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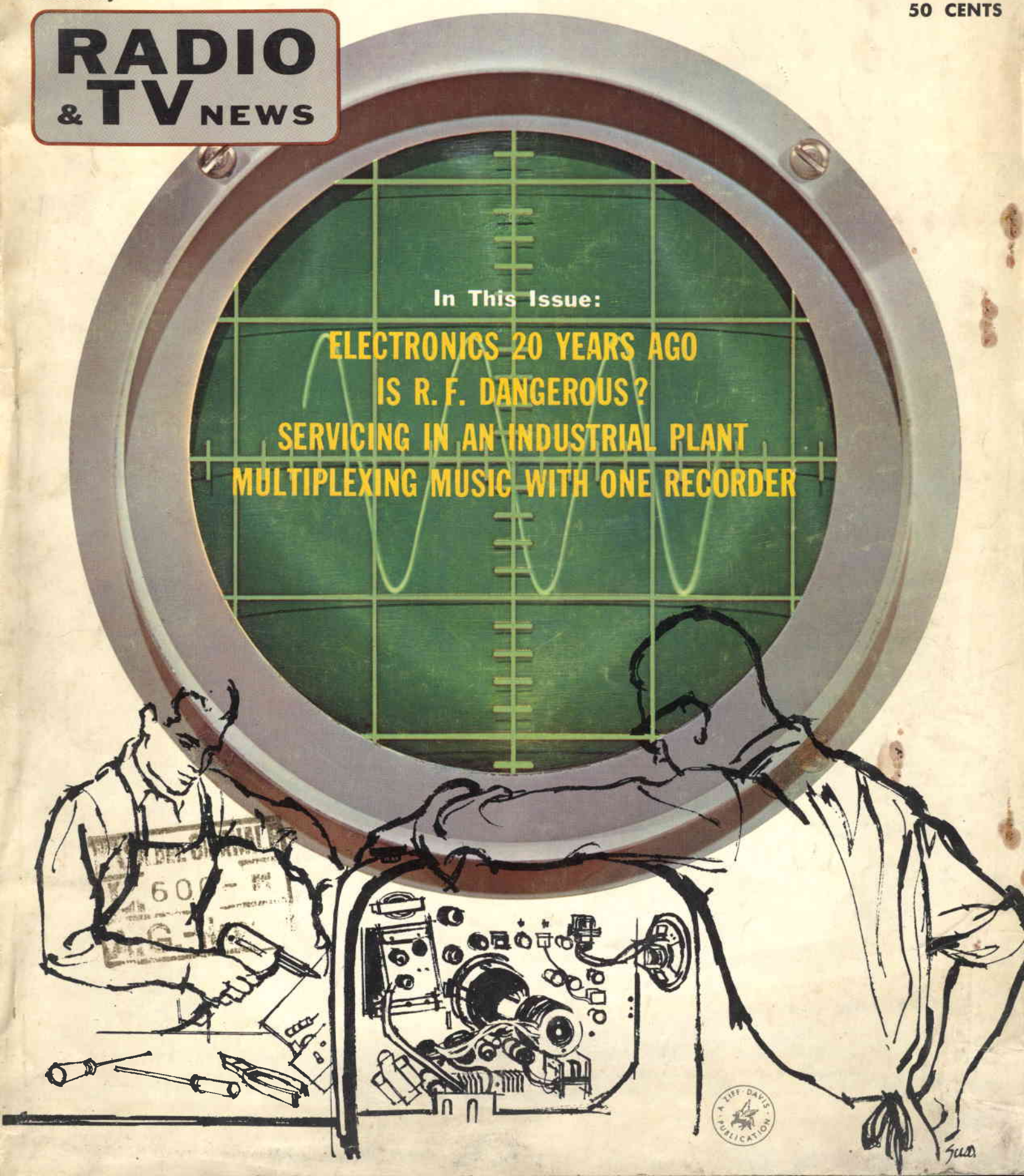

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ELECTRONICS 20 YEARS AGO

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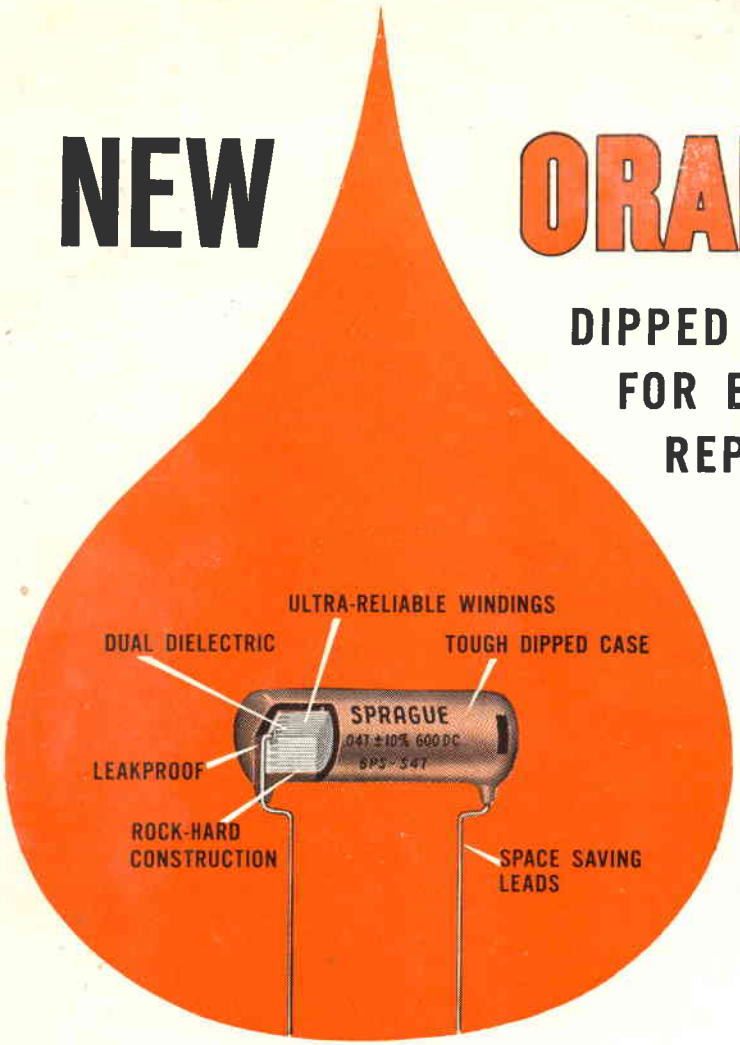

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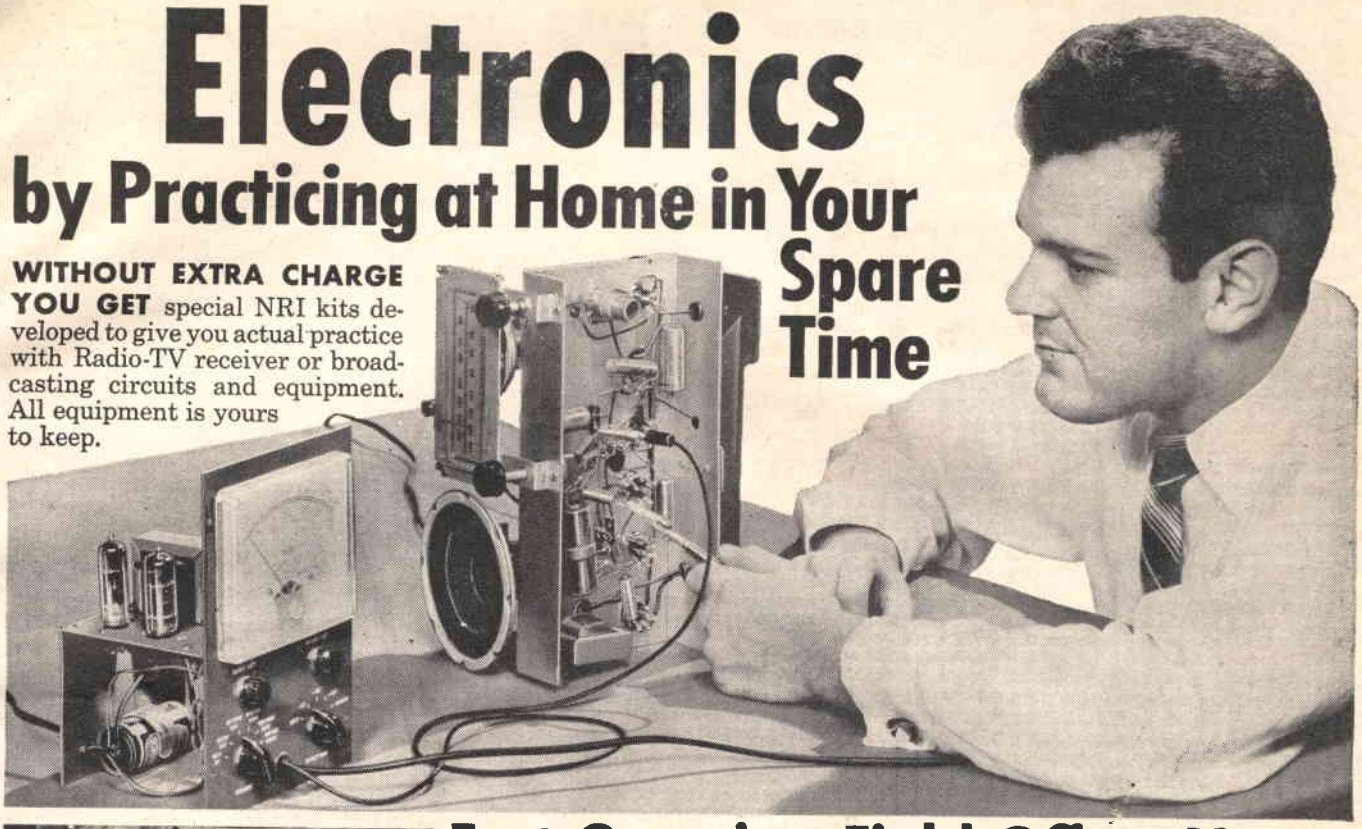

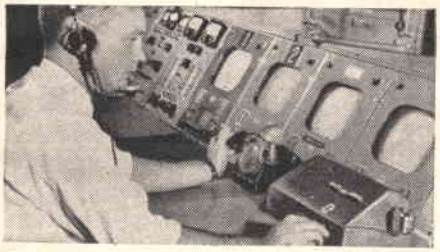

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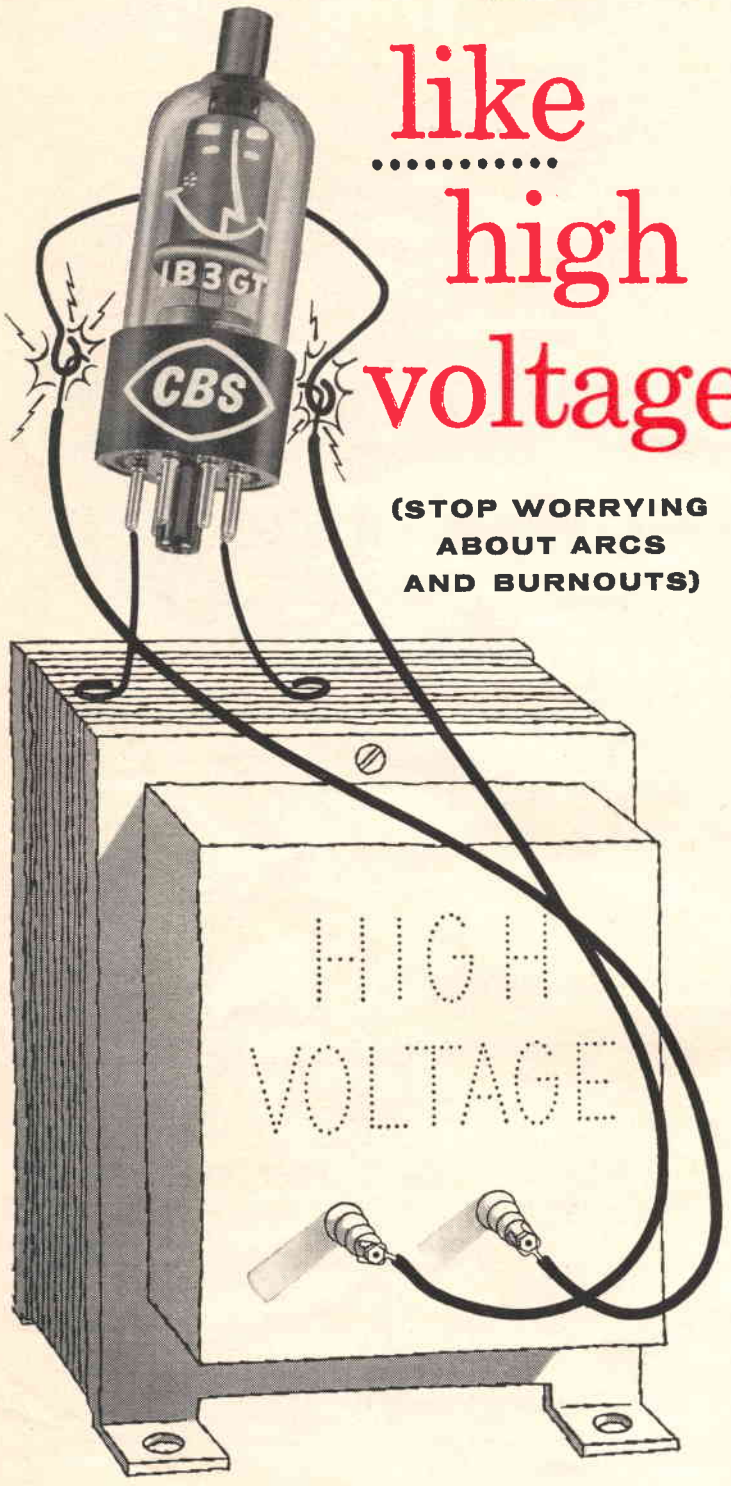

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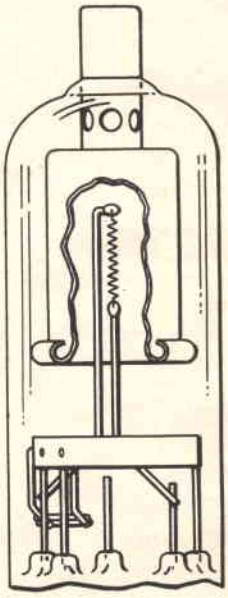

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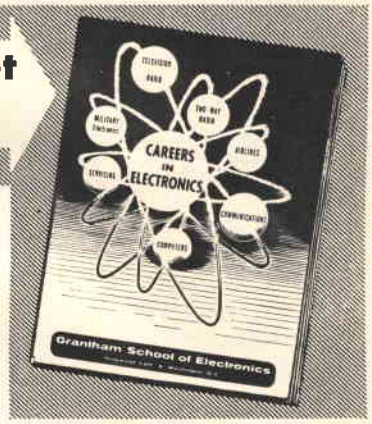

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By **W. A. STOCKLIN**
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WHICH WAY FOR SERVICE?

IS there any future for the independent service industry?

We remember one day in the late forties when we rode along with the owner of a recently launched service shop in his truck as he made his rounds. He stopped at the larger, established shop of an acquaintance in another part of town to pick up a particular TV model one of his customers wanted to buy. Our friend didn't happen to have that model in his meager stock.

Our friend, whose service work was in radio only until the year before, had recently completed a course in TV service. As a result, he took a gentle ribbing from the owner of the larger shop who knew better than to get tangled up with TV work. He was selling TV sets, and he would go on servicing radios as well as selling them, but that should keep him going, as it always had. TV was a novelty, but radio would continue to be bread and butter. Besides, the set makers would never let the independents get a decent toehold. He would farm out his TV service to any fool who would take it. Our friend, ignoring the classification, immediately made a deal with his colleague for taking over the latter's TV service contracts.

The latter dealer closed his doors within two years. Our friend's business has gone through many changes, but still does well. At one point, he gave up set sales entirely in favor of service, saying, "You can get a set from the discount boys today at less than my dealer cost." For a while, he took over service work on all types of electrical appliances for a local department store. He has also diversified with hi-fi sales, service and installation and other items.

Shop size and personnel has been another area for experimentation. He began with one helper, went up to a five-man staff at one time, and finally settled on two top-notch benchmen in addition to himself as the optimum arrangement—for his particular shop. He does some color work and is ready to go if color breaks through. He hasn't figured out exactly what the future will bring but he intends to "stay ready."

Today we hear much talk about big changes in the service business over the forthcoming decade. TV will lose its importance, some say. Or it will still be big but the sets "won't need service" any more. Or newer electronic consumer products will be the bread and butter of service. Or two-way mobile will become the big item. Or the future lies in some form of industrial service. Or it lies in diversification: "Work on everything."

But some of these statements are contradictory. And a leading maker of two-way mobile gear, who depends on independents for service, does not think a diversified operation can work out. His experience shows that, while TV work in a two-way shop may be all right early in a transition, two-way service must eventually become the sole business of the shop. As for industrial service, most of this is being handled by the manufacturer-installer of the equipment or by special crews employed by the plants where the equipment is used. At present, few independents can get a foot in the door —yet the situation could change.

In the face of this uncertainty, what can be done by an independent who is not content simply to drift along? He cannot sit back, but he cannot risk plunging forward, a victim of panic, in the wrong direction. He should indeed "stay ready." He must be aware of every possibility and technically prepared to adapt to each. In lieu of plunging in panic, he can experiment cautiously and calmly, as our successful friend has done over the years. If he stays ready, he will have time to act. And his own best solution need not be the same as every other man's.

Prophets of doom have forecast the collapse of the service industry many times during the past decade, but it continues to grow, and the alert people in it are still around to give the lie to the experts. For those who keep an unflagging eye on what is happening and keep sufficiently well informed to change with change, there will be more, not fewer, areas in this growing field where their expert, technical knowledge will be needed.

Ten years from today, many of those who are now in service will indeed have been pushed out. But some will still be around, and doing well, who were operating ten years ago. —30—

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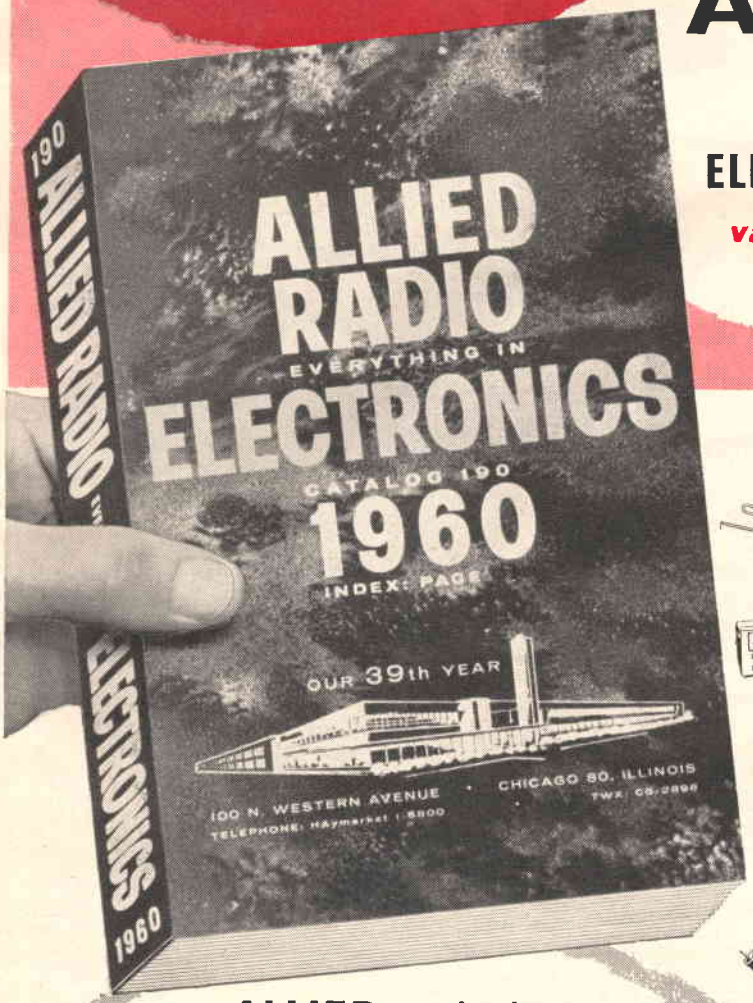

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We are constantly seeking improved products to recommend and sell to our customers, and we are pleased to inform you that Westinghouse receiving tubes and picture tubes fall into that category.

We changed over exclusively to Westinghouse tubes approximately January 1st, of this year. Since it was a new product to us, we kept complete records of tube failures and customer call backs. Our call backs due directly to tube failures were reduced by over 50 per cent.

It is with complete confidence that we recommend and sell your quality Gold Star picture tubes. The picture quality is excellent, and the tubes are exceeding our greatest expectations. In the past nine months, we have used approximately 500 picture tubes, and as of now have only replaced three. Two of which were defective out of the carton, and only one failed in actual use. In fact, we are so confident in the life of the picture tube, that we are now guaranteeing our picture tube replacements for three years.

We have gained two things by the use of your tubes. Greater customer satisfaction, and more net dollars for us due to the very minimum amount of tube failures.

Please thank your Engineers and Quality Control Department for the fine product that they are putting in our hands to sell to the consumers.

Sincerely yours,

ACE RADIO & TV SERVICE

Philip Blank

Philip Blank

PB:jd

"call backs reduced by over 50%!"

"It is with complete confidence that we recommend and sell your quality Gold Star picture tubes."

"We are so confident in the life of the picture tube that we are now guaranteeing our picture tube replacements for three years."

"We have gained...greater customer satisfaction, and more net dollars for us due to the very minimum amount of tube failures."

We can't think of a thing to add. Except, perhaps, that your local Westinghouse electronic tube distributor will be happy to introduce you to the line. If your distributor doesn't carry them yet, give us his name. We'll send someone over to enlighten the poor fellow.

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

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PREVENTING METER DAMAGE

To the Editors:

Mr. Wendt's letter in your January issue seeks further help in preventing meter damage from electrical overloads. Why not use an ordinary 1 ma. glass cartridge fuse.

These are the most dependable and inexpensive means of preventing meter damage without disturbing the calibration accuracy on all ranges that we know of, and the minor annoyance of having to replace the fuse each time it is blown is actually a desirable feature since it encourages greater care in the use of meters by the student who might otherwise become careless in practice with disastrous results when he later uses meters not equipped with protectors.

CHARLES C. LITTELL, JR.
Engineering Associates
Dayton, Ohio

It frequently happens that a simple solution is a very good one.—Editors.

* * *

MORE ON PHONE PATCHES

To the Editors:

Mr. C. D. Ehinger's article "Let's Legalize Ham Phone Patches" (Dec. issue) was of great interest to me. I would like to take issue on the discussion of so-called "foreign equipment" on private telephone lines.

Some years ago—the exact date is not known to me—the Federal Communications Commission, in Docket 9189, issued a decision and order to the *American Telephone & Telegraph Company* et al, defendants, quoted in part as follows.

"The defendants shall rescind and cancel any tariff regulations to the extent that they prohibit customer from using, in connection with interstate or foreign telephone services, any device which does not injure defendants' employees, facilities, the public in its use of defendants' services, or impair the operation of the telephone system."

Now I realize that the preceding paragraph is not a license for connecting any and every type of device, including Junior's electric train transformer, across the company's lines. However, I do maintain that properly designed telephone patches, such as are offered for sale by a number of manufacturers, are suitable for attachment to a telephone line and can be connected without fear of any reprisal from the telephone company. Perusal of directories from a number of the major cities in the United States indicates that the aforementioned order has been followed by most of the telephone companies. In other words, the prohibitive paragraph referred to in Mr. Ehinger's article is not in evidence at the front of these directories.

In conclusion, Mr. Ehinger should be aware of the various methods employed by radio and television stations throughout the country to utilize the telephone as an integral part of their broadcast facilities. As technical director for a chain of AM broadcast stations, I have been called upon time and again to make such connections between studio equipment and telephone circuits. One of our stations suffered loss of telephone service because it insisted on broadcasting telephone interviews after having been informed that to do so was in violation of the telephone company's tariff regulations. A court order, at our request, brought swift action from the telephone company with subsequent restoration of telephone service within a matter of a few hours.

ROBERT F. TILTON, WØAGP
Director of Engineering
Storz Broadcasting Co.
Omaha, Nebraska

To the Editors:

I concur with all of C. D. Ehinger's proposals except #6, "That the amateur pay a nominal, monthly fee for the service that would be provided."

The word *nominal* scares me—not the thought of paying extra. The service that would be provided, approving the phone patch, would be in the best interests of the phone company and should be free. The precedent it would set is what bothers me. The amateur is permitted by FCC rules to patch phone calls. If he has to pay the telephone company a nominal sum, he is paying for a right, not a privilege. Let me expand on this. Some states have laws prohibiting the installation or use of short-wave receivers in private automobiles. Hams who operate "mobile" in these states are breaking the law. Should a ham pay a nominal, extra fee for his auto license in these states if he wishes to operate mobile? (My private opinion is that no such state law can change FCC rules hence could not be enforced against a licensed amateur, but that is not pertinent to this issue.)

Broadcast stations and wire services are profit-making businesses. Hams are not. Requiring an amateur to pay more than the price of an extension or main phone as the case might be could easily pave the way for power companies to charge more for furnishing electricity and local municipal fees for having a "licensed" electrician approve an antenna installation, etc. States, cities, and businesses have no right to require

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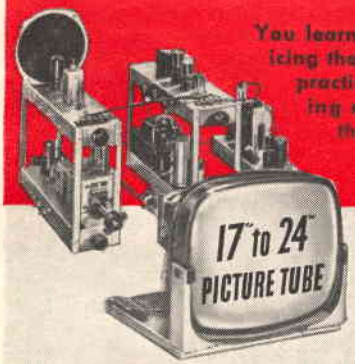

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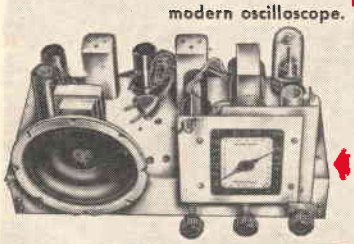

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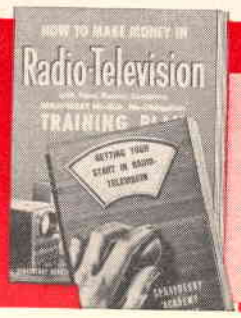

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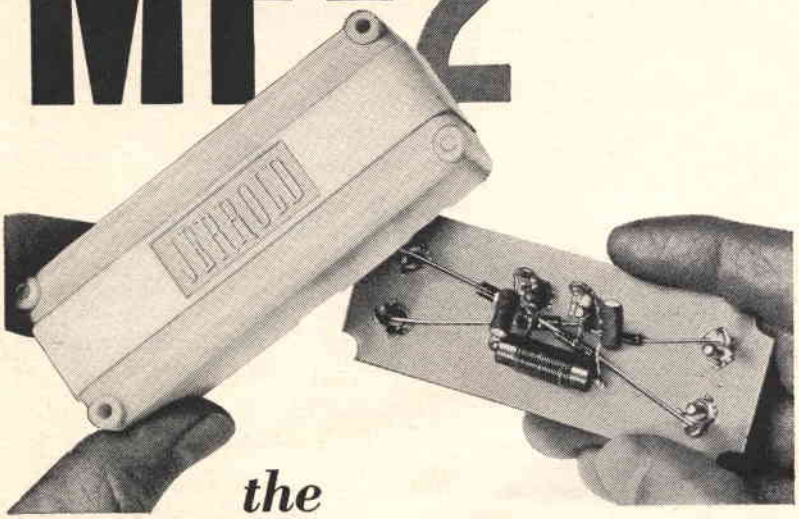

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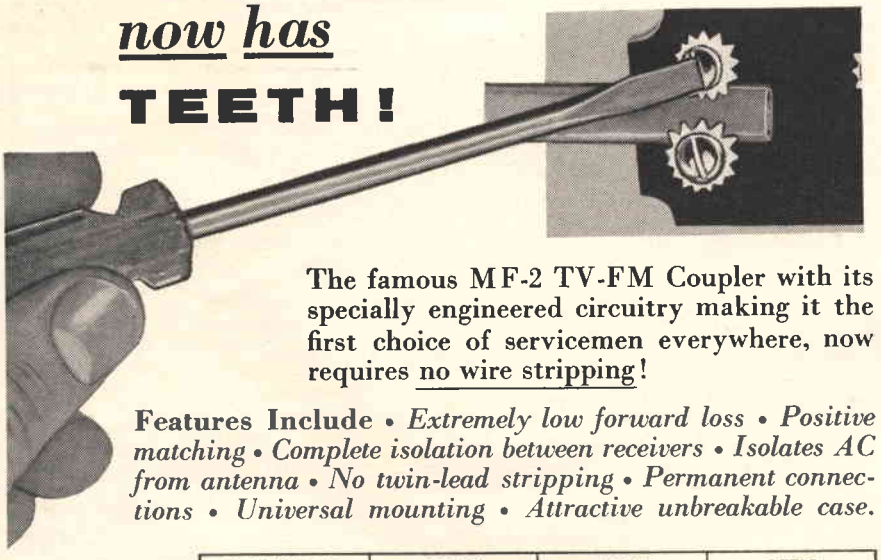

The famous MF-2 TV-FM Coupler with its specially engineered circuitry making it the first choice of servicemen everywhere, now requires no wire stripping!

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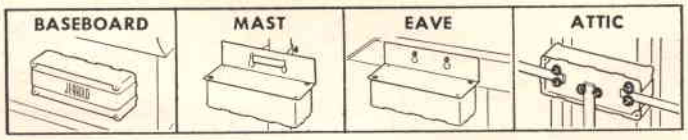

Two additional models available — the M-2 (recommended for UHF). The MF-4 (for 3 or 4 TV-FM sets fed from single antenna).

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nominal fees of amateurs before an amateur may operate as his license is issued by a Federal agency. Let's keep it that way.

LT. THOMAS F. VAN NATTA, JR.
KL7CXE
Ft. Monmouth, New Jersey

Letters are still coming in commenting on Mr. Ehinger's forthright proposals on legalizing the phone patch.—Editors.

* * *

CB CALLING FREQUENCY

To the Editors:

Your proposal to make CB Channels 13 and 15 available to marine operators and for emergency purposes (February "For the Record" editorial) receives high commendation from us. It seems so obvious that Citizens Radio could be inexpensively used for safety purposes aboard pleasure craft that it is a wonder that the FCC had not contemplated this. You can definitely add *Allied Radio* to your list of participants in your proposal. Crystals for Channels 13 and 15 will be supplied on customer requests only.

L. M. DEZETTEL
Knight-Kit Marketing Div.
Allied Radio Corp.
Chicago, Illinois

To the Editors:

Due to the fact that the number of radio channels available to the general public is so limited, we feel the manufacturers of this type of equipment should join hands to assist the potential users of the Citizens Band frequencies.

The market for this type of equipment can become very large, and it is our belief that the FCC would welcome any effort on the part of the manufacturers of said equipment to coordinate the use of this equipment to the best advantage of those who have great need of same, which takes in far more than just the marine services. Good Citizens Band equipment will have a great demand also in industry, and in benefiting the public, we will also help ourselves.

PERRY E. WIGHTMAN
Wightman Electronic Engineering Co.
Easton, Maryland

To the Editors:

Congratulations on taking a constructive stand in your February editorial. We have just had a rather long session with other CB manufacturers on the very same subject, and I can assure you there is considerable interest here in the Midwest, and there undoubtedly will be a great appreciation of your efforts.

JAMES M. PRICE
General Sales Manager
RME Division
Electro-Voice, Inc.
Washington, Illinois

We have been receiving many favorable comments on our February editorial stand. For further details giving

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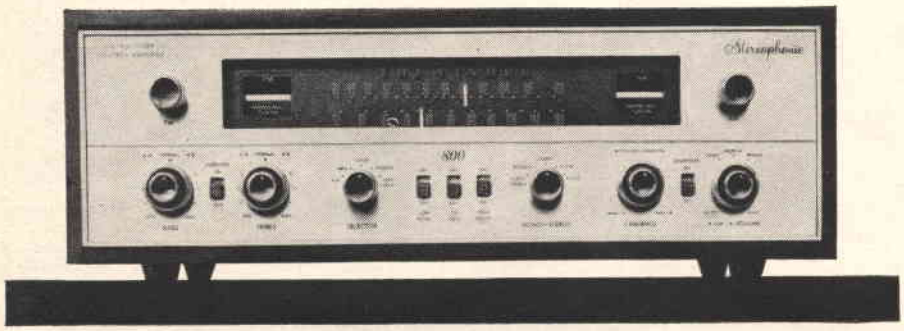

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specific recommendations of a meeting held during the recent New York Motor Boat Show concerning Citizens Band operation by marine interests, see our note in the March "For the Record" editorial. Briefly, it has been proposed that Channels 9 and 13 be set aside on a voluntary basis for marine use.—Editors.

* * *

"RUSH SUPPRESSOR" RELAY

To the Editors:

In regard to the "rush suppressor" circuit for the *Heath* CB-1 in your January, 1960 issue ("A Rush Suppressor for Citizens Radio"), please be advised that we are having a great deal of trouble locating the relay, and we were wondering if it would be possible to find out from the designer of this circuit, Mr. James D. Green, where we can purchase the relay and at what price it is available.

ROBERT C. SHEARER
Montoursville, Pennsylvania

Author Green employed a surplus unit with a coil resistance of 2200 ohms and an energizing current of 1 ma. The exact specifications of this relay are not too critical just as long as it will close on normal received signals.

Such relays may be available from surplus sources specializing in relays, such as Herbach and Rademan, Inc., *1204 Arch Street, Philadelphia 7, Pennsylvania, and other surplus dealers who advertise in our pages. These dealers usually have pretty good supplies of this type of relay on hand. Such relays usually sell for approximately $2.00 to $4.00.*

For those of our readers who are having difficulty locating a suitable surplus relay, we recommend the use of a Sigma *5F-1000-S SIL, which is rated at 1000 ohms and 2.3 ma. This relay sells new for around $8.00.—Editors.*

* * *

FAA TECHNICIANS

To the Editors:

I have just finished reading Mr. Niland's article "Air Traffic Control by Electronics" in your January issue, and I must say that I was very surprised to see no mention made of the FAA electronic maintenance technicians. These men must intelligently interpret the engineering drawings of the wiring and constantly maintain all the equipment operating properly. The usability of all the electronic systems described is left up to the technician who is alone responsible for proper operation of the gear.

CHARLES H. ASHENFELTER
Electronic Maintenance Technician
Federal Aviation Agency
Tulsa, Oklahoma

Certainly no attempt was made to take away any well deserved credit from the electronic technicians who maintain the equipment described. The article was a general one, however, and we attempted to give the over-all picture first.—Editors. —30—

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FRANCIS J. MCMANUS
Davenport, Iowa

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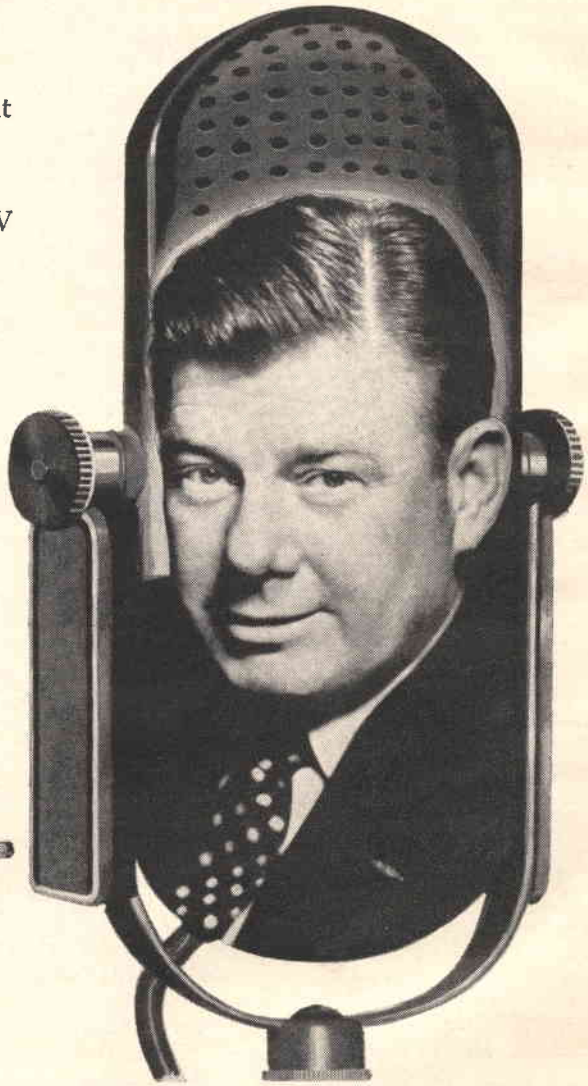

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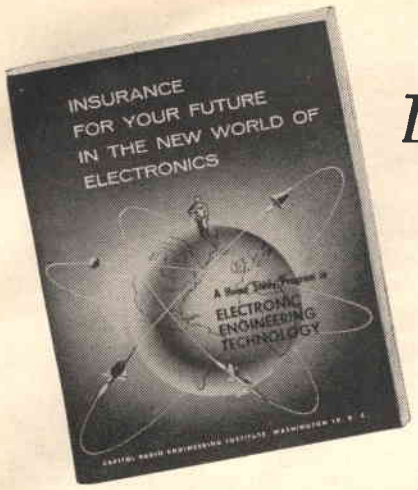

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City..... Zone..... State.....

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Other.....

Electronics Experience.....

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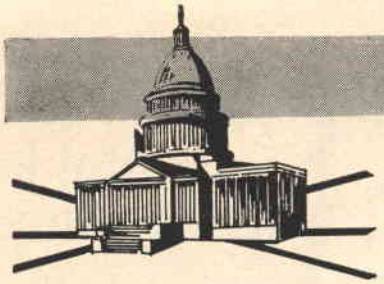

Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON EDITOR

REVOLUTIONARY MOON-RELAY COMMUNICATIONS SYSTEM UNVEILED BY NAVY—A spectacular communications network, which utilizes the moon as a passive reflector or relay of radio signals, was demonstrated recently at the U.S. Naval radio station, Cheltenham, Maryland. Messages were bounced, via the moon, in 2½ seconds, over a 480,000-mile path between Washington, D.C. and Pearl Harbor. Called the least expensive satellite known to man, the possibilities of moon relaying have been under study by the Navy since 1951. Capabilities of the new system, which cost over $5-million to develop, now include 4-channel teletypewriter and facsimile equipment operating on 438-455 mc. Experimental work is also being conducted on voice, but at a lower priority. Operation of the moon net is limited to that period when the moon is simultaneously visible at both terminals, ranging from a few hours up to a maximum of about 12 hours, depending on the orbital position of the moon in relation to the earth. Operating schedules are established by determining the time of moonrise at the westward terminal and moonset at the eastern terminal. Eventually, the moon-relay principle may be adapted to transmitting and receiving messages from ships at sea or to man-made satellites. Washington and Pearl Harbor terminals both utilize separate sending and receiving facilities, each employing equatorially mounted, fully steerable, high-gain dish-type antennas, 84 feet in diameter. The transmitting antennas are coupled to 100,000-watt transmitters, producing an effective radiated power of more than 400,000,000 watts.

GROWING SWING TO UHF-TV SEEN—It now appears as if Washington is reconciled to the fact that TV will have to move upstairs to get more air space. Commenting on this prospect, FCC Commissioner Frederick Ford told the Senate Interstate Commerce Committee that the chances of getting more v.h.f. space from the military are slim and that, accordingly, the ultra-highs seem to be the only solution. Industry has also indicated that such a move is in the offing and preparations for a palatable transition should be made as soon as possible.

INTERIM SHORTER-SPACED TV ASSIGNMENTS SUGGESTED—The Commission is now reviewing criteria and requirements for shorter co-channel separations. Under the proposals, the FCC said it would consider short-spaced v.h.f. assignments in a limited number of important TV markets. Selection of market area would be predicated on whether the need for additional service outweighs the need for any service lost as a result of interference to existing stations. Additionally, the Commission is considering a reduction of minimum adjacent channel separations from 60 to 40 miles.

MULTI-MILLION-DOLLAR AIR-TRAFFIC CONTROL FACILITY PROGRAM SET—Over $100-million has been set aside for the installation of air electronic navigation and air-traffic control systems, the Federal Aviation Agency has reported. Eight long-range radars, at an average cost of over $2-million are involved in the program. A total of 16 long-range radars will be fitted with scan-conversion equipment to provide a better display of radar information through the use of television tubes which permit viewing in a brightly lighted room. In line with the continued emphasis on radar, 24 long-range radars will be equipped with radar beacon systems. (Ground radar beacons transmit signals that trigger equipment in beacon-equipped aircraft. The airborne equipment then returns intensified coded signals to the radar scope, thus providing controllers with positive identification of beacon-equipped aircraft.) The program also calls for installation of terminal-type TVOR (very-high-frequency unidirectional radio range) at 18 locations. This type of equipment is used as an approach aid to airports while the standard type VOR's are used for en-route navigation.

NAVY FINDS V.H.F. TRANSMISSION NOW POSSIBLE OVER ATMOSPHERIC DUCT—There's an elevated transoceanic atmospheric duct, capable of trapping and propagating radio waves at low loss over considerable distance, the Navy has discovered. The duct was found to have a thickness of approximately 500 feet, centered at a height of some 5000 feet, extending from West Africa to the coast of Brazil. Equipment operating at 220 mc. was used during tests to measure signal characteristics as a function of both distance and elevation heights, varying from sea level up through the elevated duct. With a power of only 100 watts, signals were detected all the way from Brazil to a point 1430 miles away.

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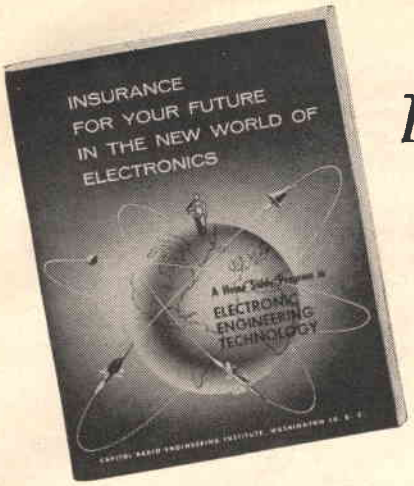

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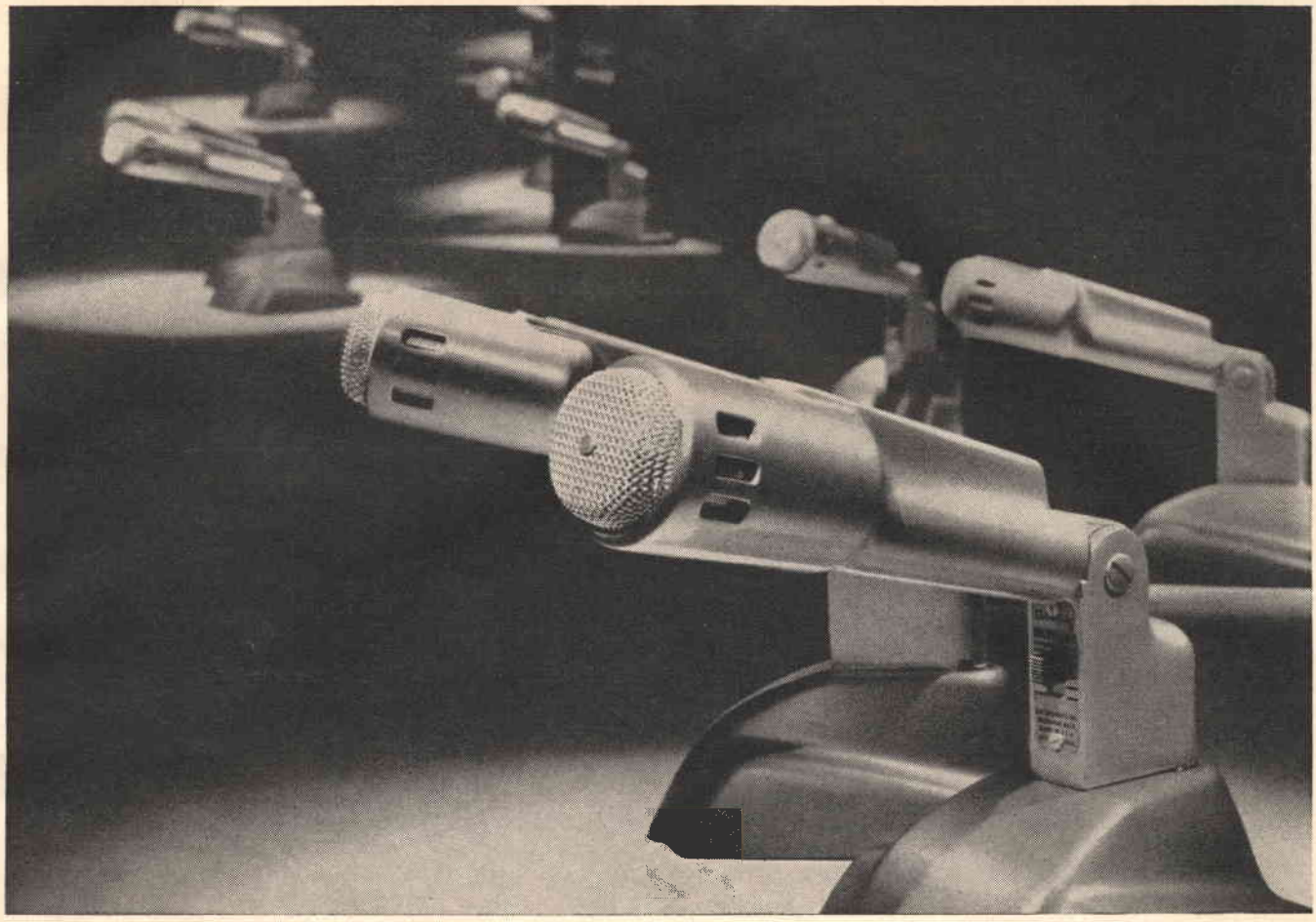

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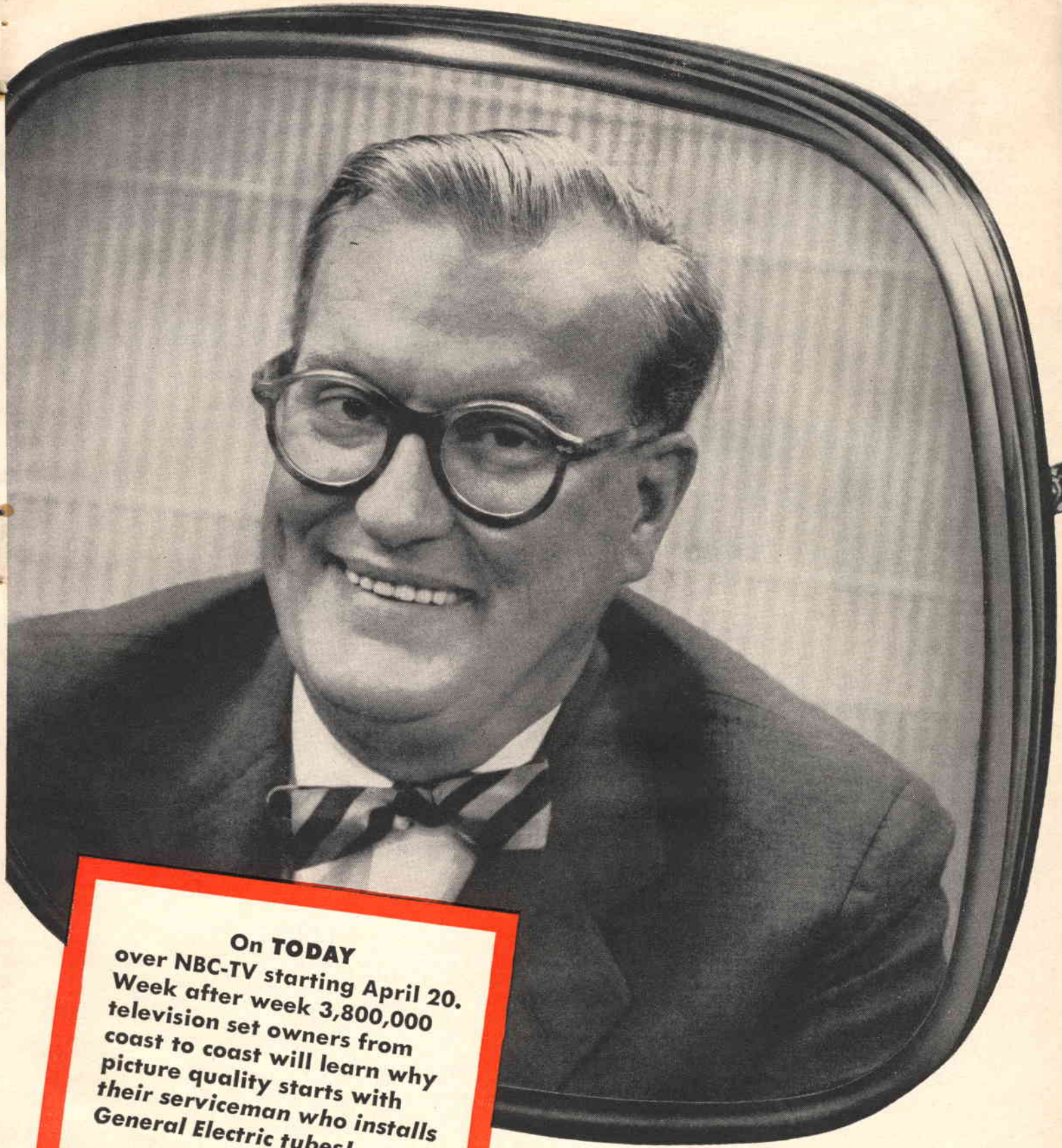
Install the PROFIT PAIR BLACK-DAYLITE SERVICE-DESIGNED **that millions**



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Within the Industry

JAMES D. McLEAN has joined *General Dynamics Corporation* as president of its *Stromberg-Carlson Division* and senior vice-president of the parent company.



Formerly president of the *Hoffman Laboratories Division* of *Hoffman Electronics Corporation* in Los Angeles, Mr. McLean succeeds Robert C. Tait, president of the subsidiary since 1949. Mr. Tait, a senior vice-president of *General Dynamics* will now be associated with the corporate office and assume new corporate-wide responsibilities.

Mr. McLean is a graduate of MIT and holds a BS and MS in electrical engineering. Prior to his association with *Hoffman*, he was with *Philco Corporation* and *General Electric Company*.

* * *

DR. EDGAR A. SACK, JR. has been chosen the "Outstanding Young Electrical Engineer" for 1959 by Eta Kappa Nu Association.

He is manager of the dielectric devices section of *Westinghouse Research Laboratories* and heads a team which has been concentrating on special applications of electroluminescence. Dr. Sack graduated from Carnegie Institute of Technology and later received his master's and doctor's degrees from the same institution.

Established in 1936 by Eta Kappa Nu, the award Dr. Sack will receive recognizes young electrical engineers for "meritorious service in the interest of their fellow men." In making their selection, the award jury considers a broad range of qualifications including professional achievement and what the young engineer has accomplished in civic and social leadership.

* * *

DONALD P. ROHRBACH has been appointed manager of marketing research for *Shure Brothers, Inc.* . . . **SEYMOUR FISHBEIN** is the new general sales manager for *Transistor Specialties, Inc.* He will assume the marketing functions previously directed by **DANIEL J. MIDHEIM**, president of the firm . . . **H. THOMAS HOLLOWELL, JR.**, president of *Standard Pressed Steel Corporation*, has been elected to the board of directors of *International Resistance Company* . . . **J. ALBERT BERTOLACCI** has been promoted to the post of treasurer of *Cornell-Dubilier Electric Corporation*. He has been with the capacitor firm since 1941 . . . *Weller Electric Corporation* of Easton, Pa. has appointed **LOUIS W. WHITE** to the post of eastern regional sales manager with headquarters in Easton . . . The directors of *Alpha Metals, Inc.* have elected **HAROLD HERTZOG** president of the firm. He was formerly vice-president of the company and has been with the organization since 1945 . . . **C. ROBERT PAULSON** has been named manager of the Professional Audio Products Division of *Ampex Professional Products Company*, replacing **FRANK G. LENNERT** who will remain with the company in an advisory capacity on audio matters . . . **MYRON S. FRIEDMAN** has been promoted to the post of marketing manager, components division, and vice-president of *Radio Shack Corp.*, Boston electronics parts distributor . . . **WILLIAM S. HEPNER, JR.**, former Commerce Department information specialist and Washington area newspaperman, has been named manager of the Office of Information of the Electronic Industries Association. He succeeds **HERBERT F. HODGE, JR.** who resigned last November after seven years with the Association . . . **CLIFFORD H. LANE** is the new manager of the Industrial Semiconductor Products Department, *RCA* Semiconductor and Materials Division . . . **HAROLD B. McKAY**, well-known author and frequent contributor to this publication, died recently at his home in San Francisco at the age of 53. His death was attributed to a heart ailment. He had been associated with *Pacific Telephone & Telegraph Co.* for almost thirty years.

* * *

JUSTIN J. McCARTHY has been appointed manager of private-brand renewal sales for *Sylvania Electronic Tubes*, succeeding Louis A. Wheelock who is retiring after more than 28 years with the company.



Prior to assuming his new post, Mr. McCarthy was metropolitan district sales manager, renewal sales, for the division. He will move his headquarters from Teterboro, N. J. to the company's sales office at 1740 Broadway in New York. He will be responsible for sales of receiving tubes and cathode-ray tubes to the company's private brand renewal customers throughout the country.

* * *

GENERAL TELEPHONE & ELECTRONICS LABORATORIES INCORPORATED has completed arrangements to buy land in the Palo Alto, California area as a site for future research facilities for the division and its parent company . . .



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SERVICE...

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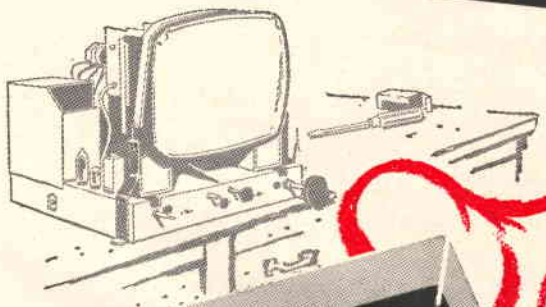

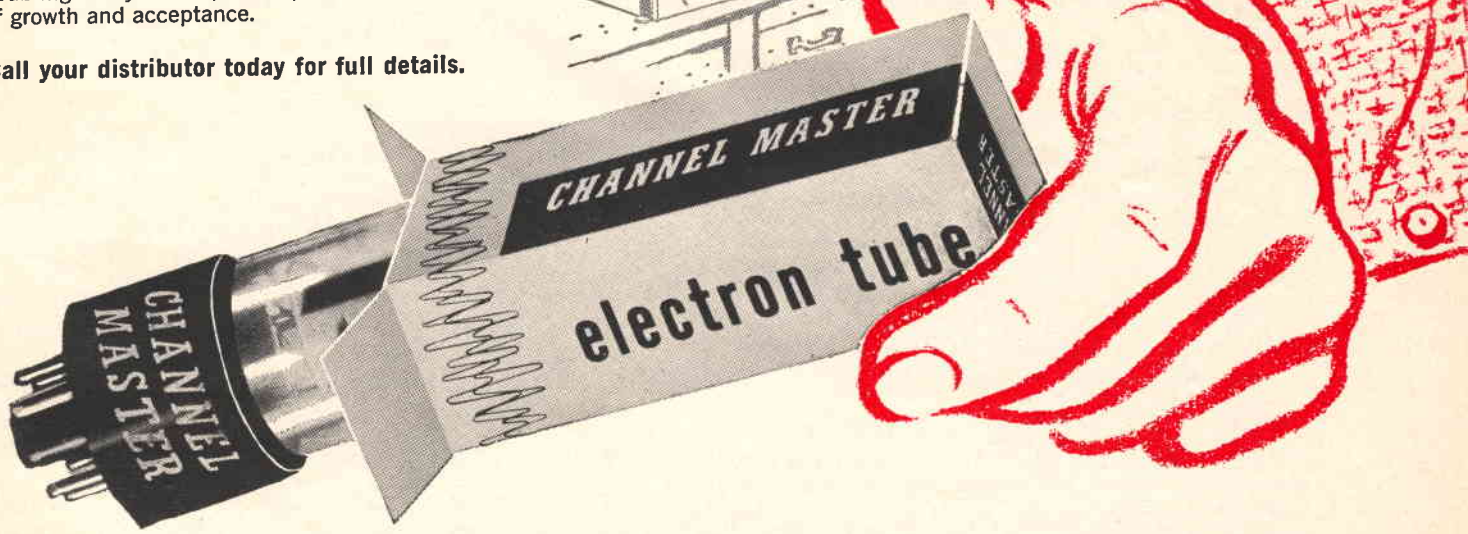

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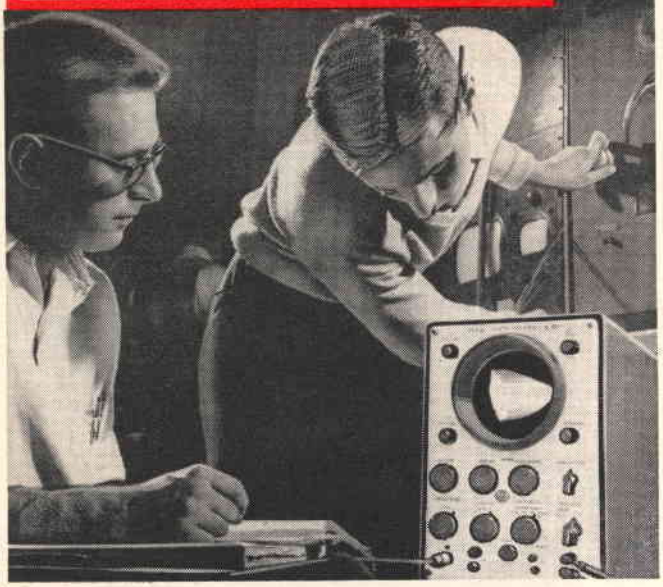

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CANNON ELECTRIC COMPANY of Los Angeles has opened a new factory in Phoenix, Arizona which will be known as the Phoenix Division. The new plant combines all engineering, manufacturing, and testing facilities for three of the company's specialized plug assemblies . . . **RADIO CORPORATION OF AMERICA** has dedicated its new Surface Communications System Laboratory near Tucson, Arizona. The new facility provides modern scientific quarters for military electronic development work . . . **AIRBORNE INSTRUMENTS LABORATORY** has completed its move to new quarters and is officially located at Deer Park, Long Island, New York . . . **THE TRIAD TRANSFORMER CORPORATION,** a division of *Litton Industries,* is breaking ground in Venice, California for a 4000 square foot building to house its growing jobber sales offices. Other additions of approximately 6000 square feet are being built and total new building area will exceed the 10,000 square foot mark.

* * *

RENE SNEPVANGERS has been appointed director of engineering for both the Consumer Product Division and the Professional Product Division of *Fairchild Recording Equipment Corp.*



He received his technical and electrical engineering education in Belgium and was research and development engineer in receivers and loudspeakers for *Bell Telephone Manufacturing Company* of Belgium. He was also associated with *Tungsram Electrical Works* in Budapest.

Mr. Snepvangers joined *Fairchild* in 1959 after having been associated with *CBS Laboratories* since 1944. Prior to that he was connected with the *RCA Research Labs* as a project engineer. Since joining *Fairchild* he has been responsible for the company's SM-1 stereo cartridge and the SA-12 stereo arm. He holds over 15 patents, primarily in the pickup field.

* * *

DR. LAWRENCE W. VON TERSCH, head of the electrical engineering department at Michigan State University, has been elected president of the National Electronics Conference for 1960.

Serving with him at the Conference, to be held in Chicago October 10-12, are: Joseph J. Gershon of *DeVry Technical Institute,* executive vice-president; James H. Kogen, *GPE Controls, Inc.,* secretary; Dr. Harold E. Ellithorn, University of Notre Dame, treasurer; and Robert J. Parent, University of Wisconsin, assistant treasurer.

The 16th annual meeting, which will be held at the Hotel Sherman in Chicago, is expected to draw over 10,000 registrants.

* * *

T. A. M. CRAVEN, FCC Commissioner, has been named the recipient of the National Association of Broadcasters' second annual Engineering Achievement Award. The award will be presented on April 6th . . . The appointment of **ALFRED C. VIEBRANZ** to the newly created post of vice-president-marketing services has been announced by *Sylvania Electric Products Inc.* He joined the company in 1946 as a sales engineer in the electronics division . . . **MATTHEW L. DEVINE,** partner of *Cresap, McCormick & Paget,* has been elected president of *Amphenol-Borg Electronics Corporation* succeeding **ARTHUR J. SCHMITT,** who will continue as chief executive officer and chairman of the board . . . **FORREST E. BEHM** has been named manager of manufacturing for the Electrical Products Division of *Corning Glass Works.* He joined the firm in 1946 . . . *Telectrosonic Corporation* has named **ROBERT A. DONNER** to the post of sales manager. He joined the firm in January 1959 after serving as general sales manager of *American Audio Corp.* . . . Promotion of **PAUL W. CRAPUCHETTES** to the post of technical director has been announced by the Electron Tube Division of *Litton Industries.* He is also manager of the Magnetron Product Line . . . **ALBERT BRAUN, JR.** is the new manager for television sales for the *Kin-Tel Division* of *Cohu Electronics, Inc.,* San Diego, Calif. . . . **W. H. AT-**

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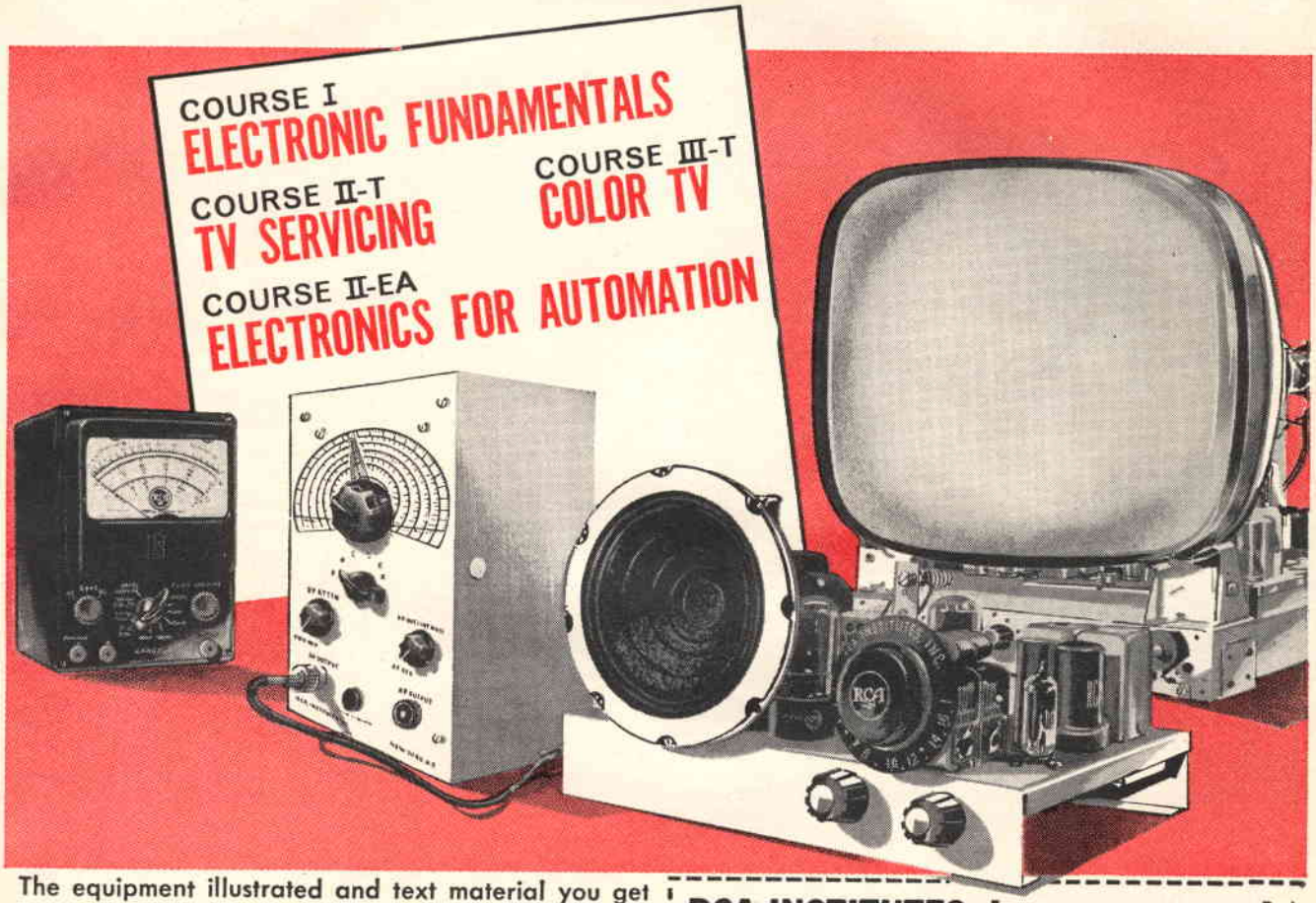

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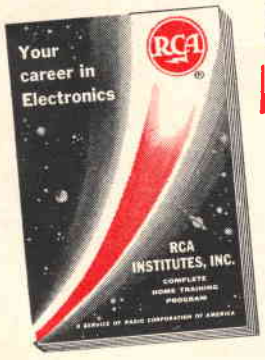

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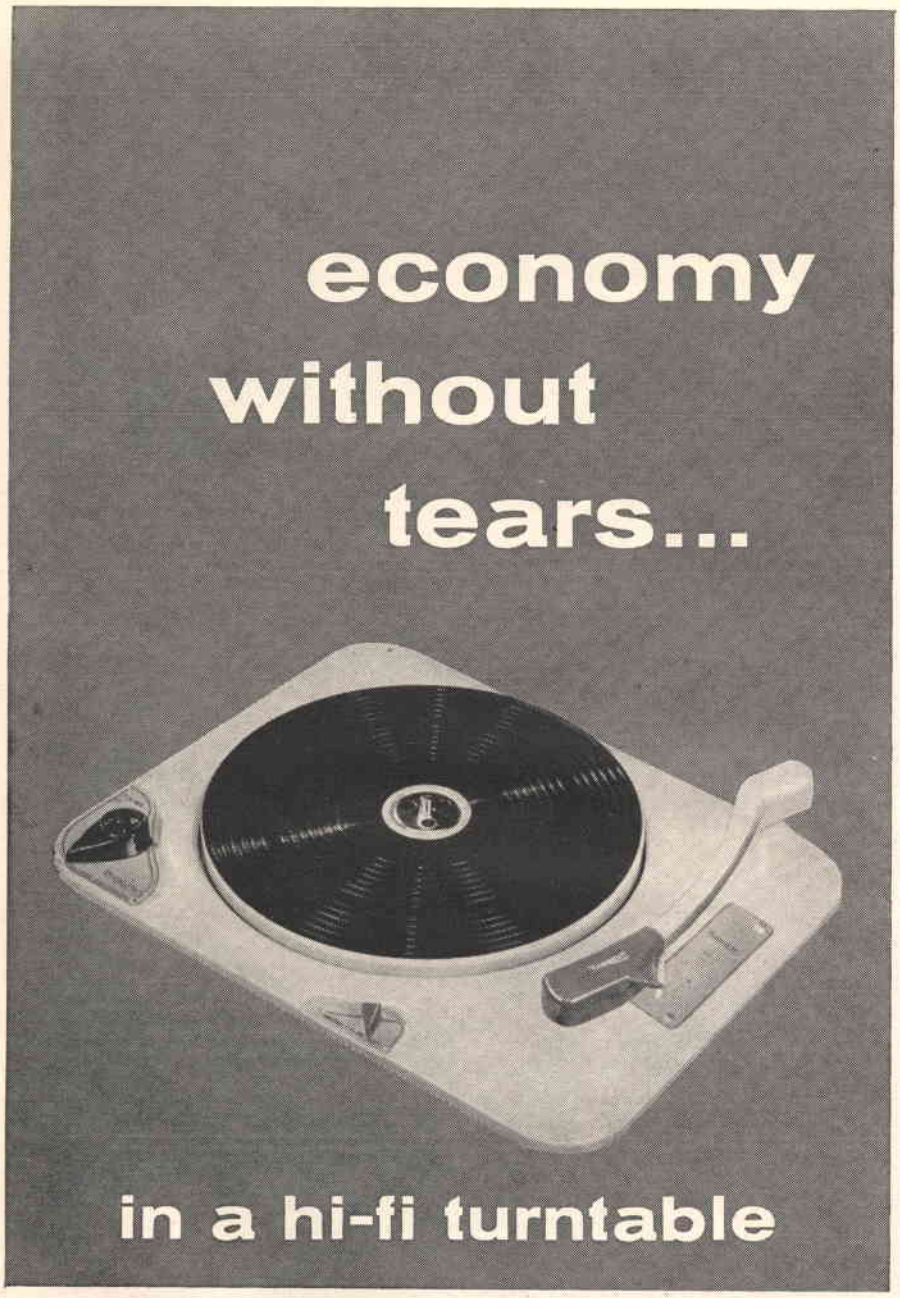

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It's the Thorens TD-134—*one* hi-fi bargain that's *really* a bargain.

Buy a Thorens TD-134, and you get the matchless Swiss-precision craftsmanship that make the superb Thorens TD-124 turntable the talk of hi-fi circles, here and abroad. Your dealer invites you to examine the mirror-finished, precision machining that contributes so much to the smooth-running, low-rumble characteristics of *all* TD-series turntables.

You save with an integral, built-in, high-performance tone-arm that has tracking ability and distortion characteristics to equal those of much more costly separate arms.

Last but not least, TD-134, like all the TD family of fine turntables, is backed by the Thorens one-year guarantee . . . a feature that gives you confidence in your decision to buy any Thorens turntable.

