, he ran a sheet of paper into the rolls and checked the operation of every key and control several times. And he found several minor flaws in the typewriter's operation that we could easily see when he pointed them out but that had gone unnoticed before. For example, he made every key hit with exactly the same force so the letters were of equal shading. All of these things were taken care of easily and quickly until finally the machine was doing the job he knew it was capable of; then he put away his tools and wiped the desk so it was actually cleaner than when he started."

Barney took in every word of this, although he pretended to pay scant attention; and Mac knew the boy would try to put into practice the points observed and stressed. For a while both men worked in silence; then Barney piped up:

"Mac, here's a queer one. This set is practically new, but it has developed a bad hum. At first I thought it was filter capacitors, but new ones don't help. I've tried new tubes in the output and audio amplifier stages with no improvement; yet I know the hum originates here because when I pull any tube ahead of the detector and audio amplifier tube, the hum is not affected; but when I pull that tube, the hum stops. A kind of funny thing is that the hum seems to get worse as the volume is turned down."

Mac noted the model number of the set and went to the service literature file and pulled out a folder covering the set. He studied the diagram for a couple of minutes and then turned the chassis over and studied it for a few seconds. Next he got a new 35W4 tube and substituted it for the one in the set. When this warmed up, the set played normally and there was no hum.

"Well, I'll be a monkey's uncle!" Barney exclaimed. "I never thought of a bad rectifier tube causing hum. Thanks a lot. I'll put it back in the cabinet now."

"Not so fast," Mac cautioned as he replaced the old 35W4 in the socket. He waited until the hum was coming through strongly and then carefully cut a lug loose from one of the tube sockets so that the resistor and capacitor leads soldered to this lug were freed from the socket. Instantly the hum quit.

"For the umpteenth time," Mac said wearily, "I repeat: study the diagram whenever you come up against an unusual symptom. In this case the unusual symptom is that business of the hum being worse when the volume is turned down. The diagram shows the bottom of the volume control does not go directly to ground, as is usually the case, but instead returns to 'B-minus' through this 2200-ohm resistor. A .05 μfd. capacitor connects to the junction of the control and this resistor, and the other end of the capacitor goes through this 4700-ohm resistor to the cathode of the output tube. The cathode resistor of this tube is not bypassed, and some of the voltage developed across it is fed back through the resistor and capacitor to the bottom of the volume control, thus supplying negative feedback to the grid of the audio amplifier tube fed from the sliding contact of the control. (*Continued on page* 82)

WHAT IS YOUR "FI-Q"?

By **W. R. NUGENT, E.E.**

Test your grasp of high fidelity with this brief yet comprehensive quiz. The twenty questions below cover the full scope of hi-fi from recording to the ear, and will give a good indication of your mastery of this timely subject. A choice of three answers is given after each question. When all questions are completed, compare your answers with the correct ones on page 129. Give yourself 5 points for each correct answer. A score of 90 to 100 ranks you as an expert; 75 to 85 indicates "advanced amateur" status; 60 to 70 places you in the "novice" class, while less than 60 shows you need to acquire a firmer background in the tools and techniques of hi-fi.

1. Increasing the speed of recording on tape will cause frequency response to:
(a) improve (b) deteriorate (c) remain the same

2. "Liveness" in a recording refers principally to:
(a) dynamic range (b) tone quality (c) reverberation time

3. With phono pickup arms of equal length, which type will introduce the least tracking distortion?
(a) straight head (b) bent head (c) no difference

4. In phono cartridges, the term "compliance" refers to the ratio of needle displacement to:
(a) tracking error (b) voltage generated (c) force applied

5. A recording with constant amplitude characteristics is reproduced by an "ideal" magnetic cartridge. As the frequency is increased, the output voltage:
(a) is essentially constant (b) increases at 6 db/octave (c) decreases at 6 db/octave

6. Bent shank needles are designed to give:
(a) increased vertical compliance (b) longer needle life (c) less surface noise

7. From the standpoint of quietness and speed regulation, the best type of motor for recording or playback use is:
(a) 4-pole induction (b) shaded pole (c) hysteresis-synchronous

8. High sensitivity is of greatest import in FM tuners employing:
(a) limiters (b) ratio detection (c) a.f.c.

9. Many quality tuners and preamplifiers are shock mounted. This reduces the possibility of:
(a) breakage (b) microphonics (c) poor connections

10. D.C. heater supplies are often used in low-level stages of preamps in order to reduce:
(a) parasitic oscillations (b) transformer drain (c) hum

11. If a preamp is to be used at a distance from the main amplifier, a wise choice of preamp output would be:
(a) cascode (b) cathode follower (c) push-pull

12. Push-pull amplifiers help to eliminate distortion by cancelling all spurious:
(a) odd harmonics (b) even harmonics (c) odd and even harmonics

13. Expander circuits are useful when playing recordings having limited:
(a) pre-equalization (b) frequency range (c) dynamic range

14. In conventional speakers, the angle of sound radiation is narrowest for the:
(a) low frequencies (b) high frequencies (c) no difference

15. The most faithful reproduction is obtained from which type of speaker enclosure:
(a) bass reflex (b) labyrinth (c) horn

16. To obtain full symphonic volume in an average livingroom, a speaker must deliver an average acoustic power of about:
(a) 1 watt (b) 5 watts (c) 10 watts

17. To the ear, the most objectionable type of distortion is:
(a) amplitude (b) phase (c) intermodulation

18. "Loudness" controls compensate for variations in the frequency response of the ear at different volume levels. The ear's frequency response is poorest at:
(a) high volume (b) low volume (c) average volume

19. The audible frequency spectrum is roughly from:
(a) 30 to 18,000 cps (b) 300 to 8000 cps (c) 800 to 30,000 cps

20. The weakest link in most hi-fi rigs is usually the:
(a) pickup arm and cartridge (b) amplifier (c) speaker system

Heathkit PRINTED CIRCUIT 5" COLOR TV Oscilloscope Kit

MODEL 0-10

$69.50

Shpg. Wt. 27 lbs.

The technical specifications for this fine instrument speak for themselves. Vertical channel sensitivity is 0.025 volts RMS/inch at 1 Kc. Vertical frequency response is essentially flat to 5 Mc, and down only 1.5 db at 3.58 Mc. Ideal for Color TV work!

Extended sweep generator range is from 20 cps to 500 Kc in five steps, far beyond the range normally encountered at this price level.

Other features are: plastic-molded capacitors for coupling and by-pass—preformed and cabled wiring harness—Z axis input for intensity modulation—peak-to-peak voltage calibrating source built-in—retrace blanking amplifier—regulated power supply—high insulation printed circuit boards—step attenuated and frequency compensated vertical input circuit—push-pull horizontal and vertical amplifiers—excellent sync. characteristics—sharp, hairline focusing—uses 5UP1 CRT—extremely attractive physical appearance.

An essential instrument for professional Laboratory, or for servicing monochrome or color TV.

Heathkit PRINTED CIRCUIT 3" OSCILLOSCOPE KIT

This light, portable 3" oscilloscope is just the ticket for the ham, for service calls, or as an "extra" scope in the shop, or lab. Measures only 9½" H x 6½" W x 11¾" D, and weighs only 11 lbs.

Employs printed circuit board for improved circuit performance. Vertical amplifiers flat within +3 db from 2 cps to 200 Kc. Vertical sensitivity 0.25 volts RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. R.F. connection to deflection plates.

MODEL OL-1

$29.50

Shpg. Wt. 14 lbs.

Heathkit PRINTED CIRCUIT 5" OSCILLOSCOPE KIT

This full-size 5" Oscilloscope incorporates many outstanding features.

Vertical channel flat within +3 db, 2 cps to 200 Kc, with 0.09 volts RMS/inch peak-to-peak sensitivity at 1 Kc. Sweep operation from 20 cps to 100,000 cps. Built-in peak-to-peak voltage calibration—3 step frequency compensated input attenuator—phasing control—push-pull deflection amplifiers. Printed circuits for reliable performance and reduced construction time.

MODEL OM-1

$49.50

Shpg. Wt. 26 lbs.

Heathkit PRINTED CIRCUIT VACUUM TUBE VOLTMETER KIT

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.

This VTVM has set a new standard for accuracy and reliability in kit-form electronic instruments. Features modern, time-saving printed circuits, and functional arrangement of controls and scales. Includes new peak-to-peak scale for FM and TV work.

Measures AC (RMS) and DC voltage at 0-1.5, 5, 15, 50, 150, 500, and 1500; peak-to-peak AC voltage at 0-4, 14, 40, 140, 400, 1400, and 4000; center-scale resistance readings of 10, 100, 1000, 10,000, 100 K, 1 meg., and 10 meg. DB scale provided also. Zero-center operation within range of front panel controls Polarity reversal switch—200 μa 4½ meter-transformer power supply—11 megohm input impedance — 1% precision resistors — high quality components used throughout.

Heathkit 20,000 ohms/volt MULTIMETER KIT

MODEL MM-1

$29.50

Shpg. Wt. 6 lbs.

Features comprehensive range coverage. 20,000 Ω/V D.C. and 5000 Ω/V A.C. Ranges: 0-1.5, 5, 50, 150, 500, 1500, and 5000 V. direct current from 0 to 150 μa., 15 a. in 5 steps. Center-scale resistance of 15, 1500 and 150,000 ohms, and db from —10 to +65.

Uses 1% precision resistors—50 μa. meter—molded bakelite case.

Heathkit DIRECT-READING CAPACITY METER KIT

Extremely valuable where speed and convenience are essential. Quality control work, production line checking, etc. Reads capacity directly on meter scale, from 0-100 mmfd, 1000 mmfd, .01 mfd, and .1 mfd. Residual capacity less than 1 mmfd. Not susceptible to hand capacity.

MODEL CM-1

$29.50

Shpg. Wt. 7 lbs.

Heathkit A. C. VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

Shpg. Wt. 5 lbs.

Measures AC voltage only, from 10 cps to 50 Kc. Covers the range from 1 millivolt to 300 volts in 10 steps at high impedance input. Incorporates full 10 ranges of db scale from —52 db to +52 db. Essential in the audio laboratory or for audio enthusiasts and experimenters. Provides sensitivity essential for low level audio measurements.

Heathkit ELECTRONIC SWITCH KIT

This device will electronically switch between 2 input signals to produce both signals alternately at the output. Used in conjunction with an oscilloscope, it will permit the observation of 2 signals simultaneously. Provides switching rates from 10 cps to 200 cps.

MODEL S-2

$23.50

Shpg. Wt. 11 lbs.

Heathkit VOLTAGE CALIBRATOR KIT

Once calibrated, this instrument provides a known peak-to-peak voltage standard for comparison with unknown voltage values on an oscilloscope. Panel calibrated directly—no involved calculations required. Operates within a voltage range of .01 to 100 volts peak-to-peak.

MODEL VC-2

$11.50

Shpg. Wt. 4 lbs

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BENTON HARBOR 15, MICHIGAN

SELECT YOUR NEXT HEATHKIT FROM

Heathkit TUBE CHECKER KIT

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

Because of its low price this fine tube tester is available, not only to the service shop and laboratory, but to part-time servicemen, experimenters, and radio amateurs, as well. Will test all tubes commonly encountered in radio and TV service work. Simple "GOOD—BAD" scale on the 4½" meter. Tests for open, short, and quality on the basis of total emission. Includes illuminated roll chart. Fourteen different filament voltage values available. Separate lever switch for each tube element.

Model TC-2P is the same electrically as TC-2, except that it is housed in a beautiful two-toned portable carrying case. Only $34.50. Shpg. Wt. 15 lbs.

Portable carrying case available separately for Model TC-2, or older model TC-1. Cab. No. 91-8, $7.50. Shpg. Wt. 7 lbs.

CRT Test Adapter, Model 355 for use with the TC-2, $4.50. Shpg. Wt. 1 lb.

Heathkit TV ALIGNMENT GENERATOR KIT

Here is the complete R.F. signal source for FM and TV alignment, (both monochrome and color). Provides output on fundamentals from 3.6 Mc to 220 Mc in four bands, with harmonic output usable up through the UHF channels. Electronic sweep circuit eliminates mechanical gadgets and accompanying noise, hum, and vibration. Continuously variable sweep up to 0—42 Mc, depending on base frequency.

Variable marker (19—60 Mc on fundamentals) and crystal marker (4.5 Mc and multiples thereof) generators built-in. Crystal included with kit. Provision for external marker if desired.

Packed with outstanding features. 50 ohm output impedance — exceptionally good linearity—effective AGC action—plenty of R.F. output. An essential instrument for the up-to-date service shop.

$49.50
MODEL TS-4
Shpg. Wt. 16 lbs.

MODEL SG-8
$19.50
Shpg. Wt. 8 lbs.

Heathkit SIGNAL GENERATOR KIT

This is one of our most popular kits, and is "serviceman engineered" to fulfill the signal source requirements of the radio serviceman and experimenter.

Covers 160 Kc to 110 Mc on fundamentals (5 bands), with output in excess of 100,000 microvolts. Calibrated harmonics extend usefulness up to 220 Mc. Choice of unmodulated R.F. output, 400 cps modulated R.F. output, or 400 cps audio output. Step-type and continuously variable output attenuation controls.

Coils are prewound, and construction manual is complete. Calibration unnecessary for service applications.

Model RS-1

Heathkit RESISTANCE SUBSTITUTION BOX KIT

Provides switch selection of 36 RTMA 1 watt standard 10% resistors, ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work.

$5.50
Shpg. Wt. 2 lbs.

Heathkit CONDENSER SUBSTITUTION BOX KIT

Model CS-1

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Aluminum panel, bakelite case, and includes 18" flexible leads with alligator clips.

$5.50
Shpg. Wt. 2 lbs.

Model DR-1

Heathkit DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1–99,999 ohms in 1 ohm steps. Indispensable around service shop, laboratory, ham shack, or home workshop.

$19.50
Shpg. Wt. 4 lbs.

Heathkit DECADE CONDENSER KIT

Model DC-1

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmfs. +1% precision silver-mica condensers used. High quality ceramic wafer switches for reduced leakage.

Shpg. Wt. 3 lbs.
$16.50

Heathkit CONDENSER CHECKER KIT

Model C-3
$19.50
Shpg. Wt. 7 lbs.

Measures capacity in four ranges from .00001 to 1000 mfds. Power factor control is provided for indication of electrolytic condenser efficiency. Tests capacitors under actual load conditions. Checks resistance from 100 ohms to 5 megohms. Direct reading scales for all tests. No calculation necessary.

Model LG-1

Heathkit LABORATORY GENERATOR KIT

$39.50
Shpg. Wt. 16 lbs.

Here is a signal generator for use where high accuracy and metered performance are essential. Covers 150 Kc to 30 Mc on fundamentals in 5 bands. 400 cps modulation variable from 0 to 50%. R.F. output at 50 Ω from 100,000 to 1 μv. Meter reads R.F. output in μv. or modulation percentage. Fixed-step and variable output.

Model T-3

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

$23.50
Shpg. Wt. 9 lbs.

This signal tracer features a high-gain R.F. channel and probe to permit signal tracing from the receiver antenna input through the R.F. and I.F. stages. Separate low gain channel for audio circuits. Both visual and aural indication by means of speaker and electron beam "eye" tube.

Also noise locater circuit, wattmeter, and terminals for "patching" output transformer or speaker into external circuit.

Model M-1

Heathkit HANDITESTER KIT

$14.50
Shpg. Wt. 3 lbs.

The M-1 is literally pocket size to fit in your coat pocket, tool-box, glove compartment, or desk drawer. Measures A.C. or D.C. v. in 5 steps from a full scale minimum of 0—10 v. to a maximum of 0—5000 v. Measures direct current at 0—10 Ma and 0—100 Ma, and provides ohmmeter ranges of 0—3000 and 0—300,000 ohms. Sensitivity of 1,000 ohms v. 1% precision divider resistors employed.

HEATH Company

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BENTON HARBOR 15, MICHIGAN

THESE HIGH QUALITY INSTRUMENTS

Heathkit HARMONIC DISTORTION METER KIT

MODEL HD-1
$49.50
Shpg. Wt. 13 lbs

Performs the functions of more elaborate and much more expensive audio distortion testing devices and yet is simple to operate and inexpensive to own. Used with a sine wave generator, it will check the harmonic distortion output of audio amplifiers under a variety of conditions. Essential in audio design work.

The HD-1 reads harmonic distortion directly on the meter as a percentage of the original signal input. It operates from 20 to 20,000 cps in 3 ranges, and incorporates a VTVM circuit for initial reference settings and final harmonic distortion readings. VTVM ranges are 0—1, 3, 10, and 30 volts full scale. 1% precision voltage divider resistors used. Distortion meter scales are 0—1, 3, 10, 30 and 100% full scale. Having a high input impedance the HD-1 requires only .3 volt input for distortion tests.

Heathkit AUDIO GENERATOR KIT

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

This basic audio reference generator deserves a place in your Laboratory. Complete frequency coverage is afforded from 20 cps to 1 Mc in 5 ranges, and output is constant within ±1 db from 20 cps to 400 Kc, down only 3 db at 600 Kc., and 8 db at 1 Mc. An extremely good sine wave is produced, with a distortion percentage below 0.4% from 100 cps through the audible range.

Plenty of audio output for all applications; up to 10 v. under no load conditions. Output controllable with a continuously variable or step-type attenuator with settings of 1 μv, 100 μv, 1 v, and 10 v. Cathode follower output.

Heathkit AUDIO ANALYZER KIT

MODEL AA-1
$59.50
Shpg. Wt. 13 lbs.

The AA-1 consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit. It offers a tremendous saving over the price of these instruments purchased separately.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units so db gain or loss can be noted quickly.

High or low impedance IM measurements can be made. High (6 Kc) and low (60 cps) frequency generators built-in. Only 4 meter scales are employed, and one of these is in color so that results are easily read on the scale. Full scale VTVM ranges are .01 to 300 volts in 10 steps, full scale wattmeter ranges are .15 mw to 150 w in 7 steps. IM analyzer scales are 1%, 3%, 10%, 30% and 100%.

Heathkit VARIABLE VOLTAGE POWER SUPPLY KIT

Model PS-3
$35.50
Shpg. Wt. 17 lbs.

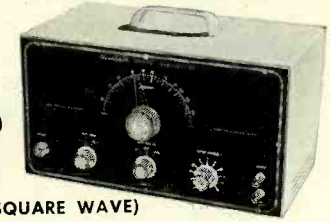
Provides regulated DC output for B+, and 6.3 v. AC at 4 amps. for filaments. Output variable from 0 to 500 v. DC at no load, linear from 0—10 ma at 450 vdc and 0—130 ma at 200 vdc! Essential for circuit design and development. Voltage or current read on 4½" meter.

Heathkit "Q" METER KIT

Model QM-1
$44.50
Shpg. Wt. 14 lbs.

Will measure Q of condensers, RF resistance and distributed capacity of coils, etc. Uses 4½" 50 μa meter for direct indication. Will test at 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ±3 mmf. Useful for checking wave traps, chokes, peaking coils. Indispensable for coil winding and determining unknown condenser values.

Heathkit AUDIO OSCILLATOR KIT



MODEL AO-1
$24.50
Shpg. Wt. 10 lbs.

(SINE WAVE — SQUARE WAVE)

Features sine or square wave coverage from 20 to 20,000 cps in 3 ranges. An instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high-level output across the entire frequency range, low distortion and low impedance output. Uses a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces good, clean square waves with a rise time of only 2 microseconds.

Heathkit IMPEDANCE BRIDGE KIT

Model IB-2
$59.50
Shpg. Wt. 12 lbs.

Measures resistance, capacitance, inductance, dissipation factors of condensers, and the storage factor of inductance. Employs 2-section CRL dial. D, Q and DQ functions are combined in one control. ½% resistors and capacitors used in critical circuits. 100—0—100 microammeter for null indications. 1000 cycle oscillator, 4 tube detector-amplifier, and power supply built-in.

Heathkit 6-12 VOLT BATTERY ELIMINATOR KIT

Model BE-4
$31.50
Shpg. Wt. 17 lbs.

Furnishes 6 or 12 volt output for the new 12 v. car radios in addition to 6 v. models. Two continuously variable output voltage ranges; 0—8 v. DC at 10 A. continuously or 15 A. intermittent, 0—16 v. DC at 5 A. continuously or 7.5 A. intermittent. Output voltage is clean and well filtered by two 10,000 mfd condensers. Panel meters read voltage and current output.

Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2
$17.50
(Less Cabinet)
Shpg. Wt. 10 lbs.

Build your own receiver with confidence. Complete instruction book anticipates your every question.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, planetary tuning from 550 Kc to 1600 Kc, 5½" speaker. Also adaptable for use as AM tuner or phono amplifier.

CABINET: Fabric covered plywood cabinet available, complete with aluminum panel and re-inforced speaker grille. Part No. 91-9, Shpg. Wt. 5 lbs., $4.50

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BENTON HARBOR 15, MICHIGAN

New

Heathkit
DX-100
PHONE AND CW
TRANSMITTER KIT

This one compact package contains complete transmitter, with built-in VFO, modulator, and power supplies. Provides phone or CW operation—VFO or crystal excitation—and band-switching from 160 meters through 10 meters. R.F. power output 100—125 watts phone, 120—140 CW. Parallel 6146's modulated by push-pull 1625's. Pi network interstage and output coupling for reduced harmonic output. Will match non-reactive antennas between 50 ohms and 600 ohms. TVI suppressed with extensive shielding and filtering. Rugged metal cabinet has inter-locking seams.

The high-quality transmitter is packed with desirable features not expected at this price level. Copper plated chassis—potted transformers—wide spaced tuning capacitors—ceramic insulation—illuminated VFO dial and meter face—remote control socket—preformed wiring harness—concentric control shafts—high quality, well rated components used throughout. Overall dimensions 20⅞" wide x 13¾" high x 16" deep.

Supplied complete with all components, tubes, cabinet and detailed construction Manual. (Less crystals.) Don't be deceived by the low price! This is a top-quality transmitter designed to give you years of reliable service and dependable performance.

MODEL DX-100

$189.50

Shpg. Wt. 120 lbs.

Shipped motor freight unless otherwise requested. $50.00 deposit required for C.O.D. orders.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

Shpg. Wt. 15 lbs.

Enjoy the trouble-free operation of commercially designed equipment while still benefiting from the economies and personal satisfaction of "building it yourself."

This CW Transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11 and 10 meters. Single knob bandswitching eliminates coil changing. Panel meter indicates grid or plate current for the final. Crystal operation, or can be excited by external VFO. Crystal not included in kit. Incorporates features one would not expect in this price range, such as key-click filter, line-filter, copper plated chassis, prewound coils, 52 ohm coaxial output, and high quality components throughout. Instruction Book simplifies assembly. Uses 6AG7 oscillator, 6L6 final and 5U4G rectifier. Up to 35 watts plate power input.

Heathkit GRID DIP METER KIT

Model GD-1B

$19.50

Shpg. Wt. 4 lbs.

This is an extremely valuable tool for Hams, Engineers or Servicemen. Covering from 2 Mc to 250 Mc, it uses 500 μa meter for indication. Kit includes prewound coils and rack. Will accomplish literally hundreds of jobs on all types of equipment.

Heathkit ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching purposes, etc. Will double, also, as a phone monitor or relative field strength indicator.

100 μa meter employed. Covers the range from 0 to 600 ohms. An instrument of many uses for the amateur.

Model AM-1

$14.50

Shpg. Wt. 2 lbs.

Heathkit VFO KIT

MODEL VF-1

$19.50

Shpg. Wt. 7 lbs.

Weigh the cost of this kit against the cost of crystals—and consider the convenience and flexibility of VFO operation. This is one of the most outstanding kits we have ever offered for the radio amateur.

Covers 160—80—40—20—15—11 and 10 meters with three basic oscillator frequencies. Illuminated and precalibrated dial scale clearly indicates frequency on all bands and provides more than two feet of dial calibration. Reflects quality design in the use of ceramic coil forms and tuning capacitor insulation, and copper plated chassis. Simply plugs into crystal socket of any modern transmitter to provide coverage of the bands from 160 meters through 10 meters. Uses 6AU6 Clapp oscillator, and OA2 voltage regulator for stability. May be powered from plug on Heathkit Model AT-1 Transmitter, or supplied with power from most transmitters.

Heathkit ANTENNA COUPLER KIT

Model AC-1

$14.50

Shpg. Wt. 4 lbs.

Poor matching allows valuable communications energy to be lost. The Model AC-1 will match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coaxial input—power up to 75 watts—10 through 80 meters.

Heathkit COMMUNICATIONS RECEIVER KIT

Covers 550 Kc to 35 Mc in 4 bands. Features electrical bandspread—separate R.F. and A.F. gain controls—noise limiter—AGC—BFO—phone jack—5½" PM speaker.

CABINET: Fabric covered plywood cabinet. Part No. 91-10. Shpg. Wt. 5 lbs. $4.50

Model AR-2

$25.50

Shpg. Wt. 12 lbs. (Less Cabinet)

HEATH Company

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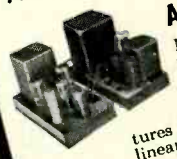
BENTON HARBOR 15, MICHIGAN

Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT



Main amplifier and power supply each have their separate chassis for flexibility of installation. Features the Acrosound "ultra-linear" output transformer. Frequency response within ±1 db from 10 cps to 100,000 cps. Power output is over 20 watts.

KIT COMBINATIONS

W-3M: Consists of main amplifier and power supply for separate construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 29 lbs., Exp. Only **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 37 lbs., Exp. Only . . . **$69.50**

Heathkit ADVANCED DESIGN *High Fidelity* AMPLIFIER KIT

This advanced-design 25 watt Hi-Fi Amplifier features a new-design Peerless output transformer, improved circuitry, and uses KT-66 output tubes. This results in higher power output; improved bass and high frequency response; and reduced IM and harmonic distortion. Incorporates all the "extra" features that make for real listening enjoyment. Power handling capabilities increased to follow instantaneous power peak of full orchestra. Also new type balancing circuit, and "tweeter saver" to suppress HF oscillation. New physical design results in attractive appearance, suitable for use either in or out of a cabinet.

KIT COMBINATIONS

W-5M: Consists of main amplifier and power supply for single chassis construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 31 lbs., Exp. Only **$59.75**

W-5: Consists of W-5M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 38 lbs., Exp. Only **$79.50**

Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson-type Amplifier ever offered in kit form. Main amplifier and power supply on a single chassis. Features Chicago output transformer. Flat within ±1 db from 10 cps to 100,000 cps. Maximum power output over 20 watts.

KIT COMBINATIONS

W-4M: Consists of main amplifier and power supply for single chassis construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 28 lbs., Exp. Only **$39.75**

W-4: Consists of W-4M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 36 lbs., Exp. Only **$59.50**

Heathkit 6-WATT AMPLIFIER KIT

Model A-7B

$15.50

Shpg. Wt. 10 lbs.

Model A-7B; although not classified as a true high fidelity amplifier, this Heathkit Amplifier provides full 6 watts power output, more than adequate for normal- home installation, and frequency characteristics are ± 1½ db from 20 to 20,000 cps. Push-pull output—detailed construction manual—top-quality parts. Output transformer tapped at 4, 8, and 15 ohms. Bass and treble tone controls provided. Two input channels.

MODEL A-7C: Same as Model A-7B except with preamplifier stage. Shpg Wt. 10 lbs., $17.50

Heathkit HIGH FIDELITY PREAMPLIFIER KIT

Model WA-P2

$19.75

Shpg. Wt. 7 lbs.

Beautiful modern appearance blends with any interior color scheme.

Completely fulfills all the requirements for remote control, compensation, and preamplification for the Heathkit Williamson-type Amplifiers or any conventional Hi-Fi Amplifier. Five separate input channels, each with separate audio level control. Full record equalization accomplished with 4-position turnover and roll-off controls.

Separate bass and treble controls. Overall frequency response within 1 db from 25 cps to 30,000 cps. Hum and noise level extremely low. This brilliant performer will do justice to the finest available program sources.

Heathkit 20-WATT HIGH FIDELITY AMPLIFIER KIT

Model A-9B

$35.50

Shpg. Wt. 23 lbs.

Here is your least expensive route to real high fidelity performance. Full 20 watt output—separate bass and treble tone controls—frequency response ±1 db 20—20,000 cps—four switch-selected, compensated inputs—low hum and noise level—output transformer tapped at 4, 8, 16, and 500 ohms. Single chassis construction combines preamplifier, main amplifier, and power supply in one unit.

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NOTE: ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

ON PARCEL POST ORDERS include postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.

Portable TV Picture

(*Continued from page 42*)

where the picture tube has an external coating, a 500 $\mu\mu$fd. high-voltage capacitor may be added between the anode of the 5AXP4 and ground. However, experience has shown that the operation of the receiver is unaffected by the missing capacitance except for about 1000 volts lower anode voltage, so the capacitor may be omitted along with its attendant shock possibilities.

Some older receivers with electromagnetic focus units use the focus coil as a filter choke. On receivers of this type, a 100-ohm, 20-watt resistor can be clipped into the focus coil circuit to replace the focus coil.

Fig. 1 shows a service technician using the 5AXP4 with a universal yoke assembly to check a receiver on his bench. The cabinet, picture tube, and receiver yoke have been left in the customer's home. With this setup, approximately ninety-five per-cent of the receiver repairs requiring shop work can be made without disturbing the receiver yoke or picture tube. These repairs include all r.f., i.f., video, sound, and sync troubles including alignment, many horizontal and vertical scan problems, and most power supply failures.

Most receivers are similar enough to permit the satisfactory use of one universal yoke with four-foot leads even though the horizontal and vertical impedances of their yokes are different. Only a very small percentage of the receiver failures, such as some linearity problems, would require that the exact replacement yoke be used with the 5AXP4 to obtain an accurate indication of servicing adjustments.

The check tube and adapter may be carried on service calls as it is extremely handy and serves as a positive check on the receiver yoke and picture tube in the customer's home. Often, the 5AXP4 yoke can be connected directly in parallel with the receiver yoke without removing it, and the picture, while half size, is still useful.

With the 5AXP4 and the yoke assembly shown here, the service technician can build a new tool that will save him at least twenty minutes on a call requiring shop service and provide a rapid positive check of the receiver yoke and picture tube. —30—

ADDITIONAL DATA ON "A PAIR OF FOLDED DIPOLES"

By HAROLD J. GRUBER, W8MGP

BACK in the October 1951 issue of RADIO & TELEVISION NEWS the author gave full details on "A Compact 20-Meter Beam" which consisted of a pair of folded dipoles 135 degrees out-of-phase.

Since the original article appeared, the author has received a tremendous amount of mail from all parts of the world—in fact—several letters are still being received each month.