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KINSON has been named marketing manager of *International Rectifier Corporation* after holding a similar post with *Texas Instruments, Inc.* . . . **HOWARD M. WINTERSON** has been advanced to the newly established post of vice-president—general services of *Blaw-Knox Company.* He joined the firm in 1953 and was named a vice-president in 1956 . . . **V. T. PACKENHAM** has been appointed advertising manager for *Capitol Radio Engineering Institute.* His duties will include handling all national and local advertising, publicity, and other promotional activities.

* * *

RICHARD M. BRUMFIELD has been elected president of the National Association of Relay Manufacturers at its annual meeting held in Miami Beach. He is president of the *Potter & Brumfield Division* of *American Machine & Foundry Company.* He succeeds John Pheffer, president of *Struthers-Dunn, Inc.* in the post.



Other officers elected to NARM posts are: V. A. Hedlund, general manager of the *RBM Division* of *Essex Wire Corp.,* vice-president; R. P. McAlister, sales manager of *Leach Relay Company,* secretary; and H. B. Steinback, president of *Magnecraft Electric Company,* treasurer.

Co-founder of *Potter & Brumfield,* Mr. Brumfield has been active in the relay industry for the past 27 years.

* * *

ARNOLD SUTTA of *Emerson Radio & Phonograph Corporation* has been elected president of the "P.A.'s" for 1960. The group, which is made up purchasing agents of the radio, television, and electronics industry, also named Edward Kovacs of *Republic Electronic Industries Corporation* as vice-president; Abe Schneiderman of *Olympic Radio & Television Corp.,* treasurer; Jules Londoner, *Emerson Radio & Phonograph Corp.,* recording secretary; and Biagio Trimboli, *Telechrome Manufacturing Corp.,* corresponding sec'y.

The association's Tenth Anniversary celebration is scheduled for May 1st at the Copacabana in New York City.

* * *

HUGH B. WRIGHT has been appointed facilities engineer of the Construction and Engineering Division of *Jerrold Electronics Corporation* . . . The appointment of **MARIO A. DeMATTEO** to the post of general sales manager has been announced by *Pyramid Electric Company* . . . **JAMES S. GALBRAITH** has been elected vice-president of *Microwave Associates, Inc.* He is manager of the Semiconductor division of the company and is responsible for all semiconductor operations . . . **C. J. ANTOGNOLI** has been elected vice-president in charge of sales for *Standard Coil Products. Co., Inc.* of Chicago. He has been with the firm for ten years. —30—



Here is the new Standard Coil Tuner Replacement and Repair Program that enables you to offer better service to your customers at greater profit. Now Standard Coil Products provides the tools that will enable you to cash in on the profitable tuner repair and replacement market.

TUNER REPLACEMENT LISTING IN SAMS PHOTOFACT

Starting in January, Standard Coil tuner replacement listings will appear in all Sams TV Photofact. Tuner replacement information will be right at your finger tips. Standard Coil is the *only* manufacturer ever to provide this service.

NEW TV TUNER REPLACEMENT GUIDE

Lists original equipment TV tuners with the Standard Coil equivalent replacement for each. Also includes major mechanical replacement parts for all Standard Coil Tuners —those used in original equipment as well as the universal replacement. Eliminates all guesswork—minimizes your tuner repair and replacement problems.

48 HOUR FACTORY GUARANTEED REPAIR SERVICE

Standard Coil's special service department set-up assures factory guaranteed repairs—*on a 48 hour in-plant cycle!* All repaired tuners carry a *six month warranty* on defective workmanship and parts failure (excluding tubes). Gives you more time for additional service calls—promptly returns your customer's set to like new operating condition.

DEFECTIVE TUNER TRADE-IN ALLOWANCE

Tuners which can *not* be repaired can be traded in against a new replacement tuner which carries a full *twelve month factory guarantee.* See your Standard Coil Distributor for complete details on how trade-ins can increase your tuner sales and profits—create greater customer satisfaction.

JUMP ON THE STANDARD COIL PROFIT WAGON TODAY!

For additional details, see your authorized Standard Coil Distributor or write to:

Standard

Coil Products Co., Inc.

2085 North Hawthorne Avenue, Melrose Park, Illinois

Now available at electronics parts stores, hi-fi salons, and record shops!

Stereo-Monophonic
Test Record

Specially packaged
at only **$1.59**
(*$1.98 In Canada*)



As a man who is seriously interested in hi-fi, you will certainly want to take advantage of this new and important test record, now on sale at electronics parts stores, hi-fi salons, and record shops. It will enable you to know your system inside-out. As a result, your listening enjoyment will be even greater than ever before.

This Stereo-Monophonic Test Record is the *most complete test record* of its kind—containing the widest range of essential check-points ever incorporated into *one* test disc! And, best of all, you need no expensive test equipment when you use this record! Just listen and get the thorough results you want—*all checks can be made by ear!*

Here are some of the questions this record will answer for you!

- ✓ *How good is my stylus? Is it worn? Will it damage my records?*
- ✓ *What about my stereo cartridge? Does it have enough vertical compliance so that it won't ruin my expensive stereo records?*
- ✓ *Is my turntable running at the right speed? Is it free of rumble, wow, and flutter?*
- ✓ *What sort of standing waves do I get in my listening room?*
- ✓ *Are my speakers hooked up correctly? Are they phased properly, and is the correct speaker connected to the right stereo channel?*
- ✓ *How perfectly is my system equalized?*
- ✓ *What about separation? Is it adequate?*

This special test record brings you an extraordinary 2-way value. First, it guides you in evaluating the quality of reproduction your equipment now produces. Second, it specifies the adjustments necessary to get the best recorded sound you have ever heard! This is easily the best value of the year for everyone who owns a hi-fi system—either monophonic or stereo!

NOW ON SALE EXCLUSIVELY AT ELECTRONICS PARTS STORES, HI-FI SALONS AND RECORD SHOPS!

You can be sure this Stereo-Monophonic test record comes as close to perfection as is humanly possible, because the editors of ELECTRONICS WORLD — leading technical magazine in the field of electronics—have poured their accumulated know-how into this record. Purchase your record today! (If you find your dealer does not yet have a supply available, ask him to order them for you.)

SPECIAL NOTE TO DEALERS: for information on ordering your supply of records, contact Ziff-Davis Publishing Company, Direct Sales Division, One Park Avenue, New York 16, N. Y.

Introduces a new small-size bi-directional Ribbon Microphone VM-16, Velocity Type.



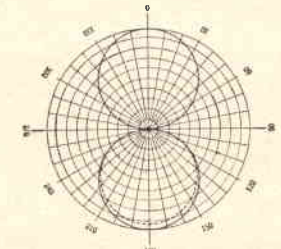
$154.95

- Superative high quality response characteristics.
- Engineered in colaboration with the Technical Research Laboratory of the Japan Broadcasting Corporation (NHK).
- Outstanding results when used for FM broadcasting and high fidelity recording because of its exacting quality of tone reproduction.
- Because of the above superior characteristics, small size and non reflecting satin-chrome finish is ideally suited for TV broadcasting.

SPECIFICATION

Frequency Response: 50-15,000 c/s ± 3 dB
Output level: - 80 dB (150 ohms/1,000 c/s)
Impedance: 150 ohms, 250 ohms or 600 ohms
Directional Characteristic: Bi-directional
S/N 20 dB or below (in parallel field at 1m gauss)

Directional Characteristic



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New Study and Economical Dynamic Microphone DM-20



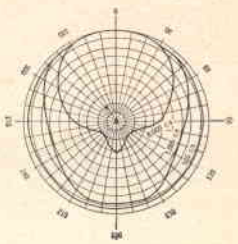
$39.50

- The DM-20 features a strong diecast body formed from exhaustive acoustical research to achieve reproduction of full audio range.
- Introduces a new plastic diaphragm free from mechanical distortion and physicel deterioration.
- An exceptional dynamic microphone for studio broadcasting or recording resulting improved clear and lifelike tone quality.
- Broadens the realism of the tone reproduction in tape recording, well above currently used types of microphone.
- Reasonable priced.

SPECIFICATION

Frequency Response: 70-10,000 c/s ± 5dB
Output level: -79 dB (150 ohms, 1000 c/s)
Impedance: 50 ohms, 150 ohms, 250 ohms, 10 K ohms, and 50 K ohms.
Directional characteristic: Non-directional

Directional characteristic:



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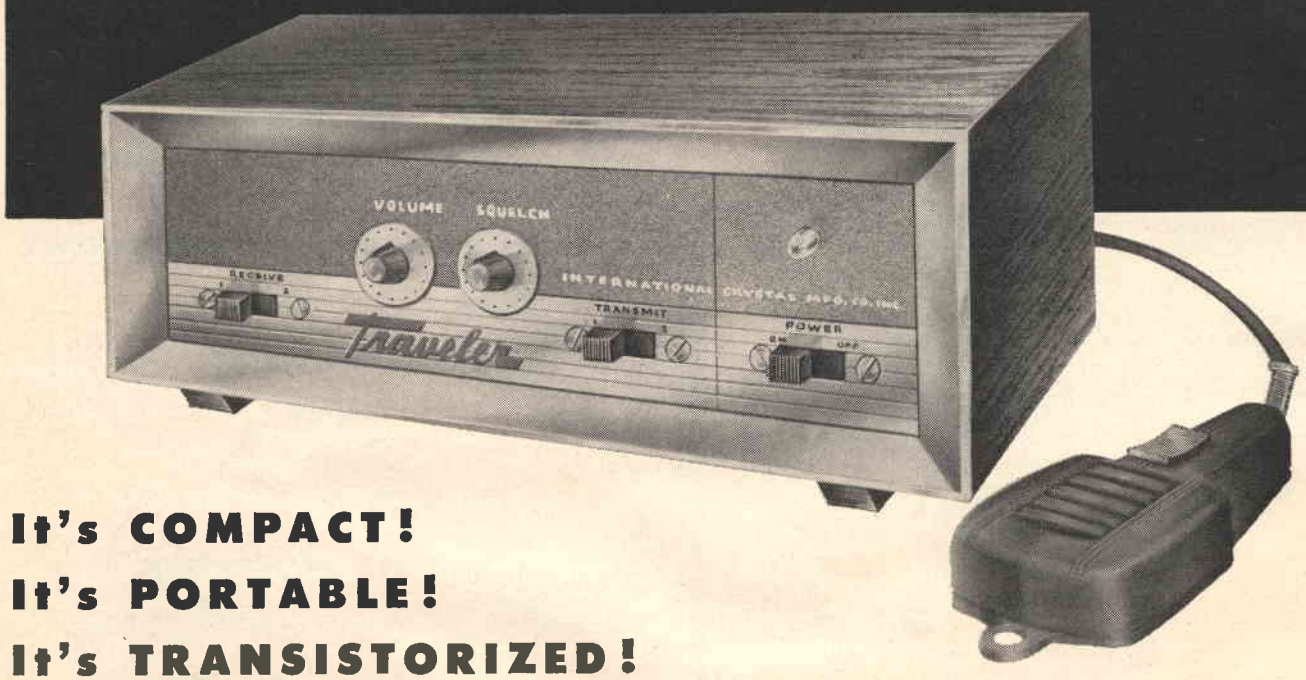

It's COMPACT!
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It's TRANSISTORIZED!

A completely new, truly portable, all transistor Transceiver for the Citizens Radio Service. Weighs less than five pounds.

Small but mighty . . . The Traveler packs 12 transistors and a walloping big signal! The perfect communicator in the home, the office, as well as outdoors. Inconspicuous atop the desk. Adjust the special shoulder strap, and it becomes your companion in the field.

Three types of power supplies. (1) Rechargable battery, complete with charger. (2) Standard dry cell. (3) 115 VAC.

Due to extremely efficient design, the International Traveler provides greater output than any other Citizens transistor transmitter currently on the market.

Special High Frequency transistors are utilized in the transmitter. The receiver's dual conversion superhetrodyne RF circuits use special High Frequency transistors. Provides microvolt sensitivity.

Other features: Noise limiter and squelch, two channel crystal controlled transmitter, two channel crystal controlled receiver.



Your choice . . . Portable case with mobile mounting bracket adjustable shoulder strap, complete with whip antenna and microphone . . . or if you prefer, a beautiful "hand rubbed" wood case* complete with microphone.

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Stereo Amplifier-Preamplifier HF81†



Stereo Preamplifier HF85††



FM Tuner HFT90††
AM Tuner HFT94††
FM/AM Tuner HFT92††



3-Way Speaker System HFS3
2-Way Bookshelf Speaker Systems
HFS5 and HFS1

NEW!



Stereo Automatic Changer/ Player 1007



100W Stereo Power Amplifier HF89
70W Stereo Power Amplifier HF87
28W Stereo Power Amplifier HF86



Stereo Integrated Amplifier AF4††

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HF81 Stereo Amplifier-Preamplifier selects, amplifies, controls any stereo source & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Provides 28W monophonically. Ganged level controls, separate balance control, independent bass and treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers. **"Excellent"**— SATURDAY REVIEW. **"Outstanding . . . extremely versatile."** — ELECTRONICS WORLD. **Kit $69.95. Wired $109.95.** Incl. cover.

HF85 Stereo Preamplifier: Complete master stereo preamplifier-control unit, self-powered. Distortion borders on **unmeasurable.** Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phono, tape head, mike, AM, FM, & FM-multiplex. One each auxiliary A & B input in each channel. **"Extreme flexibility . . . a bargain."** — HI-FI REVIEW. **Kit $39.95. Wired $64.95.** Incl. cover.

New HF89 100-Watt Stereo Power Amplifier: Dual 50W highest quality power amplifiers. 200W peak power output. Uses superlative ultra-linear connected output transformers for undistorted response across the entire audio range **at full power,** assuring utmost clarity on full orchestra & organ. 60 db channel separation. IM distortion 0.5% at 100W; harmonic distortion less than 1% from 20-20,000 cps within 1 db of 100W. **Kit $99.50. Wired $139.50.**

HF87 70-Watt Stereo Power Amplifier. Dual 35W power amplifiers identical circuit-wise to the superb HF89, differing **only** in rating of the output transformers. IM distortion 1% at 70W; harmonic distortion less than 1% from 20-20,000 cps within 1 db of 70W. **Kit $74.95. Wired $114.95.**

HF86 28-Watt Stereo Power Amp. Flawless reproduction at modest price. **Kit $43.95. Wired $74.95.**

FM Tuner HFT90: Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision **eye-tronic®** traveling tuning indicator. Sensitivity: 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence. Very low distortion. **"One of the best buys in high fidelity kits."** — AUDIOCRAFT. **Kit $39.95*. Wired $65.95*. Cover $3.95.** *Less cover, F.E.T. incl.

AM Tuner HFT94: Matches HFT 90. Selects "hi-fi" wide (20-9000 cps @ −3 db) or weak-station narrow (20-5000 cps @ −3 db) bandpass. Tuned RF stage for high selectivity & sensitivity. Precision **eye-tronic®** tuning. **"One of the best available."** —HI-FI SYSTEMS. **Kit $39.95. Wired $65.95.** Incl. cover & F.E.T.

New FM/AM Tuner HFT92 combines renowned EICO HFT90 FM Tuner with excellent AM tuning facilities. **Kit $59.95. Wired $94.95.** Incl. cover & F.E.T.

New AF-4 Economy Stereo Integrated Amplifier provides clean 4W per channel or 8W total output. **Kit $38.95. Wired $64.95.** Incl. cover & F.E.T

HF12 Mono Integrated Amplifier (not illus.): Complete "front end" facilities & true hi-fi performance. 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Incl. cover.

New HFS3 3-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.) 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26½", 13⅞", 14⅜". Unfinished birch **$72.50.** Walnut, mahogany or teak **$87.50.**

New HFS5 2-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, ⅝" excursion, 8" woofer (45 cps. res.), & 3½" cone tweeter. 1¼" cu. ft. ducted-port enclosure. System Q of ½ for smoothest freq. & best translent resp. 45-14,000 cps clean, useful resp. 16 ohms. HWD: 24", 12½", 10½". Unfinished birch **$47.50.** Walnut, mahogany or teak **$59.50.**

HFS1 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range, 8 ohms. HWD: 23" x 11" x 9". Price **$39.95.**

HFS2 Omni-Directional Speaker System (not illus.) HWD: 36", 15¼", 11½". **"Fine for stereo"** — MODERN HI-FI. Completely factory-built. Mahogany or walnut **$139.95.** Blond **$144.95.**

New Stereo Automatic Changer/Player: The first & only **LUXURY** unit at a popular price! New unique engineering advances no other unit can offer **regardless of price:** overall integrated design, published frequency response, stylus pressure precision-adjusted by factory, advanced design cartridge. Compact: 10¾" x 13". **Model 1007D:** 0.7 mil diamond, 3 mil sapphire dual stylus — **$59.75. Model 1007S:** 0.7 mil & 3 mil sapphire — **$49.75.** Includes F.E.T.

†Shown in optional Furniture Wood Cabinet **WE71:** Unfinished Birch, **$9.95;** Walnut or Mahogany, **$13.95.**

††Shown in optional Furniture Wood Cabinet **WE70:** Unfinished Birch, **$8.95;** Walnut or Mahogany, **$12.50.**

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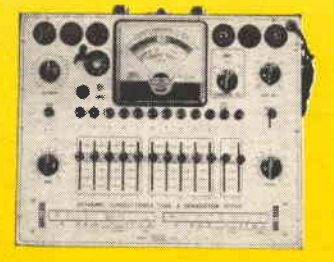

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A **Tests all receiving tubes** (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. **CRA Adapter $4.50.**

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C **150 kc to 435 mc with ONE generator** in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

D **Uni-Probe — exclusive with EICO** — only 1 probe performs all functions: half-turn of probe tip selects DC or AC-Ohms. Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.

E **Features DC amplifiers!** Flat from DC to 4.5 mc, usable to 10 mc. Vert. Sens.: 25 mv/in.; input Z 3 megs; direct-coupled & push-pull throughout. 4-step freq.-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps — 100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync. lim. & ampl. Direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen with dimmer control; plus many more outstanding features.

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New Transistor Portable Radio RA-6
Kit $29.95
Wired $49.95
Incl. F.E.T.; less 9V batt. Prealigned RF, IF xfmrs; push-pull audio; 6" spkr.

*PAT. PEND.



NEW Power & Bias Supply for Transistorized Eqpt. #1020 *
Kit $19.95
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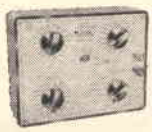
NEW Tube & CRT Fil. Tester #612
Kit $3.95
Wired $5.95
Fast-checks radio/TV tubes, pilot lamps, etc.

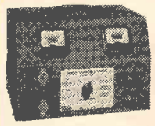


Series/Parallel R-C Combination Box #1140
Kit $13.95
Wired $19.95



Tube Tester #625
Kit $34.95
Wired $49.95
- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50



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Kit $29.95
Wired $38.95
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#1060 Kit $38.95
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ELECTRONICS in an INDUSTRIAL PLANT

How one large manufacturer has come to depend on electronics in running his business—and how the important tasks of service and maintenance are met.

By **E. N. ARNOLD,** Radio & Communications Engineer, The Timken Roller Bearing Co.

EDITOR'S NOTE: *The increasingly significant role electronics plays in other industries has brought correspondingly significant problems in its wake. Electronic systems must be maintained and repaired. "Out" time is costly. In some establishments, the supplier of the original equipment or other outside agency performs this essential service. However, as in-plant electronics becomes more widespread and complex, the trend to integral, full-time maintenance crews grows. Even where such a service team exists, there are many questions as to how it may be organized to do the best possible job. Answers may vary with requirements, but it is useful to review any successful efforts. Thus we examine a large organization, with many plants, that has done an impressive job in this field.*

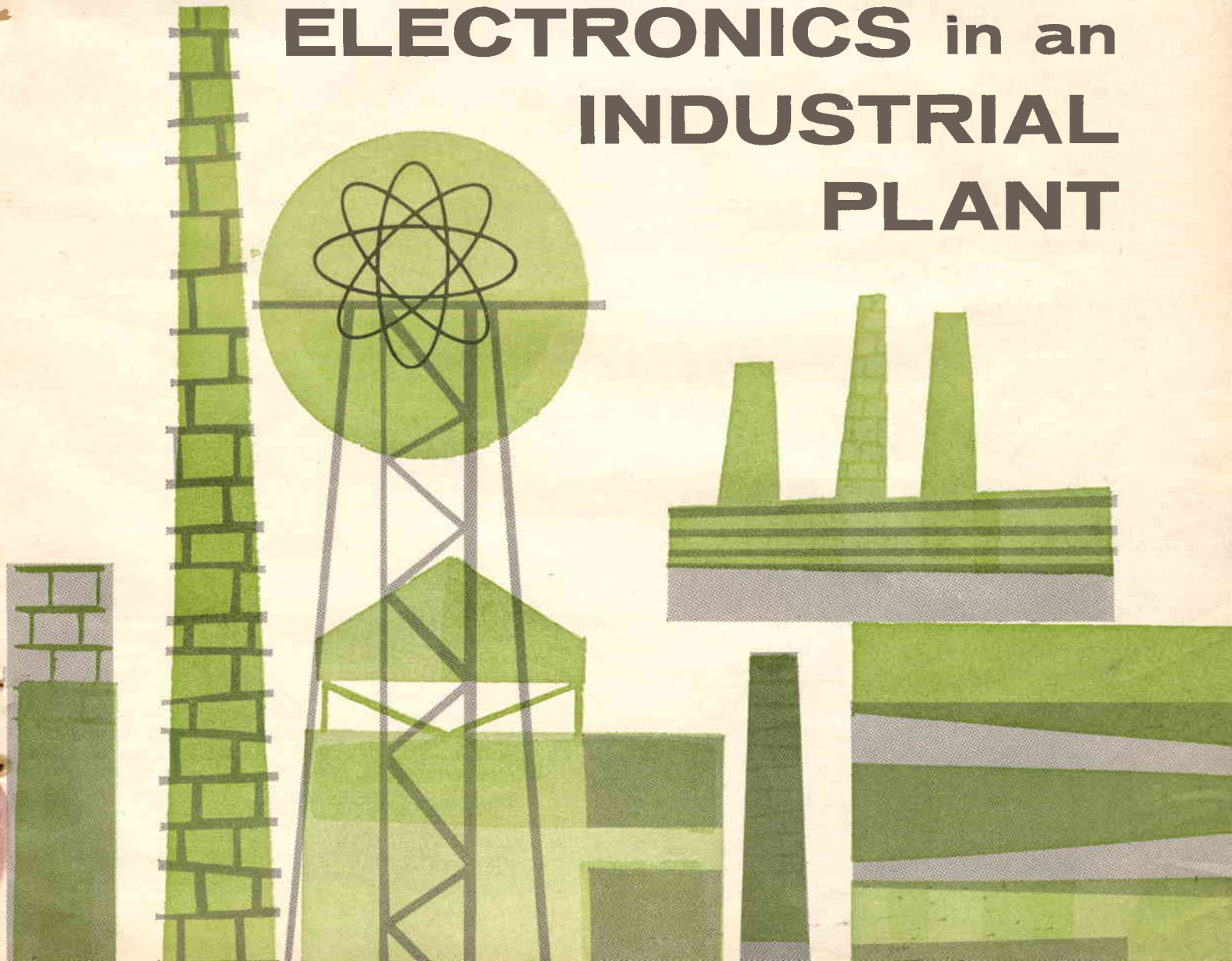
TODAY the phrase "industrial communications" is becoming obsolete because it no longer refers simply to the exchange of information. Aside from communications, all industries are making increasing use of electronics in the control of production processes for goods and services through the use of telephone, radio, ultrasonics, intercommunications systems, television—and other electronic tools.

Many large manufacturing firms are improving operating efficiency through electronics. One such is *The Timken Roller Bearing Company* of Canton, Ohio, a world-wide producer of tapered roller bearings, removable rock bits used in pneumatic drills, and its own alloy steel.

As to communications alone, the size and complexity of this company's operations call for an exceptionally effective program. Plants are located in the United States, Canada, England, France, Australia, South Africa, and Brazil. The largest installations, with which we are concerned here, are located in and near Canton, Ohio.

The Steel and Tube Division's electric-furnace melt shop and much of the equipment for processing the ingots is located at Canton. Adjacent to the steel mill is the main bearing factory, which turns out a large part of the company's annual production of bearings.

Two miles west of this installation is the company's Gambrinus plant, which handles both bearing and steel-processing operations. Although employing fewer people than the two Canton plant operations, Gambrinus covers a larger land area. The steel scrap storage area; laydown yards for finished bars, tubes, and billets; piercing operations;



and heat-treating furnaces are some of the facilities here. The Gambrinus bearing plant itself is primarily involved with screw-machine operations.

Material Handling

Electronics is particularly important in controlling the handling of materials. Most of the steel for the Canton and Gambrinus operations is moved by straddle carriers equipped with two-way radios. One such carrier can be seen through the dispatcher's window in Fig. 2, carrying an underslung load of steel. The radio units, licensed in the Manufacturers' Radio Service, operate on 153.08 megacycles.

Material movement requests are telephoned to the radio dispatcher (Fig. 2) by various departments. Outgoing material from the respective department is taken to a laydown storage yard and its exact location is recorded by the driver.

When another department is ready for this material, the latter calls the dispatcher by phone, giving him the location of the load and where it is to be delivered. The dispatcher calls a straddle carrier by two-way radio. Upon delivery of the material, the driver reports completion of the assignment to the dispatcher by radio and is given a new assignment.

When the assignment calls for a straddle carrier to move into or out of a building, doors open automatically at the driver's command. Each carrier is equipped with a supersonic whistle and each door with a receiver tuned to the inaudible tone. The driver doesn't have to leave his vehicle.

Using a simple system of written slips and visual boards, the radio dispatcher knows the location of all carriers and the jobs they are on. He controls the radio transmitter with a foot switch, leaving both hands free for recording orders. A "no-hands" telephone with separate microphone and speaker on the operating console receives incoming telephone calls. A 60-watt base station, located in an adjoining room, is remote-controlled by the dispatcher.

Fig. 1. At each base station we find a main transmitter (right) and an auxiliary (left) in case of emergencies. This guards against "out" time, which is very costly.

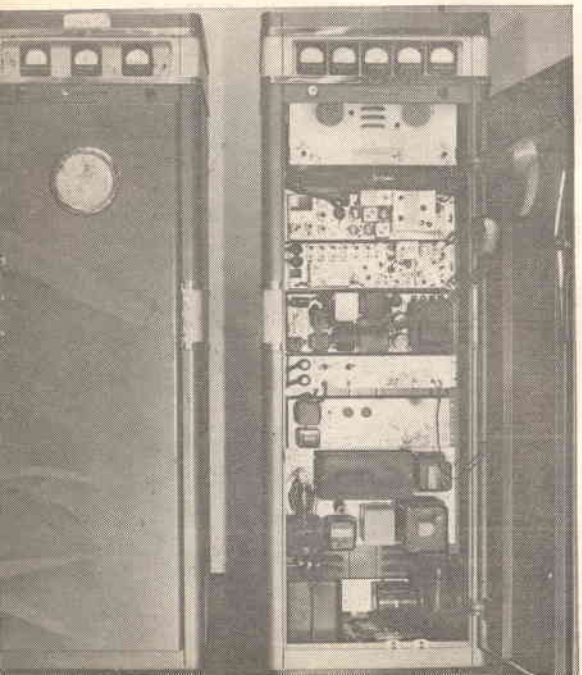




Fig. 2. The central material-handling dispatcher, located at the Gambrinus plant, directs the movements for a large fleet of vehicles. He is shown routing a straddle carrier, which is visible through the window of his booth.

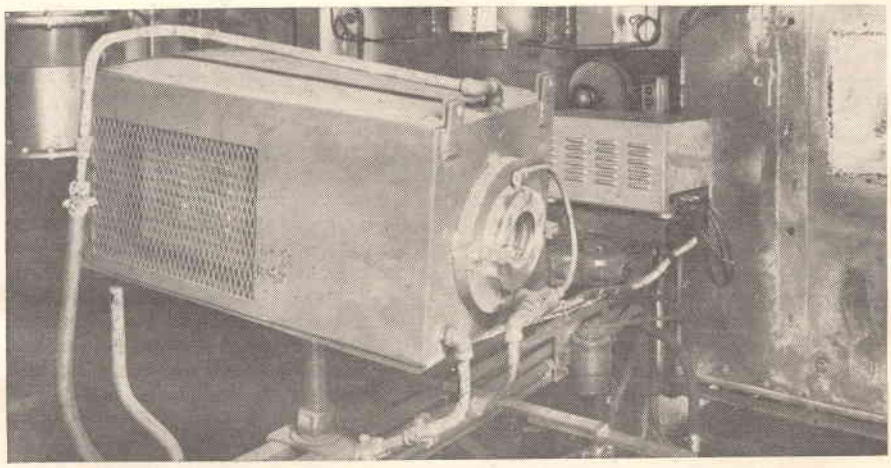


Fig. 3. This TV camera remotely observes the interior of a conditioning furnace. It is in a water-cooled case that swivels away for maintenance work.

Obviously, failure of the dispatcher's radio, even for half an hour, would have a disastrous effect on production schedules. To counteract this, an auxiliary base station (Fig. 1) is located next to the regular transmitter. In the event of failure, the dispatcher throws a switch putting on the auxiliary and continues his work. A radio technician, who is on 24-hour call, is notified and steps are taken to put the main transmitter back on the air as soon as possible.

In the event of power failure at the base station, an auxiliary, gasoline-driven generator automatically takes over. Since the supply voltage in an industrial plant often varies over wide ranges, depending on the work load, an electronic voltage regulator provides the radio equipment with constant voltage, irrespective of supply-line variations.

Two counters and a running-time meter automatically record the number of incoming radio calls, the number of transmissions, and the actual on-the-air times of the base-station transmitter. During peak load periods, three or more transmissions are sometimes made in a minute. Nevertheless, the use of codes to designate locations has succeeded in reducing actual air time to an average of about two hours for each 24-hour period.

In addition to the straddle carriers, the dispatcher also controls the movements of three locomotive cranes, numerous lift trucks, service vehicles, and supervisory personnel in radio-equipped vehicles.

Two-way radio contact with mobile units provides quick availability of material stored in outdoor laydown yards. This, in turn, frees valuable and expensive indoor storage space near the production machines which can then be used for production purposes.

All scrap iron and ores used to feed the electric furnaces in the melt shop are stored at the Gambrinus plant and are transported to the melt shop by the company's own railroad system. Each of the diesel locomotives is equipped with radio.

When radio was first installed on the locomotives, the operators complained of the constant chatter of the straddle-carrier operations and frequently turned the volume down or turned the set off. As a result, they sometimes missed calls.

To remedy this situation, the remote-control unit located at the railroad yard office now keys a tone. A decoder

on the locomotive radio then closes the audio circuit of the receiver and the message is received, but other messages are not heard. The receiver automatically mutes itself after each transmission by the engineer or, if desired, it can be muted manually. Each locomotive transmitter also keys a tone so that all railroad messages are heard by the other locomotives.

Each diesel locomotive is also equipped with a Citizens Band transmitter operating on 27.255 mc. This limited-range transmitter is used to operate crossing lights within the plant area. With this system, switch engines can work up to the crossing and then turn on the warning lights just as they intend to cross over. This eliminates traffic bottlenecks within the plant area and the need for watchmen at the crossings.

Traffic and Services Control

The Timken Company employs a second radio system for the Traffic and Plant-Protection Departments. The Traffic Department, which is primarily concerned with the shipping and handling of material among the five plant cities in Ohio, operates on a frequency of 151.925 megacycles in the Business-Radio Service. This department has control of the company's highway trucks and provides such vital plant services as waste removal, mail and messenger service, and personnel transportation.

Due to the distances involved between plant cities, a 600-watt input transmitter is used at the main plant in Canton, Ohio. The one-hundred-and-twenty-watt transmitters are installed at Columbus, Ohio (125 miles from Canton); Bucyrus, Ohio (90 miles distant); and Wooster, Ohio (35 miles from Canton). Radio contact is maintained with the highway trucks between plants. Seldom is a truck out of range of at least one of the base stations.

The obvious benefit is efficient direction of these vehicles. After a truck has left a plant location, it can be re-routed to meet any emergency. Road conditions are carefully watched and, since several alternate routes between plants are available, a tie-up on one route can be reported so that other units can be re-routed.

Basically the physical layout of equipment is similar to the Material Handling Radio System, with auxiliary standby base station and emergency gasoline-driven generator in case of power failure. An electronic voltage regulator is also employed on this system.

Normal operations during the working day are handled by a dispatcher (Fig. 4) located in the Traffic Department's garage. A remote-control unit is also located at the plant-protection headquarters, where a man is on duty 24 hours a day, seven days a week. A radio-equipped fire truck (Fig. 5) and ambulance, and several plant-protection cars are handled from this point, as well as night-time traffic from highway trucks.

All control points of both systems and the radio repair shop are equipped with Conelrad receivers. Personnel are briefed on procedures to follow in case of an alert.

End to Hand Signals

Another communication problem which the company has solved through the use of electronics is one involving overhead crane operations in the steel mill. The old methods of contacting crane operators by means of hand signals and whistles has been made obsolete, oddly enough, as the result of air-conditioning.

Formerly the crane cabs were open affairs exposed to the heat and fumes of steel-making operations. When these cabs were enclosed and air-conditioned for operators' comfort, it became difficult to communicate by the old methods.

Carrier-current radio or wired radio was the answer to this problem. Operating in the l.f. band of 61 to 190 kc., signals are imposed on the 250-volt direct-current lines supplying power to the cranes and follow the lines with very little radiation.

Floor units installed at strategic locations provide for quick instructions to the overhead crane operators. Some 45 of these units, operating on six different frequencies to avoid confusion, are in use (Fig. 6). Here again, the technicians provide round-the-clock service when necessary.

TV Tends Furnaces

A dramatic use of electronics is the closed-circuit TV system that guards the tube-mill conditioning furnaces. Five individual closed-circuit systems are employed in the Canton and Gambrinus tube mills. A camera mounted in a water-cooled case with a water-cooled lens system (Fig. 3) gives a view of the 1600-degree F interiors of tube-conditioning furnaces. This picture is transmitted by coaxial cable to the control-pulpit operator more than a hundred yards away.

Any pile-up of tubes rolling into the charging end of the furnace or any misalignment could result in extensive damage to the furnace structure if not observed in time. With the TV camera showing the positions of tubes inside the furnace, the operator can quickly stop the movement of the tubes and have the pile-up or the cocked tube corrected.

In another furnace used to cool tubes at a controlled rate after finishing operations, a TV camera is used to position the tubes as they roll into the furnace so that even stacks of four can be advanced through the furnace.

The same control-room operator watches both furnaces at once (Fig. 8) by means of two TV monitors. Since the control pulpits are small and compact, it became necessary for the technicians to devise their own monitors. Most commercially available units have 10- to 21-inch screens with cabinets exceeding the size of home TV sets.

Small home-type eight-inch TV receivers of the portable type were modified by removal of the r.f., i.f., and sound channels, making them strictly



Fig. 4. The Traffic Department dispatcher is radioing instructions to one of the company's highway trucks. He operates one of two base stations.



Fig. 5. This is a radio-linked fire truck. Other such vehicles include an ambulance, plant protection patrols, messengers, and mobile service trucks.



Fig. 6. A floor man guides the operator of the cab in an overhead crane in the steel mill through carrier-current radio. Hand signals are taboo.

video monitors. Two of these units fit side by side on the control-pulpit operating desk. Since the screens are only about four feet from the operator, the picture is easy to view.

In addition, another TV camera in the Canton plant watches the loading of a car-type furnace, with the monitor several hundred feet away in the control pulpit at the discharge end on the opposite side of the furnace.

The cameras used are of the image-dissector type, employing cold cathodes. These tubes happen to be very sensitive in the infrared region, making them ideal for observing furnace operations.

Intercom and P. A. Systems

Another important system of communications at the company involves industrial-type, high-power intercom systems, which link steel and tube mill operations. One such system extends for five city blocks and interlinks operations from the soaking pits and the 35-inch rolling mill to the 10-inch mill and wire mill. The soaking pits are actually installations for re-heating the cooled-off ingots sufficiently so that they can be rolled.

Twelve stations, in all, are located at vital operations centers along the length of the steel mill, saving both time and walking. Each station consists of a master amplifier, a station-selector panel, a microphone, and a loudspeaker.

The selector panel places power on the amplifier and at the same time ties its output to the loudspeaker at the desired location. A ceramic microphone in the selector panel or, in some cases, mounted separately is used to pick up the message. Ceramic mikes are used due to the heat and high humidity conditions encountered in steel-mill operations. Up to six conversations can be in progress at any one time.

Many benefits are obtained from this type of communications. A breakdown in mill operations can result in a pile-up of material unless the flow can be stopped. A quick call up the line can hold material until repairs are made. This is extremely important in handling hot steel, where the temperature for various operations must be maintained.

Millwrights can be called quickly in the event of a breakdown and can be informed as to the nature of the break. This allows the millwright or electrician to bring the proper tools on his first trip. Supervisory personnel can also be located quickly by calling various stations on the system.

Intercom systems are also employed within an office or department. These systems can be adequately handled by small seven-station, selective-call, common-talk circuits. The phones are of the miniature, handset type, with station selection accomplished by a series of push-button selector switches.

Many times outside calls request information on products or shipping dates. To avoid delay and the rudeness of a dead phone while information is located, a quick call on the intercom to a records clerk or other source of information results in a rapid answer to the customer. These phones serve many areas where it is impractical or unnecessary to use the standard phone system hookup.

Plant Protection

A system similar to the police and fire-protection circuits used by large cities covers all buildings of the Canton and Gambrinus plants. Call boxes located throughout the plant must be tripped by the plant police on their rounds. A coded impulse is then sent to the headquarters building showing the exact location of the box pulled. Voice communications with the officer is made by a phone circuit.

Automatic boxes on the water-supply system feeding all automatic sprinklers trip if there is a flow of water from any sprinkler. Here again a coded signal is used to show the exact location of the fire (or accidental sprinkler operation).

Fire-alarm boxes throughout the plant send a coded location report, when pulled, direct to the city fire department headquarters and at the same time give the alarm at the company operator's desk. In case of fire, a company police officer and company firemen are able to have plant gates opened and clear for fire-fighting equipment enroute to the plant.

The Maintenance Crew

Responsibility for the continuous operation of company communications and electronics equipment is in the hands of a well-trained maintenance crew. A well-equipped maintenance shop, located at the Gambrinus plant (Fig. 7), is staffed with four experienced technicians. These men, primarily radio technicians, each holds an FCC license (radiotelephone 2nd class or higher). As might be expected, their hobbies also include amateur radio.

The author, who heads this service group, has a background of some 25 years in radio. He spent five years in naval communications during World War II and was employed as radioman for *Goodyear Aircraft's* airship (blimp) operations before joining the *Timken Company*.

Floyd Leslie, Frank Dearman, and Floyd Baxter are veterans of military service. Leslie and Baxter were in communications and Dearman was in the Quartermaster Corps. All were employed in electronics before transferring to this communications service group.

A radio-equipped electronic maintenance truck, with a compartmented body for parts storage, is used to answer calls for service anywhere within the plant area.

Actually, very little repair work on electronic equipment is attempted in the field. Spare units are on hand for practically all types of equipment used

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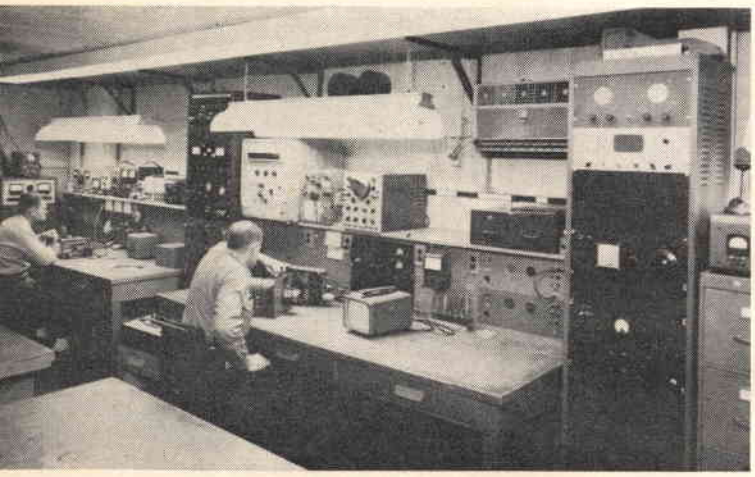


Fig. 7. This is just one corner of the electronic maintenance shop. A closed-circuit TV camera is being repaired. Equipment includes scopes, modulation monitors, deviation meters, frequency meters, wattmeters, and a WWV receiver.



Fig. 8. An operator in a control pulpit, who makes certain that steel tubes are in the right position, observes the course of this steel on two separate monitor TV sets. He keeps an eye on two conditioning furnaces at the same time.

Molecular Electronics

New concept promises thousand-fold size reduction of circuits and added reliability with solid-state material acting as complete circuits without separate components.

THE Air Force and *Westinghouse Electric Corp.* recently demonstrated how the startling new concept of molecular electronics may revolutionize the electronics industry and extend man's reach into space. A variety of sub-systems were demonstrated which were said to be vastly more reliable and as much as a thousand times smaller than even presently used transistorized equipment. New systems, employing these concepts, could be operational in missiles or satellites in three to four years to perform such functions as telemetering light intensity or radiation levels back to earth, and providing infrared detection and reconnaissance information, flight guidance, and communications. Present plans call for the development of a completely "molecularized" radio receiver for the Air Force in perhaps one year's time.

To show the feasibility of a molecular electronic amplifier sub-system, Dr. S. W. Herwald, *Westinghouse* vice-president in charge of research, demonstrated an audio amplifier used in a phonograph in which the preamplifier was the size of a match head and the 5-watt power amplifier, contained within a heat sink, was smaller than a dime.

This new technique uses a different concept than is employed in micro-miniaturization. In the latter case, the designer usually starts with a conventional circuit and then tries to make all the components used in that circuit just as small and as compact as possible. In the case of molecular electronics, the attempt is made to design all the requirements right into the material itself. For example, assume that an amplifier stage is needed. The scientists fabricate a bit of material to which four leads may be attached; two of these apply the signal to be amplified to the material, and the other two take out the amplified version of the signal. The complete amplifying function is performed by a single piece of semiconductor material such as silicon or germanium. By such techniques as plating, etching, and alloying, the structure of the tiny solid piece is arranged to perform the same functions that now require many individual components which have to be soldered together.

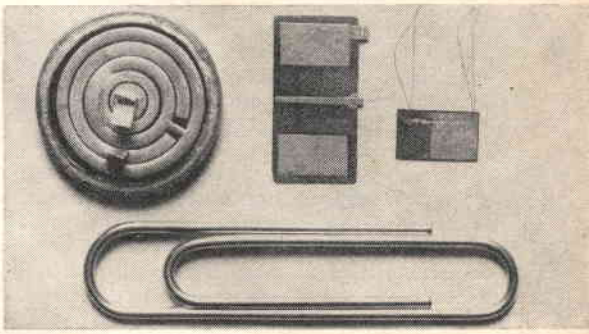
The Air Research and Development Command awarded the company a $2-million contract last spring that made possible the rapid development of the sub-systems demonstrated. These included an audio preamplifier, audio power amplifier, 40-watt d.c. amplifier, video amplifier, tuned amplifier, bistable and monostable multivibrators, and logic switches. The drastic reduction in size, weight, and power would allow space vehicles to perform a greater number and wider range of functions.

A new basic knowledge of semiconductor materials was required to produce the devices shown. This knowledge permitted a new technique to be used in growing semiconductor crystals. The new technique, a radical departure from existing methods, grows the crystals in the form of long, thin, near-perfect ribbons, or "dendritic strips." The dendrites can be incorporated into finished semiconductor devices without the need for intermediate material processing of any kind.

"Eventually," Dr. Herwald said, "we believe it will even be possible to automatically and continuously produce actual electronic equipment, such as radio receivers and amplifiers, starting from a pool of molten semiconductor materials." -30-



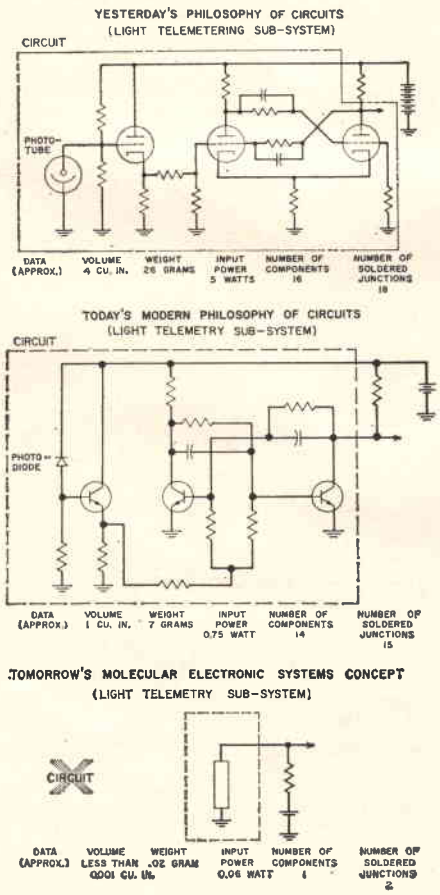
Molecular electronic phono system. Preamp is tiny unit in engineer's right hand, and 5-watt 0-20,000 cps power amplifier to drive speaker is in small black box in left hand.



Three molecular electronic sub-systems. Device with concentric arcs is audio amplifier, at center is free-running multivibrator, and at the right is a two-stage video amplifier.



Tiny light-sensitive telemetry sub-system in which a single light-responsive element delivers an output signal whose frequency changes when the light shining on the element changes. Unit is plugged into tube socket at left, and is powered by the batteries shown. For demonstration purposes the output of the sub-system is connected to a small earphone. When employed in a telemetry system, the output might be used to modulate a subcarrier oscillator. This, in turn, is connected to a transmitter that radiates the telemetry signal to a distant receiver that detects the intelligence.



Circuits required for telemetry sub-systems. ▶

ELECTRONICS 20 YEARS AGO

Our field has undergone an incredible amount of change during the last two decades—or has it?

LAST WEEK our six-year-old son asked, over the blasting of the TV set, "Daddy, what programs did you watch on television when you were a little boy?" We settled down to a father-son talk, at which we are not very good. This was going to be tougher than the feature question of the week before, "Can Superman cross his eyes?" How can you get across the idea that there was a time when nobody had even heard of TV?

Yet there was such a time, and a time when no one had heard of radar, or guided missiles, or computers, or transistors, and that time seems as though it had only just passed us. What would happen if we were to reach back, say, twenty years to see how things have changed since then? It isn't an unreasonable jump. Everbody had a radio. Electronics, though still young, was well on its way. World War II had begun, but we were not yet in it. And many of the electronic miracles we now take for granted must surely have been beyond speculation, let alone reality, at that time. So we began to thumb through our 1940 file of RADIO NEWS (which was our name then).

Tubes, Then and Now

You know you have taken a long step back as soon as you look at the first 1940 schematic, which happens to be that of an audio amplifier. A pair of 2A3's are used in the push-pull output stage, and the "B+" rectifier is a type 80. However, this doesn't seem to be typical. In a handful of similar, circuits, the 6V6 is used in the output, and the rectifier is a 5Y3 or 5U4. Those three types are still going strong. In addition to the wealth of octals, the loctals were quite popular. They're less common today, but they are not completely extinct.

You can find many grid-cap tubes in use today in older equipment, so there is nothing startling in finding the 6A7, 6K7, and others of their ilk, abounding twenty years ago. By that time, however, such types were already giving way to similar ones except that, instead of using caps, grid connections were made at the base. These included the 6SK7, 6SA7, 6SQ7, etc. Well! They're not so new; you can find some of those in television sets. Of course, they were more likely to come in metal rather than glass shells, and the proportion is reversed today, but the difference is only one of degree.

How about the all-glass miniatures? They were not only in use, but we find *RCA* announcing a new line-up of 1.4-volt "minnies" for use in small, portable receivers. These included the 1R5, 1S4, 1S5, and 1T4. We just don't know what to say to that.

Where Was Audio?

Very early in 1940—in the January issue, as a matter of fact—we have evidence of a preoccupation with audio quality: the RADIO NEWS Full-Range Amplifier made its bow. It was designed to deliver 15 watts "undistorted, or as close to that state as the art would permit." A proudly included response curve shows it to have been



◀ Fig. 1. In 1940, this radio was considered unusual because it could be built small enough for mounting on a bicycle.

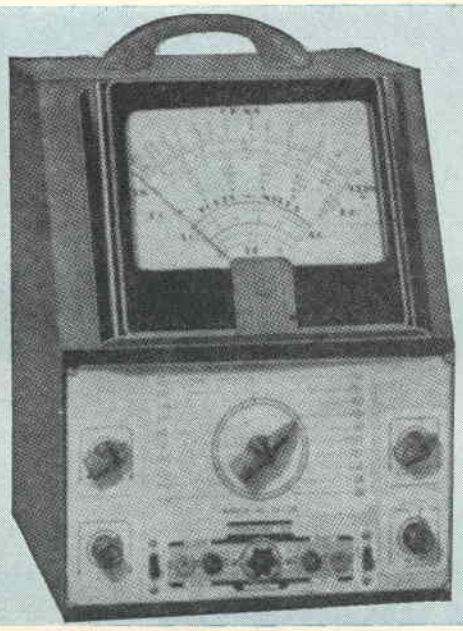


Fig. 2. This Superior v.t.v.m. stood 13½ inches high on the service bench.



Fig. 3. "The console," meant a radio in 1940, like this Meissner, not a TV.

flat from 20 to 15,000 cycles. There is little in the circuit design that is startling in the light of modern practice. The 6A3 tubes used in the push-pull output are not the kind you still run into, but the fixed-bias supply developed by a separate rectifier is not startling. It wasn't then, either.

There is a glow of satisfaction with present achievement when we look back at a "new long-life phonograph needle capable of 1000 playings" (not, of course, on long-playing records). In addition to osmium, the precious-metals tip also had some ruthenium, iridium, and rhodium. Who says we haven't progressed?

Fewer people were insistent on extreme high fidelity in their loudspeaker systems a couple of decades ago as compared to the number so concerned today. However, if you wanted the best then available, you could get something that would still be impressive. "Reproducers incorporating two or more speakers for the most critical listener" were widely available. You could have your 12- or 15-inch woofer, if you wanted it. The enclosure would most likely be an infinite baffle or a bass-reflex box, which was then very much on the rise. Horns were not a very big thing yet on the low-frequency end of the spectrum, but most popular tweeters or mid-range-and-tweeter combinations were built around the horn principle. You let your horn sit out in the open on top of the woofer box. Things are much different now, of course—today you build up the sides of the woofer cabinet so that it encloses and hides the horn.

Yet you didn't have a proliferation of biffles, buffles, and other variations of existing designs; you didn't play with the configuration of the port, which was a straightforward rectangle; and you didn't have the array of truly astonishing small systems that could put out bass twice their own size.

Some people had their own home-recording systems, even then, but these were simple disc-cutting affairs. Not that magnetic recording was unheard of. Far from it, magnetic recorders (using wire instead of tape) were definitely available, but most home units were of the disc variety for the sake of superior quality, and generally ran at 78 rpm—but not exclusively. "The Fundamentals of Recording" (February, 1940) notes that "some home recorders include that speed (78 rpm) with an alternate choice of 33⅓ rpm." And, if you wanted to invest in the best, you could buy a cutting head that was "substantially flat within 3 db from 50 to 9000 cycles." However, it was recommended that you drive it from an amplifier that employed "stabilized feedback in the output stage."

Well, maybe they did have wide-range amplifiers and speakers, and maybe they did occasionally use the slower disc speed, non-commercially, but what good was it all? The response on records was still limited, and how much frequency range could you get out of an AM broadcast? Not much, but you could really make out with one of the new "frequency-modulation receptors." They offered a "tone unequalled in radio history—up to 15,000 cycles on direct studio broadcasts." In fact, the *Meissner* console shown in Fig. 3 was one of these new-fangled FM units, which used the old FM band. The units of that day generally tuned from 42 to 50 mc. And maybe they weren't so new-fangled, at that. An article describing a new unit footnotes, "Strictly speaking, FM is not new," and offers some then aging references to prove it.

In 1940, everything had to be made smaller. That relentless year will not even spare us the novelty of miniaturization. A compact, lightweight receiver (Fig. 1) was so cut down in size that it could conveniently be mounted on a bicycle. So what if you had to use headphones instead of a speaker? However, this was soon outdone by another project for the home constructor, a receiver that could be built into an old camera case (Fig. 5). While the well-dressed user is shown wearing headphones, this was strictly an option for private listening. The case of this two-tube superregenerative set also included a 3-inch speaker.

Later that year, manufacturers were marketing camera-type, personal portables using the 1.4-volt tubes in full superhet designs. *Sonora* offered one that was no more than 8½ inches high and 5 inches wide.

Diversification

Electronics had already moved past the point where it was confined to entertainment, or even communications. A complete marine receiver was described in June, two decades ago. An aviation altimeter covered in February used r.f.—in the microwave range—to bounce echoes off the ground for accurate altitude readings. In fact, the "Installation and Maintenance of Aircraft Radio Equipment" was big enough to warrant a series rather than a single article "way back then."

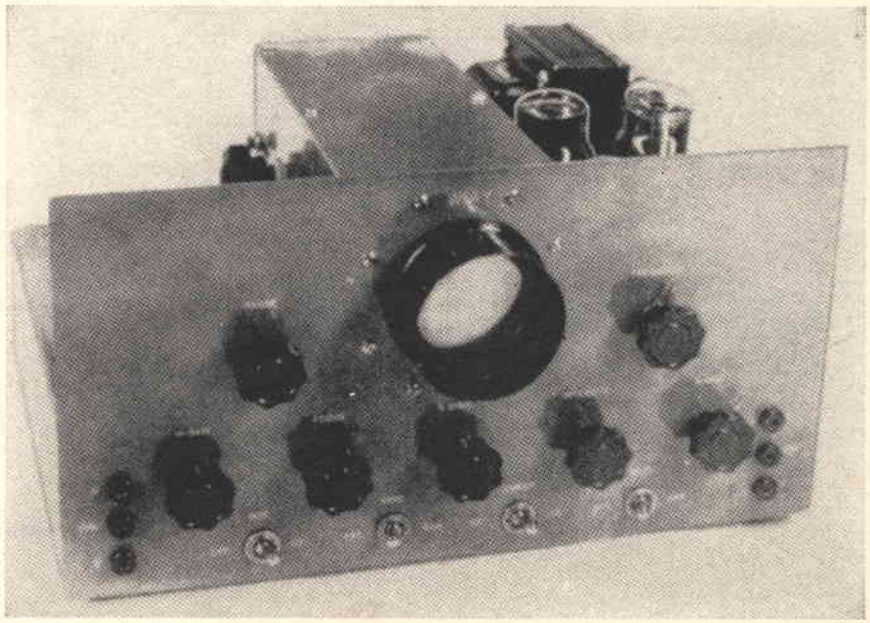


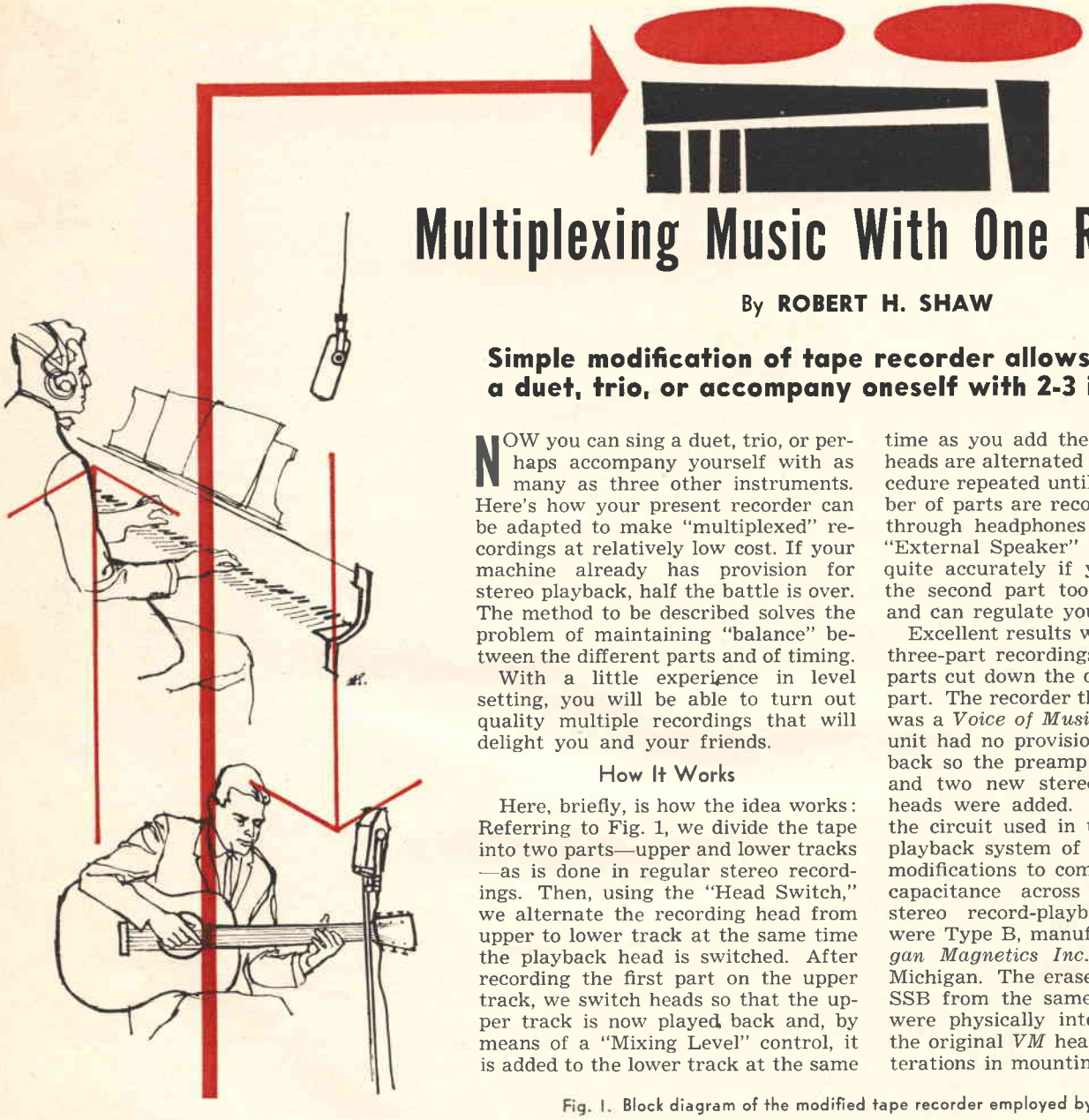
Fig. 5. A "midget" radio was one small enough to fit a (large) camera case.

Careers in the rapidly growing field were being pushed. John F. Rider, then a regular columnist in RADIO NEWS, predicted that one good thing the war was likely to bring was an enormous impetus toward growth in the field. Another article was pushing the idea

(*Continued on page* 126)

Fig. 4. Oscilloscopes for the shop were around in those days, although not common. Here is how one of them looked.





Multiplexing Music With One Recorder

By **ROBERT H. SHAW**

Simple modification of tape recorder allows one to sing a duet, trio, or accompany oneself with 2-3 instruments.

NOW you can sing a duet, trio, or perhaps accompany yourself with as many as three other instruments. Here's how your present recorder can be adapted to make "multiplexed" recordings at relatively low cost. If your machine already has provision for stereo playback, half the battle is over. The method to be described solves the problem of maintaining "balance" between the different parts and of timing.

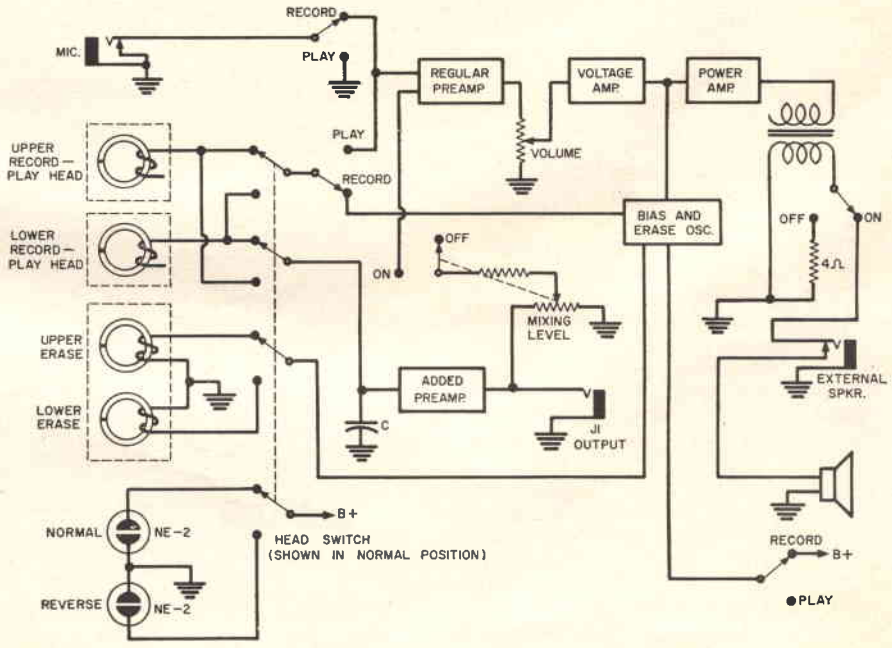
With a little experience in level setting, you will be able to turn out quality multiple recordings that will delight you and your friends.

How It Works

Here, briefly, is how the idea works: Referring to Fig. 1, we divide the tape into two parts—upper and lower tracks—as is done in regular stereo recordings. Then, using the "Head Switch," we alternate the recording head from upper to lower track at the same time the playback head is switched. After recording the first part on the upper track, we switch heads so that the upper track is now played back and, by means of a "Mixing Level" control, it is added to the lower track at the same time as you add the second part. The heads are alternated again and the procedure repeated until the desired number of parts are recorded. By listening through headphones plugged into the "External Speaker" jack, you can tell quite accurately if you are recording the second part too loud or too soft and can regulate yourself accordingly.

Excellent results were obtained with three-part recordings, but four or five parts cut down the quality of the first part. The recorder the author modified was a *Voice of Music* Model 710. This unit had no provision for stereo playback so the preamp circuits of Fig. 2 and two new stereo record-playback heads were added. This is similar to the circuit used in the regular stereo playback system of the *VM* 711, with modifications to compensate for shunt capacitance across the input. The stereo record-playback heads used were Type B, manufactured by *Michigan Magnetics Inc.* of Vermontville, Michigan. The erase heads were Type SSB from the same company. These were physically interchangeable with the original *VM* heads without any alterations in mounting.

Fig. 1. Block diagram of the modified tape recorder employed by the author.



If your recorder has provision for stereo playback then you will only have to add the extra erase head for the lower channel, the head switch, and the mixing level control. It will also be necessary to add sufficient capacity across your stereo preamp input to keep the bias oscillator from saturating it while recording. The coupling between the oscillator and preamp takes place in the recording heads. If you find this shunt capacitor noticeably affects the "highs," then change the value of your equalizing component to compensate for it. Don't let this discourage you, as it often involves changing a single component. Fig. 3 indicates the possible components making up your particular equalizing circuit. You can still have regular stereo operation by merely turning the "Mixing Level" control off and adding an amplifier for the second channel.

Procedure to be Followed

Although the following procedure is given for the *VM* Model 710 recorder, it will work equally well with most home recorders. These steps are given in the proper sequence for construction. *Important! Make certain the tools you use around the recording heads are not magnetized!*

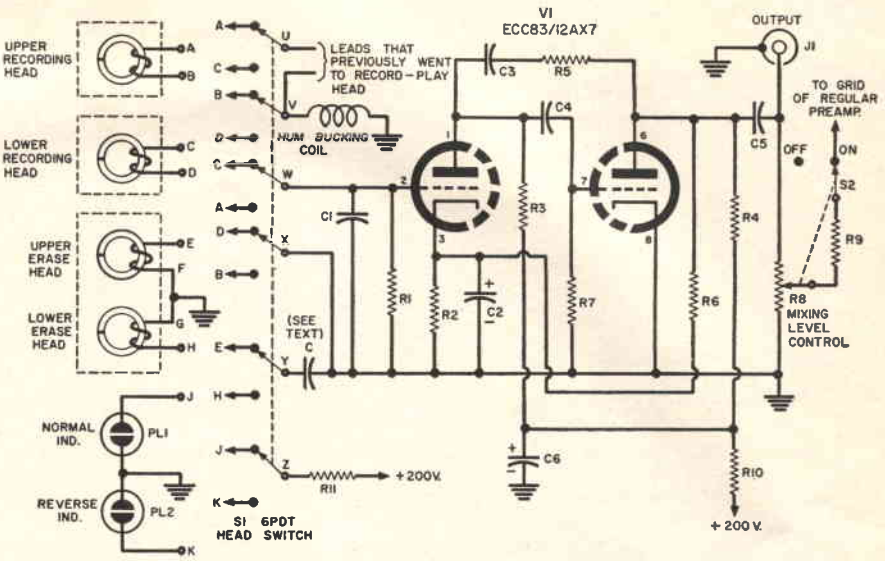
First install the stereo record-playback heads and erase heads, lining them up as shown in Fig. 4. Mount the head indicator neons. The author merely drilled holes in the plastic head cover and cemented an NE-2 neon in each hole. These neons will probably last as long as the recorder and their use conveniently eliminates the need for lamp sockets, lens, etc. Don't let them protrude too far through the hole as they could get broken off.

Next mount the head switch, phono jack, and mixing level control in an accessible location, keeping them away from the electrical fields of the power transformer and motor. Now find a spot to mount the preamp, preferably near the original preamp and as far away from the power supply circuit as possible. Cut the required holes and put in grommets. Next, solder thin copper strips to the tube socket to serve as a shock-mount for the preamp, thus reducing the chances of microphonics. Mount the tube socket and then wire in the filaments, being careful to dress the leads away from pins 2 and 7.

Now label the head switch as shown in Fig. 2. This makes identification and wiring much simpler. Now wire all common points together, *i.e.*, "A" to "A," "B" to "B," etc. Next take the leads that went to your old record-play head and re-route them to points "U" and "V" of the head switch. Wire in the newly installed record-play heads according to details shown in Fig. 2. Remember to ground only one end of the shield. One of the leads that went to the erase is grounded. Take the other "hot" lead and re-route it to point "Y" of the switch. Wire up points "E" and "H" to the same "E" and "H" points on the head switch. Likewise wire in the neon indicators to points "J" and "K" of the switch. Wire in the voltage to light the neons to point "Z," adding the 1-megohm resistor in series.

Wire in the other components, keeping all leads as short and direct as possible and using shielded cable for longer leads. Regular plastic-covered shielded microphone cable was used in the author's unit with very good results. The output of your new preamp, coming off the .047 μf. (C_5) capacitor, is to be wired to either the first or second amplifier stage of your regular recorder circuit. The author used the second stage, pin 7 of the normal preamp, as it provided sufficient gain. If more gain is required, you can use the first stage and change R_9 from 470,000 ohms to 1 megohm to minimize interaction between the "Mixing Level" control, R_8, and the microphone level.

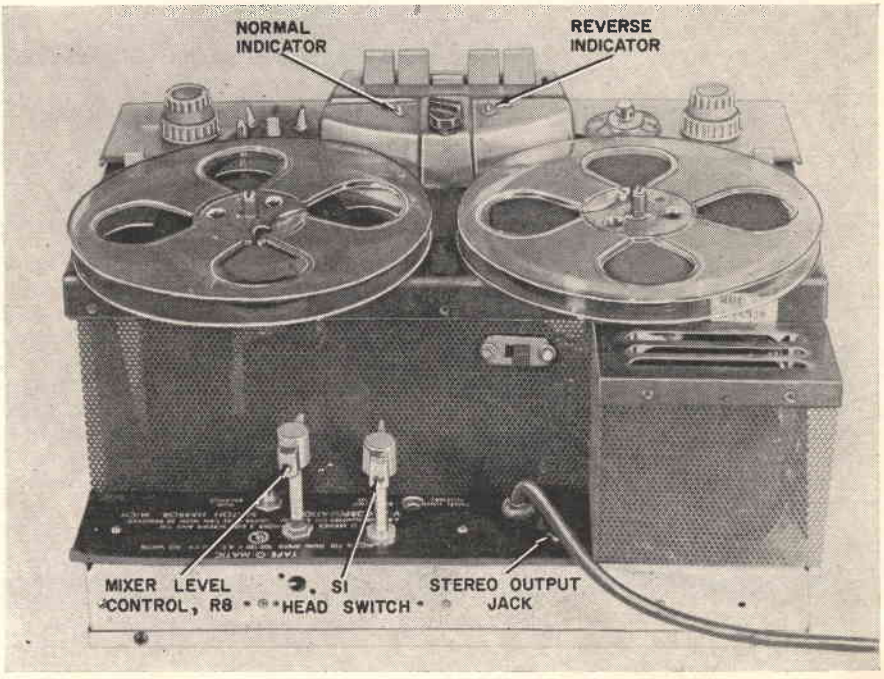
In some recorders the "External Speaker" jack is inoperative in the "Record" position. If this is the case, it will be necessary to rewire the out-



R_1, R_6, R_{11}—1 megohm, ½ w. res.
R_2—4700 ohm, ½ w. res.
R_3, R_5—220,000 ohm, ½ w. res.
R_4, R_{10}—100,000 ohm, ½ w. res.
R_7—10 megohm, ½ w. res.
R_8—500,000 ohm audio-taper pot (with switch, S_2)
R_9—470,000 ohm, ½ w. res. (see text)
C_1, C_4—.01 μf., 400 v. capacitor
C_2—25 μf., 25 v. elec. capacitor
C_3—135 μμf. ceramic capacitor
C_5—.047 μf., 400 v. capacitor
C_6—20 μf., 400 v. elec. capacitor
S_1—6-pole, d.t. switch (Centralab 2018 or equiv.)
S_2—S.p.s.t. switch (on R_8)
PL_1, PL_2—NE-2 neon bulb (NE-51 if bayonet lamp socket is used)
J_1—Phono jack
2—Stacked stereo record/playback head (Michigan Magnetics Type B or equiv. See text)
2—Matched erase heads (Michigan Magnetics Type SSB or equiv.)
V_1—ECC83/12AX7 tube

Fig. 2. Complete schematic diagram of the circuit modifications made.

Top rear view of the modified tape recorder showing the added controls.



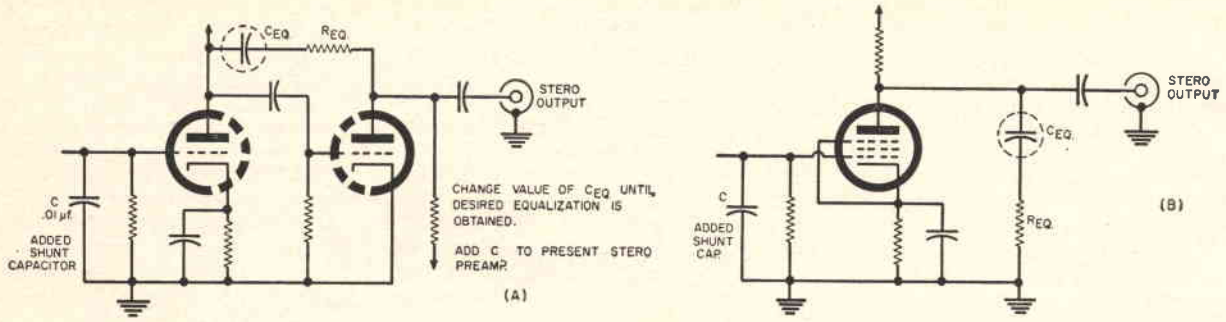
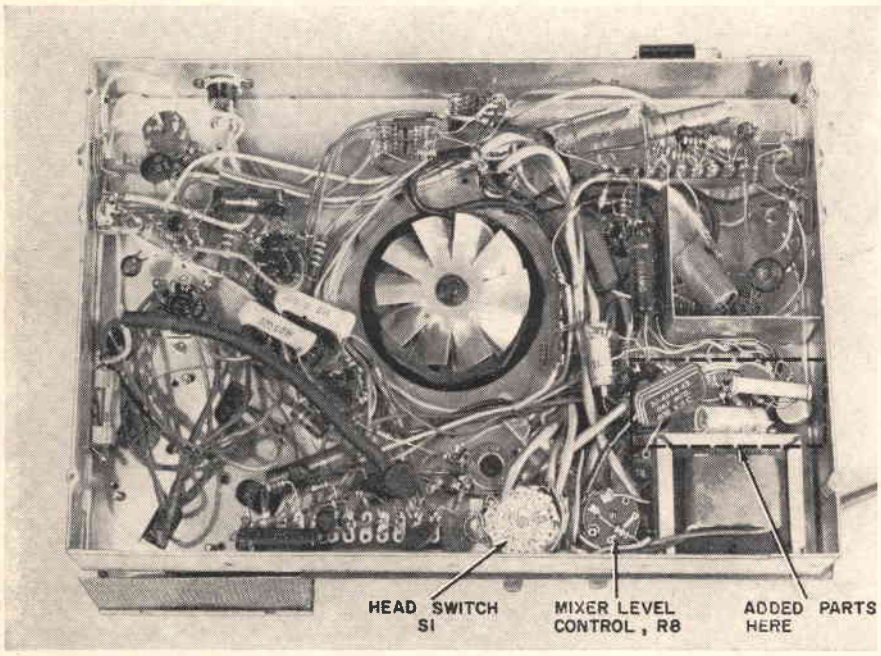


Fig. 3. Circuits showing equalization components of two basic tape amplifiers. Refer to text for details.



Under-chassis view showing the area where the added components have been located.

put jack direct from the output transformer through a simple s.p.s.t. switch to turn it on and off. Fig. 5 shows how this can be accomplished. The reason both terminals of the stereo heads are switched in the author's unit is the presence of a hum-bucking coil in the normal recording track. If your recorder has one side of the record head grounded, then a four-pole, double-throw switch can be used in place of the six-pole unit.

As previously stated, only one end of the shield should be grounded. If you were shielding only to prevent interaction from electrostatic fields, then the number of times and the places it was grounded would not matter. However, a slight ground differential may be present between the deck and amplifier chassis. If both ends of the shielded pair are grounded, then a closed loop exists and the shield now becomes a conductor for these currents, coupling hum and noise into the sensitive preamps by means of electromagnetic induction. This situation can develop even though ohmmeter readings do not show any appreciable resistance between the two points.

Head Adjustment

Now that the wiring is completed, we are ready to line up those newly installed heads. There are precise procedures for doing this and those who have alignment tapes, meters, etc. are urged to use them as directed. The recording heads selected by the author require 1 ma. of bias current with 25 μa. of audio for optimum performance. The following method is suggested for those who do not have access to regular alignment equipment and it will give satisfactory results.

Turn the "Mixing Level" control, R_8, fully off. Put the "Head Switch" (S_1) in "Normal" position. See Fig. 1. With a recorded tape containing good highs and lows, simply orient the head for maximum playback quality, paying particular attention to the extreme highs. Now adjust the erase heads so they are physically in line with the record-playback heads, as shown in Fig. 4. As the Type "SSB" erase heads require only 17 ma. of erase current for 50 db erasure, it will be necessary to check this current in order to avoid damaging the heads.

Since measuring high-frequency currents can lead to complications without special meters, here is a simple, yet practical, method of reaching the proper erase current while avoiding damage to the heads. Start out by shunting a relatively large capacitor (.01 μf.) across the output of the erase oscillator as it enters the head switch. This capacitor is designated as C in Fig. 2. Turn the "Mixing Level" control off and S_1 to "Normal" position. Put on a recorded tape that you won't mind erasing and set the recorder to the "Record" position with the volume control at minimum setting. Now play the tape back and see how clean it was erased. Gradually decrease the value of this shunt capacitor, each time testing the erasing qualities on the recorded tape until erasure is complete even when a relatively high level of recording has been made.

If the lower track is partially erased, recheck the relative position of the erase heads to the recording heads. If your erase heads are mounted separately, it will be necessary to check inter-channel erasing with S_1 in the "Reverse" position, each time re-positioning the lower erase head for the best erasure without affecting the upper track.

Trying It Out

Now you are ready to try it out. If an odd number of parts are to be recorded, put S_1 in the "Normal" position and for an even number of parts start off in the "Reverse" position. By doing this you will always end up with

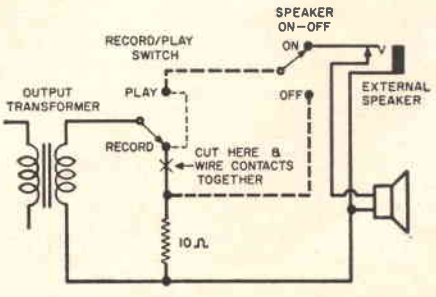
(*Continued on page* 87)



MOUNT ERASE HEADS IN LINE WITH RECORD HEADS

Fig. 4. Lineup of the tape heads used.

Fig. 5. Wiring of the output circuit.



R.F. Is It Dangerous?



By **SHERMAN H. HUBELBANK** / **At certain frequencies, radiation levels, and operating distances, harmful effects can occur.**

EDITOR'S NOTE: *Whenever man manipulates his environment, he runs the risk of producing harmful effects, however unwittingly, while achieving desired objectives. In the case of x-rays and atomic fall-out, there is a just concern over hazards. However, we have been handling other forms of radiant energy for communications purposes for so long that we take their safety for granted. Are we being too smug?*

CLOSE-RANGE exposure of the brain of a monkey to r.f. radiation can cause death. Recent experiments by the National Institute of Neurological Diseases show that, using a u.h.f. transmitter operating in the range between 225 and 400 megacycles with a peak output of about 200 watts, monkeys can be killed in about five minutes. All deaths of such test animals have resulted from hyperthermia —excessive internal temperature.

Experiments such as these raise disturbing questions. What is there about r.f. radiation that can cause death? How dangerous is it to man?

Nature of R.F.

Radiant energy, like other types, is produced by the conversion of matter from one form to another. Radiation is the transfer of this energy through space in the form of impulses or waves. The length of each cycle is the wavelength of the energy. The number of cycles that occur in one second is the frequency. Radiation also has the property of intensity. This is generally stated in the form of power output in watts for peak power and/or average power. This r.f. energy is a form of thermal, non-cumulative energy that produces localized heating when it is absorbed by matter. It is in this heating effect that the hazard lies.

Biological Effects

Studies have attributed the harmful effects of r.f. radiation, such as that in the microwave range, to a general rise in the total body temperature or to a selective rise in certain sensitive portions of the body. It is known that certain areas and organs are less capable of dissipating heat promptly than others. Those portions that tend to retain heat include the lungs, the eyes, the testes, the gall bladder, and the lumen of the intestinal tract. These structures are the ones most apt to be damaged by exposure. In general, deep tissues may absorb enough energy to cause a serious rise in over-all body temperature which, if permitted to go too far, produces permanent damage.

In observing experimental results, it is comforting to note that rather unusual test conditions were maintained and the subjects were small, fur-bearing animals. Fortunately, actual operating conditions vary considerably from those simulated. Human beings are generally exposed in free air and seldom to a stationary, energized beam. Also, small fur-bearing animals tend to have high coefficients of heat absorption, small body areas, and relatively poor heat-regulating systems. By comparison, the human body has a superior regulating system that can adjust readily and maintain thermal stability under severe stress conditions. Tests on men show that adequate physiological function can be maintained in environments of 240 degrees F for 23 minutes, if the humidity is low.

The extent to which r.f. radiation may penetrate the body can vary. It depends largely on the wavelength or frequency of the energy and the absorptive properties of the body itself. As for the amount of temperature rise in the body, this is determined by the effective radiated power output of the transmitting device, distance from it, frequency, absorptive nature of body tissue, and the length of exposure.

According to Dr. Frank W. Hartman, Office of the Surgeon General, "If an individual in the performance of his duty should near the limit of his heat tolerance, and then have exposure to microwave heat, the body tolerance to temperature increase would be rapidly destroyed. A longer exposure to microwave heat alone could produce an irreversible hyperpyrexia (high fever), either local or general."

Effects of Frequency

Earlier references to microwave energy would indicate that the frequency of radiation is a factor in determining the hazard. This is true. Frequencies below 1000 mc. down to about 200 mc. are considered the true, deep-heating

(*Continued on page* 90)

Synchronized Electronic Switch

By **H. C. WALKER**

Waveforms are unbroken and frequency response is as broad as that of the scope with this adapter.

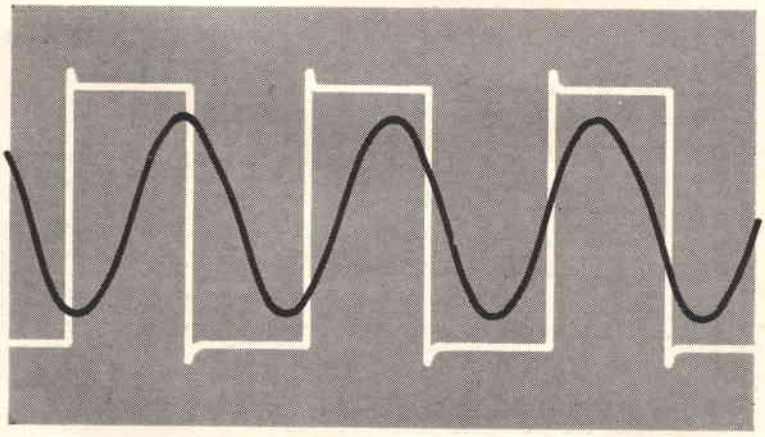
DESCRIPTIONS of electronic switches to provide dual-trace display on oscilloscopes that may also be conveniently built by the technician are not new. However, an attempt has been made here to provide two advantages not generally found in such units, although they are important. This unit presents unbroken displays by synchronizing directly from the scope's sweep and also reduces bandpass requirements of the scope. To state the last advantage in another way, it enables dual-trace displays at higher frequencies, for a given oscilloscope, than would be possible with other types of electronic switches.

The switch is basically an Eccles-Jordan flip-flop circuit, synchronized by the scope. It differs from similar free-running multivibrators in that one side of the circuit remains conducting, with the other cut off, until a sync signal reverses this condition. Thus it is easily synchronized to provide two output signals on alternate sweep cycles.

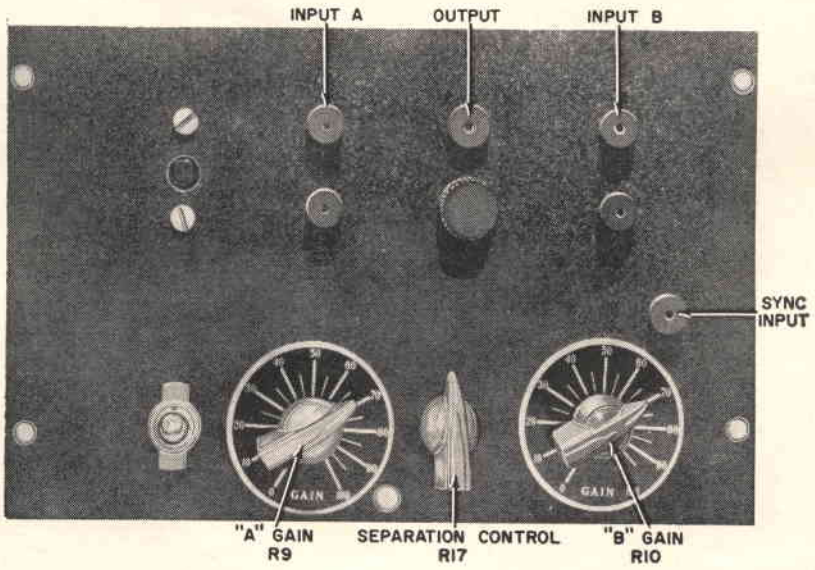
The standard Eccles-Jordan circuit, with sync input, is V_1 in Fig. 1. Each half of V_2 is a grounded-plate diode clamping the minimum value of the switching square wave to zero voltage. The two signals to be displayed are each applied to one grid of V_3. Output is taken from the cathodes of V_3 for application to the oscilloscope. More detailed operation can be followed by using approximate voltages to avoid calculations:

Assume that V_{1A} is initially conducting while V_{1B} is cut off. The conducting triode is operating with a positive bias so, disregarding its small plate resistance, its cathode and plate are at the same potential of 60 volts, determined by the voltage divider R_1-R_{18}. Each tube's plate is connected to the opposite tube's grid through a 3:1 voltage divider, and both cathodes are at 60 volts. Thus one-third of the plate voltage of V_{1A} (60 volts) is applied to the grid of V_{1B} through divider R_4-R_6. Therefore, the grid of the latter triode is at 20 volts, producing a grid-cathode net bias of minus 40 volts, which is enough to keep the tube section cut off. When V_{1B} is thus cut off, the full 240 volts of "B+" is at its plate. This V_{1B} plate voltage is reduced to one-third by R_3-R_5 and passed on (80 volts) to the grid of V_{1A}. Since the V_{1A} cathode is at 60 volts, the net bias is plus 20 volts, producing maximum conduction.

The two tube sections remain in this relationship until a sync pulse (of either polarity) causes them to "flip-flop" to the alternate condition. If a positive pulse is applied simultaneously to both grids through C_1 and C_2, it will have no effect on the already conducting V_{1A}, which is already passing maximum current. However, it will overcome the negative bias on V_{1B}, permit-



The front-panel layout used by the author in his version of the scope switch.



ting this triode to come out of cut-off and start conducting. This reduces plate voltage on V_{1B}. The reduction is coupled to the grid of V_{1A}, cutting off the latter stage.

A negative pulse at the sync input will initiate the same cycle of action in a different way. It will start to cut off V_{1A} directly by driving its grid negative through C_1. Coupling from the V_{1A} plate to the V_{1B} grid will cause the latter to start conduction.

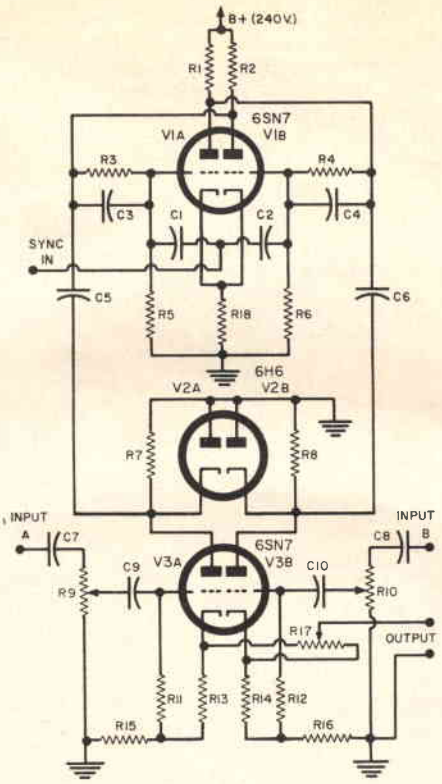
As V_{1A} alternates, between conduction and cut-off, its plate voltage alternates sharply between 60 and 240 volts. This square-wave output is applied (see Fig. 2) to the plate of V_{3B} through capacitor C_6. The purpose of diode V_{2B} is to discharge the capacitor quickly as the plate voltage of V_{1A} drops to its minimum of 60 volts. If this were not done, V_{3B} would still be passing input B from its cathode into the scope at the time when only input A should be displayed.

V_{2B} is a standard diode clamper with a grounded plate and having a long time constant at its cathode provided by R_8-C_6. When V_{1A} is cut off, its plate voltage rises to 240 volts, and C_6 charges slowly to this value through R_8. As it does so, there is a voltage drop across this resistor, making the bottom of R_8 positive. Since this is the point to which the plate of V_{3B} is connected, the latter stage is supplied with plate voltage during this period, permitting it to conduct and making its output available to the scope.

When V_{1A} switches into the conductive state, its plate voltage drops to 60 volts. Capacitor C_6 quickly discharges through the negligible resistance of diode V_{2B}, removing plate voltage from V_{3B}. The latter stage cannot conduct and its output is no longer available.

The synchronizing voltage for tripping V_1 may be obtained from the oscilloscope's sweep output in such a way that the tubes will alternate during flyback time, and the active period of whichever tube is conducting will correspond with the scope's period of normal trace. A simple way of doing this will be noted later. The important point is that, using this method of synchronization, two distinct advantages are obtained.

To understand these advantages, we must look at the conventional electronic switch. Its frequency of alternation is predetermined and not usually related to that of the waveform to be viewed, or the rate at which it is displayed. Let us suppose that we are observing a phenomenon through the switch whose fundamental frequency is 1000 cps. Let us further suppose that the switching rate is 10,000 cps. The channel through which the 1000-cps signal is passing therefore turns on and off 10 times during each cycle. The result is that, instead of having a continuous display, the 1000-cps signal looks like a broken line, consisting of 10 segments. This is difficult to view and does not provide good resolution of the observed signal. With the switch



R_1, R_2, R_{15}, R_{16}—68,000 ohm, ½ w. res.
R_3, R_4, R_{11}, R_{12}—3.3 megohm, ½ w. res.
R_5, R_6—1.8 megohm, ½ w. res.
R_7, R_8—1 megohm, ½ w. res.
R_9, R_{10}—1 megohm linear taper pot
R_{13}, R_{14}, R_{18}—22,000 ohm, ½ w. res.
R_{17}—50,000 ohm linear taper pot
C_1, C_2, C_3, C_4—.0001 μf., 400 v. capacitor
C_5, C_6—2 μf., 400 v. capacitor (see text)
C_7, C_8, C_9, C_{10}—.05 μf., 400 v. capacitor
V_1, V_3—6SN7 tube
V_2—6H6 tube

Fig. 1. An external or integral supply (not shown) powers this switch circuit.

described here, continuous, unbroken traces are provided.

Considering the matter from another point of view, we run into a problem of frequency response. Assuming the 10,000-cps switching rate just noted, this means that the electronic switch is feeding to the scope's vertical input, in addition to the signal to be viewed, a 10,000-cps square wave. To pass this square wave acceptably, the scope must be able to respond to frequencies (harmonics) that are approximately 10 times higher than the fundamental. Thus, to handle the 10,000-cps square wave, the scope would have to have good response to 100,000 cps. In this particular case, nearly any oscilloscope would be able to do the job. However, the higher the frequency of the waveform to be displayed, the higher becomes the desired switching rate, and the scope's bandwidth requirement becomes still greater. Thus phenomena displayed through the switch are limited in frequency to well below what the scope can handle without the switch. In the unit described here, the only limitations are those imposed directly by the oscilloscope.

In use, the author has found that his best point for taking off a synchronizing voltage for the switch is the left deflection plate of the oscilloscope. In most instruments, there are easily accessible external connections for the deflection plates. The two signals to be observed are applied to A and B input terminals of the switch, and the switch output terminals are connected to the vertical input of the oscilloscope. The gain controls for each channel, R_9 and R_{10}, are adjusted to determine independently the height of each trace. Separation control R_{17} is adjusted to superimpose or separate the two traces, as desired.

Power supply requirements (240 volts d.c. and heater voltage) are modest. Since this can often be obtained from existing equipment, no separate supply has been shown. The author has chosen to build an integral supply, using a 5Y3, on the chassis with the switch. Such an uncomplicated arrangement may be worked out without much difficulty by anyone who prefers it.

Two modifications of the circuit shown may be desired by some users. In certain cases, it may be found that the horizontal sweep voltage may be too small at certain frequencies to trigger the switch. If this problem develops, lift the ground ends of resistors R_5, R_6, and R_{18} (Fig. 1), but keep them connected to each other. From their junction, a variable resistor is connected to ground. Manipulation of this resistor, whose value may be determined experimentally, will bring the grid voltages of the conducting and non-conducting stages closer together, reducing the amplitude required of the sync voltage to produce triggering.

It may also be found that, at some frequencies of display, the time constants provided by C_5-R_7 and C_6-R_8 are not satisfactory. This can be overcome by using two or three capacitors, switch-selected, instead of one for C_5 and for C_6. The value for each of these capacitors has been given as 2 μf. Providing two additional values for each, 1 μf. and .5 μf., will increase the range to accommodate most needs. —30—

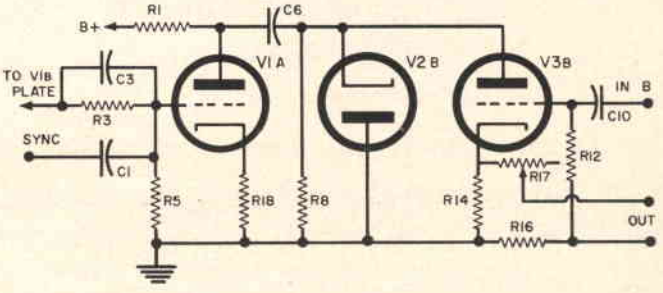
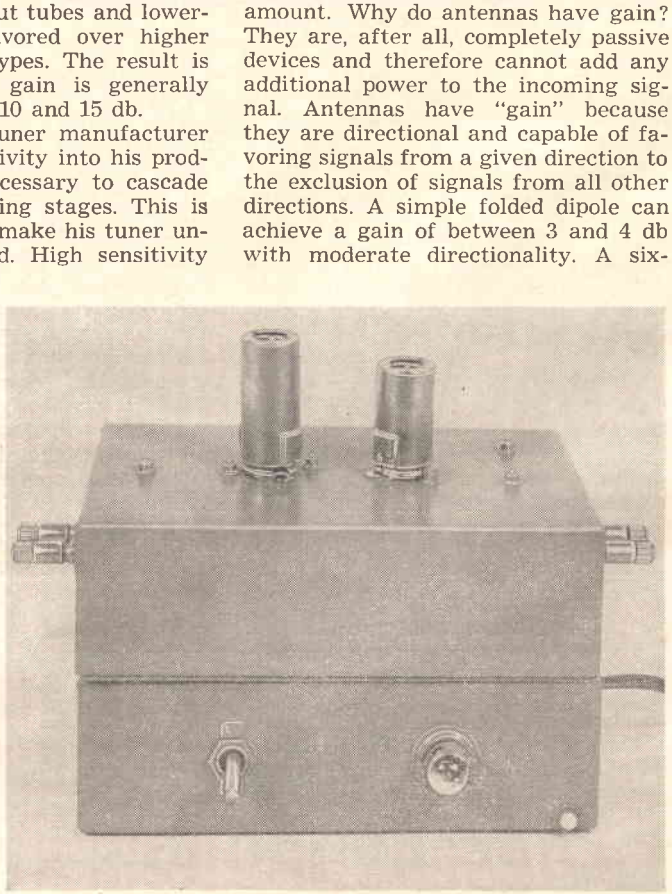


Fig. 2. Simplified circuit for the "B" channel only helps to clarify the "on-off" action for either of the inputs.

Simple Booster For FM Tuners

By **FRANCIS A. GICCA**
Senior Engineer, Raytheon Co.

Design and construction of cascode front end that increases sensitivity by 20 db. The unit can be built for only about $15.



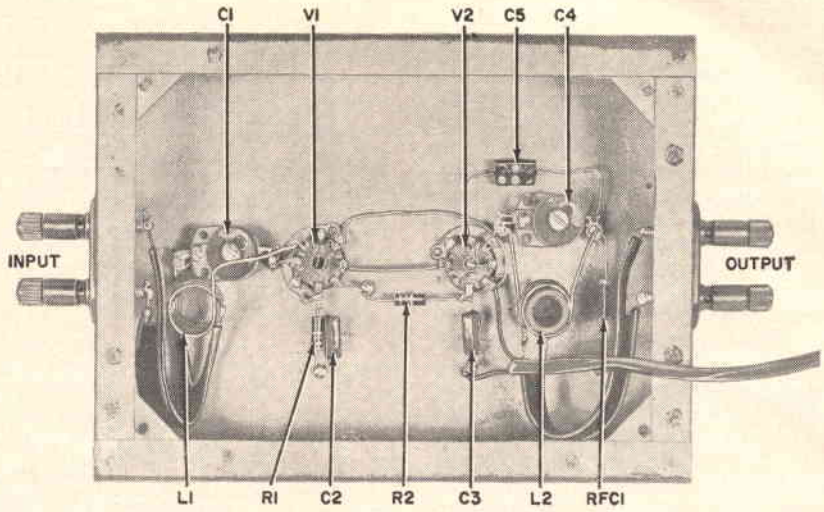
The r.f. chassis of the booster is atop the power-supply chassis. ▶

PERHAPS nothing can be more annoying than insufficient FM receiver sensitivity, particularly when you are planning to tape-record a live concert from a distant station only to find that you can't receive the station very well at all.

Why don't more FM receiver manufacturers build in sufficient tuner sensitivity so that this problem will never occur? They can, but at a price. Building high gain into the front end of an FM tuner is a difficult engineering job. First, the r.f. amplifier must be wideband since it has to amplify all frequencies in the FM band from 88 to 108 megacycles. Achieving high gain over such a wide bandwidth is almost impossible. It must be remembered that a vacuum-tube amplifier is limited in gain, that is, even with optimum circuit design, there is a *maximum* amount of gain that can be extracted from a vacuum tube. The better the tube, the higher will be its maximum available gain.

Unfortunately, a high-gain tube also generally has higher internal capacitance between its electrodes. This interelectrode capacitance means that as the input frequency is increased the gain of an amplifier begins dropping due to the shunting of these capacitors at high frequencies. As a result, vacuum tubes have a maximum achievable bandwidth because of internal stray capacitance. A good vacuum tube, therefore, is characterized by a high maximum gain plus high bandwidth capabilities. In order to compare the relative performance of tubes, a good "figure of merit" is the product of the maximum obtainable gain and maximum bandwidth. This figure of merit is generally known as the "gain-bandwidth product" (F_t). The better the tube, the higher its gain-bandwidth product. Table 1 lists the gain-bandwidth products for several popular pentodes.

Note that the 6AC7 has a gain-bandwidth product of 562 million. If the 6AC7 were to be used as an r.f. amplifier in an FM tuner, what is the maximum gain that can be expected? The FM band covers 88 to 108 megacycles; a bandwidth of 20 megacycles. The maximum gain that can be expected is 562 million divided by 20 million, or 28.1. This is a maximum gain of 29 db. In production units, such gain could never be achieved consistently, therefore a gain of about 20 db would be normal with a 6AC7.



Under-chassis view of r.f. section. Short, direct wiring should be employed here.

Gain is not the only requirement of an r.f. amplifier, it must also be relatively noise free. Here again, noise requirements are in conflict with high gain. Pentodes are noisier than triodes, but pentodes have the higher gain. Since low noise is vital in an FM tuner, a compromise is generally necessary in the choice of input tubes and lower-noise types are favored over higher gain, but noisier, types. The result is that r.f. amplifier gain is generally limited to between 10 and 15 db.

In order for a tuner manufacturer to build high sensitivity into his product it would be necessary to cascade several r.f. amplifying stages. This is expensive and may make his tuner uncompetitively priced. High sensitivity is needed only occasionally, therefore, the manufacturer compromises and designs a tuner with reasonable sensitivity at a reasonable price. On distant stations, then, many FM tuners will lack sensitivity. Even weak local FM stations may be received marginally as evidenced by background noise or annoying "snaps" and "pops" due to automobile ignition systems.

What can you do to increase the sensitivity of your FM tuner? There are two possible solutions. You can install a high-gain FM antenna or you can add an external r.f. amplifier to boost the strength of the signal before it enters the tuner.

FM antennas can improve receiver sensitivity, but by only a limited amount. Why do antennas have gain? They are, after all, completely passive devices and therefore cannot add any additional power to the incoming signal. Antennas have "gain" because they are directional and capable of favoring signals from a given direction to the exclusion of signals from all other directions. A simple folded dipole can achieve a gain of between 3 and 4 db with moderate directionality. A six-

element yagi can provide gains between 6 and 9 db at the expense of considerable directionality. These gains, although relatively low, may be adequate for many marginal stations. However, because of the directionality of antennas, all marginal stations must be located in the same general direction from the receiver in order to benefit from the antenna's gain. If this is not so, then the antenna will have to be rotated to face each station. Perhaps an FM booster is a more practical and economical solution.

FM Booster Design

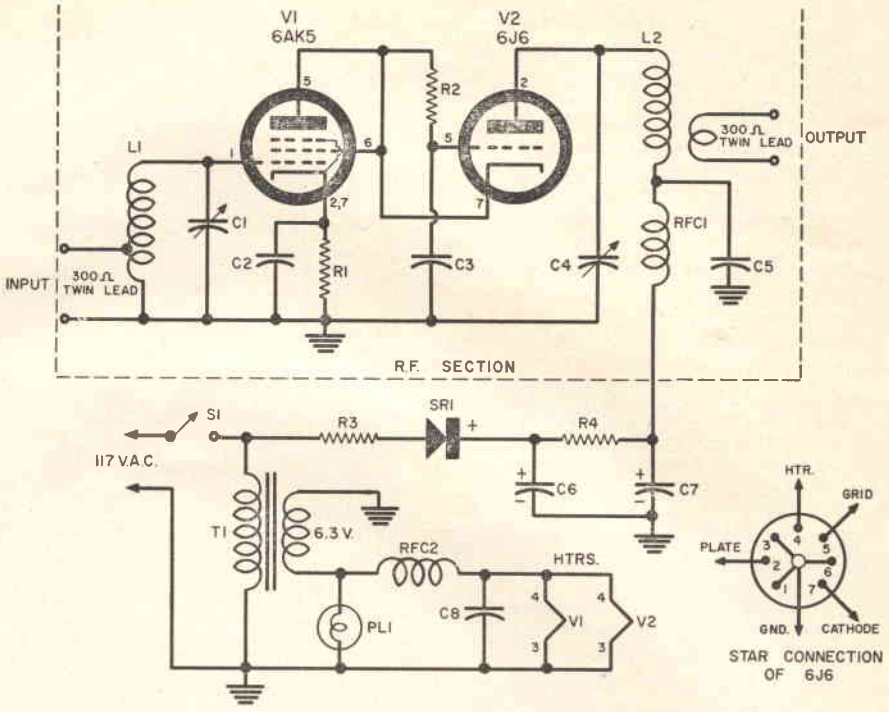
Keeping in mind what has been said about r.f. amplifiers, an FM booster can be designed which will yield higher sensitivity than any antenna system. Since low noise is of paramount importance, the circuit chosen must have inherently good noise characteristics. The triode exhibits far superior noise performance than a pentode but, as mentioned previously, it has lower gain. In the design of television front ends this same problem was met and solved with the development of the "cascode" amplifier. Basically, the cascode amplifier has the gain of a pentode with the low-noise characteristics of a triode. The cascode amplifier consists of two triodes, the first connected grounded-cathode and the second connected grounded-grid. Since the cascode amplifier offers the desired characteristics of high gain and low noise, it was decided to choose this configuration for the FM booster.

If a 6AK5 (connected as a triode rather than a pentode) and a 6J6 are connected in cascode, a gain-bandwidth product of about 500 million can be expected. Note that this compares favorably with the best pentode in Table 1, the 6AC7 with its gain-bandwidth product of 562 million.

TUBE	F_t
6AB7	385
6AC7	562
6AG7	385
6L6	236
6SJ7	127
6SK7	154
6V6	195

What gain would be desirable for our FM booster? If a gain of at least 20 db could be achieved, this would make the booster far superior to any antenna system and certainly worth considering. We must remember that the gain-bandwidth product specifies the *maximum* performance that can be expected, therefore, a safety factor should be included to account for the losses that will occur in an actual circuit. Let's arbitrarily try for a gain of 40 db, knowing that this will allow a more than adequate safety factor. Forty decibels is a gain of 100. Since the gain-bandwidth product is about 500 million, the maximum bandwidth that can be obtained is 5 megacycles

(*Continued on page* 100)

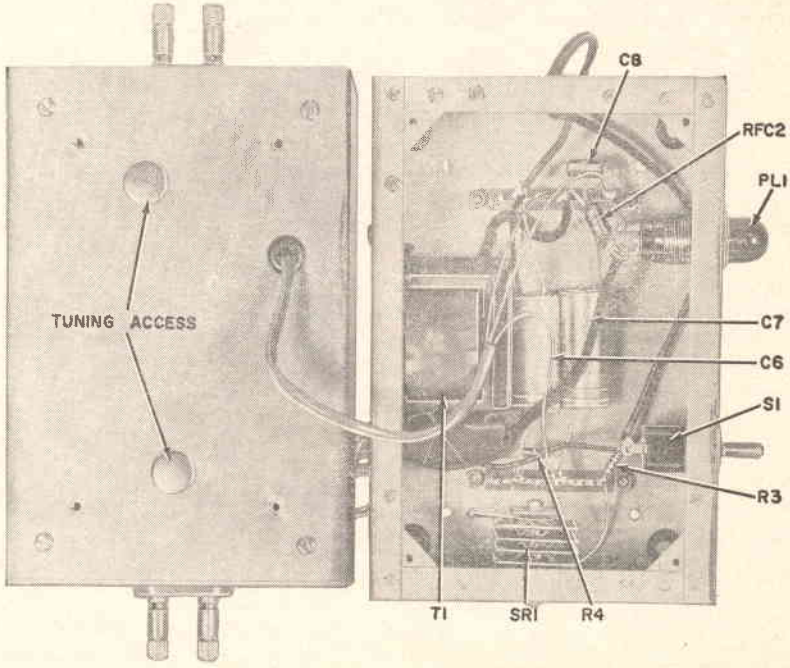


R_1—68 ohm, ½ w. res.
R_2—51,000 ohm, ½ w. res.
R_3—15 ohm, ½ w. res.
R_4—1500 ohm, ½ w. res.
C_1, C_4—6 to 12 μμf. trimmer or variable (E. F. Johnson Type 160-107, see text)
C_2, C_3, C_5, C_8—510 μμf., 500 v. mica capacitor
C_6, C_7—20 μf., 150 v. elec. capacitor
L_1—.3 μhy. tapped coil. 4½ t. #16 en. wire wound on ½-inch coil form. Turns spaced to 1-inch over-all. Tap at 1½ t. from bottom end.
L_2—.3 μhy. output tank. 4½ t. #16 en. wire wound on ½-inch coil form. Turns spaced to 1-inch over-all. 1 t. output link wound between bottom wire turns
RFC_1—10 mhy., 75 ma. r.f. choke (National R-300 or equiv.)
RFC_2—.36 μhy., 2 amp r.f. choke (National B20407-4 or equiv.)
SR_1—20 ma., 130 v. selenium rectifier (Federal 1159 or equiv.)
S_1—S.p.s.t. toggle switch
PL_1—6 v. pilot light
T_1—Fil. trans., 6.3 v. @ 1.2 amps (Triad F-14X or equiv.)
V_1—6AK5 tube (triode-connected, see text)
V_2—6J6 tube

Fig. 1. Complete circuit diagram of the FM tuner booster. Circuit within dashed lines is built into one chassis while power-supply components are in another chassis.

◀ Table 1. Gain-bandwidth products (×10⁶) are shown for several popular pentode tubes.

"Opened up" view of the two chassis making up the booster. The bottom of the r.f. section is covered for good shielding. Two openings (covered with snap-in plugs) permit access to C_1 and C_4. Layout of power-supply parts is clearly shown at right.



Recent Developments in Electronics

Tiny Atomic Generator

SNAP-3, a midget electrical generator fueled with radioisotopes, has operated successfully in a vacuum and at temperatures down to 100 degrees below zero. The Nuclear Division of *The Martin Co.*, which designed and built the unit for the U. S. Atomic Energy Comm., reports that the original generator was still producing electricity after a full year of continuous operation and that other test units have survived sharp impacts, vibration, and rocket-like acceleration without damage. In SNAP-3 (*S*ystem of *N*uclear *A*uxiliary *P*ower), heat produced by radioactive decay of 1/40 ounce of polonium-210 is converted directly into electricity by thermocouples.



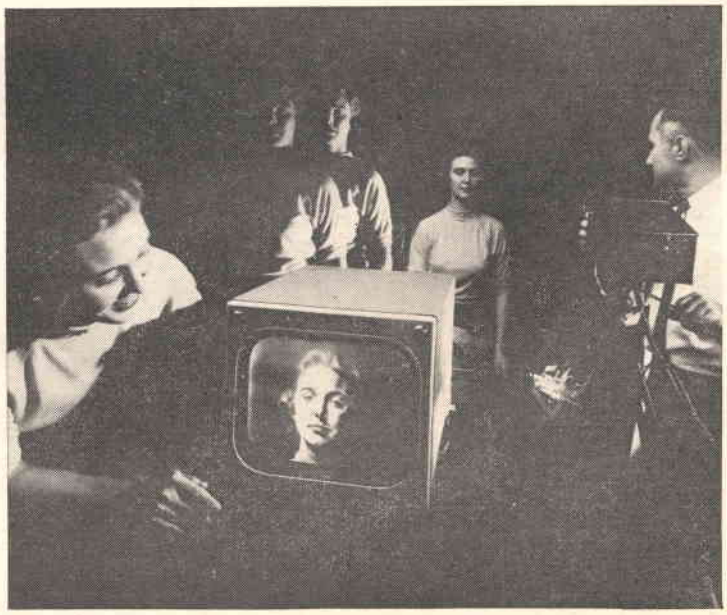


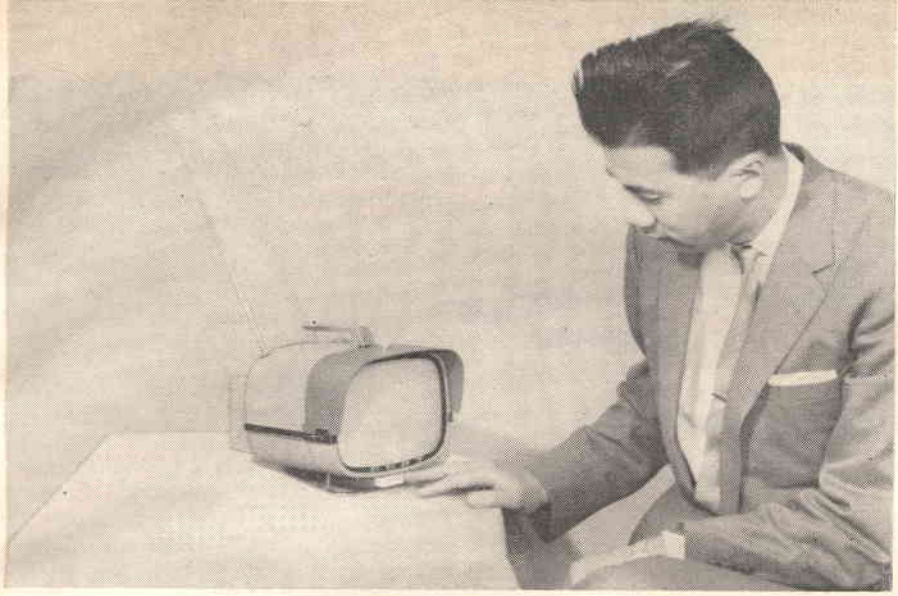
Semi-Automatic Crystal-Growing Furnace

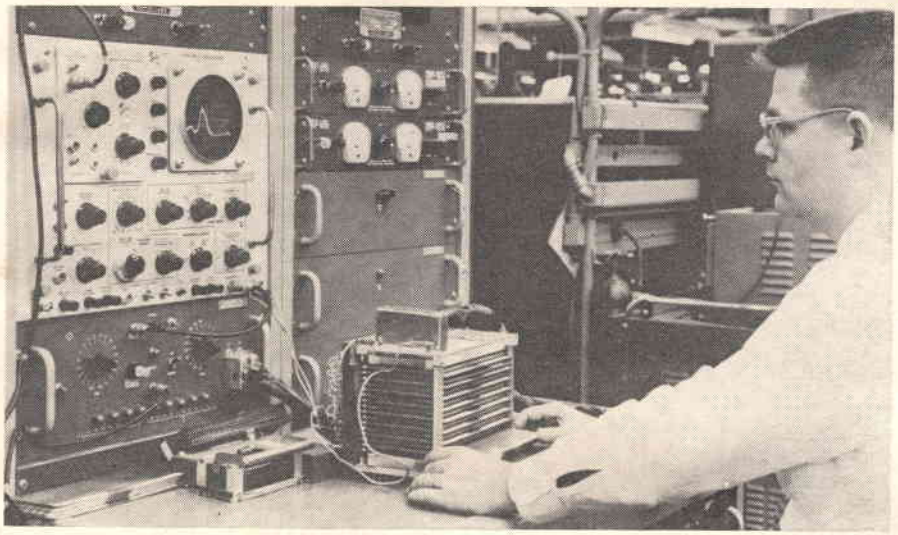
A new semi-automatic crystal-growing furnace with triple the production capacity of conventional furnaces is to be marketed by *Hoffman Electronics Corp.* One technician, formerly required to tend a furnace at all times during the crystal-growing cycle, can operate four of the new furnaces simultaneously. Complete and automatic programming of each production process is provided. The furnace can produce a monocrystalline silicon ingot weighing up to 530 grams in 150 minutes.

TV With a Memory

This multiple exposure demonstrates a new TV camera tube that "memorizes" what it sees. To show how it works, the young woman stood before the TV camera for a split-second exposure, then walked around immediately to see her image frozen on the receiver screen. Developed by the *Westinghouse* electron tube division, the new camera tube is called "Permachon." A special photoconductor material on the tube's faceplate stores the picture, and after exposure an electron beam scans the faceplate to transfer the image to a conventional TV screen. Stored pictures will remain on the screen as long as one hour for leisurely study or photographing. Potential uses include air-traffic control for continuous tracings of aircraft on the radarscope; instant photofinishes at racetracks; and memorizing fluoroscopic images to reduce exposure time.

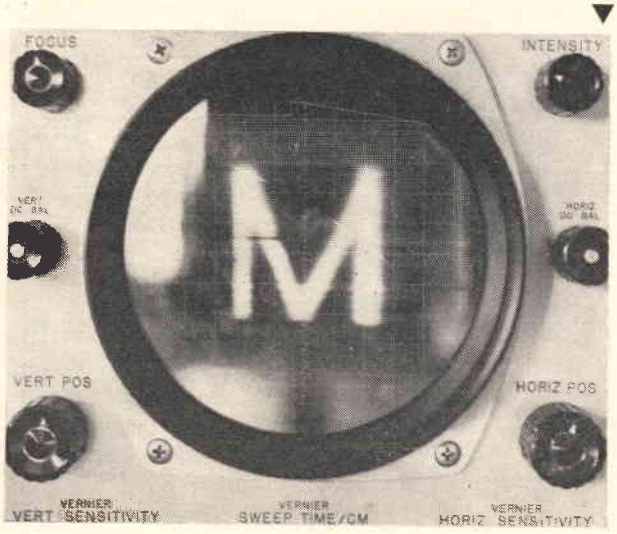






Infrared Scanning System

Philco scientists have perfected a method of reproducing electronically an image of heat-emissive targets detected by cells sensitive to infrared. Called "Filterscan," the system offers good picture quality with a TV-type image presented in a pattern of 150 scanning lines. Electronic scanning is said to be some 30 times faster than mechanical systems which use a moving mirror scanning an image at one frame per second. Rapid changes in direction or heat-intensity of a target can thus be monitored more closely.



All-Transistor TV Set

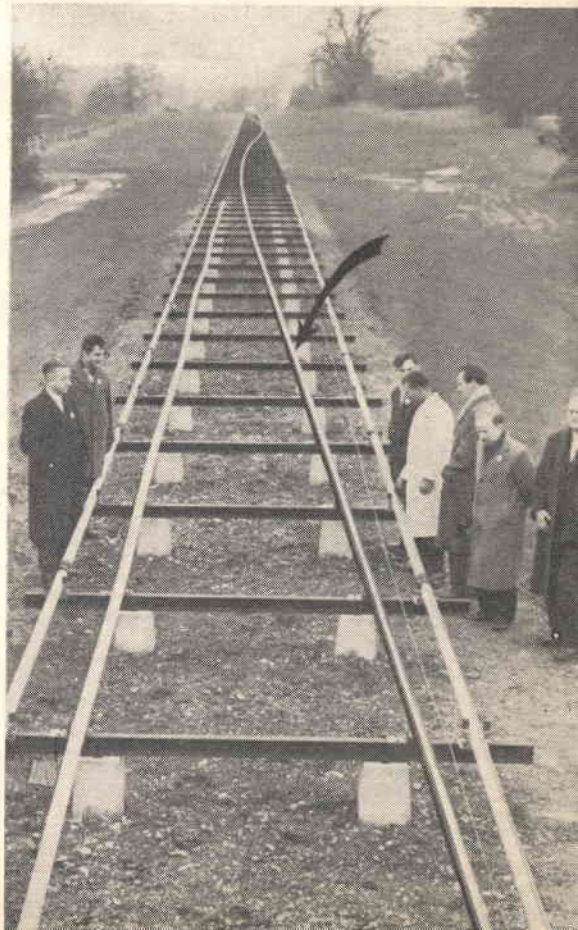
The *Sony Corp.* is putting on the market in Japan its new all-transistor personal TV set for about $200. The set will not be exported to this country until it has been thoroughly field-tested in Japan. It is expected that 1000 to 1500 sets per month will be produced, but production of 10,000 sets every month is planned by the end of 1960. The receiver uses an 8-inch direct-view picture tube, 23 transistors, and 14 diodes. It operates from a self-contained sealed rechargeable 12-volt battery or from the a.c. power lines. The receiver measures 6¼" x 8" x 8¾" and weighs 13 pounds with its battery.

"Twistor" Computer Memory

Computer technology has been advanced by a new, accurate, and fast electronic memory unit built up of alternating grids of magnetic wire strands called "twistors" and plastic cards with arrays of minute bar magnets. The development is the result of work done by *Western Electric* and *Bell Telephone Laboratories.*

TV Through a Pipe

Live TV pictures are being sent through a circular waveguide for a distance of more than half a mile by means of an experimental pulse-code modulation circuit shown here under inspection by engineers at Hertsfordshire County, England. In commercial use the 3-inch waveguide would be buried. Tests are being conducted by *Standard Telecommunication Lab.,* British affiliate of *ITT.*



A Capacitor Tester & Healer

By **MELVIN S. LIEBERMAN**

Determine leakage reliably with true operating voltages; also re-form failing electrolytics.

ONE OF THE characteristics of electrolytic capacitors is that, after they have been stored for some time without use, the dielectric will decay and will have to be re-formed before the capacitors will again be useful. If the inactive storage time has been a number of years, re-forming may never take place completely. This results in higher current leakage. Electrolytics also become quite leaky after years of faithful service. The excessive leakage current can easily go unnoticed and, in so doing, may tax the power supplies of equipment in which the capacitors are installed. Finally a point is reached where fuses blow or transformers, filter chokes, or rectifiers are damaged.

Because it is handy, an ohmmeter is frequently used to check leakage in electrolytic capacitors. However, an ohmmeter, because it is a low-voltage device, cannot give a true picture of leakage. Leakage current is plotted against applied voltage for two capacitors of the same nominal value (24 μf., 350 v.) in Fig. 1. Despite variation, they follow a similar pattern, with the amount of leakage depending on the impressed voltage. An ohmmeter, which effectively applies a low test voltage, could easily indicate that a poor capacitor is acceptable. The only satisfactory test is one in which the voltage used is at or near the rated value of the electrolytic that is under suspicion.

Need for a Tester

In the past, whenever the author had to check the condition of an electrolytic capacitor (or a non-electrolytic unit, for that matter), a power supply and a multimeter had to be gathered and arranged for the purpose. Since this test was not an infrequent one, a unit specially built to provide the function was considered worthwhile, especially since it is useful for other tasks. Aside from testing, the device is ideal for

Fig. 1. Leakage current readings depend on applied voltage.

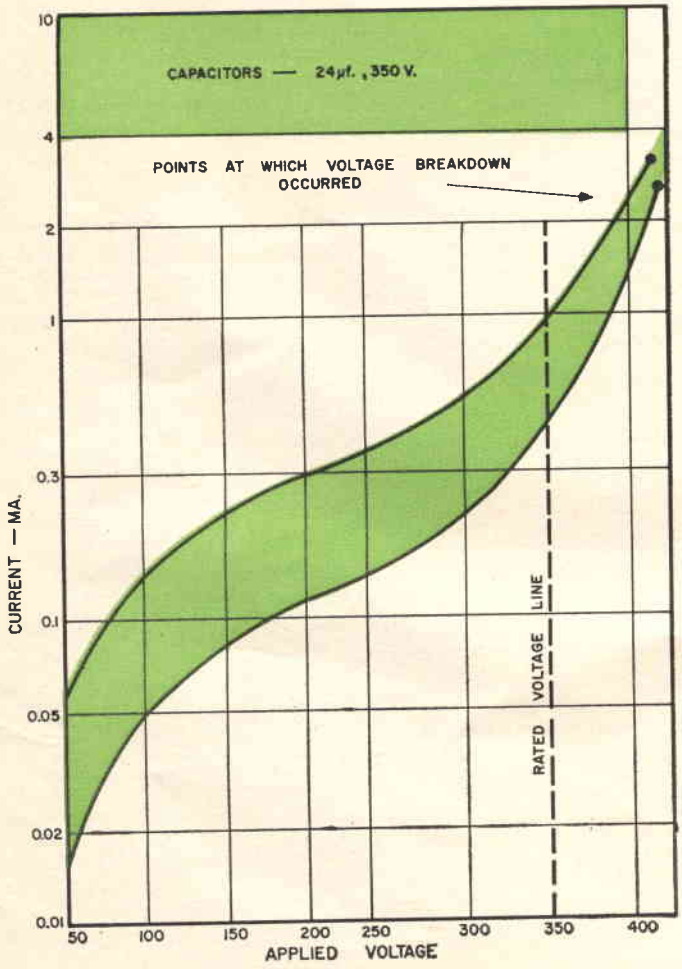
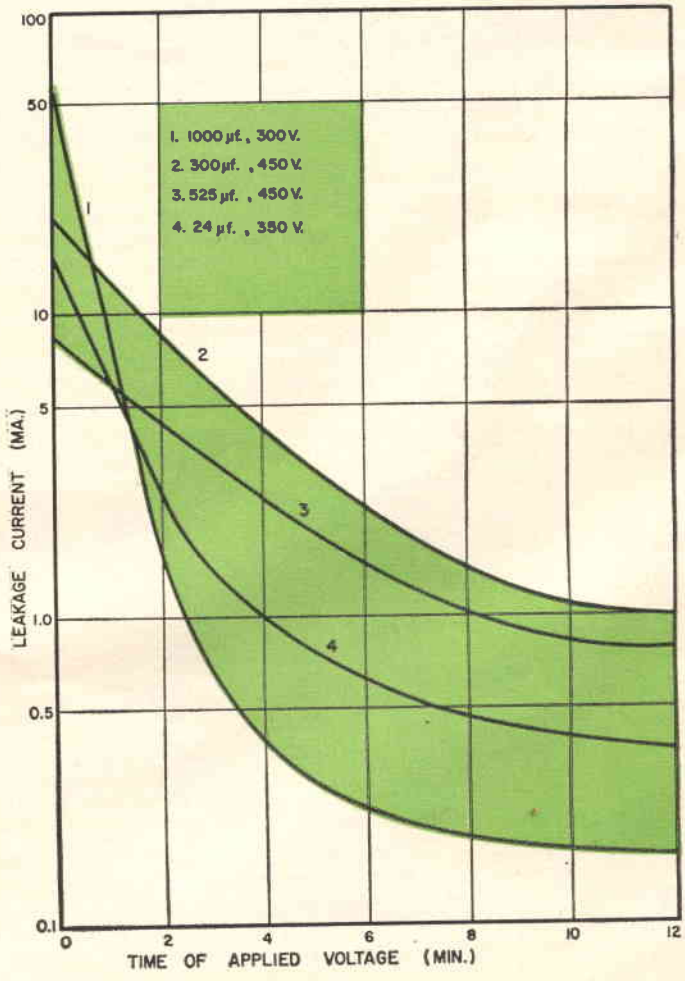


Fig. 2. Typical healing times of large electrolytic capacitors.



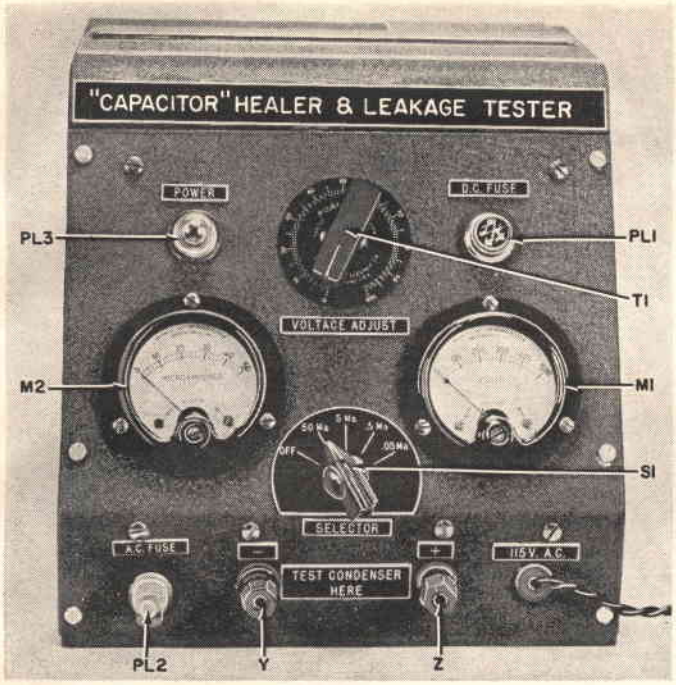


Fig. 3. Front-panel view shows layout of major components.

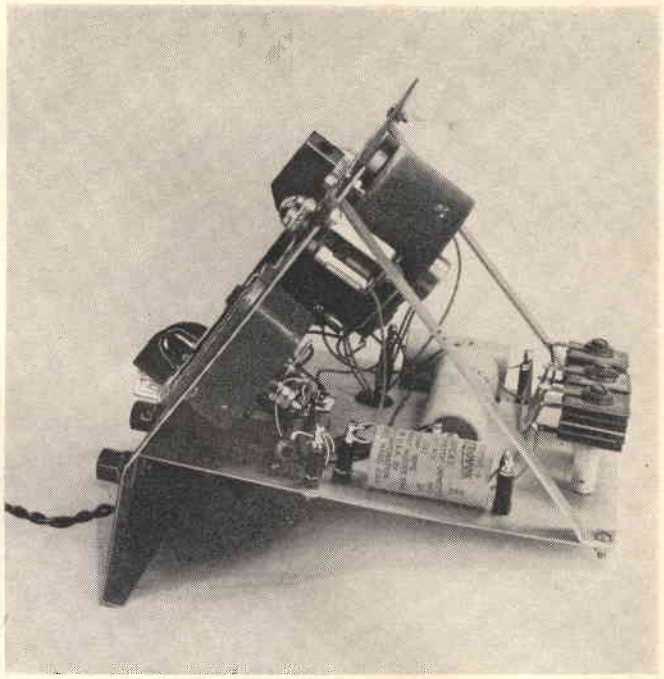


Fig. 4. Side view shows how aluminum straps support chassis.

healing the electrolytic capacitors (reforming the anodic film).

It is also useful for determining the voltage rating of electrolytics that are not properly marked or have lost their markings. After such a component has been re-formed, all one has to do is observe the curve of applied voltage *vs* leakage current. It will be observed (Fig. 1) that leakage current begins to increase rapidly at or just above the rated working voltage. The tester can also serve as a metered d.c. supply. For the two years it has been in use, it has proved dependable and trouble free.

Circuit Description

The a.c. input (Fig. 5) is applied through switch S_{1A} on positions 2 through 5, position 1 being off. A fuse assembly (*FA*) was used so that, in the event of a blown fuse, the incorporated neon light provides indication. For the sake of economy, a standard fuse holder could be used. Another neon lamp was used as the "power-on" indicator.

Current is then applied to a variable-voltage autotransformer (*Powerstat* type 10, T_1) through terminals 1 and 4. Output is taken from terminals 1 and 3, with the latter being the "Voltage Adjust" control on the front panel. Range of the transformer is from zero to approximately 130 v.a.c.

From T_1, a.c. is applied to a voltage tripler through lamp PL_1. The latter serves as a current-limiting resistor to protect the selenium rectifiers as well as functioning as a fuse for the d.c. circuit. Rectifiers SR_1-SR_3 and capacitors C_1-C_3 comprise the tripler The d.c. output is then fed to two meters.

Meter M_1 is a 0-500 voltmeter requiring 1 ma. for full-scale deflection. With the meter being used, a 500,000-ohm series resistor (R_2) was required to obtain full-scale deflection at 500 volts. The other meter, M_2, was a *Weston* model 506 equipped with a 0-50 microampere scale. Switch section S_{1B} selects the various shunts (resistors R_3 to R_5) for the leakage-current ranges to be observed. Resistor R_3, which will be in the vicinity of 1 ohm, is made up by cutting a length of resistance wire to the size that will permit full-scale deflection with 50 ma. applied. The switch is so wired that, when the tester is first turned on, the highest current range is brought into action first. This was done to provide protection when the test capacitor has abnormally high leakage, and also because otherwise good electrolytics that require some healing will exhibit their highest leakage when first inserted.

Cost is prevented from becoming excessive by avoidance of an isolating, step-up power transformer. While this deprives the user of desirable isolation, the hazard is no greater than with much conventional equipment. An isolation transformer can be used, if desired, or reasonable precautions can be taken against shock hazard.

Operation

To test a capacitor, it should be connected to terminals *Y* and *Z* (Figs. 3 and 5) *with the selector switch off*. If the unit is an electrolytic type, polarity must be observed. (If the user has failed to do so, he receives a warning during the test: heavy current will flow at a fraction of the capacitor's rated voltage). Before turning the unit on, make certain that the "Voltage Adjust" control is set to zero. Now set the selector switch to its first position (50 ma.) and begin to advance the voltage control slowly.

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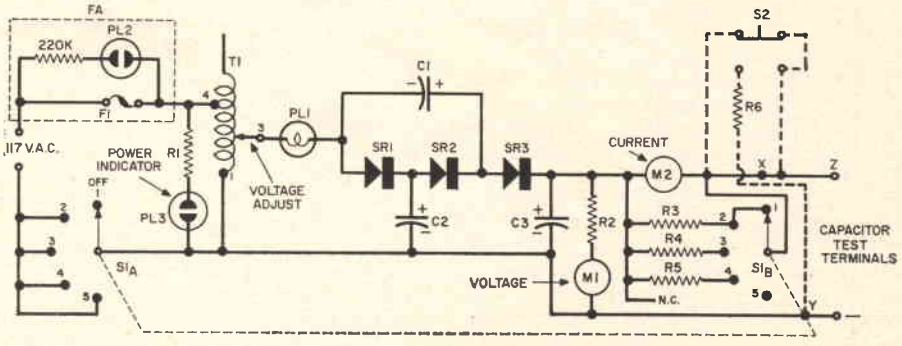
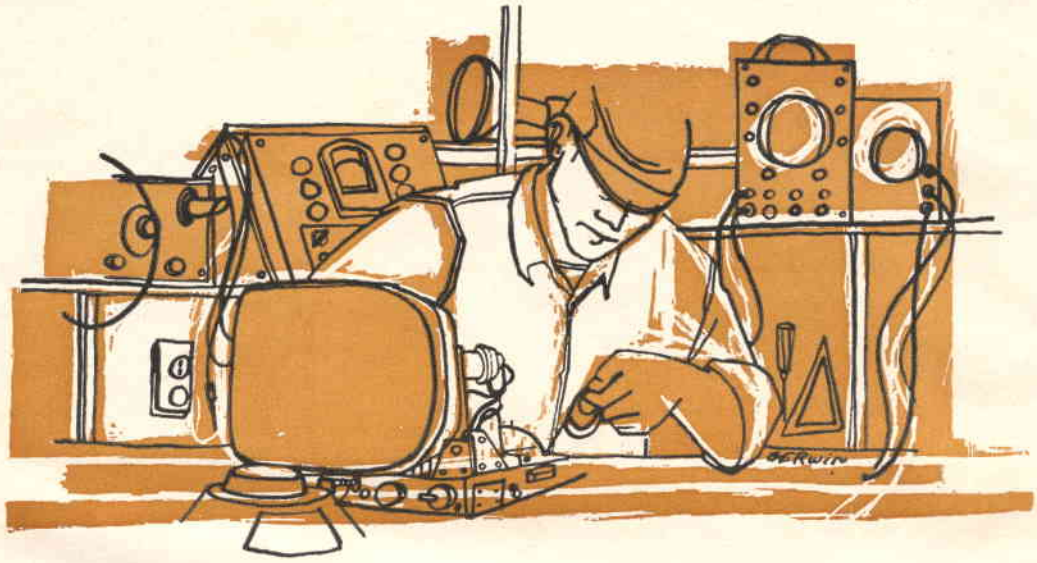
Fig. 5. Broken lines at the right indicate an optional discharge circuit.



R₁—68,000 ohm, ½ w. res.
R₂—500,000 ohm, 1 w. res.
R₃—Meter shunt (see text)
R₄—10 ohm, 5 ma. ammeter shunt
R₅—100 ohm, .5 ma. ammeter shunt
R₆—100,000 ohm, 2 w. res. (optional, see text)
C₁, C₂—25 μf., 350 v. elec. capacitor
C₃—16 μf., 700 v. elec. capacitor
M₁—1 ma. full-scale meter (Weston 506, see text)
M₂—50 μa. full-scale meter (Weston 506, see text; other meters require different shunts)
T₁—Autotransformer, 0-132 volts @ 1.75 amps. (Superior "Powerstat" #10 or equiv.)
PL₁—No. 313 lamp, d.c. fuse (G-E)
PL₂—Part of FA
PL₃—NE-51 neon lamp
FA—Indicator fuseholder assembly (Buss Type HKL or equiv.) F₁—¼ amp. fuse
S₁—D.p. 5-pos. switch (Centralab, "Range Switch")
S₂—Two-circuit momentary push-button switch (optional, see text)
SR₁, SR₂, SR₃—100 ma. selenium rectifier

SERVICE IN 1959

Action instead of talk is helping an industry stabilize its future, with organized groups playing a lead role.



HOW DID things go, in the year just past, with the men responsible for keeping the nation's 50 million television receivers and 170 million radios in good shape? "Same as usual," one might be tempted to answer. "The sets haven't changed much, and neither have the customers. Manufacturers and distributors haven't lost their knack for giving hard-working technicians fits from time to time. There is the same old outcry for (or against) licensing, about part-timers, about tube sales through non-service outlets, and about half a dozen other things. The association boys still yell their heads off. But nothing really changes."

Fortunately, there is much less truth in the assumption than at first appears. By and large, the problems are the same as they were in 1958 and the year before. But the boys haven't just been yelling their heads off. They've been *doing* things too. As a result, the nature of some of the long-standing problems is changing. Remedies are being found, or have already been found, in some cases. In any case, 1959 was a year for action.

Take the case of licensing. Although there are some segments of service still staunchly opposed to it, most of the industry is convinced that it must come. For years, the issue has hung in the balance, sharing top honors with weather as something everybody talks about but about which no one does anything. This last year has seen, at last, significant cracks in the great wall that has held back the tide. There are now at least half a dozen places in the country where licensing legislation has gone into effect. Although litigation by anti-licensing forces has held up enforcement, supporters succeeded in getting a bill passed in Kansas City, Mo. Louisiana went on record as the first *state* to try licensing. The results of a couple of years of experience with such a bill in Detroit has touched off a well-organized campaign to extend legislation throughout the state of Michigan. Niagara Falls, N. Y., also has an operative law, and such cities as Milwaukee and Madison, in Wisconsin, have had some form of license legislation in effect for many years.

The important point is that lawmakers need no longer be timid over experimentation with an untried technique. There are a sufficient number of communities now affected by service licensing so that its desirability may be evaluated, one way or another. Well organized drives for appropriate legislation are on in at least half a dozen states, and the failure of a law-making body to pass a bill in most of these is the signal for a renewed effort on the part of supporters to increase the chances of success at the next session. In such states as Ohio, Illinois, and New York, pro-licensing forces do more than press for a general bill. In each of these, a fully developed model bill is being promoted, clearing away a major roadblock. The Detroit bill has successfully weathered a test of its constitutionality.

Pressure from service itself for licensing has largely eliminated the wave of ill-conceived proposals in this area that would hurt the industry seriously instead of helping it. A conspicuous exception was a planned law in Massachusetts that would have limited the maximum fee for a service call to $3, thus encouraging rather than eliminating dishonest service. Alert action on the part of Massachusetts associations, who also were instrumental in getting set manufacturers to testify against the proposal, warded off a disaster.

Where a universal, mandatory bill is not yet a reality, service forces are promoting its cause by ingenious use of existing laws and other measures. Persistent action is the keynote. In such states as Pennsylvania, Florida, and Washington, operators who are half in the service business and half out of it are often in violation of sales tax laws. Responsible professionals are insisting on prosecution of such violators, and getting results. In other cases, the failure to maintain a shop in a classified business area is being used as a weapon, as is the failure to take out a license that is required of all business ventures.

Certification or "self-licensing" is also being re-examined as a second-best measure, as in eastern Pennsylvania and New York State. Associations in these areas are attempting to set up qualifying examinations on the basis of which technicians who pass receive credentials attesting to their qualifications. The public is being pressed to ask for these credentials from the people they call upon to service their sets.

Education

Such programs are usually tied up with the recognition of the need for adequate education. In North Carolina, for instance, failure to pass a

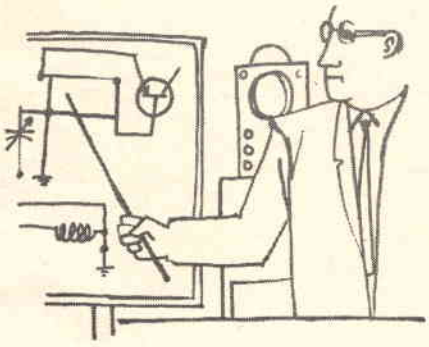
qualifying examination does not close the door in a technician's face. A technician training program, worked out in cooperation with the Vocational Educational Department of the regular school system, is designed to upgrade the unqualified. Despite frequent cries that the field is already too crowded, and charges by some segments that established service people seek legislation only so that they may block the entry of new competitors, there is a growing feeling that service must have the foresight to encourage a steady flow of new people *who are qualified.* Apprentice training programs are being articulated in Indiana, Minneapolis, Minn., Santa Clara, Calif., and other places. A program for training handicapped workers is being developed in San Antonio, Tex. Extensive business-training programs, flourishing in Detroit and elsewhere, reflect the continuing realization that technical knowledge alone is not enough.

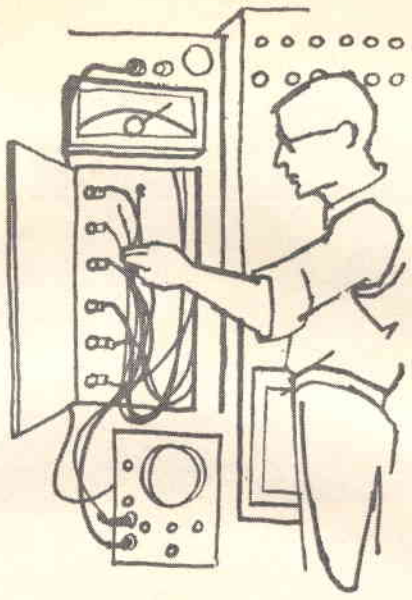
What of Part-Timers?

In a survey conducted by TESA of Southwest Missouri, members were asked to cite what they considered the "greatest deterrent to a profitable service business." The part-time operator won the role of scapegoat hands down. TESA of Chicago estimates that there are five part-time servicers to every full-time man in its area. According to TSA of Des Moines, Iowa, the ratio is 10 to 1 in that city. A revised sales-tax law in Texas, requiring all dealers to register, has revealed 35 "hidden" shops to every one previously known to be in business, according to TEA of San Antonio!