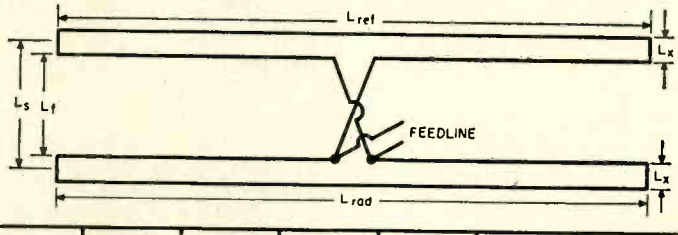
Most of the letters consisted of requests for additional information or more specific details but, on the whole, the gang wanted dimensions for constructing this antenna for other amateur bands, especially for 21 mc.

Fig. 1 shows a schematic diagram of the antenna as well as a table of formulas and actual dimensions for all amateur bands from 3.8 mc. to 145 mc. which the author hopes will take care of a lot of requests which he was not able to answer by mail.

Several of the 21 mc. versions have been in use in the author's area for several months with exceptionally good results.

The popularity of this beam over a parasitic type lies in the fact that it is only necessary to construct it according to the plans and put it on a pole or tower. It requires no tuning—you are ready to work DX at once! —30—

Fig. 1. Schematic of the antenna and table of formulas and actual dimensions for the antenna for all amateur bands from 3.8 megacycles to 145 megacycles.



FORMULA	3.8MC.	7.2MC.	14.25MC.	21.3MC.	29MC.	51MC.	145MC.
$L_{ref} = \frac{463}{F}$	121.8'	64.2'	32.5'	21.75'	15.9'	9.075'	3.19'
$L_{rad} = \frac{442}{F}$	116.2'	61.5'	31.0'	20.75'	15.25'	8.67'	3.05'
#$L_f = \frac{123 \times V}{F}$	27.3'	14.4'	7.27'	4.86'	3.57'	2.03'	.715'
$L_s = \frac{110.5}{F}$	29.1'	15.35'	7.75'	5.18'	3.81'	2.17'	.762'
$L_x = \frac{128.25}{F}$	33.7"	17.8"	9.0"	6.02"	4.42"	2.5"	.88"

ALL DIMENSIONS IN FEET EXCEPT L_x WHICH IS IN INCHES
F IS FREQUENCY IN MEGACYCLES
L_f IS LENGTH OF PHASING SECTION OF TRANSMITTING TYPE 300 OHM LINE
V IS VELOCITY FACTOR FOR TRANSMISSION LINE

New Audio Equipment

AMPLIFIER FOR PLANES

Aircraft Radio Corporation of Boonton, N. J., has begun delivery of its new Type F-13 audio amplifier which is designed to power one or more loudspeakers in the cockpit of aircraft.

The unit has an output of 8 watts into a choice of 4, 8, or 300 ohms. Its weight, complete with dynamotor and mounting, is 5.9 pounds.

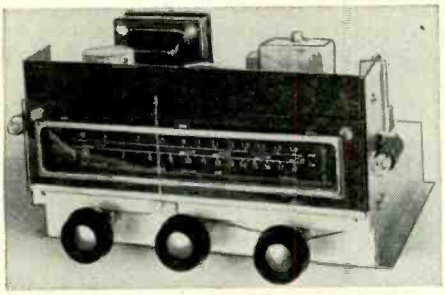
The output from several radio receivers may be fed into the F-13 for simultaneous monitoring. Use of a cockpit loudspeaker is especially welcome to pilots on long flights or during hot days where the alternative is headsets.

Descriptive brochures on this equipment are available from the company.

SW-AM TUNER

Browning Laboratories, Inc., 750 Main St., Winchester, Mass., is now marketing a short-wave-AM tuner as a companion piece to its "Brownie L-300" FM-only tuner.

The "Brownie L-500" is said to be the first tuner to cover the short-wave bands, 19 to 49 meters. The instrument features broad and sharp AM tuning, full frequency response, 10 kc. whistle filter, under 2 μv. sensitivity, a



built-in high-gain ferrite antenna, cathode-follower output, and self-contained power supply.

Full specifications and price information are available from the manufacturer.

"ORTHOPHONIC" PHONOGRAPH

The *RCA Victor* Radio and "Victrola" Division, Camden, N. J., is now offering the first of a series of "New Orthophonic" hi-fi "Victrola" phonographs—a low-cost model, the Mark V.

The new instrument is a table model which features a panoramic speaker system. The set contains one 6-inch speaker and two smaller speakers mounted at a 90 degree angle to each other for room-wide dispersion of high frequencies. According to the company, this new acoustical system provides for uniform quality in every part of the room and virtually eliminates dead spots.

Featuring a smooth-operating, three-

speed changer with one control for all speeds, the instrument has a range of from 70 to 20,000 cps and an undistorted output of three watts.

A master control panel houses the three controls for loudness, bass, and

treble in a simplified grouping for easier operation. The tone arm is balanced with a flipover ceramic pickup which has two sapphire styli.

45 RPM SPINDLE

Components Corporation of Denville, N. J., is now offering a deluxe, precision lathe-turned 45 rpm spindle of heavy gold-anodized aluminum for use with its "Professional" turntable.

Although designed for a specific unit, it will fit any standard turntable and is said to improve reproduction from 45 rpm records because of its true centering and concentricity.

The spindle is thick enough to accommodate up to three 45 rpm records. Its distribution will be handled by high-fidelity equipment dealers.

"SOUND BOOK"

Audio-Master Corp., 17 E. 45th St., New York 17, N. Y., is handling the U. S distribution of the German-developed "Sound Book."

This ultra-modern tone reproducer combines the simplicity of a record with the advantages of tape. In the "Tefifon" the sound is engraved on pure vinylite with an average of 82 grooves on a ½" band and is self-contained in a cartridge the size of a small book, 6" x 5½".

To play a "Sound Book," the window

face is first slid back and the sound-band extended in a loop, which is then placed around the playing wheel of a

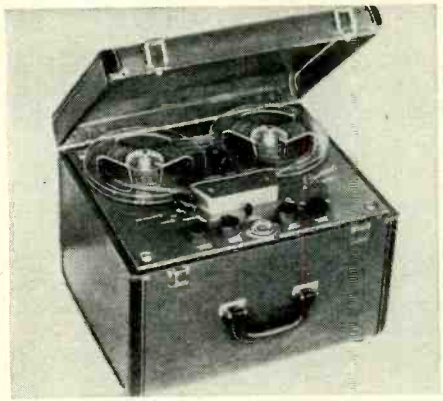
special playback machine in the same manner that a record is placed on a turntable. The needle is then set against the soundband. If a specific portion of the tape is desired, the music selector spots it immediately.

"CRESTWOOD 402"

Daystrom Electric Corporation, Poughkeepsie, N. Y., has recently added the "Crestwood 402" power amplifier and extended range loudspeaker to its line of audio equipment.

Designed especially for use with the "Crestwood Hi-Fi 404" tape recorder-preamp, the "402" has a frequency response of ±1 db from 20 to 20,000 cps, distortion of less than 2%, and 10-watt power output.

This portable unit measures 9½" x 13½" x 16" and weighs 17½ pounds. It



incorporates an 8" round speaker, a high-impedance input jack, and external-speaker jack and includes a power cable and connecting audio cable as accessory items.

Write the company for a data sheet on both this unit and the companion "Crestwood 404," shown above.

MESSAGE REPEATER

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y., is currently introducing the "Magneloop, Jr.," a multi-purpose, magnetic tape, continuous-loop, record-playback device.

Now available in two models, recordings may be made instantly on this unit by simply switching into the "Record" position. Immediate playback is possible at any time without the necessity of rewinding or resetting. Messages, announcements, or sound effects up to 12 minutes may be recorded on the Model A which operates at 3¾ ips. Model B, with a tape speed of 7½ ips, is able to record for 6 minutes and is recommended for applications where greater fidelity is required.

Complete information on either or both of these models is available from the manufacturer.

BOGEN AM-FM TUNER

David Bogen Co., Inc., 29 Ninth Ave., New York 14, N. Y., has added an AM-FM tuner to its line, the R765.

The instrument provides flat frequency response and minimum distortion, according to the company. Ease and accuracy of FM tuning are achieved

by use of the company's auto-lock tuning circuit which "zeros in" from

fringe areas, thus eliminating the need for a tuning indicator. The set has a built-in preamplifier with controls for volume, bass tone, treble tone, record equalization, and loudness compensation. A cathode-follower output circuit permits physical separation of the tuner and the power amplifier to which it is connected.

The tuner is available in chassis form or housed in a wood cabinet of either blonde or mahogany veneer.

"EXECUTONE" INTERCOM

Executone, Inc., 415 Lexington Ave., New York 17, N. Y., is marketing a new electronic intercom system, the "6000."

Featuring wall-mounted master stations and economical single amplifier operation, the new unit design conserves valuable desk or table space in offices, supply rooms, production and manufacturing areas, and other key locations.

The central amplifier, which draws only as much current as a 30-watt bulb, is the only unit in the system that requires a power outlet. Stations

may be installed and full communication provided between as many as six master stations.

In addition to functioning as a two-way intercom, the "6000" offers paging facilities as well.

TURNTABLE BASE

JKM, Inc. of 13 W. Hubbard St., Chicago 10, Ill., is offering an inexpensive base designed to mount the *Rek-O-Kut* "Rondine" Models B-12H and B-12 three-speed turntables.

Continuous felt cushioning at all contact points of the mounting board provides effective isolation as recommended by the turntable manufacturer. The base takes any transcription arm up to 16 inches.

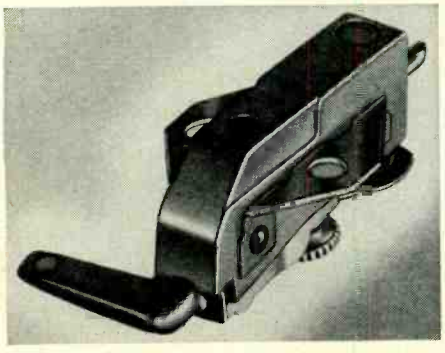
Installation of turntable and arm is easy as the mounting board simply lifts out from the base. All exposed surfaces are of grained mahogany veneers, hand-rubbed. Over-all size is

17" x 6½" x 21". The base is available in either mahogany or blonde finishes.

CERAMIC CARTRIDGE

Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill., has developed a new ceramic cartridge especially designed to enhance the quality of all popular hi-fi equipment in use today.

Known as the "Music Lover," the new cartridge comes complete with a magnetic input adapter. The company claims that the new design eliminates the problem of induced hum, eliminates cartridge drag caused by magnetic attraction to steel turntables, improves tone quality, increases record and needle life, and has high output.



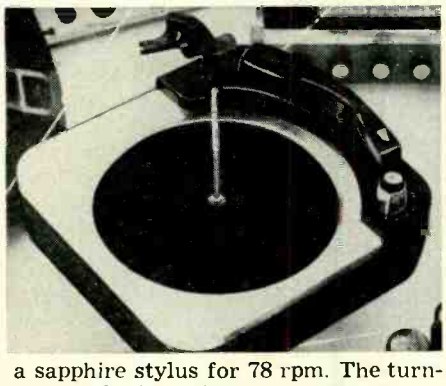
The cartridge also features a unique twin-lever needle shift transport. It provides a lower mass and individual needle compliance. Needle replacement involves no tools and may be accomplished in seconds.

WEBCOR "DISKCHANGER"

Webster-Chicago Corporation, 5610 W. Bloomingdale Ave., Chicago 39, Ill., is now offering its new G-1127-270 changer which plays all sizes and speeds of records automatically or manually.

The selective assembly of micro-finished parts and dynamically-balanced motor limit wow and flutter to less than ½ per-cent and hum to less than 40 μv. The free-floating tone arm, with stylus pressure of 6 to 8 grams, is engineered for minimum torsional and lateral pressure.

The changer comes equipped with a preselected *G-E* wide-range variable reluctance cartridge with diamond stylus for 33⅓ and 45 rpm speeds and a sapphire stylus for 78 rpm. The turntable is ball-bearing mounted and covered by electrostatic flocking that stands the fibers permanently on end to cushion the record drop and prevent slipping. -30-



Mac's Service Shop

(*Continued from page 69*)

"The hum's growing worse as the sliding contact approaches the bottom of the control made me think the hum was being fed in at this point. About the only way it could get there would be through the .05 μfd. capacitor connecting there. When you look at the chassis wiring, you see that this capacitor and the 4700-ohm resistor tie together on this blank lug of the rectifier socket. I suspected that something may have happened inside the rectifier to cause the 'blank' pin to be hot with a.c. When a new tube cleared up the hum, I was sure this was the case. Replacing the old tube and then removing the capacitor-resistor junction from the socket to again have hum-free reception cinched things. Just put in a tie-point for the connection you have taken off the socket and leave the old rectifier in. It can cause no further trouble, and neither can any other rectifier that may develop this fault."

"I don't think much of tying leads to empty socket lugs," Barney remarked as he started mounting a tie point on the chassis.

"Neither do I when those lugs have a tube pin connected to them," Mac agreed as he went to answer the telephone; "and tying a sensitive grid connection to a rectifier socket with its high-voltage a.c. is just asking for trouble."

When Mac came back from answering the phone his face was wearing a satisfied smile. "That's the kind of call I like to get. It was Mr. Rudy just calling to say his set was working fine and thanking me for clearing up his trouble. Most customers only bother to call when they want to gripe.

"Mr. Rudy's was a rather interesting case. He brought in his set about a month ago, and it was seemingly a simple repair job, for all that was wrong was a shorted plate bypass capacitor together with its charred decoupling resistor. Both were replaced and everything worked fine. I let the set run for a couple of hours and then took it back. The next day Mr. Rudy called and said it was dead again with exactly the same symptoms as before; *then* he told me he had had trouble with this set time and again and that he was about in the notion of junking it.

"Well, I picked it up and found that another high-voltage bypass capacitor had gone west, taking a resistor with it; furthermore, I noticed now that several other 'B-plus' bypass capacitors had been replaced previously. A new capacitor and resistor restored the receiver to normal operation, but I did not take it back. Instead, I called Mr. Rudy and asked him if he burned out a great many light bulbs in his house. When he emphatically said that he did, I suggested he call the light company and have them put a recording voltmeter on his line for twenty-four hours. The company did this and found the line voltage hit peaks of around 127 volts. The fellow who installed the recording voltmeter told Mr. Rudy he doubted this would cause trouble in the radio because it would only raise the voltages something less than ten percent above normal, and that would still leave the bypass capacitors with a voltage rating leeway of 150 volts or so.

"It was true that the highest voltage in the set when it was operating normally on a 117-volt line was 250 volts and the capacitors were all rated at 400 volts; *but* when a voltmeter was placed across one of the new capacitors and the set was turned on, the voltage soared to 375 volts for several seconds before finally settling down to the 250-volt figure. You see the set uses a filament type of rectifier while the rest of the tubes are of the cathode type. That means the high voltage power supply runs virtually unloaded until the tubes warm up and start drawing current. Since series dropping resistors to screens, etc., only perform their voltage dropping function when current is being drawn through them, bypass capacitors at the ends of these resistors were subjected to the full high voltage during this warmup period, even though the working voltage at these points might be below a hundred volts.

"Next I ran 127 volts on the set from our tapped isolation transformer. When I did this, the voltage on the capacitors soared to 430 volts before the warming cathodes pulled it down. That easily explained why the receiver was popping all the capacitors. Upon my advice Mr. Rudy had the electric company change the taps on the pole transformer feeding his house so that his voltage was down around 117 volts where it belonged. He reports he has not had a bit of trouble with the set since, and he has not replaced a single light bulb since the voltage was lowered."

"That's interesting," Barney remarked. "I'm so used to seeing the bad effects of low voltage, especially on TV sets, that I never thought about high line voltage giving trouble. Come to think of it, though, practically all TV sets use either filament or selenium type rectifiers; and in either case the output of the low voltage supply runs unloaded until the tubes warm up and start to draw current. From now on I'll be suspicious of this condition when I run across any sets that seem to be blowing too many capacitors."

"And don't forget that high line voltage is hard on tubes, too, just as it is on light bulbs," Mac pointed out. "Be suspicious of high line voltage when a set burns out a lot of tubes. Many TV sets have a tapped primary on the power transformer to compensate for line voltages that are abnormally high or low; but it is better to have the electric company correct the voltage fed to the house, if they can. If this is done, all the other electrical equipment in the house will be relieved of the strain imposed upon it by improper voltage, while changing the taps on the TV receiver transformer will only help it."

"Check!" Barney acknowledged. —30—

Superior's New Model TV-11

TUBE TESTER

SPECIFICATIONS:

- ★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- ★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
- ★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- ★ Free-moving built-in roll chart provides complete data for all tubes.
- ★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
- ★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- ★ ***EXTRA SERVICE*** — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

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

$47.50 NET

Superior's New Model TV-40

C.R.T. TUBE TESTER

A complete picture tube tester for little more than the price of a "make-shift" adapter!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

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.

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

SPECIFICATIONS:

- 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.

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

$15.85 NET

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We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

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Superior's new Model 670-A

SUPER-METER

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

SPECIFICATIONS:

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

ADDED FEATURE:

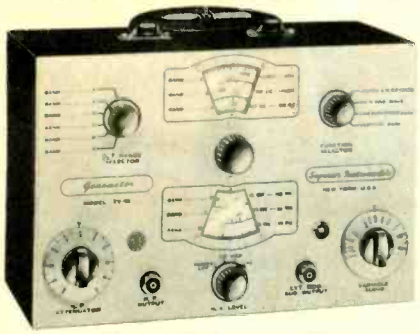
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

The New Model TV-50

GENOMETER



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- √ 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.

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.

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

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.

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.

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.

$47.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER—NO C.O.D.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-139, 3849 Tenth Avenue, New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

- ☐ Model TV-11 . . . Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 670-A . . . Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.
- ☐ Model TV-40 . . . Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-50 . . . Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

Name_____

Address_____

City_____ Zone____ State_____

We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

Dip Oscillator

(*Continued from page* 51)

No. 32 enamelled wire, closewound. This coil is then covered with a single wrapping of paper, plastic film, or *Scotch* tape, and L_2 wound on top of it. L_2 is wound in the same direction as L_1 and consists of 42 turns of No. 26 enamelled wire, closewound.

Polarity of the two coils is of the utmost importance, since the circuit will not oscillate if the coils are reversed. Fig. 2 shows winding details. The ends of the two coils are lettered in this drawing to correspond to the lettering in the circuit diagram, Fig. 2.

Additional coils may be constructed, with the aid of coil graphs and formulas found in the radio handbooks, to cover lower-frequency ranges.

It will be noted from Fig. 2 that the tuning capacitor floats above ground. It therefore must be insulated from the instrument case.

Resistor R_1 must not be lower than the 0.22-megohm value specified, otherwise the CK722 base current will be excessive and the transistor possibly damaged.

This instrument, although something of a novelty, definitely is not a toy. Within its frequency range, it is entirely practical and is operated in the same manner as a conventional grid-dip oscillator. It also may be used as an oscillator to supply clean, c. w. signals up to 1700 kc.

While every attempt has been made to keep this transistor instrument as small in size as possible with the components immediately available to the author, it certainly is not the ultimate in tininess. Considerably smaller size might be achieved through the use of a specially-designed subminiature tuning capacitor, lattice-wound powdered-iron-core coils, and a printed-circuit version of the C_3R_1 combination. —30—

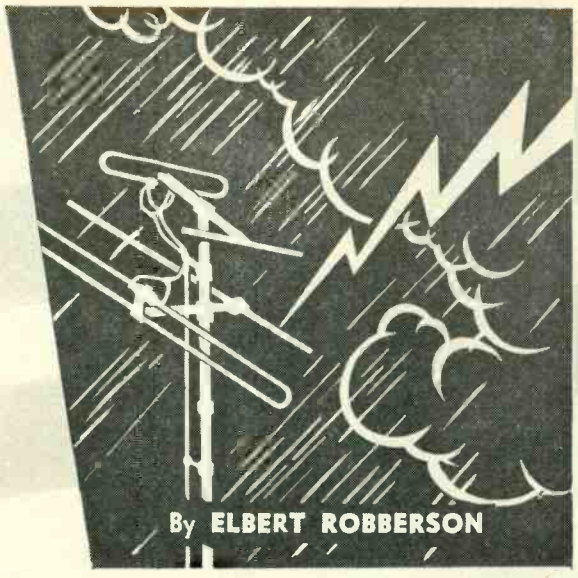
MORE CAMPUS STATIONS

IN the Editor's Note accompanying the article "Campus Carrier-Current System" in our May issue, we stated that Purdue was the only school having off-campus tie-ins with its radio system, as far as we knew.

Word has now come from Daniel B. Bradley, chief engineer of station WSLN at Ohio Wesleyan University, that the college operates a 10-watt FM non-commercial station which has a self-contained broadcast unit in the women's dormitories six blocks from the studios and an FM transmitter on the main campus.

The unit consists of an FM tuner and a home-made transmitter that broadcasts the audio signal from the tuner on 560 kc. There is a coupler with this unit for that particular dormitory and an r.f. line to an adjoining dorm, with a coupler there.

Another receiver-transmitter unit is presently under construction and the station hopes to install units in all of the university living quarters within the next few years so that its varied programs can be received by all. —30—



PROTECT AGAINST LIGHTNING

By ELBERT ROBBERSON

Protect your family and eliminate a serious fire hazard in your home by installing a simple, inexpensive arrester.

"WE WERE sitting in our library looking out at the storm." With this undramatic start an eyewitness describes one of the most terrifying things that can happen—being right under a lightning bolt. "Suddenly there was a snapping crackle and a roar—and a ball of fire that looked to be 4 or 5 feet in diameter hit the corner of the house where the antenna was attached. I was blinded for an instant and then saw a wisp of smoke curl from the window. I smelled smoke, and put some CO_2 inside the corner of the house and into the air space between the *Celotex* ceiling and the roof.

"The antenna was down—the three sections still intact. . . . The bolt apparently hit the tip of the antenna as it has marks that very much resemble the pit marks left when you quickly pass an electric welding torch across a piece of iron—a lot of little spatter marks."

Every day lightning strikes somewhere. Usually it strikes high objects. Sometimes these objects are radio antennas.

"But will lightning hit *my* antenna?" you ask. "And if it does—what will happen?"

Chances are lightning will *not* hit your antenna, but protection is so simple and inexpensive that anyone is foolish to take even the small chance. Because if lightning does hit, it may mean anything from simple inconvenience to explosions and "curtains."

The accompanying chart prepared by the U. S. Bureau of Standards, shows the number of lightning-storm days per year in different localities. However, it doesn't really matter if you expect ninety or just five storms this year—all you need is one, if it hits.

In the first place, if lightning is so powerful, how can we possibly protect ourselves? The answer lies in the very composition of lightning bolts and the fact that despite their awesome nature, they are really mostly noise. A fair-sized bolt doesn't carry much more electrical power than it takes to start your car on a cold morning.

True, there are voltages in the millions, and currents in the thousands —but this power is "turned on" for such a small fraction of a second that a conductor of adequate size doesn't have time to get warm before the show is over. Also, it is well known that to do any work, electricity must pass through a "load resistance." Keep your antenna circuit free from resistances, and there is nothing for the heaviest charge to go to work on—it's that simple.

Add to this the fact that a lightning bolt has such a steep front that any inductance whatever offers a terrifically-high impedance, and you have the secret of lightning protection: provide a straight shoot to ground for the bolt, and let the wires for signal currents have a little inductance. An "electronic switch" in the form of a simple spark gap will automatically ground the antenna whenever one of these noisy visitors comes charging down the wire.

Protection is fairly simple with receiving antennas. There are over

Antenna hardware showing the burns and scars of a direct stroke. Note burn on rim of flange, and the molten screw head. No trace of missing relay arm was ever found. Half of the Bakelite coil form also disappeared. The wire in the twin-lead fused and blew holes in the plastic. Wire of #10 gauge will carry current without strain.

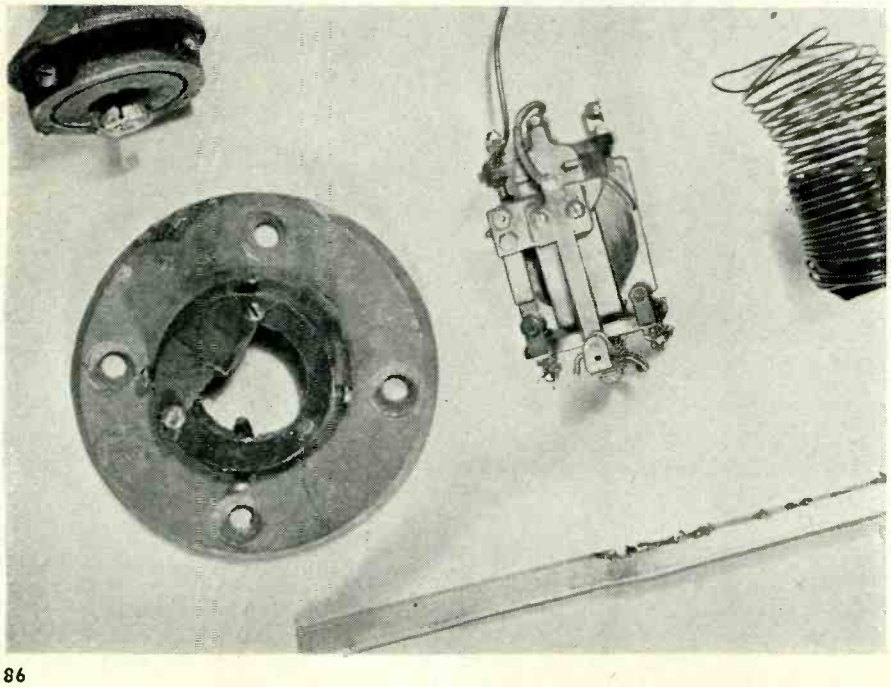


Table 1.

GAP SPACING (in inches)	PEAK VOLTAGE
.030	1000
.050	1500
.070	3000
.078	3500
.084	3800
.100	4150

twenty different lightning arresters on the market that will keep the insides of your set from melting, when they are properly installed. But nobody has ever done very much in the way of making lightning arresters for transmitting antennas. Broadcast stations make up their own systems, and amateurs usually get by on crossed fingers.

Here is how to protect your transmitting antenna. First of all, unless yours is a very low-powered transmitter, don't try to use one of the broadcast or TV arresters. Their spark gaps are not designed to withstand the comparatively high voltages applied to transmitting antennas, and the arrester usually breaks down and short circuits the antenna the first time power is turned on.

You can make an arrester quite simply just by providing a heavily-grounded spark gap. This may be improvised out of stand-off insulators, a metal rod, and ordinary nuts and bolts. The photographs give the story.

Spacing of the gap should be the minimum that will withstand the peaks of your transmitter-feeder voltage. With a low-impedance feedline, or at the bottom of a quarter-wave grounded antenna, the gap can be very close. But if the antenna operates in the half-wave mode, or if it has high-impedance feed, greater spacing is required.

This spacing can be determined experimentally, but if you know the antenna impedance at the point of lightning-arrester connection (which you can find with an antenna-impedance bridge, or the popular "Antennascope") and the power output of your transmitter, you can calculate the effective voltage at this point by using the formula: $E = \sqrt{PR}$

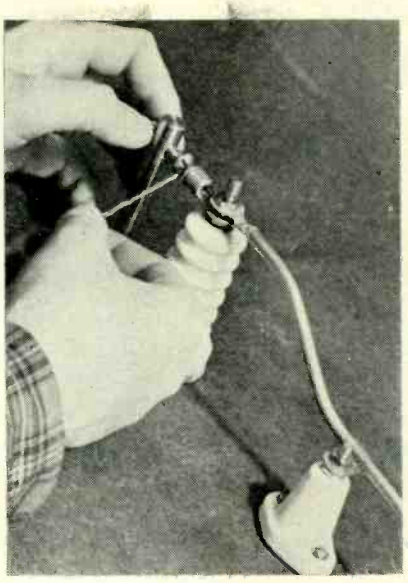
Peak voltage will be 1.41 times this value. Then, allow spacing according to Table 1. The gap can be set with a "feeler" gauge, or measure the proper diameter with a drill from a numbered-drill set.

The lead from the arrester to your equipment can present even higher impedance to the lightning if you install a "lightning choke," which is simply a small coil. The inductance is not critical, so the choke can be a few turns cut from self-supporting coil stock or 18" of copper tubing formed around a 2" mandrel.

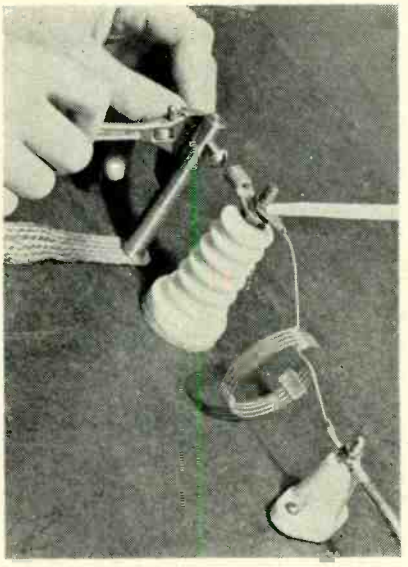
The same added protection can be given the TV receiver, or conventional radio, by wrapping a few turns of the lead-in wire into a self-supporting coil *on the equipment side of the arrester*. This coil can be secured with *Scotch* tape. It should have no appreciable effect on signal currents, while at the same time strongly encouraging the lightning bolt to be on its way to ground, rather than to take the long route into the house.

The middle of a storm is a poor time to do the job! Make preparations for your protection now. Then, when one of those black clouds rumbles along, you need not be afraid of lightning.

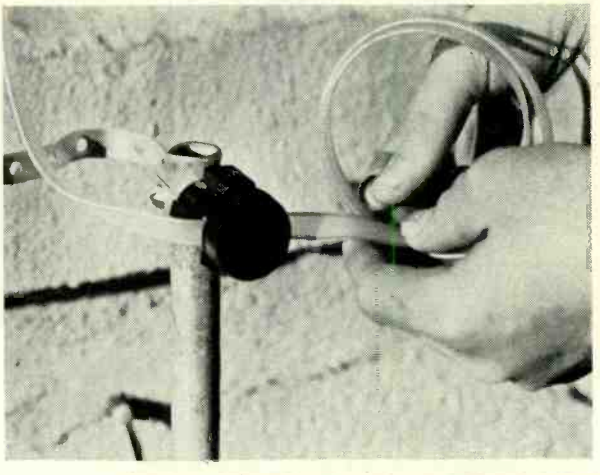
—30—



Simple transmitting antenna arrester is made from a rod, drilled and tapped for ¼-20 brass bolt and a bolt-head electrode in a heavy lug on the lead-in insulator. The gap can be set to proper spacing with feeler gauge, a numbered drill, or a wire.