Notwithstanding this situation, organized service was less disposed than ever, in 1959, to find an easy goat. Without a doubt, many part-timers lack sufficient training and experience, operate without adequate equipment, and conduct basement businesses with such curtailed overhead that they can price the legitimate businessman right out of the market. However, many servicers now well established remember that they themselves had to begin as part-timers, albeit ethical ones. NATESA officially distinguishes between the two types. An article in the "Hoosier Test Probe" (Indiana) points out that we should differentiate, not between part-timers and full-timers, but between ethical and non-ethical service people.

San Antonio service people claim





that, in seeking restrictive legislation, they are not trying to drive part-timers *out* of business but are trying to put them *in* business—legitimately. Many associations, like ARTSNY of New York, welcome such newcomers as provisional members. The educational programs already cited also reflect some understanding of this problem. In few of its activities has organized service shown greater evidence of its growing maturity and its willingness to evaluate all sides of a problem, with fairness and without hysteria.

Captive Service

Captive service, factory service, extended warranties, and other related activities by set manufacturers that tend to take the nation's defective receivers out of the hands of the independents continue to be a major headache. The annual national service bill, now measurable in billions of dollars, is being eyed seriously by many manufacturers as a possible source of profit.

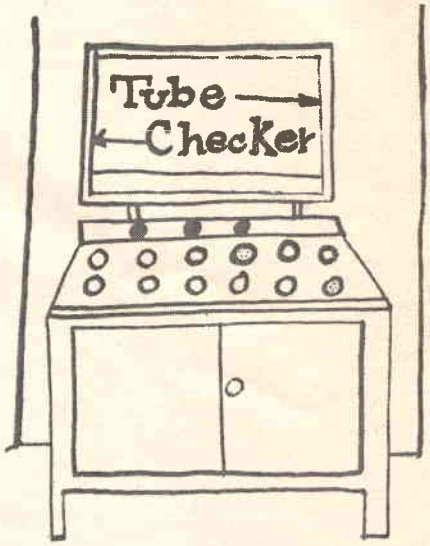
Although legal attacks against manufacturer activity in this area may have some theoretical basis, independents generally feel a battle in the courts is not practical. However, most of the manufacturers involved in such activity also have other divisions engaged in the manufacture, distribution, and sale of tubes and other components. While a direct retaliatory boycott is illegal, "selective buying" has become a war cry of the independents. "No one can force you to support your competitor by buying from him," the argument goes.

The strategy has had an interesting effect on many manufacturers, since the large ones involved permit considerable autonomy in setting policy among their various divisions. Those people concerned with selling sets continue to see the advantages of also selling service. Hardest hit by selective buying, however, are not the set people but the tube and component divisions. The latter groups are often as much opposed to the set divisions' service policies as are their customers, the independents. Yet the final decision is out of their hands. The responsibility for breaking such conflicts within an organization obviously resides in top management, which has failed to recognize its obligation in this matter. The tragic comedy is highlighted when the set division announces an extended service program one day and the tube or component division issues a counter-statement the next, as so often happens. In the meantime, although little in the way of satisfactory results was evident in 1959, independent service has little choice but to continue to apply the pressure to force the issue.

Meanwhile, service has fared much better, by speaking out clearly, in other dealings with manufacturers. A cooperative effort between these two interests (NATESA and ESFETA of New York State, on the one hand, with the Institute of Printed Circuit Manufacturers and individual set manufacturers, on the other) has resulted in progress in one area from which both groups will benefit, as well as set owners. Printed boards are being built better, coded better, and laid out better. In fact, with service having made the buying public aware of the problem, serviceability of sets has become an important sales feature.

Wholesale or Retail?

Manufacturers have never been the only segment of electronics with which

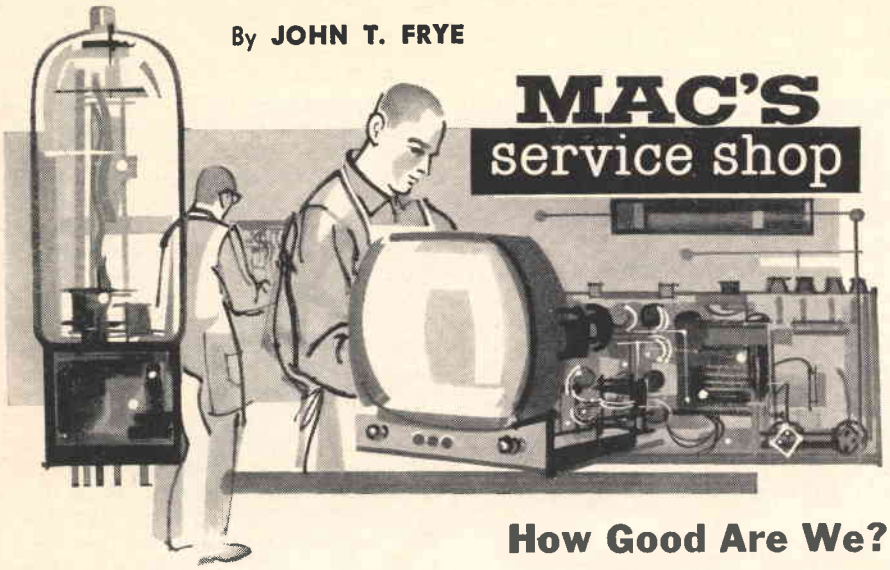


the service arm of the industry has had conflicts of interest. There have always been some distributors and wholesalers, most of them also independents, who have played the dual role of selling to dealers and to private individuals as well. Selective buying has been practiced in this direction, too, with some success. In some communities, sales tax and other laws require that merchandisers assume a definite identity as either a wholesaler or retailer, and service dealers are insisting on full enforcement.

However, there have always been large numbers of distributors who find

(*Continued on page* 118)

By **JOHN T. FRYE**



MAC'S service shop

How Good Are We?

BARNEY stood in the wide-open door of Mac's Service Shop drinking in the beauty of the spring day outside. The warm sun beat down from a cloudless sky, and the breeze was so gentle it barely stirred the limp pennants adorning the gas station across the way.

"Man, what a sample of summer this is!" he called over his shoulder to Mac, his employer, busy at the service bench.

"Don't let it fool you," Mac grunted. "Tomorrow it will probably be snowing; so let's not catch spring fever quite yet, huh?"

"Soul-shrunken slave driver!" Barney growled as he turned reluctantly away from the door and walked into the service department. "I really need something to pick me up. The woman who owned the TV set I delivered just before lunch really read my pedigree. In fact, she read the pedigree of the whole service profession. 'Robbers, crooks, and inefficient boobs' were among the kinder things she called us."

"What was her beef?" Mac asked with a quick frown.

"Nothing in particular, but she said she had already spent a fortune on that set before she called us. Now we were sticking her another ten dollars, and she was sure the set would go out again in a few days."

"Did you tell her that if her husband had kept his busy little screwdriver out of the set when the capacitor shorted we would not have had to bring in the receiver for alignment?"

"Sure, but she said that was just an excuse. Her husband tells her electronic technicians are obviously a sorry lot; otherwise they could fix a set so that it would stay fixed. Just between us girls, what do you think? Are we doing a reasonably good job or are we fooling ourselves and our customers? After letting her bend my ear, I'm not sure."

"She *must* have been a persuasive talker," Mac said with a grin; "but let's examine her suspicions and accusations as objectively as we, the accused, can. In the first place, service technicians can refuse to shoulder *all* the blame for the set's failure. The manufacturer has to daddy the first breakdown because it happened before any of us touched the receiver. What's more, we both know that a very high percentage of subsequent failures have absolutely nothing to do with repairs we have made. They are caused by continued breakdown of original components. But a lot of people seem to think like the Chinese when it comes to TV sets. It is said that when you save the life of a Chinaman you are responsible for him from that time on; and many customers seem to believe that once a service technician has taken the back off their receiver, anything that happens to it from that day forth is his fault."

"And how!" Barney agreed.

"Of course we must not overlook the fact a technician could put in a wrong replacement that would place additional strain on an original part and make it fail, but this rarely happens. Anyway, saying that if a technician really knew his business he could repair a TV set so it would not break down again is foolishness. It is only slightly nearer the truth to say that if a manufacturer knew his business he could produce a set that would never need maintenance at all.

"But actually all this proves nothing. To judge how good or bad a job the service technicians are doing, we need something with which to compare; and I think I've found it in a couple of reports coming out of the 41st annual Preparedness meeting of the American Ordnance Association that met in New York the last of 1959 and the Sixth National Symposium on Reliability and Quality Control in Electronics held in Washington the first of this year. Much of the discussion in these two groups centered around problems of maintaining military electronic equipment."

"Hold on!" Barney objected. "I don't think such a comparison would be fair to us. After all, military electronic equipment is built to very exacting specifications, employing only the best of parts. Much of that equipment is manufactured on a cost-plus basis so the manufacturer does not have to cut corners to meet tough competition as radio and TV manufacturers do. Then, too, the maintenance men are carefully trained to be specialists. Ordinarily each one services only a few pieces of equipment and so becomes darned familiar with that equipment. On top of that, the military electronics shops I have visited had fine, laboratory-type service equipment beyond the reach of the average service technician. My mouth waters just remembering the wide-band scopes, the calibrated signal generators, and the spare-parts storeroom of that Air Force Base electronics shop I visited last Armed Forces Day."

"Before you start hollering 'Foul!' answer me this: how many TV sets per hundred do you think are out of commission waiting to be serviced here in town at this moment?"

"M-m-m-m-m, not more than seven or eight per hundred at the outside," Barney said after a little reflection.

"I'll go along with that. Compare it with the 1952 survey cited by Rear Admiral Paul B. Stroop, Chief of the Navy Bureau of Weapons, which showed only one-third of its electronic equipment was functioning properly, with the remaining two-thirds either partially or entirely out of commission. And consider the remarks of Lt. Gen. Robert F. Sink, commander of the Army 18th Airborne Corps describing communications: 'When they are good, they are very good; and when they are bad, they are horrid.' He went on to say that Army communications equipment is superior to any ever before devised and is inherently capable of operating on any battlefield in the world. 'Under hothouse conditions it does,' he added sarcastically. 'The funny thing is, when they push-to-talk, commanders never know whether the system will work.'"

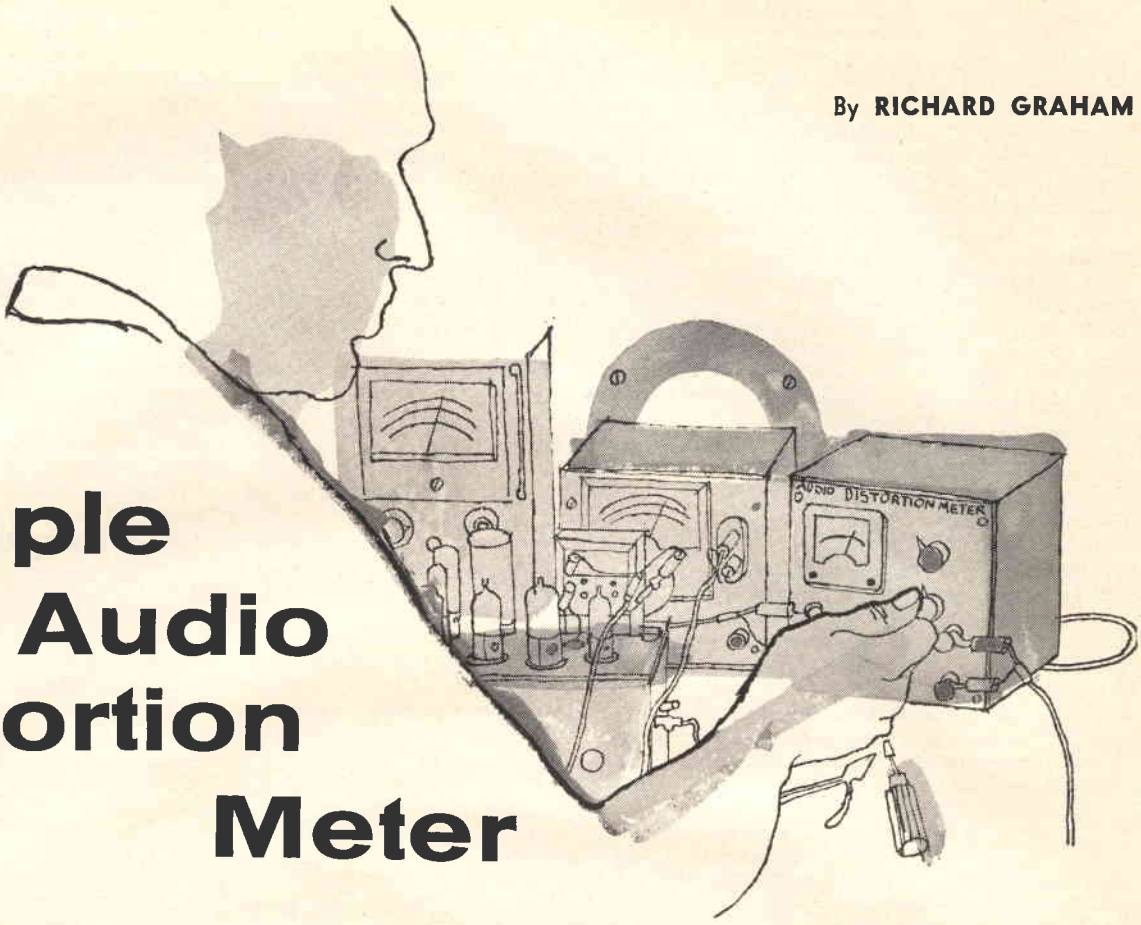
"Wow! Those military maintenance boys really are in a rough spot," Barney remarked. "At least our customers are not our superior officers."

"Vice Admiral William R. Smedberg, commander of the Second Fleet, paid the maintenance men a thoughtful compliment when he said that 'somehow the men who control and maintain our equipment have managed to stay on top of it.' That 'somehow' he uses indicates he understands that maintaining complicated electronic equipment is not easy. Rear Admiral Stroop appreciates this, too. He declared industry cannot answer the military's electronic problems through pyramiding circuitry, additional black boxes, and super-colossal gadgetry. He said, 'We must guard against producing equipment so sophisticated that our personnel cannot maintain it. Equipment must be tailored to talent available in the Armed Forces to operate and maintain it.'"

"Boy, I hope the manufacturers who make civilian radio and TV sets were listening," Barney said earnestly.

(*Continued on page* 80)

By **RICHARD GRAHAM**



Simple Audio Distortion Meter

Measures relative distortion without additional equipment. May also be used with meter or scope for exact percentage.

WHILE the human ear is a pretty wonderful mechanism when you stop to think about it, it does lack certain features the audio enthusiast needs when tracking down the cause of distortion in his hi-fi rig. For example, when the distortion levels are low, it is almost impossible to tell, without making an A-B test, if the "improvement" accomplished anything at all. Switching back and forth like this, from the original condition to the new condition, is a time-consuming operation, particularly if tubes have to warm up between tests. What usually happens next is that the memory of the two conditions becomes a little fuzzy and the test has to be repeated a few times. The result is that there is always a little room for doubt as to the validity of the test.

It is apparent that what those of us in this situation need (and this includes just about all of us) is some means of telling us, in numbers, the amount of distortion present. The audio distortion meter to be described should fit the bill quite nicely as it will provide relative distortion readings on an amplifier without any other piece of test equipment required. For those who happen to have an oscilloscope or an a.c. v.t.v.m., the audio distortion meter can be used to determine the exact percentage of distortion in the amplifier under test. Used either way the audio distortion meter will help to speed up the servicing of any piece of audio gear. There are many subtle changes that can occur which will defy detection with a voltmeter. Furthermore, this instrument will help in keeping the audio system up to par since this meter is capable of detecting distortion changes before the ear can notice the deterioration in audio quality.



Front-panel layout that is employed in the author's distortion meter.

Perhaps the best feature of this audio distortion meter is that it uses only two tubes. This makes it a reasonably simple device to construct and relatively low in cost. The exact price will depend, of course, on how many of the miscellaneous parts the builder has on hand and how many he has to purchase from his electronics parts store.

This meter measures distortion by what is commonly known as the phase-shift method. In this method, the input signal to the amplifier (or any piece of equipment) is compared to the output signal. If the two signals do not agree in shape, then the difference is read on the front-panel meter as distortion. The more the output differs in shape from the input, then the higher will be the distortion and the higher the meter reading. This system of measuring distortion has an advantage over other methods because it is independent of the waveshape of the signal being fed into the amplifier, that is, the distortion meter reading is unaffected by the distortion present in the signal being fed through the amplifier. For example, the signal being fed through the amplifier can be a severely distorted sine wave, yet the distortion readings, as shown on the meter, will be unaffected. This greatly simplifies the requirement for a signal source to be fed through the amplifier. As a matter of fact, for just general checks, this signal could be 60 cps taken from the power line. More will be said on this subject later. For distortion measurements at other fre-

quencies an audio signal generator will be required. However, it doesn't have to be too elaborate since the distortion in the generator is of little importance.

Comparison of the input and output signals of the amplifier under test is made in the audio distortion meter. Actually, the two signals, *i.e.*, amplifier input and amplifier output signals, are subtracted electrically. The remaining signal, which represents the distortion, is amplified and measured on the front-panel meter. To get consistent results when performing this electrical subtraction, two conditions must be fulfilled. The first is to make the amplitude of the two signals exactly equal but opposite in polarity at the time they are subtracted. The second condition is to make the signals exactly 180 degrees out-of-phase with each other. These two conditions are shown in Figs. 2A and 2B. The subtraction of the two signals is shown in Fig. 2C.

If either of the two aforementioned conditions is not fulfilled, then the subtracted signal, which represents distortion, will be much larger. We can therefore see that to get results that are valid and mean something, we have to be certain that the signals cancel as completely as possible. This accounts for the two controls on the front panel of the audio distortion meter. These two controls are "Amplitude Balance" and "Phase Balance". In use they are adjusted for a minimum reading on the front-panel meter.

How it Works

The signal source for the distortion test is fed into input "A", Fig. 1, while the output of the amplifier under test is fed into input "B". The gain of each input is adjusted by means of the dual pot, R_1-R_9. This pot is arranged so that as the level of one input is increased, the other is decreased. This allows each input to be adjusted for equal amplitude at the plate of the 6AS6, V_1, irrespective of the amplitudes of the signals being applied to inputs "A" and "B".

The signal from input "A" is next applied to the primary of an audio transformer, T_1, the secondary of which is center-tapped. Transformer T_1, in conjunction with R_1-R_9 and C_1, serves to shift the phase of the incoming signal relative to the input signal of input "B". This is done by adjusting R_2, which compensates for any phase shift that may occur in the amplifier under test and facilitates a more complete cancellation of the two signals. This results in more accurate distortion indications. The type of phase shifter does not change its output voltage as the phase is shifted, thus the two controls are independent in their action. This type of phase shifter is also capable of shifts approaching 180 degrees, however the amount of shift will depend on the frequency being used for testing.

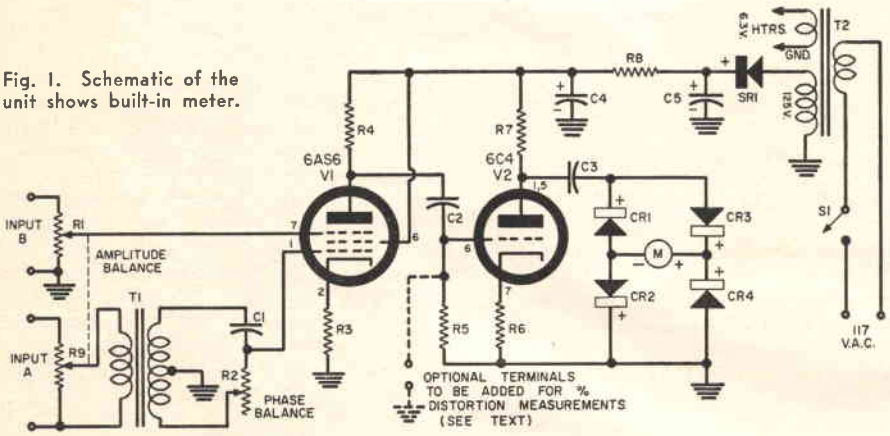
The two input signals "A" and "B" are placed on the first and third grids of the 6AS6, V_1. This tube has two signal input grids, each of which is capable of controlling the tube independently. The result is that the two signals fed into inputs "A" and "B" are mixed in the plate circuit of V_1. If the two signals are exactly opposite in amplitude and are 180-degrees apart in phase, then the two signals will subtract. If the two signals are identical at this point (which indicates there is no distortion present) they will completely cancel out. Normally a small amount of distortion is present and these two signals will not cancel completely. In this case, there will be some signal present at the plate of V_1. This signal, which is the distortion present in the amplifier under test, is fed to the grid of the 6C4, V_2. This additional amplifier tube is necessary because the distortion level is quite low in most amplifiers, making it difficult to measure without additional gain. The V_2 amplifier stage is conventional. The amplified distortion signal at the plate of V_2 is applied to a full-wave bridge rectifier consisting of four germanium diodes and a 0-1 ma. meter. Thus the distortion signal is rectified and registers on the 0-1 ma. meter, M, located on the front panel of the unit.

Construction

The construction of the audio distortion meter should hold no terrors for anyone who has had any experience in constructing audio equipment. Actually, there are no tricks involved in building this instrument—standard audio practice should be observed. Leads should be reasonably direct—especially those associated with the input grids of V_1 and the coupling between V_1 and V_2.

The unit is constructed on a standard aluminum chassis measuring 4⅞" x 4⅞" x 1¼". This is held to the panel of the 6" x 6" x 6" aluminum box housing the unit by the input binding posts and the a.c. line switch, S_1. Note that all but one of these terminals are insulated from the chassis. This is done so that the signals being applied to input "A" can be reversed 180 degrees,

Fig. 1. Schematic of the unit shows built-in meter.



R_1, R_9—Dual 10,000 ohm pot (see text)
R_2—100,000 ohm pot
R_3, R_6—120 ohm, ½ w. res.
R_4, R_7—10,000 ohm, ½ w. res.
R_5—470,000 ohm, ½ w. res.
R_8—1500 ohm, 2 w. res.
C_1—.04 µf., 200 v. paper capacitor
C_2, C_3—.1 µfd., 200 v. paper capacitor
C_4, C_5—20 µf., 150 v. elec. capacitor
T_1—Audio trans. single plate to push-pull grids, 2:1 ratio (Stancor A-52-C or equiv.)
T_2—Power trans. 125 v. @ 15 ma.; 6.3 v. @ .6 amp. (Stancor PS8415 or equiv.)
CR_1, CR_2, CR_3, CR_4—1N34 crystal diode (meter rectifier bridge)
SR_1—65 ma. selenium rectifier
S_1—S.p.s.t. toggle switch
M—0-1 ma. meter (see text)
V_1—6AS6 tube
V_2—6C4 tube

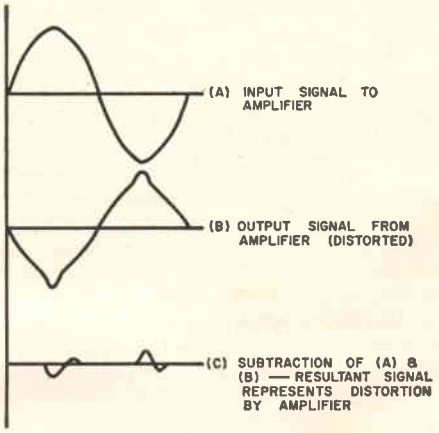


Fig. 2. The electrical subtraction that takes place in the audio distortion meter.

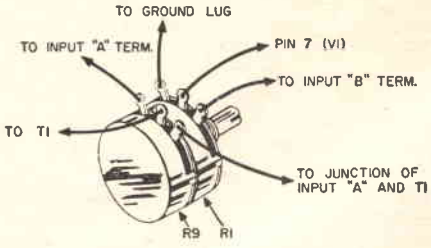
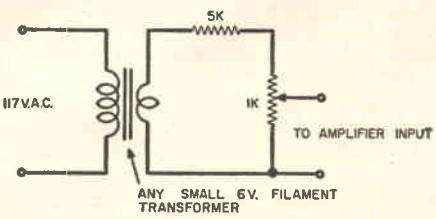
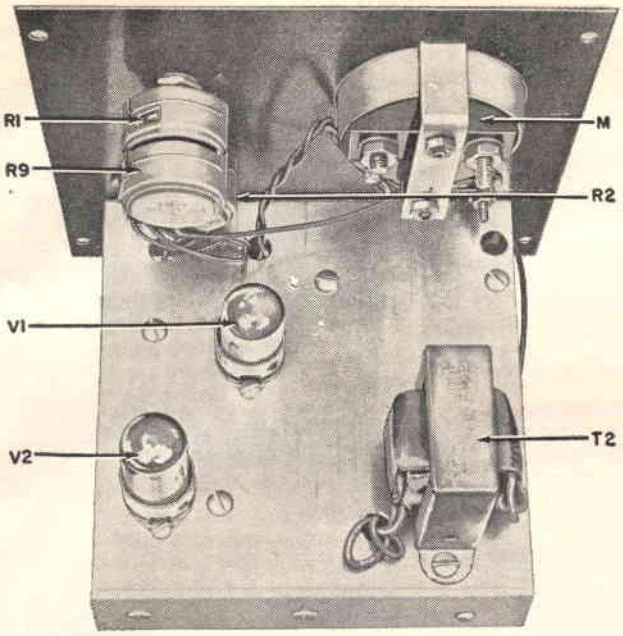


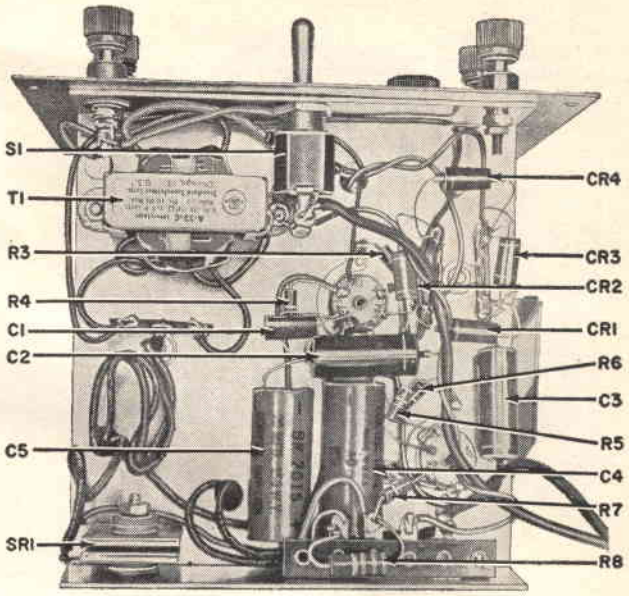
Fig. 3. Wiring of the dual pots R_1, R_9 so that one input will rise while other falls.

Fig. 4. Suggested signal source to be used if a.f. generator is not available.





Top-chassis view shows tubes, meter, dual pot, and transformer.



Under-chassis view shows phasing transformer and small parts.

giving added range to the phase-balance control.

Since the meter is used only for relative distortion measurements, other meter types than that specified in the parts list may be used. As a matter of fact, more sensitive distortion readings can be obtained if a 500-μa. meter or better is used. Unfortunately the more sensitive meters carry a higher price tag—but could be used if one is on hand.

In the interests of economy two separate controls could be used in place of the more expensive dual unit, R_1-R_9. This will add another control to the front panel and, of course, another operation when the instrument is in use. The dual control, although costlier, guarantees an amplitude balance without any juggling of controls.

Since the purpose of R_1-R_9 is to increase the level of one input signal while decreasing the other, care should be exercised to be sure both inputs are not increased or decreased together. In such a case, no balance could be obtained. Fig. 3 provides details on wiring this pot to avoid error.

When wiring the unit be sure to observe the polarity of the meter rectifier diodes, CR_1 through CR_4, as shown in the schematic of Fig. 1. If any one of the diodes is incorrectly polarized, the meter will scarcely lift off the bottom of the scale. If the polarity of all of the diodes is reversed, the meter will read backwards. In this case simply reverse the two leads to the meter. Solder the diodes into the circuit rapidly, using long-nose pliers as a heat sink. Leads should be allowed to remain full length.

Operation

The audio distortion meter can be put to work the minute construction has been completed and checked. There is no calibration procedure involved in setting up or using the unit. Of course, one shouldn't let one's enthusiasm or eagerness get out of hand. It is worth a few minutes, after the last solder joint is made, to recheck the wiring. A few minutes here might save a transformer or other component.

After the unit is checked out to the builder's satisfaction it can be plugged in and turned on. As a check on its operation, apply the same signals to both input "A" and input "B" of the meter. This signal can be any audio signal of about 1 volt. If an audio signal generator is available, it can be used quite satisfactorily. If one is not available, similar results can be obtained by using the hook-up shown in Fig. 4. Now with the same signal being applied to both inputs of the audio distortion meter, adjust both the phase balance and amplitude balance controls for a minimum reading. It may be necessary to reverse the two leads going to the "A" input and re-adjust the phase balance control to get the absolute minimum reading. If the unit is performing satisfactorily, this minimum reading should be essentially zero. This means that the two input signals have completely cancelled, leaving a zero distortion voltage. Since these two signals are applied to the distortion meter from the same source with no amplifier or other distortion-producing elements in between, there should be no reason why the two signals shouldn't cancel out. If anything more than a barely perceptible reading is noted, something is wrong. As stated previously, if hum is present on one input, it will remain uncancelled and will produce a reading as distortion. Under these conditions of signal input, with the amplitude and phase balance controls misadjusted, the meter should read full-scale or better. If it doesn't then perhaps one of the meter diodes is open or perhaps the d.c. voltages on the tubes are incorrect. A little checking with a voltmeter and the circuit diagram should pinpoint the difficulty.

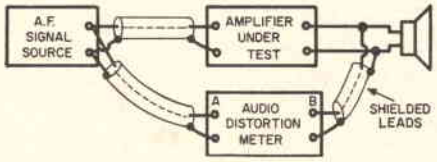
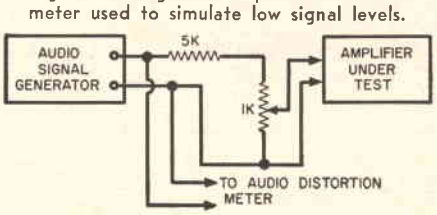


Fig. 5. Equipment setup used for test.

Fig. 6. Arrangement to provide 1 volt to meter used to simulate low signal levels.



The meter is now ready to check the distortion of an amplifier. The typical setup shown in Fig. 5 can be used. The signal source can be either the 60-cycle voltage divider shown in Fig. 3 or an audio signal generator. A signal generator will allow distortion measurements to be made at all frequencies throughout the audio spectrum and is to be preferred if available.

Adjust the amplifier and signal generator for normal input and output levels. If the normal input to the amplifier is a tuner or phono cartridge, simulate this voltage level with the signal generator. Use care not to overload the amplifier under test since this will cause high distortion readings which are not truly representative of normal amplifier performance. Now adjust the amplitude balance and phase balance controls for a minimum reading. Try reversing the leads to the "A" input on the audio distortion meter and re-adjust the phase balance control for minimum reading. If the amplifier under test is working properly and has an inherent low distortion

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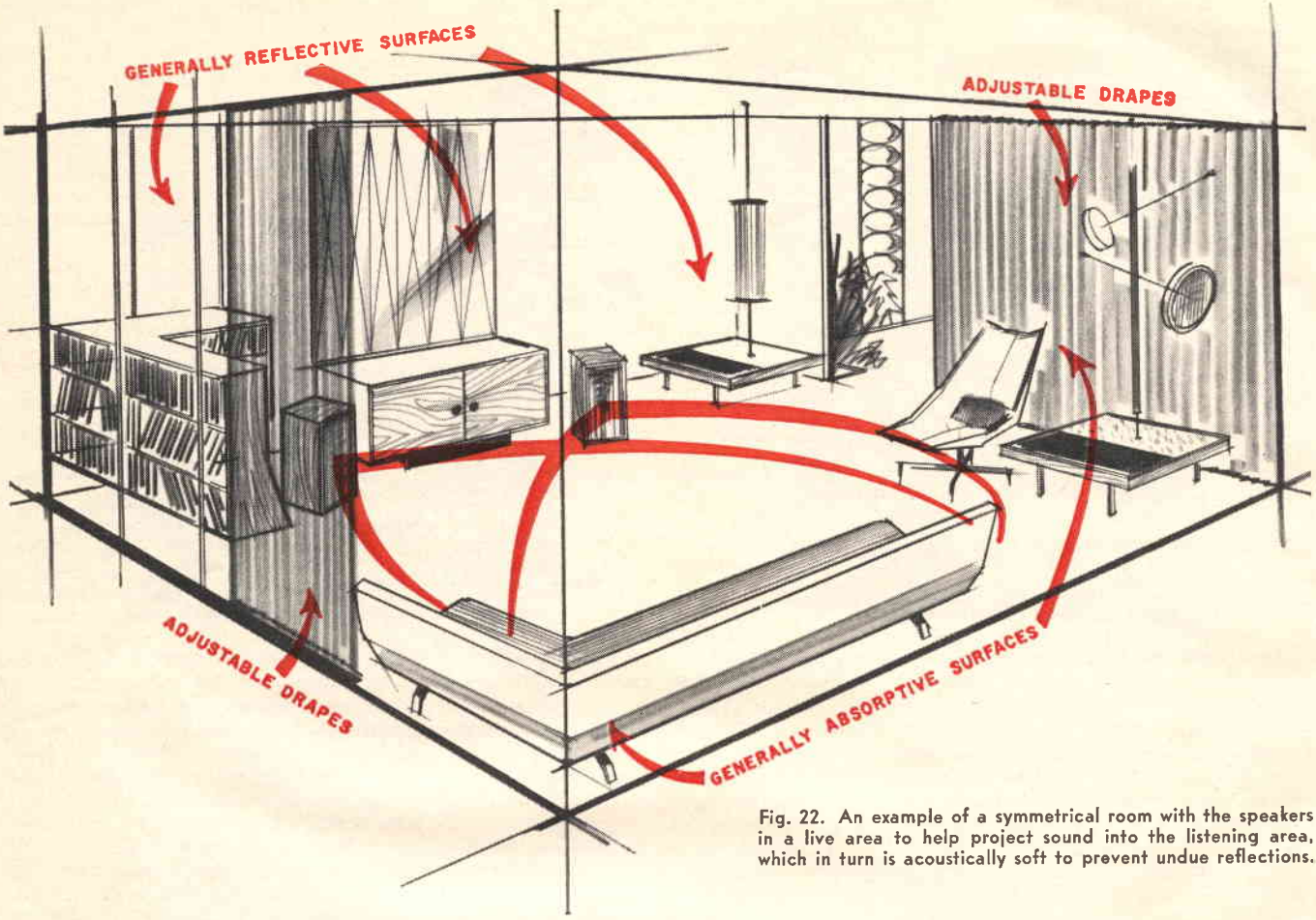


Fig. 22. An example of a symmetrical room with the speakers in a live area to help project sound into the listening area, which in turn is acoustically soft to prevent undue reflections.

Room Acoustics for Stereo

Part 4. Balancing the Room

By **ABRAHAM B. COHEN** / Advanced Acoustics Corp.

Practical techniques that can be used for proper room adjustment in order to get the best results from your stereo speaker setup.

IN THE first three articles of this series we discussed the basic principles involved in setting up a good acoustic environment for music; room treatment and reverberation; and variable sound absorption devices and special speaker setups. Now we will take up the matter of balancing the room.

A room which is physically balanced may need only general reverberation control while a physically unbalanced room may require a decidedly different wall treatment to provide proper balance for stereo listening purposes. The final treatment of the room and the placement of the furniture should be based on the establishment of a symmetrical listening axis from the speakers to the listener so that the same apparent acoustic characteristic will be presented on either side of the listener. Adjacent rooms leading into the main listening room, if not acoustically subdued internally, may act as coupled resonators, reflecting troublesome low-frequency resonances back into the listening room.

Physically Balanced Room

Irrespective of actual room configuration and the treatment throughout the room or the speaker system used, the end result should be such that one side of the room will produce the same acoustic reaction on the listener's ears as the other side of the room. Two interdependent conditions will exist. In one instance, the reaction of the room's acoustics *upon the listener* will determine what he hears while in the second instance the reaction of the room *upon the speaker* will determine how well it radiates or projects its sound.

In rooms which are physically symmetrical, the room is fairly simple to adjust to stereo requirements. In such a case we simply make sure that the room reverberation falls within the acceptable limits as outlined in the earlier parts of this series: *i.e.*, whatever absorbent treatment is applied is randomly distributed throughout the room and that the speakers are located at one end or wall of the room which is somewhat more "live" than the rest of the room. This simple situation, using balanced speaker systems, is illustrated in Fig. 22. We can calculate the total absorption by multiplying each discrete area by its own specific absorption coefficient, not forgetting, of course, the lumped total absorption of the chair, divan, and people in the room.

If these figures work out right for the cubic volume of the room, then we will have the right reverberation time. We will, in this instance, try to keep a reasonable minimum of absorbent material at the location of the speakers since we want a somewhat "live" proscenium from which the sound can bounce out into the listening area.

In this latter area—the listening area—we want the optimum (not maximum) sound absorption so that we will hear the correct proportion of reflected-to-direct sound to produce the correct liveness in the reproduction. In the present instance, placing the speakers against the hard wall with the highly reflective wall "mirror" behind them may add just the right amount of reverberation to the loudspeaker "proscenium" area.

The lounge chair, bookcases, distributed drapery, and floor covering may provide sufficient randomly distributed absorption area to properly diffuse the sound so that no acoustic "hot spots" will occur. In a room such as this, we may put our balanced speakers the conventional six to eight feet apart and toe them in, about 15 degrees toward the axis. The room acoustics will be fairly evenly balanced on either side of the listening axis and the room will be quite good for stereo listening, both ears being subjected to the same "liveness" from both sections of the room and full program content of each channel diffusing into the balanced room.

The Unbalanced Room

Now let's examine the situation with regard to the more irregular room layout and then apply our basic rules to obtain an acceptable stereo environment. It must be recognized that complete solutions for *all* types of systems would involve a complex analysis covering innumerable situations which is clearly beyond the scope of this series. Each system must, in effect, be "played by ear," keeping in mind the basic rules of good acoustics. If these rules are followed, then the listener should encounter a minimum of trouble in balancing his system, whatever it may be, with the room.

In order to demonstrate the technique involved, we will revert to our two balanced and similar speaker systems and try to optimize their stereo placement in the irregular room of Fig. 23. This is a type of room layout typical of many large apartments in many new developments. As one walks into the apartment through the door there is, to the right, a large area of plastered wall extending toward the far end where there is a closet and a door leading to another room. On the left there is a short stretch of plastered wall, then an open area leading to the living room which is dropped two steps below the hall level.

Farther along this direction, the area is still open but there is a railing divider between the central hallway and the dining alcove on the left. Stepping down into the living room, on the left there are built-in bookcases to the ceiling and then a bare plaster wall. In the corner is a rather large casement window, then two more plaster walls terminating in the dining alcove with a window at its wall side and the usual opening to the kitchen area through two room-divider elements between the dining "L" and the kitchen. The ceiling is 8 feet high, the central hallway floor is linoleum covered, and the other floors are wood parquet.

Our problem is to first determine the original bare-room acoustic condition then see how the room can be corrected to improve its over-all absorption, then distribute the absorption so that it makes a maximum contribution to the stereo acoustical balance of the room, and finally, to examine the various furniture arrangements to provide a suitable stereo listening environment.

Adjustment for Reverberation

From the dimensions of the room, its bare walls, ceiling, flooring, panelling, and windows and with the help of Table 1 (Part 2), which lists the absorption coefficients for these various building surfaces, it is not too difficult to determine the total absorption of the room.

Without going through the calculations, it turns out that the room has an absorption characteristic of 40 units. Entering this figure in the equation for the room reverberation constant, we get $T = .05V/A = 3$ seconds, where the total room volume is nearly 2400 cubic feet and $A = 40$.

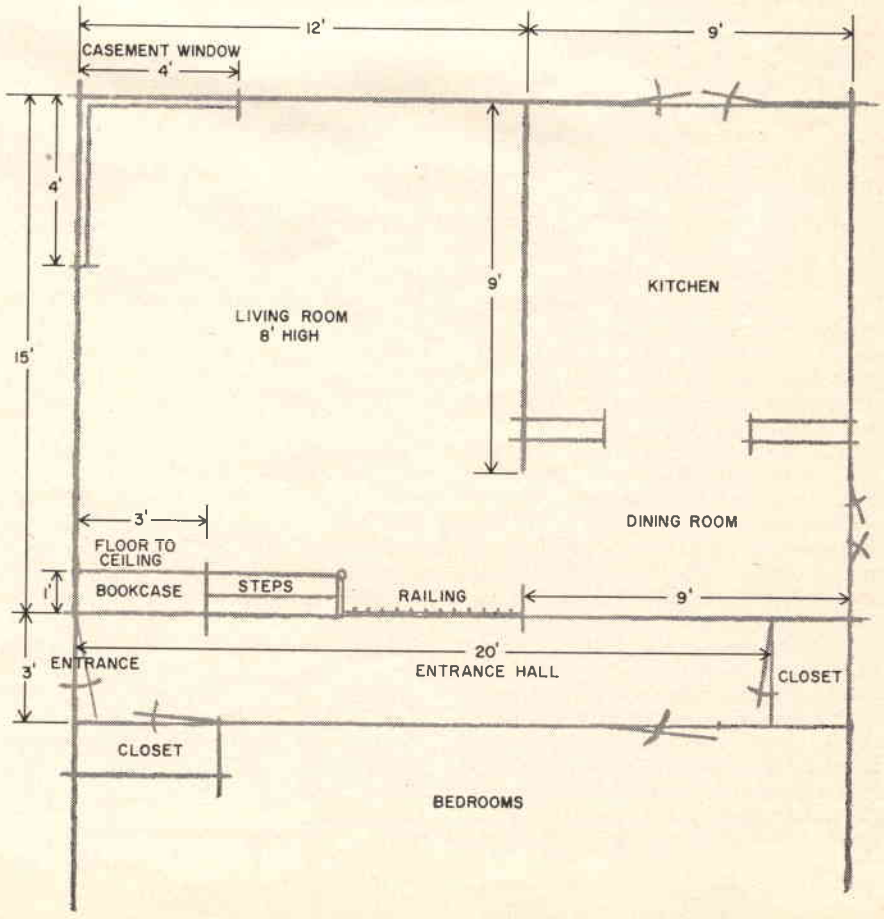
From our intuitive knowledge of completely bare enclosures, we know that the room will be too live, a hunch that is borne out by the 3-second figure which is far too high. Our problem now is to bring the reverberation down to "size" and to balance the room acoustically.

In order to strike a happy medium, let's try for an absorption of, say, 150 units which for this size room will bring the reverberation time down to .8 second: $T = (.05 \times 2400)/150 = .8$ second.

Incidentally, the kitchen area was not included in arriving at either the "room volume" or the absorption. The reason is that we have treated the kitchen area as a "coupled acoustic area" rather than as an integral part of the area being controlled. We shall be more specific about this matter of "coupled areas" after we have gone through the necessary acoustic corrections for the room.

To correct the room we will need 110 additional absorption units (150-40). Some of this absorption will naturally be contributed by sofas, settees, upholstered chairs, etc. We will assume that there is seating capacity for five persons. This will be the equivalent of five mohair-upholstered chairs which individually have an absorption characteristic of 4 units, making a total of 20 units which will be added. Most likely there will be a rug on the floor and we will assume wall-to-wall carpeting in the living room only, leaving the bare parquet floor in the dining area. The 512-cps absorption coefficient of carpeting on a felt pad is approximately .37. The *total absorption* for the rug covering the 180 square feet of the living room floor is $180 \times .37 = 66$ units. Adding these 66 units of carpeted floor area to the 20 absorption units contributed by the chairs, brings the newly added absorption up to 86 units. We now have approximately $110 - 86 = 24$ units of additional absorption to be discretely applied throughout the room to provide acceptable reverberation and stereo acoustic balance. To be per-

Fig. 23. Layout of the listening area and surrounding rooms discussed in the text.



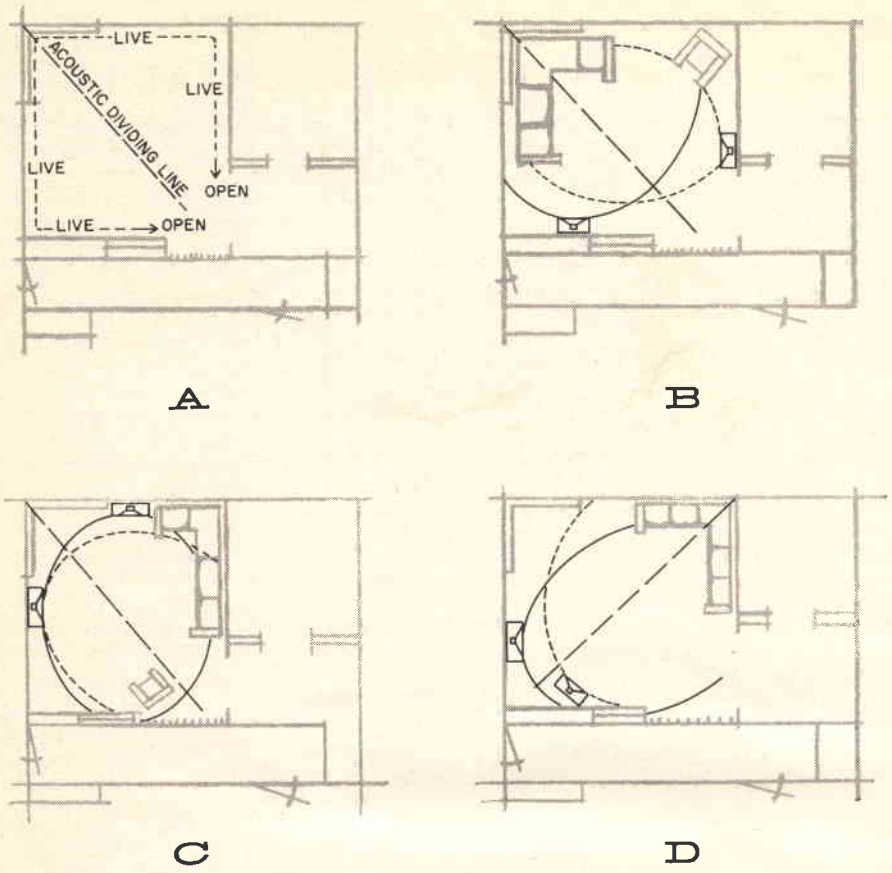


Fig. 24. Various means of arranging the listening room for stereo reproduction.

fectly accurate, we have more than that amount to play with. For instance, suppose we do hang some drapes. By actually hanging such drapes we mask off some of the wall area and thus obtain a sort of see-saw balance between new absorption material being hung as against the original material being covered up. However, where the original bare area has a very low absorption characteristic, such as plaster with a factor of .06, which is then covered with drapes with a coefficient of .5, then the absorption of the original wall may be neglected when masked by the drapes.

We now have 24 units to be deployed around the room. Some of these 24 units will, of course, be absorbed by the people in the room. The average absorption (acoustic) of an adult is approximately 4 units and for a child 2.5 units. If our "stereo evenings" are comparatively small family affairs, we may assume two adults and two children in the room for a total absorption of 13 units. This leaves approximately 11 units to be "installed."

The lady of the house will have no doubt noted the absence of curtains and/or drapes. As far as light gauzy curtains are concerned, these may be used in any quantity desired for they contribute practically nothing in the way of acoustic absorption. Thus, even if the entire window area of the room is hung with sheer curtains, the absorption of that area would still be governed by the absorption characteristic of the glass.

When it comes to the heavier materials, such as velours, monks cloth, or weighted cotton fabrics, they do, of course, contribute to the room's absorption. For instance, if we were to hang cotton drapes over a total of 10 linear feet (with the drapes 8 feet long) then we would have $8 \times 10 = 80$ square feet of drapes whose mid-frequency (512 cps) absorption coefficient is .15 when stretched out to ⅞th of their width. Then the total absorption of the drapes would be $80 \times .15 = 12.0$ units. Now we see that we have arrived at about the correct room adjustment.

Symmetrical Listening Axis

If the room is completely symmetrical (as is the case in Fig. 22), the problem of stereo balancing is fairly simple. We draw an imaginary line down the center of the room and proportion our absorption material in equal quantities on either side of the room (but still in random fashion). This will produce a situation where, when the stereo speakers are symmetrically placed with respect to the center balance line, they will "see" essentially the same acoustic environment on either side, with the result that the sound reflections from one wall will be practically the same as from the other wall; the spatial distribution of the sound within the room will thus be "stereo balanced."

Where, however, the room is not symmetrical, as in the problem we are treating, we must draw our imaginary line through the contemplated center of the listening room area, then place the speakers on either side of this line and balance both sides acoustically by adding or removing absorbing areas from either side to bring about an acoustic stereo balance.

Referring to the diagram of our irregular room in Fig. 23, we can see that if we can find a line which bisects the room on an acoustically symmetrical basis, the stereo system can be placed accordingly. Then, as an extreme example, we can select another direction within the room which leaves the room unbalanced acoustically—and try to bring it into balance.

Referring to Fig. 24A, we have drawn such an acoustic dividing line from the corner casement window toward the dining area (there are other dividing lines which will be discussed in turn). It will be noted that there is fairly good geometric and acoustic symmetry about this line. There are two triangles of fairly equal acoustic influence on either side of this listening line. They have similar live walls opposite each other and then both end in an open area at the dining "L". We must now make a choice as to which end of the axis is to be used for listening and which end for speaker placement.

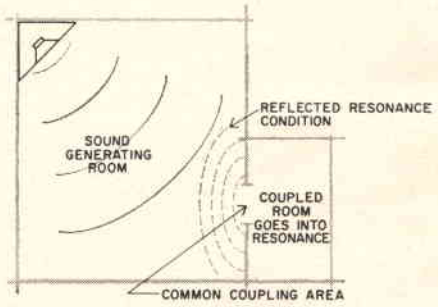


Fig. 25. Sound entering the door of the coupled room may cause the room to resonate and to inject this resonance back into the room in which the listening is done.

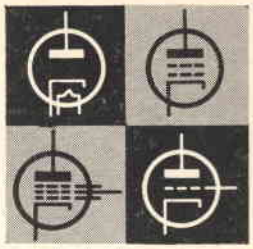
If the casement window area is used as the center of the settee and chair grouping, as shown in Fig. 24B, then the loudspeakers would be placed at the opposite end of the listening axis and, of course, on either side of it. It will be observed that the acoustic coverage of the listening area is fairly uniform from both sound sources. There are, however, some drawbacks to this arrangement other than the matter of decor!

Let us apply the five criteria for good stereo room adjustment discussed earlier. As far as (*a*), the room absorption characteristic, is concerned we can make the necessary adjustment irrespective of furniture placement. Concerning (*b*), the distribution of absorbent material, again this is relatively independent of furniture distribution. In relation to (*c*), the avoidance of large parallel reflecting areas, these again may be treated in a manner relatively independent of furniture placement. However, when we came to (*d*), the placement of the sound sources in comparatively live areas, the configu-

(*Continued on page* 112)

By **MURRAY BARLOWE**
Barlowe Electronics

Tube Inventory for Service Shops



Do you run short on some types while others gather dust? Plan your stock.

1960

AS IN the past, recommended quantities are minimum figures that can be multiplied by 2 or a larger figure for busy shops. The parade of new tubes continues, with 288 listings this year as compared to 253 in 1959, despite the weeding out of 16 types for which demand is vanishing. Even without the separate hi-fi group, the 1960 list numbers 267—and recommended quantities are generally up.

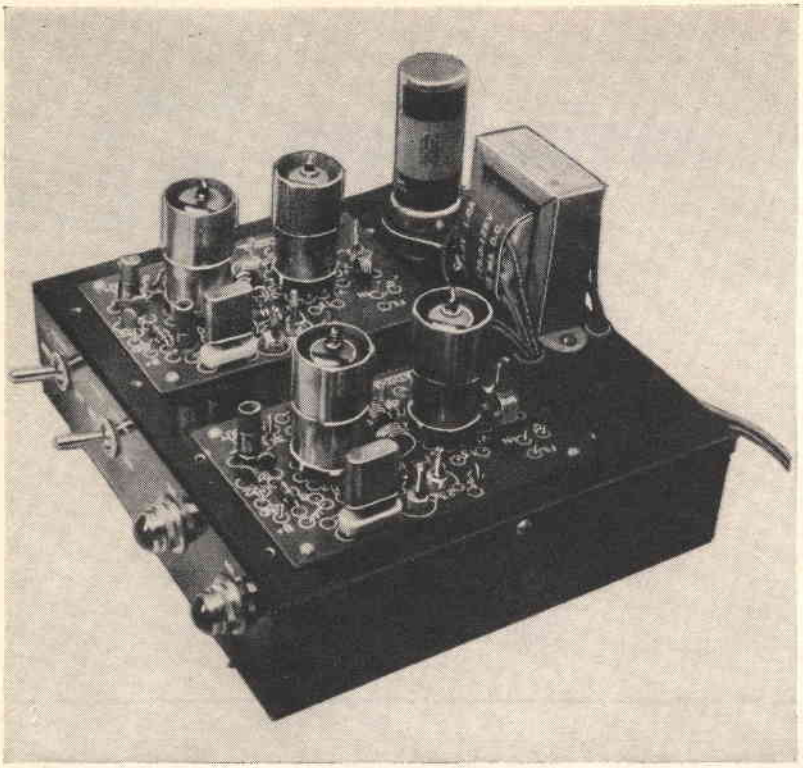
Since the importance of industrial electronic and color TV work varies, the tubes involved are specially marked. For those with audiophile customers, hi-fi types are listed separately with good reason. Many foreign tubes have domestic equivalents, already on the regular list, but equipment owners often insist on the "original" types, which have acquired prestige. Most of the tubes dropped this year are 7-volt loctals, a vanishing breed. However, some types no more than two or three years old also have been deleted, apparently because they have not been adopted widely. Let us hope that this foreshadows a trend. —30—

Type	Quan	Type	Quan	Type	Quan	Type	Quan	Type	Quan	Type	Quan
0A2*	2	5J6	2	6BF6	2	6DN7	1	12AQ5	1	19T8	1
0B2*	2	5R4GYA*	5	6BG6	5	6DQ5**	3	12AT6	2	25AX4	1
0Z4	5	5T8	2	6BH6	1	6DR7	1	12AT7	6	25BK5	2
1AX2*	2	5U4GB	10	6BH8	1	6DQ6	7	12AU6	1	25BQ6/CU6	4
1G3/1B3	10	5U8	2	6BJ6	1	6DT5	1	12AU7	10	25CD6	1
1R5	1	5V4G	3	6BJ8**	1	6DT6	2	12AV5	2	25DN6	2
1S4	1	5X8	2	6BK4**	2	6E5	1	12AV6	2	25L6	4
1S5	1	5Y3GT	3	6BK5	2	6ES8	2	12AV7	3	25W4	3
1T4	1	6AB4	4	6BK7A	3	6FM8	1	12AX4	5	25Z6	2
1U4	1	6AC7	5	6BL4**	1	6H6	1	12AX7	6	35A5	2
1U5	1	6AG5	5	6BL7	3	6J5	3	12AY7	1	35B5	3
1V2	3	6AG7	2	6BN6	4	6J6	6	12AZ7	1	35C5	3
1X2B	6	6AH4	2	6BN8**	1	6K6GT	6	12B4	3	35L6	4
2D21*	2	6AH6	3	6BQ5	3	6L6	2	12BA6	3	35W4	5
2ER5	2	6AK5	2	6BQ6/CU6	10	6M3**	1	12BA7	1	35Y4	1
3A2**	2	6AK6	1	6BQ7A	10	6S4	5	12BD6	2	35Z5	4
3A3**	4	6AL5	10	6BR8	2	6SA7	3	12BE6	4	40A1	1
3AL5	1	6AL7GT	2	6BS8	2	6SC7	1	12BF6	3	40B2	1
3AU6	2	6AM8	3	6BU8	1	6SF5	1	12BH7	6	50A5	1
3AV6	1	6AN8	4	6BX7	2	6SG7	1	12BK5	2	50B5	2
3B2**	2	6AQ5	4	6BY5	1	6SH7	1	12BN6	1	50C5	2
3BC5/3CE5	2	6AQ6	2	6BY6	1	6SJ7	2	12BQ6/CU6	4	50L6	5
3BN4	1	6AQ8	2	6BZ6	6	6SK7	3	12BY7	3	5642	2
3BN6	1	6AR5	1	6BZ7	3	6SL7	3	12BZ7	2		
3BU8	1	6AS5	2	6C4	2	6SN7	10	12CA5	1		
3BY6	2	6AS7G*	1	6CB5**	2	6SQ7	3	12CR6	2		
3BZ6	2	6AT6	3	6CB6	10	6SR7	1	12CU5/C5	3		
3CB6	2	6AT8	3	6CD6	5	6T8	3	12D4	1		
3CF6	2	6AU4	4	6CF6	2	6U8	6	12DQ6	3		
3CY5	1	6AU5	3	6CG7	8	6V3	2	12K5	2		
3CS6	2	6AU6	10	6CG8	3	6V6GT	6	12L6	1		
3DK6	2	6AU8	2	6CK4	1	6W4	10	12SA7	2		
3DT6	2	6AV5	1	6CL5**	1	6W6GT	4	12SG7	1		
3Q4	1	6AV6	4	6CL6	3	6X4	2	12SH7	1		
3S4	1	6AV8	1	6CL8	3	6X5	2	12SJ7	1		
4BQ7A	5	6AW8	6	6CM6	1	6X8	5	12SK7	3		
4BZ7	2	6AX4	8	6CM7	3	6Y6	1	12SL7	1		
4DT6	2	6AX5	1	6CN7	3	7AU7	4	12SN7	4		
5AM8	2	6AZ8	4	6CR6	3	7B5	1	12SQ7	3		
5AN8	2	6BA6	4	6CS6	2	7C5	1	12V6GT	5		
5AQ5	2	6BA8	2	6CS7	1	7F8	1	12W6	2		
5AT8	2	6BC5/6CE5	6	6CQ8	1	8AU8	1	12X4	2		
5AV8	1	6BC7**	1	6CU5	2	8CG7	1	13DE7	1		
5BK7A	3	6BC8	2	6CU8	1	9BR7	1	17AV5	1		
5BR8	2	6BD4A**	1	6CX8	1	10DE7	3	17AX4	2		
5BW8	1	6BD5	1	6CY5	2	12AB5	2	17D4	2		
5CG8	1	6BD6	2	6DA4	2	12AD6	2	17DQ6	2		
5CL8	2	6BE6	5	6DE6	2	12AE6	2	19AU4	2		
5CQ8	2	6BF5	1	6DJ8	1	12AL5	1	19BG6	1		

HI-FI TYPES

Type	Quan
ECC81/12AT7	3
ECC82/12AU7	3
ECC83/12AX7	4
ECC85/6AQ8	2
ECF80/6BL8	2
EL34/6CA7	4
EL37/6L6	4
EL84/6BQ5	4
EL86/6CW5	2
EZ80/6V4	2
EZ81/6CA4	2
GZ34/5V4GB	2
KT66	2
KT88	2
1614	2
7025	4
7199	2
7355	2
7408	4

*Industrial Electronic
**Color TV



Over-all view showing the boards in place. Power components are at rear of chassis.

Crystal-Controlled Converter for 2 and 6 Meters

By **DONALD A. SMITH, W3UZN**

Construction of a sensitive, two-band converter from two pre-assembled kit boards. I.f. output 3 to 7 mc.

ARE you a Novice operating on 2 meters? A Technician on 6? Or a General Class Amateur operating in the v.h.f. bands? Described here is a crystal-controlled converter for everyone. You won't have "bugs" in it and you won't have to worry about lead lengths. Even the "B+" and filament voltages required for the operation are "built-in."

The desire for a 6- and 2-meter converter brought on an investigation of the amateur market to see what was available in both kit and wired units. There are several complete kits on the market but the prices exceeded the budget. Even with the fancy price tags power supplies were not included in these units.

An *International Crystal* FCV-2 6-meter converter was on hand and had been in use for some time. Good results had been obtained with it and, being of the printed circuit type, no problems were encountered with lead lengths or other characteristic v.h.f. problems. With these advantages in mind, a 2-meter model of the FCV-2 was ordered for use in the two-band converter. These units are available in either kit or wired-and-tested versions.

Power Supply

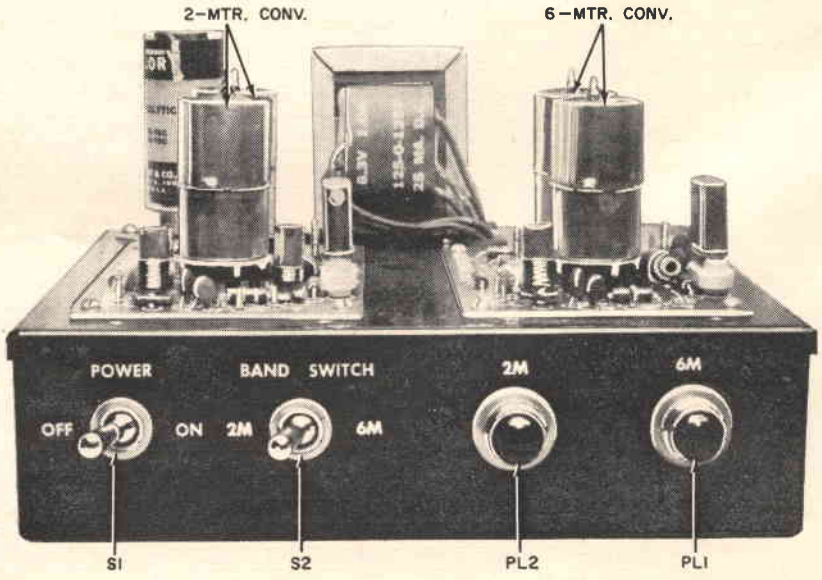
Supply voltages for outboard equipment is not always available or desirable. For this reason, the unit was designed with its own built-in a.c.-operated power supply. See Fig. 1. There is no shock hazard using the small power transformer. The only receiver connection required is a shielded lead from the i.f. output jack to the receiver antenna terminals. The unit has a separate jack on the rear apron of the box chassis—one for the 2-meter antenna and one for the 6. The bandswitch on the front panel serves two purposes. First it connects the output of the converter in use to the i.f. output jack, J_3. Second, it connects filament voltage to the converter.

Switching of the filament voltage involves a short delay until the filaments warm up, but is worthwhile since it permits the use of a less expensive power transformer. A pilot lamp is used with each converter—the lamp also being wired to the bandswitch. This tells the amateur which band is in operation—2 or 6 meters. Another switch, S_1, is used as the a.c. "on-off" switch.

Construction

The unit is built on a 7" x 7½" x 2" box-type chassis, which completely shields the bottom of the printed cir-

Front view shows the placement of the power and band switches and two pilot lamps.



cuit boards. Two shields (not shown) shield the converters above the chassis. These shields are available from the same company that supplies the printed-circuit converters, but a saving can be effected by making your own. Screening or "do-it-yourself" aluminum can be used. Do not use a material which does not have adequate ventilation. The heat from the tubes should be allowed to circulate and be dissipated in the air.

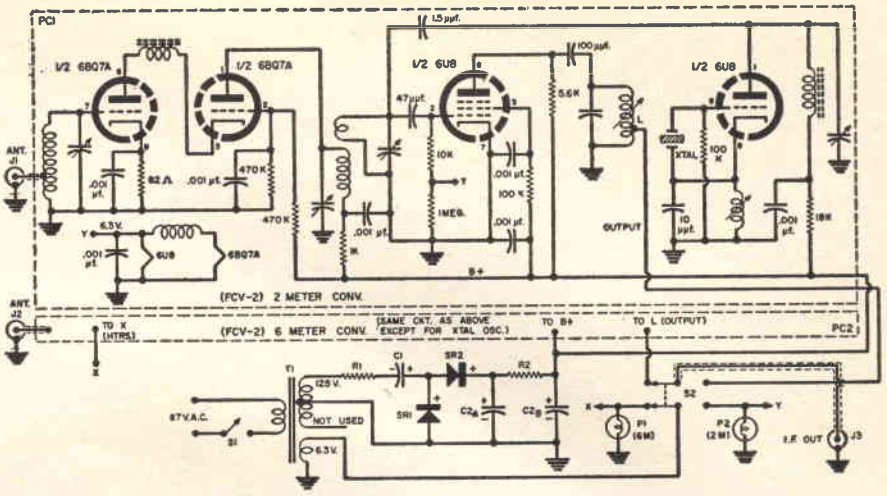
Begin construction by cutting holes in the chassis to accommodate the two printed circuit boards. This is not difficult. The chassis is made of aluminum and can be cut with a pair of tin snips after a "starter hole" has been punched. If desired, you can drill around an outline and then file the cut-out smooth. Make the cut-out for the printed circuit boards about ⅛" smaller than the actual board so that the board will have a little "lip" on which to rest. Be sure to leave the lip at the points where the mounting holes for the printed circuit boards are located. You will note that these are drilled in each corner. The small nuts and bolts required for mounting are included with the kits.

Now finish the sheet metal work by drilling holes for the switches, pilot lamp sockets, transformer, etc. Terminal strips are used under the chassis for mounting the silicon rectifiers and series filter. Check your chassis space to be sure all the parts will fit and then solder in the components.

When all the parts are mounted, wire the power supply. The silicon supply is of the voltage-doubler type. The output voltage will be between 200 and 250 volts, depending on the value of the input filter used and that of the filter resistor, R_2. It is not necessary to use shielded leads from the output of each converter to the bandswitch, S_2. However, the leads from each of the antenna input jacks to the converter inputs must be shielded. Use the type of shielded wire which has an insulated covering over the shield. This will prevent shorting of parts under the chassis.

Connect a shielded wire from the i.f. output jack, J_3, to the receiver antenna connections and insert the tubes, pilot lamps, and crystals. Note that the frequency of the crystals will depend on the i.f. output frequency desired from the converters. When ordering the printed circuit kits, state what i.f. output you require. The model shown was designed for an i.f. output of 3 to 7 mc. Other i.f. outputs from 600 kc. to 30 mc. are available.

If you have selected the wired printed circuit boards, no alignment is necessary. When the unit is turned on and the desired band selected by means of the bandswitch, an increase in receiver noise will be noted. Simply tune your receiver to the frequency of the i.f. output that is used and you are in business!



R_1—47 ohm, ½ w. res.
R_2—1000 ohm, 2 w. res.
C_1—40 µf., 150 v. elec. capacitor
C_2—20/20 µf., 350 v. can-type elec. capacitor
S_1—S.p.s.t toggle switch
S_2—D.p.d.t. toggle switch
SR_1, SR_2—150 ma. silicon diode (Tarzian M-150)
P_1, P_2—6.3 volt pilot lamp (#47)
J_1 J_2—V.h.f. jack (Amphenol #83-1R)
J_3—Phono jack (comes with printed circuit kit)
T_1—Power trans. 125-0-125 @ 25 ma. (half of secondary not used); 6.3 volts @ 1 amp. (Stancor PS-8416)
PC_1—Printed circuit board for 2 meters (International Crystal FCV-2, in kit or wired form)
PC_2—Printed circuit board for 6 meters (International Crystal FCV-2, in kit or wired form)
Note: These printed boards come with all parts which are shown within dotted lines. Other parts listed above are not included.
Chassis—Box type chassis, 7" x 7½" x 2" (LMB #20)

Fig. 1. Schematic of power supply and interconnections for the 2-band converter.

Alignment

When kits have been used, a simple alignment procedure must be followed. The oscillator can be checked on each of the converters, to insure that it is oscillating, by removing the 6BQ7A and connecting a v.t.v.m. to pin 9 of the 6U8 and measuring the bias voltage. Tune the oscillator slug for maximum grid voltage. This will be a small negative voltage. In the 2-meter converter, after setting this slug for maximum, turn the adjustment screw of the oscillator coil one-half turn counterclockwise. This will keep the oscillator from "dropping out" of oscillation while you make the other adjustments.

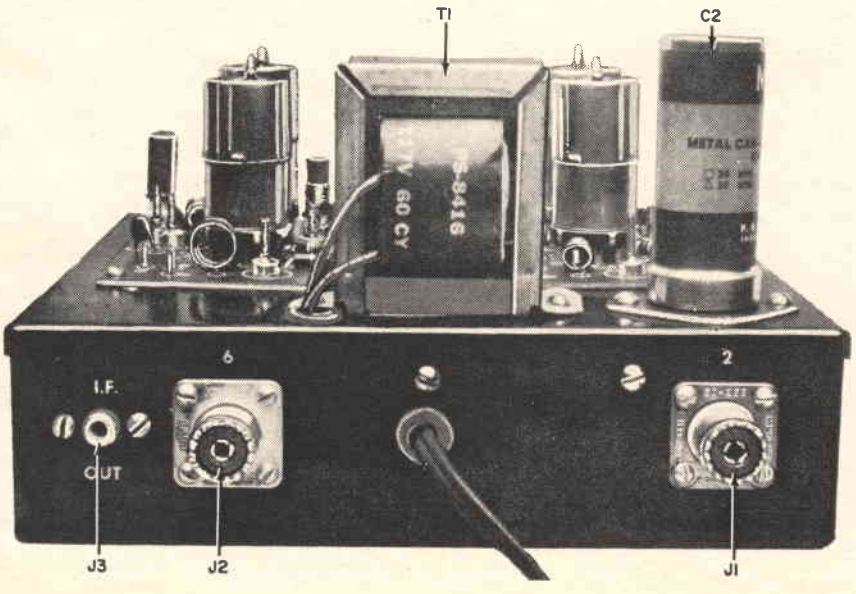
Replace the r.f. amplifier tube, then find a weak signal on the band and peak the trimmers. Do not re-adjust the oscillator. You will notice that maximum signal and minimum noise do not occur at the same setting of the trimmers. This is normal, so adjust the trimmers for maximum signal, while keeping the noise level as low as possible.