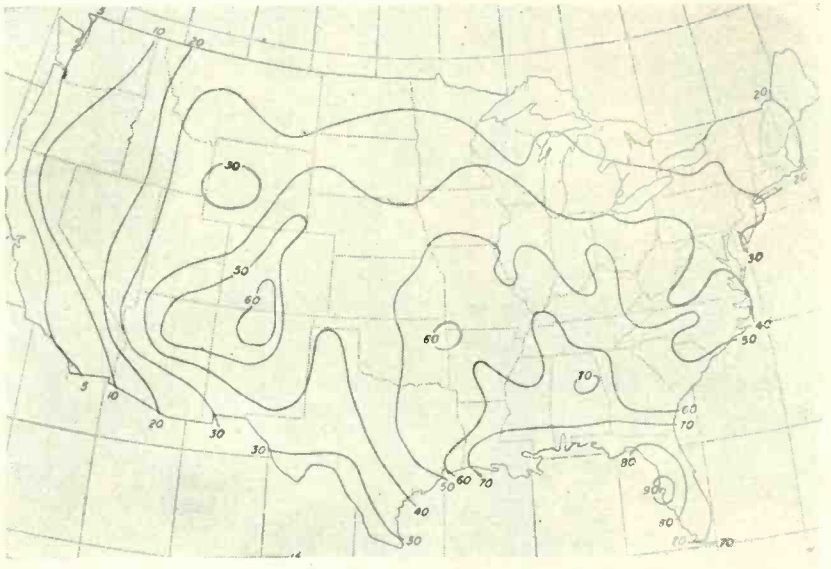


For the maximum protection, follow this technique. Here the antenna's downlead attaches to one side of a safety gap supported by a porcelain stand-off insulator. A lightning choke is installed in the lead to the equipment used with the antenna.



Television receivers can be given positive protection by means of a lightning choke which is installed on the equipment side of a conventional arrester.

Bureau of Standards map shows lightning storms per year in various areas.



REGULAR $59.95 LIST TIMEX MAGNETIC RECORDER

McGEE'S SPECIAL PURCHASE SALE $29.95

RECORDS AND PLAYS BACK—PLAYS 16⅔ AND 45 RPM RECORDS

MODEL 40 TIMEX RECORDER $29.95
CRYSTAL PICKUP HEAD TO PLAY PHONO RECORDS $2.95 EXTRA

A product of United States Time Corp. (Timex) A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adaptor and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 9½ x 11½ x 4⅞". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-R1 recorder, ship. wt. 13 lbs. Sale price, $29.95.

Recording discs, package of 6 for 99¢. One blank shipped with recorder.

You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

SALE PRICE **29.95** MODEL 40 TIMEX

8" EXTENSION SPEAKER $16.95 EXTRA

For $16.95 extra you can have our regular $19.95 Imperial IV extension speaker, equipped with an 8" G.E. speaker as described on the opposite page. When you order this with your Timex recorder we install a jack which makes your Timex play 45 RPM records with better tone quality and with the switch in the record position unit doubles as a small public address system.

McGEE'S LOW COST HIGH FIDELITY

20 WATT HI-FI AMP

Response 30-15000 CPS. Push-Pull 6L6's Inputs for Mike and Crystal or V.R. Phono Pickup. Twin Tone Controls.

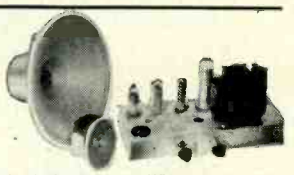
SALE PRICE **$22.95**

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer, with crystal or variable reluctance cartridge; radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 14 lbs. Stock No. HF-20, 20 watt amplifier. McGee's sale price, $22.95. With our CU-14Y, 12" coaxial PM speaker, $32.95. With 15" coax. speaker, $42.95.

8 WATT HI-FI PHONO AMP

Push-Pull Output. Thordarson HI-FI Output Tran. 12" Woofer and 5" Tweeter.

McGee's Sale Price..... **$19.95**



Another outstanding McGee value. 8 watt low cost Hi-Fi phono amplifier for use with any crystal phono pickup. Approx. 1 volt input gives 8 watts audio. Features push-pull 35C5 output and 12AX7 tubes, 12" dynamic woofer and 5" dynamic tweeter. Voltage doubler power supply gives extra power. Amplifier size, 4" x 9¾" x 4⅝" high. Heavy shielded Thordarson Hi-Fi output transformer. Response 30 to 12,000 cps. Amplifier is ready to use. Complete with tubes and speakers. (Does not have gain for mike.) Use as a record player amplifier. Stock No. HF-8, 8 watt amplifier and speakers. Ship. wt. 14 lbs. Sale price, $19.95. Model HF-5, similar to HF-8, except 5 watts output and equipped with a single 12" dynamic speaker. Sale price, $14.95.

$29.95 $19.95 NRT-21M $59.95 BT-210 $22.95

17" FULL DOOR $29.95

Fig. (e) No. AH-430. Mahogany with full doors. 36" h., 24" w., 21¾" deep. Chassis area 22" w., 17¾" h., 18¾" deep. Blank panel. Holds 17" TV easily. Baffle cut for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price, $29.95.

17" with PHONO DRAWER $19.95

Fig. (g) SE-21, 17" mahogany TV cabinet with phono drawer 40" h., 24" w., 18½" deep. Blank panel. TV chassis area 19" h., 20½" w. Changer drawer 19¾" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price, $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M, Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22¾" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 85 lbs. Sale price, $22.95. No. WT-210, walnut 21" TV cabinet, same as above, Sale price, $19.95. No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

6-TUBE, 2-BAND RADIO KIT $14.95
6-18 MC 550-1650 KC

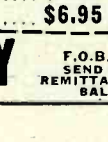
6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model ME6-2, Net $14.95.

3-SPEED AMPLIFIED PLAYER KIT $10.95
2 TUBE AMPLIFIER—8" SPEAKER

New, 3 speed amplified record player kit for only $10.95. Leatherette covered cabinet 9½" x 12" x 18½" high. Wired 2 tube amplifier with separate tone and volume controls, 70L7 and 7E5 tubes. Heavy 8" speaker, all-play pickup, motor and turntable. Cabinet is pre-cut, no holes to drill. Just fasten parts in cabinet. Only a few minutes required to assemble. Complete with simple, easy to follow instructions and all necessary items to build this 3 speed record player. Buy this player kit at less than the cost of the parts. Ship. wt. 15 lbs. Model No. RP-743K. Sale price, $10.95.

8", 10", 12" SPEAKER-BAFFLE COMBINATIONS

$3.95 **$4.95** **$6.95**



Our most popular speaker-baffle combinations. Brown leatherette covered wood baffle and 8", 2.5 oz. Alnico V magnet speaker. Most economical wall speaker. Stock No. 818-X. Sale price, $3.95 each. Lots of 3 or more, $3.79 each.

Brown leatherette covered wood baffle and 10", 3.16 oz. Alnico V magnet speaker, at little more than the 8" size. Stock No. CA-10Z. Sale price, $4.95. Lots of 3 or more, $4.79 each.

Brown leatherette covered wood baffle and 12" RCA PM speaker. A terrific McGee value. Only 500 to sell. You get the baffle and speaker for the value of the speaker only. Stock No. RCA-812. Sale price, $6.95. Lots of 3 or more, $6.79 each.

TELEVISION BOOSTER CLEARANCE SALE

Clearance sale on VHF television boosters for channels 2 through 13. RMS Model SP-5, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascode front end. Sale price..... **$4.95**

RMS Model SP-6, brown plastic case. Same as SP-5 except has variable gain control. Sale price..... **$4.95**

McMurdo-Silver GB-6B continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price..... **$5.95**

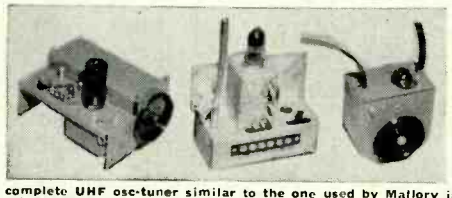
Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price..... **$6.95**

MINIATURE BROADCASTING STATION FOR THE HOME
NEW 1955 MODEL WITH CRYSTAL MIKE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

6" SESSIONS CLOCK-TIMER
With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9⅝" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¾" x 4" high and 2⅜" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63, Sessions Clock-Timer with case of your color choice. Sale price only $3.95.



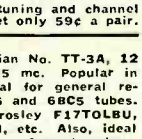
UHF CONVERTER TUNERS $2.95
3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory in-ducto-tuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH12 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice of any of these for only $2.95 each, or 3 assorted for $7.50.

FAMOUS STANDARD COIL CASCODE TUNERS

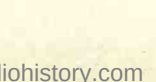
TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

SALE PRICE **$12.95** 2 FOR $25.00



No. TV-4001-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.



TWO-TUBE SARKES-TARZIAN TV TUNER $8.95 WITH TUBES

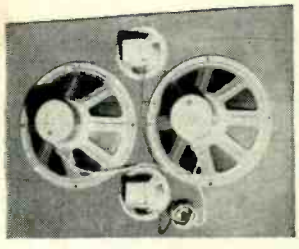
New 2 tube Sarkes-Tarzian No. TT-3A, 12 channel TV tuner. 21-25 mc. Popular in many makes. Also, ideal for general replacement use. Has 6J6 and 6BC5 tubes. Used in CBS, Arvin, Crosley F17TOLBU, TOLH, TOLU, F21CDLBH, etc. Also, ideal for general replacement use. A good replacement for one tube tuners. 3½" shaft. No. TT-3A, Sale price, $8.95. Takes SCK-2 knob set described above.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

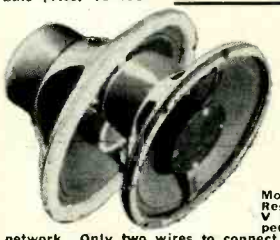
McGEE'S LATEST 1955 LOW COST HI-FI SPEAKER SYSTEMS



25 WATT HI-FI SPEAKERS AND BAFFLE BOARD

2—12" WOOFERS
2— 5" TWEETERS
$24.95
350 CYCLE CROSSOVER $10.00 Extra

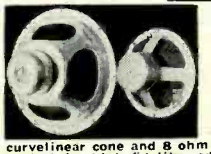
Stock No. 4P-SS, four speakers mounted on a ¾" plywood baffle board 21⅛" x 28⅛" long. For mounting in your present cabinet or wall-mounting. You save time and trouble of properly mounting and baffling. Equipped with 2—12" heavy magnet woofers and 2—5" tweeters. Response 50 to 18000 cps. Works properly on any radio or amplifier with 3.2 or 8 ohm output. Ship. wt. 20 lbs. List value over $40.00. Sale price, $24.95.
Model X4P-SS, same as above but equipped with a 350 cycle LC type super deluxe crossover for attenuating highs and augmenting low frequency response. Variable control. Sale price, $34.95.



McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

12-Inch Model CU-14Y **$12.95**
15-Inch Model P15-CR **$23.95**

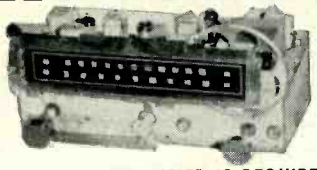
Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price, $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P-15-CR, McGee's Sale Price, $23.95.



HIGH FIDELITY SPEAKERS

8" BLUE STREAK ..... $ 6.95
15" BLUE STREAK WOOFER $16.95

Model HF-8J, 8" "Blue Streak," High Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,500 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt., 6 lbs., Model HF-8J, Sale price, $6.95.
Model HF-15 J, 15" "Blue Streak," HiFi woofer. Has a 14½ oz. Alnico V magnet with curvelinear one piece cone and 1¼", 8 ohm voice coil. Will give good response from 50 to 9500 cps. Takes 15 to 20 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.



CROSLEY FM-AM TUNER

SALE PRICE **$19.99**

AUDIO AMPLIFIER IS REQUIRED TO OPERATE A SPEAKER

Model 362-2, 6 tube Crosley FM/AM tuner. Receives broadcast 550 to 1600 kc, FM 88 to 108 mc. With tubes; 3-6BA6, 6BE6, 12AT7 and 6T8. Power this tuner from your audio amplifier or TV set. (6.3 v. filament and 125 to 180 v. at 20 mils "B" voltage required.) Chassis 5½" x 10¾" x 5⅜" high. Illuminated slide rule dial 8½" long. 4 position switch selects FM, AM, TV or Phono. One-half of 6T8 used as pre-amp for variable reluctance pickup. Has no volume control. Audio is fed to your TV or hi-fi amp. These are new Crosley FM-AM tuners that cost over $20.00 to build. Model 362-2, complete with escutcheon, knobs, diagram, instructions and parts list. Ship. wt. 9 lbs. Sale price, $19.99.
Crosley 362-2VC, same as above but has volume control and power supply added to make a self-powered AM-FM tuner. Ship. wt. 10 lbs. Sale price, $24.99.
Note: An Audio amplifier is required to operate these tuners thru a speaker.

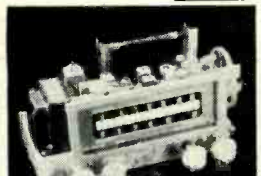
9-TUBE HI-FIDELITY

12 Watts Audio
Dual Tone Controls
$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9½" x 6" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 9 lbs. Sale price, $39.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

JACKSON AM9A



HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER

BOTH FOR **$49.95**

9 TUBES-PLUS 2 RECTIFIERS
10 W. AMP. PHONO INPUT

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 3 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased, we will include the necessary pre-amp, no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 2—6BA6, 6AT6, 6AL5 and 6X4 rectifier. Amp has 2—6V6's, 6SN7 and rectifier. Full superhet circuit with AVC, 3 position tone control, 9" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone control, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. FA9-2CR tuner and amplifier complete. Ship. wt. 22 lbs. Sale price, $49.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

NEW IMPERIAL IV with General Electric

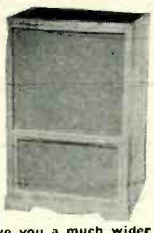
8 in. HIGH FIDELITY SPEAKER **$19.95**

New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95.

CONSOLE HIGH FIDELITY SPEAKER SYSTEM

$49.95

EQUIPPED WITH 3 PM SPEAKERS
12 IN. GENERAL ELECTRIC WOOFER
10 IN. MID RANGE SPEAKER
8 IN. GENERAL ELECTRIC MID-HIGH RANGE



Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or booming lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE, Sale price, $49.95.

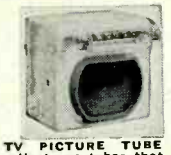
60 WATT CONSOLE AMPLIFIER WITH 3 SPEAKERS $275.00 VALUE

$169.50

$275.00 value 60 watt console auditorium amplifier system for only $169.50. A 43" high, ¾ door mahogany console cabinet that cost $100.00 to build, plus a regular $150.00 dealer value Operadio 60 watt auditorium amplifier. This is a completely assembled amplifier system with a super heavy duty 15" Operadio speaker and 2 heavy 10" PM speakers properly installed and baffled. The 60 watt Operadio Model PA-125 has 4-6L6G's in push-pull-parallel, driven by a 6SN7 with 2-5U4G rectifiers. We have specially designed a pre-amplifier that has two mike inputs with separate gain controls, input for crystal or magnetic phono pickup and bass and treble tone controls. This pre-amplifier may be used in the cabinet or as a remote control. System has a built-in 600 cycle crossover network. Schematic diagram and instructions furnished. This unit sounds like a giant Juke Box. A terrific value if you need lots of audio and plenty of bass response. Stock No. PA-25MA5, 60 watt Auditorium Amplifier System, ship. wt., 130 lbs. Sale price, $169.50.

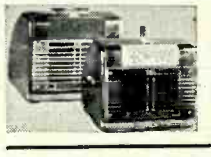
$100.00 LIST—1953 BUICK—12-VOLT AUTO RADIO

$39.95



No. 981323. 8 tube 12 volt Buick radio. Custom made for all '53 Buicks except the Special. Cost over $100 retail. Magic Selectronic single push-button tunes selector mechanically. Built-in 8" speaker, tone control, PP 12V6 audio. Ship. wt. 20 lbs. Sale price, $39.95.

TV PICTURE TUBE RESTORER, to rejuvenate the cathode on tubes that have weak picture due to cathode deterioration. Also burns out shorts and welds open elements in most cases. Fully transformer operated. More equipment in this metal cabinet than any restorer that we have offered. This unit will perform like units that sold as high as $250.00. It is superior to units offered at $50.00 to $75.00 today. Tests picture tube, rejuvenates cathode with relay time pulse, to control cycle. Burns out shorts, welds open elements. Effective on 90% of all picture tubes. Stock No. AJ-59. Ship. wt. 20 lbs. Sale price, $49.95.



3-STATION MASTER SUB-STATIONS $3.95 EACH

$16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MPM-3. Ship. wt. 15 lbs., $16.95. Matching sub-station PM-A5, with 5" PM and call-back switch, $3.95 ea.; 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft.; 500 ft. for $8.95.

GARRARD—COLLARO—WEBCOR 3-SPEED RECORD CHANGERS

$65.00 LIST COLLARO 3/532 $38.95

Here are top values in modern up-to-date 3 speed automatic record changers. New Webcor model 114-43, 3 speed automatic changer with RPX-050 G.E. cartridge. Size, 13½" x 12". Ship. wt. 12 lbs. Sale price only $29.95.

Regular $65.00 list Collaro model 3/532, 3 speed automatic record changer made in England. Intermixes 10 and 12" records of same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and std. records. Plug-in head will hold any popular cartridge. 14¾" long, 12¼" wide and 4¾" above motor board, 2⅞" below. Available in grey, cream and gold hammertone. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95 less cartridge. Large 45 RPM spindle, $2.50 extra. 3/532 Collaro changer with G.E. Golden Treasure RPX-052 cartridge, $58.95.

RC-80 Garrard "Triumph," 3 speed automatic changer. 13¼" wide, 15½" deep and 8" high, 2½" below motor board. Net price, less cartridge, $48.51. 45 RPM spindle $3.43 extra. RC-80 with G.E. RPX-052 Golden Treasure cartridge, Net $68.51. RC-80 with crystal flip-over cartridge, only $52.46.

RC-90 Garrard "Crown," 3 speed automatic changer. 13½" x 15½". 5¾" above motor board and 3⅞" below. Net price, less cartridge, $68.11. With crystal flip-over cartridge, $72.06. With G.E. RPX052 Golden Treasure, $88.11. 45 RPM spindle, $3.43 extra.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

Electronic Ignition

(*Continued from page* 63)

approximately ground potential. It should be noted that the time of recharging capacitor C is determined by the resonant circuit consisting of the charging inductor L_1 and the firing capacitor itself. With the components used, recharging time is on the order of one millisecond. This time is thus considered to be the upper firing rate limit or 1000 pulses per second. This, incidentally, on an eight-cylinder engine corresponds to over 10,000 rpm.

Fig. 6 shows the complete schematic. The power supply makes use of a filament transformer as a vibrator transformer. Power requirements are quite reasonable since operation at as high as 1000 pulses per second requires only 100 ma. at 250 volts. The negative supply establishes cut-off bias for the 2D21 thyratron. Transformer T_2 supplies the trigger to the thyratron grid as the points open. This then fires the thyratron, discharging C_5 through the coil. Capacitor C_5 attains a peak voltage of between 500 and 600 volts and therefore should have a 1000 volt rating. Since the 2D21 requires a minimum of 10 seconds heating time before operation, the time delay relay and relay RL_1 are wired in a latching manner so that thyratron cathode protection is maintained under all possible conditions. During the warm-up interval, relay RL_1 also switches capacitor C_5 to provide conventional ignition when starting, thus alleviating any problems with low plate voltage during starter engagement as well as eliminating any inconvenient starting delay.

Construction is comparatively simple as the photographs clearly indicate. The chassis used was an aluminum 5 x 10 x 3 inch chassis which is actually larger than necessary. Aluminum should be used to minimize corrosion. It is best to mount everything possible, with the exception of plug-in units, under the chassis for shielding, both mechanical and electrical. For reliability good components should be used and particular attention should be given to good wrap-around solder joints to withstand severe vibration. The charging inductor L_1 is the only component that might be hard to find. The one used by the author had a rating of .2 henry, 10 ohms. If necessary about 50 per-cent of the turns can be removed from a *Stancor* C-2326 filter choke to provide the right inductance. After wiring, the unit should be bench tested, making sure that the battery polarities are the same as the car in which it is to be mounted. Connect a coil primary between the coil terminal and ground. Provide a gap for the coil and connect a lead from the distributor terminal to ground. The thyratron should fire only when this latter ground lead is broken. If such is not the case, reverse the trigger transformer leads at the terminal strip.

Installation is mostly a matter of

finding a mounting spot in the engine compartment and making the necessary interconnections as shown in Fig. 7. Cabling should be well insulated and of no smaller than number 14 wire size. The only distributor modification necessary is the removal of the capacitor contained therein. The photograph on page 62 shows the installation in the author's V-8 *Dodge*. After all connections are made the engine should be started. After the time delay relay has latched, the thyratron should then be checked to see that it is firing. You are now ready for a road test.

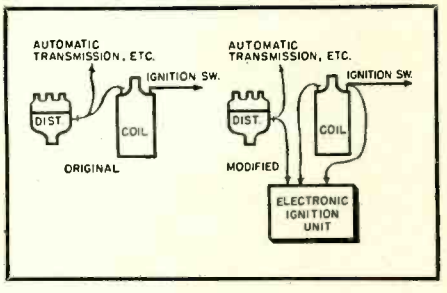
Your first impression will undoubtedly be centered around the much improved acceleration, particularly at speeds above forty miles per hour. You should also find that this system is very tolerant of fouled and dirty plugs. Some improvement in gasoline mileage should also be apparent. Resistor or standard plugs work equally well. A thirty-five thousandths gap should be used. Where spark plug leads are tightly cabled together it may be necessary to separate them or individually shield them with braid to prevent cross-firing.

An interesting addition to this circuit can be made where the jumper is shown in Fig. 6. The d.c. current flowing in this jumper varies directly with the number of times per second that the thyratron fires. With some calibration, you have a tachometer by connecting a milliammeter here in place of the jumper. A two-range meter simply means a meter shunt and switch. Some nonlinearity will be noticed at both the low and high speed ends of the scale, this being due to the selenium diode leakage current and power supply regulation respectively.

The author's unit has been in operation for a good many thousand miles without a single failure. Switch S_1, however, is there "just in case" and returns the system immediately to its original form. It is expected that point failure will be mechanical rather than electrical. In the event of a 2D21 failure it is best to have a spare mounted directly on the unit as shown in the photograph since most local radio repair shops may not stock this tube.

Those who really enjoy tinkering with their cars and who want something just a little unusual should try building this ignition system. It is more than a gadget and will provide a worthwhile improvement in the operation of any make or model of automobile. —30—

Fig. 7. Interconnection for ignition unit.

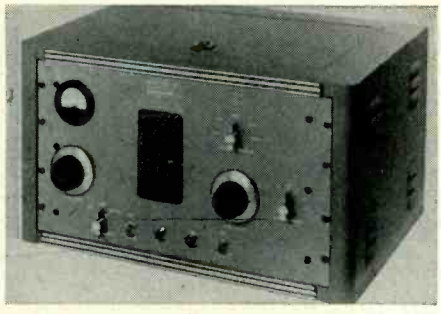


What's New in Radio

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

500-WATT AMPLIFIER

A new, compact linear power amplifier, designed for high power outputs on c.w., AM, and SSB operation at 75, 40, 20, 15, and 10 meters has been an-



nounced by *Transitron, Inc.*, of 154 Spring St., New York 12, N. Y.

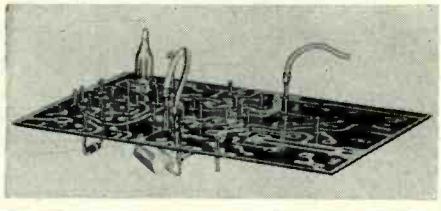
The amplifier, which requires low driving power, provides low harmonic output, excellent stability, and freedom from parasitics, according to the company. A continuously-tuned grid circuit from 3.5 to 30 mc. and band-switched pi-network tank circuit for matching to a 50 to 75 ohm antenna, minimize tuning adjustments and eliminate the need for plug-in coils. The amplifier is adjustable from class A through class C operation.

The T-11 is mounted in a 21" x 15" x 12" metal cabinet with self-contained, heavy-duty power supply, including two 866A rectifier tubes. The complete unit weighs 80 pounds.

PRINTED CIRCUIT PARTS

Malco Tool and Mfg. Co., Dept. REN, 4025 W. Lake St., Chicago 24, Ill., has developed a new line of miniature terminals and contacts for printed circuits which is said to cut wiring time, speed production, and save assembly costs.

The tubular pin is readily adapted to numerous wiring problems. Two beads on the lower part of the pin terminal



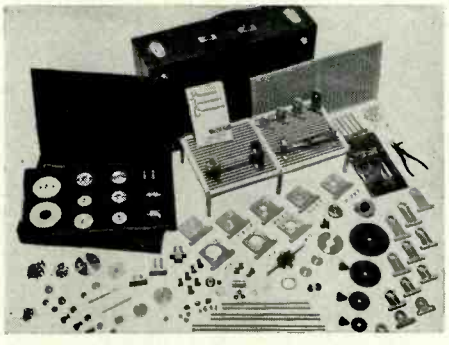
depress and snap out again when pushed through an accommodating panel hole. The pin snaps into the panel with a positive locking action, eliminating roll-over operations and possible fracturing of the panel or chipping of the plate. This locking action retains the pin until additional components are added or until it is permanently soldered.

The female contact is for use where quick connect and disconnect type connections are desired. The solderless wire crimp can be varied to meet requirements.

BREADBOARD KIT

Pic Design Corporation, 160 Atlantic Ave., Lynbrook, Long Island, N. Y., is now offering a practical kit of precision laboratory instrument components consisting of 630 different parts such as gears, shafts, differentials, breadboard plates, hangers, bearings, etc. The kit of parts is complete in every way as it incorporates all parts necessary to solve any mechanical or electronic problem. The material is designed for re-use.

The kit can be used for military engineering or development contracts,



university laboratories, educational institutions, etc. The entire kit is contained in a leather carrying case 5" x 12" x 18", felt lined to protect the parts. The kit comes complete with tools to assemble and disassemble the parts as desired.

PICTURE TUBE TESTER

Century Electronic Company of Mineola, N. Y., is offering a budget-priced cathode-ray tube tester designed for the service field.

The Model 102 tests all 10" to 30" picture tubes for quality by the emission method. It also tests for inter-element leakage, shorts, and open elements. The instrument is completely self-contained and supplies its own CRT power through a unique circuit which allows efficient testing whether the tube is in the set or not. A single master control eliminates complicated switching and instantly shows the condition of the tube under test.

RECHARGEABLE BATTERY

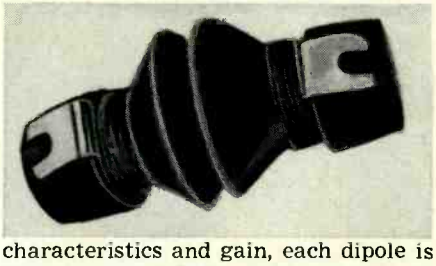
The development of a rechargeable storage battery, believed to be the world's smallest, the size of an ordinary postage stamp, has been announced by *Yardney Electric Corp.*, 40 Leonard St., New York 13, N. Y.

The battery is suitable for use in portable communications, recording, telemetering, and photographic equipment. This new storage cell, built on the silver-zinc principle, measures only 3/16" x 5/8" x 1 1/8". It is rated at one-tenth ampere-hour and weighs one-sixth of an ounce. It provides maximum continuous drains of 500 ma. and peak pulse currents in excess of 2 amps.

INDOOR TV ANTENNA

Tentenna, Inc., 122 E. 42nd Street, New York 17, N. Y. is now offering a unique indoor television antenna which has been tradenamed the "Twin Ogyro."

Using twin dipoles of "Ceroc" which is a specially processed wire of unusual



characteristics and gain, each dipole is wound on a rubber molded combination spool and suction cup, slightly less than one inch high and wide. Both dipole spools take up no more room than two thimbles.

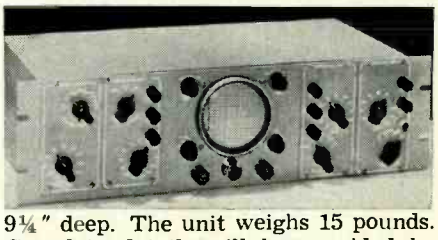
The dipoles are attached by suction to any baseboard molding, window pane, or sill.

RACK-MOUNTED SCOPE

Hickok Electrical Instrument Company, 10534 Dupont Ave., Cleveland 8, Ohio, is now offering its new 3" oscilloscope in rack-mounted form.

Known as the Model 385R, this instrument features a six-section unitized circuit construction similar to that used in equipment made for the Armed Forces. Circuit sections are available as individual units for replacements. Provision is also made for two-axis modulation.

Over-all dimensions of the new rack mount are 19" wide, 5 1/2" high, and



9 1/4" deep. The unit weighs 15 pounds. Complete details will be provided by the company on request.

TINY MICA CAPACITORS

The Electro Motive Mfg. Co., Inc., of Willimantic, Conn., is in production on a new dipped mica capacitor which is said to be the world's smallest mica unit and the first with parallel leads.

The "Dur-Mica DM-15" is rated at from 1 to 510 μμfd. at 300 w.v. and up to 400 μμfd. at 500 w.v. It provides minimum capacity tolerance of ±1% or .5 μμfd. (which ever is greater)

CRYSTAL PACKAGE SALE!

Genuine Govt. Surplus Crystals! Same day shipment! Assorted frequencies!

START YOUR OWN CRYSTAL BANK NOW!

U. S. CRYSTALS OFFERS THIS GIGANTIC BARGAIN! SET UP YOUR OWN CRYSTAL RESERVE!

SAME DAY SHIPMENT! SATISFACTION GUARANTEED!

WARRANTY! Crystals in all packages on this page are GENUINE government surplus crystals manufactured by NATIONALLY-KNOWN companies such as Bliley, Piazza, Monitor, John Meck, Cecor, Tellcon, etc. U. S. CRYSTALS, INC. GUARANTEES YOUR SATISFACTION OR YOUR MONEY BACK IN FULL!

SPECIAL PACKAGE DEAL NO. 1

100 CRYSTALS!

SPECIAL PACKAGE DEAL NO. 1 CONSISTS OF:
80........FT-243 10........FT-171 10........DC-34-35

MIXED FREQUENCIES! At least 20 HAM BAND frequencies! For operation on 160, 80, 40, 20, 10, 6 and 2 meters on either FUNDAMENTAL or HARMONIC frequencies.

SHIPPING TERMS: Same day shipment! Shipping wt.: 5¾ lbs. Check postal zone and ADD SUFFICIENT POSTAGE to cover cost of mailing.

SPECIAL PACKAGE DEAL NO. 1 **$9.95** Regular value $69.00!