If wide-band coverage is necessary or desired, a signal generator will be necessary. The instructions accompanying the printed circuit boards explain this alignment procedure in detail. Since in most cases operation on these two bands is confined to one end of the band, the simple tune-up outlined previously will be satisfactory.

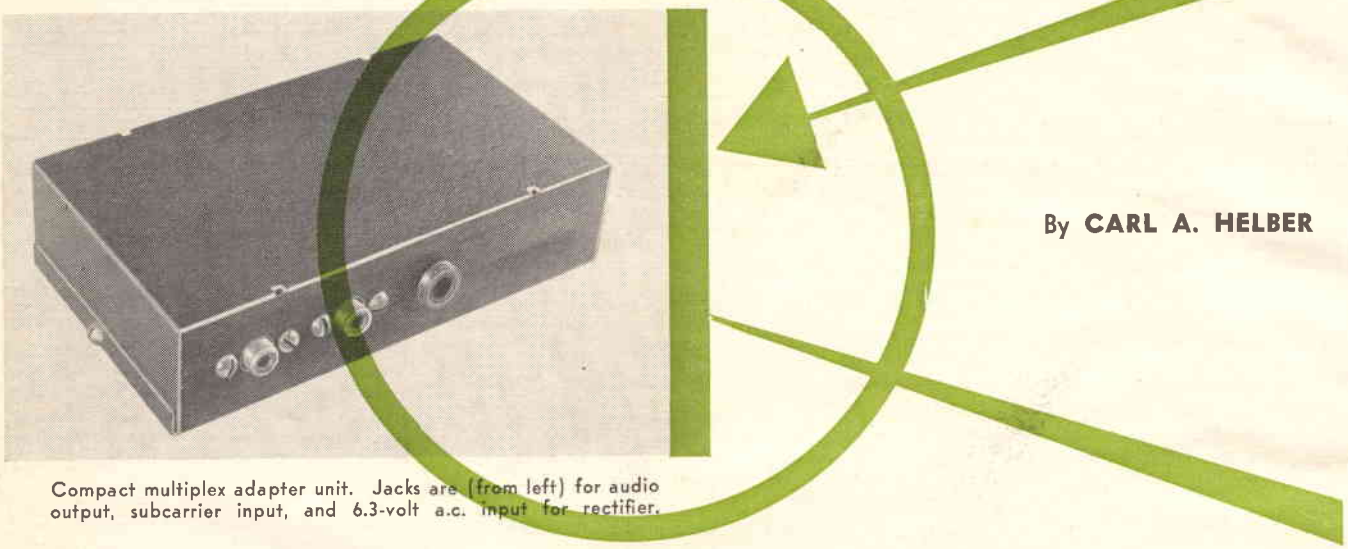
The 2- and 6-meter converter is used with a ground-plane antenna for 2 meters and an 8-element beam for 6.

-30-

Rear view of the unit shows coax fittings for the six- and two-meter antennas that are employed, along with the phono jack for intermediate-frequency output.



Transistorized FM Multiplex Adapter



Compact multiplex adapter unit. Jacks are (from left) for audio output, subcarrier input, and 6.3-volt a.c. input for rectifier.

By CARL A. HELBER

Construction of experimental unit used with FM tuner to detect narrow-band multiplex signals. Requires separate matrixing circuits for multiplexed stereo.

HAVING recently completed the construction of an FM tuner kit, the author decided to design an experimental multiplex adapter which could be used with the tuner. Two excellent articles on the fundamentals of FM multiplex appeared in the January and February 1959 issues of this magazine and were used as the springboard for designing the adapter to be described.

The primary aim in designing this adapter was to gain some practical experience with FM multiplex systems. Several experimental devices were built in the course of this work and the one described is thought to be of interest to readers, from the standpoint of circuit simplicity.

While the unit in its present form is suitable only for narrow-band FM multiplex stereo, when used with suitable matrixing it can be modified for wide-band use. Considerably more tuner output is required for reliable operation, however.

To date the FCC has not decided which of the many proposed stereo multiplex systems to approve. In the interim the experimenter can content himself by becoming acquainted with the problems peculiar to some or all of the many types and can, if so inclined, accept the challenge of finding the simplest device capable of acceptable performance.

While previously published information applied to tube circuits, it appeared, after a cursory analysis, to be feasible to design an adapter using inexpensive germanium transistors. The advantages of such a device are simplicity, low power consumption, small size, and low cost. In fact the total cost of parts, including the 5½" x 3" x 1¼" case, was approximately $12.00.

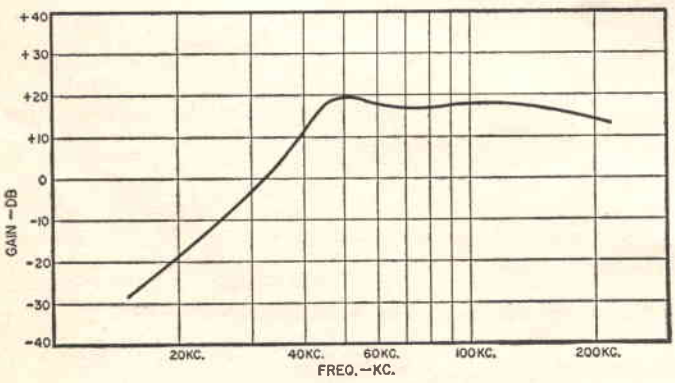


Fig. 1. Measured response of the filter and amplifier. Equipment was designed for a 67.5-kc. subcarrier so that the filter cuts off at around 40 kc. For a 50-kc. subcarrier, a cut-off frequency of about 25 kc. would be preferable.

Circuit Design

In the interests of simplicity a constant-*k*, high-pass filter and amplifier circuit was designed rather than the more complex bandpass type. The adapter described herein was for experiments on a subcarrier of 67.5 kc. and the filter was designed to cut-off in the neighborhood of 40 kc. For a 50 kc. subcarrier, a cut-off frequency of about 25 kc. would be more desirable. Fig. 4 is the diagram of the filter and amplifier while Fig. 1 shows the over-all gain characteristics as a function of frequency.

The filter was designed to match a 2700-ohm load as a reasonable compromise between the large physical size of the high-value inductors required for high-impedance filters and the excessive power required to drive a low-impedance filter to a given voltage output. A value of 2700 ohms is close enough to the input impedance of the transistor amplifier to provide a reasonable match for the filter. Measurements made on several 2N229 *n-p-n* transistors in the circuit shown gave an input impedance of about 3500 ohms at 67.5 kc. Mismatches of 2 to 1 showed no discernible ill effects as far as a hearing test was concerned.

The frequency discriminator was designed originally as a monostable multivibrator and is shown in Fig. 2. Transistor V_3 is normally held in

saturation by base current flowing through R_8 while V_2 is conducting lightly because of its much lower base current. Transistor V_2 could be cut-off completely by decreasing the value of R_6 but at the expense of larger trigger requirements. When a positive pulse is applied to the base of V_2, the collector of V_2 drops sharply, as does the base of V_3. This action causes the collector of V_3 to rise and causes C_6 to start charging toward +6 volts. In about 4 or 5 microseconds C_6 has charged sufficiently, through R_8, to bring V_3 back into conduction, at which time the emitters of both transistors rise to a point where V_3 is conducting heavily again and V_2 only lightly.

Since the width of the generated pulse is essentially independent of the triggering rate, the average voltage appearing at the collector of V_3 will be

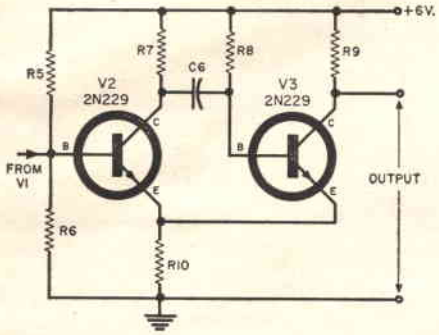


Fig. 2. Monostable multivibrator circuit.

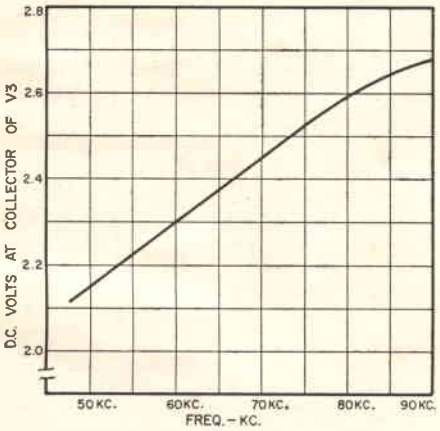


Fig. 3. Monostable multivibrator response.

directly proportional to the triggering frequency up to the point where V_3 is off all the time. In this case the collector of V_3 would be at +6 volts. Usually before this condition is reached, the multivibrator begins to trigger on every other pulse and thus the average voltage at the collector of V_3 is linearly proportional to frequency over a limited range.

Fig. 3 shows the results of actual measurements taken on the circuit of Fig. 2 connected to the filter and amplifier of Fig. 4. A sinusoidal voltage of sufficient amplitude to cause reliable triggering of the multivibrator was applied to the input of the filter. From this curve it can be seen that a peak-to-peak audio component of about 0.22 volt will be developed for a maximum frequency deviation of ± 7.5 kc.

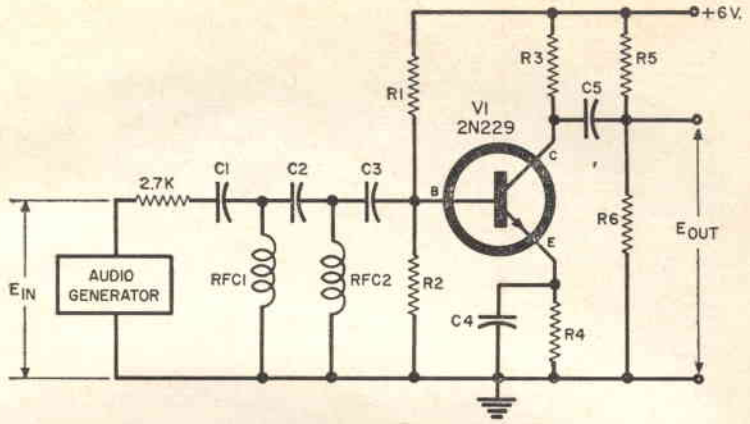


Fig. 4. Filter and amplifier portion of the transistorized multiplex adapter.

Measurements made on the overall circuitry showed that triggering started with an input signal of about 40 millivolts r.m.s. at 67.5 kc. and that no further change in d.c. level at the collector of V_3 occurred when the voltage increased beyond about 80 millivolts. Tests were made all the way up to 10 volts r.m.s. For this purpose a 2700-ohm resistor was connected between the filter input and the signal generator and the voltage measured at the generator end of the resistor.

In order to eliminate any possibility of distortion or overloading occurring between the FM tuner discriminator and the filter, it was decided to connect the filter directly to the tuner multiplex jack. It was necessary to replace the 100,000-ohm resistor normally present in the tuner with a 2700-ohm unit in order to achieve the necessary driving source impedance and high enough signal levels. No noticeable effect on normal FM reproduction appeared as a result of this change.

A filter between the collector of V_3 and the audio amplifier is required in order to keep the high-amplitude pulses from over-driving the input stage. The filter incorporated in the diagram provides adequate pulse filtering along with a substantial amount of de-emphasis of the high frequencies.

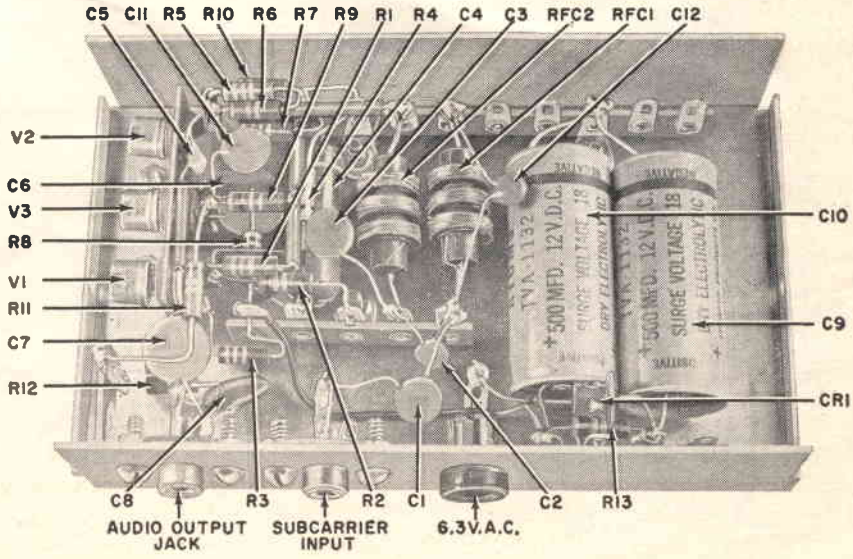
Power-supply measurements were made and showed that at 6 volts a current of 13 ma. was required. Since this was less than the current required by the average pilot light, it was decided to obtain power for the adapter from the rectified and filtered filament power of the tuner. The complete diagram of the unit, including the power supply, is shown in Fig. 5. Residual ripple is negligible.

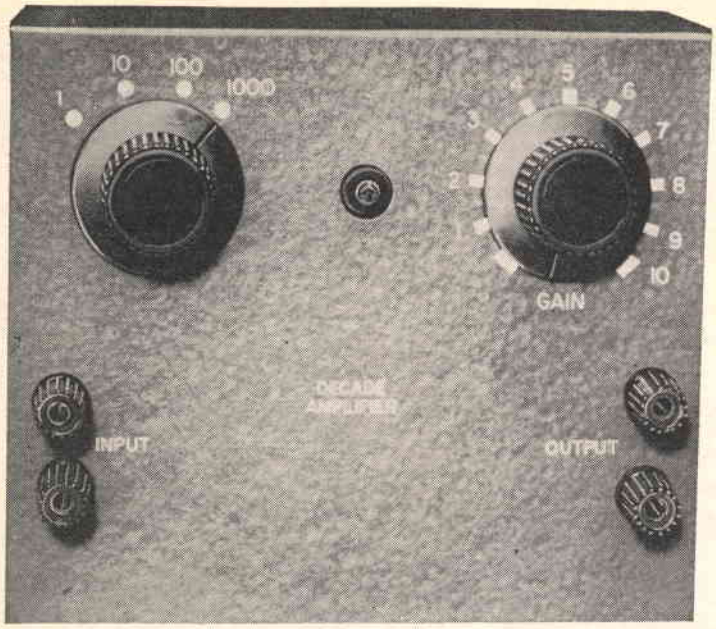
Construction

Following the preliminary design, a circuit was built up and tests made. It was found experimentally that improved signal-to-noise ratio for initially noisy signals could be obtained by means of a slight modification of the filter (C_{12} was added to boost the subcarrier 4 or 5 db) and the monostable multivibrator was modified to a free-running multivibrator capable of being locked easily to the incoming modulated subcarrier. Nominally the multivibrator runs at about 65-70 kc. and puts out a somewhat triangular waveform. While for sufficient trigger levels the "off" time for V_3 remains fixed, the time between pulses is inversely proportional to the triggering

(*Continued on page* 120)

Bottom view of the adapter unit which is built inside a 5½" x 3" x 1¼" case. All the components have been labeled to minimize difficulty in construction.





A Calibrated Decade Amplifier

By **TOM JASKI**

This precise, wide-range instrument expands the utility of other test instruments in low-level measurement.

WHEREVER you need to measure, display on an oscilloscope, or have to work in some other way with very low voltages, some standardized form of amplification is almost indispensable. The decade amplifier to be described can supply such a standard amount of amplification and, besides that, it comes in handy as a general laboratory or shop amplifier. It can be built to give you exactly 10-times, 100-times, or 1000-times amplification over a wide range of frequencies and will give less accurate, but substantial, amplification beyond this range. The frequency range over which the amplifier may be considered accurate is from 1 cycle to well over 200 kc., and the drop at 1 mc. is less than 1 db. External appearance of this relatively inexpensive unit is shown above, with the schematic appearing in Fig. 3.

The input voltage is first applied to a cathode-follower; next, to one, two or three almost identical amplifiers; and finally, to another cathode-follower, making the circuit independent of input and output impedance. We say "almost" identical because there will be some slight differences in amplifiers, if you want accuracy over the three steps. You can achieve this accuracy in either of two ways: you can do it as the author did, by selecting plate-load resistors for the 12AT7 voltage amplifiers, or you can make the plate-load resistor of the first amplifier a potentiometer. Why is this necessary? Because the cathode followers each have a gain of slightly *less* than one.

As shown, the gain of each of these cathode-followers is about 0.93, but this may vary with the particular tubes you use. Suppose gain is 0.9. Then, without amplification, you'd get through the two followers a signal about 0.81 of the original. To get exactly 10-times amplification, the gain of the first stage must be 12.4. Now, when using the 10X stage only, you will get just what you want (12.4 x .81 x *signal* = 10X *signal*). To get 1000X, then, the second stage needs to be exactly 10 times and the third stage also exactly 10 times. For this reason the plate resistors in the three voltage amplifier circuits are labelled "approximately," so that you can adjust the gain by selecting these resistors.

The gain of a single stage of voltage amplification is roughly (ignoring the following grid resistor) : μR_L / (R_L + R_p) in which μ is the amplification factor, R_L the load resistor, and R_p the tube plate resistance. Thus by increasing R_L we can increase the gain of the stage. This increase is not rapid, but then we need only very little increase—less than 25%, depending on the performance of the cathode-followers.

The bias adjustment (R_{15}) is provided to allow calibration of the amplifier for slightly differing line voltages and to compensate eventually for tube aging. It is assumed that all the

Fig. 1. For those who wish to follow the author's layout, location of most components is shown in this bottom view.

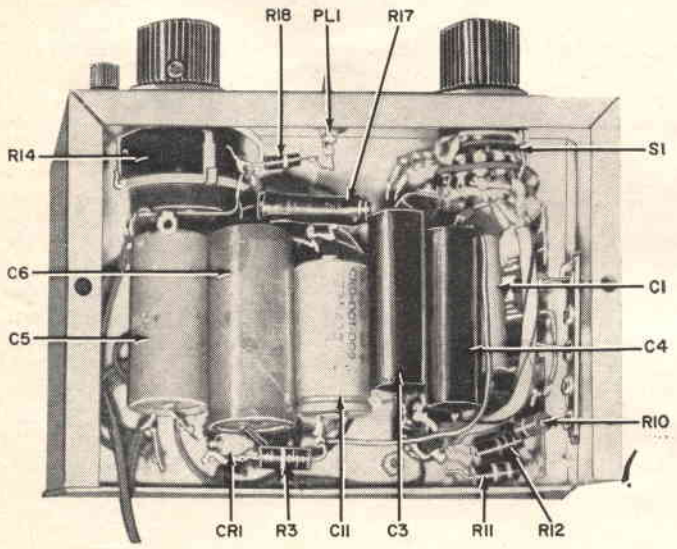
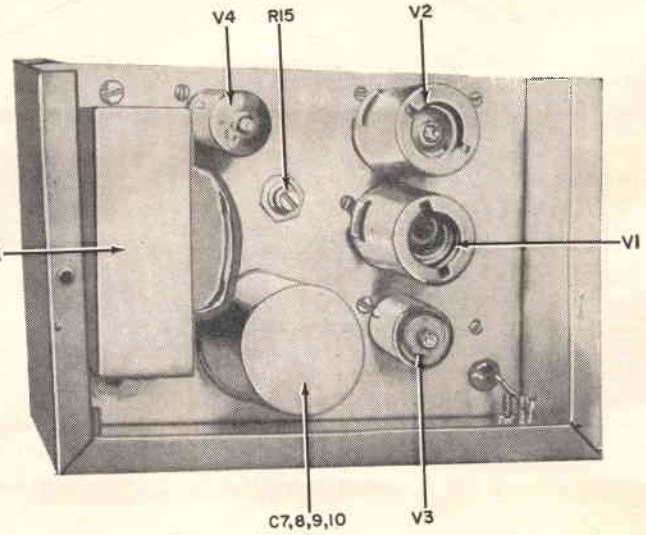


Fig. 2. Tubes, the multiple filter capacitor, the transformer, and the bias control are mounted atop the chassis.



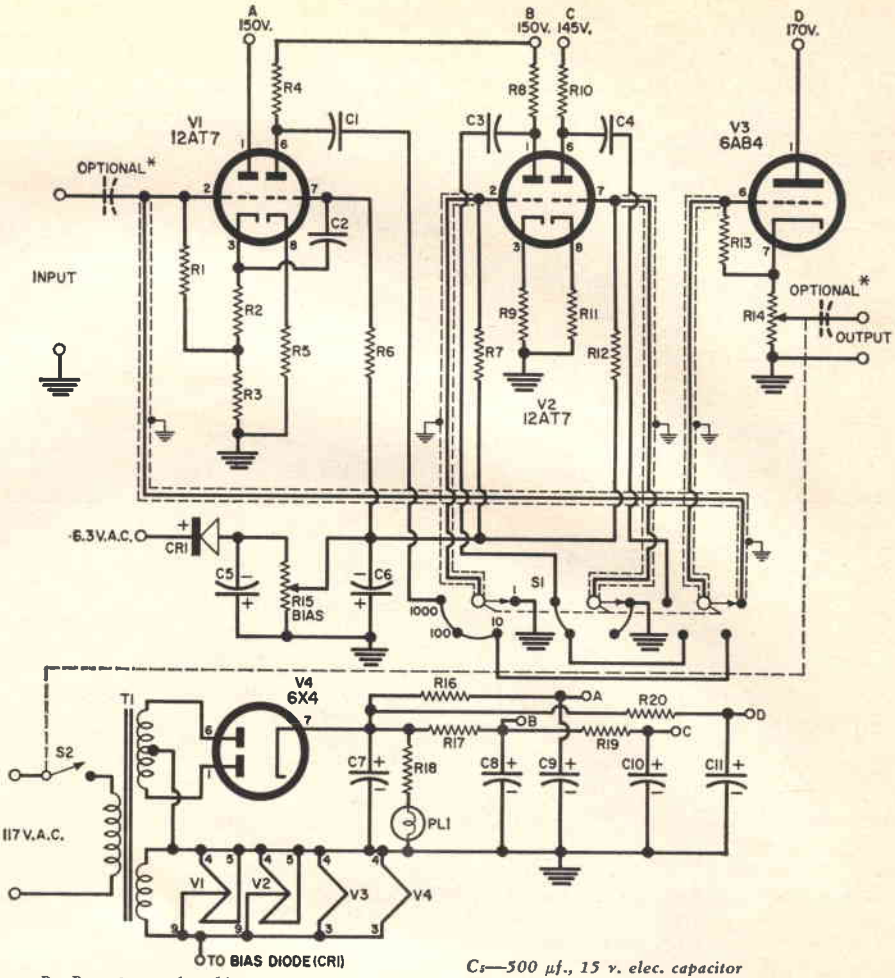
tubes will be equally affected by either line voltage or aging, and this is reasonable in view of the nearly identical circuits and the identical tubes. If you are more particular than that, you can duplicate the bias adjustment for each stage individually. By careful selection of plate-load resistors, the amplifier was built to give accurate steps within 2%. This is sufficient for most practical purposes. Input and output can be supplied through capacitors if you wish to eliminate d.c. components. These capacitors should be .25 μf., 200 v. each.

The maximum signal input for the 1000-times gain setting is 10 millivolts and, for the other settings, it is proportionately larger. Thus, the undistorted output of the amplifier is about 10 volts. This is a conservative figure; actually you can probably get up to 15 volts undistorted if all circuit components conform exactly to the values indicated in the parts list.

The entire amplifier is housed in a 4" x 5" x 6" utility box. Tubes are shielded and need to be tested in advance for cathode-filament leakage, since 60-cycle hum must be kept to an absolute minimum considering the low voltages with which we are dealing. For that reason, the grid leads to all tubes are carefully shielded—and remember to tie the shields to ground all at one location and only at one end of the shield. It will be best to use a steel utility box, since strong magnetic fields, such as leakage fields from power transformers, can affect the circuit. In use, the case should be well grounded to whatever other instruments are used.

Parts arrangement (Figs. 1 and 2) is not extremely critical, but thought must again be given to minimizing 60-cycle hum. Dress all filament leads close to the chassis and keep grid connections as physically short as possible. Always connect the outside foil of capacitors to the plate of the tube rather than to the succeeding grid and do not run any grid or plate wires parallel, even for a short distance, to filament wires. Poor construction *can* result in making the 1000-times stage unusable because of 60-cycle pickup. If you are concerned about this possibility of trouble, you can profitably make the cabinet larger and magnetically shield the power transformer from the rest of the circuit or build the power supply into a separate cabinet. Steel shields should be used around the tubes instead of aluminum ones. Connections to and from other equipment should also be carefully shielded.

The amplifier stages are not difficult to calibrate. With a scope and a voltage source you can adjust each stage individually for its proper gain. First determine the loss of both cathode-followers and correct the first amplifier stage accordingly. The next two amplifier steps should be adjusted until they give steps of exactly 10. The accuracy of the instrument is then limited only by your patience in connecting the correct plate-load resistors and the care



R1, R13—1 megohm, ½ w. res.
R2—1000 ohm, ½ w. res.
R3—10,000 ohm, 1 w. res.
R4—24,000 ohm, 1 w. res. (approx., see text)
R5, R9, R11—470 ohm, 1 w. res.
R6, R7, R12—240,000 ohm, ½ w. res.
R8, R10—22,000 ohm, 1 w. res. (approx., see text)
R14—5000 ohm, 4 w. wirewound pot (with switch S2)
R15—500 ohm, 1 w. pot
R16—10,000 ohm, 2 w. res.
R17, R20—5000 ohm, 5 w. wirewound res.
R18—2.2 megohm, ½ w. res.
R19—1000 ohm, 1 w. res.
C1, C2, C3, C4—.25 μf., 200 v. paper capacitor
C5—500 μf., 15 v. elec. capacitor
C6—1000 to 2000 μf., 6 v. elec. capacitor
C7, C8, C9, C10—20/20/20/20 μf., 450 v. elec. capacitor
C11—20 μf., 350 v. elec. capacitor
S1—3-pole, 4-pos. non-shorting switch
S2—S.p.s.t toggle switch (on R14)
CR1—1N34 crystal diode
PL1—NE-2 lamp (mounted in grommet on front panel)
T1—Power trans. 260-0-260 v. @ 50 ma. (40 ma. is sufficient); 6.3 v. @ 1.2 amp.
V1, V2—12AT7 tube
V3—6AB4 (or ½ 12AT7) tube
V4—6X4 tube
** Optional capacitors for input and output should be .25 μf., 200 volt paper units.*

Fig. 3. For exact decade steps, plate-load resistors must be chosen carefully.

with which you read your scope or v.t.v.m. Make all adjustments at one frequency, say 1000 cycles. The amplifier should remain accurate over a wide range.

In use there is nothing simpler. Connect the input and output and select the proper gain step. For 10X steps, leave the output potentiometer at its top position. Intermediate degrees of amplification can also be selected with this potentiometer, which can be calibrated.

Applications

The amplifier can be used for a number of jobs, including that of increasing the sensitivity of many test instruments. The effective sensitivity of a scope, for example, can be increased from 25 mv.-per-inch to 25 μv.-per-inch, enough to display such low voltages as occur in human brain waves. (However, if you've a mind to try this, be sure to filter out 60-cycle pickup in the subject, leads, and instruments for such low voltages!) In all cases where actual amplitude of a phenomenon is of interest, remember to divide the readings obtained on the measuring instrument by the setting of the amplifier.

With an ordinary multimeter, you can measure the output of a microphone or a low-level phonograph pickup. The amplifier will also increase the sensitivity of a bridge null detector. The output of low-level signal generators can be displayed on oscilloscopes at sufficient amplitude to make calibration of the generator with the scope possible. Output pulses from photocells may also be displayed.

Using this decade amplifier in conjunction with measuring instruments of normal range will give many answers that are otherwise unobtainable. To the author, it has been a very useful tool. —30—

Directory of Service Associations

THE GROWING maturity and importance of the independent service industry is supported by no stronger evidence than the role played by service associations. As never before, they are the instruments through which independent operators are shaping their own destinies rather than letting their fate be determined by others.

The editors of ELECTRONICS WORLD believe this directory, consisting of more than 200 entries, to be the most complete *verified* list of its kind now available. Since we have checked this original, directly compiled list against others running to as many as 300 entries, explanation of the claim is in order.

As many as 50 per-cent of the entries in other tallies we have screened are in error. Groups long since dissolved are still carried. Others, due to name changes, address changes, and mergers with other groups, are inadvertently listed two or more times. Professional, mercantile, and technical societies that have little or nothing to do with electronic service abound. The list appearing here has been verified as carefully as possible. We know of no other that comes closer to completeness and accuracy. It carries many names we have seen recorded nowhere else. If legitimate, active organizations do not appear or their entries contain errors, we hope they will notify us to that effect so that this directory, which is undergoing constant correction and verification, may be improved.

The only national group we can confirm as being currently active is NATESA, which will be found under the Illinois listing because its headquarters are in that state. Similarly, the Midwest Electronic Alliance is included with the Ohio entries because its chief officer resides in Ohio.

—30—

ALABAMA

Radio & TV Technician's Guild, Inc., 404 North 16th St., Gadsden. Guy Brooks, Sec'y.

ARIZONA

Better Electronic Service Technicians of Arizona, Inc., P.O. Box 1284, Phoenix. Ray Oxman, Pres., David Gordon, Exec. Sec'y.

ARKANSAS

TESA-RTTA of Ft. Smith, P.O. Box 133, Ft. Smith. James Crouch, Pres., O. W. Donald, Sec'y.

TV Service Ass'n of Arkansas, 807 W. Markham, Little Rock. Norman Baxter, Pres.

Tri-State TV Ass'n, 1824 State Line Ave., Texarkana. Eldon R. brown, Pres.

CALIFORNIA

California State Electronics Ass'n, 1111 Weldon Ave., Fresno. Keith Kirstein, Pres., Earl Robbins, Sec'y.

Society of Radio & TV Technicians, Inc. P.O. Box 126, Van Nuys. Arnold J. Meyer, Pres., George Gilmer, Sec'y.

SRTT-Glendale-Burbank Chapter. P.O. Box 4012, N. Glendale Sta., Glendale. Ralph Johonnot, Pres., Gene Sheppard, Sec'y.

RTA-Long Beach Chapter, P.O. Box 4085, Long Beach. John Whittaker, Pres., Col. James C. Hughes, Sec'y.

RTA-Riverside Chapter, P.O. Box 74, Arlington. Howard Bogue, Pres., Wade Nelson, Sec'y.

RTA-San Antonio Chapter, Box 626, South Gate. Harry Midkiff, Pres., James Spalding, Sec'y.

RTA-Pasadena Area Chapter, Main P.O. Box 1143, Pasadena. Wayne Hartwell, Pres., Virgil V. Gaither, Sec'y.

RTA-Pomona Valley Chapter, 1551 N. Pleasant, Ontario.

RTA-South Bay Chapter, 1154 Manzanita, Manhattan Beach. G. P. R. Christensen, Pres.

RTA-San Gabriel Chapter, P.O. Box 187, El Monte.

RTA-Los Cerritos Chapter, Box 129, Bellflower. Jim Mackay, Pres., Al Gardner, Sec'y.

RTA-San Diego County Chapter, 4145 Voltaire St., San Diego. Steven Reynard, Pres., Sherman W. Pethley, Sec'y.

RTA-Orange County Chapter, 4729 E. Gage, Bell. Frank Rice, Pres., Frank Montelli, Sec'y.

RTA-Bay Area Chapter, 1642 Ocean Park, Santa Monica.

RTA-San Bernardino Chapter, Box 3398, San Bernardino. O. C. Deardorff, Pres., Homer Clark, Sec'y.

RTA-High Desert Chapter, Box 963, Apple Valley.

Electric League of Los Angeles, 2508 W. Olympic Blvd., Los Angeles. Frank Ballman, Pres., Glen L. Logan, Sec'y.

Independent TV Service Dealers Ass'n of Los Angeles County, Inc., 213 S. Coronado St., Los Angeles. H. W. Wilkins, Pres., Abe Bowers, Sec'y.

Alameda County TV & Radio Ass'n, Inc., 5585 Thomas Ave., Oakland. Philip M. Fisher, Exec. Sec'y.

TV Service Dealers Ass'n of San Mateo County, P.O. Box 801, San Carlos. M. W. Kehler, Pres., Lloyd Williams, Sec'y.

Radio & TV Ass'n of Santa Clara Valley, Room 467A, Porter Bldg., San Jose. Russell J. Hamm, Pres., John Murphy, Se 'y.

San Francisco TV Service Ass'n, 391 Sutter St., San Francisco. William E. Finnerty, Pres., Roy L. Faverty, Sec'y.

Professional TV Technicians, 1959 W. Carson Blvd., Torrance. Jack Higar.

North Bay Radio & TV Ass'n, P.O. Box 52, Vallejo. Ray Warthen, Pres.

CONNECTICUT

TV Service Ass'n, Inc. of Conn., 306 Valley Street, Willimantic. Peter Lucas, Pres.

TV Service Ass'n of Waterbury, P.O. Box 683, Waterbury. George Daddona, Sec'y.

Ass'n of Certified TV Dealers, Overbrook Drive, Stamford. T. Armstrong, Pres.

DISTRICT OF COLUMBIA

TV Service Ass'n of Metropolitan Washington, Room 852, Washington Bldg., Washington. Bernard Bognovitz, Pres., Hymie Nussbaum, Exec. Sec'y.

FLORIDA

R.T.T.G.-TESA Miami, 35 Almeria Ave., Coral Gables. A. Edward Stevens, Pres., Max Reiser, Sec'y.

GEORGIA

Savannah TV & Radio Dealers Ass'n, c/o Downey's, Inc., 2503 Waters Ave., Savannah. W. L. Parktee, Pres.

IDAHO

TV & Electronics Service Ass'n of Canyon County, Inc., 220 Diamond, Nampa. Bud Phillips, Pres.

ILLINOIS

National Alliance of Television & Electronic Service Ass'ns (NATESA), 5906 S. Troy St., Chicago. Mac Metoyer, Pres., Frank J. Moch, Exec. Dir.

TESA of Chicagoland, 5905 S. Troy St., Chicago. Sam Maksimuk, Pres., Angelo Chrysogelos, Sec'y.

Associated Radio & Television Servicemen of Illinois, 433 S. Wabash Ave., Chicago. Howard J. Wolfson, Chmn., Yuki Minaga, Sec'y.

Du Page TV Service Ass'n, 11 South Lincoln, Hinsdale. Robert A. Conn, Pres., Dick Wilson, Sec'y.

Electronic Technicians Ass'n of Northern Illinois, 2110 Broadway, Rockford. Don Nelson, Pres., Edward G. Tanrath, Sec'y.

Greater Rockford Appliance Dealers Ass'n, 815 E. State St., Rockford. J. Albert Johnson, Pres., Herbert L. Berry, Sec'y.

INDIANA

Indiana Electronic Service Ass'ns, Leonard's Radio & TV, Fortville. James W. Baker, Chmn. Glen Leonard, Sec'y.

Radio & TV Service Engineers Ass'n of Anderson, Radio Sales & Service Co., 1836 E. 5th St., Anderson. Garland Wooldridge, Pres., Gerald Whitesel, Sec'y.

Lawrence County Electronic Technicians Ass'n, Porter's TV, 2903 Mitchell Rd., Bedford. Charles Lantz, Pres., Carl Porter, Sec'y-Treas.

Bloomington Radio & TV Service Ass'n, Inc., Boruff Electronics, 304 W. 2nd St., Bloomington. Frank Brummett, Pres., Jesse Boruff, Sec'y.

Radio & TV Service Dealers Ass'n of Columbus, Paris Radio & TV, 91 S. Brooks St., Columbus. George Fox, Pres., Harold Paris, Sec'y.

TV Bureau of Elkhart, Wayne L. Clem TV, 1136 Mishawaka Rd., Elkhart. Dean R. Mock, Pres., Wayne L. Clem, Sec'y.

Radio-TV Service Mens Ass'n, Inc., 225 Fernwood Dr., Evansville. Julius Groeninger, Pres., Stirman Rowland, Sec'y.

BOPPT of Fort Wayne, 804 E. Jefferson, Ft. Wayne. Robert Maxwell, Pres.

Radio & TV Servicemens' Ass'n of Hammond, Community Radio, 5807 Calumet Ave., Hammond. Gerald Van Prooyen, Pres., Thomas Leeney, Sec'y-Treas.

Radio & TV Technicians Ass'n of Grant County, 312 S. Race St., Marion. Charles R. Schwark, Pres., William W. Irwin, Sec'y.-Treas.

Indianapolis TV Technicians Ass'n, Inc., P.O. Box 23125, Indianapolis. Leon Howland, Pres., Howard Joergens, Sec'y.

Radio & TV Service Engineers Ass'n, Inc. of Kokomo, 1136 N. McCann St., Kokomo. Harold Crume, Pres., Charles Conwell, Sec'y.

Radio & TV Service Engineers Ass'n, Inc. of Logansport, 530 N. Cicott St., Logansport. William L. Boller, Pres., Don Hyman, Sec'y.

Radio-TV Service Ass'n of Muncie, TV Installation & Service Co., 2121 S. Madison St., Muncie. Charles Irelan, Pres., Frank Robb, Sec'y.

Electronic Service Technicians Ass'n, Inc., of Henry County, Brent's Radio-TV Service, S. 8th St., New Castle. T. Frank Oxley, Jr., Pres., Brent Hay, Sec'y.

TV Servicemen's Ass'n, Inc. of Jackson County, Luecke TV Service, R.R. 3, Seymour. J. Allen Brackemyre, Pres., Robert E. Luecke, Sec'y.-Treas.

ARTS of St. Joseph Valley, Bill's Radio Service, 1410 Sorin St., South Bend. William Rapport, Pres., Russ Bills, Chmn.

Wabash Valley Electronic Technicians Ass'ns, Inc., 805 S. 8th St., Terre Haute. William Durham, Pres, Charles H. McKay, Sec'y.-Treas.

TESA-Vincennes, Louie's Radio-TV, 211 Busseron St., Vincennes. Leroy Vaughn, Pres., Bertha F. Fravel, Sec'y.-Treas.

IOWA

Television Servicemen's Ass'n of Iowa, 514 E. Locust, Des Moines. J. R. Jackson, Pres., B. R. Moon, Sec'y.

TESA Quint Cities, 2517 Oak St., Bettendorf. H. H. Duffield.

TSA of Des Moines, c/o B. R. Moon, 514 E. Locust, Des Moines. Floyd Webb, Pres., Howard Cox, Sec'y.

North Central Chapter of TSA of Iowa, c/o Lynn Cole, V.P., 303 S. Taylor, Mason City. Leon McDermott, Pres., Otto Schwartz, Sec'y.

Ottumwa TV Service Ass'n, 515 Church St., Ottumwa. Gerry Brown, Sec'y.

Buena Vista County TSA, Box 636, Storm Lake. Howard L. Bonar, Sec'y.

KANSAS

TV Electronics Service Ass'n of Kansas, Inc., Box 81, Chanute. C. J. Lett, Jr., Pres., Paul Metzinger, Sec'y.

TESA of Kansas-Dodge City Chapter, Carlyle Radio TV Service, Dodge City. Jim Carlyle, Pres., Bob Holden, Sec'y.

Missouri-Kansas Electronic Ass'n, 12900 Santa Fe Dr., Lenexa. Cecil Harden, Pres., J. B. Welsh, Exec. Sec'y.

TESA of Wichita, 841 S. Poplar, Wichita. Homer Miller, Pres., Fred Spring, Sec'y.

KENTUCKY

Kentuckiana TV & Radio Technicians Ass'n, Inc., 2519 Portland Ave., Louisville. Giles R. Allen, Sr., Pres., George Leitner, Sec'y.

LOUISIANA

TESA of the South, 4210 Eagle St., New Orleans. H.P. DuConge, Pres., Ralph R. Hogan, Sec'y

TESA-Evangeline, Opelousas, L. Edward Castille, Sec'y

MARYLAND

Maryland Electronics & TV Ass'n, 3338 Old York Rd., Baltimore. Harry O. Johnson, Pres.

MASSACHUSETTS

Electronic Technicians Guild of Mass., 10 Wakefield Ave., Saugus. Nicholas Averinos, Pres., Leonard A. Smith, Jr., Sec'y.

ETG of Mass.-Fall River Chapter, The Lane, Assonet. Henry N. Nadeau, Dir.

ETG of Mass.-Brockton Chapter, 742 N. Main St., Brockton. Vincent Cassani, Pres., Robert Peasson, Sec'y.

ETG of Greater Lawrence, 30 S. Broadway, Lawrence. Donald Baron, Pres., Jim Mulligan, Sec'y.

ETG of Mass.-Greater Lowell Chapter, 76 Walker St, Lowell. Louis Landry, Pres, Conrad Rondeau, Sec'y.

ETG of Mass.-Suburban Chapter, 845 Washington St., Newtonville. Leo Conzo, Pres., Gilbert P. Clark, Sec'y.

ETG of Mass.-South Shore Chapter, 154 E. Squantum St., N. Quincy. Ralph Cobb, Dir.

ETG of Mass.-North Shore Chapter, Box 361, Salem. Robert Pelletier, Pres, Arthur Drolet, Sec'y.

ETG of Mass.-Greater Boston Chapter, 236 Main St., Woburn. Lawrence J. McEvoy, Pres., James H. Kelley, Sec'y.

Radio & TV Technicians Guild of Greater New Bedford, Inc., 110 Topham St., New Bedford. E. K. Rogers, Pres., James L. Shepley, Sec'y.

MICHIGAN

Television Service Ass'n of Michigan, Inc., 8225 Woodward, Detroit. Patrick Laforet, Pres.

TESA of Michigan, Inc., 49—40th St., S.W., Grand Rapids. John Stefanski, Pres., Charles H. La Roche, Sec'y.

Independent TV Repairmen's Ass'n, Inc., 428 Algonquin, Detroit. M. R. Kowalski, Sec'y.

Electronic Service Ass'n, 7321 W. Warren, Detroit. Dale F. Brock, Pres., Howard Larsen, Sec'y.

Gogebic Iron TV Service Ass'n, c/o Mike Smolich Radio & TV Service, Ramsay. Mike Smolich.

South Oakland County TV Ass'n, Inc., 1127 S. Washington St., Royal Oak. Sam Baldwin, Pres., John Palmer, Sec'y.

MINNESOTA

Minnesota TV Service Engineers, Inc., P.O. Box 4429, Minneapolis. Warren Schei.

American Institute of TV Service, 801—44th Ave., N.E., Minneapolis. John W. Hemak.

Duluth TV-Radio Service Ass'n, 1601 Woodland Ave., Duluth. John Ringsred, Pres., M. Koekler, Sec'y.

Radio TV Service Ass'n, 6613—50th Ave., N., Minneapolis. Myron Biddle, Pres., Clarence Bocklund, Sec'y.

TESA of St. Paul, 635 S. Smith Ave., St. Paul. R. Linde.

MISSOURI

TESA-Missouri, 1342 Winchester, Kansas City. Vernon Towner, Pres., Earl Steffes, Sec'y.

TESA-Southeast Mo., Box 116, Vanduser. Carl Baily, Pres.

TESA-Southwest Mo., Greenfield. William S. Moudy, Pres., George Scott, Sec'y.

TESA of Greater Kansas City, 7504 Troost Ave., Kansas City. Don F. Ellis, Pres., J. Alex Earp, Sec'y.

TESA-South Central Mo., Mountain Grove. James Rathbun, Pres., Bill Pryer, Sec'y.

TESA-St. Louis, 1724 S. 39th St., St. Louis. Ray Wirtel, Pres., Morton Singer, Sec'y.

TESA-Ozarks, 854 S. Glenstone, Springfield. Gene Hoss, Pres. Tom East, Sec'y.-Treas.

The Electronic Ass'n of Mo. (TEAM), 4134 Easton, St. Louis. W. C. Pecht, Pres., Arthur A. Mayer, Sec'y.

The Electric Ass'n of Kansas City, 2201 Grand Ave., Kansas City. Robert K. Zimmerman, Pres., John S. McDermott, Sec'y.

MONTANA

Electronic Service Ass'n., Templers Hall, 121 N. Main St., Butte. R. G. Tuszynski, Pres., James Glase, Sec'y.

NEBRASKA

Nebraska Electronic Service Ass'n, 1617 S. 17th St., Lincoln. Marvin Mock, Pres., T. M. Duffield, Sec'y.

Nebraska-Iowa Electrical Council, Inc., 1103 W.O.W. Bldg., Omaha. R. J. Harrison, Man. Dir.

NEW JERSEY

Allied Electronic Technicians Ass'n of N. J., Box 15, Gloucester City. Joseph J. Papovich, Pres., Bob Tames, Sec'y.

TV Service Ass'n of Ocean County, Pyenson Precision Co., Church Rd., Toms River. John Bartlett, Pres., Jack Pyenson, Sec'y.

Radio Servicemens' Ass'n, Inc., 343 William St., Trenton. W. D. Moore, Pres., Michael E. Toth, Sec'y.

Electronic Guild of N. J., 583 Valley Rd., W. Orange. Augustus F. Pengitore, Pres., Salvatore Ricca, Sec'y.

NEW YORK

Empire State Federation of Electronic Technicians Ass'ns, Inc. (ESFETA), 703 Main St., E. Aurora. Irving Toner, Pres., Mel Cohen, Sec'y

TV Service Ass'n, Inc. of Northeastern N. Y., 250 2nd Ave., Albany. Louis A. Ristau, Pres., Warren Baker, Sec'y.

Radio Servicemen of America, Box 201, Binghamton. Harold Hazzard, Pres., Michael Harris, Sec'y.

Associated Radio-TV Servicemen of N. Y., Inc., Box 32, Brooklyn 37. Eddie Eisen, Pres, Peter La Presti, Sec'y.

TV Radio & Appliance Dealers' Ass'n, 925 Kings Highway, Brooklyn. E. Y. Perlman.

Radio Technicians' Ass'n, Inc., 694 Broadway, Buffalo. Ted J. Telaak, Pres., R. A. Wutz, Sec'y.

TESA of Greater Buffalo, Station E, Box 1182, Buffalo. P. Pratt, Pres, Norm Telaak, Sec'y.

Western New York Electronics Guild, 22 Kerns Ave., Buffalo. Fred DiTondo, Pres., Elmore L. Bement, Sec'y.

Radio & TV Guild of L. I., Inc., 464 Sagamore Ave., E. Williston. Robert Larsen, Pres.

Southern Tier Electronics Ass'n, Box 442, Elmira. Donald J. Sadler, Sec'y.

Ulster Electronic Technicians Ass'n, 94 Furnace St., Kingston. Raymond E. Trumpait, Pres., Charles A. Kohl, Sec'y.

E.T.A.-Jamestown, 120 Winch Rd., Lakewood. Fran Samuelson, Pres., Sam Canaley, Sec'y.

Genesee Valley TV & Electronics Service Ass'n, Leicester. L. Conrad, Sec'y.

Mohawk Valley Radio & TV Technicians' Guild Inc., 20 Allman Place, New Hartford. Frank T. Kurowski, Pres., Geoffrey May, Sec'y.

Auto Radio Electronics Ass'n, Inc., 745 5th Ave., Room 811, New York. Robert Silagi, Exec. Sec'y.

Certified Electronic Technicians Ass'n, c/o N. Y. Trade School, 312 E. 67th St., New York. Robert Cornell, Pres., Alfred Schabhuttl, Sec'y.

TTTA, 1032 Nash Rd., N. Tonawanda. Leonard Block, Pres., Don Clark, Sec'y.

Rockland Ass'n of TV & Electronic Services, Inc., 55 E. Central Ave., Pearl River. Larry Critchlow, Sec'y.

Kingston TV Dealers Ass'n, Light's Radio & TV, Port Ewen. John Madden, Pres., Floyd Light, Sec'y.

Tri-County Electronic Technicians Ass'n, 28 S. Main St., Portville. Anthony DeLucio, Pres., Jack P. Golden, Sec'y

TESA of Rochester, N. Y., P.O. Box 802, Rochester 3. Peter M. Ferrari, Pres.

TV Council of Nassau, 35 Ivanhoe Pl., Valley Stream. L. Vogel, Sec'y.

NORTH CAROLINA

North Carolina Federation of Electronic Ass'ns, Inc., 1533 W. Boulevard, Charlotte. Kenneth LaRue, Pres., Ray Stanley, Sec'y

Radio & TV Service Dealers Ass'n of Durham, P.O. Box 222, E. Durham Sta., Durham. L. L. Leathers, Pres., Norman Schultz, Sec'y.

Cumberland County Radio & TV Ass'n, 2731 Bragg Blvd., Fayetteville. Edmund F. Barbour, Jr.

Greensboro TV Service Ass'n, c/o Joseph R. Woods, 1708 Spring Garden St., Greensboro. Bob Best, Pres., L. C. Tate, Sec'y.

High Point Radio & TV Technicians Ass'n, 1228 Montlieu Ave., High Point. Joseph J. Warren, Pres., G. J. Hornaday, Sec'y.

Rowan Cabarrus Businessmens Electronic Ass'n, 1115 N. Ridge Ave., Kannapolis. H. L. Holbrooks, Pres., Steve Tucker, Sec'y.

Surry TV Service Dealers Ass'n, P.O. Box 308, Mt. Airy. Mac Wood, Pres., Glenn Thacker, Sec'y.

Cawtawba Valley Radio & TV Ass'n, 112 E. First St., Newton. Howard Stutts, Pres.

Capital Area Electronics Technicians Ass'n, 2003 Wake Forest Rd., Raleigh. James L. Stough, Pres., Robert Corns, Sec'y.

The Caldwell County TV Ass'n, Box 17, Whitnel. Herbert H. Griffin, Pres., Woodrow Turmire, Sec'y.

Electronic Technicians Ass'n, Inc., P.O. Box 5193, Winston-Salem. Archie Bartlett, Pres., B. D. Moorfield, Sec'y.

NORTH DAKOTA

Tri-State Radio & TV Technicians Ass'n, Dickinson. Dale A. Thomas, Pres.

Red River TV & Radio Servicemens Ass'n, c/o Valley Piano & Radio, Grand Forks. Merlin Knudsvig.

OHIO

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TESA of Bellefontaine, 503 Eastern Ave., Bellefontaine. Harry Snyder, Pres.

TESA of Bellevue, 516 High St., Bellevue. Tom Davenport, NATESA Dir.

TESA of Chillicothe, 87 S. Brownell St., Chillicothe. Perry Horton, NATESA, Dir.

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Electronic Service Dealers Ass'n of Greater Cleveland, 11602 McCracken Rd., Cleveland. George Maropis, Pres., H. J. Soukup, Sec'y.

TESA of Cleveland, 5827 Turney Rd., Garfield Hts. Eugene L. Kotrba, Pres.

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Midwest Electronic Alliance, Inc., 2552 N. High St., Columbus. Verne La Plante, Pres.

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TESA of Lorain County, 92 E. Broad St., Elyria.

Southern Ohio Radio & TV Technicians Ass'n, 634 N. West St., Hillsboro. Harry Hakes, Pres.

TESA of Middleton, 1426 Central Ave. Middleton. Marvin Hall, Pres., O. Dale Burdge, Sec'y.

MMETA-Meigs City, 2 Liberty St., Pomoroy. R. C. Steffy, NATESA Dir.

TESA of Sandusky, 245 E. Market St., Sandusky.

TESA of Springfield, Ohio, Inc., P.O. Box 851, Springfield. Jack Carpenter, Pres., Marvin Miller, V.P.

Electronic Technician's Ass'n of Toledo, Inc., P.O. Box 6658, Toledo 12. Carl Stallfus, Pres.

Western Reserve Electronic Ass'n of Warren, P.O. Box 966, Warren. Bernard Murray, Pres., A. S. Hroncheck, Sec'y.

TESA of Willoughby, R.F.D No. 2, Chardon Rd., Willoughby. William Howell, Pres.

TESA of Wilmington, 105 N. South St., Wilmington. Russell Merker, Pres., Wayne Wills, Sec'y.

MVTVDA of Youngstown, 1742 Market St., Youngstown.

OKLAHOMA

Television Service Ass'n of Oklahoma, 2908 N.W. 23rd St., Oklahoma City. Bob McKillips, Pres., Roy Allen, Sec'y.

OREGON

Oregon TV Service Ass'n, c/o TV Appliance Ass'n, 424 Failing Bldg., Portland. Les Armstrong, Chmn., Cliff Kadell, Sec'y.

TV Appliance Ass'n, 424 Failing Bldg., Portland. Tom Targler, Pres., R. E. Watts, Sec'y.

PENNSYLVANIA

Federation of Radio-TV Service Ass'ns of Pennsylvania, Inc., 67 S. Main St., Carbondale. Wayne Prather, Pres., Leon J. Helk, Sec'y.

Lackawanna Radio-TV Technicians Ass'n, R.D. #2, Dalton. James Jerome, Sec'y.

Electronic Technicians Ass'n of Lancaster County, Inc., PO. Box 264, Ephrata. Harold Snader, Pres.

(*Continued on page* 108)

By **JOSEPH ARKIN,** CPA

Tax Depreciation Allowance for Service Shops



A special allowance beyond regular depreciation applies to many purchases made for the business.

ARE YOU saving all the tax dollars to which you are legitimately entitled? A federal ruling included in the Technical Amendments Act of 1958 permits a special twenty per-cent allowance for depreciation on certain equipment and furnishings in a service shop that was not possible before. Although this applies to purchases of such property made from the beginning of 1958 and thereafter, many small businessmen have failed to take proper advantage of the provision.

Briefly speaking, here are the facts about the ruling: You can deduct a *one-time* allowance of 20% on equipment costing up to $10,000. If a joint return is filed, even though the wife does not own the property, 20% can be deducted on equipment costing up to $20,000. This allowance is on fixed assets which, by law, are classified as personal property, not as real property. Also, it may be applied only on items having a useful life of at least six years. It does not matter whether the equipment is new or used, nor during what part of the year it was purchased. Just how the 20% allowance applies can best be understood by considering some typical questions asked about it, along with their answers:

QUESTION: I bought new equipment for $2000, having a useful life of ten years, in the early part of January 1959. I want to use the double declining-balance method for regular depreciation. I also want to take advantage of the new allowance. What is the amount of my deduction and how is it computed?

ANSWER: The amount of your depreciation deduction for 1959 is $720. First you take 20% of the $2000, which gives you $400. To get the adjusted base for computing regular depreciation for the year, subtract the $400 from the actual cost of $2000. This gives $1600 as the adjusted base. A useful life of ten years means you can use 10% as your annual depreciation rate. However, with the double-declining method, you double up on the rate, giving you 20%. Thus 20% of the adjusted base ($1600) is $320. The total of $400 (special allowance) and $320 (regular depreciation) is $720.

QUESTION: I bought some used office furniture for the back of the shop. Does such furniture qualify for the allowance?

ANSWER: Yes. The equipment can be either new or used, as long as it meets other requirements.

QUESTION: As part of a business expansion, I added a new wing to my present building. Does this addition qualify for the allowance?

ANSWER: It does not. Real estate is specifically excluded.

QUESTION: A relative who was formerly in the service business himself gave me some test equipment and other shop furnishings, all of use to me. Do these items qualify?

ANSWER: No. Items acquired by gift or inheritance, rather than by purchase, do not qualify.

QUESTION: How do I let the government know that I wish to avail myself of this new allowance?

ANSWER: You must make what is called an election. This election to take the 20% allowance must be made by the taxpayer within the time prescribed for filing the tax return for the year involved (including any extensions granted). To do so, the taxpayer must simply attach a statement to the tax return itself indicating that the election is being made and setting forth the following information:

1. Description of the equipment or other personal property; 2. Date property was acquired; 3. Estimated useful life at date of acquisition; 4. How and from whom property was acquired; 5. Total cost of each item of property with respect to which election is being made; and 6. Portion of cost of property selected for this allowance.

QUESTION: Does this allowance apply to any items purchased during the year?

ANSWER: No. It applies only to those assets (other than real estate, of course) used in the taxpayer's trade or business or in the production of income.

QUESTION: Within the limits set forth in the last four answers, then, can I deduct on every type of personal property for this allowance?

ANSWER: One additional limitation has been overlooked here. Remember that, to qualify, the item must have a useful life of at least six years.

QUESTION: Suppose I have met all the other requirements and the new items were *bought* from a relative. May I take advantage of the allowance?

ANSWER: Since there may be attempts to abuse the ruling with respect to purchases claimed to have been made from certain closely related persons, there are regulations designed to curb such abuses. However, if the transaction is made at "normal" prices, and if the relative from whom the purchase is made regularly deals in such products, the deduction will be allowed.

QUESTION: I didn't buy anything dur-

(*Continued on page* 81)

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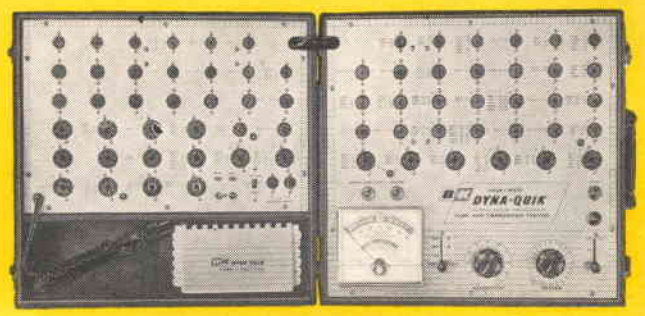



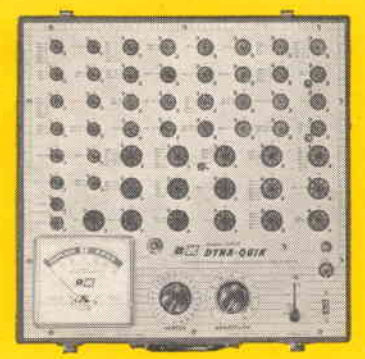

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MODEL 675. Completely reliable, long-service Automatic Tube and Transistor Tester. Only 60 indexed phenolic Dyna-Cards test over 99% of tubes most widely used in television receivers. Tests each section of multiple tubes separately for Gm, Shorts, Grid Emission, Gas, and Life. Easily kept up-to-date with extra cards and punch included. Tests transistors, too. Net, **$169.95**

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Model S-2200, FM-AM-MX Stereo tuner, Fair Trade Price—$179.50



AMERICAN AUDIO INSTITUTE

396 EAST 18th ST. PATERSON 4, N.J.

October 27, 1959

Sherwood Electronic Labs., Inc.
4300 North California Avenue
Chicago 18, Illinois

Gentlemen:

We find that the incorporation of a center-channel output and a damping factor selector in July, 1959, increases the Summary Rating of the Sherwood S-5000 to the highest of all 18 Stereo Amplifiers tested in the AAI Evaluation Test Reports.

Sincerely,

AMERICAN AUDIO INSTITUTE

Felix R Bremy

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Executive Director

The "Most honored of them all" S-5000 stereo amplifier-preamplifier is joined by the S-2200 stereo tuner. As with its "Top Rated" predecessors, the S-2200 features FM "Interchannel Hush" plus push button selector, internal plug-in adaptor for Stereo FM Multiplex, 2 "Acro-beam" tuning indicators, simulcast FM/AM stereo. All Sherwood tuners feature FM sensitivity below 0.95 microvolts and ⅓% distortion @ 100% FM. For further details write: Sherwood Electronic Laboratories, Inc., 4300 N. California Avenue, Chicago 18, Illinois.

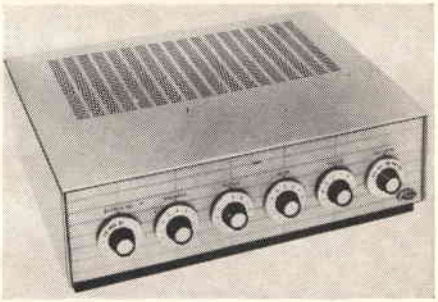
For complete specifications write Dept. EW-4

Hi-Fi-Audio Product Review

DUAL AMP/PREAMP

Olson Radio Corporation, 260 South Forge St., Akron, Ohio is now offering a dual amplifier-preamp as its Model AM-147.

The unit combines a stereo control center with dual 15-watt amplifiers on a single chassis. The equipment selects, controls, and amplifies any stereo program source to give 15 watts on each channel or a total of 30 watts in the monophonic mode. There are six front-panel controls: stereo reverse switch, balance control, concentric bass and concentric treble controls, loudness-volume control, and input selector switch. Two dual low-level inputs for tape or magnetic phono cartridges and



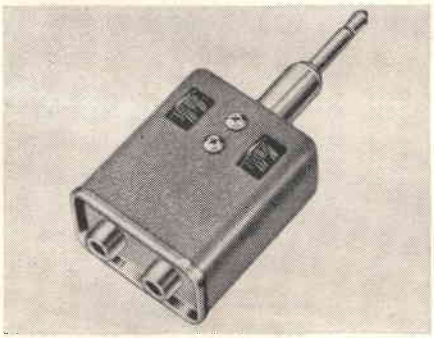
three dual high-level inputs for tuner, TV-auxiliary, and crystal phono cartridges are provided.

Frequency response is ±.5 db from 20 to 30,000 cps at 1 watt. Output impedances of 4, 8, and 16 ohms are provided in each channel. For complete details on this new unit, write the company direct.

"MINI-MIX" AUDIO MIXER

Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill. has announced the addition of the Model 313 to its line of audio mixers.

The new unit is designed to fit late models of *Revere* and *Wollensak* re-



corders. The "Mini-Mix" enables the user to make professional tapes by mixing two sound sources. Two high-impedance inputs can be accommodated. Special jacks on the unit will accept the short plug used with the recorders or a standard 2-conductor plug without using an adapter. Separate volume controls for each channel are recessed inside the housing.

NORELCO CARTRIDGE

The High Fidelity Products Division, *North American Philips Company, Inc.,* 230 Duffy Ave., Hicksville, N. Y. is now marketing the Dutch-built Model AG3400 stereo cartridge which features the unique combination of extremely high vertical compliance and high output.



The extremely high output of the cartridge—better than 30 mv. per channel at 10 cm/sec.—eliminates hum and noise generated by amplifiers forced to operate at maximum gain. It also makes unnecessary the use of step-up transformers and permits the cartridge to be used with older, low-output preamps, according to the company.

Channel separation is 22 db at 1000 cps. The stylus is easily replaced as the replacement unit comes mounted with its own damping blocks and is completely self-aligning. Automatically replacing the damping blocks whenever the stylus is replaced insures a permanent high level of performance.

The cartridge is shielded by Mumetal throughout and has five terminals which makes it compatible with practically every known tone arm now available. The unit comes complete with a 0.7 mil diamond stylus, mounting plate, and hardware.

"KNIGHT" HI-FI SPEAKERS

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has released two new "Knight" hi-fi speakers, both British-built to the company's specifications.

The Model KN-812A is a 12" two-way unit while the KN-815A is a 15" model. Both speakers feature very heavy magnet structures of Alcomax III, new rectangular exponential horn tweeters, and new mid-frequency radiator cones mounted in the center of the woofers.

In addition to the three sound-producing elements, a double-section, two-coil, two-capacitor crossover network is mounted directly on a heavy die-cast frame. A wired-in "L" pad high-frequency level control on a 72" cable regulates mid- and high-frequencies to

room acoustics or personal listening preferences. The heavy, cast metal frame is utilized to keep the aluminum voice coil permanently centered.

The KN-812A has a free-air resonance of 35 cycles with over-all response of 30-20,000 cps while the KN-815A has a response of 20-20,000 cps and a free-air resonance of 25 cycles. Both have an impedance of 16 ohms and will handle 50 watts.

STEREO RECEIVER

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. has just introduced its new "800" stereo receiver—a 60-watt unit which combines AM-FM tuners, stereo amplifier, and stereo master audio control on a single chassis. All that is required to complete a stereo sound system is the addition of a pair of good speakers and record-playing equipment.

The FM tuner has 1-μv. sensitivity for 20 db of quieting with 300-ohm antenna. Signal-to-noise ratio is 62 db at 100-μv. input. The circuit incorporates automatic interstation noise suppression, while a low-noise triode mixer with separate oscillator insures maximum stability and minimizes spurious radiation.

The AM tuner features a three-position AM bandwidth for best AM-FM stereo reception. A rotatable, high-impedance AM antenna is included.

The amplifier provides 60 watts of music power. Frequency response is 19



to 32,000 cps. The control section features 22 controls for all present and future program sources and applications. There are 15 input and output jacks and separate dual bass and treble controls.

For full details on this new unit, contact the manufacturer or any of its authorized distributors.

NEW TAPE DEGAUSSER

Microtran Company, Inc., 145 E. Mineola Ave., Valley Stream, N. Y. is now offering a new and improved version of its bulk tape demagnetizer.

The Model HD-11 reduces the residual sound level of typical fresh, virgin tape by 3 to 15 db, dependent on its previous exposure to stray magnetic fields, according to the company. Additionally, it provides a 75-db minimum erasure of saturated magnetic tape. These db levels were determined by running fresh unrecorded and saturated tape through an *Ampex* Model 300 tape recorder. Tests were made at 1 kc. and read through a 1-kc. bandpass filter.

The new unit will handle reels from 5" through 10½" in diameter. An adapter hub for NARTB reels is available.

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FM high fidelity tuner

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Miller has designed every quality feature into this tuner, to bring you big value.

There's a tuned R.F. stage for good image rejection. There's ultra-stable permeability tuning. Dual limiters provide maximum noise control. The oscillator stage is completely shielded to maintain radiation well below FCC requirements. Tuner has AFC with defeat control, and cathode-follower audio output. Multiplexing outlet provided.

SPECIFICATIONS: A six-tube unit, it has a tuning range of 86 to 110 Mc. Typical sensitivity is 1.0 μv for 20 db quieting; 2.1 μv for 30 db quieting. Typical selectivity: 200 kc at 6 db. Frequency response: 15 to 25,000 cps. Distortion is less than ½% at rated output, and warmup drift is negligible. Size: 9" wide, 4" high and 7" deep.

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Model 579 – sub-assembly only, completely wired **$37.50**

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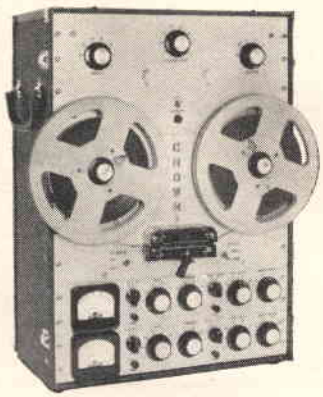


Model 714-C/A30-30

RECORD PERFORMANCE

4T FREQUENCY RESPONSE	IPS SPEED	FLUTTER & WOW	NOISE RATIO
±2 db 50-28000 CPS	15	.06%	57 db
±2 db 40-17000 CPS	7½	.09%	54 db
±3 db 30-9000 CPS	3¾	.18%	51 db

Write to Dept. EW-4 for FREE Catalog— also data on professional tape duplicator.

CROWN INTERNATIONAL NOW OFFERS YOU THESE OUTSTANDING FEATURES

- **Worldwide recognition for high professional quality and built-in guaranteed performance.**
- **29 years of electronic experience combined with skilled technicians.**
- **Complete line of tape recording equipment.**
- **Exclusive, basic-patented features bringing the finest in operating functions.**
- **Unsurpassed design, dependability, and durability.**
- **4 and 2-track combination heads.**
- **Long play machines for industrial, commercial, and consumer usage.**
- **238 franchised dealers throughout the USA to sell and service CROWN. Write for name of your nearest dealer.**

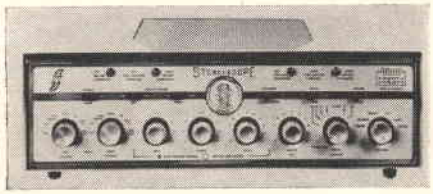
CROWN INTERNATIONAL
Division of
INTERNATIONAL RADIO & ELECTRONICS CORP.
ELKHART, INDIANA

The units come complete with instruction sheets and charts for the simple measurement of tape speed errors as small as ½ second in 30 minutes. For further details on either of the standard models or the custom unit, write the manufacturer direct.

E.M.I. "STEREOSCOPE"

Scope Electronics Corporation, 10 Columbus Circle, New York 19, N. Y. is the U. S. distributor for the new integrated preamp/amplifier built by *Electric & Musical Industries, Ltd.* of England.

Featuring a built-in cathode-ray in-



dicator for the precision matching of the stereo channels, the "Stereoscope" is rated at 20 watts peak each channel. Frequency response is 20-20,000 cps, ± 1 db measured at 10 peak watts. The tube line-up consists of two EF86's, six ECC83's, and four EL84's.

A separate 7-position rotary switch is provided for each channel and permits the choice of any of seven inputs. A six-position function switch allows normal or reverse stereo, mono, left or right channel only, and combined output from both preamps to both amplifiers.

A comprehensive data sheet on the Model 555 is available from the U. S. distributor on request. —30—

Nancy Ann Corcoran, Miss United States of 1959, draws the winners' names in the recent Blaupunkt car radio "Wings of Sound" sweepstakes while Ernest L. Hall of Robert Bosch Corporation looks on. A trip to Europe for two via Lufthansa was won by Peter Laffe of Al Sager Motors, Inc., Jacksonville, Florida. Arthur W. Leduc of B. V. Motors, Inc., Worcester, Mass., won a Blaupunkt stereo hi-fi radio phono console. Mrs. Robert Doran of Glen Cove, L. I., won a European trip in the customers' category. Over 30,000 entries were received.



front panel and sienna brown molded legs. Knobs have polished brass inserts. The cabinet measures 14⅜" wide, 11½" deep, and 5⅜" high.

ARGOS "TUNING TUBE"

Argos Products Company, Genoa, Ill. has announced the development of a "Tuning Tube" which permits the audiophile to match an *Argos* enclosure to any speaker. The unit permits the tuning of cabinets to the resonant frequency of the woofer.