SPECIAL PACKAGE DEAL NO. 2

***Guaranteed to oscillate!* Consists of 5 choice crystals:**

1—ZENITH MODEL DC-18-A 1,000 KC CRYSTAL: Built-in 12 V. automatic thermostatic controlled heating unit. 8-pin octal base. Reg. value $5.95

1—SR-5 BLILEY. 10,000 Kc. Reg. value $1.99
1—FT-243. 5,000 Kc. Reg. value. 1.99
1—FT-241. 200 Kc. Reg. value.. 1.99
1—FT-241. 500 Kc. Reg. value.. 1.99

Total regular value $13.91

SPECIAL PACKAGE DEAL NO. 2 **$8.95** POSTPAID Satisfaction guaranteed!

SPECIAL PACKAGE DEAL NO. 3

36 FT-241 LOW FREQUENCY CRYSTALS

FOR SINGLE SIDE BAND

Frequency range from 370.370 Kc. to 435.185 Kc. in steps of every 1.852 Kc. approximately. Channels: 0 to 35.

SPECIAL PACKAGE DEAL NO. 3 **$3.95** POSTPAID! Satisfaction guaranteed! Regular value $14.04

SPECIAL PACKAGE DEAL NO. 4

The Biggest Crystal Bargain Ever Offered! Consists of:
1 Special Pkg. No. 1. Reg. value $9.95
1 Special Pkg. No. 2. Reg. value 8.95
1 Special Pkg. No. 3. Reg. value $3.95
Total value $22.85

SPECIAL PRICE FOR ALL 3 PACKAGES ...... **$19.95** POSTPAID! Satisfaction guaranteed!

SPECIAL PACKAGE DEAL NO. 5

Guaranteed to oscillate!
22 FT-241—SINGLE SIDE BAND LATTICE FILTER PACKAGE

Incl. 2 ea. 455 Kc IF Xfmrs.

Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)
38	440.741	42	448.148	46	455.556	50	462.963	54	470.370	58	477.778
39	442.593	43	450.000	47	457.407	51	464.815	55	472.222	59	479.630
40	444.444	44	451.852	48	459.259	52	466.667	56	474.074		
41	446.296	45	453.704	49	461.111	53	468.519	57	475.926		

Regular value: $18.28. Same day shipment. Satisfaction guaranteed.

SPECIAL PACKAGE NO. 5 POSTPAID **$9.95**

SPECIAL PACKAGE DEAL NO. 6

FOR SINGLE SIDE BAND

80 FT-241—LOW FREQUENCY CRYSTALS
Including One Channel 70, 500 Kc.

ONE EACH of frequencies from 370.370 to 518.667 Kc. in steps of every 1.852 Kc.

Regular value: $63.20. Same day shipment. Satisfaction guaranteed.

SPECIAL PACKAGE NO. 6 POSTPAID **$14.95**

SPECIAL PACKAGE DEAL NO. 7

4035	5205	6373.3	7373.3
4045	5235	6406.7	7406.7
4080	5305	6440	7440
4095	5327	6473.3	7473.3
4110	5335	6506.7	7506.7
4135	5397.5	6540	7540
4175	5437.5	6573.3	7573.3
4190	5485	6606.7	7606.7
4215	5500	6640	7640
4255	5587.5	6673.3	7673.3
4280	5706.7	6706.7	7706.7
4295	5740	6740	7740
4340	5773.3	6773.3	7773.3
4395	5806.7	6806.7	7806.7
4397.5	5840	6840	7840
4445	5873.3	6873.3	7873.3
4450	5906.7	6906.7	7906.7
4490	5940	6940	7940
4495	5973.3	6973.3	7973.3
4535	6006.7	7006.7	8006.7
4620	6040	7040	8040
4680	6073.3	7073.3	8073.3
4695	6106.7	7106.7	8106.7
4735	6140	7140	8140
4840	6173.3	7173.3	8173.3
4845	6206.7	7206.7	8206.7
4852	6240	7240	8240
4930	6273.3	7273.3	8273.3
4950	6306.7	7306.7	8306.7
5030	6340	7340	8340

120 FT-243

Complete with CRYSTAL *storage box*

Regular value $87.75

Same day shipment. Satisfaction guaranteed.

$24.95

SPECIAL PACKAGE NO. 7 Ship. Wt. 9 lbs.

SPECIAL PACKAGE DEAL NO. 8

120 FT-243

Complete with crystal storage box

Regular value $87.75

Same day shipment. Satisfaction guaranteed.

$24.95

5675	6425	7175	7925
5700	6450	7200	7950
5725	6475	7225	7975
5750	6500	7250	8000
5775	6525	7275	8025
5800	6550	7300	8050
5825	6575	7325	8075
5850	6600	7350	8100
5875	6625	7375	8125
5900	6650	7400	8150
5925	6675	7425	8175
5950	6700	7450	8200
5975	6725	7475	8225
6000	6750	7500	8250
6025	6775	7525	8275
6050	6800	7550	8300
6075	6825	7575	8325
6100	6850	7600	8350
6125	6875	7625	8375
6150	6900	7650	8400
6175	6925	7675	8425
6200	6950	7700	8450
6225	6975	7725	8475
6250	7000	7750	8500
6275	7025	7775	8525
6300	7050	7800	8550
6325	7075	7825	8575
6350	7100	7850	8600
6375	7125	7875	8625
6400	7150	7900	8650

SPECIAL PACKAGE NO. 8—Ship. Wt. 9 Lbs.

SPECIAL PACKAGE DEAL NO. 9

CRYSTAL BANK COMBINATION SPECIAL!

Regular value: $175.50

CONSISTS OF PACKAGE DEAL NO. 7 *AND* PACKAGE DEAL NO 8!

240 FT-243

Same day shipment. Satisfaction guaranteed.

Complete with 2 crystal storage boxes.

SPECIAL PACKAGE NO. 9 Ship. Wt. 18 lbs. **$39.95**

SPECIAL PACKAGE DEAL NO. 10

CRYSTAL BANK SUPER PACKAGE!

CONSISTS OF PACKAGE DEALS NO. 1, 2, 3, 5, 6, 7, 8!

The most colossal buy ever offered in crystal history!

Regular value: $353.03

Same day shipment. Satisfaction guaranteed.

GRAND TOTAL: **483 CRYSTALS** **$89.50**

SPECIAL PACKAGE NO. 10—Ship. Wt. 30 Lbs.

TERMS: All items subject to prior sale and change of price without notice. Minimum order: $3.95. ALL crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. NO C.O.D. Postpaid shipments made in U. S. and possessions only. Calif. buyers add sales tax. ADD SHIPPING COSTS FOR ALL PACKAGES OTHER THAN THOSE SENT POSTPAID.

INDIVIDUAL CRYSTALS

Guaranteed to oscillate! Your choice of frequencies! Same day shipment!

Numbers listed are fundamental frequencies in kilocycles.

NOVICE BAND

FT-243 FUNDAMENTAL FREQUENCIES

Lots of 10 or more. Ea. **99c**
Individually. Ea. $1.25

YOUR CHOICE OF FREQUENCIES!

80 Meters 3701, 3702, 3703 through 3748 in steps of 1 KC.

40 Meters 7176, 7177, 7178 through 7198 in steps of 1 KC.

DOUBLING TO 40 METERS: 3588, 3589, 3590 through 3599 in steps of 1 KC.

MISCELLANEOUS & SHIP BAND FREQUENCIES

81.95 KC. Octal tube type (Used in SCR-584 & SPM-1) $3.99
200 KC. FT-241 CR2/U.. 1.99
200 KC. Type DC-15 in octal tube base type holder 1.99
327.8 KC. No. D-168342. (Used in TS-102/AP). 9.95
500 KC. FT-241 .... 1.99
1000 KC. Type DC-9, in octal tube base type holder 3.45
2009 KC. DC-34 .... 2.99
2110 KC. DC-34 .... 2.99
2126 KC. DC-34 .... 2.99
2142 KC. DC-34 .... 2.99
2166 KC. DC-34 .... 2.99
2174 KC. DC-34 .... 2.99
2182 KC. DC-34 .... 2.99
2182 KC. FT-243 .... 2.99
2206 KC. DC-34 .... 2.99
2406 KC. FT-243 & DC-34.. 2.99
2500 KC. FT-243 .... 1.99
2559 KC. DC-34 .... 2.99
2567 KC. FT-243 & DC-34.. 2.99
2629 KC. DC-34 .... 2.99
2632 KC. FT-243 .... 2.99
2637 KC. DC-34 .... 2.99
2637 KC. FT-243 .... 2.99
2638 KC. DC-34 .... 2.99
2638 KC. FT-243 .... 2.99
2670 KC. FT-243 .... 2.99
2647 KC. FT-243 .... 2.99
2670 KC. DC-34 .... 2.99
2738 KC. Type 1-C 2.99
2738 KC. FT-243 .... 2.99
2738 KC. MC-7 .... 2.99
2891 KC. DC-34 .... 2.99
2907 KC. DC-34 .... 2.99
2951 KC. DC-34 .... 2.99
2973 KC. DC-34 .... 2.99
2977 KC. DC-34 .... 2.99
2983 KC. DC-34 .... 2.99
3000 KC. FT-243 .... 1.99
3021 KC. DC-34 .... 2.99
3023 KC. DC-34 .... 2.99
3043 KC. DC-34 .... 2.99
3053 KC. DC-34 .... 2.99
3055 KC. DC-34 .... 2.99
3088 KC. FT-243 .... 2.99
3093 KC. DC-34 .... 2.99
3093 KC. FT-243 .... 2.99
3098 KC. FT-243 .... 2.99
3103 KC. FT-243 .... 2.99
3123 KC. DC-34 .... 2.99
3125 KC. DC-34 .... 2.99
3188 KC. FT-243 .... 2.99
3193 KC. DC-34 .... 2.99
3193 KC. FT-243 .... 2.99
3198 KC. FT-243 .... 2.99
3203 KC. FT-243 .... 2.99
8230 KC. FT-243 CAP.... 1.99
5000 KC. FT-243 .... 1.99
10,000 KC. Type SR-5 Bliley, in CR-1 holder....1.99

SINGLE SIDE BAND—FT-241-A

Low Frequency Crystals

Lots of 10 or more. Each ..79¢
Lots of 5 or more. Each ..89¢
Individually. Each ..99¢

400	440	441
442	444	445
446	447	448
450	451	452
453	454	455
456	457	458
459	461	462
463	464	465
466	468	469
470	472	473
474	475	476
477	479	480

FT-243

Lots of 10 or more. Ea...... **69c**
Lots of 5 or more. Ea. 79¢
Individually. Ea. ....99¢

										5700	6000	6325	6700	7100	7383.3	7550	7658.3	7758.3	7858.3	7958.3	8060	8160	8260	8360	8466.7	8566.7	8666.7
										5706.7	6006.6	6335	6706.6	7106.6	7391.7	7558.3	7660	7760	7860	7960	8066.7	8163.4	8266.7	8366.7	8470	8570	8670
										5725	6025	6340	6725	7125	7400	7560	7666.7	7766.7	7866.7	7966.7	8070	8166.7	8270	8370	8473.3	8573.3	8673.3
1110	2300	2510	2710	2885	3030	3225	4035	4610	5090	5730	6040	6350	6740	7140	7406	7566.7	7670	7770	7870	7970	8073.3	8170	8273.3	8375	8475	8575	8675
1129	2305	2515	2715	2890	3035	3230	4045	4620	5127.5	5740	6042	6362	6750	7150	7406.6	7570	7673.3	7773.3	7873.3	7973.3	8075	8173.3	8275	8380	8480	8520	8680
1150	2320	2520	2720	2895	3040	3235	4080	4635	5165	5750	6050	6373.3	6773.3	7160	7408.3	7573.3	7675	7775	7875	7975	8080	8175	8280	8383.3	8483.3	8583.3	8683.3
1195	2350	2525	2750	2905	3045	3240	4095	4680	5180	5760	6073.3	6375	6775	7173.3	7416.7	7575	7680	7780	7880	7980	8083.3	8180	8283.3	8390	8490	8590	8690
1525	2355	2530	2755	2910	3050	3290	4110	5782.5	5205	5773.3	6075	6400	6800	7175	7425	7580	7683.3	7783.3	7883.3	7983.3	8090	8183.3	8290	8391.7	8491.7	8591.7	8691.7
1915	2360	2535	2760	2915	3055	3310	4135	5800	5235	5775	6100	6405	6806.6	7200	7433.3	7583.3	7690	7790	7890	7990	8091.7	8190	8291.7	8400	8500	8600	8700
1930	2365	2545	2765	2920	3060	3320	4165	5806.5	5245	5780	6106.6	6406.6	6815	7206.6	7440	7590	7691.7	7791.7	7891.7	7991.7	8100	8191.7	8300	8406.6	8506.6	8606.6	8706.6
1940	2370	2550	2770	2925	3065	3340	4175	5820	5285	5825	6125	6425	6825	7225	7441.7	7591.7	7700	7800	7900	8000	8106.6	8200	8306.6	8408.3	8508.3	8608.3	8708.3
1950	2375	2557	2775	2930	3070	3410	4190	4695	5295	5840	6140	6440	6840	7240	7450	7600	7706.6	7806.6	7906.6	8006.6	8108.3	8206.6	8308.3	8410	8510	8610	8710
1965	2390	2560	2780	2935	3075	3420	4215	4710	5300	5850	6142	6450	6850	7250	7458.3	7606.6	7708.3	7808.3	7908.3	8010	8110	8208.3	8310	8416.7	8516.7	8616.7	8716.7
2015	2415	2565	2785	2940	3095	3455	4220	4735	5305	5852.5	6150	6473.3	6873.3	7273.3	7466.7	7608.3	7710	7810	7910	8016.7	8116.7	8210	8316.7	8420	8520	8620	8720
2017	2430	2570	2790	2945	3110	3465	4255	4780	5327.5	5860	6173.3	6475	6875	7275	7473.3	7610	7716.7	7816.7	7916.7	8020	8120	8216.7	8320	8425	8525	8625	8725
2020	2435	2575	2795	2950	3130	3510	4280	4785	5335	5873.5	6175	6500	6900	7300	7475	7616.7	7720	7820	7920	8025	8125	8220	8325	8430	8530	8630	8730
2025	2440	2580	2815	2955	3135	3525	4295	4815	5385	5875	6185	6506.6	6906.6	7306.6	7483.3	7620	7725	7825	7925	8030	8130	8225	8330	8433.3	8533.3	8633.3	8733.3
2035	2442	2585	2825	2960	3140	3640	4300	4820	5397.5	5880	6200	6525	6925	7308.3	7491.7	7625	7730	7830	7930	8033.3	8133.3	8233.3	8333.3	8440	8540	8640	8740
2040	2450	2590	2830	2965	3145	3655	4330	4840	5435	5892.5	6206.6	6540	6940	7316.7	7500	7630	7733.3	7833.3	7933.3	8040	8140	8240	8340	8441.7	8541.7	8641.7	8741.7
2055	2455	2595	2835	2975	3150	3680	4340	4845	5437.5	5900	6225	6550	6950	7325	7506.6	7640	7740	7840	7940	8041.7	8141.7	8241.7	8341.7	8450	8550	8650	8750
2060	2460	2650	2840	2980	3155	3700	4395	4852.5	5485	5906.7	6235	6573.3	6973.3	7333.3	7508.3	7641.7	7741.7	7841.7	7941.7	8050	8150	8250	8350	8458.3	8558.3	8658.3	
2065	2465	2655	2845	2985	3160	3760	4397.5	4880	5500	5907.5	6240	6575	6975	7340	7510	7650	7750	7850	7950	8058.3	8158.3	8258.3	8358.3	8460	8560	8660	
2090	2470	2660	2850	2990	3165	3800	4445	4900	5545	5925	6250	6600	7000	7341.7	7516.7												
2105	2475	2665	2855	2995	3170	3885	4450	4930	5582.5	5940	6273.3	6606.6	7006.6	7350	7520												
2125	2480	2680	2860	3005	3175	3940	4490	4950	5587.5	5950	6273.5	6625	7025	7358.3	7525												
2130	2485	2685	2865	3010	3202	3955	4495	4980	5645	5955	6275	6640	7040	7366.7	7530												
2135	2490	2690	2870	2015	3205	3980	4535	4995	5660	5973.3	6300	6650	7050	7633.3	7533.3												
2140	2495	2695	2875	3020	3210	3990	4540	5030	5675	5975	6306.6	6673.3	7073.3	7373.3	7540												
2195	2505	2705	2880	3025	3220	3995	4580	5035	5687.5	5995	6315	6675	7075	7375	7541.7												

TERMS: All items subject to prior sale and change of price without notice. Minimum order: $2.50. ALL crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. No C.O.D. IN ORDERING INDIVIDUAL CRYSTALS, INCLUDE APPROX. 5¢ PER CRYSTAL FOR POSTAGE. Also indicate second choice frequencies wherever substitution may be made. Calif. buyers add sales tax.

U.S. CRYSTALS, INC.

805 SOUTH UNION AVENUE
LOS ANGELES 17, CALIF.

with good stability over a wide temperature range.

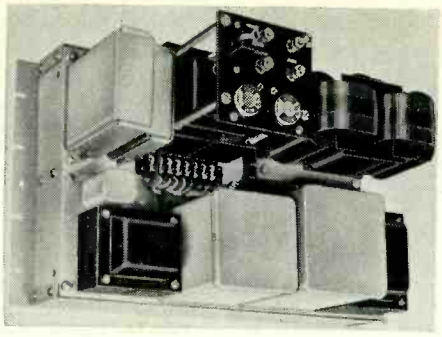
Measuring only 7/16" long and 9/32" wide to 3/16" thick, the DM-15 meets all RETMA and MIL-C-5 specifications for regular capacitors. It uses standard #22 wire leads with a minimum length of 1½" and 15/64" ± 1/32" between leads.

Free samples and complete data are available from Dept. RN of the company.

TUBELESS REGULATOR

An automatic regulator designed for unattended installations has been developed by *The Superior Electric Company* of Bristol, Conn.

Operating without tubes or moving parts, the "Stabiline" automatic voltage regulator Type TM can be used in microwave or other installations where standard voltage regulators cannot be attended or where there is vibration that would cause electronic tubes to break.



The unit holds output voltage to within a one-volt band, has a speed response of less than one second for full-range correction. Maximum waveform distortion is 3 per-cent. The regulator is currently available in rack mounting and cabinet models.

POLYSTYRENE CAPACITOR

Condenser Products Company, 140 Hamilton St., New Haven, Conn., has announced the development of a polystyrene capacitor of extremely high insulation resistance. The capacitor is designed for use as a charge storage unit and as a capacitance divider.

The capacitor, except for its studs and aluminum foil winding, is completely plastic. The case itself has much higher insulation resistance than either glass or metal, thus keeping surface leakage to a minimum.

The insulation resistance at room temperature is 30,000,000 meg. × μfd. at 400 volts d.c. while at 75 degrees C the insulation resistance is 1,000,000 meg. × μfd. at 400 volts d.c. These resistance values are measured by the time decay of voltage method.

THREE-WIRE OUTLET

Under the new *UL* requirements eliminating the pigtail for grounding on line cords, the three-prong, parallel blade layout will undoubtedly be the standard on new appliance and equipment cords.

In order to conform to the new design trend, *Alden Products Company,* Brockton, Mass., has designed a tiny, three-wire "Mini-spACe" outlet for the original equipment manufacturer who supplies convenience outlets for power take-offs as part of his equipment.

The new receptacle uses a unique adapter plate to provide the third contact. This adapter plate slips over the company's standard outlet. The mounting surface is punched with a regular layout punch and an additional hole made to allow the third grounding prong to pass through. The outlets are then riveted, spot welded, or eyeleted to the panel.

For samples or additional information, write Nelson W. Hearn in care of the company at 117-GG N. Main St. in Brockton.

"SUPER-STAR-HELIX"

JFD Manufacturing Company, Inc., 6101 16th Ave., Brooklyn 4, N. Y., is now offering a new television antenna, the "Super-Star-Helix," which incorporates the "Star-Helix" microwave configuration with a special front-end modification for peaking channel 13 performance.

Since channel 13 has proven troublesome in many areas throughout the country, the new antenna has been especially designed to solve the problem. According to the manufacturer, the new antenna has proven effective in developing high "lock-in" wattage, clearer, brighter, cleaner pictures, free from noise and snow.

Preassembled, the elements need only be flipped into place. No tools or screws are required. The antenna is constructed of *Alcoa* aluminum for rust and corrosion resistance.

VARIABLE DELAY LINE

Advance Electronics Co., Inc., 451 Highland Ave., Passaic, N. J., has developed a precision variable delay line, the Type 605.

The new unit consists of sixty sections of *LC m*-derived networks and one 60-position rotary switch. The *LC m*-derived networks are especially designed for fast rise time and negligible overshoot. The rotary switch is used to change the amount of time delay between the input and output by connecting the output terminal to any one of the sixty sections of the *LC* networks.

Both the *m*-derived networks and the rotary switches can be removed from the cabinet and incorporated into any equipment where a variable time

PRACTICE CODE TAPES & TG-34A KEYER

PRACTICE CODE TAPES Code Training and Practice Inked Paper Tapes on 16MM 400 Ft. Reels for Telegraph and Radio Operators. Fifteen (15) Reels to a Set—in Wood Case. For use with TG-34A or TG-10 KEYERS. COMPLETE SET—Price: **$14.95**

TG-34A KEYER 115 or 230 Volts at 50 to 60 cycles—an automatic unit for reproducing audible code practice signals previously recorded in ink on paper tape. By use of the self contained speaker, the unit will provide code practice signals to one or more persons—or provide a keying oscillator for use with a hand key. Unit is compact, in portable carrying case, and complete with Tubes, Photo Cell and Operating Manual. Size: 10⅝" x 10½" x 15⅜". Shipping weight: 45 lbs.....NEW: **$16.95**

SET OF 15 TAPES and TG-34A KEYER—BOTH: $30.00

RECORDER For CODE TAPES and TAPE PULLER

RECORDER BC-791 Recorder & Amplifier of Code Signals from Radio Receiver or Local Key sending on ¾" Paper Tape with Ink Writing Stylus. Tape can be played back on any TG-34 or TG-10 KEYER. 115 Volt 60 cycle operation with Tubes. (No Tape or Tape Puller included.) Prices: NEW: $9.95.....USED: **$6.95**

TAPE PULLER MC-310 Tape Puller—Variable speed Motor driven—for use with ¾" Paper Tape, 115 Volt 60 cycle operation. Complete with Motor Reel Assy. & Blank Reel. Prices: NEW: $12.95.....USED: **$9.95**

BOTH BC-791 RECORDER and MC-310 TAPE PULLER—NEW: $20.00
Or BOTH—USED: $15.00

BC-221 FREQUENCY CASE

BC-221 FREQ. CASE—Aluminum Case for BC-221 or TS-164 Freq. METER—W/ Voltage Regulator Supply using 1/VR-105—2/Ballast Tubes, Relay, Cable, etc. Front Comp. 9¾" x 7½" x 7⅜". Rear Compartment 2" Deep. Shock-mounted..NEW: **$4.95**

DYNAMOTORS:

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW:
14 VDC	330	150	BD-87	3.95	$5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	29.95
14	500	500	BD-500		12.95
14	600	300	BD-86		12.95
14	1030	260			
	515	215	DM-42	8.95	12.95
28	1000	350	PE-73	8.95	
12 or 24	275	110	USA/0516		4.95
12	230	90	PE-133	4.95	6.95
14 VDC	375	150	BD-83	3.95	4.95

ALL ITEMS PREVIOUSLY ADVERTISED STILL AVAILABLE—SEND FOR LIST!

ANTENNA RELAY

UNIT—BC-442 consists of switching relay, 0-1Ω RF Indicator, & 50 MMF Vacuum Capacitor...NEW: **$3.95**

CLASSIFIED ITEMS:

BC-229/429 REC., 2500-7700 KC., w/Coils...	U:	$ 5.95
BC-230 TRANS., 2500-7700 KC., w/Coils....	U:	8.95
BC-347 AMPLIFIER—1/6E8G....N: $3.95;	U:	1.95
BC-709 Amp.—Batt. Op.—1 Tube..N: $3.95;	U:	2.95
BC-745 TRANSCEIVER—3 to 6 MC.....U:		14.95
RT-34/APS-13 TRANSCEIVER—Less Tubes.	U:	3.95
FL-8A Range Filter..U: $1.49—FL-5 Filter..U:		1.00
TS-9 Carbon HANDSET.....U:		3.95
TS-10 Snd. Powrd. Hndset or Hd. & Ch. Set.	U:	3.95

BLOWERS:

12/24 VDC-AC CAST ALUMINUM BLOWER—100 CFM: 3" Intake; 2" outlet. Shunt Motor 4" x 2", 3000 RPM @ 24 VDC..... **$5.95**

6 VDC SINGLE—100 CFM—No. 6100 .....$4.95

6 VDC FLANGE—150 CFM—No. 6150 .....$6.95

12 VDC SINGLE—10 CFM—Min.—No. 1210..... 7.95
24 VDC SINGLE—10 CFM—Min.—No. 2410..... 5.95
24 VDC DUAL—20 CFM—Min.—No. 2420..... 7.95

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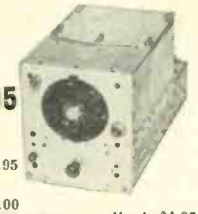

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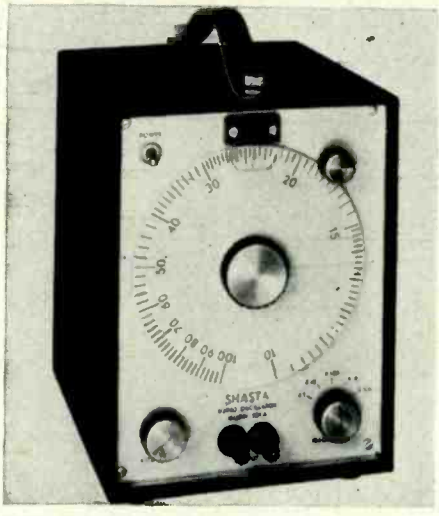
AUDIO OSCILLATOR

The *Shasta Division* of *Beckman Instruments, Inc.*, P. O. Box 296, Station A, Richmond, Calif., is offering its Model 301A audio oscillator for general purpose laboratory applications.

Covering the frequency range from 10 cps to 1 mc. in five steps, this unit



will drive impedances as low as 600 ohms with sufficient output to satisfy most general test requirements.

The entire unit is housed in a cabinet measuring only 9 5/32" high by 7 5/32" wide by 8 1/16" deep.

VERTICAL HAM ANTENNA

Universal Products Company, 4100 Taylor Ave., Racine, Wis., is now manufacturing a new, self-supporting, base-insulated vertical r.f. radiator which is equipped with a winch-operated "Snorkel Mast" to permit varying electrical length of the antenna up to 18 feet.

Patented and licensed by *Lewis Patents Foundation,* the antenna is being made available in four low-cost models in tower heights of 37½, 47, 56½, and 66 feet. Equivalent conductor diameter is such that it provides excellent aspect ratio for broad tuning. A low standing wave ratio is obtained over both the 40 and 80 meter bands and it performs well without buried radials, although radials do improve performance, according to the company.

The *"Lewis* Vertical" requires less than one square yard at the base. It can be erected or relocated anywhere with a minimum of time and labor. Bulletin No. 66, giving complete details, is available from the manufacturer on request.

HEADLIGHT CONTROL

Dynotron Corporation, Shaker Square, Cleveland, Ohio, has introduced a new automatic control for automobile headlights which incorporates a unique photoelectric circuit with an electronic delay.

The delay is essential to the proper functioning of the dimmer since it provides smooth and positive control of car headlights under all operating conditions and eliminates annoying flick-

ering of headlights and improper return to upper beam after dimming.

The dimmer features a universal-type mounting which permits installation on all makes of cars. The entire photoelectric circuit and power supply is enclosed in a compact metal case which is mounted on the instrument panel at the lower left corner of the windshield, inside the car.

The unit is now available in 6 and 12 volt models for all makes of cars. The manufacturer will provide full details on request.

HOFFMAN "COLORCASTER"

The *Hoffman Radio Division* is currently shipping its 21-inch color television receiver to distributors.

The "Colorcaster," Models 21M1100 and 21B1102, features simplified circuitry which uses 24 tubes plus 4 rectifiers, increased color stability, increased picture detail, and greater viewing area. Automatic luminance and chroma tracking are accomplished with a single control.

The set has its own swivel base and tuning controls mounted vertically at the side of the color picture tube. A

hinged panelled door on the chassis side of the cabinet has been incorporated to permit maximum ease in servicing the receiver.

The retail price of the set is under $900. -30-

Certified Record Revue

(*Continued from page* 64)

a mantle of modern hi-fi sound, it is infinitely more rewarding. Dr. Sitwell sounds much the same as she did on the old recording, except that she is more easily understandable with the improved sound. Dr. Sitwell's "avant garde" poetry set to the impudent music of Walton, has to be heard to be believed! One does not have to listen (and follow the printed text) very long to discover why this work created such a riot at its premiere in 1923. It is really quite mad! The estimable Peter Pears shows his remarkable

faculty for making the machine-gun patter of the verses completely articulate and Mr. Collins keeps everything moving lightly and gets excellent support from his instrumentalists. If you like the lilting rapid fire verse of Gilbert and Sullivan you may find this diverting. Voice and orchestral sound is clean and clear throughout the disc. No curve adjustment was needed.

While this isn't a "must" in the well-stocked record library, it does provide lots of good, clean fun. If you want something just a little different to spring on your friends, this would be a good disc for the purpose. Dame Edith stands a good chance of surviving as one of the "people" of our time, so this might turn out to be a real collector's item.

TCHAIKOVSKY

SWAN LAKE BALLET (COMPLETE)

Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury OL-3-102. RIAA curve. Price $22.80 (Three discs).

This is one of the most outstanding productions of this year. *Mercury*, encouraged by the great success of its "Nutcracker," has turned once again to Tchaikovsky and with stunning realism has recorded the first complete, uncut version of the magnificent "Swan Lake." The *London* recording is listed as "complete," but actually the score contains much that is not in the *London* album. Indeed, there is some question as to whether many of the sections herein recorded, have ever been played before! It is good to report that musical quantity has not been made subsidiary to quality. The sound of this album beggars description. The over-all effect is huge, quite overwhelming and I assure you that if your experience with this work has been limited to records rather than the ballet or concert hall, you have a treat in store, as the "presence" on these discs is nothing short of miraculous! Mr. Dorati is, of course, an acknowledged master of the ballet idiom and his reading is a model of disciplined good taste. His tempi are authentic, his phrasing deft, and his orchestral balance is just and carefully maintained. Some critics have characterized Dorati's reading as "cold," a statement I find incomprehensible. They also said the bass drum was too prominent. I think the root of this criticism stems, in many cases, from a mistaken concept of ballet music, especially as performed in a concert hall. A ballet is, after all, largely movement and as such the music must keep pace with the action. In the concert hall or on records, we are dealing with the score without the benefit of the dancers and I think this tends to throw emphasis on the rhythmic aspects, hence the heightening of percussives and the notion that the performance is "cold."

(*Continued on page* 98)

There is much new material here and while there are redundant sections where some cutting is justified . . . there is also much that is completely captivating, so that ownership of the complete ballet is sensible. *Mercury's* engineers have come up with a real dazzler in the sound department. The strings are silken smooth, the brass is fantastic . . . extremely brilliant, yet carrying great weight, the woodwinds are flawlessly reproduced with nary a trace of flutter and, as is usual with the percussion heard from the Minneapolis Symphony, great solid clean whumps of bass drum and tympani and the explosive transients of cymbals. Acoustic perspective is pervasively "live" and all is very wide in range with little distortion of any type including "pre- and post-echo." Dynamics and transient response are really incredible and you will have to watch your gain control carefully if you have neighbor problems! As befitting such a magnificent musical and engineering triumph, the album is quite deluxe with light blue silk moiré covers and with the program notes some superb sketches by the eminent Cecil Beaton. The music is fabulous, the hi-fi is ultra high and I predict that this irresistible recording will set new sales records for ballet music.

RACHMANINOFF
SYMPHONY #3
VOCALISE
Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML 4961. Old-NARTB curve. Price $4.98.

This will be welcomed by Rachmaninoff fans with unabashed delight, as up to this present recording they have had to contend with the miserable sounding Russian version on the *Rachmaninoff Society label*. Why as lushly lyrical and romantic a work as this has been overlooked by the recording companies so long is hard to understand. This has all the elements to make the record a success . . . the fabulous Philadalphia strings, Ormandy in his element and at the top of his form, excellent hi-fi sound and music which will find an immediate and sympathetic audience. Generally string tone is quite clean and in the lovely "Vocalise" you will find string playing that is quite incredible and probably unmatched for warmth and precision by any orchestra in the world today. Sound was wide in frequency response, dynamics were impressive. My only quibble is some rather thick sounding percussion, too much pre- and post-echo and an acoustic environment which seems a shade over-reverberent. These are relatively minor however, and I think I can safely say that most people will find this a most desirable recording.

GOULD
DANCE VARIATIONS
Wittemore and Lowe, duo-pianists with San Francisco Symphony Orchestra conducted by Leopold Stokowski.
MENOTTI
SEBASTIAN BALLET SUITE
Members of the NBC Symphony Orchestra conducted by Leopold Stokowski. Victor LM1858. RIAA curve. Price $3.98.

This is an absolutely sensational recording in every respect! The hi-fi fans will have a field day with this one. This music is the sort of thing that begs for hi-fi treatment and under the inspired leadership of Stokowski and the best engineering yet from *RCA*, this is quite a sonic showpiece! The Gould work is a virtuoso exercise for duo-pianists Whittemore and Lowe. Modern, but not excessively so, the work is quite exciting and his plenty of dazzling effects for the hi-finatics. The pianos are used quite percussively and, in combination with the rousing brass and sharp, accurate snare, tympani and cymbals, etc., your speaker will get quite a workout. The "Sebastian Ballet Suite" is a wonderful little score. There is some very lovely, engaging writing here and the famous Menotti touch for lyrical thematic material is much in evidence. This, too, will delight the sound conscious. Some beautiful bell and chime work here and ultra-sonorous contrabassi and gay and effervescent woodwinds. Throughout both works the sound is very wide range, dynamics are of notable breadth and the most outstanding characteristic is the wondrously "live" acoustics. It is possible that with a thicker-textured score this reverb would prove too much; with this music it is a near perfect example of liveness with detail. Don't fail to hear this! The RIAA curve was OK.

TCHAIKOVSKY
MANFRED SYMPHONY
Philharmonic Orchestra conducted by Paul Kletski. Angel 35167. RIAA curve. Price $4.98.

It is surprising how few dyed-in-the-wool Tchaikovsky enthusiasts know this symphony. It is even more surprising when one considers that the work is in the tradition of the 4th, 5th, and 6th symphonies and as a hi-fi vehicle is quite spectacular. There have been three previous versions in the *LP* catalogue, the only one of which was any good at all being the Toscanini effort. This present recording is far beyond the others in matters of sound and as performance goes, while Kletski is no match for the fiery Toscanini, he gives a good competent reading. The orchestration is lavish and is among the best ever done by Tchaikovsky. It calls for a very large orchestra and a good one at that. The Philharmonic fits this bill very adequately and produces some stupendous sounds. Hi-fi fans will particularly like the brass and percussion scoring in the "Orgy scene" in the finale. Sound generally is somewhat sharper focused than is usual with *Angel* and is good for this score. Strings are their usual smooth self, but brass seems brighter and percussion has more solidity and impact. Dynamic range was quite wide and groove distortion, virtually non-existent. If you are not familiar with this work and you like Tchaikovsky, you will find this most rewarding. Curve was OK and surfaces were quiet.

RAVEL
INTRODUCTION AND ALLEGRO
DEBUSSY
DANSES SACREE ET PROFANE
SCHOENBERG
TRANSFIGURED NIGHT
Hollywood String Quartet, Ann Mason Stockton, harpist; Concert Arts Strings conducted by Felix Slatkin. Capitol P8304. RIAA curve. Price $4.98.

Those of you who have an antipathy towards chamber music are urged to listen to this disc. If you don't like what you hear, I will be very surprised. The "Introduction and Allegro" is one of the most beautiful small-scale works ever written. I have found that the sensuous, almost other-worldly beauty of this score, with the lilting strings, the soft cascades of sound from the harp and the pure lambent tones of the flute, has an extraordinary effect on women! (All those courtin' and sparkin' take heed!) I would sincerely recommend that you play this work for the little woman if she has been giving you a hard time about your hi-fi. I've seen more than one woman won to the cause of hi-fi with this music. Of the five versions in the catalogue this wins hands down. Performance is expert, sound is smooth, wide range, splendidly balanced. The Debussy work is in the same vein as the Ravel and is equally well performed. The Schoenberg is a great work that may take a little acclimatization, but it is well worth your trouble. It is heard here

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377	397	418	485	507	530	445	465
379	398	419	487	508	531	446	466
380	401	420	488	509	533	447	468
381	402	422	490	511	534	448	469
383	403	423	491	512	536	450	470
384	404	424	492	513	537	451	472
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4445	5675	6225	6825	7660	7970
4450	5677	6240	6850	7673	8240
4490	5700	6250	6875	7675	8250
4495	5706	6273	6900	7700	8273
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4735	5760	6306	6975	7725	8306
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in the original chamber version, but has achieved more popularity in its orchestral guise. Those interested can hear the orchestral version on a *Columbia* disc with Eugene Ormandy and the Philadelphia orchestra. Curve was OK and, as usual, *Capitol* surfaces were outstandingly quiet.

BLISS

MIRACLE IN THE GORBALS
MUSIC FOR STRINGS

Philharmonia Orchestra conducted by Sir Arthur Bliss. Angel 35136. RIAA curve. Price $4.98.

This will be welcomed by balletomanes who like this blood-curdling vignette of life in the "Gorbals" . . . the slum district of Glasgow. This extraordinary ballet has sold very well in the old Constant Lambert/*Columbia* version, and this should have a ready market for those who wish to upgrade their libraries and with those who will be discovering it for the first time. The scoring can be termed modern, although atonality is not very prominent. The structure is most interesting and has many sections which will appeal to those who like the lyric and those who relish hi-fi effects. Sir Arthur Bliss lends his authority to the performance and the result is a more tightly organized, more dramatic reading than the old Lambert effort. Smooth sound throughout in the *Angel* manner and quiet surfaces add up to an attractive buy.

BEETHOVEN

SYMPHONY #6 (PASTORAL)

Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50045. RIAA curve. Price $4.98.

One of the most extraordinary facets of Paul Paray is his uncanny ability to give superb performances of music which is presumably incompatible with his background and temperament. This reading of the "Pastoral" is further evidence in support of this. It is not a Germanic, or Italianate, or French performance, but rather is something special that belongs to Paray himself. One thing is certain . . . it can stand comparison with the best. It is a warm, glowing, completely relaxed and unhurried reading. But it is not flabby, rather the "storm" has a strength here not apparent in many other versions. In terms of sound, this recording is unchallenged. *Mercury* shows here that they know how to record the less spectacular repertoire as well as they do the fire-breathers. The superbly live smooth strings and woodwinds are heard with every nuance, every shading perfectly reproduced. The frequency response is very wide as are the dynamics. The "storm" is really stormy in this version, with great growling tympani cleanly reproduced. I believe this version will become the favorite of those who like the work and who want the best-sounding disc, and who will leave the arguments about performance to the critics. Curve and surfaces were OK.

SCHUBERT

SYMPHONY #8 (UNFINISHED)
SYMPHONY #5

Vienna Philharmonic Orchestra conducted by Karl Bohm. London LL1105. RIAA curve. Price $3.98.

With a combination like Bohm and the Vienna Philharmonic, this recording was bound to be successful. At least with this particular repertoire. Bohm is an old and astute hand with Schubert and his essayal of the 5th is simply magnificent and unlikely to be surpassed too soon. The "Unfinished" is subject to a few mannerisms, but they are of minor significance and this reading must be adjudged along with the best. The sound is in the "big-boned, big hall" tradition and some of the orchestral sonorities are fabulous. Dynamics are exceptional and generally the

sound is clean and distortion free. The playing of the Philharmonic is magnificent and they are as close to their pre-war skill as we are likely to hear. An excellent disc for upgrading libraries and for beginning audiophiles.

Jazz Corner

POPULAR FAVORITES

Clifford Brown with Strings. EmArcy MG 36005. RIAA curve. Price $3.98.

This is the first of the new jazz releases on the *EmArcy (Mercury Record Corporation)* label. I like what I hear, in fact I'll go so far as to say that this is some of the most hi-fi jazz I have yet encountered. Clifford Brown is a fabulous talent on the trumpet and in some excellent arrangements by Neal Hefti of such popular favorites as "Laura," "What's New," "Embraceable You," "Stardust," etc., he gives ample evidence that his reputation is well founded. The recording is very close to, yet retains enough reverb for an extremely live sound. The trumpet of Brown is sharp and "gutty" and the fidelity is such that you can hear the wind sounds of his tongue and lip techniques. In addition to the string complement, Brown is supported by such estimable sidemen as Max Roach on the skins, Richie Powell on the piano, and George Morrow on the bass. The over-all sound is very wide range and in fact with the very quiet surfaces, sounds very much like a tape! If you are in the mood for some ultra hi-fi jazz in the "cool" vein try this. -30-

Spot Radio News

(*Continued from page* 18)

large ad agency in Chicago told the Commission that income from this new source will make it economically feasible for stations to operate in areas that have had to be bypassed up to now.

Bluntly announcing that subscription-TV is inevitable, the ad men said that . . . "the public is aware that it is now technically feasible, by means of this new system, to bring to the home important entertainment that is now impractical due to high production costs . . . Public dissatisfaction will become more acute as the knowledge grows that an inexhaustible source and variety of programs are being denied access to television because of governmental restriction."

Scoring the critics, the agency told the Commission that no solid objections have really been raised. "It seems to us," they said, "that the pursuit of obscure claims by minorities and special interests should not be permitted to delay any longer the great benefits that can result from this new development."

Opponents to the toll-TV idea told the Commission that the fee plan would wreck the free-air TV broadcasting system. One group said that it would show officials in Washington the conversion of receivers for decoding apparatus . . . "would impose a severe economic hardship on the viewing public running into hundreds of millions of dollars."

Service shop operators also revealed their concern over the problems that the pay-TV mechanics could create. An association in Pennsylvania filed a brief with the Commission, which said that . . . "manufacturers of subscription television units will probably insist that they control and monopolize the installation, maintenance, and servicing of these units . . . because the equipment is of a coded nature . . ."

If this practice is approved, the technicians told the Commission, established servicing agencies of independent radio and television shop owners will be eliminated. And, continued the brief, the millions of dollars invested in equipment, special components, shop facilities, trucks, trained personnel, and experience would thus be wiped out.

"Therefore," said the association, "we petition your body to issue rules and regulations which will prohibit the granting of any franchise to any manufacturer of TV sets for subscription TV, if they attempt to control or monopolize the sale, installation, maintenance, and service of such equipment."

THE VELOCITY OF LIGHT has been re-determined by a radio method, which makes use of phase-shift measurements on v.h.f., with the aid of a radio interferometer

(*Continued on page* 102)

NEW TV STATIONS ON THE AIR

(As of June 25, 1955)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Alabama					
Birmingham	WBIQ-TV†	10	192-198	5.08	30.9
Idaho					
Twin Falls	KLIX-TV	11	198-204	4.93	29.5
Louisiana					
Lafayette	KLFY-TV	10	192-198	5.08	28.2
Missouri					
St. Louis	KTVI	36	602-608	1.63	500
Nebraska					
Scottsbluff	KSTF-TV	10	192-198	5.08	12.3
Ohio					
Lima	WIMA-TV	35	596-602	1.65	16.2
Texas					
Beaumont	KFDM-TV	6	82-88	11.8	100
San Antonio	KCOR-TV	41	632-638	1.55	16.42
Washington					
Seattle	KTVW	13	210-216	4.65	100
Wisconsin					
Green Bay	WFRV-TV	5	76-82	12.74	100
Hawaii					
Wailuku	KMAU-TV	3	60-66	16.06	10

KTVU, channel 36, Stockton, California; WTVI, channel 54, Belleville, Illinois; KGTV, channel 17, Des Moines, Iowa; WLAM-TV, channel 17, Lewiston, Maine; WMIN-TV, channel 11, St. Paul, Minnesota; WRTV, channel 58, Asbury Park, New Jersey; and WFMZ-TV, channel 67, Allentown, Pennsylvania, have gone off the air. †Educational.

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 436 (117 of which are u. h. f.).

developed by a member of the Bureau of Standards.

The velocity of electromagnetic waves has been a subject of investigation for many years. In the period preceding World War II, the value 299,776 plus or minus 4 kilometers (1 km. = .62137 mile) per second was generally accepted. However, since the war, higher values have been obtained by most investigators, largely through the measurement of the velocity of propagation of microwaves. Consideration of this more recent work has led to an average value of 299,793 plus or minus 1 kilometer per second. In the radio method evolved by the Bureau, a value of 299,795.1 plus or minus 3.1 kilometers per second was obtained.

In making the light-value tests, measurements were carried out on a dry-lake bed to obtain a very flat surface completely devoid of vegetation for a distance of five miles or more. Essentially the method involved accurate determination of the wavelength of radio waves of a given frequency by measurement of a phase shift. After correction for various environmental factors, this wavelength was multiplied by the frequency of the radiation to obtain the velocity of electromagnetic waves. A radio frequency in the v.h.f. range (172.8 megacycles) was employed to avoid sky-wave interference, to minimize ground effects, and to reduce the physical size of the measuring system.

Even though the radio waves were transmitted over a flat surface, the value of wavelength determined was

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Arizona	Tucson	.....	9	186-192	57.5
Florida	Ft. Pierce	.....	19	500-506	17.8
Nevada	Reno	.....	4	66-72	27.5
South Dakota	Florence	KDLO-TV	3	60-66	25.7
Virginia	Roanoke	.....	7	174-180	316

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
California	Sacramento	KCRA-TV	3	60-66
Iowa	Des Moines	KRNT-TV	8	180-186
North Carolina	New Berne	WNBE-TV	13	210-216
Virginia	Roanoke	WDBJ-TV	7	174-180

CALL LETTER CHANGES

California	San Jose	KNTV (Formerly KQXI)	11	198-204

*ERP=(effective radiated power, kw.) ..... Call letters to be announced

affected by the presence of the ground. It was also affected by the atmosphere, through which the waves had to travel since the velocity of propagation of radio waves depends on the index of refraction of the air. Thus, to obtain the free-space wavelength (that is, the wavelength in vacuum), it was necessary to correct for ground effects and for the index of refraction of the air. Accurately known ground constants were used to adjust for ground effects, while the index of refraction of the air was calculated as a function of temperature, pressure, and relative humidity.

Actual phase measurements were made at an audio frequency, rather than the radio frequency used for transmission. The audio frequency was obtained by heterodyning the r.f. signals with another signal differing in frequency from the first by 1 kilocycle. Both the transmitted radio frequency and the 1-kc. heterodyne audio signal were monitored and adjusted against a 100-kc. crystal oscillator. The frequency of this oscillator was periodically checked and adjusted to 1 part in 10 million by comparing either its 50th or 100th harmonic with either the 5 or 10-mc. signal broadcast from the Bureau's standard station, WWV.

DEMIXING CONTINUED to hold the stage in the hearing rooms of the Commission. A number of cities were involved in petitions asking for channel shifts which would clear the air for all v.h.f. or all u.h.f. operation.

Among the areas included in the band-revision requests were Toledo, Ohio; Norfolk, Virginia; Corpus Christi, Texas; and Raleigh-Durham, North Carolina.

In the meantime, a few standard authorizations were approved, including one for the high bands; see page 102 for listing.

THE GIANTS IN THE MOVIE industry in Hollywood who for years refused to accept TV as a factor, have succumbed and begun to convert their huge sound lots for telecasting pick-ups.

One movie maker, operating on the assumption that all TV will eventually be on film, has taken over ten sound stages, divided them up into three each, providing a total of 30 sound stages. Millions of dollars have been and are being spent in redesigning the stages, installing the latest equipment, lighting and other allied facilities.

Another movie operator, who has been in TV, and who recently moved its station to a ten-acre lot, is considering the use of substantial land on the new site for TV sound stages. At present, only about an acre is being used for TV, but additional stages are under construction on the remaining part of the lot.

TV has become a giant and the old flicker moguls not only know it, but recognize the fact that it may even outpace theater films. So they have decided to join the parade and sit in on the TV bandwagon. . . . L.W.

Sound Systems

(*Continued from page* 37)

nected to their 2000-ohm input taps. When thus connected, these four units will present an impedance of 500 ohms to the power amplifier, and the power into each unit will be entirely a function of the voltage that is put onto the feedline notwithstanding the fact that the very same tap indicates 2½ watts for the 70.7 constant-voltage system. The fact is that if a constant-impedance amplifier of 500-ohm output were to develop this same 70.7 volts across its own line when loaded by such a unit representing 2000-ohms input, that 2½ watts would definitely be produced across it since irrespective of what we may wish to call a system, we still have to deal with the same electrical laws of wattage, power, and impedance. In this approach, then, if we want 20 watts to be delivered to this unit when connected to the 2000-ohm tap (along with three other units) and across the constant-impedance, 500-ohm line, then we would have to develop 200 volts across the transmission line.

It will be noticed that direct access is available to the voice coil of the driver unit itself where it may be necessary to use its 16-ohm input impedance characteristic directly. When so used there is an added safety factor protecting the unit against excessive overload. This safety factor is the secondary of the transformer which is connected directly across the voice coil. In horn-loaded systems, the low-frequency output of the horn is determined by the low-frequency cut-off characteristic of the horn. If frequencies below this theoretical cut-off point are fed to the driver unit, the unit finds itself virtually unloaded for these below-cut-off-point frequencies, and the diaphragm has a tendency to run wild and may suffer damage. One way of preventing such low-frequency overload is to use either a capacitor in series with the driving unit which will offer increasing reactance to the lower frequencies and so prevent their being fed to the driver unit; the alternate method is to shunt the voice coil with a choke which will bypass the very low frequencies around the voice coil. Essentially then, the secondary of the transformer in this unit bypasses the low-frequency energy from the voice coil and that the diaphragm will not see as an acoustic load, and thus affords overload protection against excessive unused power.

There is sometimes confusion as to how to set a constant-voltage amplifier when its full rated power is not utilized. For instance, one might think it proper to turn down the gain of the amplifier which may be rated at 100 watts when only 35 watts are drawn from it on the basis that economy of amplifier power will thereby be obtained, or that the speakers will be overdriven. Both of these propositions are wrong. Consider your home light and power system. If all your appliances were turned off, your wattmeter would stand still, but the line voltage would still remain at 117 volts. The same thing holds true in the audio 70.7-volt system. Even though the gain control may be set to provide a maximum 70.7-output volts, if there is no load tied to the amplifier, then the amplifier will deliver no power, and take no power from the line (other than standby power). The power it will take from the line, and the power it will deliver to the load, will be completely dependent upon the actual load itself. As to the question of overdriving the units on the system if the full power rating of the amplifier is not used, this is obviously impossible since it is voltage which overdrives a unit which is of fixed impedance and not power; and since the voltage is maintained constant by the amplifier irrespective of load, then even one unit (set at 2½ watts) may be put across a wide-open 100-watt system with complete safety. Turning down the gain of the constant-voltage amplifier will naturally reduce the power input to the driver units, if one desires to do so, but at the expense of upsetting the sound power distribution as a whole. If the system is set up after a legitimate sound survey has been made, and the power ratings of the individual units of the system were set accordingly, there should be no reason to play with the gain controls of the amplifier. If variations are required in certain areas due to changes in ambient noise conditions, then these changes should be made by tapping at the transformer of the unit in that particular location to achieve the proper sound output at that station without upsetting the rest of the installation.

We are now in a position to more fully understand the compound advantages of the 70.7 constant-voltage system.

(*A*) In multi-speaker systems, impedance matching is completely eliminated. It is not necessary to arrange a network of speakers in fancy series-parallel combinations to obtain the proper impedance match to a transformer. In the constant-voltage system, the impedance is meaningful only to the extent that it determines how much power will get into the speaker, and this is already taken care of by the manufacturer of the unit by fixing the wattage ratings on the terminal board of the driver unit. One simply chooses the required power tap and puts it directly across the constant-voltage line.

(*B*) Since the 70.7-volt line maintains constant voltage irrespective of load, once an individual power adjustment on a speaker has been made, it continually receives the same amount of power even when other speakers are added or subtracted from the system. More constant and uniform coverage is thus the result of volume controls which have not been readjusted.

(*C*) By being able to proportion individual speaker power to immediate local and specific needs without upsetting other local adjustments of the other components, more efficient utilization of available sound power is made feasible.

(*D*) Maximum utilization of available audio power is made possible by the elimination of volume controls or attenuators which burn up power to make a level change, in contrast to transformers which are essentially nonpower consuming devices.

(*E*) It becomes relatively easy to determine one's amplifier needs and to keep these needs to a minimum by simply counting up the actual speaker power requirements without the necessity of allowing for uncertain attenuator losses.

(*F*) More adequate overload protection is afforded each individual speaker unit on the constant-voltage system. Should a unit somewhere in an installation fail, the line voltage would still remain unaltered and so this unit failure in one location does not start any chain reaction such as a rise in line voltage that might, in other distribution systems, overdrive the remaining speakers. —30—

1955 Emerson TV Sets
(*Continued from page 35*)

before making the tests with a voltmeter or neon bulb. When the plug is properly installed in the outlet, you will not measure any a.c. voltage between the chassis and a power-line ground such as a radiator, "BX" cable, or a.c. receptacle box cover. If you are using a neon bulb, it will not glow when connected between these two points. If it does or you get a meter reading, reverse the plug in the a.c. power receptacle.

If good receiver operation cannot be restored by a tube change, then remove the rear chassis mounting board. This exposes most of the underside of the chassis without having to remove it from the cabinet.

The various test points for checking receiver operation are shown in Fig. 2. The method for using these test points to service these chassis is described in Table 1, which also lists the normal meter readings.

Aside from the main sources of "B+" voltages at the power supply, the test points which indicate whether a signal is present or whether the circuit is functioning correctly, can be broken down to those tubes which show grid current in proportion to the signal applied. In Table 1, the trouble analysis chart, we are assuming that all heaters are lit and that tube changes have been made. This table covers some of the high points but is not intended to cover every service need. If you understand the development of this chart, which is derived from a knowledge of the block diagram, you should have no difficulty in servicing these chassis. —30—

Traffic Lights

(Continued from page 61)

buildings. The 250-watt FM transmitter will operate on 27.255 mc. and the antenna will tower 605 feet above the ground.

The control center for the network will be in the basement of City Hall, a few blocks away. Existing underground cables will link the transmitter with this room. A *G-E* EC-10-B remote control unit will be located here along with the automatic program device, the manual controller, the tone generator and tone coder, and an automatic three-dial master controller.

Heart of the entire operation is the tone generator, which has eleven basic tones, all in the voice frequency range of 300 to 3000 cycles. At the present time, the city will use only seven combinations but expansion can be economically made into hundreds of two-tone combinations.

The operation begins when the basic weekly program is set up on a small metal drum. Current plans call for three automatic changes each day as follows: southbound traffic between 6 a.m. and 11 a.m. will get signals to move it along at about 30 mph. At 11 a.m. "normal" balanced conditions will begin and remain until 3:30 p.m. Then the flow is shifted to move northbound cars out at the higher ratio until 7 p.m., when the "normal" condition is initiated again.

Cars in the priority direction actually will move at a 7 to 1 ratio to those in the opposite direction. Under existing conditions, 17 mph is the average speed of traffic during rush hours.

This pattern will be maintained Monday through Friday with weekends getting the normal pattern. When foul weather hits, the manual controller can be cut in to slow down traffic until conditions improve.

As each change is called for by the automatic master controller, the tone generator and coder emit three half-second two-tone signals which are relayed to the transmitter and broadcast.

At each of the traffic signals, the wave is received by a crystal-controlled FM receiver and fed into a decoder. If the particular two-tone combination emitted at that time passes the selector, circuits are closed and the synchronous motors set off the newly-designed timing pattern.

Following each program change, the transmitter also sends out a series of pulses much like those used to set electric clocks to make sure that the whole system remains in step.

Over-roadway neon signs at the entrance to the traffic lanes will go on automatically to indicate the time interval at which drivers can best proceed. Cost for the entire *General Electric* system of thirteen remote-controlled intersections and the transmitter gear will be $36,000. Since first announcements of the system were made, Chicago officials have received requests for information from all over the U. S. and even from Holland and England.

Early experimentation with a similar system was made in Greeley, Colorado, in October, 1953. Here, too, each intersection has a conventional receiver with the output fed into a decoder unit. It selects those impulses intended for the particular location and, in the units made by *Colorado Electronics*, these, in turn, activate mercury switches which handle the lamp load.

Of special interest in this network is the use of a tape recorder as the storage mechanism for coded signal voltages. These are recorded on tape and reproduced continually for broadcast. The signals are processed through a pre-modulated unit and fed into a conventional transmitter much the same as ordinary microphone output.

The transmitter used in Greeley is a standard *Motorola* type PA-9355 designed for FM mobile communications at 454.15 mc. in the u.h.f. band. It is rated at 18 watts output and designed for a 30 kc. bandwidth.

Receivers are also standard *Motorola* units, Model PA-9344, designed again for mobile use with the previously-mentioned base station transmitter. In spite of the relatively narrow-band design of the equipment, several systems can be put in this band with overlapping radiation patterns and operate without interference between systems. This feature was necessary to accommodate systems in neighboring cities.

Naturally details such as transmitter power, receiver selectivity, and receiver sensitivity can only be determined through reference to a specific installation with specific equipment.

Receiver sensitivity is not as critical, for instance, when relatively high transmitter power is used and field strength is high. Inversely, some receivers with high sensitivity will operate well from a weaker field.

Roy R. Newson, president of *Colorado Electronics*, says, "For average installations, a bandwidth of 30 kc. is sufficient. For a more complex system in a larger city desiring several independent systems, 60 kc. might be required to insure that one system does not interfere with another."

The novel modulating, filtering, and decoding circuitry of the Colorado units is intended to give maximum protection against interference from other transmissions, screen out skip interference, and permit operation with a signal-to-noise ratio far below that required for conventional communications.

Officials of the company declined to reveal details of the tape-making process, the pre-modulation circuitry, or the decoding action, but claim that their system is capable of transmitting "hundreds of switching functions simultaneously with maximum integration and control of the traffic system of any American city."

The tape recorders used in Greeley were built by *Colorado Electronics*. They are conventional units, providing dual-track recording at 1.875 ips.

Magnetic drums or other storage methods may be used in lieu of the tape mechanism if individual installation requirements so indicate.

Manufacturers of all remote radio systems are striving for maximum flexibility in their units.

Traffic engineers look to the use of radio-controlled signals as a major step forward in solving one of the toughest problems in modern city life. Beyond this lies other vital applications in public safety and even Civil Defense.

There can be a time in the near future when emergency vehicles like fire apparatus and police squads will move through a lane of cleared lights and eliminate intersection collisions which still claim the lives of dozens of firemen every year. And in the event of air raid warning, radio controlled lights could speed the evacuation of whole cities. —30—

LOUDSPEAKER SELECTION

By CHARLES A. WILKINS

"LOUDSPEAKERS should be judged by listening tests and not by curves." Surely most of us have heard this many times. Usually such a statement is issued dogmatically with no support, but there does seem to be some evidence in its favor.

A few years back a paper was published in the "Journal of the Acoustical Society of America" treating the tonal differences between a Stradivarius violin and an inexpensive instrument of contemporary make. Every type of acoustical test and analysis was rigorously performed on both. The conclusion was that none explained why the Strad sounded better.

Frequency vs. sound pressure response curves for loudspeakers are often shown in literature. They all show nice responses down to 30 cycles or so. But how many readers realize that these curves show only that the speaker responds to a given frequency with so many db of sound output and nothing more? Below a certain frequency, the speaker is so lightly loaded that it produces very little fundamental. Then why do the curves look so pretty?

The recording oscillograph, used for tracing the curves mechanically, is coupled to the signal generator. When the generator is producing 30 cycles, the recording pen is resting on the 30-cycle line of the graph paper. In this way, any sound from the speaker will register on the graph as a 30-cycle response—and so on through the spectrum. Suppose that the speaker has no 30-cycle response but instead the frequency doubles to 60 cycles. This 60-cycle sound—this distortion—will be registered on the graph as legitimate 30-cycle response in spite of the fact that the speaker is producing 60 cycles. It is obvious that this type of curve does not help much in passing judgment on the bass end of a speaker system. If it were accompanied by a distortion vs. frequency curve or a constant distortion contour curve in addition to stating the damping factor of the amplifier used to drive the speaker, matters would be happier.