The tube effectively shortens or lengthens the internal air path from the back of the speaker through the cabinet and out the tuning tube. The sound waves coming from the back of the speaker are made to meet and reinforce the waves from the front of the speaker.

A catalogue sheet and details on this new device are available from the manufacturer. The "Tuning Tube" is now standard equipment on all of the company's hi-fi enclosures.

STEREO MIKE

North American Philips Co.'s High Fidelity Products Division, 230 Duffy Ave., Hicksville, N. Y. has just introduced a new stereo microphone for home use which is said to enable non-professionals to produce excellent recordings.



Consisting of two microphone elements set at right angles and mounted in a single housing, the Model EL3752/01 microphones are of the moving-coil type with a cardioid pattern. Sensitivity is unusually high with the output down only 50 db from 1 volt at an input pressure of 1 microbar/cm². Impedance is 25,000 ohms.

The unit may be used outdoors as well as indoors. The microphone elements are encased in aluminum and cadmium plated iron and the housing is of strong plastic finished in blue and gray. A felt layer in front of the diaphragm protects the unit from dust.

The unit comes with 16 feet of shielded cable and a three-conductor telephone plug. Over-all weight is 20.6 ounces. Further details are available from the manufacturer on request.

NEW "TAPESTROBE"

Scott Instrument Labs, Inc., 17 E. 48th St., New York 17, N. Y. is now offering a new tape speed measuring device which has been tradenamed "TapeStrobe."

The unit will permit the determination of tape speed accuracy ranging from 1⅞ to 60 ips. Special 50-cycle models are also available. The Model A handles 7½, 15, and 30 ips units while the Model B is designed to be used with 3.75, 7½, and 15 ips machines. A special stepdown adapter (Model W) extends the range of the Model A to cover 3.75 ips and the Model B to 1⅞ ips.

Build This Superb *Schober* Organ From Simple Kits and SAVE OVER 50%!



The Beautiful *Schober* CONSOLETTE — the only small organ with two full 61-note keyboards and 22 stops. Requires only 2' x 3'2" floor space! Commercial value approximately $1600 or more — yet you save over 50% when *you* build this thrilling instrument!

LET US SEND YOU **FREE DETAILS** HOW TO ASSEMBLE A *Schober* ELECTRONIC ORGAN IN SPARE TIME!

Give Your Family A Lifetime of Musical Joy With A Magnificent Schober ELECTRONIC Organ!

Now you can build the brilliant, full-range Schober CONSOLETTE or the larger CONCERT MODEL with simple hand tools. No skills are necessary to construct an instrument with one of the finest reputations among electronic organs. No woodworking necessary — consoles come completely assembled and finished. All you do is assemble clearly marked electronic parts guided by clear illustrations and detailed step-by-step instructions. Even teen-agers can assemble the Schober! You build from kits, as fast or as slowly as you please...at home, in spare time — with a small table serving as your entire work shop!

THE GREAT **CONCERT MODEL** meets specifications of **American Guild of Organists**

Pay As You Build Your Organ; Start With As Little As $18.94!

You may start building your Schober at once with an investment of as little as $18.94. The musical instrument you assemble is as fine, and technically perfect, as a commercial organ built in a factory — yet you save over 50% on top-quality electronic parts, on high-priced labor, on usual retail store mark-up! In your own home, with your own hands you build an organ with *genuine pipe organ tones* in an infinite variety of tone colors to bring into your home the full grandeur of the Emperor of Instruments. You may build the CONSOLETTE for your home, or you may want to build the great CONCERT MODEL for home, church, school or theatre. You save 50% and more in either case.

Send For Complete Details On Schober Organs and For Hi-Fi Demonstration Record

The coupon will bring you a handsome 16-page booklet in full color describing Schober organs in detail, plus articles on how easy and rewarding it is to build your own organ and how pleasant and quick it is to learn to play the organ. In addition, we have prepared an exciting 10" hi-fi LP record demonstrating the full range of tones and voices available on the Schober, which you may have for only $2.00 (refunded when you order a kit). Literature on the Schober is FREE! There is no obligation; no salesman will call.



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The Schober Organ Corp., Dept. RN-4
2248 Broadway, New York 24, N. Y.

☐ Please send me FREE full-color booklet and other literature on the Schober organs.

☐ Please send me the 10" hi-fi Schober demonstration record. I enclose $2.00 (refundable on receipt of my first kit order).

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Address.....

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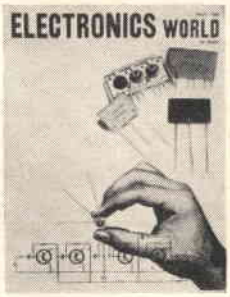
KNEE-HIGH ...*Wafer-thin*

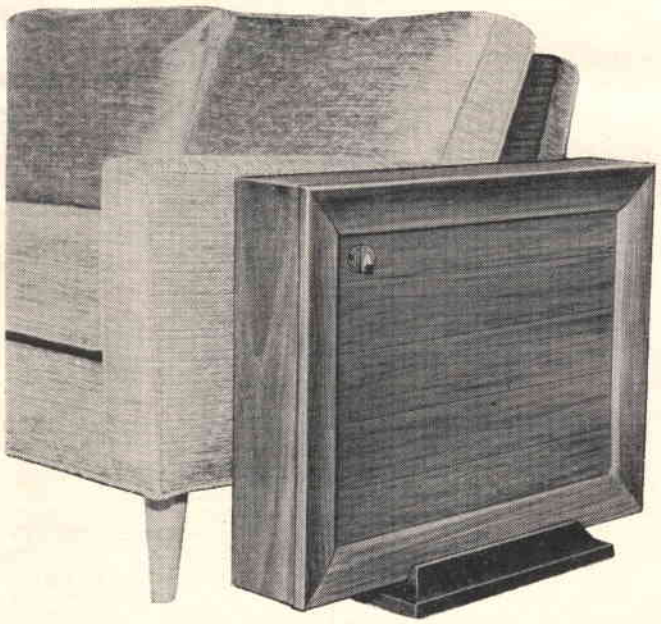
That's the remarkable new Bi-Phonic Coupler

And the inside story on it is in May



An entirely new type of speaker enclosure has just been introduced! The woofer has no cone... requires no baffle... there's not even a grill-cloth. You'll want to know how this new bi-phonic coupler rates against standard enclosures... how and why it was developed... and what its future holds. Don't miss this important feature—coming in May ELECTRONICS WORLD.

YOU'LL ALSO ENJOY THESE FEATURES IN MAY ELECTRONICS WORLD:



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Packaged electronic assemblies are now being turned out, integrating several related circuit components into compact units. You'll want to read this discussion of unusual fabrication techniques... special applications... plus complete practical advice for service technicians.

● SENSING DEVICES IN AUTOMATION

Here's a complete rundown on such transducers as pressure sensors, thermostats, proximity switches and other non-electrical elements used in association with circuits to provide automatic measurement, control, or adjustment. It's a complete technician's guide—giving important instructions on handling such devices.

● TRANSISTORIZED HAND-HELD 10-METER TRANSMITTER-RECEIVER

Complete construction details on entire self-contained, limited coverage mobile station for the radio amateur. Completely mobile, this unit is powered by eight penlight cells and weighs under two pounds.

Whether electronics is your hobby or business—you can't afford to miss articles like these — samples of the wealth of information that's yours in the important May issue of ELECTRONICS WORLD.

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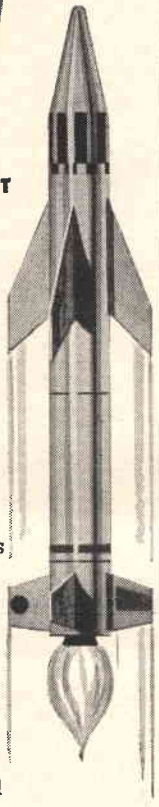
At MSOE, you can equip yourself for a career in many exciting, growing fields: **MISSILES RADAR • AUTOMATION RESEARCH • DEVELOPMENT ELECTRICAL POWER AVIONICS • ROCKETRY**



When you graduate from the Milwaukee School of Engineering, you are prepared for a dynamic career as an Electrical Engineer or Engineering Technician. Under a faculty of specialists, you gain a sound technical education in modern, completely equipped laboratories and classrooms. As a result, MSOE graduates are in great demand and highly accepted by industries nationally.

At MSOE you will meet men from all walks of life and all parts of the country — some fresh out of high school or prep school, others in their twenties — veterans and non-veterans.

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FREE CAREER BOOKLET! If you're interested in any phase of electronics, radio or television, be sure to look into the programs of study offered by the Milwaukee School of Engineering. Just mail the coupon.

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☐ Mechanical Engineering

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MS-123

Mac's Service Shop

(*Continued from page* 56)

"Yes, and let us hope they were listening when W. T. Hudness, director of maintainers, Air Material Command, USAF, urged designers to consider the problems in finding defective small parts in a complex system which fails. He declared Air Force studies have shown the majority of system failures can be attributed to resistors and capacitors. Failures of this type, he pointed out, are very often difficult for a technician to find."

"I wish resistor and capacitor failures were the toughest service problems we had," Barney remarked; "but I wonder how a person could compare the cost of maintaining military equipment with the cost of service to our customers."

"Well, Mr. Hudness said the Air Force alone spent about six-hundred-million dollars last year for maintenance. Lt. Col. Wm. F. Stevens, operations staff, Weapons Guidance Laboratory, Wright-Patterson Air Force Base, Dayton, said the AF estimates it spends ten times as much to maintain a complex system as it costs to build it. Rear Admiral Stroop said an AF report showed maintenance costs on electronic equipment during its operational life varies from two to ten times the acquisition cost. And just remember the operational life of AF electronic equipment is pretty short compared to a radio or TV set that may be kept in daily operation from ten to fifteen years."

"Wheeee-whoooo!" Barney whistled. "Wouldn't some of our customers squawk if they had to put out six-hundred dollars in service bills on their three-hundred-dollar TV set? And imagine what they would say if those service charges went up to $3000, or ten times the cost of the receiver!"

"Undoubtedly there are some factors in military servicing we are not taking into account," Mac said; "but these facts and figures are still mighty interesting. Military maintainers are carefully and intensely schooled and permitted to specialize on a few pieces of electronic gear. We are expected to be equally at home with hundreds of different models of radios, TV sets, tape recorders, record players, and hi-fi amplifiers. Government electronic shops are ordinarily stocked with the finest test equipment and an unlimited supply of replacement parts. We have to be satisfied with the test equipment we can afford; and we can't simply trace down the trouble to a comparatively large portion of the circuit and replace the whole thing as military maintainers often do. We've got to find the exact small component that failed and replace it from our limited stock of universal replacement parts in order to keep the service charges down."

"Yeah, and don't forget the ordinary customer feels he's been had if he has to pay out half the original cost of his

KEEP CANDEE HANDEE!

A TRIO OF HEADSET BARGAINS!
HS-23: Hi Impedance. Leather covered headband. Brand new. Great buy. Only **$4.95**
HS-33: Low impedance. Leather covered headband. Brand new. A J. J. Candee Special. **5.95**
Hi Fi Headset: 15,000 cycles! Brand new with chamois cushions. It's terrific! Only **8.95**
CO-307A Headset Extension Cord: Brand new. Approximately 5 ft. length. Only **49c**

BC-1033 MARKER BEAON RECEIVER
Freq: 75 Mc. Operates on 28 V. Excellent cond. Two (2) for $4.95. EACH ONLY **$2.95**

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Freq.: 75 Mc. Operates on 12 VDC. Checked out and in excellent condition. Only **$14.95**

BC-611 HANDIE-TALKIE CHASSIS
Crystal controlled. 3-6 Mc. Brand new. Boxed. WITH antenna, less tubes, crystals, coils. Only **$6.95**

BC-733 RECEIVER
A sputnik tracker—see C.Q. Magazine Oct/59 for conversion. VHF, 10 tubes, 6-channel, crystal controlled. Freq. 108.3-110.3 Mc. Dual filter range. Excellent condition **$4.95**

INTERPHONE AMPLIFIER
AM-26/AIC. 28 VDC. Complete with dynamotor and tubes. Excellent condition. Only **$5.95**
Surplus Conversion Manual No. 2: All conversion dope for above and other surplus items. 125 pages. ONLY **$2.50**

RS-38 HAND CARBON MIKE
With curly cord. Excellent condition **$2.95**

HAMMARLUND SUPER PRO COVER
Brand new in original case. ONLY **$3.95**
MD-7 PLATE MODULATOR: Excel. **$6.95**

79-B PULSE GENERATOR
Mfd. by Measurements Corp. Freq.: 60-100,000 pps. Pulse width cont. variable from 0.5-40 microseconds. Output voltage approx. 150-200 V. Built-in power supply. Excellent condition **$19.95**

TS-182 ATTENUATOR SYNCHROSCOPE
Calibrated! This unit also serves as 150-240 Mc Receiver **AND** a Signal Generator. Built in 115 V power supply. Measures peak RF power to 4 KV. Sig. generator built in. Excellent **$19.95**

APN-1 FM TRANSCEIVER
420-460 Mc. Compl. with tubes. Exc. Ea. **$2.95**
Approx. shp. wt. per unit 25 lbs. **TWO for $5.00**

AN/APA 38 PANADAPTOR
115 VAC. Single phase. 400-2700 cycles. 30 Mc. adaptor. Approx. 10 Mc. band width. For conversion dope, see July/59 C.Q. Magazine. Excellent cond. **$14.95**
NEW TS-13 HANDSET Ea. $3.95; Two for $6.95

YOU GOT IT! WE WANT IT! LET'S DEAL?
We're paying top $$$ for GRC-9; PRC-0, -8, -9, -10; GN-58A! All elect. test equip.

APX-6 TRANSPONDER
A midget warehouse of parts! Blowers, three Veeder-Root counters, I.F. strips, cavity, over 30 tubes etc. **Includes 3E29 tube.** Good cond. A STEAL AT ONLY (2 for $19.00) **$9.95**

R-4A/ARR-2 RECEIVER
234-258 Mc. 11 tubes. UHF, tunable receiver. See Aug/59 C.Q. Magazine for conversion. **$2.95**
Excellent cond. **TWO** for $5.00. Each . .
FAMOUS Q 5'ER RECEIVER. Excel $9.95

All items FOB Burbank, Calif., subject to prior sale. In Calif. add 4%. Min. order $3.95.

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CLASS "D" CITIZEN BAND CRYSTALS



3rd Overtone: Hermetically Sealed .005% tolerance—Meet F C C requirements. ½" pin spacing—.050 pin diameters. (.093 pins available, add 15¢ per crystal.)

22 CHANNELS $2.95 EACH

(add 5¢ per crystal for postage and handling)

The following Class "D" Citizen Band frequencies in stock (frequencies listed in megacycles): 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225.

Matched crystal sets for Globe, Gonset, Citi-Fone and Hallicrafters Units . . . **$5.90 per set.** Specify equipment make.

RADIO CONTROL CRYSTALS
in HC6/U HOLDERS—SIX FREQUENCIES

In stock for immediate delivery (frequencies listed in megacycles); tolerance .005%. ½" pin spacing. .050 pin diameter. (.093 pins available, add 15¢ per crystal.) Specify frequency desired.

26.995, 27.045, 27.095, 27.145, 27.195, 27.255 . . . . . $2.95 EACH
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ASK YOUR PARTS DEALER FOR TEXAS CRYSTALS
See big red display . . . if he doesn't stock them, send us his name and order direct from nearest factory.

OUR FLORIDA PLANT NOW IN OPERATION
ORDER FROM NEAREST PLANT

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ALL ORDERS SHIPPED 1st CLASS MAIL

TV set in maintenance; yet the minimum maintenance figure you mentioned was four times this, and twenty times seemed to be the average. That hardly makes the service technician's solder gun look like a highwayman's pistol."

"True; but possibly the most significant thing in the long run is that the military is awakening to the fact that easy, low-cost maintenance begins with design. Equipment *can* be made easy to service if maintenance problems are kept in mind right from the start. What's more, the Armed Forces are no more convinced than we are that 'more complicated' necessarily means 'better.'"

"We've been saying that for a long time," Barney added; "but very little attention was paid to our griping. Now that Uncle Sam is echoing our words, I'll bet they carry more weight."

"Right," Mac said as he picked up his solder gun; "and if I'm not badly mistaken, the insistence of the Armed Forces on equipment that is easier to maintain is going to carry over into civilian design and make our job easier and our customers better satisfied in the long run."

—30—

Depreciation Allowance

(*Continued from page* 72)

ing this last tax year that would qualify for the allowance. Can I use the allowance in the future?

ANSWER: Yes. You can get an allowance for items purchased in future years, and the limits remain at $10,000 worth of equipment for one taxpayer, $20,000 worth of equipment in the case of a husband or wife filing a joint return.

QUESTION: Is this limit cumulative? In other words, can I carry over the unused portion of $2000 special depreciation allowance not used in one year to another year?

ANSWER: No. The limit for any year is fixed whether you did or did not use it in preceding years, but you can get that limit every year.

QUESTION: My establishment is incorporated. Will this make any difference if I wish to take advantage of the allowance?

ANSWER: It will make no difference. Corporations can use the new allowance, but the limit is $2000 based on purchases of qualifying assets costing up to $10,000. This rule and limitation also applies to those corporations that have elected to be taxed as partnerships.

Although he may still have some specific questions to resolve, the service shop owner should now have a good idea as to how the special allowance may affect him. For further clarification of details and questions, he should, as always, consult with his regular tax accountant.

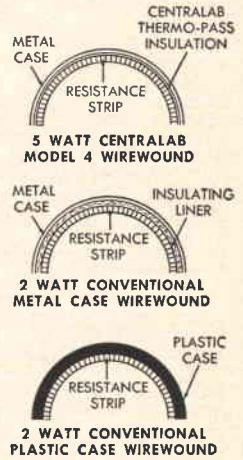
—30—



Nowadays all kinds of critters have Texas capacity with Rhode Island size. Tubes, relays, and many other components have gotten smaller without any sacrifice in performance.

Now it's true with wirewounds, too! CENTRALAB has corralled 5 watts of power in a 2-watt size wirewound . . . by using "Thermo-Pass" insulation. A control's rating and size depend on the speed with which heat can be transferred from the resistance element to the atmosphere. CENTRALAB "Thermo-Pass" insulation combines exceptional heat transfer with a dielectric strength of 4500 volts per mil at 25° C. Result: a conservatively rated 5 watt Radiohm control measuring only 1 3/32" in diameter and 9/16" in depth. They are available in values from 1 ohm to 100 K ohms.

Meanwhile, back at the ranch, you'll find this one small size taking care of your 2, 3, 4 and 5 watt replacements in tv, hi-fi, home and auto radio sets. Just make sure you use the wirewounds—short (Model WN) or long (Model WW) shaft style—that carry the ERL brand.



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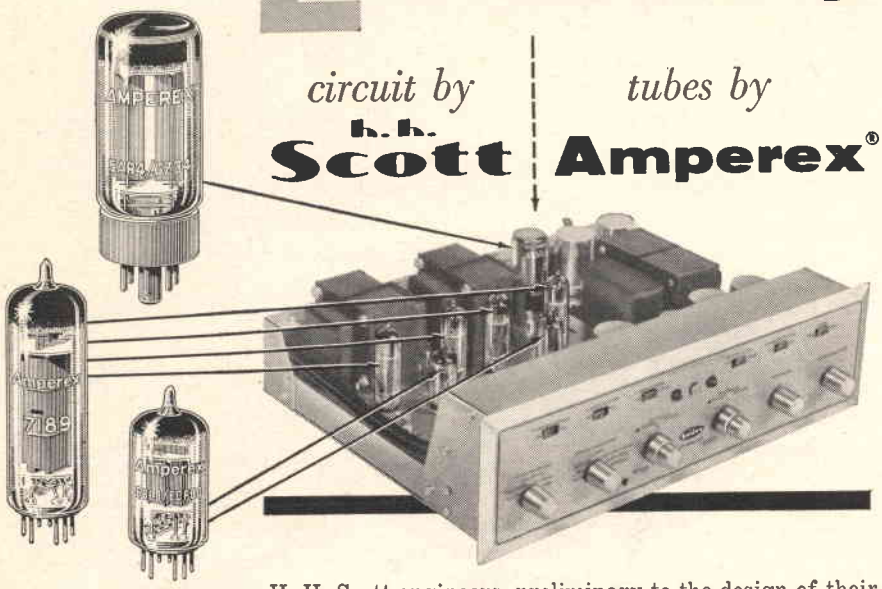
circuit by h.h. **Scott** | *tubes by* **Amperex®**



H. H. Scott engineers, preliminary to the design of their *Model 299 (40 Watt) Complete Stereo Amplifier,* canvassed the industry for tube types offering something truly exceptional in the way of reliability, low distortion, low noise, low hum and absence of microphonics.

As has frequently been their experience, the people at Scott found these qualities best exemplified by Amperex tubes. Thus, the tube complement of the Scott Model 299 includes four Amperex 7189's, one Amperex 5AR4/GZ34, and one Amperex 6BL8/ECF80.

These and many other Amperex 'preferred' tube types have proven their reliability and unique design advantages in the world's finest audio components.

Applications engineering assistance and detailed data are always available to equipment manufacturers. Write: Amperex Electronic Corp., Special Purpose Tube Division, 230 Duffy Ave., Hicksville, Long Island, New York.

ask Amperex

about hi-fi tubes for hi-fi circuitry

AMPEREX TUBES FOR QUALITY HIGH-FIDELITY AUDIO APPLICATIONS

POWER AMPLIFIERS
6CA7/EL34: 60 w. distributed load
7189: 20 w., push-pull
6BQ5/EL84: 17 w., push-pull
6CW5/EL86: 25 w., high current, low voltage
6BM8/ECL82: Triode-pentode, 8 w., push-pull

VOLTAGE AMPLIFIERS
6267/EF86: Pentode for pre-amps
12AT7/ECC81: } Twin triodes, low
12AU7/ECC82: } hum, noise and
12AX7/ECC83: } microphonics
6BL8/ECF80: High gain, triode-pentode, low hum, noise and microphonics

RF AMPLIFIERS
6ES8: Frame grid twin triode
6ER5: Frame grid shielded triode
6EH7/EF183: Frame grid pentode for IF, remote cut-off
6EJ7/EF184: Frame grid pentode for IF, sharp cut-off
6AQ8/ECC85: Dual triode for FM tuners
6DC8/EBF89: Duo-diode pentode

RECTIFIERS
6V4/EZ80: Indirectly heated, 90 mA
6CA4/EZ81: Indirectly heated, 150 mA
5AR4/GZ34: Indirectly heated, 250 mA

INDICATORS
6FG6/EM84: Bar pattern
IM3/DM70: Subminiature "exclamation" pattern

SEMICONDUCTORS
2N1517: RF transistor, 70 mc
2N1516: RF transistor, 70 mc
2N1515: RF transistor, 70 mc
IN542: Matched pair discriminator diodes
IN87A: AM detector diode, subminiature

WHAT IS A RADIO BOOKSHOP?

It is a place where you can get radio books mail order (they pay the postage). Been in business for three years. Here are some of the books you should have in your library.

RCA Radiotron Designers Handbook $7.50
Design notes on every possible type of circuit. Fabulous.

Surplus Conversion Manual I $2.50
BC-221, 312, 342, 348, 412, 645, 946, 1068; SCR274, 522; TBY, etc.

Surplus Conversion Manual II $2.50
BC-454/459 & ARC5 VHF; APS-13; BC-357, 946B, 375; ART-13, TA-12, AVT-112A, GO-9, LM, etc.

15th Edition Radio Handbook by Bill Orr, W6SAI $7.50

Quad Antennas by W6SAI $2.85

Better Shortwave Reception by W6SAI $2.85

Beam Antenna Handbook by W6SAI $2.70

Novice & Technician Handbook by W6TNS & W6SAI $2.85

VHF Handbook by W6QKI & W6SAI $2.95

Radio Engineering Handbook by Terman $15.50
Used by many colleges as a basic theory book. The answer to almost any technical problem is here. 1078 pages!

Antennas by John Kraus, W8JK $11.50
Strictly a theory book, but top notch. If you are interested in designing 'em you'll have to have this book.

RTTY Handbook by W2JTP & W2NSD $3.00
A-Z of ham Teletype, only book available on the subject.

Conversion Handbook $3.00
Schematics & photos: BC-222, 312, 314, 342, 344, 348, 603, 611, 624, 652, 654, 659, 669, 683, 728, 745, 764, 779, 794, 923, 1000, 1004, 1066, 1206, 1306, 1335; APN, APS, ARC4 & 5, ARN, ARR, TBY, TCS, VT/Jan tube index.

Reference Data for Radio Engineers (IT&T) $6.00
Formulas, graphs, and tables for every conceivable phase of radio.



Transistor Circuit Handbook $4.95
Complete, simple. Dozens of interesting applications.

Antennas For Citizens Radio by W6SAI $1.00

How To Read Schematic Diagrams $3.50

SPECIAL: RF Wattmeter-Field Strength Meter $12.95
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EIA Standard for Packaged Audio Equipment

Music power output is specified at a harmonic distortion of 5%.

THE Electronic Industries Association (EIA) has just issued a new standard covering power output ratings of packaged audio equipment for home use. This standard, designated RS-234, was formulated by EIA's Engineering Committee on High-Fidelity Equipment. It specifies the measurement of *music power output* only and this is to be done at a frequency of 1000 cps and a total harmonic distortion of 5 per-cent.

The new standard specifies that the packaged amplifier is to be tested at 117 volts a.c. line voltage after having been operated at one-third power output for at least one hour. A non-inductive resistance load is employed that can handle the full rated power output while maintaining its resistance within 1 per-cent. Loudness or volume control is set for maximum gain while the tone controls are adjusted for flattest electrical output. If any other position of the loudness or volume control produces more favorable results, this position may be used for the tests.

The output power rating of the amplifier is to be music power output; no mention is made in the standard of a continuous power output rating. Music power output is invariably higher than continuous power output, in some cases by as much as 20 per-cent or more. The definition of music power output as given in this standard is *"the single frequency power obtained at 5% total harmonic distortion or less when measured immediately after the sudden application of a signal and during a time interval so short that supply voltages within the amplifier have not changed from their no signal values."* This power is expressed in watts and is calculated by dividing the square of the voltage across the load by the resistance of the load. Note that the *supply voltages* referred to in the above definition are the by-passed plate and screen voltages only. Also, when stereo systems are measured, the total power output is simply the sum of the power outputs of each channel.

To measure music power output, the amplifier is first operated with no signal input and the supply voltages are measured. Then, a 1000-cps signal is applied and its level is increased until a 5 per-cent total harmonic distortion condition is produced, while, at the same time, maintaining the supply voltages at their no-load value. This may be done by using a separate well-regulated power supply or by boosting the a.c. input voltage to the amplifier. A voltage measurement is then taken across the load and the music power output is calculated. —30—

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HEATHKIT AA-20 $34.95



HEATHKIT XR-2L $34.95
HEATHKIT XR-2P $29.95

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you can carry your music with you
6-transistor portable radio kit

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Transistor Radio Circuits

Part 6. Concluding article covers signal-seeking radios and details on the relay control unit used in these sets.

THIS is the last article in the current series we have been running on servicing and troubleshooting transistor radios.

This material, which has been reprinted through the courtesy of the *Delco Radio Division* of *General Motors*, has been mainly concerned with receivers and circuits to be found in transistorized auto radio sets but many of the points regarding such circuitry are applicable to home type transistor sets as well and the techniques can be transferred to this type of servicing with profit.

Our thanks to *Delco* for permission to pass this information along to our readers.

Signal-Seeking Radios

In transistor radios which employ a method of automatically tuning the receiver, a circuit must be included for triggering the tuner relay. The circuit must have the ability to amplify the signal from the receiver enough to operate the relay which controls the tuner motor.

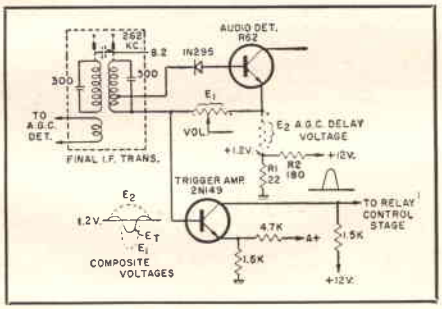


Fig. 11. Trigger amplifier circuit used in the signal-seeking radio receivers.

The i.f. signal, after it has been rectified by the audio detector stage, is used as a source for the trigger voltage. As seen in Fig. 11, the signal is taken from the negative end of the volume control and applied directly to the base of a 2N149 trigger amplifier. The trigger amplifier obtains a d.c. base bias voltage of 1.2 volts from resistors R_1 and R_2 which form a voltage-divider network between ground and the 12-volt line. The purpose of this voltage is to keep the trigger amplifier conducting until the negative trigger voltage is applied. In series with detector voltage E_1 is a.g.c. delay voltage E_2, which is positive in polarity and therefore adds to the 1.2 volts of d.c. bias. The a.g.c. delay voltage, developed in the a.g.c. detector stage, actually "bucks" the signal voltage E_1 to prevent the triggering action from occurring too quickly on strong stations. Triggering the tuner at the sideband of strong signals would result in inaccurate tuning.

The manner in which voltages E_1 and E_2 vary the d.c. base voltage is shown by the composite voltage curves on the diagram. Since both E_1 and E_2 voltages increase in proportion to signal strength, one in the positive direction and the other in the negative direction, a constant difference-voltage, E_T is produced. This is applied to the trigger amplifier base and since it is in the negative direction it drives the transistor toward cut-off. This reduces collector current through the 1500-ohm collector resistor and collector voltage E_C rises in a positive direction. This positive voltage, which is an amplified and inverted E_T voltage, will be used to trigger the relay control stage.

Relay Control Stage

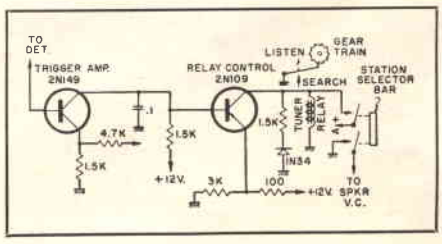
The positive voltage at the output of the trigger amplifier in a signal-seeking radio is filtered by the .1-μf. capacitor from collector to ground (Fig. 12), producing an E_C voltage which is d.c. This is applied to the base of a 2N109 relay control stage. This reverse bias cuts off the 2N109 collector current, the relay in the collector circuit de-energizes and blocks the motor, stopping the tuner. Once the tuner has been stopped, it is necessary to send current through the relay in order to start it searching again. This is accomplished by the starting circuit of Fig. 12.

As the selector bar is depressed, "A+" is applied to the top of the tuner relay and since the bottom of the winding is grounded, current flows through the relay. This energizes the tuner relay and starts the tuner seeking. Also as the bar is depressed, another switch contact shorts the speaker to ground so that no arcing noise is heard as the tuner is started.

A 1500-ohm resistor and a 1N34 diode are connected in series across the relay coil to protect the transistor from surge voltages which may develop as the relay is suddenly de-energized at station points. This inductive kick would cause the collector of the 2N109 to go highly negative and draw excessive current, but this same negative voltage also causes the 1N34 to conduct and leak the excess current to ground.

—30—

Fig. 12. How the relay is actuated in a signal-seeking set, starting search.



Multiplexing Music

(*Continued from page 44*)

the completed recording on the normal track, thus the tape can be played on any recorder. Always record the first part with the "Mixing Level" control (R_8) turned off. After recording is completed for the first part using mike, radio, phono, etc., rewind the tape to the starting position. Turn S_1 to the opposite track and turn R_8 full on. With headphones in the "External Speaker" jack, and the recorder volume control about half way on, start recording, but this time harmonizing with the first part. You can hear the two parts blended together in the headphones and with a little experience you will soon know the proper levels needed to turn out good quality recordings.

If the first part is too loud, change the setting of R_8. Your regular volume control changes the level of both tracks. Rewind the tape to the starting point again, change the setting of S_1, leaving R_8 in the same position. Record the third part, harmonizing with the other parts. Continue this procedure, each time rewinding the tape to the starting position and changing the setting of S_1. When you are all through, turn R_8 full off and play back the tape in the regular manner. A form of "pseudo stereo" can be obtained by putting an amplifier and speaker on the output of the second channel.

You can also play regular stereophonic tapes by simply adding an amplifier to the output of the second channel and turning the "Mixing Level" control full off. If R_8 is turned on, you can play both tracks through your regular tape amplifier and enjoy the good quality of stereophonic tapes—even monophonically.

You will find this addition to your recorder a very worthwhile effort and its applications are limited only by your own ingenuity and imagination. This scheme works very well with organ-piano duets as well as vocals. You can even sing your "barber shop" quartet numbers.

There are a number of extras that some might like to add, such as level indicators for each channel, etc., but with what's given here you can have lots of fun and—who knows—you may discover that you have "hidden talents."

To the author's delight, he has found that the more parts, the less significant are the mistakes of the single parts—in other words—a trio seems to sound better than a solo.

Have fun, but remember one's talents aren't always adequately appreciated by others and your neighbors may look upon your new "pride and joy" as being nothing more than a monstrously amplified device for magnetically multiplexing musical noise and aggravating others! Don't let this discourage you as they just don't know the fun they are missing. —30—

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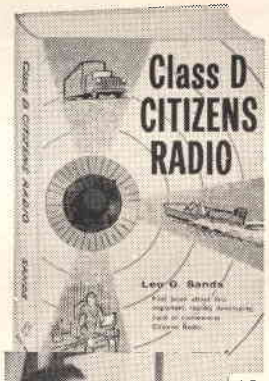

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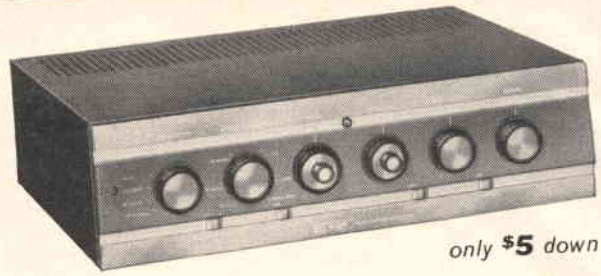

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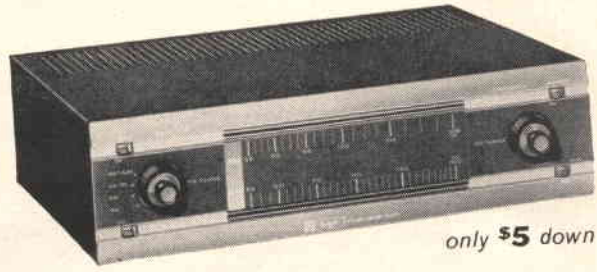

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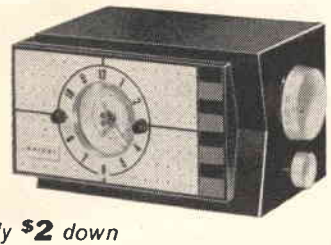

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G-30 Amateur Grid Dip Meter (continuous coverage, 1.5-300 mc).....**$22.95**

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100 kc Crystal Calibrator
RF "Z" Bridge
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2-Way Intercom
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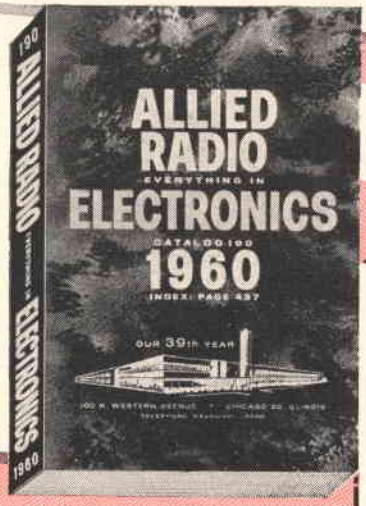
and many others



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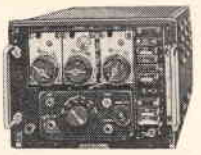

10-channel xtl-controlled Autotune xmtr-rcvr 100-156 mc. Favorite for flight, now available to amateur. Export packed by NavAer in absolutely like-new condition. With schematic & instructions, fob Corpus Christi, Texas **$49.50**
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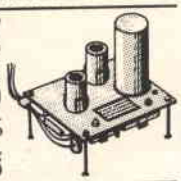
SPEECH AMPLIFIER/PWR SUPPLY for 100 watt xmtr. No splatter. AGC holds 30 watt AF output to +5% for input blast of +78% above the 90%-modulated level. For dyn. or carbon mike. Has keyed 1 kc tone osc. 115 v 1 ph 50/60 cy power supply has 4 mercury-vapor 3C23's and 2 blower-cooled selen. stacks; furnishes 600 vdc, 445 ma; 300 vdc, 175 ma; 12 vdc, 1 A; and adjustable 0 to −150 vdc, ½ A. With schematics and AGC-adjust. instructions.
FOB Milpitas, Calif., all for only..... **$29.95**

Same as above but less the tubes..... $14.95

400 CY, 10^{-5} ACCURACY



Am. Time Prod. $125 Fork in 2-tube ckt; needs 150vdc & 6.3 vac. .001% accurate. Tested and guaranteed; with schematic.
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Same, in case with regul. pwr supply & AF amplifier. $97.50

Above Fork only, guaranteed, with schematics of both items above... **$9.95**

VARO 6228, 400 cy ± 0.1%. Complete ckt w/tube, fork output xfrmr, in HS can. Needs 28vdc. New, w/diagram..... **$27.50**

1000/500/250/125/62½ cy, ±.02%. Am. Time Prod. fork osc., 4 binary counters. Needs 250vdc, 6.3 vac. New, w/diagram..... **$79.50**

$850 TEST OSCILLOSCOPE FOR ONLY $49.50

TS-34/AP. Portable, but with magnifying lens, same as a 5" screen. In addition to the 10-50,000 cy internal variable-rate sweep, it can be triggered by incoming pulses, with sweep choices of 5, 50, or 250 u-secs. duration. In carrying case. With 16-page booklet. Flat 11 cy to 3½ mc. Clean used, checked OK. 40 lbs fob Los Angeles. Less cords. **$49.50**

SAME, but brand new, with all cords $69.50

TS-34A/AP. No carrying case. Same as above except that the triggered sweeps can be varied 4½-8, 20-50, and 120-280 u-secs. Used, but checked out and guaranteed same as new. Less cords.. **$69.50**

ONLY $79.50 FOR 5" DUMONT TEST SCOPE

DUMONT #241. 5" screen. X, Y, and Z amplifiers. With reprint of the instr. book. Used but checked out and guaranteed. 75 lbs fob Los Angeles. A rare buy at only..... **$79.50**



MEAS. CORP. MOD. 79-B Pulse Generator. 60-100,000 cy + pulses ½-40 usecs wd, and + sync pulses delayed ½ period. Can pulse modulate an external RF source and can be synched by an external sine source. This is the model preceding the current catalog model which sells for $495.00. Brand new in original packing, with instruction book, 40 lbs fob Harrisburg, Pa. **$97.50**

MICROVOLTER SIGNAL GENERATORS
(All have internal modulation.)

MEAS. CORP. MOD. 80, 2-400 mc, certified by Standards Lab, fob Los Angeles.. **$299.50**

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NAVY LAE, 520-1300 mc, new in original packing, fob Charleston, S. Car..... **$119.50**

MEAS. CORP. MODEL 84, 300-1000 mc, certified by Standards Lab, fob Los Ang. **$179.50**

NAVY LAG, 1200-4000 mc. certified by Standards Lab, fob Los Angeles..... **$349.50**

TRANSMIT 4 X 400 WATTS A1, A2, A3

AN/FRT-1 complete and brand new. 2 sets available. Four transmitters T-4/FRC can be set up to 4 different frequencies 2-18 mc, crystal or MO. Each emits 400 watts RF in simultaneous operation, all modulated by one MD-1/FRC, and all 5 pieces powered simultaneously by one PP-1/FRC from 220 v, 3 ph, 50/50 cy. Export boxed, w/spares
FOB Los Angeles, each complete set... **$4950.00**
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GET THIS VERSATILE MULTITAP ISOLATOR

565 watt 50/60 cy. transformer has 4 120v 1.3 A primaries for 120/240/480v and a 4.1 A secondary tapped 142/133/127/120/114/109/104v. The following voltages can be taken between taps: 5/6/7/9/10/11/13/15/16/18/19/22/23/24/28/29/33/38v. Or use backward for 120:240v line stepup or as plate xfrmr varied by input tap from 554 to 404 v CT. With diagram. Shipped only by collect RailEx
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R. F.—Is It Dangerous?

(*Continued from page 45*)

ones. What makes them especially hazardous is the fact that a dangerous rise in temperature can occur before an adequate warning is sent to the brain. Radiation in this range penetrates the outer layers of the skin and sub-layers of fat, raising the temperature of deep muscle tissue. Continued exposure to the eye can cause cataracts. By the time a sense of warmth is felt, it is usually too late to avoid some ill effects.

Frequencies above 1000 mc. up to 3000 mc. may be absorbed completely by the skin fat and muscle, with the degree of absorption depending on the thickness of these layers. Individuals exposed to these frequencies feel the warming effects on the skin. Immediate removal from the radiation area will probably avoid any problems.

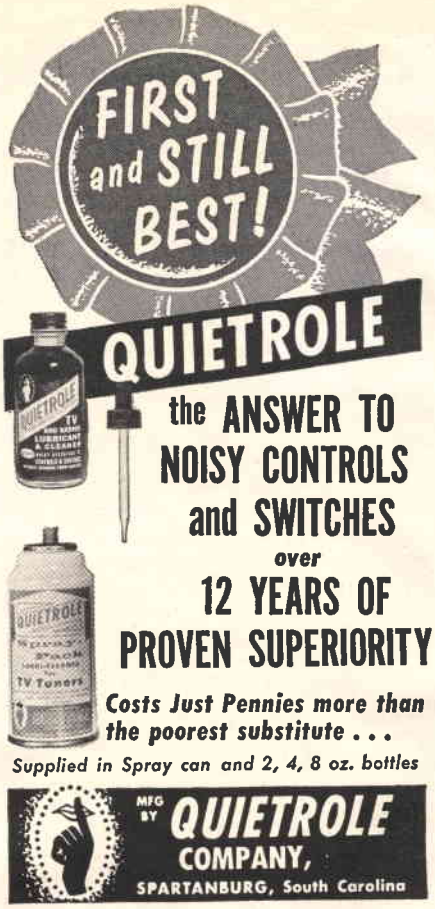
Frequencies above 3000 mc. are absorbed on the surface of the body. Since heat dissipation to the outside is excellent, a good percentage of this radiation is reflected, presenting no problem. Also, since the skin layers are very responsive to temperature change, an overheat warning is sent to the brain promptly.

Extent of Hazard

Measurement units that would relate a specific quantity of r.f. energy to specific biological effects have not been developed. However, threshold exposure levels have been established in terms of watts per square centimeter. This refers to the power per unit of cross-sectional area of the transmitted beam.

Research shows that an exposure of 4 to 5 minutes to an intensity of .6 watt/cm.^{2} of microwave energy can cause damage to human tissues, particularly those in the eye. As a result, the Armed Forces have established a maximum safe exposure level of .01 watt/cm.^{2} What does this mean to personnel whose work involves equipment that radiates energy at the critical frequencies? In the words of Col. George M. Knauf, USAF(MC), Chairman of the Tri-Service Conference on Biological Effects of Microwave Energy, "The most powerful radar set in operation today cannot produce this .01 watt/cm.^{2} of power at 500 feet even in the axis of the main beam." Nevertheless, the level can indeed exist in the immediate area of the transmitting device.

In addition to the factors already noted that determine the extent of the hazard, the clothing worn by the individual also has some effect. Recognizing that new communications and radar equipment will utilize still higher powers, the Air Force is developing special clothing to absorb or reflect r.f. radiation. While the exact nature of this "microwave radiation suit" is still classified, it will permit personnel to work safely in areas where ambient power levels are considerably in ex-



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Exceptional Tonal Qualities! Excellent Performance!



Model 905 **$99.95**

TWO WAY RADIO

complete with crystal for one channel and microphone

For Every Citizen
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Quality Features Include:
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- 2-10 Mile Range
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cess of the recommended threshold.

Ionizing Radiation

While the direct effects of r.f. energy have been the main concern here, it should not be forgotten that high-power r.f. equipment may also produce ionizing radiation, which is a hazard in itself. Increasing r.f. power, particularly as generated by special tubes, may be accompanied by serious amounts of such ionizing radiation as x-rays. Harmful effects from this cause may be produced by a single, intense exposure or by chronic, less intense exposure (see "X-Rays from TV Sets: Are They Harmful?" RADIO & TV NEWS, Nov. 1958). Possible effects include eye cataracts, various types of cancer, sterility, and shortened life.

In electronic equipment, x-rays are produced by such high-power tubes as the amplitron, magnetron, klystron, and thyratron. With magnetrons and klystrons, there seems to be an almost linear relationship between applied plate voltage and the production of x-rays. There is also a relationship between the physical characteristics of the power tube and its ability to produce ionizing rays. From the standpoint of x-radiation, tubes producing longer wavelengths (operating at lower frequencies) are potentially more hazardous than those producing shorter wavelengths.

Appreciable radiation may also develop from cathode-ray tubes, high-voltage rectifiers, and r.f. power amplifiers using operating potentials in the vicinity of 20,000 volts and higher. With these tubes, the danger is chiefly in cumulative dosage rather than one-time exposure. As to the television set, the danger to the viewer is negligible.

Protection against x-radiation is chiefly a matter of preventing exposure. Such measures as doubling one's distance from the source, for example, decreases the radiation dose to one quarter of its value. Minimum safety standards have been established that recommend keeping at least one foot from shielded sources of radiation.

Dangers from r.f. radiation, either directly or through the secondary development of x-radiation, are not so great as to create a serious problem, but they do exist and cannot be ignored. The first type is a problem with microwave frequencies only. In either case, hazards exist for personnel who must work in the immediate vicinity of operating equipment. Knowledge of how and where the peril may occur is the first step in taking preventive countermeasures.

REFERENCES

1. *"Health Hazards Information on Microwave Radiation," Air Force Pamphlet #160-6-13.*
2. *"Radio Frequency Radiation Hazards," Air Force T.O. #31-1-80.*
3. *"Electromagnetic Radiation," Boeing Field Service News, January 1958.*
4. *"Proceedings of the Second Tri-Service Conference on Biological Effects of Microwave Energy," Armed Services Technical Information Agency Document No. AD 131-477.*
5. *Schwan, H. P. & Li, K.: "Hazards Due to Total Body Irradiation by Radar," Proceedings of the IRE, November 1956.* —30—



1 NEW PACO "SPEED CHECK" TUBE TESTER KIT

An economy priced tube tester which has been specifically designed to reduce tube testing time to an absolute minimum.
Model T-61 (Kit)
Net Price: $49.95
Model T-61W (Factory-wired)
Net Price: $69.95



2 NEW PACO "IN CIRCUIT" CAPACITOR TESTER KIT

Instantly reveals open or shorted capacitors of all types while they are wired into circuit; discloses dried-out and open or shorted electrolytics in one quick test without removing capacitor from circuit.
Model C-25 (Kit)
Net Price: $19.95
Model C-25W (Factory-wired)
Net Price: $29.95



3 NEW PACO RAPID FILAMENT TESTER KIT

Quick-checks receiving tubes and TV picture tubes for filament continuity; checks TV and radio set fuses for continuity; checks pilot lamps and TV sets for AC circuit continuity.
Model T-5 (Kit)
Net Price: $4.50
Model T-5W (Factory-wired)
Net Price: $6.50

...and now *PRECISION* adds 10 more value-packed items to the PACO Kit Line



4 NEW PACO CONDENSER SUBSTITUTION BOX KIT

Contains 18 capacitors, selectable on one clearly-marked switch; eliminates the need for maintaining a variety of individual standard-value capacitors.
Model SC-1 (Kit)
Net Price: $8.95
Model SC-1W (Factory-wired)
Net Price: $11.95



5 NEW PACO DECADE CONDENSER KIT

Ideal for determination of capacitor values in all types of experimental circuitry; for use in tuned circuits, filters, RC networks, etc.
Model CD-3 (Kit)
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Model CD-3W (Factory-wired)
Net Price: $24.95



6 NEW PACO RESISTANCE SUBSTITUTION BOX KIT

Permits rapid substitution of 36 values of resistors through use of either of two clearly-identified rotary switches.
Model SR-2 (Kit)
Net Price: $8.95
Model SR-2W (Factory-wired)
Net Price: $11.95



7 NEW PACO DECADE RESISTOR/DIVIDER KIT

A flexible and accurate source of substitute resistance; also for use in the determination of resistance values in test, development and experimental work.
Model RD-5 (Kit)
Net Price: $23.95
Model RD-5W (Factory-wired)
Net Price: $29.95



8 NEW PACO AM-FM STEREO TUNER KIT

A super-sensitive AM-FM stereo tuner kit; a masterpiece of design, performance and appearance.
Model ST-45 (Kit)
Net Price: $84.95
Model ST-45PA (Semi-Kit), with both AM and FM tuner sections factory-wired and completely pre-aligned and calibrated for hairline sensitivity.
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Model ST-45W (Factory-wired)
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9 NEW PACO FM TUNER KIT

A superb FM tuner of exceptional sensitivity and selectivity; brilliantly engineered and styled.
Model ST-35 (Kit)
Net Price: $59.95
Model ST-35PA (Semi-Kit), with tuner section factory-wired and completely pre-aligned and calibrated for hairline sensitivity.
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Model ST-35W (Factory-wired)
Net Price: $89.95



10 NEW PACO WIDE-RANGE TWO-WAY SPEAKER SYSTEM SEMI-KIT

Compact, high-efficiency, 2-way speaker system having truly smooth wide-range response; with cross-over network and built-in acoustic balance control.
Model L-2U (Unfinished)
Net Price: $59.95
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PACO Test Equipment and Hi Fi Kits are produced under the auspices of *PRECISION* Apparatus Company, Inc., world-famous manufacturer of industrial electronic test instruments for over a quarter of a century. Write to Dept. P for the new complete 1960 PACO Catalog, just off the press. You'll keep it for permanent reference.

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SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER



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

- ✓ Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- ✓ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- ✓ Model 77 uses new improved SICO printed circuitry.
- ✓ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.

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

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

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

- ✓ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- ✓ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- ✓ Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

SPECIFICATIONS

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

Model 77—VACUUM TUBE VOLTMETER ... Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.....

$42.50 NET

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER



A Combination VOLT-OHM MILLIAMMETER.
Plus CAPACITY. REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.
Also Tests SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Specifications

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

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. All Germanium Diodes.
All Silicon Rectifiers. All Silicon Diodes.

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasng number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra scale, SICO used its new full-view 6-inch meter.

Model 79—SUPER-METER . . . Total Price $38.50—Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months if satisfactory. Otherwise return, no explanation necessary!

Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads.....Only

$38.50 NET



GENOMETER

7 Signal Generators in One!

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

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

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

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

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

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

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

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

MARKER GENERATOR: The Model TV-50A 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-50A comes absolutely complete with shielded leads and operating instructions.

Model TV-50A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER



Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

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

EXTRAORDINARY FEATURE

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

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a handsome, portable Saddle-Stitched Texon Case. Only..... **$47.50**

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER



Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert tube into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

SPECIFICATIONS

- Tests over 600 tube types
- Tests OZ4 and other gas-filled tubes
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence
- Dual Scale meter permits testing of low current tubes
- 7 and 9 pin straighteners mounted on panel
- All sections of multi-element tubes tested simultaneously
  Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms

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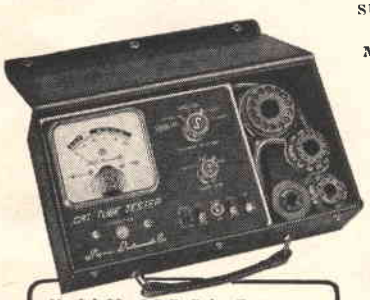

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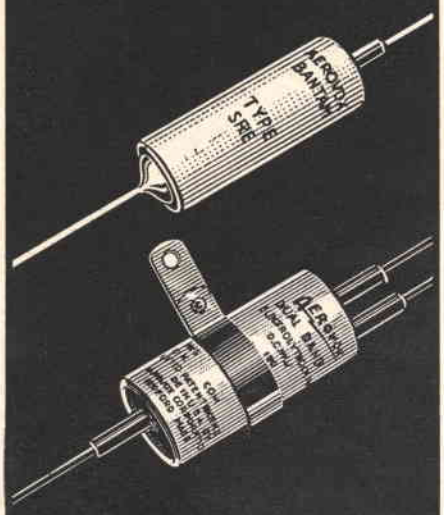

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By
BERT WHYTE

CERTIFIED RECORD REVUE

THERE are a great number of worthwhile discs on the fire this month so rather than waste any valuable space on mere chit-chat, here goes with a magnum serving of reviews! Happy listening all.

BARTOK
CONCERTO FOR ORCHESTRA
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London Stereo CS6086. Price $5.95.

Even in the stereo world, duplication is starting to rear its ugly head. This version of the Bartok masterpiece follows closely on the splendid Kubelik performance. It has much to recommend, but Ansermet espouses some odd tempo changes and *ritards* which robs his reading of continuity.

Over-all he is slower than Reiner, Dorati, or Kubelik. However if you want the best stereo sound, then you will have to make allowances for the reading and accept this. This features extreme brilliance, good depth and directionality, and wide dynamics.

BOUQUET DE PARAY
Detroit Symphony Orchestra conducted by Paul Paray playing familiar works by Rossini, Saint Saens, Weber, Liszt. Mercury Mono MG50203. Price $3.98.

This is a heaping serving of corn, but as offered as hot and deliciously buttered by Paray and his men, it makes for an innocuous but most palatable recording. The performances are all first rate, very lively and spirited and these are abetted by superb mono sound which is superior to many stereo discs. Big brilliant brass, lush strings, sharp, accurate percussion, all are heard very clean in great wide dynamic and frequency range. For those who are still "mono," this is a fine demo record.

BEETHOVEN
SYMPHONY #9
Emilia Gundari, soprano; Nell Rankin, mezzo; William Wildermann, bass; Albert DaCosta, tenor with Westminster Symphonic Choir.
SYMPHONY #8
Columbia Symphony Orchestra conducted by Bruno Walter. Columbia Mono M2L264. Price $9.96. Two discs.

This is all I received of the recent complete edition of the nine Beethoven symphonies recorded by Bruno Walter. Unfortunately, it was also sent in the mono edition which, in the case of the 9th, is especially irksome. However, it must be admitted that there are still many thousands of people who are not equipped for stereo and any new "9th" and especially one by Bruno Walter is deserving of attention.

My reaction to this Walter reading is rather mixed. The sound is superior to the last effort with this work, done some 6 or 7 years ago. The singers, with the exception of Rankin, don't generate as much excitement, nor are they as steady as the older group. Walter's performance has many similarities as is to be expected . . . but is by no means a carbon copy.

Main difference to me is the lack of tension and the more mellow approach of this later version. Here he pays more attention to detail, the phrasing is broader. In the second movement he seems almost introspective. The finale generates its own excitement but does not have the heroic proportions of the earlier recording. The sum total cannot be said to be disappointing, but rather is another view of the work . . . equally valid.

Many people will prefer this reading as a sort of summation of the score on Walter's lifetime record. These good folk have always chosen the Walter approach rather than the "Heaven storming" of Toscanini. Soundwise, I was at a disadvantage, for this score with its tumultuous chorale section needs the delineation of stereo. Thus, while the over-all sound is much cleaner here and has better dynamic range, the vocal part still seems a shade muddy, although an over-prominence of bass would accent this feeling. Good handling of acoustics here helps to maintain clarity.

The 8th Symphony is much more in the Walter tradition—it is graceful, superbly balanced, the tempi are just right and there is a general air of pleasant geniality about it that is most ingratiating. Sound, too, is clean, nicely proportioned in dynamics with excellent strings and fine woodwind sound. I understand other symphonies in the complete set fare very well, especially a wonderful "Pastorale." I hope I can get the rest of this set to review for you.

BEETHOVEN
PIANO CONCERTO #1
SONATA #8 ("PATHETIQUE")
Wilhelm Backhaus, pianist, with Vienna Philharmonic Orchestra conducted by Hans Schmidt-Isserstedt. London Stereo CS6099. Price $5.95.

This will be the fifth stereo version of the 1st Beethoven piano concerto and it is by all odds the best. Interpretively, Backhaus and Rubenstein are fairly close, with Rubenstein providing perhaps a little more dash, and Backhaus hewing shades closer to the score. The big deciding factor then is the sound and here this disc runs away with the honors. It is typical *London* piano recording . . . good balance between piano and orchestra, good fixed positioning of the piano between the speakers. Piano is miked moderately close and there is plenty of presence. The orchestra spreads out beautifully on either side and the acoustics are such as to afford a good feeling of depth.

All is very clean and the transients of the piano especially so . . . wide frequency range and dynamics are notable bonuses. This should be a big seller for *London*.

BARBER
MEDEA
CAPRICORN CONCERTO
Eastman Rochester Orchestra conducted by Howard Hanson. Mercury Stereo SR-90224. Price $5.95.

This is a wonderful recording, both musically and sonically. The ballet "Medea" has been recorded before on a *London*, I believe, but never with the sound nor reading afforded it here. The ballet follows the story based on the Greek tragedy and Sam Barber has interwoven through it some powerful and evocative music. The scoring could be called modern in the usual sense of the word, and while there are dissonances and atonalities, they are definitely not "way out" and the work is fairly easy to assimilate.

The "Capricorn Concerto" is a virtuoso exercise for Joseph Mariano on the flute; Robert Sprenkle, oboe; and Sidney Mear, trumpet. It is a jolly little work and one finds it immediately ingratiating.

The sound in the "Medea" is ultra-sonorous and rich, very clean and wide in dynamics. Stereo direction and depth and instrumental definition were all tops.

ADAM
GISELLE (Ballet)
Paris Conservatoire Orchestra conducted by Jean Martinon. London Stereo CS-6098. Price $5.95.

Martinon is more in his element here with "Giselle" than with some of the recent repertoire *London* has had him record. This is a nicely paced reading with expressive dynamics and the playing Martinon gets from his orchestra is very fine indeed.

The sound is also exemplary with just the right stereo direction and depth and an overall lack of distortion that is notable. This is pleasant to listen to for a few minutes—after that I find this a bit tedious, if not altogether boring. But don't let me dissuade you! That is what makes horse races!

STRAUSS
VIENNA CARNIVAL
Vienna Philharmonic Orchestra conducted by Willi Boskovsky. London Stereo CS6149. Price $5.95.

If you are a lover of Strauss and Vienna, this record is for you! This is one of the gayest, sprightliest collections of Johann and Josef Strauss ever committed to records. The items are off the beaten track, but still not too far out . . . such things as "Music of the Spheres," "Banditen Galop," "Morning Papers" waltz, "Plappermaulchen" polka, and others of equally persuasive character. They are played with boundless energy and zest by Willi Boskovsky and the famous Weinerphilharmoniker, to whom the entire project is obviously a labor of love.

The sound is big and bright, recorded with good close-up detail, yet maintaining a nice roundness from the lovely acoustics. Good directional and depth characteristics and excellent instrumental separation. A winner on all counts!

PIPE ORGAN FAVORITES IN STEREO
D. J. Rees playing the Altwen Chapel organ at Pentardane, Glamorgan. London Stereo CS6102. Price $5.95.

A collection of works either written for the organ originally or transcribed for the instrument, this poses no severe intellectual problems in assimilation. One could be unkind and call most of what is recorded here "corny," but, on the other hand, there is

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some Bach and Handel deserving of respect.

Actually all the works are very lovely sounding . . . chosen primarily for their melodiousness. As such they will be enjoyed by many people. Included are such items as Bach's "Come Blessed Rest" and "Jesu, Joy of Man's Desiring" and Handel's "Largo," "Air from the Water Music Suite," and the "Hallelujah Chorus," etc.

The organ is an odd sort of thing, very "churchy" in character but certainly not baroque, nor full-blown romantic. Whatever, it is exceptionally clean-voiced and all stops are very articulate. Combined with the not-too-reverberent characteristics of the hall, the clarity is outstanding. Rees plays the pieces well, but without any real distinction. For pleasant, quiet listening, this is ideal.

LALO
SYMPHONIE ESPAGNOLE
RAVEL
TZIGANE
Ruggiero Ricci, violinist, with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London. Stereo CS6134. Price $5.95.

This is the 4th version of the "Symphonie Espagnole" in stereo, which merely points up the perils of duplication, even in a medium as new as stereo. This recording wins the sound sweepstakes with no competition, being much cleaner and brighter than any of the competition. It is also very full and sonorous and displays all the stereo virtues. It should be noted, however, that directional effects are less pronounced than is usual with *London*.

Ricci turns in a good enough performance, but I find his tone curiously thinner than is usual and not a good thing for this score. This effect may be heightened because the one sound fault in this recording is that the violin is not projected well enough in front of the orchestra. The violin balance is better in the Ravel piece and Ricci's tone is fuller too, which is all to the good because this is a very elegant performance that will find favor with many.

BEETHOVEN
QUARTET #1 IN F MAJOR
QUARTET #2 IN G MAJOR
The Budapest String Quartet. Columbia Mono ML 5393. Price $4.98.

Here is the famous Budapest String Quartet in the first two of a projected plan to re-record all the Beethoven Quartets in stereo. So what happens? I get the mono version. Oh, well . . . I'll get to them eventually. In the meanwhile comparison with the original reveals a Budapest Quartet which has changed but little. There is more solidity to the playing in the older set, more mellowness here. Tempi differences are slight with the older set generally a little faster. The Budapest is still the Budapest, a superlative group of musicians who perform Beethoven in a manner that is hard to beat.

In the sound department naturally there have been many advances in techniques since the old recording. This makes for a cleaner sound with wider frequency response, but the man who engineered the older set had a better idea of proper chamber music perspective. In this recording there is just a little too much reverb which robs the music of the intimacy it should have when played in an average living room. I look forward to the next release in this new series with interest.

VIVE LA MARCHE!
Detroit Symphony Orchestra conducted by Paul Paray. Mercury Stereo SR90211. Price $5.95.

Paul Paray is a Frenchman and as such can be expected to have a fond spot in his heart for some of the fine French marches that have become part of the symphonic rep-

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They are all exceedingly well played and performed, and the sound is generally quite good, except that it does not seem to have the clarity I have always associated with recordings made in Detroit's old Orchestra Hall. Stereo effects are fine throughout and those who say a big bass drum sound can't be impressed on a stereo disc are invited to listen to the very low frequency thumps heard in the "Marche Hongroise."

BLOCH
CONCERTO GROSSO #1
CONCERTO GROSSO #2
Eastman-Rochester Symphony Orchestra conducted by Howard Hanson. Mercury Stereo SR90223. Price $5.95.

Here is some of the finest string music ever written in two great performances by Howard Hanson and the Eastman-Rochester Orchestra. The Concerto Grosso Number 1 is the better known of the two and has been recorded by *Mercury* once before with Kubelik and the Chicago Symphony.

Choosing between two recordings made in halls with as good acoustics as Rochester and Chicago isn't easy, but the stereo in this latest recording tips the balance. This is a cleaner, but less weighty sound than Chicago. String tone is rich, but brighter. Good directional effects are maintained, the individual string choirs are easily discernible, yet all is nicely blended into an incredibly smooth sonic wall.

Hansen is a shade faster than Kubelik in his reading, but both do very well. Choice here, stereo sound considerations aside, is strictly a matter of personal taste. The Concerto Grosso Number 2 is equally well performed and recorded and is a fine piece in its own right. In both works the strings of the Eastman-Rochester Orchestra display their considerable virtuosity.

BEETHOVEN
SYMPHONY #4
CORIOLAN OVERTURE
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London Stereo CS6070. Price $5.95.

Ansermet isn't supposed to be a Beethoven man, but once again he confounds his critics with this altogether fine reading of the 4th Symphony. I would not venture to say that this stands comparison with Toscanini or Walter, on the other hand, it is far better than the recordings of many who are supposed to be much more at home with Beethoven than is Ansermet. Ansermet takes a few liberties with tempi and phrasing and especially dynamics, but there is nothing too serious and the over-all result is quite interesting.

Probably adding to the good impression is the fine sound which is, without question, the biggest, most sonorous sound ever afforded this work on records. The bass line is particularly awesome with some of the weightiest tympani ever allowed on a Beethoven disc . . . yet they are in balance with the power and dynamics of the rest of the score. Stereo is more prominent and useful here than in most recordings of this classical repertoire. It really amounts to the way the orchestra and mikes are set up . . . done properly and with some appreciation that this is to be listened to in stereo, this repertoire can benefit fully from these techniques.

Sorry, that's all the room I have this month to cover the current discs but I hope to be able to bring you another generous helping of new records next month! —30—



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NEW ARKAY-HARTING MS-5 STEREO RECORD • PLAYBACK TAPE DECK

$129.95

Records and plays back in STEREO and 4 track monaural

Now you can afford the satisfaction and pride of owning a professional quality tape deck. The MS-5 features amazing simplicity of design and operation, yet is engineered to broadcast standards. Compare it to tape decks costing over $200!

With all the features you'd expect in a professional quality stereo tape deck . . . **PLUS:**

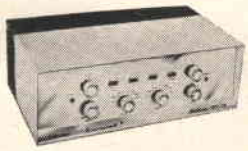
- **5 push button operation and drop-in loading**
- **Automatic interlock prevents accidental erasure**
- **Double shoe brakes for split-second non-slip stops**
- **All metal tape fingers for longer tape life**
- **Oversized capstan insures constant tape speed**
- **2 speed Stereo and monaural operation**

ARKAY HFT-7 FM-AM Tuner
Another Golden '60 component with the Lifetime Guarantee



KIT **$32.00** $49.95 Wired

ARKAY CS 28-watt Stereophonic Dual Amplifier-Preamp
Another Golden '60 component with the Lifetime Guarantee



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Another Golden '60 component with the Lifetime Guarantee



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QRZ QRZ QRZ... de ESSCO CB HQTS... TO ALL Citizen Banders with HEATHKIT CB-1 Transceivers

NOW AVAILABLE: A super selective & highly sensitive receiver adaptor. SPECIALLY designed by ESSCO to fit INSIDE the CB-1 transceiver case.

EASY TO INSTALL, only a few wires to connect and a couple holes to drill. Total installation time about one half hour average.

THE ESSCO Adaptor consists of a 6BA6 RF stage, 6BQ8 1st mixer/oscillator band pass filter connected to 6AN8 2nd mixer/oscillator with crystal controlled 3 mc 1st IF, 6BA6 2nd IF at 455 mc using special high gain transformers, & 12AU7 infinite impedance 2nd detector and AVC control tube.

THE ESSCO Adaptor feeds into present CB-1 audio circuits and speaker, & powered from CB-1 power supply. Single dial tuning of ALL 23 CB channels on present tuning condenser and dial. Fabulous adjacent channel selectivity from closeby stations which formerly blanketed your super-regen receiver. And with a sensitivity and power output that will make operation an extreme pleasure.

THE UNIQUE DESIGN, high grade components and unexcelled master craftsmen workmanship is far better value than one expects from the low introductory price of this factory wired-tested receiver which **$37.95** is worth many times our low price of....

SPECIAL NOTE: This unit also supplied in it's own desk type case with power supply, audio circuits, 4 in. PM speaker and fabulous S meter circuit **$74.95**

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NOW YOU CAN HAVE YOUR CHOICE OF CENTURY'S UNIQUE Peak-to-Peak VACUUM TUBE VOLT METERS

Model VT-10
LINE OPERATED

Model VT-1
BATTERY OPERATED

WITH LARGE EASY-TO-READ 6" METER

featuring the sensational new

MULTI-PROBE (Patent Pending)

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

1 DC Probe 2 AC-Ohms Probe
3 Lo-Cap Probe 4 RF Probe

No longer do you have to cart around a maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to function as either a DC Probe, AC-Ohms Probe, Lo-Cap Probe or RF Probe.

NEW





LINE OPERATED

Ideal for use on the test bench. Designed to run cool even under continuous operation . . . Line isolated.

BATTERY OPERATED

Completely portable . . . Invaluable wherever line connection is undesirable or unavailable . . . Unique circuitry assures low battery drain.

Model VT-10 **$58.50 Net** — TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

Model VT-1 **$58.50 Net** — TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

FUNCTIONS OF VT-1 and VT-10

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

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

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

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

FEATURES OF VT-1 and VT-10

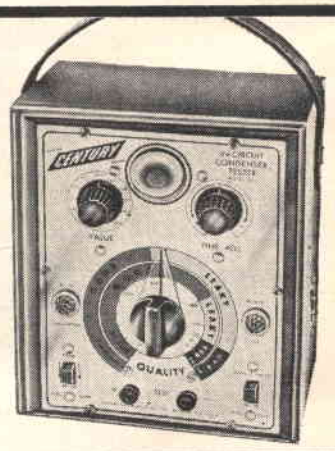
- New advanced pentode amplifier circuit
- Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.s
- Simplified multi-color easy-to-read 4-scale meter
- No heat operation assures stability and accuracy
- Amplifier rectifier circuit with frequency compensated attenuator — a feature found only in costly laboratory instruments
- Meter completely isolated
- Hand-crafted circuitry eliminates the headaches of printed circuitry
- 1% resistors used for permanent accuracy
- Rugged gray hammertone steel case provides necessary shielding and eliminates plastic case drawbacks of cracking or melting
- Deep brushed long lasting etched aluminum panel
- Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS OF VT-1 and VT-10

- **DC Volts** — 0 to 1.5/6/30/150/300/600/1500 volts
- **AC Volts (RMS and Peak-to-Peak)** — 0 to 3/12/60/300/1200 volts
- **Ohms** — to a billion ohms, 10 ohms center scale — RX1/10/100/1K/10K/100K/1M
- **RF** — Peak reading demodulator supplied for use on all DC ranges
- **Zero Center** — available on all DC volt ranges with zero at mid-scale
- **Decibles** — from —10 Db to +10/22/36/50/62 based on the Dbm unit: ODb-1MW in 600 ohms
- **Impedance** — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- **Input Capacity** — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model CT-1 IN-CIRCUIT CONDENSER TESTER

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condensers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.



in-circuit checks:

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

out-of-circuit checks:

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

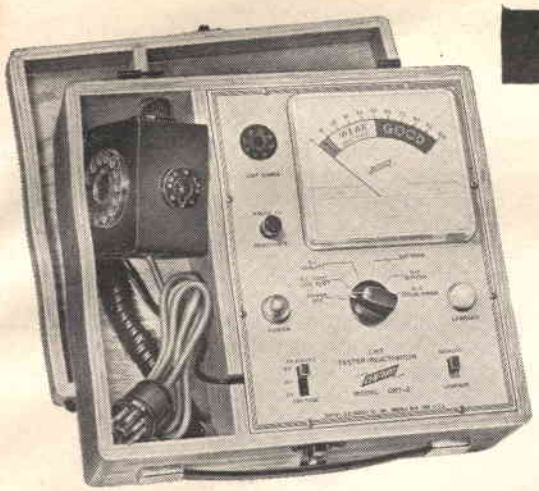
OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for even greater accuracy
- Isolated power line
- Deep brushed long lasting etched aluminum panel
- Housed in sturdy gray hammertone finish steel case . . . comes complete with test leads

Model CT-1 **$34.50 Net** — TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

10 DAY *FREE* TRIAL ON CENTURY INSTRUMENTS OF YOUR CHOICE

See for yourself at no risk why thousands of servicemen all over the country selected CENTURY test equipment above all others. Send for instruments of your choice without obligation . . . try them for 10 days before you buy . . . only then, if satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.



Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD

Model CRT-2 **$57.50 Net**

TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

Model CRT-2 CRT TESTER-REACTIVATOR

TESTS, REPAIRS and REACTIVATES

- ***ALL BLACK AND WHITE PICTURE TUBES*** *(including 110° tubes)* . . . from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . and the very latest 7 pin base.
- ***ALL COLOR PICTURE TUBES*** . . . Each of the red, green and blue color guns is handled separately.

CHECK THESE EXCLUSIVE FEATURES

- **THE MULTI-HEAD** (Patent Pending) . . . **A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** —A tremendous advance over the maze of cables and adapters generally found with other testers.
- **WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place. This allows you for the first time to properly control the reactivation voltage and eliminates the danger of stripping the cathode of the oxide coating. It also enables you to see whether the build-up is lasting.
- **CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers — high enough to really do the job — yet controlled to avoid damage to the picture tube.
- **UNIQUE HIGH VOLTAGE PULSE CIRCUIT**— Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.

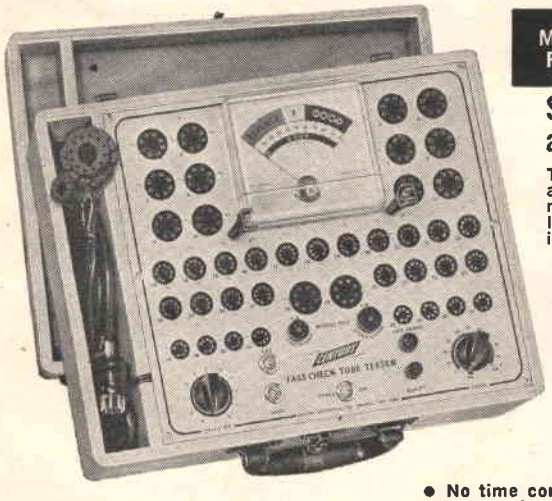
THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST
- For quality of every black and white and color picture tube, employing the time proven dynamic cathode emission test principle.
- For inter-element shorts and leakage up to one megohm. Separate short test provided for each element in the picture tube.
- For life expectancy.

REPAIR
- Will clear inter-element shorts and leakage.
- Will weld open elements.

REACTIVATE
- The "SHOT" (high voltage controlled pulse) method of reactivation provided by the CRT-2 will restore picture tube to new life in instances where it was not possible before. The high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The "BOOST" method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will also improve definition, contrast and focus greatly and add longer life to the picture tube.

- **VISUAL LIFE TEST** — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter . . . helps eliminate resistance to picture tube replacement when necessary.
- **SPECIAL LOW SCREEN VOLTAGE TUBES** — Will handle new type picture tubes with special low voltage of approximately 50 volts.
- **SEPARATE FILAMENT VOLTAGES** — including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
- **NEW 'SF' PICTURE TUBES** — Accommodates the different base pin connections of this new type picture tube.



Housed in hand-rubbed oak carrying case complete with CRT ADAPTER

Model FC-2 **$69.50 Net**

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

Model FC-2 FAST-CHECK TUBE TESTER

Simply set two controls . . . insert tube . . . and press quality button to test any of over 900 tube types completely, accurately . . . IN JUST SECONDS!

The FAST-CHECK enables you to cut servicing time way down, eliminate unprofitable call-backs and increase your dollar earnings by selling more tubes with very little effort on your part. You make every call pay extra dividends by merely showing your customer the actual condition and life expectancy of the tube. The extra tubes you will sell each day will pay for the FAST-CHECK in a very short time.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

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

RANGE OF OPERATION

- Checks quality of over 900 tube types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

● No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers ● No annoying roll chart checking . . . tube chart listing over 900 tube types is located inside cover. New listings are added without costly roll chart replacement ● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● 41 phosphor bronze beryllium tube sockets never need replacement ● 7-pin and 9-pin straighteners mounted on panel ● Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● Compensation for line voltage variation ● 12 filament positions ● Separate gas and short jewel indicators ● Line isolated — no shock hazards ● Deep brushed long lasting etched aluminum panel.

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

MAIL FREE TRIAL COUPON TODAY!

CENTURY ELECTRONICS CO., INC. 111 Roosevelt Ave., Dept. 204, Mineola, N. Y.

- ☐ Model VT-10 Vacuum Tube Volt Meter.....$58.50 $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter.....$58.50 $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester.....$34.50 $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model CRT-2 CRT Tester-Reactivator.....$57.50 $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester.....$69.50 $14.50 within 10 days. Balance $11 monthly for 5 months.

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

Yes, I want to take advantage of your 10 day FREE try-before-you-buy offer. Ship on approval the instruments I have checked. After I have tried the equipment for 10 full days I will either send you the down payment and agree to pay the balance in the monthly payments shown, or I will return the units and owe nothing.

Name.....

Please print clearly

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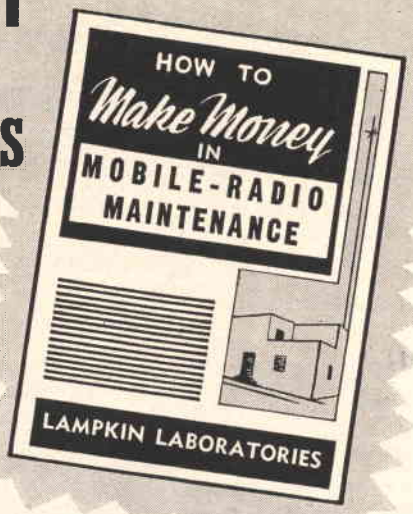
FREE BOOKLET
with
FACTS & FIGURES



You can be on the threshold of an entirely new income! One of the biggest booms nowadays is in 2-way mobile-radio communication. Every installation is practically a guaranteed income for some qualified serviceman. These stations must be kept on the air . . . must have FCC-required checks . . . and because they make money for their owners, they can afford to pay well for service.

Lampkin Laboratories, Inc., has made a study of how other servicemen are making money in this business. Now they offer the results of this study to you — in this FREE booklet — so that you can increase your income thousands of dollars. *Use the coupon today!*

Lampkin instruments are used by thousands of mobile-radio engineers!



LAMPKIN 105-B FREQUENCY METER, RANGE 0.1 TO 175 MC AND UP. PRICE $260.00 NET.



LAMPKIN 205-A FM MODULATION METER. RANGE 25 TO 500 MC. PRICE $270.00 NET.

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NOW! After months of development and field testing . . . consistent dependability under difficult conditions . . .



. . . with the new

EICO CITIZENS BAND TRANSCEIVER

- Station license available to any citizen over 18—No exams or special knowledge required. FCC station license application form supplied free with each unit.
- As simple to operate as an intercom—No skill or experience necessary.
- Covers up to 20 miles depending on terrain and antenna height.

MODEL 760
117 VAC only; less bracket
$59.95 kit $89.95 wired

MODEL 761
117 VAC and 6 VDC
$69.95 kit $99.95 wired

MODEL 762
117 VAC and 12 VDC
$69.95 kit $99.95 wired

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- 530 MARKELY ST., NORRISTOWN, PENNA.
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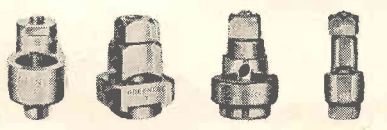
- 317 PARK HEIGHTS AVE., SALISBURY, MD.

CUT HOLES IN 1-1/2 MINUTES
(OR LESS)



with Greenlee Chassis Punches

Many sizes . . . quickly make smooth, accurate holes in metal, hard rubber, or plastics . . . for sockets, plugs, controls, meters, panel lights, etc. Easy to use, simply turn with wrench. Write for literature.



GREENLEE TOOL CO.
1782 Columbia Avenue
Rockford, Illinois

GREENLEE

Simple Booster for FM Tuners

(*Continued from page 49*)

(F_t divided by 100). This means that in order for the booster to cover the entire FM band of 20 megacycles it must be tunable since it can only cover 5 megacycles at a time.

This result was to be expected. Since we are trying for high gain, the maximum achievable bandwidth must suffer. This is not a drawback, particularly if only one, or a series of stations located within 5 megacycles of one another, are to be boosted. In this case the booster can be initially tuned to these stations and forgotten. This is so because beyond its 5-megacycle bandwidth the gain of the booster drops, but it must drop 20 db before it attenuates other signals since it has a maximum gain of 20 db. This point does not occur until over 15 megacycles from the center of the booster passband. That is, if the booster is tuned to boost a station at 93 megacycles, then all stations within the 5-megacycle bandwidth of the booster (90.5 to 95.5 megacycles) will be boosted by 20 db. As we move higher in frequency, the gain decreases until it reaches unity 15 megacycles from 93 megacycles, or at 108 megacycles. At this point, the booster provides no gain, but it provides some gain at all other frequencies, rising to a maximum of 20 db at 93 megacycles.

If, on the other hand, it is desirable to be able to boost *any* signal frequency, then the booster must be tuned whenever a station needs boosting.

Since these calculations show that a cascode FM booster can be built with more than adequate gain, such a booster was constructed and is diagrammed in Fig. 1. In order to keep circuit costs low, a simple version of the cascode circuit using direct coupling was used. This minimizes the number of components, particularly coils and variable capacitors. A simple power supply was also adopted to avoid the expense of a power transformer. Total cost of the booster is only about fifteen dollars.

Performance of the cascode booster is excellent. It provides over 20 db gain which has been found more than adequate to pull in FM stations which couldn't be received previously without the booster. Since the author was mainly interested in boosting two stations on the low end of the FM band, trimmers C_1 and C_4 were used to tune the input and output coils and then left.

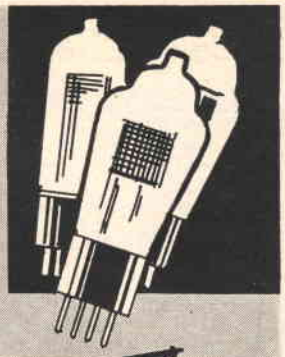
Constructing the Booster

Since the circuit of the booster is simple, its construction should present no problems. As can be seen in the photographs, the author used two 5″ x 7″ x 2″ chassis screwed back-to-back. The top chassis holds the booster proper and the bottom chassis houses the simple power supply.

Since the booster must amplify signals of high frequency, it is vital that

your best buy . . .

TRU-VAC®



REMARKABLE TUBE VALUES AT 1950 PRICES

ALL TUBES INDIVIDUALLY BOXED, CODE DATED AND BRANDED "TRU-VAC®"

Typical TRU-VAC® Bargains!

THIS IS A PARTIAL LIST — Thousands More Always In Stock

6SN7GT ..... ALWAYS 30c

6W4GT ..... ALWAYS 30c

OY4	3AU6	6A6	6B8	6CH8	6S7	7B4	12AT6	12SA7	36
OZ4	3BC5	6AB4	6BA6	6CL6	6S8GT	7B5	12AT7	12SJ7	38
1A7GT	3BN6	6AC7	6BC5	6CM6	6SA7	7B6	12AU6	12SK7	39/44
1B3GT	3BZ6	6AF4	6BC8	6CM7	6SD7GT	7B7	12AU7	12SN7GT	41
1C6	3CB6	6AG5	6BD6	6CN7	6SF5	7B8	12AV6	12SQ7	42
1C7	3Q4	6AH4GT	6BE6	6CQ8	6SF7	7C4	12AV7	12V6GT	43
1F4	3S4	6AH6	6BF5	6CR6	6SG7	7C5	12AX4GT	12W6GT	45
1F5	3V4	6AK5	6BG6G	6CS6	6SH7	7C6	12AX7	12X4	50A5
1G4	4BQ7A	6AL5	6BH6	6CU5	6SJ7	7C7	12AZ7	14A7/12B7	50B5
1H5GT	4BS8	6AM8	6BJ6	6CU6	6SK7	7E5	12B4	14B6	50C5
1L4	4BZ7	6AN8	6BK5	6D6	6SL7	7E6	12BA6	14Q7	50L6
1L6	4CB6	6AQ5	6BK7	6DE6	6SQ7	7E7	12BA7	19	56
1N5GT	5AM8	6AQ6	6BL7GT	6DG6GT	6SR7	7F7	12BD6	19AU4GT	57
1R5	5AN8	6AQ7	6BN6	6DQ6	6T4	7F8	12BE6	19BG6G	58
1S5	5AT8	6AR5	6BQ6GT	6F5	6U8	7G7	12BF6	19J6	71A
1T4	5AV8	6AS5	6BQ7	6F6	6V6GT	7H7	12BH7	19T8	75
1U4	5AZ4	6AT6	6BR8	6H6	6W6GT	7N7	12BQ6	24A	76
1U5	5BR8	6AU4GT	6BS8	6J4	6X4	7Q7	12BR7	25Z6GT	77
1V2	5J6	6AU5GT	6BY5G	6J5	6X5GT	7S7	12BY7	26	78
1X2	5R4	6AU6	6BZ6	6J6	6X8	7X6	12CA5	27	80
2AF4	5U4	6AU8	6BZ7	6J7	6Y6G	7X7	12CN5	35	84/6Z4
2BN4	5U8	6AV5GT	6C4	6K6GT	7A4/XXL	7Y4	12D4	35A5	117Z3
2CY5	5V4G	6AV6	6CB6	6K7	7A5	7Z4	12F5	35B5	
3A4	5V6GT	6AW8	6CD6G	6N7	7A6	12A8	12K7	35C5	
3A5	5X8	6AX4GT	6CF6	6Q7	7A7	12A85	12L6	35W4	
3AL5	5Y3	6AX5GT	6CG7	6S4	7A8	12AQ5	12Q7	35Z5	

35¢ ea.

1 YEAR GUARANTEED PICTURE TUBES

Brand New* — Allied A-1 Tubes — Brand New

Below Listed prices do not include dud. Add Additional $5.00 Deposit on tube sizes to 20"; on 21" and 24" tubes - $7.50. Deposit refunded immediately when dud is returned prepaid. Aluminized tubes - $4.00 extra.

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	1AX2	.62		4BZ7	.96		6BC7	.94		6K6	.58		12AZ7	.86		12U7	.62
	1B3GT	.79		4CB6	.59		6BC8	.97		6S4	.48		12B4	.63		12V6GT	.53
	1DN5	.55		4CS6	.61		6BD6	.51		6SA7GT	.76		12BA6	.50		12W6	.69
	1G3	.73		4DE6	.62		6BE6	.55		6SK7GT	.74		12BD6	.50		12X4	.38
	1J3	.73		4DK6	.60		6BF6	.44		6SL7	.80		12BE6	.53		17AX4	.67
	1K3	.73		4DT6	.55		6BG6	1.66		6SN7	.65		12BF6	.44		17BQ6	1.09
	1L6	1.05		5AM8	.79		6BH6	.65		6SQ7	.73		12BH7	.73		17C5	.58
	1LA6	.69		5AN8	.86		6BH8	.87		6T4	.99		12BK5	.70		17CA5	.62
	1LC6	.79		5AQ5	.52		6BJ6	.62		6T8	.80		12BL6	.56		17D4	.69
	1LN5	.59		5AT8	.80		6BK5	.80		6U8	.78		12BQ6	1.06		17DQ6	1.06
	1R5	.62		5BK7A	.82		6BK7	.85		6V6GT	.54		12BY7	.74		17L6	.58
	1S5	.51		5BQ7	.97		6BL7	1.00		6W4	.57		12BZ7	.75		17W6	.70
	1T4	.58		5BR8	.79		6BN4	.57		6W6	.69		12C5	.56		19AU4	.83
	1U4	.57		5CG8	.76		6BN6	.74		6X4	.39		12CA5	.59		19BG6	1.39
	1U5	.50		5CL8	.76		6BQ5	.65		6X5GT	.53		12CN5	.56		19T8	.80
	1X2B	.82		5EA8	.80		6BQ6GT	1.05		6X8	.77		12CR6	.54		21EX6	1.49
	2AF4	.96		5EU8	.80		6BQ7	.95		7AU7	.61		12CU5	.58		25AU4	.87
	2BN4	.60		5J6	.68		6BR8	.78		7A8	.68		12CU6	1.06		25BQ6	1.11
	2CY5	.71		5T8	.81		6BS8	.90		7B6	.69		12CX6	.54		25C5	.53
	3AL5	.42		5U4	.60		6BU8	.70		7Y4	.69		12DB5	.69		25CA5	.59
	3AU6	.51		5U8	.81		6BY6	.54		8AU8	.83		12DE8	.75		25CD6	1.44
	3AV6	.41		5V6	.56		6BZ6	.54		8AW8	.93		12DL8	.85		25CU6	1.11
	3BA6	.51		5X8	.78		6BZ7	.97		8BQ5	.60		12DM7	.67		25DN6	1.42
	3BC5	.54		5Y3	.46		6C4	.43		8CG7	.62		12DQ6	1.04		25EH5	.55
	3BE6	.52		6AB4	.46		6CB6	.54		8CM7	.68		12DS7	.79		25L6	.57
	3BN4	.63		6AC7	.96		6CD6	1.42		8CN7	.97		12DZ6	.56		25W4	.68
	3BN6	.76		6AF3	.73		6CF6	.64		8CX8	.93		12EL6	.50		25Z6	.66
	3BU8	.78		6AF4	.97		6CG7	.60		8EB8	.94		12EG6	.54		35C5	.51
	3BY6	.55		6AG5	.65		6CG8	.77		10DA7	.71		12EK6	.56		35L6	.57
	3BZ6	.55		6AH6	.99		6CM7	.66		11CY7	.75		12EZ6	.53		35W4	.52
	3CB6	.54		6AK5	.95		6CN7	.65		12A4	.60		12F5	.66		35Z5GT	.60
	3CF6	.60		6AL5	.47		6CR6	.51		12AB5	.55		12F8	.66		50B5	.60
	3CS6	.52		6AM8	.78		6CS6	.57		12AC6	.49		12FM6	.45		50C5	.53
	3CY5	.71		6AN4	.95		6CU5	.58		12AD6	.57		12K5	.65		50DC4	.37
	3DE6	.62		6AN8	.85		6CU6	1.08		12AE6	.43		12SA7M	.86		50EH5	.55
	3DK6	.60		6AQ5	.50		6CY5	.70		12AF3	.73		12SK7GT	.74		50L6	.61
	3DT6	.50		6AR5	.55		6CY7	.71		12AF6	.49		12SN7	.67		117Z3	.61
	3Q5	.80		6AS5	.60		6DA4	.68		12AJ6	.46						
	3S4	.61		6AT6	.43		6DB5	.69		12AL5	.45						
	3V4	.58		6AT8	.79		6DE6	.58		12AL8	.95						
	4AU6	.54		6AU4	.82		6DG6	.59		12AQ5	.52						
	4BA6	.51		6AU6	.50		6DQ6	1.10		12AT6	.43						
	4BC5	.56		6AU7	.61		6DT5	.76		12AT7	.76						
	4BC8	.96		6AU8	.87		6DT6	.53		12AU6	.50						
	4BE6	.54		6AV6	.40		6EU8	.79		12AU7	.60						
	4BN6	.75		6AW8	.89		6EA8	.79		12AV5	.97						
	4BQ7	.96		6AX4	.65		6EB8	.94		12AV6	.41						
	4BS8	.98		6AX7	.64		6H6GT	.58		12AV7	.75						
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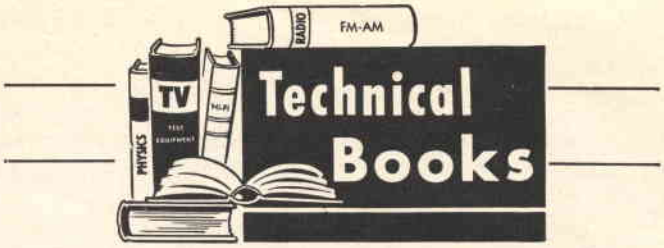

"STEREO HANDBOOK" by G. A. Briggs. Published by *Wharfedale Wireless Works Limited,* England. Available in the U. S. from *British Industries Corporation,* 80 Shore Road, Port Washington, N. Y. 144 pages.

Mr. Briggs' many "fans" in this country will welcome the appearance of still another volume of pithy and pertinent comment on audio—this time as it pertains to the stereo medium.

This non-technical exposé of the subject is written, as the author insists, for any reader who (like the author) can count up to twenty. The statement is an entirely valid one and those who have "switched to stereo" as well as those contemplating the move will find plenty of meat in this small book. Lest the volume appear to dwell too heavily on British developments and the status of stereo overseas, Mr. Briggs has drawn on U. S. sources for reports on the progress of stereo here.

The text material is divided into 15 chapters which cover general information; sound source effects; tonal discrimination; recording techniques; hum, rumble, and noise; pick-ups, tone arms, and turntables; record and stylus wear; amplifiers; loudspeakers; stereo tapes; room acoustics; concert halls; broadcasting; and questions from audiophiles with the author's answers. The text is lavishly illustrated with photographs and line drawings which help to amplify the author's pungent and pertinent commentary. Those familiar with the author's style will find this volume of "vintage" quality while those encountering Mr. Briggs for the first time will be both amused and instructed.

* * *

"MOST-OFTEN-NEEDED 1960 RADIO DIAGRAMS AND SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications,* Highland Park, Ill. 192 pages. Price $2.50. Soft binding. (Vol. R-20.)

The 20th volume in this publisher's "Radio Diagram" series covers popular sets of all makes including auto radios, packaged stereo equipment, transistor radios, and other types of equipment.

The units of some 23 manufacturers are represented along with schematics diagrams, parts lists, service notes, alignment data, etc. A complete index of the service material is appended to facilitate the location of a specific diagram.

* * *

"FROM TIN FOIL TO STEREO—EVOLUTION OF THE PHONOGRAPH" by Oliver Read & Walter L. Welch. Published by *Howard W. Sams & Co., Inc.,* Indianapolis. 502 pages. Price $9.95.

In this encyclopedic treatment of the phonograph from its earliest beginnings to the sophisticated products of today, the authors have performed a labor of love. It is obvious from the very first page that here is a subject to which the authors are deeply devoted and wish to share their enthusiasm with their readers.

There are 29 chapters in this dictionary-sized volume which covers virtually every aspect of the recording art from man's earliest attempts to imitate the sounds of nature to the tape and discs of today. A staggering amount of research has gone into the preparation of this volume for which students and writers in the future can be eternally grateful.

In addition to tracing, in minutest detail, the various steps in the development of sound reproducing equipment, the authors have assembled an interesting and varied collection of historic documents and photographs which have been lavishly reproduced in the text. An 8-page bibliography lists many additional sources of information but it is a moot question whether the reader of this complete history would

have need to refer to other sources for answers to his questions. The authors have apparently covered the field exhaustively.

We believe that anyone interested in the reproduction of sound—be he a professional in the audio field or a well-informed hobbyist—will want a copy of this definitive reference work on an absorbing subject.

* * *

"INTERNATIONAL ELECTRONIC TUBE HANDBOOK" compiled and published by "Radio Bulletin," Holland. Available in North America through *Diamond Television Limited,* 8636 Birnam St., Montreal 15, Canada. Price $4.00 postpaid in North America. Soft binding.

This is a multi-lingual handbook which has been prepared specifically for service technicians. If our mail is any criterion, evidently more and more electronic gear using foreign-made tubes *is* turning up in service shops in this country—involving the technician in a search for duplicates or U. S. equivalents.

This handbook contains data on all European as well as U. S. receiving tubes, CR tubes, transistors, thyratrons, etc. The tubes are classified under eight main headings with descriptions for use of the tables given in nine languages. All important data is provided in an easy-to-read diagram. At the end of each section there is a column of cross-reference information which gives equivalent tubes.

Being compact in size and bound in durable plastic, this handbook could easily become a standby in the tube caddy as well as on the shop reference shelf.

* * *

"WORLD RADIO HANDBOOK" edited and published by O. Lund Johansen. Available in the U. S. from *Gilfer Associates,* P.O. Box 239, Grand Central Station, New York 17, N. Y. 200 pages. Price $2.70 postpaid. Soft binding.

The 1960 edition of this world-wide listing of broadcast and television stations and short-wave programming has been increased in both size and coverage over last year's edition.

Included in this comprehensive listing is information on short-wave reception predictions for 1960, frequency allocations, number of receivers in use throughout the world, world time zones, call signs, bands for best reception, broadcasting and television organizations, religious broadcasting organizations, the status of "Eurovision," reception of TV and v.h.f. transmissions, DX programs, abbreviations, long and medium wave stations, short-wave stations of the world, and other pertinent data.

Those seeking a comprehensive and compact reference book to all sorts of pertinent broadcasting and telecasting data are directed to this handbook which in its fourteen editions has proven invaluable to listeners throughout the world. —30—

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• 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL • EMPLOYS 4 PREMIUM-TYPE 7189 TUBES • 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING • FREQUENCY RESPONSE 20-40,000 CPS ± ½ DB AT 18 WATTS • LESS THAN 1% HARMONIC OR IM DISTORTION •

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Size 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shpg. wt., 22 lbs.

KT-310 WX Stereo Power Amplifier Kit ..... 2.00 Down ..... Net **47.50**

LA-310 WX Stereo Power Amplifier, wired and tested ..... 5.00 Down ..... Net **72.50**

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NEW! Lafayette 50 Watt Complete Stereo Phono System











COMPONENTS

LAFAYETTE LA-250A 50-WATT STEREO AMPLIFIER . .	99.50
GARRARD RC121/11 STEREO CHANGER	41.65
NEW GE VR-22 (.7 MIL) DIAMOND STEREO CARTRIDGE .	24.45
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2-LAFAYETTE SK-58 FAMOUS FREE EDGE 12" COAXIAL SPEAKERS at 29.50	59.00
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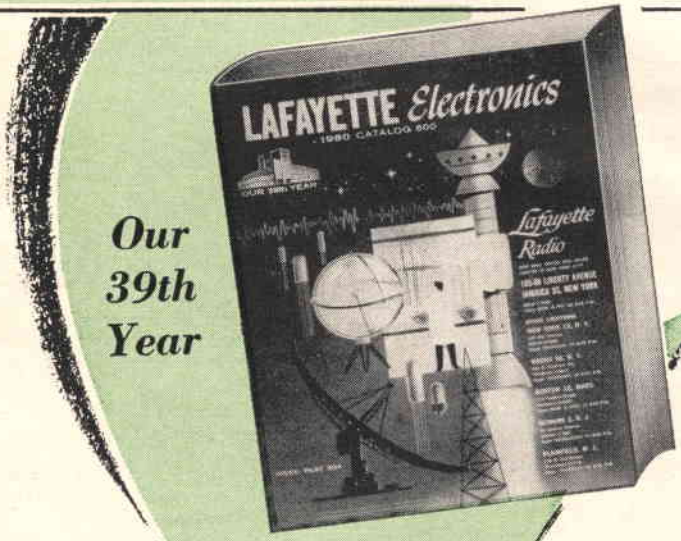
This superb system will add a new dimension in living to your home with all the excitement and realism of a live concert. The new Lafayette LA-250A 50-watt stereo amplifier (25 watts each channel) forms the heart of this outstanding stereo hi-fi phonograph music system—the features, versatility and advanced circuitry of this unit are second to none. Also included is the famous Garrard RC121/11 intermix 4-speed automatic record changer with full manual or automatic operation supplied with your choice of stereo cartridges—the new GE VR-22 (.7 Mil) diamond stereo cartridge, Pickering 371-7D (.7 Mil) diamond stereo cartridge, Shure M7D (.7 Mil) diamond stereo cartridge or the new Electro-Voice 31 MD7 (.7 Mil) diamond stereo cartridge. Supplied with the Lafayette wood base cut for the RC121 in your choice of finishes. These outstanding components are coupled with the 2 famous free edge Lafayette SK-58 12" Coaxial speakers with built-in crossover network and brilliance level control. System supplied with plugs, cables and simple instructions. Shpg. wt., 67 lbs.

HF-670WX Hi-Fi STEREO PHONO SYSTEM with choice of cartridge and mahogany, walnut or blond changer base (please specify) 5.00 Down ..... Net **184.50**

HF-671WX Same as HF-670, but with 2 Lafayette Eliptoflex Series Bookshelf Enclosures (please specify finish). Shpg. wt., 143 lbs. 10.00 Down ..... Net **247.50**

HF-675WX Stereo AM-FM-Phono System. Same as HF-670 but including the Lafayette LT-50 stereo tuner. Shpg. wt., 85 lbs. 28.75 Down, 10.00 Down ..... Net **299.50**



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Leaders in Hi-Fi

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SEND FOR FREE COMPLETE TUBE LIST & ORDER BLANK. YOUR INQUIRY WILL PUT YOU ON OUR MAILING LIST

TELTRON SMASHES PRICES on TUBES for '60!

GIFT OFFER
ONE 6BG6G tube will be shipped FREE with any $10.00 or more order accompanying this ad.

FREE
$7.50 list value. Bonus box includes 3 6SN7 tubes & 25 assorted resistors & condensers with each order of $25.00 or more of receiving tubes and special purpose tubes

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By popular demand we are repeating this fabulous FREE GIVE-AWAY.
You get this EICO tube tester kit #625K ABSOLUTELY FREE when you purchase $199.00 worth of receiving tubes from TELTRON within 60 days. Tube tester may be purchased outright for $34.95 Prepaid
Send for FREE list of other EICO test equipment & HI FI components that we distribute.

Partial List—Most Often Used Tubes

0Z4	.45	6AH6	.47	6CF6	.45	12AU7	.58
1B3GT	.45	6AL5	.43	6CG7	.44	12AV6	.42
1R5	.62	6AM8	.59	6CM8	.54	12AV7	.73
1S5	.51	6AN8	.64	6CM7	.44	12AX-	
1T4	.43	6AQ5	.48	6CS6	.44	4GT	.60
1U4	.51	6AS5	.52	6CU6	.95	12AX7	.61
1U5	.43	6AU4GT		6DE6	.43	12AZ7	.65
1X2	.62		.50	6DQ6GT		12B4	.52
2AF4	1.02	6AU5GT				12BA6	.46
2BN4	.55		.60	6DQ6	.50	12BE6	.46
3AU6	.43	6AU6	.43	6N6	.89	12BH7	.61
3BC5	.43	6AV6	.37	6J5	.47	12BQ6	.63
3BN6	.90	6AW8	.50	6J6	.49	12BY7	.65
3BZ6	.45	6AX4GT		6K6GT	.51	12CR6	.43
3CB6	.45		.60	6S4	.39	12CU6	.63
3DT6	.51	6BA6	.56	6SA7	.41	12DB5	.59
3V4	.51	6BA8	.49	6SC7	.45	12DQ6	.63
4BC8	.48	6BC5	.48	6SK7	.54	12K5	.44
4BQ7	.69	6BC8	.59	6SL7GT	.45	12SA7	.45
4CB6	.75	6BE6	.46			12SK7	.45
5AM8	.51	6BF5	.48	6SN7GT	.60	12SN-	
5AN8	.59	6BG6G				7GT	.56
5AT8	.64		1.18	6SQ7	.60	12SQ7	.38
5AV8	.54	6BH6	.51	6T8	.71	12V6GT	
5BK7	.54	6BJ6	.51	6U8	.76		.43
5J6	.61	6BK5	.75	6V6GT	.48	12L6GT	
5T8	.59	6BK7	.78	6W4GT			.43
5U4G	.43	6BL7GT			.43	12W6GT	
5U4GA			.78	6W6GT			.43
	.45	6BN4	.44		.43	17DQ6	.68
5U4GB	.45	6BN6	.90	6X4	.53	19AU4	.60
5U8	.45	6BQ6GT		6X8	.37	19BG6G	
5V4G	.59		.83	7AU7	.53		1.48
5X8	.55	6BQ7A	.85	8CG7	.54	25BQ-	
5Y3GT	.55	6BY5G	.75	8CM7	.54	6GT	.82
		6BZ6	.45	9U8	.38	25CD6G	
6AB4	.30	6BZ7	.95	10DE7	.79		1.19
6AC7	.43	6C4	.41	12AB5	.44	25CU6	.82
6AF4	1.02	6CB6	.51	12AF6	.44	25L6GT	
6AG5	.52	6CG6G		12AT6	.37		.41
			1.63	12AT7	.71	25W4GT	
				12AU6	.43		.43

Send for FREE complete list of most often used tube types

New and Hard to Get Types. Prompt Del'y

1DN5	.60
1G3GT/1B3	.70
2CY5	.50
3AF4	1.02
4DE6	.55
4DT6	.59
5CQ8	.59
6BJ8	.64
6BQ5	.74
6CQ8	.59
6CX8	.64
6DS5	.69
8AW8	.75
8CX8	.90
11CY7	.74
12EK6	.59
17AX4GT	.50
17D4	.50
50EH5	.59

Send approx. cost, excess refunded.

Obsolete & seldom used tubes. Save now.

1A6	.93	7A7	.42
1C5GT	.57	7B4	.44
1C7G	.39	7B5	.41
1F5	.39	7B8	.47
1H4G	.39	7C5	.44
1LA6	.66	7F8	.71
1LB4	.69	7H7	.51
1LH4	.66	7N7	.52
1LN5	.66	7V7	.82
3LF4	.66	7Y4	.35
5T4	.59	7Z4	.40
6A7	.59	12A8GT	
6A8	.40		.45
6AB7/1853	.60	12K7GT	.40
6AQ7GT	.60	12Q7GT	.48
6AS7G	1.50	12SR7	.57
6D6	.59	14A7	.43
6F5GT	.44	14B6	.36
6F6	.42	14Q7	.52
6S7	.89	27	.45
6SB7Y	.50	35A5	.48
6SR7	.43	35Y4	.35
6U5	.54	37	.59
6U7G	.40	39/44	.39
7A4/XXL	.47	45	.55
7A6	.47	50A5	.48
7A8	.46	50X6	.53
		56	.48
		71A	.65

Semiconductors for immediate delivery.

1N34	.49	2N63	3.75
1N38	.95	2N130A	
1N60	.34		2.75
1N66	.49	2N329A	
1N82A			40.00
	1.00	2N484	
1N253			1.75
	4.25	2N622	
1N256			30.00
	19.95	2N633	
1N295	.30		1.35
1N460A		CK13	4.00
	4.60	CK22	3.50
1N1096		CK709	
	9.00		16.50

New Price Schedule of Television PICTURE TUBES
PICTURE GUARANTEED FOR ONE (1) YEAR

8DP4	*	16RP4	11.95	20DP5	15.75
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12LP4	10.75	17AVP4	15.75	21ALP4	18.75
14BP4	11.75	17EP4	13.25	21AMP4	18.75
14CP4	11.95	17CP4	17.25	21AP4	21.25
14QP4	13.25	17GP4	17.95	21ATP4	19.25
14RP4	14.25	17HP4	16.49	21AUP4	19.25
16AP4	16.45	17JP4	16.49	21AVP4	19.25
16CP4	12.49	17LP4	17.45	21AWP4	18.75
16DP4	11.49	17QP4	13.25	21EP4	17.25
16EP4	15.99	17TP4	16.49	21FP4	19.25
16GP4	15.99	17TP4	16.49	21MP4	21.25
16HP4	12.49	17YP4	16.49	21WP4	17.25
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Aluminized on Any Tube, $4.00 Extra.
All Picture Tubes require a deposit on your dud. Please add an additional $5.00 on tube sizes to 17". Add $7.00 on sizes 19", 20", 21" and 24"s. Your cash deposit will be refunded immediately upon receipt of your dud prepaid.
Picture Tubes are shipped promptly from our warehouse (the US Continent and Canada only) Harrison, N. J. * Price upon request.

Special purpose transmitting & industrial tubes for immed. ship.

0A2	.70	807	1.00
2A4G	.75	811A	3.25
2D21	.65	813	9.25
2E26	2.50	833A	
2X2	.75		40.00
5R4GY		866A	1.00
	1.00	2050	.85
6J4	1.00	5675	
12A6	.60		12.25
FG27	8.50	5879	1.10
HY69	1.75	6146	3.85

Receiving Tube Specials

6SN7GT A & B	
Lots of 50	$24.50
Lots of 100	$44.50
6W4GT	
Lots of 50	$18.95
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12AU7 & A	
Lots of 50	$24.95
Lots of 100	$47.95
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Heavy Duty Solder Gun Kit. 135 watt gun . . . dual spot-light illuminates work when gun is on. KIT INCL.: wire soldering brush, & aid; to make tight wire twists & reopen old joints, so der. Ppd. Only $4.99.
3 for $14.29

FIBER FUSE CLIPS . . . 15c ea.
12 for $1.65
PREPAID

RCA CHEATER CORDS . . . 39c ea.
6 for $1.95
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Complete Outdoor All Channel Conical Antenna
Local or fringe. Incl. 8 elmt. antenna with crsbr; 5' mast alum; chim. mt or 7' wall brkt (state need). 8 stand Offs. 50' 300 ohm wire. List $15. $7.99
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Immediate delivery FOB, Harrison, N.J.

Switch-Type Indoor Antenna
Shipped Postage Paid
New 6 position switch for use on UHF, VHF color sets. Neat Pkg. $2.99. Buy 6, $2.49.

PARALLEL PICTURE TUBE BRIGHTENER 99c
Series type $1.39

AUTO VIBRATORS
6 Volt 4 Prong Universal . . . $1.59
12 Volt 3 Prong Standard . . . $1.79
12 Volt 4 Prong Standard . . . $1.99

NEW LIBERAL TERMS: No minimum order. Free postage on all tube & parts orders over $5.00 in U.S.A., APOs & Territories. 25% deposit required on CODs. Please send approximate postage on Canadian and foreign shipments—excess will be refunded. All picture tubes and outdoor antennas shipped FOB Harrison, New Jersey.

Tubes listed may be factory seconds or used tubes and are clearly marked.

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Dept. EW-4
428 Harrison Ave. Harrison, N. J. Phone HUmboldt 4-9848

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Ask By Name For GENUINE "NOISE" PRODUCTS
BEWARE OF CHEAP SUBSTITUTES

NO-NOISE TUNER-TONIC With PERMA-FILM
- Economical — a little does a lot.
- Cleans, lubricates, restores all tuners, including wafer type.
- Non-toxic, non-inflammable.
- Use for TV, radio and FM.

6 Oz. Aerosol Can
$3.25 NET to Servicemen





NO-NOISE VOLUME CONTROL and CONTACT RESTORER
- Cleans
- Protects
- Lubricates

Not a Carbon Tet Solution
2 Oz. Bottle $1.00 NET to Servicemen
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NOW AVAILABLE FREE AT YOUR JOBBERS
5" PLASTIC EXTENDER



With Push Button Assembly For Pin-Point Applications Does Not Cause Shorts

ELECTRONIC CHEMICAL CORP. 813 Communipaw Avenue Jersey City 4, N. J.

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(Continued from page 71)

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Master Radio TV Ass'n, P.O. Box 1251, Galveston. Pat McDuream, Pres.

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TESA-Houston, 1822 Berry Rd., Houston. F. B. Koepnick.

Mainland Electronics & TV Ass'n, P.O. Box 691, La Marque. E. J. Jones, Pres., Ray Peterson, Sec'y.

T.E.A. of San Antonio, 810 E. Commerce St., San Antonio. Kurt Wertheim, Pres., Leonard Zahlman, Sec'y.

Tyler Radio & TV Ass'n, Inc., P.O. Box 3302, Sta. A, Tyler. Robert Greenlee, Pres.

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Radio & TV Technicians Ass'n, Box 522, Vancouver. Robert C. Walters, Sec'y.

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Electronic Technicians Ass'n, P.O. Box 2022, Huntington. Scott Adams, Pres.

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TESA of Milwaukee, Wisconsin, 2401 N. Weil St., Milwaukee. Ed Bruning, Pres., Elsie Jorgensen, Sec'y.

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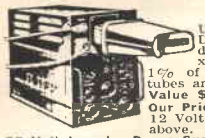
—30—

LORAN R-65/APN-9 RECEIVER & INDICATOR



Used in ships and aircraft. Determines position by radio signals from known xmitters. Accurate to within 1% of distance. Complete with tubes and crystal. Exc. used. Value $1200.00. **Our Price** **$79.50**

12 Volt Inverter Power Supply for above. BRAND NEW..... **$32.50**

28 Volt Inverter Power Supply, exc. cond.... **$49.50**

Circuit diagram and connecting plugs available.

AIRBORNE RADAR INDICATOR ID-93/APG-13

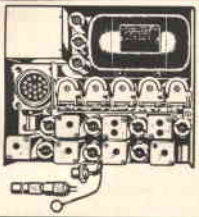


Frequency range 2780 to 2820 Mc. Input power required: 265 Watts from AC supply 120V at 380 to 1600 cycles. Easily converted for 60 cycles. Controls: Horizontal, Vertical, Intensity, Focus, Slope, Marker Amp. Receiver Gain, Yards Range. Tubes used: 6-6SN7GT, 5046, VR105, 2-6H6GT, 2X2, 5V3GT and 3-inch scope tube type 3BP1. Made by G.E. Supplied complete with all tubes, scope tube, and visor. **BRAND NEW. OUR LOW PRICE** **$21.50**

GOLD PLATED SPECIAL! TS-1/ARR-1 TEST OSCILLATOR

Portable, complete with two 955 tubes, cavity and antenna. BRAND NEW, in metal housing 9¾" x 6¾" x 7" high. OUR LOW PRICE, each **$3.45**

RADIO CONTROL RECEIVER 30-42Mc.



R64/ARW-17. Small size, lightweight FM radio Receiver for 5 control channels. Signal outputs actuate control relays up to 3 channels simultaneously. Complete with 10 tubes: 5—6AK5, 3—6J6, 1—6AS6, 1—6AL5, and dynamotor for 24V DC. **BRAND NEW**..... **$12.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike		$5.45
T-30	Carbon Throat Mike	$ .34	.74
T-45	Army and Navy Lip Mike		1.25
TS-9	Handset		3.88
TS-11	Handset		3.95
TS-13	Handset		4.25
RS-38	Navy Type		4.75

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.19	$4.65
HS-33	Low Impedance	2.69	4.65
HS-30	Low Imp. (featherwt.)	.90	1.65
H-16/U	High Imp. (2 units)	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS. BRAND NEW, PER PAIR **$3.25**

CD-307A Cords, with PL55 plug and JK26 Jack .99

Earphone Cushions for above—pair..... .50

LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT



Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.

INDICATOR ID-6B/APN-4, and RECEIVER R-9B/APN-4, complete with tubes, Exc. used **$49.50**

Receiver-Indicator as above, BRAND NEW.. **$79.50**

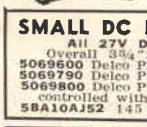
12 V. Inverter Power Supply for above, BRAND NEW **$32.50**

28 V. Inverter Power Supply for above, exc. cond. **$49.50**

RADIO RECEIVER NAVY TYPE RAY-3

Model AN-PR6N is for 14V DC operation. These receivers are supplied complete with built-in dynamotor, 11 tubes. Weston output meter on front panel, as well as coax antenna and output connection, phone jack, on-off switch. For 14V or 24V, please specify. **Like New Condition**.....Our Price **$14.95**

BC-906 FREQ. METER—SPECIAL



Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included. OUR LOW PRICE..... **$10.88**

SMALL DC MOTORS



All 27V DC Input.
Overall 3¾"x1¼" Dia.

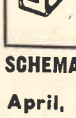
5069600 Delco PM 250 rpm.. **$4.45**
5069790 Delco PM 100 rpm.. **$4.95**
5069800 Delco PM 575 rpm, reversible governor controlled with 27V DC Clutch..... **$4.95**
5BA10AJ52 145 rpm, reversible..... **$4.45**

WILLARD 6-VOLT MIDGET STORAGE BATTERY



3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte ..... Only **$2.95**

2 VOLT BATTERY "PACKAGE"



1—2V. 20 Amp. Hr. Willard Storage Battery, Model #20-2. 3" x 4" x 5¼" high..... **$2.79**
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW!
Combination Price **$5.45**

SCHEMATIC DIAGRAMS For any equipment on this page, each.. **65c**

AN/ART-13 100-WATT XMTR

11 CHANNELS
200-1500 Kc
2 to 18.1 Mc



$48.50

Complete with Tubes

Famous Collins Autotune Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier/clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xtal controlled calibrator. PP811s modulate 813 in final up to 90%, class "B." A Real "HOT" Ham buy at our low price!

Orig. cost $1800. Exc. Used	**$48.50**
0-16 Low Freq. Osc Coil for ART-13	7.95
24V Dynamotor for ART-13	11.95
Same as above less meter	39.50

APR-5A UHF RECEIVER

The APR-5A is a superhet receiver with 2 frequency ranges: (1) from 1000 to 3100 megacycles. (2) from 3000 to 6000 megacycles continuous by means of interchangeable mixers using a single dial tuning control. It has a 10 meg. I.F. band width of 30 megacycles center. Operates from 80-115 V. 1 phase, 60-2600 cycles. Variable I.F. gain by use of a pot. Use for frequencies above 1000 megacycles to supplement range of APR-4 receivers. Brand new in original cases with technical manuals and all tubes..... **$69.50**

New Shipment Just Arrived! FAMOUS BC-645 TRANSCEIVER

15 Tubes 435 To 500 MC



BRAND NEW

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE-316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. **$29.50**

Shipping weight 25 lbs.

PE-101C Dynamotor, 12/24V input	$7.95
UHF Antenna Assembly	2.45
Complete Set of 10 Plugs	5.50
Control Box	2.25

SPECIAL "PACKAGE" OFFER:

BC-645 Transceiver, Dynamotor and all accessories above. COMPLETE, BRAND NEW, White Stocks Last..... **$42.00**

TG-34A CODE KEYER



Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.

BRAND NEW **$22.50**

Checked out, exc. used $18.95

MOBILE-MARINE DYNAMOTOR

Model DM35



Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs. **OUR LOW PRICE, BRAND NEW... $8.45**

OTHER DYNAMOTOR VALUES:			Excellent Used	BRAND NEW
Type	**Input**	**Output**		
DM-25	12V 2.2A	250V .050A		$4.50
DA-1A	28V 1.6A	230V .100A		3.95
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.50
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	7.95	10.50
PE-86	28V 1.25A	250V .050A	2.75	3.85

MOBILE DYNAMOTOR SPECIAL

INPUT: 9 Volts DC @ 7.5 Amps.
OUTPUT: 405 Volts DC @ .095 Amps.
May be used for 6 volt operation. BRAND NEW in original carton **$3.95**

PE-103 DYNAMOTOR. INPUT: 6/12 Volts DC. OUTPUT: 500 V. @ .160 Amps. BRAND NEW, complete with filter base, shock mount and cables **$24.50**

STANDARD TUBES

Removed from Brand New Gov't Equipment

RECEIVING		12SG7	.75	807	.95
6AG5	.35	6J5	.65	813	6.95
12AT7	.45	6H6	.55	814	2.25
6AK5	.40	65L7	.85	815	2.15
6C4	.25	12A6	.45	826	.44
6AL5	.38			1625	.29
6AC7	.55	SPECIAL PURP.		4X-150	5.95
6J6	.32	2C39	3.50	6072	2.50
6V6	.65	3E29	4.25	1P25A	7.95

Please include 25% Deposit with order—Balance C.O.D., or Remittance in Full. 50c Handling Charges on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

G & G Radio Supply Co.
Telephone: CO 7-4605
51 Vesey St., New York 7, N. Y.

BC-603 FM RECEIVER

20 TO 27.9 MC. **$14.95**



Excellent Used .....
BRAND NEW..... **$16.95**

Convert to 30-50 Mc., and A.M.! (See CQ Sept. '58 and Dec. '59.) 10 Channel, pushbutton tuning or continuous tuning. Complete with speaker, tubes, squelch.

12 or 24V Dynamotor for Above Exc. Used $4.25..... Brand New **$5.50**

BC-604 TRANSMITTER—Companion unit for BC-603 Rcvr above. With all tubes. BRAND NEW.... **$10.95**

BC-683 same as above except 27 to 38.9 Mc. Brand New..... **$27.50**

AC POWER SUPPLY FOR BC603, 683

Interchangeable, replaces dynamotor. Has On-Off Switch. NO RECVR. CHANGE NEEDED. Provides 220 VDC @ 80 Ma. 24VAC @ 2 Amps..... **$10.49**

Complete 240-page Technical Manual for BC-603, 604 ..... **$2.95**

BC-652A RECEIVER—Hot Special! 2000 to 6000 Kc AM Receiver, 2-band, complete with all tubes, 200 Kc Xtal Calibrators, and 12 V Dynamotor. Fine for 80-meter Ham band, Marine, etc. Provides for CW, MVC, AVC. Speaker Jack and two Headphone Jacks. Shpg. Wt. 50 lbs. Like new, only.. **$22.50**

POWER SUPPLY for BC-620, 659, available for 6, 12 or 24 Volts DC. Specify..... **$8.95**

BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc. F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Exec. Used..... **$11.95**

Less tubes, exec. used..... **$7.95**

Antenna for BC-659. Telescoping 20" to 8-Ft.... **$2.95**

FM TRANSMITTER-RECEIVER



APN-1. 420 to 460 Mc Aircraft Radio altimeter equipment. Tubes: 4—955, 3—12SH7, 4—12SH7, 2—12H6, 1—VR150. Complete with all tubes and mount. For 27 V DC. **BRAND NEW**..... **$8.95**

Original operating manual for above..... **$1.00**

BC-733 VHF 10-TUBE AIRCRAFT RECEIVER. 6-channel xtal control. Freq. 108.3 to 110.3 Mc. Dual filter range. Easily converted for tracking Sputniks! Exc. used. Complete with tubes..... **$7.95**

Brand New complete with tubes..... **$8.95**

Dynamotor for above 24 V. New..... **$5.95**

NAVY AIRCRAFT RADIO RECEIVER



ARB/CRV 46151—190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change. Sharp and broad tuning. AVC, CW. Illuminated dial. Complete with tubes and dynamotor. BRAND NEW.. **$34.50**

Like New **$26.50**

Power Supply 110 V. AC. Wired..... **$8.50**

ARC-5/R28 RECEIVER



2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **BRAND NEW** **$24.45**

110V AC Power Sup. Kit for above **$9.75**

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. **BRAND NEW**..... **$21.50**

SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. Excellent Used, less tubes..... **$5.95**

MD-7 MODULATOR for T-23, complete with 4 tubes. LIKE NEW..... **$9.95**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**

MODULATOR for above, new with tubes.....**$5.95**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC.....	$12.95	$14.95
BC-454	Receiver 3-6 Mc.....	9.45	12.45
BC-450	3-Receiver Control Box.....	1.29	1.75

110 Volt AC Power Supply Kit, for all 274-N and ARC-5 Receivers. Complete with metal case, instructions **$7.95**

Factory wired, tested, ready to operate... **$11.50**

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only **49c**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.85**

BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW **$9.75**

BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. **$13.95**

ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$10.95**

	USED	NEW
BC-456 Modulator	3.45	5.95
BC-451 Transmitter Control Box..	1.25	1.49

ALL ACCESSORIES AVAILABLE FOR COMMAND EQUIPMENT.

234-258 MC RECEIVER AN/ARR-2



BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price! Complete with tubes **$8.88**

Send Name, Address on Post Card for FREE CATALOG of Wonderful Surplus Buys!

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Here is the sequel to Bob Middleton's first book on the subject, prompted by the insistent demand of readers for still more of the unique and practical help found in the popular "101 Ways" series. This working guidebook for the service technician or for any scope user, stresses the proper interpretation of observed waveforms. Specifies equipment needed, connections required, procedure and evaluation of results for each use. Special notes supplement the uses described. Profusely illustrated. 180 pages; 5½ x 8½". *Only*..... **$2.50**

"Electronics For The Beginner"



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The latest volume in this best-selling series; complete data on popular transistor model radios produced in 1958-59. You get the famous Sams Standard Notation Schematics, with CircuiTrace used throughout; full photo views of each chassis; complete alignment data; full replacement parts data—everything you need to be successful in fast-growing transistorized radio servicing. Includes valuable section on special techniques for servicing transistor circuits. With cumulative index for all volumes in the series. 160 pages; 8½ x 11". *Only*..... **$2.95**

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Newest volume in Sam Marshall's valuable series. Consists of 456 practical trouble-shooting hints for solving hard-to-find faults in many late model TV receivers. All models are indexed by brand name, model and chassis number for quick reference. Each hint is accompanied by an explanatory diagram or schematic. An invaluable shop reference; a real time-saver. 160 pages; 8½ x 11". *Only*.. **$2.95**

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Service Industry News

WITH business management drawing as much of the service dealer's concern as it does these days, the last word on that subject is not likely to be said for a long time. Nevertheless, the *General Electric Co.* comes as close to the last word as one may wish in a new package entitled "Profitable Service Management." The package consists of two volumes, a long-playing record, and a work book. The attractively prepared volumes are entitled "Sound Business Practices" and "Selling Electronic Service." The disc is called "Sounds of Success."

While these materials contain some interesting new ideas, much of the contents consists of things we have heard many times before. What, then, makes this set so distinctive? The package is set apart by the manner in which it was compiled, its obvious first-hand authenticity, and the specific applicability of its information.

Rather than re-hash the reams of business-management material that has already been printed, some of it valid and some of it untested, *G-E* went to an expert, Dr. John K. Pfahl, who is Associate Professor of Business Organization at Ohio State University. The business course was developed from a combination of Dr. Pfahl's specialized knowledge and genuine, grassroots research. To prepare it, successful service dealers throughout the country were interviewed. What better source do we have for the right techniques than the people who have proved they are using these methods?

The text on business practices covers such matters as expansion planning, pricing, cost analysis, inventory, record-keeping, taxation, and cash planning. The volume on selling deals with attracting new business, keeping old business, and promotion. Seasonal planning, special offers, advertising, and market research are some of the specific items. As part of the latter, an impressive county-by-county breakdown of TV and radio ownership for every state of the union (including Alaska, Hawaii, and the District of Columbia) is included. The recording contains intelligently edited excerpts from interviews with 30 successful dealers throughout the nation.

One of the best things about the management course is that, despite its thoroughness and wealth of clearly presented specific material, it is not inflexibly dogmatic. It recognizes that no two establishments in this single field of ours are identical and allows for this difference. In other words, you, rather than the books, make the decisions to suit your own situation. But it would be hard to find a better outside source for putting you in the best position to make those decisions for yourself.

The recording is a good illustration of this point. The original taped interviews were, no doubt, somewhat random in nature despite the fact that they were conducted by skilled interviewers. However, they are excerpted and reorganized most intelligently. To take a specific case, all comments made about advertising in the interviews have been grouped together to form a pattern. We have all heard the promotion techniques discussed (handbills, mail pieces, newspaper ads, listings in the yellow pages, and so on). But some techniques work better for some businesses than others. You may hear one fellow's comments on *why* he thinks phone-book advertising has been one of his most useful tools, and another fellow's opinion as to why it is not much use to him, but why something else is just the thing for his situation. Less important than the well-known methods are the reasons for their success or failure, if you are to evaluate their potential for you analytically.

The books also make you ask yourself questions. Why are you in business for yourself? How much should you expect to make? How can you tell? The ways of finding the answers rather than the answers themselves are there. We wonder how many dealers who believe they know exactly what they are doing will get a few surprises.

The work book includes short-answer tests to be filled out and mailed back to *G-E*. In return the manufacturer sends you a certificate of achievement that may make a nice impression on customers if you display it. More important, it is an inducement to make sure that the useful books get read. They are not large volumes, and they read easily.

How do you get the course? It is "being offered through authorized *General Electric* electronic parts distributors." What the terms and conditions are, we have not yet been told. If your distributor can't give you all the details as yet, we suggest you write to Advertising and Sales Promotion, *General Electric Co.*, 316 E. Ninth Street, Owensboro, Ky.

Ohio Convention

On Sunday April 3, TESA-Ohio holds its state-wide convention at the Zane Hotel in Zanesville. Action begins at 9 a.m., with well over a hundred service people expected to show up. Mem-

bers of all service associations, as well as all other dealers and technicians, are invited to attend. This state group, a member of NATESA, was formed five years ago to coordinate the activities of the many local groups in Ohio.

Texas Publication Change

Readers of "SARTA News," official monthly of the San Antonio Radio and Television Association, will be sorry to hear that this successful paper is out of operation. However, the gap will be filled by the newly formed "TEA Times," which will cover the entire state of Texas. The "Times" will include all local news for San Antonio and other cities, as well as state matters. Accordingly the San Antonio local of TEA has elected to concentrate publication efforts in a single, strong state organ. "SARTA News" readers who have not begun to get copies of the "TEA Times" can be put on the mailing list by writing to Leonard Smith, 1105 May St., Ft. Worth, Tex.

Cincinnati Licensing

Sometimes the fastest way to get results is to slow down. Thus Joe Barg, executive director of TESA-Cincinnati, is moving to withdraw a proposed license ordinance from consideration by the city council. The reason is to get the broadest possible support from all segments of the industry on the best possible law.

The action was taken at a heavily attended meeting called by the Master TV Servicemen's Association. A committee to study and formulate the best possible license bill was set up to include representatives of many interests including, among others: independent service, manufacturers, jobbers, the University of Cincinnati, the BBB, broadcast stations, and technical schools. There appears to be little disagreement on the need for a law. The only problem seems to be that of developing an effective one that will satisfy all interested parties, ensuring widespread backing.

New York Elections

New officers of TSA of Northeastern New York for 1960 include Lou Ristau, president; Henry Szypulski, vice-president; Warren Baker, secretary; Robert Froehlich, treasurer; and Peter Halstead, sergeant-at-arms.

The Western New York Electronics Guild has also installed its top men for this year. Fred Ditondo succeeds himself as president. Other officers are Lester Marschall, vice-president; Clarence Thielke, treasurer; Elmore L. Bement, secretary; and James Archibald, sergeant-at-arms.

In addition to these, Harold Lance and Jack McDonough were elected to the Guild's executive committee. The new officers were installed at a special dinner by New York State Assemblyman George Dannebrock. The association's current mailing address is that of Secretary Bement, 22 Kerns Avenue, Buffalo 11, N. Y. —30—

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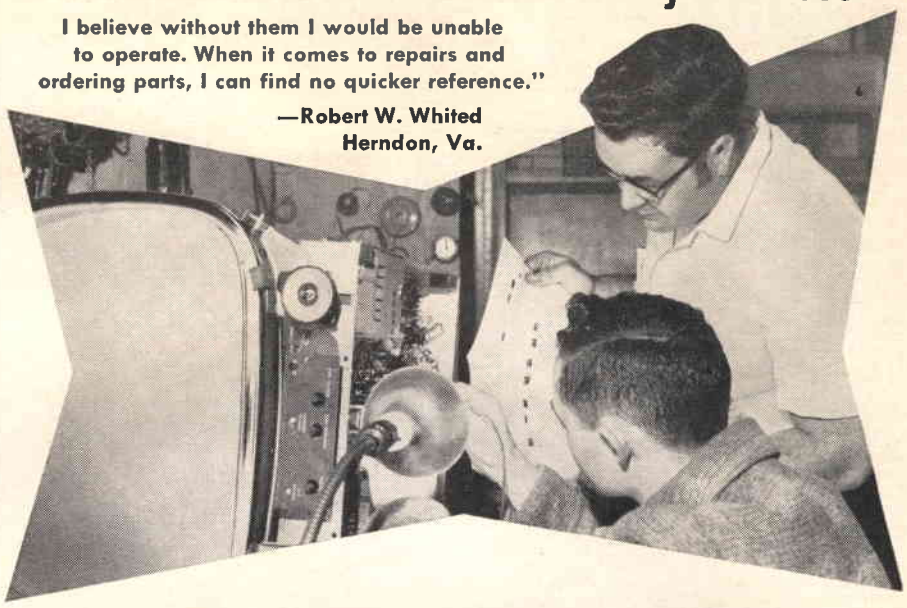
Herndon, Va.



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Resettable 12 VDC coils, 3 deck, 10 pos. w/add. 1A & 1B contact at reset position **$8.95**
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Pri. 115V, 60 Cy. Sec., 400-0-400 @ 200 ma., 6.3V @ 4 amp., 5V @ 2 amp., 8 hy choke, (2) 8 mfd. 600 V oil condensers ..... Kit $7.50

M A R Power Supply

115 V. 60 cyc. input 12-14 VDC, 2 Amp. output filtered and fully housed. SPECIAL **$8.95**

★ ★ POWER TRANSFORMERS ★ ★

117 V. Pri., 800 VCT., 350 Ma.; 6.3 V., 7.5 Amps; 5 V., 6 Amps **$7.69**
720 VCT., 200 Ma.; 12.6 V., 3 Amps; 6.3 V., 10 Amps; 5 V., 3 Amps **$3.95**
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1200 VCT, 600 ma; 6.3 V @ 30 amps, 5V @ 12 amps, Xtra 6.3 & 5V windings .. **$12.50**

—TRANSFORMER Buys!!—

ALL WITH 115 VOLT PRIMARY

6.3 V SEC. 1 Amp .. $1.25
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12 V SEC. 2 Amp .. 1.49
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Step up/down Transformer 110 V-220 V 10 Amp. 9.95
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6.3 V SEC. 15 Amp CT 3.95
12 V SEC. 1 Amp .. 1.19

★ ★ RELAYS! RELAYS! RELAYS! ★ ★

110 VAC DPDT $2.75
110 VAC DPDT, Ceramic-Leach 3.45
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24 VDC, 4 PDT 2.95
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6 VDC SPDT 1.35
Sigma 3,200-ohm SPDT 2.45
24 VAC SPDT Sigma 41-F $1.35
w/transformer for 110 VAC 1.65
16,000-ohm plate, Sigma SF SPDT. Will operate on 500 Mma 3.95

LARGE STOCK AC, DC RELAYS!

SOLENOIDS

115V 60 cyc. cont. dty, 22 lb. pull ..... ea. $5.75
18 lb. pull .... ea. $4.75
8 lb. pull .... ea. 2.30

Chokes—Fully Cased

6 hy. 100 Ma. $1.09
22 hy. 100 Ma. 2.59
20 hy. 110 Ma. 2.15
6 hy. 200 Ma. 1.69
8 hy. 200 Ma. 1.89
10 hy. 250 Ma. 2.75
10 hy. 350 Ma. 3.95
20 hy. 300 Ma. 7.95

TELEPHONE HEADSET

Murdock model H-58U high. imp. SPECIAL Ind. Boxed **$3.69**

3 or 4 Wire Telephone Coiled Cords (or specify)
Hvy. duty. Each .... 99¢ (6 for $5.50)

RG CO-AX CABLE—UG CONNECTORS

58/U. 100-ft. lengths $4.75
59/U. 100-ft. lengths 4.75
SO 239 connectors ..... 3 for 1.25
PL 259A connectors ..... 3 for 1.25
M 359A connectors ..... 3 for 1.15
Adaptors for 58/U or 59/U ..... 22¢ ea.

OIL CONDENSER BARGAINS

2 Mfd 600 VDC .. $0.45
4 Mfd 600 VDC .. .69
8 Mfd 600 VDC .. .90
10 Mfd 600 VDC .. 1.10
15 Mfd 600 VDC .. 1.90
16 Mfd 600 VDC .. 1.75
25 Mfd 600 VDC .. 3.25
1 Mfd 1000 VDC .. .55
2 Mfd 1000 VDC .. .69
15 Mfd 1000 VDC .. 2.95
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3 Mfd 1500 VDC .. 3.25
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1500 mfd., 80V $1.59
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SPECIAL 10 for $6.00

JENNINGS VACUUM CAPACITOR

25 mmfd., 10 KV $7.19

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0-5 Mills 3.25
0-100 Mills 3.45
0-200 Mills 3.95
0-5 Amp AC (scale marked 0-150) .. $3.25
0-20 Amp RF 3.95
0-75 Amps AC 4.25
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200-0-200 VDC 3.95
0-1.5 KV DC W/shunt 6.95
0-3.5 KV DC W/shunt 6.95
0-300 Amps DC, with shunt 5.95
−10.0 to + 6DB ... 5.95
RUNNING TIME METERS!
0-9999 GE 110V ... 7.95
0-9999 JBT, 230V. 9.50
Comb w/freq. meter, JBT, 110 VAC .. 17.95
Fram freq. meter 400 cyc. 9.95

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150 mills $1.25
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Room Acoustics for Stereo

(*Continued from page 62*)

ration of Fig. 24B is really "off base."

Both speakers are immediately adjacent to large open spaces at their sides and backs. This rather destroys any effective acoustic backing to reproject the sound into the listening area. This open area acts somewhat as an absorption area, thus the sound "throw" back into the room is stifled, rather than projected. We thus lose some of the liveness of the concert proscenium that we want to give the room the "concert hall" feeling.

To briefly examine the last criterion (*e*) where the listener should be in a generally "soft" acoustic location with some controlled liveness, this is readily taken care of by acoustic treatment involving drapes or acoustic tiles, in proper proportion to the bare plastered wall areas in the listening sector.

Let us now reverse the relative location of speakers and listeners in the room, putting the speakers near the corner area and the listeners at the open apex of the room, as shown in Fig. 24C. This latter suggestion may limit, or somewhat restrict, the number of permanently placed chairs but it does have certain acoustic advantages in keeping with the earlier enunciated principle of good listening room practice.

First, the speakers will be near a corner area of the room which not only enhances the lows but minimizes the creation of bothersome standing waves. Second, the corner itself may be kept fairly live due to the glass and plastered area behind the speakers; this gives a "stage" liveness to the sound source. Finally, the listener is in a rather open area where he is neither too close to excessive absorption which would deaden the sound nor yet too close to reflective surfaces which would cause excessive liveness directly at the ear. Despite these obvious acoustic advantages, the awkwardness of the seating arrangement and its limited stereo balanced area warrant exploration of still another room arrangement.

Decor May Unbalance Room

As far as the home decorator is concerned, the upper right-hand corner of the room (Fig. 24D) would seem to be a natural location for either a corner settee or lounge chairs and, without a doubt, such upholstered furniture will show up in this area. This area, then, may accommodate at least three to five persons in comfort. The central listening direction for this group will go diagonally across the room. The first thing we can do is put the speakers on either side of the dividing line and oriented towards the listening area.

Although we have physically balanced the listening area with the speakers, the room is far from being acoustically balanced on either side of the axis. Let us examine this unbalance and then correct it. On the left we have a plastered wall and a window section which produces a live condition. On the right we have a large open space leading off into the dining "L" which, because it is an open area, acts as an absorption area dependent on its own wall treatment. For the fortunate ones who live in southern climes, or even for northerners during the summer months, there is a quick and simple solution to this problem. If we simply open the casement windows in the corner we will have introduced considerable absorption into this live corner area, probably enough to equal the open area of the dining "L" on the opposite side of the listening axis. By this expedient, we may balance the room acoustically (provided the neighbors don't object). The preferred alternative is, of course, to acoustically "soften" this corner and "harden" the opposite open area.

Dealing first with the corner, we have a choice of draping the area and/or using acoustic tiles. The drapes will probably border the window and run from the ceiling molding to the floor. A spread of a couple of feet of drape on either side of the window will usually not suffice and probably acoustic tiles will have to be employed as well. Such tiles will not only help the acoustic situation but will add acoustic "finesse" to the room. Tiles placed above the window areas on both side and back walls and extending to the ceiling will remove much of the sound splash from the corners. The combination of acoustic tiles above the windows and the drapes on either side will go a long way toward softening the walls and corner.

If after making these adjustments to the corner wall area, we find we apparently hear more sound from the adjacent wall than from the opposite direction, then we will want to provide some reflective surface in that open area near the dining "L." For the modern homemaker a folding door across the dining "L" will not only enhance the appearance of the room but, when expanded across the area, provide a fair amount of acoustic reflective surface that will liven up that side of the room to balance the opposite corner.

As an alternative, a simple wood-panelled folding screen can be placed across the open area to add considerable acoustic "splash" and thus liven up the sound coming to the listening area from this section.

It would, of course, be impossible to outline all possible solutions to all room layouts. The examples just given, however, illustrate the general method of approach, first through determining the over-all acoustic condition of the room, then by adjusting it, when necessary, by the proper addition or removal of absorption material and, finally, by making symmetrical the *acoustic* condition of the room on either side of the listening axis.