The Strad tests show that there are still some things we do not understand. The speaker response curves show that interpretation must be tempered with understanding. —30—

New Designs

MAGNETIC DEVICE AMPLIFIES

A BRAND new rival to transistors and vacuum tubes is a device developed by the *Potter Instrument Company* and known as a "Magnistor" (Fig. 1). These are small saturable reactors having unique shapes and flux paths. In their simplest form, "Magnistors" consist of a ferroceramic ring on which two windings are wound. One winding, called the signal coil, is used to carry a sine-wave signal in the range from

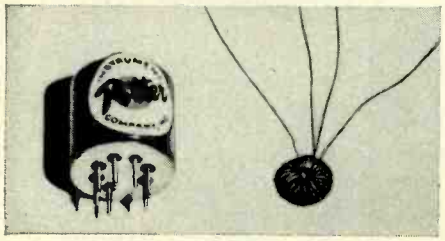
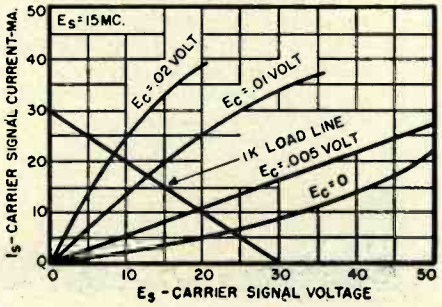


Fig. 1.

100 kilocycles to 15 megacycles or pulses having a repetition rate from 0 to 10 megacycles. By varying the d.c. current applied to the second winding (called the control coil), the impedance of the signal winding to the carrier frequency or pulses can be varied over a ratio as high as 500 to 1, if desired. Thus, we have a form of control action here that is similar to that obtained in vacuum tubes and transistors.

As a matter of fact, the analogy to vacuum tubes can be carried much further. It has been found that for small signal levels, the control coil behaves essentially as a linear inductance, *i.e.*, it is not appreciably dependent on the magnetization characteristic of the ferroceramic core. For this reason, the characteristics of the "Magnistor" can be most easily presented in a similar fashion to that employed in describing vacuum tubes. The curve which is used compares with the customary plate characteristic curve for vacuum tubes and is shown in Fig. 2. The signal coil current (I_s) is plotted as a function of a 15-megacycle carrier signal voltage (E_s) for

Fig. 2.



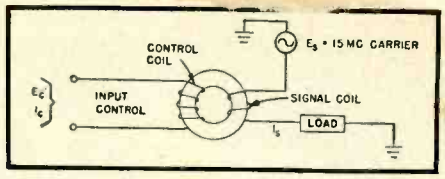


Fig. 3.

various control coil input voltages (E_c) normally employed in the operating range. The load line of a 1000-ohm resistor is also plotted on the same graph. (This resistor would occupy the position indicated by the load in Fig. 3). For an input control voltage (E_c) change of 0.01 volt (from zero to 0.01 v.), the output signal current will change 11 milliamperes (6 to 16) or a voltage change of 11 volts across the 1000-ohm load. Gain would then be given by the ratio

$$Gain = \frac{Change\ across\ load}{Change\ in\ E_c}$$

$$= 11/0.01 \text{ or } 1100$$

Potter engineers have developed two general classes of "Magnistors": transient and permanent. The transient variety, just described, has "no memory"; that is, it retains no "record" of the currents which have passed through it. On the other hand, the permanent or "two state" unit will remember its "set" or "reset" conditions indefinitely even if all power is removed. To achieve this remembrance facility, permanent "Magnistors" basically contain three windings on a special ferroceramic coil. One is a signal winding similar to that used in the transient "Magnistor." The other two are control windings normally designated as "set" and "reset" coils. The signal winding has two possible impedances—a low impedance if the "set" coil has previously passed a specified minimum current in either direction and a high impedance if the "reset" coil has previously passed a specified minimum current. Either condition persists until the other is established irrespective of the presence or absence of energy anywhere in the system. The "Magnistor" is a static storage device which will retain its "information" as long as desired; principal applications are in high speed computers, business data handling systems, automation control systems, high speed counters and magnetic tape systems.

TUBE TESTER PERMITS GM AND EMISSION CHECKS

THE old argument of which is better: —a G_m or an emission test for a tube —has been met in the tube tester kit Model 111 which *Precise Development Corporation* has recently announced. This instrument will permit both checks to be performed on every amplifier tube. The different controls that are to be set for each type of test are indicated separately on the roll chart. This permits either test, or both, to be run, as desired. For some tubes, particularly pentode amplifiers used in the i.f. and video amplifier stages, the G_m test is best. For other tubes where re-

latively large amounts of current are required, the emission test provides the more reliable indication. With this in mind, *Precise* has starred the most important single test for each tube or section thereof. If you do not wish to make both tests, it is recommended that the one with the asterisk be selected.

Several other interesting design features are found in this same instrument. For example, the filament current drawn by a tube can be accurately measured. This facility becomes particularly important in view of the trend toward series filaments. Any tube which draws 10 per-cent or more under its normal current indicates a higher-than-normal resistance. In a series string, this tube would take more than its share of the available voltage, leaving less for the remaining tubes. Under these conditions it is possible for a critical tube, such as the local oscillator, to receive so little filament voltage that it operates intermittently if at all.

The same tube tester will also permit direct determination of the cut-off bias of a tube. This feature can be used in grading a batch of similar tubes according to their cut-off value. Then the tubes can be used in accordance with these results. For example, in any video i.f. system, the tubes having the lower cut-off bias values should preferably be placed in the earlier stages where the signal level is low. If these same tubes are placed in the later stages, they could easily distort or cut-off with normal signals. The advantages to be gained by such a classification are considerable and set manufacturers have been known to follow the same procedure with the tubes they receive.

Tests can also be made for leakage, shorts, gas, noise, and life. The latter test, while admittedly not conclusive,

nevertheless does enable the user to evaluate the potential of a tube. Actually, of course, there is no true method of ascertaining the life expectancy of any tube. But, from the behavior exhibited when this life test is made, and from experience with similar tubes, an educated "guesstimate" can be made of the probable life of a tube.

There are two additional features of this instrument which are worth noting. One is the ability to insert an external meter to measure the current

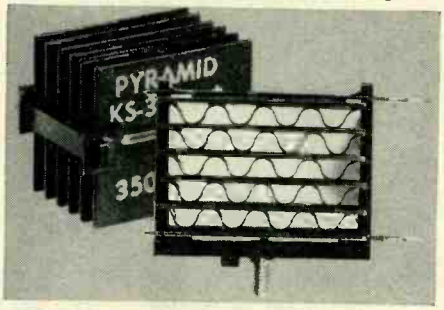
flowing in any of the elements of a tube, such as plate, screen, filament, etc. The other feature makes it possible, with the aid of an oscilloscope, to view the tube's characteristic curve.

The *Precise* Model 111 tube tester is available wired or in kit form.

EDITOR'S NOTE: *We have actually built up one of these kits and would like to commend the engineer of this unit for a design job well done. We do, however, want to point out that the assembly, although all the instructions are very clear and precise, is not too simple a task. Time required to wire this kit is approximately 25 hours with a few additional hours needed for checking and calibration. Our recommendation is that only those thoroughly familiar with wiring, circuitry, etc. should attempt to build this kit.*

SELENIUM RECTIFIER LIFE EXTENDED BY NEW CONSTRUCTION

ONE of the causes of selenium rectifier failure is overheating. This may be due to the high ambient temperature of the equipment in which the rectifier is used or it may be due to the additional heat which is generated in the rectifier itself. Heat reduction at either point would help prolong rectifier life and it was with the latter aim in mind that *Pyramid Electric Co.* engineers developed their new line of selenium rectifiers. Current which is forced to flow through a relatively small, concentrated area in conventional rectifiers is here dispersed over the full width of the rectifier plates. This is accomplished through a change in support position from the center of the plates to the sides. See photo. The resulting dispersion of current enables these units to run some 10° to 15° C cooler than comparable rectifiers carrying the same amount of current.



Another factor said to be responsible for the extended life of these rectifiers is the high purity of the vacuum-deposited selenium and the composition of the barrier layer placed over the selenium. These two layers, placed between nickel-plated aluminum on one side and cadmium bismuth on the other, constitute the basic construction of a complete selenium rectifier. Actually, the rectifying action occurs between the selenium and barrier layers and much of the efficiency of the unit depends upon the purity of these substances. It has been estimated that an increase in impurity by as little as 3 parts-per-million can be the difference between a good rectifier and a poor one.

Additional features of this rectifier include low pressure stacking of the various plates and a high resistance to moisture. The low pressure stacking is significant because it has been found that too much pressure tends to impair rectifier efficiency. When the holding screw passes down through the rectifier assembly, it is difficult to avoid changing the pressure on the plates as the holding screw is tightened. In the *Pyramid* rectifier the holding screw is imbedded in a Bakelite strip which is mounted along the bottom of the unit. See photo. With this arrangement, plate pressure is not affected, no matter how tight the fastening nut is made.

Pyramid selenium rectifiers are listed by *Underwriters' Laboratories* for 85° C operation. They are available in all standard ratings used in radio, television, and other electronic equipment.

RANGE-SWITCHING VACUUM-TUBE VOLTMETER

THAT occasional lapse of memory which besets even the most experienced service technician and results in a burned out meter may be a thing of the past thanks to a unique circuit that has been incorporated in *Bergen Laboratories'* new "Volt-Ohmatic" automatic range-switching vacuum-tube voltmeter.

The instrument itself is a general-purpose one and offers the usual ranges found in service meters but, in addition, it provides an automatic feature which is unique. The user touches the probe tip to an unknown voltage or resistance at the same time depressing the "Automatic" button on the instrument.

This action allows the special range selector switch to rotate automatically and stop at the appropriate voltage or resistance range. The user then releases the probe button and notes the range, d.c. polarity, and measured value.

During the automatic range selection procedure the meter movement is disconnected from the circuit, thus protecting the instrument from damage. When not being used in the "Automatic" mode, the range switch

may be operated manually as a conventional voltohmmeter.

A single probe is used for all meter functions (a.c., d.c., and ohms). Changing of these functions does not require changing of the probes. A multiplier switch in the probe itself extends the a.c. and d.c. ranges to 1500 volts, as required.

The company is currently making this instrument at its Fair Lawn, New Jersey plant. -30-

MONTANA HAMFEST

THE Glacier-Waterton International Peace Park Hamfest will be held on July 23-24 at Apgar Camp Grounds at the foot of McDonald Lake in Glacier National Park.

Cabins, camping, and all recreational facilities will be available. The annual "junk sale," a popular feature, will be repeated and the proceeds used to defray hamfest expenses. -30-

THE BATHTUB CAPACITOR

By ROY E. PAFENBERG

WHEN the junk box is being screened for the particular capacitor required to build that "ultra-modern, gold-plated electronic jewel," it is easy to pass up gold in the rough. The case in point being the common ordinary garden variety of bathtub capacitor.

On first consideration there are often many seemingly apparent reasons why the bathtub should not be used for the application in mind. However, let's go through the advantages of this type of component. First of all, it is a high quality, oil-filled capacitor, built to the highest standards of the industry and still used extensively. Simple tests applied to old or used capacitors of this type can weed out the "bad ones," and you will be surprised how few there are. The same standards apply, in general, to other types of metal-cased, oil-filled capacitors.

Now let's look at the disadvantages and see how they stack up for many applications. First of all, the size of the beast: Well, take a triple, .1 μfd. unit and examine it. It has three bypass sections with case grounded. Try and mount three .1 μfd. plastic molded paper tubulars and their associated tie points in the same space and you will see the logic in this. Then look at the shielding that is afforded by the metal case—isolation of critical circuits, and all for free!

Of course, there are limitations. First, don't use a bathtub capacitor in a critical, high-frequency coupling circuit. The capacity to ground could throw off the best of calculated response curves. Further, the presence of bulky components mounted above the chassis may physically interfere with the mounting screws required for the bathtub capacitor. Also, as a final warning, don't forget that the voltage rating of a capacitor may not only be the dielectric rating, but also may be the rating between either plate and ground. Of course, in normal applications this will not matter, but, in such usage as scope deflection plate coupling, it cannot be ignored.

Those are the facts, and with a little imagination, it will be seen that the advantages of this type construction, plus the availability of these parts in the junk box far outweigh their disadvantages. -30-

THE MULTIMETER IS USEFUL IN P.A. SERVICING

INSTALLING and servicing p.a. systems can be a highly profitable occupation, particularly during the summer months when such systems are used extensively out-of-doors. A valuable aid in this type of work is a good multimeter, an instrument which will perform a number of useful functions but is not excessively bulky nor difficult to use.

Among its applications in such service work on public address systems of all types are one or more of the following.

Continuity checks of cables and plugs are easy with the "ohms" range of a multimeter in its lowest position. Voice coil resistance can be measured, and the approximate impedance determined by adding 10% to the measured value of d.c. resistance. Open transformer windings, corroded solder joints, broken wires, and many other faults can be readily located. And, of course, resistors can be measured to determine if their values have changed.

A multimeter having an a.c. voltage scale can be particularly useful in audio work. Losses in long transmission lines can be spotted by measuring the voltage at the input and output ends of the line under load. Balancing of push-pull output stages under dynamic operating conditions can be carried out with such a meter. The approximate audio power fed into a device such as a loudspeaker can be determined if the impedance of the device is known. Sometimes the p.a. man is interested in obtaining maximum power output, ignoring distortion, rather than maximum undistorted power output. The proper transformer tap for such operation can be determined by choosing the tap giving the greatest voltage across the speaker load.

Ability to measure a.c. current can also be useful in audio work, provided that insertion of the meter into the circuit under consideration does not add so much resistance as to disrupt normal operation and mask the quantity being measured. With care, the a.c. current and a.c. voltage scales may be used to determine the impedance of a device such as a loudspeaker voice coil or transformer winding. In addition, the approximate power output of an amplifier can be measured.

The cover photo shows the *Phaostron* Model 555 multimeter being used in p.a. work. This instrument is manufactured by the *Phaostron Company*, 151 Pasadena Avenue, South Pasadena, California. —30—

Phone Compressor

(*Continued from page 49*)

the *RC* filter is perfectly satisfactory.

In order to conserve space on the operating desk, the compressor was built in a 3" x 4" x 5" aluminum "Flexi-mount" case. The power supply was built on a separate 2" x 4" x 6" chassis which could be placed on an out-of-the-way shelf.

The location of the parts of the amplifier is clearly shown in the photographs. The gain control, R_4, microphone jack, J_1, and the electron-ray tube are mounted on the front panel. Balance control, R_8 and the electron-ray control, R_{13}, are mounted alongside the tubes on the top of the case. The preamp tube, V_1, is mounted nearest the front panel and behind it in order are V_2, V_3, and V_6. The 6AL5 is mounted to the side of V_6. Most of the resistors and capacitors are connected between the tube sockets and a *Cinch-Jones* type 2013 terminal strip directly under the center line of the four sockets. The heater leads are tightly twisted and run along the edge of the case away from the grid and plate pins of the tube sockets. In spite of the compactness of the assembly, no difficulty was experienced with hum.

After the compressor has been wired, only two adjustments are necessary before putting it to use. The first step is the balancing of the two 6BA6 tubes. Plug the unit into the a.c. line, turn it on, and let it warm up for about fifteen minutes or so. Connect a d.c. voltmeter between pin 6 of V_2 and pin 6 of V_3. Slowly adjust R_8 until the voltmeter reads zero. If the voltage difference between the two points cannot be brought to zero, it indicates that either the two 6BA6's differ widely in characteristics or resistors R_6 and R_9 are not closely matched. Interchange the socket positions of the two tubes. If the correct setting still can not be obtained, check the resistance of R_6 and R_9. Replace one of them if they differ by more than about 2000 ohms. If the tubes still can't be balanced, obtain another 6BA6 and select the two tubes which will balance.

The next step is the setting of the electron-ray tube control. The 6E5 acts as a voltmeter to measure the d.c. control voltage which is used for gain reduction. R_{13} is adjusted so that the eye just closes when the desired compression is obtained; in that way, it indicates the proper setting of the gain control, R_4, when compressor is in use.

To set R_{13}, the unit is turned on and a high-resistance voltmeter is connected between pin 7 of the 6AL5 and the chassis. Next connect an audio oscillator, set to about 1000 cycles, to the input jack, J_1. R_4 is now adjusted until the voltmeter reads 32 volts. With this 32 volts between pin 7 and chassis, R_{13} is adjusted until the eye of the 6E5 just closes. As shown in the graph, Fig. 3, 32 volts of control voltage produces 20 db of compression.

The compressor is now ready to be connected to the transmitter. By means of a suitable cable, connect the output jack, J_3, to the microphone jack of the transmitter. Turn on the transmitter and adjust the speech amplifier gain control so that the test tone, which just closes the 6E5, modulates the transmitter 100 per-cent. Disconnect the test tone oscillator and plug a microphone into the injut jack of the compressor. Talk into the microphone and set the gain control of the compressor so that speech peaks just close the 6E5 eye.

The ham phone compressor is now ready to be used on the air. Contact a nearby amateur who can be relied upon to give an accurate voice quality report. If the compression appears to be too noticeable, reset R_{13} so that the eye closes on 30 volts and test again. Continue testing until a satisfactory setting is obtained. The higher the voltage from pin 7 to chassis, the greater the compression, and the higher the average level of modulation.

The release time of the compressor is governed by the total resistance of R_{13} (one megohm) and the value of C_7. .25 μfd. has been selected for C_5 as about the minimum satisfactory value. If it seems desirable, as indicated by the voice quality tests, to increase the "hold-down" time, then a .1 or a .2 μfd., 200-volt capacitor can be connected across C_5. The exact value to use depends to some extent upon voice characteristics and the value can best be determined by test. —30—

REDUCING RECORD-PLAYER RUMBLE

By ARTHUR TRAUFFER

IT WAS a happy day for this writer when he ran across some under-the-rug "Nonskid" in a local department store. "Nonskid" is sheet sponge rubber a little over 1/16" thick with a non-slip surface on both sides. It is designed to be placed under rugs to keep them from slipping on highly polished floors. The characteristics of this material make it ideal for cushioning various parts of phono-record players to reduce rumble caused by motor vibration.

Fig. 1 shows a disc of "Nonskid" placed on an 8" diameter metal turntable. The material not only helps to cushion the records from the turntable, but it provides a non-slip surface for the records. Since the material lays flat and doesn't slip easily, it isn't necessary to cement the disc to the turntable. Two discs of "Nonskid," one placed on top of the other, will provide even better cushioning for the record; and it will also reduce "hidden pull" of certain magnetic phono cartridges on steel turntables. The sponge rubber also provides a cushion in case the pickup is accidentally dropped on the turntable.

"Nonskid" is easier to keep dust-free than felt or flocked turntable surfaces; when dust collects on "Nonskid" you can easily blow it off since there are no small hairs for the dust to catch in. This writer dislikes flocked turntables because the small hairs come off and stick to the records. To cut a neat disc from the "Nonskid," simply remove the turntable, lay the turntable on top of the "Nonskid" sheet, and cut all around the turntable edge with a sharp razor blade. To cut a neat center hole, simply file a sharp edge on a metal tube which has the same o.d. as the turntable spindle, and twist the tubing in the exact center of the "Nonskid" disc.

Fig. 2 shows two discs of "Nonskid" cemented between the base of the tone arm swivel and the cabinet, in order to cushion the tone arm from the motor cabinet. The two discs were cut by running a sharp razor blade around the base of the swivel, and a hole was punched through the centers of the discs to pass the pickup cord. No screws were used to fasten the swivel onto the cabinet since that would have ruined the cushioning effect; simply cement the two discs together, and then cement the bottom disc to the cabinet and the top disc to the base of the swivel. The writer used "Spiegels" liquid adhesive. "Perma-Tite" liquid adhesive is also good. Both of these all-purpose cements are sold in auto supply stores. Be careful not to get any of the stuff on your hands, it's very difficult to get off!

"Nonskid" material can also be used to cushion the motor mounting plate from the cabinet. In this case, simply cut a "gasket" from "Nonskid" and cement it between the motor plate and the cabinet. In this case it isn't necessary to use screws for mounting the motor plate to the cabinet, the all-purpose cement mentioned above will hold the assembly securely. Use two layers of "Nonskid" for the gasket if you want even better cushioning.

Don't throw away the scraps, they come in handy for making sponge rubber washers for different purposes. —30—

Fig. 1. How a rug cushion, "Nonskid," can be used to provide a non-slip surface for records while reducing rumble of turntable.

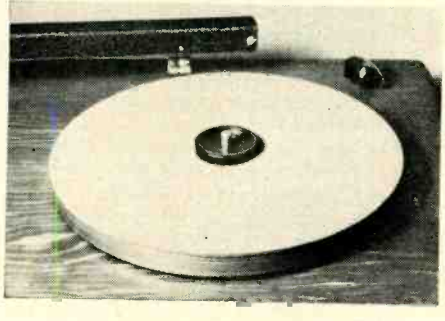
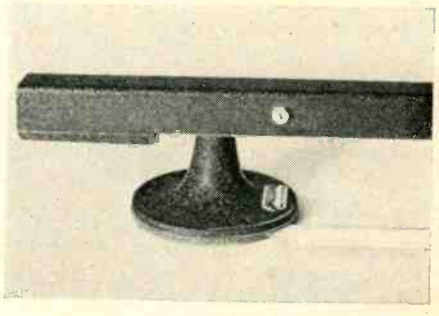


Fig. 2. Two discs of "Nonskid" cemented between base of tone arm swivel and cabinet to cushion the tone arm against vibration.



Instrument Calibration

(*Continued from page 41*)

calibrated oscilloscope lies in the fact that it measures a.c. peak voltages. Knowing the a.c. peak voltage means that we can calibrate an a.c. meter which usually measures r.m.s. or average values. Assume, for example, that we want to calibrate the 10-volt a.c. scale of an r.m.s.-reading voltmeter. First, calibrate the oscilloscope by means of a d.c. reference voltage so that each vertical division represents 1 volt. Next, connect the vertical scope amplifier across the heater of a 6.3-volt tube in an operating circuit. This should give 17.7 volts peak-to-peak on the scope. If the 6.3-volt source is actually only 5.6 volts, the peak reading will be 15.8 volts. Knowing what the peak reading is permits us to convert to r.m.s. values simply by dividing the peak voltage by 2.82.

If we can measure voltage accurately and know the resistance across which the voltage is measured precisely, the current can be calculated by dividing the voltage by the resistance according to Ohm's Law. In this manner, the current meter scales can be calibrated too. The ohmmeter scales are adjusted simply by comparing the measured value to the nominal value of the 1% precision resistors.

Knowing which method to use for calibration and what to utilize as a standard are not enough unless we are satisfied to use calibration charts for all instruments. In the majority of cases it is advisable to use such charts only for the signal or sweep generators as regards frequency. Most meters have some internal adjustment which can be set for correct calibration. A circuit diagram of the test instrument and manufacturer's service data for it are invaluable in any calibration procedure. In many of the multimeter circuits, variable resistors are used for more than one purpose so that it is possible to correct the calibration of, for example, the 10-volt d.c. scale and completely throw off the calibration for the 10,000-ohm range. Be sure to always check the circuit before changing any resistance.

Aside from the adjustment of rheostats in the meter circuit, fixed resistors occasionally need replacement because their resistance has changed too much. To check the replacement resistor for accuracy, another meter can be used, or else a number of resistors with the right nominal value can be tried in the meter circuit until the calibration comes out correctly.

While the service technician is calibrating and adjusting his test equipment, it is also a good idea to clean instrument cases and dials, replace broken glass windows on meters, repair and tighten all jacks and connectors, and generally spruce them up. Broken or chipped housings, dirty meters, bent or badly scratched dials, etc. make a poor impression. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

NORTH, east, south, and west, there is evidence that an aroused legitimate service industry is determined to do something to curb the activities of fraudulent service firms and technicians. There is a new crop of local and state licensing laws under consideration and many associations that heretofore were opposed to licensing in any form have reconsidered their stand on the matter of licensing. The most recent association shift in attitude toward licensing was the action of the executive board of the National Appliance & Radio-TV Dealers Association (NARDA) in approving a "local option" stand on service licensing.

Under the currently approved plan, NARDA will survey its members in an area where licensing is an issue and the chairman of the state or local NARDA affected will testify for or against licensing.

Positive Actions

In contrast to the pressure for licensing in some states, more positive action to curb fraudulent service practices has been launched in many cities in cooperation with Better Business Bureaus.

In San Jose, California, thirty service firms formed the Radio & Television Association of Santa Clara in cooperation with the Better Business Bureau to combat fraud and unethical service practices in that area. Members will be required to make adequate financial arrangements to insure the fulfillment of all contracts, to inform customers of service charges, to give advance estimates of labor and materials charges on shop jobs, to avoid the use of deceptive advertising, to use parts of a quality equal to or better than the original units, to return all parts removed from a set upon request, to furnish itemized statements of labor and materials, and to service sets in the home whenever possible.

Officers of the Radio & Television Association of Santa Clara are H. F. Ash, president; Len Scarpelli, vice-president; Jack Kellogg, treasurer; and Wesley Strouse, of the San Jose Better Business Bureau, secretary.

In Colorado, an organization known as the Television Service Division of the Denver Area Better Business Bureau was recently formed. Although it is sponsored by the Better Business Bureau, the organization will be completely self-governing. Seventy-five television service companies joined the association as charter members. The purpose of the organization is to formulate a program of public education and protection as well as to adopt industry standards.

Officers of the BBB Service Division are William Teck, president; Dick Seabough, vice-president; and Ralph Buoniorne, secretary.

An association of television and appliance dealers and service companies has been formed in Dubuque, Iowa, for the purpose of promoting television and appliance sales and service and protecting the public against overcharges and malpractice. According to the Key City TV & Appliance Association, their membership represents 90 per-cent of the television and appliance business in Dubuque. Officers of this new association are: Jim Renier, president; Don Allendorf, secretary-treasurer; Cliff Colson, Ken Morgan, Vince Miller, Herb Jennis, and Ray Kluck, members of the board of control.

The Milwaukee Association of Radio and Television Service is stepping up its campaign to bring about the elimination of bait advertising and dishonesty in replacing tubes and parts. Stressing the fact that it is economically impossible to make home calls for a $1.50 service charge, association members claim that this type of bait advertising is predicated on the manipulation of parts replaced and inflated tube and parts prices to provide the necessary income per call. They claim also that it is the gimmick unscrupulous service business operators use to get a high volume of shop jobs for which the charges are completely out of line for the actual work required to service the sets.

The Milwaukee Association has requested the assistance of their Better Business Bureau and the Milwaukee district attorney's office in an aggressive campaign to curb bait advertising and to root out unethical service business operations.

It is always an unfortunate experience for legitimate service business operators when a newspaper quietly puts on a campaign to expose local "TV Service Racketeering" without first fortifying itself with basic facts about the known professional gyps in its city. This type of exposé recently exploded in San Francisco. Where and why it failed to accomplish its purpose was ably explained by Ernest S. Copley, editor of *TV Flashes,* the monthly house organ of the Television-Radio Association of Alameda County, Inc.:

"The Bay Area television service industry has just had the treatment. It has just had the dubious honor of being on the wrong end of a newspaper exposé. Whether *The San Francisco Chronicle* sold more papers or not while exposing sharp practices in TV servicing, we have no way of knowing. But we do know the paper loused up a beautiful exposé and flubbed the thing completely.

"The idea was terrific. The publicity was badly needed, but the sharp-shooters in the industry rated more than three weak articles.

"What meat our crusading reporter would have had if only he had taken the trouble to follow one of our 'volume' service trucks for an hour. He would have reported seeing four service calls being made in one hour, and out of the four calls, he could have reported three chassis being hauled to the shop. Within two hours of leaving the shop he could have reported seeing a 'volume' service truck fully loaded with chassis. He would have noted the truck wasn't large enough for the load. The last chassis rode in the front with the driver.

"This was the 'take' for 2 hours by one 'volume' service outfit in Oakland. Yes, the *Chronicle* missed the boat. The reporter fished for minnows and that's what he caught. He missed the salmon run completely.

"Perhaps the reporter would have fished for the big ones had he first sat with the district attorney and listened to some of the unbelievable stories poured across that desk. Maybe a few hours spent with the Better Business Bureau would have given him the true picture.

"Three short articles don't begin to cover the mess.

"The true story would have to report cases where 9 and 10 tubes were replaced on house calls. And of the 9 tubes, 7 would check good, and what's more, they would operate satisfactorily in a TV set. The story would have shown cases of receivers actually lost because the customer couldn't pay the inflated repair bill.

"All cases cited here are fact, and it took no master sleuth to uncover them.

"What, if anything, can the industry itself do to combat cut-priced volume operators? Are these fast-buck fellows to be left alone until some form of licensing and police regulation is forced down the throat of a good industry?

"It is well to say the fast-buck boys

are in the minority. True. But ten volume operators, doing twenty calls a day, can needlessly pull hundreds of tubes, and indeed, pull dozens of chassis at the same time.

"Can the newspapers, the district attorneys, and the Better Business Bureau sit idly by while the public is being fleeced? We think not.

"We have been informed by the district attorney that he intends to see what his office can do to curb the multitude of complaints flooding the Better Business Bureau, and in fact, the district attorney's office itself. What steps he contemplates we are not able to say. But little man, watch out!

"This development, then, holds some hope for the ethical dealer. Whether the bait advertiser and the fast-buck boys will be allowed to wreck a sound business remains to be seen. Whether the ethical service organization will be forced into fast-buck operations, only the future will tell."

Cost of Doing Business

While it is well known to every service businessman who knows his costs of doing business that the actual cost of putting a technician into a home to look at a TV set ranges from $4.00 to $5.25 (depending on a variety of local conditions), many TV technicians still delude themselves into thinking they can handle home service calls for $2.50 or less. They close their eyes to the "out of business" signs that constantly show up on store fronts that once were TV service shops operating on submarginal labor income. When queried about the reason for their low labor charges, most service technicians blame competition for "forcing" them to work for sub-standard charges.

In a recent article in *ARTSNY News,* the monthly house organ of the Associated Radio-Television Servicemen of New York, Inc., Arthur Rhine presented some pertinent facts about how to operate a business at a profit *honestly* that merits careful consideration by every man who is trying to build a permanent business in electronic servicing:

"Since no ethical technician will pad a bill, the individual who operates on the theory of meeting competitive prices will find himself repeatedly asking this question: 'I wonder why it is that although I have made a fair charge for my benchwork in addition to about 40% gross on the parts I used, I find myself with only a mere week's salary. This salary is barely enough to get me by. Am I not entitled to more than a mere living wage?'

"If you want to profit under our American system of free enterprise, meaning open competition (and this includes both clean and dirty competition) the first thing you must learn is to *let the other fellow worry about you. Never waste your time worrying about what he does.*

"The national average cost of making a service call is between $4.00 and $5.00. Some readers will immediately dispute that statement, but it is absolutely true. Some will say to themselves, 'This is where I have it on the other fellow, I can do it for less.' *Do not kid yourself.* You could not possibly bring your own cost of making a service call below $3.75, even though all of your calls were confined to a radius of a comparatively few blocks.

"I am addressing those professionals who consider themselves rightfully as businessmen and who operate on an average of 8 hours daily and will not work on Sundays. Why should not any businessman, whether he is a TV service professional or a banker, be able to make a good living plus a reasonable profit during normal business hours?

"Let us say you are an average service operator. If you have enough service calls to fill your day, this week, next week, and every week, you will not be able to complete more than 48 calls even if you spend all of your time covering those calls within the weekly work-hour time limit of 48 hours.

"Therefore, the average time consumed in making each call will be one hour, provided you do not remain in the homes any longer than an average of one-half hour per call. In that case, you will have spent 4 hours daily in the homes or a total of 24 actual hours servicing time during the week. The remaining 4 hours daily will have been spent not just in traveling between calls, but in parking, walking into and out of buildings, waiting for elevators, walking up and down stairs, waiting for traffic lights, consulting superintendents, in telephone contacts with your office or shop, and in benchwork.

"If your purpose must be to get in and out of the home within one-half hour (the basis on which your service-call fee should be predicated), that should be your exact goal. *This must be done for profitable operation.* Your service-call fee represents your charge for services rendered in the home for the first half-hour of your time.

"Smart operators notify their customers after 20 or 25 minutes have elapsed while they are working on a set in the home, that it will be impossible to complete the work within one-half hour (if indeed it is true), and tell the customer that after the first half-hour has elapsed there will be an additional charge for labor at the rate of $5.00 per hour (in some areas this rate is higher).

"Some operators notify their customers that the additional charge will be $1.50 for each additional fifteen minutes. Some add the entire hourly charge to the service-call charges regardless of whether the extra time takes up the full hour or only a portion of it. This is perfectly fair and legitimate providing the customer is told in unmistakable language how legitimate, professional technicians operate. Men who pursue their calling on the basis of these methods are never tempted to charge the customer for parts and tubes not actually replaced.

"When you are making a satisfactory living and profit from your efforts, the temptation to charge for something you did not do will never exist. Men who do business by buying their way into homes and then attempting to all but sell the set back to the customer, do those things because they start out with those intentions. They do not pursue such tactics because they are barely making a living and feel they are forced to sell the customer something his set does not require. They do not find themselves in that kind of a position. Racketeers never take any such risks. When they receive a call for service their first and all-consuming thought and aim is to get all the traffic will bear and then some more.

"When you stop fearing to establish your labor charges on a level with your professional dignity and stop kidding yourself that you can make service calls at a lower cost than the other fellow, you will find out that the one who goes out of business first will be the competitor with the low service charges you have been worrying about. Never stoop to the level of an unfair competitor. It is too hard to climb back."

Quite a number of letters have come to your editor in response to the announcement that a survey of the actual costs of operating a radio-TV service business is now underway. Many of these letters have added additional factual proof to the previous surveys which indicated that the actual average cost per service call in the home is now above $4.50.

The following excerpt from a letter indicates the type of information that is being sent in to assist in determining the costs of doing business in electronic servicing. We would sincerely welcome similar information from other service business operators.

"Like most service business operators who entered radio-TV servicing by degrees, I went through the part-time stage by charging $3.50 to $4.00 per call. Since I did not know my actual costs of operating, I felt that those charges were fair to me and fair to my customers.

"Now I am operating a full-time service business from a regular business location and I realize that if all low-price operators who honestly try to give good service would realistically analyze their costs of making a service call, and figure in a reasonable return on their investment over wages, I am sure most of them would realize that they *must* get from $5.00 to $5.75 per call to receive adequate compensation for their time, knowledge, and equipment investment."

Service businessmen who would like to participate in this cost of doing business in radio-TV servicing survey may obtain a form by sending a stamped, addressed envelope to the TTLB Special Service Department requesting a copy of the "Cost of doing business survey form." Write to TTLB Special Service Department, P. O. Box 1321, Indianapolis 6, Indiana. —30—

"ELEMENTS OF SERVOMECHANISM THEORY" by George J. Thaler. Published by *McGraw-Hill Book Company, Inc.,* New York. 278 pages. Price $7.50.

This text has been designed for senior engineering students and as such is a specialized and hard-hitting handbook. Persons without the requisite mathematical and engineering background would undoubtedly find this text too "deep," but for those prepared for it, this book fills a definite need.

Since servomechanisms have been widely adopted in industry, the need for engineers who understand the design and operation of such equipment is a pressing one. The text is divided into twelve chapters and three appendices. The introductory material presents the problem of automatic control and then discusses various applications for suitable systems. The other chapters deal with the general aspects of analysis and design; transient analysis of servomechanisms; transfer functions; transfer-function plots; analysis of single-loop systems; methods of meeting performance specifications; gain adjustment of servomechanisms; series compensation of servomechanisms; feedback compensation in such equipment; introduction to linear theory; and an introduction to nonlinear systems.

* * *

"BIGGER PROFITS IN TV" by Ray A. Snyder & Donald B. Shaw. Published by *Coyne Electrical School,* Chicago. Distributed by *Howard W. Sams & Co., Inc.,* Indianapolis. 122 pages. Price $1.50. Paper bound.

No matter how talented a technician is with the soldering iron or how successful in tracking down intermittents and other service faults, if his business is not run with a realistic appreciation of the importance of business records and customer relations he will fail. The fact that just such failures have occurred with heartbreaking regularity has prompted the authors to write this practical handbook for practicing technicians.

The book is divided into nine fact-filled chapters each dealing realistically with a single topic. The book covers the keeping of business records; how to figure profit; business forms; how to price labor charges; how to get capital to start a TV service business; setting margins and retail prices; when to mark down merchandise and trade-in allowances; credit and collections; and the legal aspects of business.

One especially noteworthy point about this text is that the examples cited are realistic and very much in line with the operations of one-man and small TV service establishments. There are no flights of fancy into the half-million-a-year type of bookkeeping but examples are culled from more down-to-earth operations. This same characteristic permeates the entire book so that the user will be enabled to use every scrap of information provided.

* * *

"MOST-OFTEN-NEEDED 1955 RADIO DIAGRAMS AND SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications.* 123 pages. Price $2.00. Paper bound.

This is Volume 15 in this publisher's series of concise and practical servicing handbooks. It follows the pattern of the previous volumes in that the complete schematic, tube location guide, dial cord stringing information, and pertinent voltage readings, etc. are provided for each receiver.

The 1955 output of some thirty manufacturers is included. Users of this volume will be glad to find that information on a number of auto radio receivers has been presented, including schematics on sets used in *Cadillacs, Chevrolets, Fords, Mercurys, Pontiacs,* etc. in addition to car radios made by *Western Auto, United Motors, Delco,* and *Motorola.*

* * *

"PRACTICAL ELECTROACOUSTICS" by M. Rettinger. Published by *The Chemical Publishing Co., Inc.,* New York, N. Y. 266 pages. Price $10.00.

This is an engineering handbook for the serious audioman and fills a hiatus in the literature. Of necessity the treatment is mathematical but those with a working knowledge of advanced high school and college math could handle the formulas.

The text material is divided into eight chapters and covers microphones, loudspeakers, circuits, magnetic structures, public address systems, vibrations, architectural acoustics, and magnetic recording. Four valuable appendices covering octaves; decibels, volume units, dbm *versus* watts; dbm *versus* voltage; and a bibliography complete the book.

The lavish use of graphs, charts, and schematic diagrams contributes to the practical value of this handbook. The engineer entrusted with the job of planning various types of sound installations—whether for a huge outdoor amphitheater or for a family living room—will find this book of great assistance in coping with his particular problems.

* * *

"ANALYSIS OF FEEDBACK CONTROL SYSTEMS" by Robert A. Bruns & Robert M. Saunders. Published by *McGraw-Hill Book Company, Inc.,* New York. 376 pages. Price $7.50.

Although the material in this text has been prepared with the senior or graduate engineering student in mind, the subject matter is of such vital im-

portance in our everyday lives that it is to be hoped that the technically inclined will try to acquire a practical understanding of the techniques and processes involved.

The text itself is divided into two parts—the first dealing with the components which comprise the various systems and the second covering feedback-system theory. The first part includes discussions of mechanical systems; electric actuators; hydraulic elements; pneumatic elements; electric circuit elements; electronic amplifiers; magnetic amplifiers; dynamoelectric amplifiers; transducers, data transmitters, and error detectors; and reference standards. The part dealing with theory includes chapters on specifications and stability, block diagrams and network reduction, experimental methods for obtaining transfer functions; transient response from frequency-response data, nonlinear systems, and discontinuous systems.

As a basic handbook this text serves admirably as a practical and worthwhile introduction to the subject. —30—

TV WHILE YOU RIDE

ONE of the eye-catching features of the General Motors "Motorama" which is on a coast-to-coast tour is the deluxe "Westchester" Cadillac which has all the comforts of home including a television set in the rear seat.

The 14-inch set was designed and built by the Universal Broadcasting System, Inc., of 2193 Commonwealth Ave., Boston. The set has been engineered so that it can be used in the family car as well as in the "Westchester" for which it was designed.

It can be installed in the back of the front seat of any automobile with a rigid front seat.

The set has a safety glass between the screen and the viewer. It is shock-mounted so that when the car goes over a bump the set will ride up and down with the viewer.

The speaker, picture tube, and controls are the only parts of the set in the interior of the car. The rest of the circuitry is mounted in the trunk.

Installation in an automobile is relatively simple. A new short tube has been used which is aluminized to give a more brilliant picture. It will operate from the car's 12-volt electric system. —30—

In order to avoid missing a single Crosby appearance on TV, Bob Hope thinks having a television set in the car a swell idea.

ALLIED SUPPLEMENT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., has issued its Supplement No. 146 which is currently available on request.

Designed as an addendum to its 1955 general catalogue, this publication lists hundreds of new electronics product releases as well as outstanding values now available.

Tape recorders, TV accessories, test instruments, and amateur gear are all included in this new supplement along with new tool and component listings, etc. For a free copy of Supplement No. 146, write the company direct.

FM POCKET RADIO

Details on its new FM pocket radio receiver are included in the four-page booklet just released by *Hastings Products, Inc.,* 171 Newbury St., Boston 16, Mass.

The booklet pictures and describes the company's new "FM Jr." receiver which measures only 2½" x 3⅛" x ⅞" and weighs just 5½ ounces complete with batteries and earphones.

For a copy of "High Fidelity in the Palm of Your Hand," write the manufacturer direct.

TRANSISTORS AND RECTIFIERS

Transitron Electronic Corporation, Melrose 76, Mass., now has available two catalogues and two data sheets of interest to the trade.

The catalogues cover high-temperature silicon power rectifiers for magnetic amplifier and power supply applications and transistors. One data sheet deals with silicon junction diodes for high temperature applications while the second data sheet summarizes the firm's line of silicon and germanium products.

Any of these publications may be obtained by writing the firm.

LOCK NUTS AND FASTENERS

Palnut Company, Irvington 11, N. J., has just issued a 16-page catalogue covering its line of lock nuts and fasteners for the radio, electronic, and television industry.

The publication describes the firm's regular, washer, tension, inverted, and wing type lock nuts as well as shield can fasteners and coil tube fasteners. Each type of fastening device is described in detail and then typical applications are pictured and described.

SILICON DIODES

Microwave Associates Incorporated, 22 Cummington St., Boston 15, Mass., has just issued a four-page data sheet covering its line of silicon diodes.

Designated as Catalogue 55S, the new publication provides general information on uniformity; low-noise operation; diode life; the effects of shock, vibration, humidity, and temperature; operating limits; etc.

Characteristics of these diodes are presented in tabular form for quick and ready reference, along with physical dimensions and other pertinent data.

ADHESIVES GUIDEBOOK

National Adhesives, 270 Madison Ave., New York 16, N. Y., has just released a newly-revised edition of its handbook, "How to Handle Adhesives for Transparent Films."

The most interesting feature of the booklet is a completely new chart describing the properties and characteristics of all principal types of transparent film including Mylar, cellophane, pliofilm, polyethylene, cellulose acetate, etc.

PIEZOELECTRIC CRYSTALS

The Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., has announced publication of a comprehensive manual on the application of piezoelectric crystals for the control of radio frequencies.

This 600-page handbook was produced under Wright Air Development Center contract for the guidance of design and developmental engineers of military electronics equipment.

The book is available from the Department of Commerce for $6.00 a copy. When ordering specify publication PB 111586. Payment must accompany all orders.

C-D CAPACITOR DATA

Cornell-Dubilier Electric Corporation, South Plainfield, N. J., has just issued a comprehensive twist-prong-type capacitor cross index and price list of recommended replacements for four leading brands.

Over 1000 different twist-prong capacitor types are listed for quick interchangeability, along with stock numbers and approximate price of the *C-D* equivalent.

For a copy of Form UPX155 contact your local *C-D* distributor or write the company direct.

CARTRIDGE REPLACEMENTS

A new "Master Cross-Index Replacement Chart," covering all makes of phonograph cartridges, has been compiled by *The Astatic Corp.,* Conneaut, Ohio.

Consisting of eight 8½" x 11" pages, the chart lists not only the company's cartridges but those made by other manufacturers, together with their current *Astatic* replacement number. The chart is compiled in booklet form, with a three-hole punch for insertion into any standard loose-leaf binder.

A free copy of this chart is available from Dept. RC of the company.

GOODY'S AUDIO CATALOGUE

Goody Audio Center Inc., 235 W. 49th St., New York 19, N. Y., is now

offering copies of its 1955 catalogue covering a complete line of equipment for the audiophile and hobbyist.

The 100-page booklet, fully illustrated and of modern design, describes a comprehensive collection of phono equipment, tuners, amplifiers, speakers, cabinets, and tape recorders from all of the leading manufacturers.

The introductory pages tell the music lover, in simple, non-technical terms, what he needs to know when shopping for home music systems. The booklet not only has a complete index but, to make it even easier to use, the items are presented alphabetically-by-manufacturer within each major grouping.

Copies are available without charge by mail or in person.

DENSON DATA SHEETS

The Denson Electronics Corp., Box 122, Rockville, Conn., is now offering several data sheets covering products in its current line.

Upon request, the company will supply any or all of the following data sheets: r.f.-mixer-crystal oscillator head assembly; 10.7 mc. i.f. amplifier; "tone plates"; and special purpose audio amplifier and FM receiver. Each of these publications gives complete specifications on the equipment including performance data, tube line-up, and physical dimensions of the gear.

For copies of these publications or further details on any of the items, write the firm direct.

"HI-FI FACTS"

Sun Radio & Electronics Co., Inc., 650 Sixth Ave., New York 11, N. Y., has announced the availability of a 72-page booklet entitled "*Sun's* 1955 Hi-Fi Facts."

This publication is a digest of useful high-fidelity information and includes descriptive details on a complete line of high-fidelity equipment. Approximately 300 illustrations are included.

Features included in this book are: how to construct speaker enclosures, the function and evaluation of hi-fi components, how to select a hi-fi music system to meet your individual needs, a glossary of hi-fi terms, and other pertinent data.

The booklet is available for 35 cents a copy direct from the company.

TUBE CHARACTERISTICS

A new edition of "Essential Characteristics" has been issued by the Tube Department of *General Electric Company.*

This handbook on receiving tubes, picture tubes, special purpose tubes, and germanium diodes contains 192 pages. It includes characteristics of some 2000 tube types of which over 150 are new. Other new features include a classification chart on receiving tubes which permits selecting a tube by the type of application; characteristic curves of representative types; a thumb index; and a table of contents. It sells for 50 cents.

Distribution is through the company's tube distributors. —30—

Sales Aids

"ROCKET TO PROFIT"

Free portable batteries and advertising aids are the rewards that await dealers and service technicians who participate in *Philco's* nationwide "Rocket to Profit" promotion.

The promotion supports the introduction of the company's new battery models. Based on the theme that 87 per-cent of all portable battery sales are produced by six "best sellers," the promotion enables dealers and technicians to earn free quantities of "best sellers" with their regular purchases of these six most popular style batteries.

Heavy merchandising support includes a complete sales and display package which contains a set of window streamers, three-dimensional window and counter display, a shower of store pennants, and jumbo direct-mail cards.

TUBE PROMOTION

The key to one of the first new Tube Caddies received by a distributor in *Raytheon's* Spring Tube Promotion was presented to Morrie Green, owner of *Almo Radio Company* of Philadelphia, by E. I. Montague, advertising and promotion manager of *Raytheon's* replacement tube sales.

This represented the start of a new receiving tube promotion designed by the company to provide its distributors, through a new tube caddy promotion, with a means of obtaining a greater portion of the receiving tube business in their areas.

The caddy itself incorporates all of the outstanding features of the company's previous tube caddies along with the newly added features of roomy tube compartments, lock cornering, and luggage styling in a modern and durable blue airplane luggage finish with crisp white inlaid piping.

"ABSORBING" LETTER

CBS-Columbia is now sending out a unique sales promotion letter as part of its extensive program to expand the sales of radio and TV receivers.

The letter is printed on real compressed sponge which enlarges when wet. The 8" x 10" sponge letter, alerting distributors to some of the highlights of the current campaign, concludes with an invitation for the recipient to wet the letter and promises that his "sales will expand like this letter."

The unique compressed sponge mailing was worked out in conjunction with the *Autopoint Company* of Chicago.

ANTENNA COUNTER DISPLAY

A new four-color counter display, featuring the "Invader" fringe antenna, is now available to jobbers from *Ward Products Corp.*, 4710 State St., Ashtabula, Ohio.

The display has a pocket on it for a small folder, "How to Conquer the Fringe," which is actually a condensed catalogue on the "Invader."

Diane Daniggelis, Miss Photo Flash of 1955, poses with the display.

RCA PORTABLE PROMOTION

RCA Victor is demonstrating the ruggedness of the "Impac" cases on its new portable radios by means of a dramatic motion display showing a mallet striking one of the non-breakable plastic cases.

This display is the keynote of a wealth of sales promotion aids being offered dealers. The available aids include streamers and wall charts. The eleven different streamers feature humorous sketches of woodland animals with tie-in sales slogans.

CBS TUBE PROMOTION

CBS-Hytron of Danvers, Mass., has initiated a heavy radio and TV tube sales promotion and advertising program specifically angled toward the women's market.

According to a recent survey, women initiate 88.5 per-cent of the telephone requests for TV service and 76.95 per-

cent of the service calls are made when the woman of the house is pres-

ent. The program is being tied in with the *Good Housekeeping* "Guaranty Seal." This seal now appears on the new tube cartons which were recently streamlined to feature the *CBS* initials.

"VICTROLA" PROMOTION

RCA Victor is promoting its line of "Victrola" phonographs with an elaborate display featuring an eye-catching and regal mid-Victorian clock as the centerpiece. Small copy panels around it add emphasis to the main theme, "Music When You Want It," which appears on the face of the clock.

Wrought iron racks hold "45" and three-speed instruments on both sides of the centerpiece.

The displays are now on their way to *RCA Victor* distributors throughout the country.

PEGBOARD ISLAND DISPLAY

Arvin Industries, Inc., Columbus, Ind., has introduced a new pegboard island display which is designed to hold from 20 to 25 radios, depending on their size.

This display, designated RA-441, consists of a white pegboard display area with contrasting black table and wrought iron legs. The nameplate is blonde natural finish wood with the "*Arvin*" logotype in black and "radios" in aqua.

Twelve sets of brackets fit into the pegboard display area and can be ad-

justed for any arrangement or for any size of table model radio. Each unit is individually packed and can be easily assembled by following the instructions enclosed in each carton.

The display is designed for distributor or dealer use.

SALES LITERATURE KIT

A sales promotion kit for jobbers is now being distributed by *Ward Prod-*

ucts Corp., 4710 State St., Ashtabula, Ohio, covering its new *Fiberglas* "Duraramic" automobile antenna.

The kit includes a four-page, eight-color catalogue, punched for use in both automotive and radio notebooks, describing the new features; a window streamer; an identity pennant; and a "replace your old aerial" tag. Both dealer and distributor price sheets are included.

SYLVANIA PROMOTIONS

The Radio-Television Division of *Sylvania Electric Products Inc.* is now offering six separate and distinctive dealer campaigns for across-the-board sales promotion of its TV sets.

The highlight of the campaign includes two outstanding premium offers —one a free mink scarf with the purchase of one of the firm's "HaloLight" sets and the other a specially designed TV hostess "lazy susan" with the purchase of the same item.

Individually designed kits for each of the six promotions have been prepared. A dealer's promotional guide serves as a handy ready-reference to all events. It is available from the company's distributors.

CROSLEY "SALES TONICS"

The *Crosley Division* is currently offering its television dealers an option of several different "sales tonics."

The "tonics" consist of several TV-related furniture items. These include a contour chair and ottoman, coffee table, shelf table, and collapsible snack tables.

The decision whether to give the premium items to consumers with the purchase of *Crosley* TV receivers or to sell them with the set at slight extra charge rests with the individual dealer.

Dealers should contact their local distributors for full details on how this promotion is being carried out. —30—

JOBS WITH NAVY

THE U.S. Naval Ordnance Plant at Indianapolis, Indiana now has several interesting openings for engineers and scientists who want to apply their knowledge and experience to projects of critical importance to the national safety and welfare.

Vacancies exist in the fields of research, development, design, and production of mechanical and electronic airborne fire control systems, including radar, servomechanisms, visual and non-visual sighting elements, controls, gyros, computers, and associated electrical and electronic circuitry.

The plant is seeking qualified engineering and scientific personnel—with or without experience—who have degrees in physics, mathematics, and engineering—electrical, electronic, or mechanical.

Salaries range from $3410 to $6940 per year with opportunities for personal and professional advancement under the guidance of competent supervisors. Other benefits are also offered.

For complete information on these openings, write the Industrial Relations Officer, U.S. Naval Ordnance Plant, Indianapolis, Ind. —30—

Servicing Without Meters

(*Continued from page 39*)

Shunting these units across corresponding circuit components in the stage will restore operation when the defective unit is shunted. Sometimes, especially in the case of capacitors, you will have to disconnect one lead of the suspected component from the circuit before connecting your test unit. As an example, suppose coupling capacitor, C_8, were shorted or leaking badly (distorted output). Shunting it with your test capacitor would not correct the condition. In this case, C_8 must be disconnected and your test capacitor substituted before operation can be restored.

The few examples given here should start you well on your way toward servicing defective sets quickly and easily. Remember, the initial inspection, if done thoughtfully, can very often direct you to the defective stage without resorting to many of the tests discussed here. A loud hum in the loudspeaker usually indicates faulty filter capacitors, but it can also mean a cathode-to-heater short in one of the tubes. Naturally, you would decide first to perform the tests on the simplest and most suspected components before turning your attention to other possibilities.

It should be remembered that the methods described here are for quick diagnosis or repair, and not substitutes for accurate test equipment.

When replacing parts, always use components equal in value and quality to the items being replaced. —30—

Flyback Transformers

(*Continued from page 53*)

to the tertiary rim or to ground. When it breaks down to the tertiary, first repair the arcing point on the rim with vinyl tape. Next, tape the filament lead and reposition it away from the rim. If the filament lead has broken down to ground, tape the breakdown point and redress the lead.

When one or more of the leads going to the terminal board are broken, they can be repaired if they have not been broken too close to the windings. If the break is at a point where two taps on a winding are brought out, such as at terminal 5 in Fig. 2, make sure both leads are present. Next, wrap a piece of thin bare copper wire around the lead or leads. Solder this strengthening wire to the leads, slip a piece of spaghetti over the junction, and solder the other end of the strengthening wire to the terminal lug.

If the suspected trouble is a cold soldered joint at one of the terminal lugs due to improper cleaning of the wire, unwind the wire or wires from the lug and gently clean them with a piece of fine emery cloth. Wrap the cleaned wires back on the lug and solder.

INDEX OF Advertisers

JULY 1955

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

Classified

Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

CODE practice Oscillators, Year Warranty, $4.00 Postpaid. Details free. Stout, 2241 E. Broadway, Muskegon, Michigan.

TAPE Recorders, Accessories. Catalog of best values. Pre-recorded tapes. Will quote on hi-fi components. Boynton Studio, 10R Pennsylvania, Tuckahoe, N. Y.

GEIGER Counters, $19.95 to $89.50. Wired or kits. Dealers wanted. Electronics Unlimited, 3486 Kurtz Street, San Diego 10, California.

GUARANTEED to improve your TV picture or money refunded! Genuine Hamco C R T Rejuvenator. Send only $1.00. Pay Postman $2.95 C.O.D. Hamco Electronics, 560 Claremont Pkwy., N. Y. 57, N. Y.

FIDELITY Unlimited Company: Authorized Distributors of Scott, Fisher, Pilot, Garrard, Red-O-Kut Electric-Voice, Reeves Harmon-Kardon, Fairchild and many others. Complete stock, all inquiries promptly answered. Shipments Prepaid and Insured in U. S. A. Write today. 63-03 39th Ave., Woodside 77, N. Y. Dept. RN.

TELEVISIONS, repairable from $10, also working. W4API, 1420 South Randolph, Arlington 4, Virginia.

ALUMINUM Tubing, Angle & Channel, Plain and Perforated Sheet. Willard Radcliff, Fostoria, Ohio.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TUBES—70% to 90% Discount. Government, manufacturers, jobbers, etc. surplus. Guaranteed 1 year. Free catalog on request. Cadillac Trading, Dept. AD, 231-07 Linden Blvd., Jamaica 11, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 512 Broadway, New York 12, N. Y.

FOR SALE—Geiger Counter Kits $38.50. Geiger Counter & Scintillator Diagrams $1.00. Free Catalog. "R. F. Chambers," 13833 San Antonio Dr., Norwalk, Calif.

SALE—High Fidelity—All Nationally advertised Brands Direct from factory to you Low Low Prices. Tuners, Amplifiers, Speakers, Cartridges, Turntables, etc. Consult us for your Hi-Fi needs. Write for catalog today. Lovill Electric, 33-42 72 Street, Jackson Heights, 72, N. Y.

TV Trade-In sets. Philco, R.C.A., Emerson, others. List available. 10"—$17. 12" to 17"—$20. up. Washtek Service Co., Dept. R, 956 Southern Blvd., Bronx, N. Y.

WALKIE-Talkie. Build wireless two-way portable radiophone for less than $10.00. Plans 50¢. Springfield Enterprises, Box 54-H7, Springfield Gardens 13, New York.

SCINTILLATION Crystals. NE-101 Plastic Phosphors have distinct advantages over sodium iodide: Cost is low. Sensitivity is high. Not affected by moisture. Unbreakable. Easy to attach. Mfrs. and individuals are adopting their use. Write for details. Western Radiation Laboratory, 1107 West 24th Street, Los Angeles 7, California.

COMPLETE VHF Radio Terminals. These are designed for telephone service in the 72-76 mc. band, and are ideal for setting up a communication system along a pipeline, railroad, or in mountainous or bush country. Each terminal consists of the following: 1—Link Radio Type 1498T Transmitter; 1—Link Radio Type 1498P Power Supply; 1—Link Radio Type 1498R Receiver; 1—Budelman 200 watt Power Amplifier; 1—Type PP13 Power Supply; 1—Federal Type 101B V-F Ringer; 500 ft. —Type RG 8U Coaxial Cable; 2—Welded steel Yagi Antennas—5 element; 1—Lister Diesel-Generator set, 2 KW. P. J. Plishner, 550 Fifth Avenue, New York City.

FREE: Get our monthly electronic lists. Dick Rose, Everett, Wash.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

SCINTILLATION Crystals. Sodium Iodide, Thallium activated hermetically sealed tested. 1"x1" $75, 1½"x1" $120, 1¾"x2" $250. Shelby Instrument, 1701 Magnolia, Long Beach, Calif.

WANTED

WANTED: CV 187 or 235CV English make Rectifier tubes new, will pay $10 each for two to four tubes. Captain James J. Faye, Ottoman, Virginia.

CYLINDER and old disc phonographs. Edison Concert, Balmoral, Conqueror, Opera, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia disc and cylinder Graphophones, Bettini micro-reproducer. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % Radio & Television News.

WILL Buy All. ART-13/type T-47A $225.00. Art-13/type T-47 $150.00. BC-788C Altimeters Receiver, $150.00. R5/ARN7 Radio Compass $160.00. ARC-3 Complete $185.00. BC-348 Rec'r Modified $35. BC-348 Rec'r unmodified $50. ARC-1 Radio $150.00. BC-312 Rec'r $40.00. BC-342 Rec'r $50.00. Ship Via Express C.O.D., Subject to inspection to: H. Finnegan, 49-57 Washington Ave., Little Ferry, New Jersey.

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

HELP WANTED

TELEVISION Jobs—Names and addresses of companies to contact. $1.00. Fitzgerald, Dept. A-14, 815 Countryside Drive, Wheaton, Illinois.

BUSINESS OPPORTUNITIES

$200 weekly cleaning Venetian Blinds. Free Book. Burtt, 2434CE, Wichita 13, Kansas.

CORRESPONDENCE COURSES

USED Correspondence Courses, Books, Bought, Sold. Catalog Free. Educational Exchange, Summerville, Ga.

USED correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

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PREPARE for high paying job in Radar. Correspondence Course. Write Progressive Electronics Institute, P.O. Box 543, Akron 9, Ohio.

RECORDS

25-50% DISCOUNT on guaranteed factory fresh LP records, and pre-recorded tape. Send 20¢ for complete LP catalogue. Record Sales, 4710 Caroline, Houston 4, Texas.

PHONOGRAPH Records 20¢. Catalogue. Paramount, N-313 East Market, Wilkes-Barre, Penna.

MISCELLANEOUS

TEST Equipment Repaired and Calibrated by Factory staff. All makes. Superior, Simpson, Triplett, etc. Free estimate. Our nineteenth year. Douglas Instrument Laboratory, 176 Norfolk Avenue, Boston 19, Mass.

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vessey St., New York 7, N. Y.

MATHEMATICS Service, problems, calculations. Electronics, mathematics. Reasonable rates. Mathematics Service, Box 6671, Orlando, Florida.

AUDIO Enthusiasts "Used Traders Market Place" in High Fidelity magazine—the place to buy, swap, or sell Audio equipment. Rates only 30¢ a word. Send ad to High Fidelity, RT, Publishing House, Great Barrington, Mass.

"TAB"
THAT'S A BUY

NEW HIGH CURRENT POWER SUPPLIES—ONE YEAR GTD

Variable 0-28 VDC. Completely Built. Full Wave Selenium Rectifier. Transformer, Variac, Volt & Amp Meters, Switch, Terminals & Fuse. In Hvy Duty Steel Cabinet. Std 115V/60cy In. 110 or 220V† and 3 phase to order. Specify.

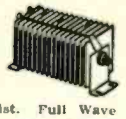
Stk No.	Cont. Rating	W/ Meters
T28V5A	0-28VDC 5 amp.	$ 45
T28V5ACC	5 Amp (1% Ripple)	$ 75
T28V12A	0-28 VDC at 12 Amp.	$108
T28V12ACC	12 Amp (1% Ripple)	$145
T28V24A†	0-28 VDC at 24 Amp.	$135
T28V24ACC†	24 Amps (1% Ripple)	$195
T28V50A†	0-28 VDC at 50 Amp.	$260
T28V50ACC†	50 Amp (1% Ripple)	$370

New! Basic Supplies, 115VAC In

B115P5A	115 WVDC at 5 Amp.	$ 90
B115P10A	115 WVDC at 10 Amp.	$190
B230P5A	230 WVDC at 5 Amp.	$188
B230P10A†	230 WVDC at 10 Amp.	$283

Less Meters. †115 & 230 VAC and 3 phase.

NEW "TABTRON" SELENIUM BRIDGE RECTIFIERS DATED & YR GTD



We mfg. Power Rectifiers to your specs. From 1 Amp up to and above 1000 Amps. Following List. Full Wave Bridge.

Curr. Cont.	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1AMP	$1.40	$2.35	$3.75	$8.25
2AMP	2.10	2.95	5.35	10.00
3AMP	3.00	4.15	5.85	12.75
4AMP	3.70	7.35	11.35	24.75
6AMP	4.45	8.75	12.85	32.00
10AMP	6.50	12.50	19.50	41.50
12AMP	8.00	15.75	22.10	44.25
20AMP	13.05	25.05	37.25	78.50
24AMP	16.00	31.95	44.50	85.00
30AMP	19.75	33.50	56.50	109.00
36AMP	24.75	47.50	65.00	134.00
50AMP	29.50	54.35	97.35	174.00

New Rectifier Xfmrs

Primary 115V 60 Cyc

5 Amp†. . . .	$8.65; 2/$15.75
12 Amp†. . . .	$16.65; 2/$29.95
24 Amp†. . . .	$35.75; 2/$69.95
50 Amp*. . . .	$59.00; 2/$112
100 Amp*. . . .	$108.00; 2/$210

18 Volt 2 Amps $1.98; for Scc (Dual†) 18-15-9-0-0-9-15-18 Volts †Wndgs in Series at ratings shown; Parallel 2x Amps, Voltage One-half Max. *Dual Pri 115 & 220V 60 cy; Tapped 36VCT

New Rectifier Chokes

CR1A10/1AMP .01HY/1.4R/3=	$3.95
CR1E11/2AMP .01HY .67R/3=	$5.95
CR7H12/5AMP .07HY .6R/10=	$7.95
CR1L13/12AMP .01HY/.1R/12=	$14.95
CR4N14/24A/.004HY/.025R/20=	$29.95

New Variable 0 to 6 & 12 Volt/12A DC Power Supply

Battery Eliminator, Charger, Model RR, Plater, Aircraft, Marine or any DC Req. Extra Hvy Duty Selenium Rectifier, 2 Meters V & A. Designed for cont. service & up to 20 Amps intermittent overload. Model T612V12AC. . . . $31.95

New 110-115VDC Power Supplies

for Fans, Shavers, Motors, Bells, Drills, Solenoids, Business Machines, Battery Chgrs, Machine Tools & Signal Systems. up to 50W. . . $4.98; up to 100W. . . $7.95 up to 250W. $12.95; up to 350W. $14.95 up to 800W. $28.95; up to 1100W. $32.95

New Variable Voltage Xfmrs SUPERIOR—GR—STACO—UTC

0-132V 1.25A	$7.99
0-135V 3A	11.99
Cased 0-135V 7.5A	21.95
Uncased 0-135V 7.5A	17.25
Cased 0-270V 3A	24.95
Uncased 0-270V 3A	18.95
Cased 0-135V 15A	41.98
Cased 0-270V 9A	41.98

Six or More 10% Disc.

230 to 115V Autoformers

For 220-240V/50-60 cy in. To 110-120V or Step-up.† W/Cord, Plug & Receptacle.

TPA050/50W*	$2.55
TPA075/75W*	3.65
TPA100/100W†	4.00
TPA200/200W†	5.75
TPA250/250W†	6.75
TPA300/300W†	7.25
TPA500/500W†	8.25
TPA750/750W†	11.75
Model TPA1000/1000W/1 KW†	16.95
Model TPA2000/2000W/2 KW†	34.00

$100 Order Take 10% Disc. *Less C, P & R

"TAB" MONEY BACK GUARANTEE

$$ PRICED SLASHED $$ AB "J" POTENTIOMETERS

Screwdriver Shaft 1/4", 150, 200, 500, 3K, 5K, 10K, 15K, 25K, 30K, 50K Ohms, 50¢ ea; 12 or more asst'd @ 40¢ ea; lots of 100. Special 30¢ ea. W/Shaft 1/4" & up, 5, 50, 150, 200, 1K, 1500, 2K, 2500, 3K, 10K, 25K, 30K, 50K, 70K, 100K, 750 K, 10 Meg. Ohms @ 65¢ ea; 12 or more asst'd @ 55¢ each; Special Deal on 100 Lots @ 39¢ each. Dual 1/8" Shaft up, 100/50, 1500/50, 1500/500, 2x25K, 25k/450, 25K/5K, 35K/7.5K, 50K/5K, 2x500K, 2x10 Meg. Triple 5K/1K/1 Meg, 3x750K Ohms; @ 85¢ ea; 12 or more asst'd 75¢ ea; 100 Lots @ 50¢ ea. Asst'd Kit 12 @ 48 Pots @ 12 for $4.00 Many Other Values In Stock, Write

PRECISION RESISTORS

W.E.—IRC—Wilkor 1% Accuracy Gtd.

Special 20¢ ea.

10 of One Value. . . . . ea.	15¢
100 of One Value.	$10
10 Asst'd Values.	$2.50

Write for Complete Listing

CIRCUIT BREAKERS

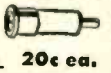
He'mmann Magn Bkrs. Amps; 3, 5, 7, 9, 10, 12, 15, 20, 30, 40, 50, 60, 80, 100, 120, 150, 180. EA: $1.98 12/$20; 50/$75 Sq D & CH Toggle Sw Bkrs. Amps; 5, 10, 15, 20, 25 . . . 98c; 10 for $8.98; 50 for $39

Klixon Therma Push Button Bkrs. Amps: 5, 10, 15, 20, 25, 30. . . . . 89c 10/$7.98

COMPONENT KITS

Resistors, 100½ & 1W/95¢; 6/85¢
Tube Sockets, 20 Asst'd., 85¢; 6/75¢
Ceramicon Cond., 25 Asst'd., 85¢; 6/75¢
VitvwwRes., 15 Asst'd., $1.45; 6/$1.25
Rotary Sw, 12 Asst'd., 95¢ 6/85¢
Knobs, 10 Asst'd. . . . . 98c 6/89¢

TERRIFIC OFFER!! Crystal Diode



IN21

"TAB" SPECIAL 20¢ ea. 6 FOR $1.00 100 FOR $15

SPECIALS ★ TEST EQUIPMENT

EMC #208 Tube Tester $24.90 Reg. $21.95
EMC #206 Mutual Cond. Tube Tester $83.50 Reg. . . . "TAB" Special. . . . $67.50
HICKOK 600A Tube Tester $164 Reg. $150
TRIPLETT 630 VOM $38.71 Reg. . . . $36
SIMPSON 260 VOM $38.17 Reg. . . . $36

NEW SONIC SOUND WASHER

115VAC INPUT
Cleans! Agitates! Mixes! Washes, Pulsates

"TAB" SPECIAL $19.95

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TUBES

• Hickok Mu Tested •

OA2	.74	6AF6	1.18	6X5	.46
OA3	.98	6AG5	.71	6Z7	2.11
OB2	.74	6AG7	1.14	7A4	.78
OB3	1.19	6AH6	.88	7A6	.46
OC3	.88	6AK5	.62	7AD7	1.41
OD3	.78	6AK6	.74	7B6	.72
OZ4	.50	6AL5	.48	7B8	.82
1A5GT	.64	6AL7	1.22	7C4	.26
1A7GT	.96	6AQ5	.52	7E6	.68
1AD4	3.95	6AQ6	.54	7E6	.54
1AE4	3.75	6AR6	2.74	7E7	.72
1AH4	1.07	6AS6	2.22	7F7	.82
1AX2	.25	6AS7	3.48	7F8	1.18
1B3	.79	6AT6	.42	7H7	.72
1C6	.49	6AU6	.48	7N7	.90
1D8GT	.89	6AV5	.84	7S7	1.29
1E5	.69	6AV6	.48	7V7	1.06
1E7	.49	6AX4	.81	7X6	.89
1G4GT	.69	6B4	1.12	7Y4	.64
1G5	.69	6B5	1.18	10	.49
1G6GT	.69	6B7	.91	12A6	.48
1H4G	.49	6B8	.64	12AH	.79
1H5GT	.72	6BA6	.48	12AH7	.92
1H6	.69	6BD6	.74	12AL5	.54
1J6G	.79	6BE6	.54	12AT6	.46
1L4	.48	6BG6	1.58	12AT7	.82
1LA4	1.01	6BH6	.62	12AU7	.68
1LB4	1.09	6BJ6	.68	12AV6	.52
1LC6	.89	6BK7A	1.11	12AW6	.84
1LD5	.98	6BL7	1.19	12AX7	.78
1LE3	.99	6BN6	1.14	12BA6	1.22
1LH4	1.01	6BQ6	.98	12BA6	.69
1LN5	.78	6C4	.46	12BA7	.94
1P5	.78	6C5	.68	12BE6	.62
1Q5	1.19	6C8	.82	12BH7	.99
1R4	.96	6CB6	.58	12BY7	.62
1R5	.58	6CD6	1.58	12H6	.48
1S4	.88	6D6	.84	12J5	.48
1S5	.66	6D8	.81	12K8	.48

FULL RETMA WARRANTY

1T4	.68	6E5	1.09	12SC7	.78
1T5	.98	6F6	.76	12SF7	.78
1U4	.68	6F7	.68	12SF7	.62
1U5	.54	6G6	.92	12SJ7	.54
1V2	.68	6H6	.57	12SK7	.62
1X2A	.88	6J4	4.59	12SL7	.62
2A4	2.37	6J5	.46	12SQ7	.54
2A5	.78	6J6	.58	12SR7	.46
2A6	1.49	6J7	.72	12Z3	.89
2A7	.89	6K6	.61	14A7	.89
2B7	.89	6K7	.46	19BG6	1.98
2E5	.92	6L5	1.09	19T8	1.49
2V3	2.90	6L6	.98	19V8	1.49
2X2A	1.15	6L7	.80	24A	.92
3A4	.48	6N7	.80	25A6	1.79
3B4	2.70	6P5	.99	25BQ6	1.30
3B7	.56	6Q7	.81	25L6	.46
3Q4	.46	6R8	7.44	25Y5	.84
3Q5	.68	6S4	.99	26	.79
3S4	.46	6S7	1.30	28D7	1.29
3V4	.79	6S8	.92	34	.69
5AX4	1.22	6SA7	.67	35A5	.71
5AZ5	.54	6SC7	.74	35B5	.54
5R4GYW	1.56	6SF7	.74	35C5	.71
5T4	1.48	6SG7	.62	35Y4	.68
5U4	.54	6SH7	.46	35Z3	.68
5V4	1.28	6SJ7	.69	35Z4	.64
5X4G	.78	6SK7	.54	39/44	.56
5Y3	.42	6SL7	.62	45Z3	.66
5Y4	.62	6SN7	.74	50A5	1.29
6A3	1.29	6SQ7	.56	50A5	.72
6A5	2.98	6SS7	.89	50C5	.54
6A6	.81	6T7	1.27	50L6	.60
6A7	1.09	6T8	.82	71A	.74
6A8GT	1.09	6U5	.99	71	.82
6A84	.62	6U7	.64	76	.68
6A87	.78	6V6GT	.56	77	.68
6AC5	1.19	6W4	.38	83V	1.22
6AC7	.68	6X4	.42	117Z3	.68

—ONCE AGAIN BY DEMAND— Pocket AC-DC Multitester "TAB" 27C

$9.45 Lots of 3

Hi-accuracy precision VOM 1000 Ohms per V. Reads AC & DC Volts 0, 5, 25, 250, 1000V. DCMA; 0, 10, 100MA. Ohms 0, 10, 100K. Size 1¼" D, 4⅜" L, 3¼" W. Test Leads. Sold Singly $9.95; (plus 40¢ ship. in U.S.A.).

TRANSFORMERS

All 115V 60 Cyc. Input TV, & CR pwr. xfmr. up to 20" tubes. Hi Volts to 20 Kv. (w/quadrupler ckt.) All tubes. PL & FIL wndgs. 5000 VDC. 5MA. 300 VDC/275 Ma Full-Wave; 6.4V/10.3A. 5.4V/8A 2.5V/3A Hypersil Core, Oil Fill. . . $4.98
2500V/20MA. 6.3V/.6A. 2.5V/1.75A for BC412 Scope Replmt. . . . $7.98
900V/35MA. 2x2.5V/2A Xclent 1800V Dblcr. TWO 2x2 FIL WNDGS. . . $1.98
778VCT/200MA, 5V/3A, 6.3VCT/5A THORDARSON. $4.98; 2 for $9; 6 for $24
770V/2.5MA, 2.5V/3A, HMSLD FILTER PARTS 4/scope. . . $3.69; 2 for $6.00
700VCT/70MA,5VCT/3A,6.3VCT/2.5A$3.95
600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A HALF SHELL $2.49; 2 for $4.50; 10 for $20
550VCT/250MA,5V/2A, 6.3VCT/2.5A, 12.6 V/3.5A, RCA CSD. . . $4.50; 2/$8
500VCT/60MA, 6.3V/4A HMSLD. . . $2.98
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230VAC @ $1.49

NEW PRECISION POTENTIOMETERS

Helipot 1000 Ohm/0.5%/$6.49
Helipot 2000 Ohm/0.5%/$6.49
Helipot 5000 Ohm/0.5%/$6.49
Micropot 5000 Ohm/0.1%/$6.49
Micropot 20,000 Ohm/0.1%. $6.49

Buy in Quantity—Six for $24

NEW 106W/SEC PHOTOFLASH AC & DRY BATTERY KIT.

Includes condensers two 525MFD/450V/Total 106W/Secds Resistors, capacitors, rectifiers, flash tube in indicating flash gun, guide #40 Daylight Kodachrome, 120 on Ektachrome. Does Not Incl. Batteries, AC Only. . $35.98
FIVE (5) 90 VOLT (N60) BATTERIES. . . . . @ $12.50
Flash Lamp Gun, Holder & 10" wide range Reflector, $4.98; w/Lo or Hi volt Flash Trigger Coil Lamp. $12.98
525MFD/450V/53W-Scds. Cond. new low leakage famous mfgr. DATED. . $9; 2/$16
16MFD/2500VDC/60W-Scds. . . . 6; 2/$10
16MFD/1.8 to 2.8KV/60W-Scds. . $5; 2/$8
CK5517 Mini. gas rectifier. $2.88
600VAC Selenium Rectifier. $4.25
1600VDC Selenium Rectifier. $2.98
Electronic Flash Handbook Ckt. Data. . . 50¢

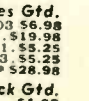
FOTO FLASH & STROBE LAMPS

"TAB" No.	Replaces	W-Sec. Max.	Each
TLW	FA104/FT118	150	$5.98
THI	AMGL05804X	100	10.98
23ST	GE FT210	200	9.98
THVA	SYLV. 4330	200	9.98
V4X4	X400	200	10.98
TLX	DXK&FA100	150	9.00
TDX	DXC/250-350	150	10.00
353GTQ	FT503	2000	49.98

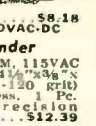
Trigger coil for HI&LO V.Flash. 1.47
Write for "TAB" Flash Tube Data. . . . 50¢

• Check These "BARGAIN VALUES" from "TAB'S" •
• Summer Warehouse Clearance •

866A KIT (2) 866A Tubes, Sockets and Transformer. . . Special $4.98
HOOK UP WIRE, Asst'd 5 Colors, 100 ft./roll; 500 ft., $1.98 ea.; 6/$10
CLAMP LAMP, Adjustable, w/Bulb & Reflector. . . . $1.57 ea.; 7/$10
POWER SUPPLY KIT, Incl. Transformer, Selenium Rectifier and Filter Condensers "TAB" Buy Only. . . . $2.25 ea.; 3 for $1.98
GTD VINYL ELECTRIC TAPE, Hi Volt ¾" x 30 ft. @ 6 for $2.00
SOUND PWR HEADSET, Chest & Throat Mike U.S.N. Per Pair $29.98
ISOLATION XFMR, VS 110 to 220 or 440/150 Watt, Only. . . . $4; 2/$7
PLANETARY DRIVE, S:1 & 1 to 1, Special Buy. . . . $2.49 ea.; 5 for $10
MICROSWITCH KIT, Assorted Types. . . . 4 for $1.00; 20 for $4.00
WILLIAMSON AMPLIFIER KIT, Ultra Linear 20 Watt. 10-70KC/10W (±) 1DB. Model TA8 20, Only. . . . $47.50; Wired to go $61



"TAB" DO-IT-YOURSELF TOOLS Hi Quality Power Saws



CUMMINS 6¾" MAXSAW (90° cut 2¼" 45° cut dress 2x4)
"TAB" Bargain Buy. . $39.95
THOR 5" POWER SAW (90° + 45° cut) Special. . . $22.50

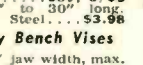
Thor Electric Speed Drills

200J¼" Electric Speed Drill w/Jacobs chuck. 2400 RPM/115VAC. Now Only. . $14.25
400J½" Electric Speed Drill w/geared chuck. 425 RPM/115VAC. $29.95

Chrome Vanadium Speed Drills

60-pc. Set #1 to 60 C.V. . . . $5.95
29-pc. Set 1/16" to ½" by 64ths. . $7.98
13-pc. Set 1/16" to ¼" with Index. $1.98
Drill Index HUOT for 60-pc. Set. . . . $1.49

Esico Soldering Irons 115VAC/DC



60W ¼" Tip. . . $1.91
100W ⅜" Tip. . . $2.51
130W ½" Tip. . . $3.17
100W ⅜" Tip. . . $5.29
300W ⅞" Tip. . . $8.18
† Industrial Constant Use 120VAC-DC

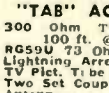
Thor Bench Speed Grinder

Model 117—3450RPM, 115VAC Motor; wheels 4½"x⅜"x ½"; (1-60 grit, 1-120 grit) Self-Aligning, Oilless, 1 Pc. Aluminum Body. Precision Mfg. Special Only. . . . $12.39

Servicemen! Radio, TV, Refrig. Kit

Time Saver Master Kit 17 Pc., Incls. every nut & screwdriver used in Radio, Refrigerator & TV repair. Kit contains Hvy. duty handle, ratchet & extension drive. (2) Phillips & (3) screwdriver long blades. (8) nut drivers (¼" to 9/16"). (Deeply recessed for long chassis screws). Ill Quality Tempered Steel, GTD to SATIS-FY. Special. . . $5.98 ea.; 3 for $17
Swiss "Quickie" Wrench, 10 Way. Fits 95% all sizes Sq. & Hex. head nuts & bolts ¼" to 9/16". Gtd. Rustproof, Brk-proof. (Prepaid U.S.A.). . . . . 98c; 6/$5
Swedish Hand Saw, 24" long. Crosscut. Finest Sandvick Steel. . . $3.98

Wilton Quality Utility Bench Vises

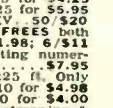


V107—2½" jaw width, max. open. 2¼" Straightline Pull Acme Thread spindle & malleable iron casting. . . $3
V106—3" jaw width, max. open. 3" w/swivel Base. Steel pipe jaws & wire cut-off tool. Rugged. . . . $5.75

Write For New "Thor" Tool Catalog

TELEVISION BARGAINS

Television Antennas



Fringmaster V Conical, Broad response, All Ch. . . . $6.69
TV Conical Ant., All channel, Sturdy 10 Element, cross & clamp $3.49; 3 for $9.49
UHF Bow Tie & Reflector. . . . $1.95
Double-V Ant., All Channel, Sturdy Cons. w/mtg. Clamps Hvy. Duty. . . $3.49
Corner Array w/Bow Tie (UHF 14-83) Flicker free, Hi Gain. . . . $6.49
Panoramic Broad Band "Vagi" VHF. (Channels covd. 2-6) $41 Reg. Only $19.95 (Channels covd. 7-13) $21 Reg. . . . $10.95

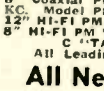
"TAB" ACCESSORY SPECIALS! !

300 Ohm Twinex 65 Mil. Hvy duty, 100 ft. @ $1.19; 1000 ft. @ $10.25
RG59U 73 Ohm 100 ft. $5; 500 ft. $22
Lightning Arrestor UHF/VHF. . . 20 @ $11
TV Pict. Tube Brightner 85¢ ea.; 10/$7.95
Two Set Coupler, operate 2 sets from one Antenna. . . . . 97¢ ea.; 5 for $4.25
TV Cheater Cord 6 ft. . . . 28¢; 25 for $5.95
Ceramic Cond., 500 mmfd/20KV. . . 50 @ $20
Brow Lite, 25' focused beam. FREES both hands. W/Batteries. . . . $1.98; 6/$11
Electric TV Clock & Lite, rotating numerals. Walnut case. . . . $7.95
Mounting Steel Strapping ¾"x25 ft. Only 57¢ ea.: Special. . . . 10 for $4.98
Guy Wire Hook Eye. . . . 100 for $4.00
Chimney Mount, Hvy. duty 25' strapping & hardware. . . . $1.39; 5 for $5.95

"TAB" HI-FI RECORDING TAPE 1200' Finest Tape S, S, S Back Gtd.

Precision Coated & slit, Gtd Splice Free, Quality Controlled, Plastic Base. Gtd Constant Output Freq. 7½ IPS 40 to 15KC (Oxide Wnd In). 7½" Reel, 1200 ft. P/Reel Sold Singly. $1.80 Twelve Lot Special. . . . ea. $1.58

HI-FI AUDIO COMPONENTS Phono Cart. 6 Needles Gtd.



RPX050* Dual .001 & .003 $6.98
RPX052* Gold Treas*. . . $19.98
RPX041* Single (s) .001. $5.25
RPX040* Single (s) .003. $5.25
RPX053* (DD)GoldTreas* $28.98

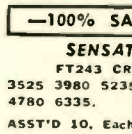
*GE Original Boxed, S, S, S Back Gtd.

RPJ010 Dual (s) .001 & .003 (GE) $1.98
RPJ012 Dual(D) .001&.003TETRAD $18.99
RPJ001 or RPJ005 Single S (GE). . . $1.35
RPJ013 Dual (DS) .001&.003 TETRAD $10.99
RPJ003 or RPJ004 Sing. D TETRAD $9.99
MG or 78 Single Sapphire Str. . . $1.15
MG and 78 Dual Sapphire $1.98; 4/$7.50
MG or 78—Sing. Diamond "TETRAD" $9.89
MG and 78 Dual Dia. "TETRAD". . . $20.89

HI-FI SPEAKERS

Inbuilt network, 2 wires needed for HF & LF Response. Famous Hi-Fi Speaker mfgs.
15" Coaxial PM & 5" Tweeter 25 Watt/20-17500 cycles. Model P25CO. . . . $19.50
12" Coaxial PM & 3½" Tweeter 12 Watt/45-15000 cycles. . . $12.75; 3/$35
8" Coaxial PM & 2½" Tw/8 Watt/70-15 KC. Model P8CO. . . . $7.98; 2 for $15
12" HI-FI PM 10W/35-14 KC. $10; 2/$18
8" HI-FI PM 7 W/45-14KC. . . $7.25; 2/$13
C "TAB" B 4 U BUY HI-FI
All Leading Makes at Great Saving

All New Dual Voltage PHONO CARTRIDGE



$1.70 Lots of 6

Replaces 127 Popular Type Cartridges 95% of ALL 78 RPM'S

Externally mounted condenser slips off for output of 4½ Volts. With condenser in place, voltage at output terminals is 2 Volts. Freq. response 8000 cys. A terrific deal for Servicemen. Write for Replacement Chart. Sold Singly/$1.80 ea.

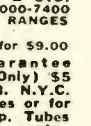
TUBE SOCKETS CINCH—JOHNSON—AMPH

Octal (low-loss mica) rng. mtg. Each 12c; 10/$1; 20/75¢
Octal (mica) ring mtg. 12/$1
Octal (steatite). ring mtg. . . . 12 for $2.00
Loktal (mica) saddle mtg. . . . 12 for $1.00
7 pin min (mica) base shld. 20¢; 12/$2.00
7 pin min (bkit) rubber shock mtg.; 12/$2
9 pin min (mica) bottom mtg. . 25¢; 12/$2
9 pin min (bkit) bottom mtg. . 18¢; 7/$1
9 pin min (bkit) base shld. . . . 20¢; 5/$1

—100% SATISFACTION GTD—

SENSATIONAL OFFER!!

FT243 CRYSTALS*



3525 3980 5235 8233.3 3725 4780 6335.

ASST'D 10, Each. . . . 59¢

Asst'd 5 ea.	69¢
Sold Singly, ea.	89¢

4190 5030 5485 5880

Assorted 10, each. . . . . 26¢
Sold Singly, each. . . . . 39¢
* Listed in Kilocycles.

NEW HAM BAND CRYSTALS

Hi-Stability Oscillators, Newly Ground, Fresh Stock, Individually Tested & GTD. 3500-4000KC; 5275-5312KC; 7000-7400 KC; 8000-8222 KC; OR ANY RANGES 3500-8700KC ± 2KC.
"TAB" Bargain @ $1.69 ea.; 6 for $9.00

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges or for C.O.D. 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice. Phone Rector 2-6245

THAT'S A BUY **// TAB //** THAT'S A BUY

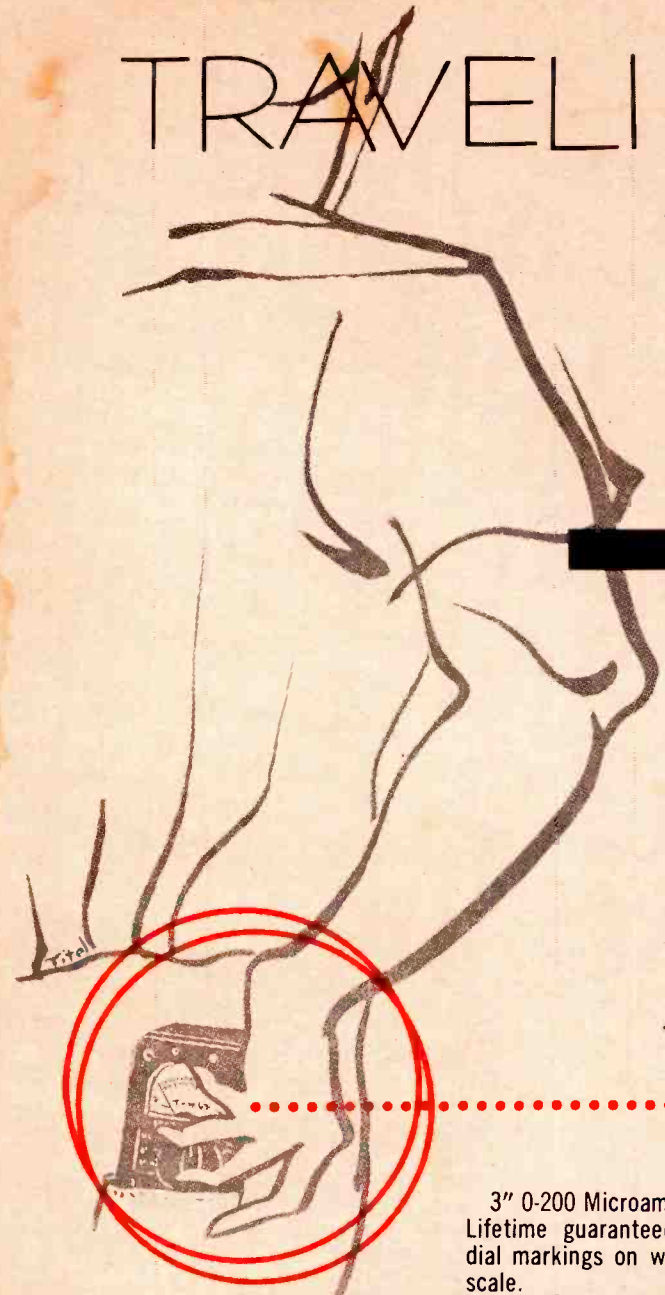
DEPT. 7RN5 111 LIBERTY STREET NEW YORK 6, N. Y., U. S. A.

PRINTED IN U.S.A.

TRAVELING LIGHT

BUT WITH A COMPLETE pocket-sized LABORATORY

Burton browne advertising



ON HAND for his service needs in the Triplett Model 666R pocket size VOM

TRAVELING LIGHT, too, on expense

Model 666R is only $26.50 dealer net

Dim.: 3 1/16 x 5 7/8 x 2 9/16

Enclosed selector switch of molded construction keeps dirt out. Retains contact alignment permanently. A Triplett design representing the culmination of a quarter-century of switch making experience. Unit construction—All resistors, shunts, rectifier and batteries housed in a molded base integral with the switch. Eliminates chance for shorts. Direct connections. No cabling.

Precision film or wire-wound resistors, mounted in their own separate compartment—assures greater accuracy. Four connectors at top of case, controls, knobs and instrument are all flush mounted with the panel.

3" 0-200 Microammeter, RED • DOT Lifetime guaranteed. Red and black dial markings on white. Easy to read scale.

Precalibrated rectifier unit. Batteries—self-contained, snap-in types, easily replaced.

RANGES

D.C. VOLTS: 0-10-50-250-1000-5000, at 1000 Ohms/Volt.
A.C. VOLTS: 0-10-50-250-1000-5000, at 1000 Ohms/Volt.
D.C. MA: 0-10-100, at 250 M.V.
D.C. AMP.: 0-1, at 250 M.V.
OHMS: 0-3000-300,000 (20-2000 center scale).
MEGOHMS: 0-3 (20,000 Ohms center scale).
(Compensated Ohmmeter circuit.)

Also available—Model 666-HH Pocket V O M, Dealer Net $24.50.

TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT CO.
Bluffton, Ohio

HUM HUSHING DESIGN

makes Mallory's "25th Anniversary" model the quietest vibrator ever

TAKE a look inside the Mallory 25th Anniversary Vibrator*—and you'll see why it's so free of mechanical hum. The vibrator mechanism "floats" in a bell-shaped rubber liner. Noise produced by the vibrating element just doesn't have a chance of getting to the case or mounting plug.

That's not all. The rubber cup at the plug end also "floats" in place . . . never touches the can at more than one point. Even the leads are designed to minimize transmitted noise.

The net result is the quietest-running vibrator you've ever seen . . . or heard. Its mechanical hum is actually less than the electrical noise emitted by the speakers of most auto radio sets. And it costs no more than previous Mallory models.

On every vibrator replacement job, treat your customers to the quietest performance on the market. Check your stock today . . . and call your local Mallory distributor for quick delivery.

*Pat. Pending

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