The Coupled Room

We mentioned earlier that we would

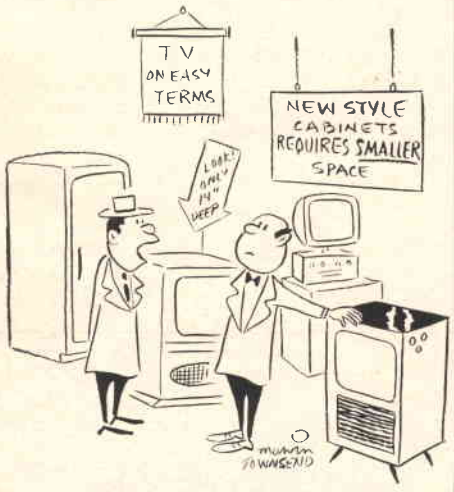
have something to say about "coupled areas." The problem, it will be recalled, came up during the initial discussion concerning the reverberation characteristics of the room of Fig. 23. In making the calculations we did not include the kitchen area on the grounds that it was a "coupled area." Now this simply means that, for acoustic absorption purposes, the surfaces of this room *cannot* be considered as direct extensions of the surfaces of the larger room. They are, in fact, not part of the main room but elements of a new room which, through the narrow archway or doorway, connects with or is coupled to the main room. The smaller room becomes an acoustic entity in itself—with its own reverberation characteristic and, more important, its own resonances. See Fig. 25.

The "coupled room" does make itself felt, however, not so much in terms of reverberation but in terms of reflected resonances. If a sound in the main room has a frequency component (in the low end of the audio spectrum) such that its wavelength is close to one of the dimensions of the smaller room, then this small room will be acoustically excited through the coupling door area, will then go into self resonance, and finally reflect the built up resonance condition back into the larger room.

The end effect of the "coupled" room will not be one of reverberation time but one of imposing a virtual resonant condition back into the listening room. The remedy for this is to see that any coupled room is itself treated so that no one axis of the room can be excited into resonance or to provide isolating panels or doors that will effectively destroy the common coupling area between the two rooms.

Once these stereo acoustic matters have been resolved, we are left with the one basic conflict that is as old as high-fidelity itself—the conflict between room decor and loudspeaker enclosure design. Shall we say (in a very small voice), Down Decor! Up Stereo?

—30—



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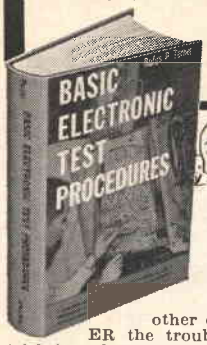



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Audio Distortion Meter

(Continued from page 59)

level, the reading on the audio distortion meter will be very low. It will probably be just slightly higher than the reading obtained with the two inputs connected together. If the amplifier is defective, however, the meter reading will be quite high. Now various checks and changes can be made to the amplifier under test, noting the changes and improvement (we hope) in the distortion level.

Since the distortion meter requires a signal of approximately one volt to simulate normal signal level of the amplifier under test, it may be necessary to use the circuit shown in Fig. 6. This effectively allows the amplifier under test to have any signal level that it requires yet also allows the distortion meter to have a constant but higher input signal level that it requires.

The distortion readings just obtained are relative readings, that is, they compare one distortion level with another. The reading does not tell the percentage of distortion. The actual percentage distortion in an amplifier may not be of any real interest if the audio distortion meter is intended mainly for service work. Similarly, percentage distortion is of little use in maintaining hi-fi system quality. In this case comparative readings can be made at regular intervals and any increase in distortion noted promptly.

However, the audio distortion meter can be readily adapted to the task of measuring the percentage distortion present in an amplifier but requires the use of either an a.c. v.t.v.m. or a calibrated oscilloscope. The distortion percentage in an amplifier is 100 times the ratio of the distortion voltage to the total output voltage. Expressed mathematically, this is: $\%\ distortion = 100\ (E\ distortion/E\ output)$.

For such measurements an additional set of terminals should be brought out to the front panel. These are shown dotted in the diagram of Fig. 1. These terminals allow the measurement of distortion voltages present in the amplifier.

To measure percentage distortion with the aid of the audio distortion meter, the equipment should be set up in the same way as for relative distortion measurements, covered earlier. Adjust the distortion meter for a null with both the amplitude and phase balance controls as before. Now measure the voltage with an a.c. v.t.v.m. or calibrated scope at the terminals just added for this purpose. Now remove the signal from the "A" input by removing the leads to the terminals. Do not touch any of the controls. Now measure the voltage at these same terminals. The ratio of these two voltages multiplied by 100 will be the percentage distortion present in the amplifier. This is in accordance with the formula for percentage distortion given earlier. —30—

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EDITOR'S NOTE: *The following material is excerpted from a recent release from the FCC. It should be of interest to all Citizens Radio operators, especially in view of the large number of violation notices that have been given out of late.*

IT APPEARS that a number of licensees of Citizens Radio stations, particularly Class D stations, have either intentionally or mistakenly interpreted Part 19 of the rules to permit unrestricted use of the stations and amateur-type communications. It seems apparent, when you stop and consider the meteoric growth of this service and the limited number of frequencies available, that any substantial use of Citizens Radio stations for amateur-type or "rag-chewing" activities would create intolerable interference and defeat the Commission's purpose in establishing the service.

Further, although Citizens Radio stations are intended to communicate primarily with other units of the same station, when necessary for purposeful and substantive communications in connection with the business or personal activity involved, such station may communicate with other Citizens Radio stations. Under no circumstances, other than civil defense activities or similar emergencies, may they communicate with stations not licensed in the Citizens Radio service.

A licensee of a station in the Citizens Radio service should neither call nor answer distant stations which are located outside the local ground-wave coverage area of his station, nor should he relay messages from a distant station to either another distant station or a local station. Even within his local area he should refrain from communicating with other stations unless he has a definite and purposeful communication requirement. The practice of using a "test" call for the purpose of inviting "DX contacts" with unknown stations will be considered by the Commission to be subterfuge in lieu of the general call "CQ" and in violation of the rules.

In short, the Amateur Radio service is available to all persons who seriously desire to engage in amateur-type activities, and the Citizens Radio service was intended to provide the average citizen with a means to communicate by radio when necessary in the conduct of his personal affairs or business activities. If you are interested in using radio in a manner which is normal in the Amateur Radio service, you should obtain a license in that service and avoid misusing the privileges that might be granted under a Citizens Radio station license. -30-

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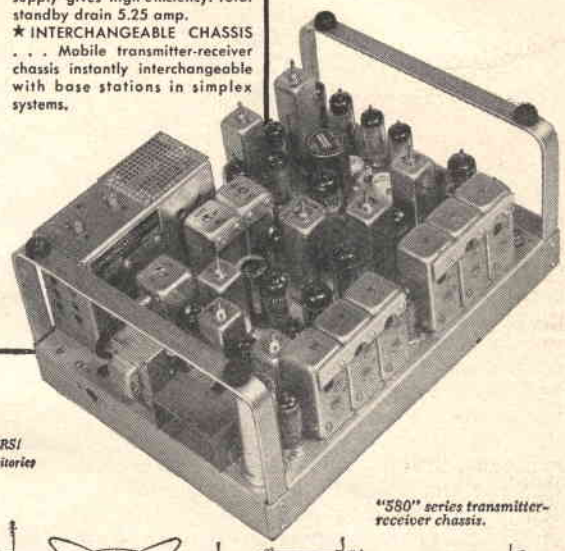

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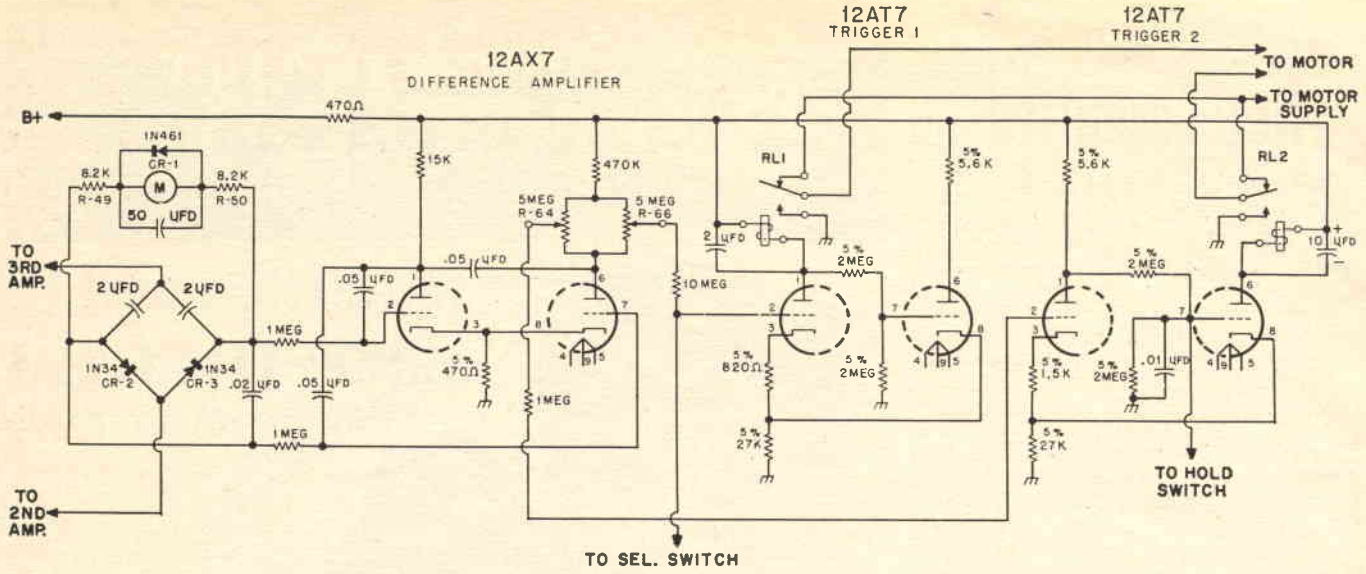


Partial schematic diagram of the a.c. v.t.v.m. showing the automatic range-selecting circuit that controls the motor. Front-panel lamps on meter show which of the 11 ranges has been picked.

Automatic Range-Selecting Circuit for V.T.V.M.

By **CLIFFORD RATLIFF**
Project Engineer, Allied Radio Corp.

Motor-driven range switch automatically picks correct range when probes are applied to circuit under test.

AN interesting circuit is to be found in *Allied Radio's* new a.c. v.t.v.m. kit (Model V-608D). Because of the special circuit, there is no manual range-selector switch; rather it incorporates a motor-driven, self-seeking range-selector circuit that automatically chooses the proper range when the probes are touched to the circuit under test. The selector can race through the eleven ranges of the v.t.v.m. in less than 2½ seconds. The range selected is the one that gives the highest deflection for the voltage being measured. This automatic range-selecting feature makes this unit especially valuable when unknown a.c. voltages are being measured.

The heart of this unique test instrument is its precision motor mechanism. Supplied completely pre-assembled, this d.c.-operated motor and associated gear box are activated the instant the probes are touched to the circuit under test. Once activated, the motor turns the internal switch to the proper range and a light immediately flashes on the front panel to indicate the range in use. A "Hold-Auto" switch permits locking the meter into any range, if desired.

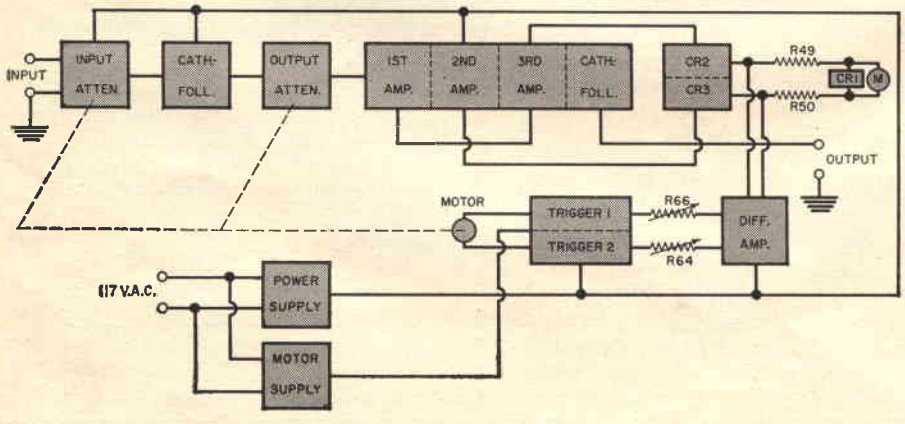
Automatic Range Selector

The block diagram, shown in Fig. 1, breaks the circuit down into four sections: the cathode-follower and attenuators, the amplifier, trigger circuits for motor control, and power supplies. When a signal is applied to the input it passes through the attenuator, cathode-follower, and amplifier. The signal is rectified and a d.c. voltage is developed across resistors R_{49} and R_{50} with the meter connected at the junction of these resistors. R_{49} and R_{50} provide a voltage drop which is fed into the difference amplifier.

In the plate circuit of the difference amplifier R_{64} and R_{66} adjust the triggering levels. At approximately full scale, trigger #1 fires, closing RL_1, in one of two similar trigger circuits. See Fig. 2. This action causes the motor to rotate the switch up-range until the correct voltage range is reached and RL_1 opens. The low trigger #2 fires at approximately one-fifth scale, thus closing a second relay and the motor rotates the range switch down-range until a correct voltage range is reached, opening this second relay. The switching speed and RC time-constants in the difference amplifier are such as to reduce the amount of hunting to a minimum.

The power supply is electronically regulated, which provides low output impedance and eliminates the effects of line voltage variation. A d.c. heater supply is used for the first three tubes (6DK6's). A separate d.c. power supply for the motor prevents noise and switching transients from feeding through to the amplifier.

Fig. 1. Functional block diagram of the new automatic a.c. v.t.v.m. kit. Trigger circuits drive the motor which rotates the range-selector switch.



Circuit Details

The heart of the a.c. vacuum-tube voltmeter automatic-ranging feature is the difference amplifier and trigger circuits. A negative and positive voltage is developed across R_{49} and R_{50}. This voltage is applied to the difference amplifier from which a third voltage (proportional to the sum across R_{49} and R_{50} times the gain of the circuit is developed. The two 5-megohm pots (R_{64}, R_{66}) adjust the firing levels of the triggers.

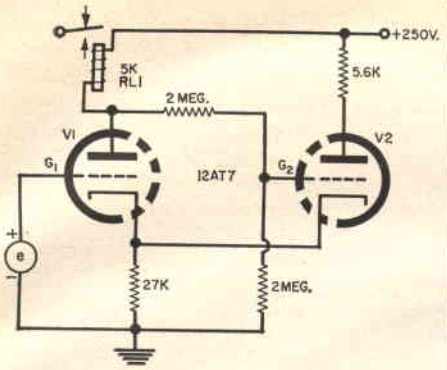


Fig. 2. Trigger #1 circuit. In trigger #2 multivibrator, the sensitive relay and 5600-ohm resistor are interchanged.

A cathode-coupled binary circuit (known as the Schmitt circuit) is employed for down-range and up-range switching control. The cathode-coupled binary is essentially a bistable multivibrator with one plate-to-grid attenuator network removed. A simplified version of this circuit is shown in Fig. 2.

When the voltage e is below a value to cause current flow, V_1 will remain cut off. As e is increased in value to the point when current begins to flow, the voltage at G_2 will drop due to the drop across RL_1. Current through V_2 will decrease, causing the drop across the 27,000-ohm cathode resistor to decrease.

If the loop gain of the circuit exceeds unity, a regenerative action takes place, driving V_2 to cut off and V_1 to clamp. This action is very fast and the difference between voltage input to close or open RL_1 covers a very small segment of the meter scale.

Calibration

A calibrator, providing 0.0031 volt and 0.00065 volt for gain and trigger calibration, is supplied with the unit. There are two small calibration (triangle) marks on the meter scale corresponding to these voltages. The gain and up-range switching trigger are set at the upper triangle (0.0031 volt) while the down-range trigger is set at the lower triangle (0.00065 volt). -30-

IHFM ELECTS

HERMON H. SCOTT, president of H. H. Scott, Inc., has been named chairman of the board of the Institute of High Fidelity Manufacturers. Serving as vice-president and a director of the association is Ray V. Pepe, vice-president of James B. Lansing Sound, Inc. He will also act as the Institute's president until a special election can be held to fill the post.

Also named to the board of directors were the IHFM secretary, Saul Marantz, president of Marantz Company, and Donald Plunkett, president of Fairchild Recording Equipment Co.

Other board members continuing to serve include Walter O. Stanton, president of Pickering and Company, Joseph N. Benjamin, president of Bogen-Presto Div., Milton D. Thalberg, president of Audiogersh, and William S. Grommes, Grommes Division. -30-

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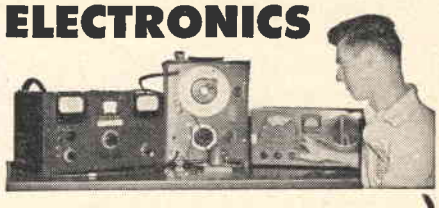

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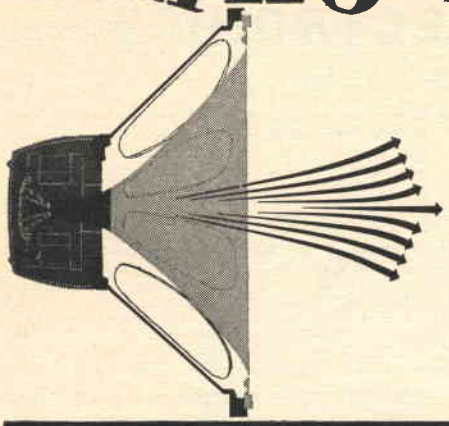

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Service in 1959

(*Continued from page 55*)

mutual interest rather than conflict with service dealers, and who have accordingly pursued strict wholesale-only policies. This has paid off, and gives emphasis to the view that, even with respect to manufacturers, efforts in a recognizable common interest are more fruitful than strife. In 1959, TESA of Miami achieved a milestone in cooperation with far-sighted local wholesalers. A mutually satisfactory program governing sales was worked out and, as evidence of good faith, some distributors have posted bonds to back up the stated policy. This move was widely heralded by association publications through the nation and was quickly followed by similar action in Green Bay, Wis.

Self-Service Tube Testers

Although the effect varies greatly throughout the nation, responsible industry statisticians estimate that do-it-yourself tube checkers are involved in the sale of more than one-third of all replacement electron tubes. This is a serious loss of business to the service dealer. Some shops have succeeded in winning back lost sales by making use of the same type of tester, either inside their own premises or by operating them in other locations.

Many others regard these devices as leering monsters. In Seattle, Wash., service people have asked the city council to investigate these devices following consumer complaints concerning their accuracy. NATESA has challenged all such devices to laboratory tests of their capabilities. The National Electronic Distributors Association has conducted its own tests, which indicate that inaccuracy and malfunction is the rule rather than the exception when the testers are not under the supervision of competent technicians. The public may be learning to rely on the man behind the tester.

Associations

Many other developments of interest —concerning service fees, shop practice, the impact of imported merchandise, organized theft, employment, and diversification—highlighted the year. Most important, however, is the fact that service has had more to say in successfully determining its own fate then ever before. There has been more effective *action* and less aimless crying than ever before. It is no accident that the growth in the number and size of service associations and increased communication and cooperation between them is at its peak. A useful solution to an industry problem developed in San Antonio or Seattle is heralded in association publications from coast to coast before the month is out—and the number of such publications is also at a peak. These are not the symptoms one expects to find in a dying or futile industry. —30—

Capacitor Tester-Healer

(*Continued from page 53*)

As voltage is applied, the d.c. fuse (PL_1) will glow, indicating heavy initial current, and then extinguish as current decreases. Continue to increase voltage by rotating the control clockwise until leakage current approaches 50 ma., but do not go beyond this point. Also, voltage should never be set beyond the rated value of the capacitor, unless you are in the process of trying to determine what that rating is. As Fig. 1 indicates, breakdown is likely to occur beyond rated voltage.

Once the working voltage is reached and leakage current has begun to drop, the selector switch can be progressively lowered from one current range to another as each one becomes safe. This is done until the leakage current settles down. S_1 should be returned to the 50-ma. position then return the voltage control slowly to zero at the end of a test cycle.

The technique for healing an electrolytic capacitor is essentially the same as that described for testing, except that it is likely to take somewhat longer when a unit must be re-formed. Leakage current *vs* time has been plotted in Fig. 2 for several capacitors of different value, with rated voltage applied in each case.

The a.c. plug of the tester should never be disconnected unless the selector switch has been turned off. If the a.c. plug is indeed pulled while a charged capacitor is connected to the test terminals, the component will discharge through meter M_2. This large reverse current is likely to damage the meter, especially if the tester is set on its lowest current-reading range.

In the unit shown, no provision was made for discharging the capacitor after test. However, as indicated by the broken lines in Fig. 5, it is easy to make provision for this desirable feature. A two-circuit, push-button, spring-return switch and a resistor (value not critical) are the only additional parts required. Open the circuit at point *X* and make the connections as shown. When switch S_2 is in its normal position, the tester operates as already described. When this switch is depressed, two things occur. The discharge path through M_2 is opened and the discharge resistor is inserted across the capacitor between points *Y* and *Z*. Care should be taken to avoid contact with the capacitor's leads during a test, as the potential may be 500 volts.

Mechanical Considerations

The completed instrument was installed in a *Bud* SF-500 sloping-front cabinet, whose dimensions are 8" by 8" by 8". The chassis was kept simple by using an aluminum plate measuring 7" by 7", with a half-inch right-angle lip for mounting to the back of the front panel (Fig. 4). The rear of the chassis is supported by aluminum straps. –30–



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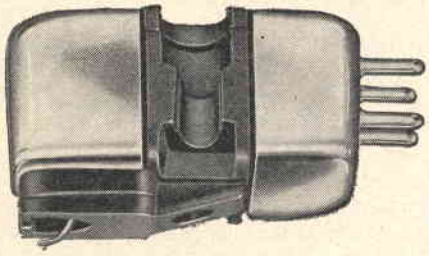

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FM Multiplex Adapter

(*Continued from page 67*)

frequency and thus the d.c. level at the collector of V_3 is proportional to frequency. The range of linear operation is limited but adequate for the ± 7.5 kc. subcarrier deviation systems.

One of the main reasons for improved signal-to-noise ratio with the free-running multivibrator is that should noise modulation of the subcarrier result in insufficient voltage to synchronize the multivibrator, the d.c. level would be somewhere in the mid-range of d.c. levels corresponding to the free-running multivibrator collector level. With the monostable multivibrator, insufficient trigger will cause the d.c. level to drop to less than a volt. For example, suppose that the average voltage to the collector of V_3 is 2 volts d.c. when the multivibrator is free-running or is 2 volts at, say, 70 kc. when the multivibrator is a monostable device with sufficient triggering amplitude. Suppose that at 67.5 kc. the d.c. level in both cases is 1.95 volts and that the d.c. level of the monostable m-v is 0.8 v. untriggered. If the free-running multivibrator fails to trigger properly the noise pulse produced is 2.00−1.95 or .05 volt peak, whereas for the monostable case it is 1.15 volts peak. In practice, because of a smaller area waveform, the free-running multivibrator produces a lower audio output (about .05 to 0.1 volt peak-to-peak) than the monostable multivibrator but is far more immune to noise in the subcarrier. Where adequate noise-free subcarrier signal is available, the monostable multivibrator gives more nearly linear operation over a wider frequency range.

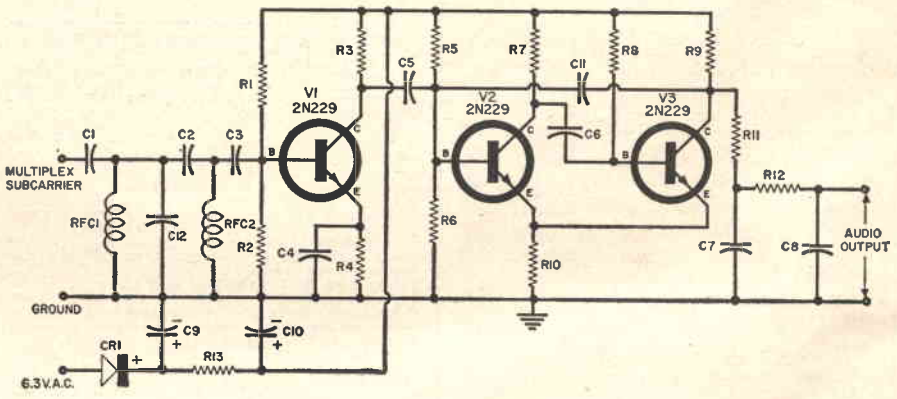
The accompanying photographs show one possible layout for the components. the layout is not at all critical but the circuitry should be completely enclosed to prevent pickup and demodulation of signals from powerful AM stations. The parts list accompanying the schematic diagram of Fig. 5 lists several specific parts but any equivalent components would be satisfactory. The circuit was designed to work with *Sylvania* 2N229 *n-p-n* transistors which are available for about 75 cents each, but will work equally well with similar *n-p-n* units of other manufacturers as well as *Sylvania's* 2N233's. By reversing the polarity of the power supply, many of the low-cost *p-n-p* units also worked very well.

Connections to the tuner are made by means of a length of shielded lead. A foot or two of lead is satisfactory. The connection to the ungrounded side of the heater in the tuner is made by means of a single flexible lead with *Amphenol* 71-1S plugs and 78-1S sockets installed in the tuner and adapter.

The tuner the author used employs a ratio detector but any tuner having a discriminator capable of supplying 100 to 200 millivolts r.m.s. of subcarrier into a 2700-ohm load should be satisfactory. For use with a 50-kc. subcarrier the filter constants should be changed to about 8 mhy, for RFC_1 and RFC_2, .0022 μf. for C_1 and C_3, and .001 μf. for C_2. The impedance of the filter will remain about 2700 ohms but the cut-off frequency will move down to about 25 kc. The values of C_6 and C_{11} should be changed to about 3900 μμf. and 3000 μμf. respectively.

As pointed out in earlier articles on FM multiplex, the use of an adapter to receive commercial transmissions for personal gain is a violation of Federal Law and makes the violator subject to criminal prosecution. There are no objections, however, to building an adapter such as this for personal and experimental purposes. —30—

Fig. 5. Complete circuit diagram and parts listing for the multiplex adapter.



R_1—56,000 ohm, ½ w. carbon res.
R_2, R_{12}—10,000 ohm, ½ w. carbon res.
R_3—5600 ohm, ½ w. carbon res.
R_4, R_9—1000 ohm, ½ w. carbon res.
R_5—6800 ohm, ½ w. carbon res.
R_6—1500 ohm, ½ w. carbon res.
R_7—470 ohm, ½ w. carbon res.
R_8—3300 ohm, ½ w. carbon res.
R_{10}—68 ohm, ½ w. carbon res.
R_{11}—22,000 ohm, ½ w. carbon res.
R_{13}—100 ohm, ½ w. carbon res.
C_1, C_3—1500 μμf. ceramic capacitor (see text)
C_2—750 μμf. ceramic capacitor
C_4—0.1 μf., 200 v. paper capacitor
C_5—.005 μf. ceramic capacitor
C_6—.003 μf. ceramic capacitor (see text)
C_7, C_8—.01 μf. ceramic capacitor
C_9, C_{10}—500 μf., 12 v. elec. capacitor (Sprague TVA-1132)
C_{11}—.002 μf. ceramic capacitor (see text)
C_{12}—.001 μf. ceramic capacitor
RFC_1, RFC_2—5 mhy., 200 ma. r.f. choke (Miller 6304 or equiv.)
CR_1—1N91 or 1N92 germanium diode
V_1, V_2, V_3—"n-p-n" transistor (Author used Sylvania 2N229's. See text for alternates)

ELECTRONIC CROSSWORDS

By **JOHN J. GILL**

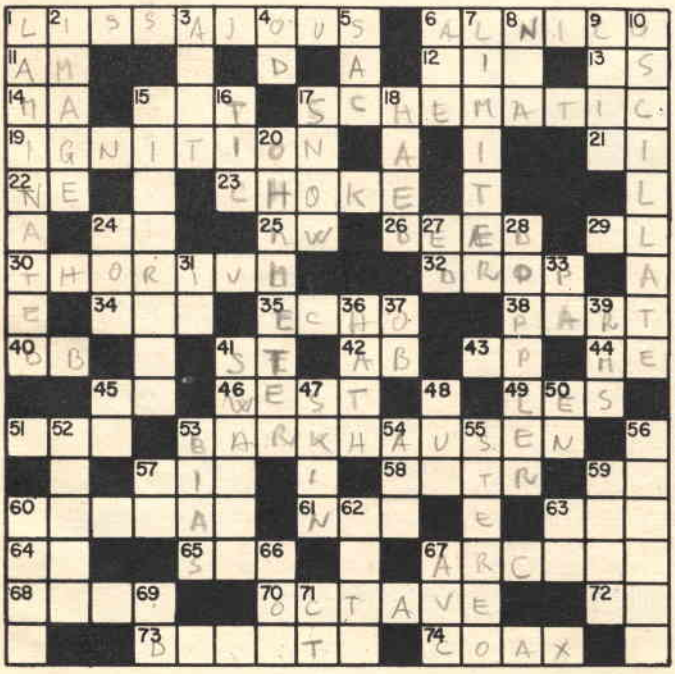
(*Answer on page* 135)

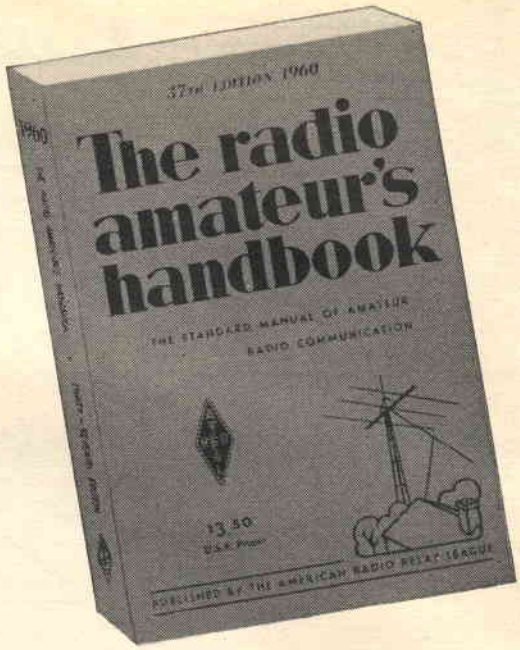
ACROSS

1. Figures on scope.
6. Metal used for PM speakers.
11. Type of modulation.
12. An amateur's equipment.
13. Octal socket (abbr.).
14. Unit of current (abbr.).
15. ——work (a system of interconnected parts).
17. Electronic "map."
19. Causes interference in TV and radio.
21. 51 (Roman numeral).
22. Element #10 (abbr.).
23. Type of coil.
24. Inductance (abbr.).
25. 1/1000th of a watt (abbr.).
26. Expired.
29. The (Span.).
30. Element used to coat filaments.
32. Current flowing through resistor causes voltage ——.
34. Gained.
35. Reflected signal.
38. Component.
40. Unit of relative power.
41. "City road" (abbr.).
42. Followed by "C."
43. Voltage reading on a scope (abbr.).
44. Myself.
45. Electrical engineer (abbr.).
46. Originally from the Storm Country.
49. French article (plural).
51. Delay in voltage or current.
53. Unwanted oscillations on a TV set.
57. Metallic strut.
58. Electronic broadcasting device (abbr.).
59. Yes (Spanish).
60. Type of tube base.
61. Direction (abbr.).
63. Not "max.".
64. Tube socket dimension (abbr.).
65. Radio ——.
67. Discharging through air.
68. To soak through.
70. Eighth note in scale.
72. City transportation (Colloq.).
73. Electrical measuring device.
74. Concentric cable.

DOWN

1. Thin layers of metal as used in transformer.
2. Fictitious electrical counterpart.
3. Aid.
4. Outside diameter (abbr.).
5. Strategic Air Command (abbr.).
6. Part of "to be."
7. Removes AM from FM signal.
8. "Tee" hound assn. (abbr.).
9. A number of turns of wire.
10. To fluctuate in a system or circuit.
15. Resistance wire.
16. Nervous affliction.
17. Denotes weak signal on TV tube.
18. Shaded.
20. Device for measuring resistance.
24. To cut down.
27. Term used in psychoanalysis.
28. ——effect. Change in frequency due to motion.
31. Not out.
33. Amplifying system (abbr.).
36. Noise produced by defective vibrators.
37. Octal base (abbr.).
39. Root mean square (abbr.).
41. Constant.
45. Grid Voltage (abbr.).
47. ——effect. Surface current.
48. A defective filter capacitor causes it.
50. Half an em (Print.).
52. Plate in vacuum tube.
53. Fixed voltage between grid and cathode.
54. Cutting tool.
55. Not monophonic.
56. ——sideband transmission.
57. Total resistance (abbr.).
59. ——wave. One cycle on a scope.
60. Wasted energy.
62. Fasteners.
63. 1001 (Rom. Num.)
66. Pedal extremity.
67. Automatic volume control (abbr.).
69. Type of speaker (abbr.).
71. Picture tube (abbr.).





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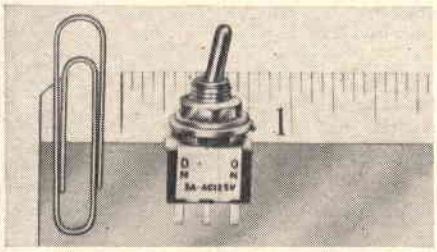
What's New in Radio

TINY TOGGLE SWITCH

ALCO Electronic Products, Inc., 3 Wolcott Ave., Lawrence, Mass. is now offering a new 5-amp toggle switch



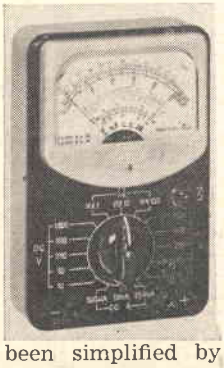
which has been specifically designed to meet the requirements of miniature circuit applications.

The new unit, which is rated at 5 amperes, 115 volts a.c., is capable of handling up to a 100% overload. In addition to its subminiature size and high rating, the life cycle ratings are over 100,000 operations; contact resistance is 30 microhms; insulation is over 100,000 megohms; while voltage breakdown is 1000 volts a.c.

The unit measures ½" x ⅜" x ¼". It is currently available in both s.p.d.t. and d.p.d.t. versions. Write the company for complete details and prices.

MULTI-TESTER KIT

Olson Radio Corporation, 260 South Forge St., Akron, Ohio is offering a 16-range multi-tester, the Model TE-139, in kit form.



The new instrument has an over-all accuracy of 3% of full scale on d.c. ranges and 5% of full scale on a.c. ranges. The circuit employs 1% shunts and multiplier resistors. Construction has been simplified by using a unique pre-mounted component layout. Only the wiring remains for the constructor.

The input resistance is 20,000 ohms-per-volt d.c. and 10,000 ohms-per-volt a.c., eliminating circuit loading under test. The a.c. and d.c voltage ranges include: 0-10, 50, 250, 500, and 1000 volts while d.c. current ranges are 0-500 μa., 0-10 ma., and 250 ma. Resistance ranges are 0-10,000 ohms, 100,000 ohms, and 1 megohm. Decibel coverage is −20 to +36 db while capacitance from 250 μμf. to .02 μf. and inductance from 0-5000 henrys is measurable.

The cabinet is in contrasting black and gray finish and measures 5¾" x 3¾" x 1⅞". The kit comes complete with test leads, battery, all parts, and a 16-page instruction manual.

WIRELESS MICROPHONE

The Audio Electronics Division of *Superscope, Inc.,* 8520 Tujunga Ave., Sun Valley, California is handling the U. S. distribution of the "Sony" Model CR-4 wireless microphone, a transistorized FM unit which operates on the 27.12 mc. band.

Designed for use by TV and radio stations, night club entertainers, private investigators, hospitals, coaching staffs, etc., the system includes a self-powered transistorized transmitter, an 8-tube FM receiver, and a dynamic lavalier microphone—plus a portable carrying case.



The range of the transmitter is between 300 and 800 feet. No FCC license is required for operation. Maximum frequency deviation is ± 10 kc. and spurious radiation is limited to 25 db or more below the unmodulated carrier. The unit operates with a 5-foot flexible antenna. The transmitter weighs 6.5 ounces and measures 2¼" x 4" x 1".

The receiver operates from any 117 volt a.c. power line and tunes the 27.12 mc. band ± 250 kc. The receiver weighs 7 pounds and measures 9¾" x 6¾" x 4½".

The microphone is a dynamic, non-directional type with a frequency response of 70 to 10,000 cps ± 3 db. It weighs 7 ounces and measures 2¼" x 4" x 1".

A data sheet giving complete specifications is available.

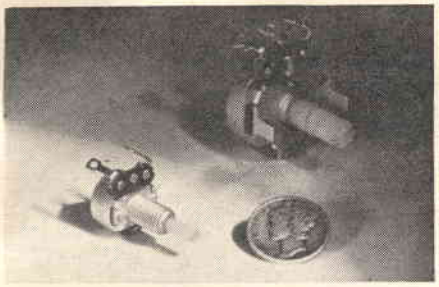
HALF-INCH CONTROLS

P. R. Mallory & Co. Inc., 3029 E. Washington St., Indianapolis 6, Ind. has introduced a conventional-type carbon control which is only ½-inch in diameter but offers the performance characteristics and features of its larger counterparts.

The control can be supplied with a full-rated switch for 2 ampere, 125-volt a.c. service, using a floating contact ring of the same size and design employed in the company's larger

switches for minimum contact resistance.

Either a nylon or steel shaft can be



supplied with the control, which is designated Type MLC. Initial applications of this new miniature control are expected to be in miniature table and clock radios, portable TV receivers, portable dictating equipment, hi-fi amplifiers, and in test instruments.

Write the manufacturer direct for any additional information on this component required.

KAY-TOWNES CB UNIT

Kay-Townes Antenna Company, 1511 Dean Ave., Rome, Ga. is now offering a Citizens Band unit as its Model No. BS-27.

This two-way unit incorporates a printed circuit, ½" diameter "Hi-Q" coils, r.f. power meter, and fused plate supply for circuit protection.

Three different types of units are currently available: the 117-volt a.c. model, a 6-volt d.c., and a 12-volt d.c. version. The set uses four tubes and the receiver is superregenerative with one stage of amplification. Tuning range of the receiver is the Citizens Band plus the 10-meter amateur radio band.

The output impedance is 52 ohms. The ceramic microphone is equipped with a push-to-talk switch and is suitable for desk or mobile applications.

The unit comes complete with a matching antenna plug while the mobile version is offered with a mounting bracket for dashboard installation.

The cabinet is finished in blue crinkle with a light blue panel. Dimensions are 7¼" deep, 8¼" wide, and 5½" high. The unit weighs 9½ lbs.

TRANSISTORIZED DF KIT

The Heath Company, Benton Harbor, Mich. has added a three-band,



transistorized direction finder to its line of "build-it-yourself" kits.

The Model DF-3 tunes the marine and aircraft band, the marine tele-

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6 MFD	600 VDC .85	2 MFD	3000 VDC 3.50
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3x8 (24 MFD)		4 MFD	4000 " 12.95
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16,000 ohm in dual 8,000 ohm coils. SPDT adjustable silver contacts and armature tension. Operates on 500 Microamperes or less.....Ea. **$3.95**
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24V. AC 4PDT.....ea. **$1.85**
110V. AC 3PDT.....Ea. **$1.85**
ALLIED 110V. AC 4PDT.....Ea. **$2.75**
Potter-Brumfield SM5LS 5000 ohm, 4 Ma. Sens.....Ea. **$2.25**
Allied Relay 110 V. AC. DPST.....ea. **$1.35**
Hermetically Sealed Relay Coil 110V AC 60 cy SPDT Contacts 5 Amps.....ea. **$1.50**
6 Volt DC DPDT H.S.....ea. **99c**
12 Volt DPDT DC Relay.....ea. **$1.35**
SIGMA type 22RJC 8,000 ohm SPDT, small sealed relay..... **$2.49**
Sealed Relay. SPDT, 6,000 ohm coil..... **$1.95**
G.E. Relay control, contains 8000 ohm relay, sensitivity 2 mils. 10 for $9.25. ea. **$1.10**
LEACH ANT. RELAY 110V. AC DPDT Ceramic Ins.....ea. **$3.45**

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STANDARD BRANDS
1½" METERS
0-1 Mil.....2.95
0-100 Micro.....3.95
2" METERS
0-50 Micro (0-5 scale).....4.95
0-10 Amps DC....2.95
0-20 Volts DC....2.95
18-36 Volts DC...1.99
0-150 V. AC.....3.49
0-3 Amps RF....2.95
3" METERS
100-0-100 Micro Amps DC.....5.95
0-150 Mil DC.....3.95
0-12 Volts AC....3.95
0-15 Volts AC....3.95

MISCELLANEOUS SPECIALS

SPERTI Vacuum Switch used in ART13 ea. $1.50
36 OHM 50 Watt Globar Non-Ind. Res.....60c ea. 2 for $1.00
3-12 MMF Erie Ceramic Trimmers.....21¢
Murdock Headphones—BRAND NEW 10,000 ohm imped. with std. phone plug.....ea. $2.95
Replacement 6' phone cord for Standard Headsets.....35¢
CUTLER-HAMMER TOGGLE SWITCH SPDT (ST42D) 4 for $1.00.....ea. **29c**
WILLARD STORAGE CELL—2V. 28 Amp hrs. Clear plastic case. Shipped dry..ea. **$2.50**
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phone band, and standard broadcast band with unusual selectivity, sensitivity, and tone quality. The 9-transistor circuit operates from six long-life standard flashlight cells.

Accurate fixes are assured by a balanced loop rotating antenna and a collapsible whip "sense" antenna which eliminates 180-degree ambiguity. The assembly of the kit is simplified by means of the pre-assembled and pre-aligned tuning section.

RECTIFIER CHECKER

Sencore of Addison, Illinois has re-released another time-saving test instrument for service technicians—the RS106 rectifier trouble shooter.

According to the company, this unit acts as a substitution box for checking suspected rectifiers and diodes. The instrument provides a positive check, eliminating guesswork as to whether



or not the component should be replaced. The RS106 provides instant direct substitution for selenium rectifier types used in radio, TV, and electronic circuits up to 500 ma.; silicon rectifiers, single diodes (with the exception of some high-frequency units); dual diodes, etc.

Write the manufacturer direct for additional details and price information.

U. S. L.'S "RADIO-PHONE"

United Scientific Laboratories, Inc., 35-15 37th Avenue, Long Island City 1, N. Y. has entered the CB market with



a low-cost superhet transceiver which is being offered as the Model TR-800 "Radio-Phone."

The circuit features five transmitting channels; 22-channel, vernier-tuned reception; 3 watts audio output; input power to the transmitter of 5 watts of fully plate-modulated power; and a power pack for 6- or 12-volt mobile use. The transmitting channels may be changed through a removable panel located on the front of the unit.

The transceiver is supplied fully assembled complete with one crystal and a microphone. It measures 10¼" wide, 6½" deep, and 5⅝" high. Full details, including price, are available from the manufacturer on request.

LOW-COST ULTRASONIC UNIT

Ultrasonic Industries, Inc., Albertson, New York is currently in production on its System Forty "diSONtegrator," an ultrasonic cleaning unit which is priced under one-hundred dollars.



The System Forty is a full half-gallon capacity model which will disintegrate more than fifty distinct classes of soils and contaminants from a wide variety of products ranging from surgical instruments to delicate electronic components. The device includes a 40-watt generator with an output of 90,000 cps and a cleaning tank with a cleaning compartment measuring 5¾" long, 5¼" wide, and 4" deep. The tank is of heavy gauge stainless steel with rounded corners. It is finished with a 4A grade high polish to avoid soil entrapment, thereby insuring surgical cleanliness.

The unit operates by means of a single push-pull control knob from any convenient source of 117 volts, 50/60 cycle a.c.

NEW TV TUBE TYPES

The Distributor Products Division of *Raytheon Company*, Westwood, Mass. has added ten new receiving tubes to its replacement line.

Three of the new tubes are half-wave rectifiers. The 6DE4 and the 17DE4 are both octal based and are used in television damper applications. The 50DC4 is a seven-pin miniature rectifier for use in intercoms and small audio amplifiers.

The 6DQ6B is an improved version of the 6DQ6 and the 6DQ6A and can be used in place of either. The seven-pin duo-diode-triode, the 12EL6, is designed to be used as a detector in radio receivers.

The other new offerings are nine-pin miniatures: the 5BW8, 6EU8, 6GH8, 6GK6, and 6DT8.

Complete specifications on these new replacement tubes are available from Glen Foster at the company address.

FRAME-GRID ECC88'S

CBS Electronics is now offering the ECC88/6DJ8 high-gain twin triode with true frame-grid construction for high reliability applications in instrumentation, industrial controls, nuclear electronics, communications and broadcast equipment, and TV tuners.

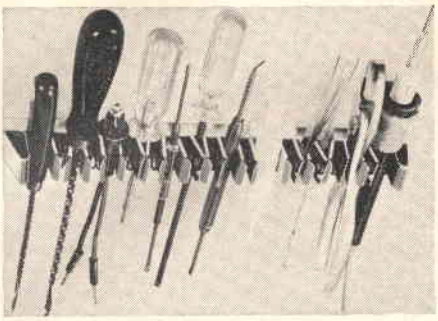
The new tube provides high transconductance, high input impedance,

low noise figure, and uniform characteristics, according to the company. The superior mechanical strength of the grid is supplied by a welded molybdenum frame while the excellent electrical characteristics are the result of the tightly wound, precisely positioned fine tungsten wire comprising the grid.

Complete technical data on this new tube is available from the company's Information Services at 100 Endicott Street, Danvers, Mass. Ask for Bulletin E-369.

SHOP "TOOL KADDY"

G-C Electronics Co., 400 S. Wyman St., Rockford, Illinois is now offering a unique "Tool Kaddy" which has been designed especially for the technician group.



Intended as an aid to eliminating the clutter around the workbench, the unit will hold tools of all sizes and types from hammers and soldering irons to tweezers and probes. A snap-in, snap-out feature provides the easily mounted holder with this unusual versatility. Additional details on this unit will be supplied by the company on request. —30—

ALL-AM STEREO SYSTEM TRIED

A COMPLETELY AM stereo system is being tried out by CJAD; Montreal; XEW, Mexico City; and Radio Rumbos and Radio Continente in Caracas, Venezuela. The system, developed by Kahn Research Laboratories, Freeport, N. Y., transmits the two stereo channels on the two sidebands of the AM signal. A special transmitter adapter is required to produce the broadcast signal.

In order to receive the transmission, two ordinary AM broadcast receivers are used. One of these is tuned to the upper sideband and the other is tuned to the lower sideband. When only a single broadcast set is used and this is tuned directly to the carrier, both sidebands add to produce a compatible monophonic signal. For further details, see "SSB Broadcasts Promise Hi-Fi" in the August 1957 issue of this publication (page 127). —30—

DISTRIBUTION SEMINAR

CBS Electronics is sponsoring an intensive five-day industrial management seminar for distributors of CBS tubes. The course will be given at Clarkson College of Technology in Potsdam, New York, from June 12 to 17th.

Distributors who meet the requirements will be invited to attend and to send their key personnel to the course.

The company will provide transportation to and from the campus, pre-paid tuition, meals, and dormitory facilities, as well as all study materials needed for the course. At the close of the seminar a certificate of achievement will be awarded to those successfully completing their studies.

Details on the seminar are available from the tube division at Danvers, Mass. —30—

FIRST ARMY MARS SCHEDULE FOR APRIL

THE First U.S. Army MARS SSB Technical Net has announced the following program schedule for April over 4040 kc. upper sideband, Wednesday evenings at 9 p.m. (New York time):

April 6—"Filter Design and Applications" by James L. Prather, Instructor, Radio Division, USASCS, Fort Monmouth, New Jersey.

April 13—"New Semiconductors for High Frequency Circuits" by W. A. McCarthy, Chief Applications Engineer, Semiconductor Division, Raytheon Co., Boston.

April 20—"Modern Trends in Electronic Instrumentation" by Walter A. Knoop, Jr., Gawler-Knoop Co., Roselle, New Jersey.

April 27—"TACAN and Similar Aircraft Navigation Systems" by William Loebel, Project Engr., Olympic Radio & TV Div., Siegler Corp., Long Island City, New York. —30—



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8" p.m. 45-13,500 cps.	$24.95	$ 9.95
12" p.m. 37-13,500 cps.	$34.95	$14.95
STEPHENS MID-RANGE HORNS & TWEETERS		
214, Super Tweeter 8-multicellular horn. Compl. 3,500-22,000 cps.	$37.50	$25.95
814, 4-multicellular, 800-16,000 cps. W/216 driver	$94.00	$55.00
824H, 8-multicellular horn compl. w/216 driver. Range 800-16,000 cps.	$110.00	$69.00
825H, 10-multicellular horn w/P30 driver, 800 to 18,000 cps.	$164.00	$95.00
826H, 12 multicellular horn w/P30 driver, 800 cycle	$170.00	$99.00
625H, 10-multicellular horn w/P30 driver. 600-18,000 cps.	$190.00	$115.00
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600X, 600 cycles, 16 ohms	$49.50	$33.00
800X, 800 cycles, 16 ohms	$33.00	$22.00

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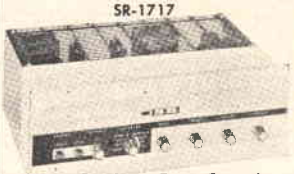
SR-1717



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☐ **60 Terminal Strips** Solder lug type; .1 to 10 lugs. Used in elec. proj. $1

☐ **60 COILS & CHOKES** RF, ant, osc, slug-tuned & IF, 15 types. Reg. $22. $1

☐ **70 ONE WATTERS** Resistors incl 1 & 5% carbons. 20 pop' 1'r vals. Reg. $18. $1

☐ **40 TUBE SOCKETS** 4-9-pins. Octals, mini types. Some shield, mica, cer. $1

☐ **4 OUTPUT XFMRS** 50L6, 6K6, etc. Open frame types. Some worth $2.50 ea. $1

☐ **2 Silicon Rectifiers** 500 mil. Axial leads. Size of 1w resistor. Reg. $5. $1

☐ **2 Power Transistors** 10 watts. For audio circuits in cars, etc. Reg. $10. $1

☐ **3 Ferri Loopsticks** New! Adj broadcast band for transistor radios. $3 val. $1

☐ **8 Sil. & Xtal Diodes** Inc: 1N21, 1N128, 1N82, etc. Some worth $5. "C-thru" pak. $1

☐ **100 HALF WATTERS** Carbon resistors. 30 values. 10% too. $1

☐ **15 Lucite Carryalls** Snap top box types to 4" sq. For all parts. $1

☐ **Hearing Aid Phone** Crystal. With cord & plug. Use as mike too. $1

☐ **30 DISC COND'SERS** 15mmf to .01mf. 15 vals. Submini types too. $1

☐ **10 ELECTROS — $15** Val. FP & twist, tub, rect. Multiples too. 8-500mf to 450 V. $1

☐ **"Giant" Sun Battery** Worth $6. 1½" dia. Uses sunrays & AC lite energy. $1

☐ **40 Printed Cir. Parts** Boards, pulse xfmr, cond, sockets, res, chokes. Reg. $15. $1

☐ **6 ROLLS VINYL TAPE** In handy pak. 1000 uses. Strong adhesive; reg. 50¢ roll. $1

☐ **2 PNP TRANSISTORS** Mini types. Similar to CK-722. 2N107. $1

☐ **2 NPN TRANSISTORS** Worth $3 ea. Useful in 100's of hobby projects. $1

☐ **500 & 65 Mil Rect'f'rs** Inc. most pop. units for transistor & 110 AC-DC work. $1

☐ **30 Power Resistors** Vitreous, enamel, porc, etc. 10-50W to 10,000 ohms. $1

☐ **60 Insulated Res't'rs** ½, 1, 2W. Finest carbons made. 1 & 5% too. 30 vals. $1

☐ **10 PANEL SWITCHES** Sensitive, rotary, toggle, power, slide, micro. Reg. $5. $1

☐ **40 One Percent-ers** Resistors: prec carbofilm, ½, 1, 2W. Reg. $30. $1

☐ **125 FT. MICRO-WIRE** For submini work. #24 to 32. Incl. tinned stranded. $1

☐ **8 RCA Plug 'N' Jack Sets** Matched pairs. For tuners, amps, recorders. $1

☐ **60 Condenser Spec.** Moldeds, mica, ceramic, oil, paper, discs. $15 value. $1

☐ **11-Pc. Nutdriver Set** 8 sizes: 3/16 thru 7/16. Lucite handle; ratchet. $1

☐ **1" Sq. Crystal Mike** 100 to 7000 cps. Sensitive. For hide-away, etc. $1

☐ **6 Transistor Sockets** With mtg brackets. For PNP's, NPN's & submini tubes. $1

☐ **20 Panel Pilot Lites** Mini bay & screw types; wide asst. Neon too. $1

☐ **$25 TRANSF. SPEC.** Handy asst for hobbyists, repairmen. $1

☐ **65 RESISTOR SPEC.** W.W., carbon, precision, vari., 10 to 50W. $1

☐ **$20 CONTROL PAK** Some w/switch, carbon & W.W.; for volume, 10 types. $1

☐ **20 TWIST DRILL SET** In calibrated case; 1/16 thru ¼". Elec drills. $1

☐ **60 Porcelain Conds** 15mmf to .01mf. 25 vals. Hi-Q, NPO's, discs too. $1

☐ **60 MICA COND'S'RS** Silvers & 1%. 20 vals. .00025 to .01mf to 1000VDC. $1

☐ **60 SUBMINI CONDS.** Paper tubulars; long leads. ½" x ⅛" asst. $1

☐ **$30 ELECTRO PAK** 10mf to 1000mf & 450V. Duals & triples too. 10 vals. $1

☐ **$25 SURPRISE PAK** Wide variety of radio'n popular electronic parts. $1

☐ **70 Tubular Cond'rs** 20 values .0001 to .5mfd to 1000 VDC. Reg. $10. $1

☐ **30 "SILVER" MICAS** 1 & 5%. Asst. values. Finest made. $1

☐ **300-Ft. Hook-Up Wire** 16 thru 24. Glass, plastic insul.; colors, tinned. $1

☐ **60 RADIO-TV KNOBS** Colored, set screw types too! ½" to 4". Some $1. $1

☐ **1500 Pcs. Hardware** Nuts, bolts, brackets, screws, etc. in shop pack. $1

☐ **3 Hobby Transistors** For experiments, shop use. Specs unknown. Worth $3 ea. $1

☐ **12 Germanium Diodes** For radio & TV. Glass sealed, long leads. $1

☐ **30 "Sealed" Circuits** Built-in resistor coupling networks. Reg. $20. $1

☐ **30 Molded Cond'n'rs** .0001 to .1 to 1000 VDC. Oils, porc; reg. $30. $1

☐ **15 "Grain-O-Wheat"** Lamps: by GE. 1.5 VDC; mini work. Worth 25¢ ea. $1

☐ **35 TWO WATTERS** 10 radio-TV val, 100 ohms to 500K. 5% too. Reg. $8. $1

☐ **8 ATOMIC LIGHTS** Glow-in-dark; place anywhere. No wires; self-charge. $1

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☐ **10-IN-1 PAKETTE** Diodes, resistors, electros, sockets, lites, wire, pots, knobs, strips, condensers. $1

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Electronics 20 Years Ago

(*Continued from page 41*)

of enlistment in the Signal Corps for those who wanted to train for the future. We wonder how many people reading these words got their starts in that way? Seers were writing and talking about the great future for "industrial electronics"—much as they do today.

The ham had been an active and enthusiastic contributor to the field for many years. At that time, however, his hobby was much less costly. He was told how, as a beginner, he could assemble an impressively complete ham shack for less than $50. However, what with all the interest, the airways were becoming a little crowded, and he was being urged to move up into spectrum space that was getting relatively little use. "Let's Try 112 Mc." urged one author, extolling the virtues of 2.5 meters. For "very-ultra-short-wave reception," there was one unit that would take him up to 1 meter (300 mc.). And there's no point in showing you any pictures of what amateur equipment looked like "in those old days." You might mistake this article for one about a new item. So what's new?

Yes, We Had Television

If you really want something new, you had better stick to transistors, although experimentation with semiconductor materials and properties was well under way. If you expect to thumb your nose across the time gap because you now happen to own a TV set, you're in trouble. Of course, the nation was not smothering under a pile of 50 million sets in use, but there was enough interest for this magazine to run under its title on the contents page "Including Articles on Popular Television." The editors weren't fooling, either. The regular monthly feature, "The Video Reporter," had plenty of meat in it each month; there was a series on basic television; and there were many reports on new developments.

Early fans were already snickering at the excessive conservatism of broadcast executives who, adhering to the principle that over-the-horizon reception was not practical, were not promising good reception more than fifty miles away. Excellent results were being obtained up to a hundred miles away, and set salesmen in New York City were beginning to probe the upstate resort areas that far out. No summer hotel, they were insisting, could afford to lose its customers to nearby competitors who were putting in video receivers. In fact, two stations sharing the same channel (50 to 56 mc.), located in New York and Philadelphia, had to work out a time sharing agreement, to avoid the growing problem of co-channel interference.

A video broadcast had been picked up successfully in an airplane, and "re-

AN/ART-13 100-WATT TRANSMITTER

(Government original cost $1,000.00)

Designed to provide radio communication by voice, (MCW) or CW telegraphy. Class "B" audio modulator system capable of modulating the carrier at least 90% on voice or MCW. Incorporates automatic tuning mechanism which may be used to select any one of 11 frequencies, range 2000 KC to 18,000 KC. Frequencies 200 KC to 1500 KC range is provided by addition of oscillator 0-16/ART-13-A. Shipping weight 90 pounds.

With Tubes and Meters—Condition Fair **$29.50**

Less Meters and Tubes—(for spare parts only) $10.00
0-16 Low Frequency Oscillator ..... $ 5.95

AN/ART-13-T47 with Tubes and Meters. Condition Good **$39.50**

T47 with Tubes and Meters. Condition Excellent **$49.50**

BC-603 FM RECEIVER—20-27.9 MC
Unused $12.95
With 6 Spare Tubes 14.95

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With 3 Extra Tubes 4.95

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DM-35 DYNAMOTOR — Input 12 volts. Output 625 volts, 225 MA.
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TWO 3" GALVANOMETERS—Test Leads, Multiplier Switch in hinged carrying case. BRAND NEW—G.E. Servo Testmeter .. $9.95
X-BAND POWER LEVEL TEST SET, TS-36/AP. BRAND NEW, in original packing, with accessories. Measures 10 to 30 dbm, 8700-9500 mc. Acq. cost $477.00 ..... ONLY $59.50
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mote" broadcasts were coming right along: a pickup of a prize fight from Madison Square Garden came through with studio quality. *Du Mont* had just come up with a screen phosphor of improved persistence, which successfully eliminated flickering in the picture. Speculation began that this would permit increasing the number of scanning lines in the raster above the then popular 441 lines to improve definition. This same manufacturer also introduced a giant picture tube with a 20-inch diameter. However, TV was still "an engineering achievement and a commercial enigma." The public just wasn't going for it as well as expected, and no one knew why. We now know that the acceptance finally came. (Are you listening, color advocates?)

Test Equipment

If you were in "radio service," you probably did not own an oscilloscope—but you could have. It might have used a 2-inch CR tube, like the bench job in Fig. 4. It had a minimum complement of five tubes and its bandpass wouldn't take your breath away, but it worked.

However, the v.t.v.m. was being promoted heavily. Yours probably didn't even use a bridge circuit, but it did use the high input impedance of a one-tube d.c. amplifier to prevent circuit loading. "Up to 2 megohms per volt input resistance!" advertisers were correctly claiming. To make a real impression, your v.t.v.m. had to be big, like the unit in Fig. 2 (13½ inches high). Was there room on the bench for much else? You could have that model for under $18.

You could have an r.f.—a.f. signal generator for about $13, but for $35 a deluxe unit would give you up to 30 mc. on fundamentals with high output and take you right up to the u.h.f. band on 6th harmonics. Tube checkers (mostly emission types) went for $12 and $17. They would test all types including loctals, 117-volt tubes, and the new single-ended (no grid caps) types. A transconductance tester went for less than $50.

Tubes, incidentally, were getting to be a problem. "Are there too many tube types?" asked one authority. He thought the unnecessary duplication was creating inventory problems for service shops, and that the available number could profitably be reduced without much loss of flexibility!

Service problems included tube mark-ups (would reducing them help or hurt business?), service fees (flat-rate or hourly?), factory service (one manufacturer would fix any radios of his own make for $1), the unskilled newcomer, and the customer who wanted something for nothing. You were also being told not to knock your competitor.

Yes, much has changed in electronics since 1940—in size and scope, if in little else. We can't even find an original phrase for summing up those twenty years. Let's settle for, "The more things change, the more they remain the same." —30—

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NEW CRT 440





TESTS AND REJUVENATES all black & white and color picture tubes at correct filament voltage from 1 to 12 V.

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Model C40 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates TV color picture tubes and 6.3 volt 110° picture tubes. Net, $9.95

Model CR48 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates 110° picture tubes with 2.34, 2.68, and 8.4 volt filaments. Net, $4.95

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0A2	.80	6BJ6	.69	12AT6	.59	1851	1.00
0B2	.65	6BK7	.99	12AT7	.84	117Z6	1.10
OC3	.69	6BL7	1.25	12AU6	.69	4-65A	16.00
OD3	.35	6BN6	.98	12AU7	.69	2D21	2/$1
OZ4	.59	6BQ6	1.19	12AX7	.79	3D23	3.85
1A7	.89	6BZ7	1.25	12BA6	.65	717A	5/$1
1B3	.78	6C4	.43	12BA7	.99	4-125	29.00
1R5	.78	6C5	.69	12BD6	.59	4-250	35.00
1S4	.78	6C86	.80	12BE6	.59	4E27	7.00
1T4	.78	6CD6	1.49	12BF6	.59	4PR60	29.50
Send 25c for Catalog!							
1U4	3/$1	6H6	3/$1	12BH7	.99	4X150G	15.00
1U5	.73	6J5	.52	12BY7	.98	4X250	35.00
1X2A	.68	6J6	.48	12BZ7	.99	4X500	38.00
3Q4	.68	6K6	.59	12CU6	1.45	5BP1	4.98
3Q5	.86	6K7	.74	12SA7	.94	5BP4	4.98
3S4	.68	6L6	1.19	12SG7	.89	35T	4.00
3V4	.83	6S4	.59	12SH7	.89	100T	7.00
5R4	.98	6S8	.99	12SJ7	.75	316A	5/$1
5U4	.59	6SA7	.69	12SK7	.94	388A	3/$1
5V4	.89	6SB7	1.19	12SQ7	.84	416B	16.00
Wanted Surplus Electronics from schools & U							
5Y3	.59	6SC7	.89	19BG6	2.15	450T	42.00
6AB4	.59	6SG7	.79	19T8	1.16	807	1.00
6AC7	.70	6SH7	.69	25BQ6	1.39	809	3.00
6AG7	.89	6SJ7	.69	25L6	.69	811	4.40
6AH6	.99	6SK7	.72	25W4	.77	812	3.00
6AK5	.69	6SL7	.89	25Z5	.63	813	9.00
6AL5	2/$1	6SN7	2/$1	25Z6	.75	814	3.45
6AG5	.63	6SQ7	.74	EL34	3.49	815	2.75
6AS7	3.00	6SR7	.79	EL37	2.49	826	.59
6AT6	.49	6T8	.98	35L6	.69	829B	8.00
Wanted 304TL tubes! Top $$$ Paid							
6AU4	1.10	6U8	.98	35W4	.49	832A	7.00
6AU5	1.19	6V6GT	.70	35Y4	.69	866A	2.75
6AU6	.69	6W4	.79	35Z5	.63	1625	5/$1
6AX4	.79	6W6	.89	50A5	.69	6146	4.00
6BA6	.59	6X4	2/$1	50B5	.69	5879	.98
6BA7	1.00	6X5	.49	50C5	.69	5881	2.70
6BD6	.69	6Y6	.97	50L6	.69	6550	3.90
6BE6	.59	7N7	.89	KT66	3.29	5654	1.00
6BG6	1.50	12AL5	.59	75	.89	5894	12.00
6BH6	.72	12AQ5	.75	80	.59	7193	10/$1

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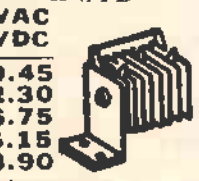
10AMP	6.10	12.15	26.30	48.90



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Kit 65 Tubular Cond'sers
Kit 500 Lugs & Eyelets
Kit 10 Bathtub Oil Cond's
Kit 5 lbs. Surprise Pckg.
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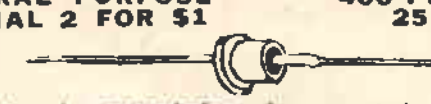

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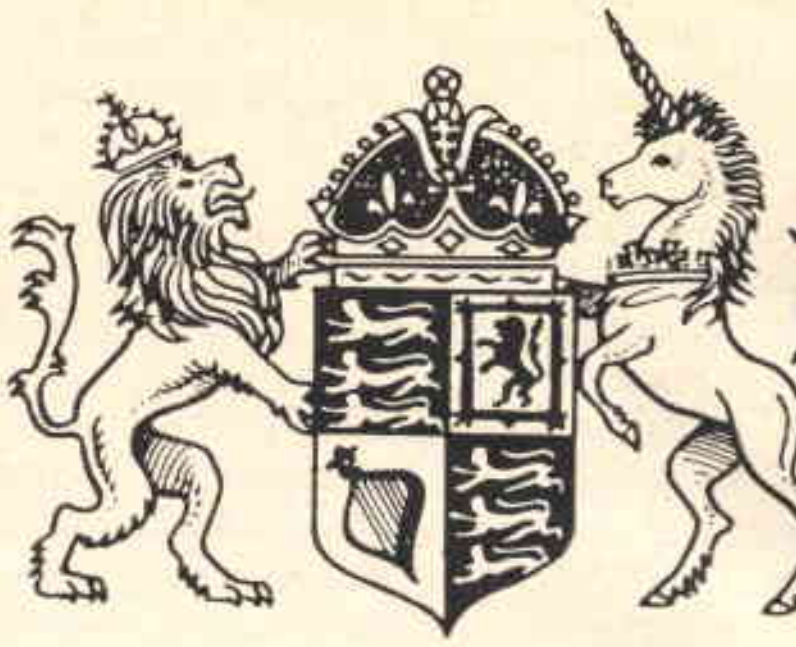
British Radio & TV Market



By **PATRICK HALLIDAY**

With easing of dollar import restrictions by British government, these facts and figures from London on Britain's trade practices should be of great interest.

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British TV Booming

British viewers are spending some $465,000,000 annually on upward of 2½-million television receivers—the highest peak since the world's first high-definition television service opened in London in 1936. Not only import restrictions but also the unique nature of the UK transmission standards (405 lines, positive "peak white" video modulation, and AM sound) have helped keep this a 100% domestic market. Within the British industry, however, extremely keen competition exists with seven brand names (*Bush, Ekco, Ferguson, Murphy, Philips, Pye,* and *Sobell*) taking a 55% cut of the market with 15 to 20 other brands sharing the remaining 45%. Several firms, such as *Philips,* have close overseas ties but manufacture in England. Recently, the fierce competition has led to a number of mergers to concentrate manufacturing into larger units, with several of the principal organizations now controlling three or more brand names.

By far the most popular screen size in British sets is 17 inches, accounting for 90% of all sales. Although many 21-inch and a few 24-inch models have been available for some years, there has been no swing by the public toward them. This is partly because the average size of rooms in Britain is small, partly because the "lininess" of a picture having 377 horizontal lines (the equivalent of 28 lines are used for sync pulses) becomes noticeable with the larger screens, and partly because of the high cost of picture-tube replacement. However, with the recent removal of the government "purchase tax" on replacement picture tubes, their cost has fallen dramatically. For instance, a new top-grade 17-inch electrostatically focused tube which in 1958 cost about $57 now bears a price tag of $31. Rebuilt tubes are also readily available.

The average 17-inch table model receiver costs around $190 (of which $47 goes to the tax collector), has 15 to 17 tubes, fits a 90- or 110-degree deflection tube, has a vertically mounted chassis, usually with one or more printed-wiring panels (but a few firms still hold out for conventional wiring), and can receive on 5 channels in Band I (41-68 mc.) plus 8 channels in Band III (174-216 mc.) although, to date, only two programs are available in any given location.

For some years, no double-wound power transformers have been used so that the chassis, of the a.c.-d.c. type, is always connected to the power line. With the usual power line voltage of 200 to 240 volts (used for almost all British domestic lighting and appliances) manufacturers take great pains to insure user-safety, working in most instances to a rigid code of safety recommendations (BS415) issued by the British Standards Institution.

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The world over, the average user just hates to pay repair charges. In the UK this dislike, combined with the operation of the government purchase tax and the application during 1957-58 of a severe credit "squeeze," has encouraged many viewers to rent receivers. These are hired on a "free maintenance" basis, either from local radio shops or from the large rental and relay firms which are still growing and some of which operate "piped" television in the larger towns. The average charge for renting is around one dollar a week. Many of the smaller dealers view with concern the spread of

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Kit 10 Xmttr Mica Condsr.
Kit 3 Phone/Patch Xfmrs
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British Radio & TV Market



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For some years, no double-wound power transformers have been used so that the chassis, of the a.c.-d.c. type, is always connected to the power line. With the usual power line voltage of 200 to 240 volts (used for almost all British domestic lighting and appliances) manufacturers take great pains to insure user-safety, working in most instances to a rigid code of safety recommendations (BS415) issued by the British Standards Institution.

Compact transportable receivers, with 14-inch and 17-inch screens, are popular but the only model (9 inch) intended for direct operation from automobile batteries has now disappeared from the home market. Completely transistorized sets—one incorporating an ingenious *Mullard* magnetic "scan magnification" system—have been demonstrated but not marketed.

The world over, the average user just hates to pay repair charges. In the UK this dislike, combined with the operation of the government purchase tax and the application during 1957-58 of a severe credit "squeeze," has encouraged many viewers to rent receivers. These are hired on a "free maintenance" basis, either from local radio shops or from the large rental and relay firms which are still growing and some of which operate "piped" television in the larger towns. The average charge for renting is around one dollar a week. Many of the smaller dealers view with concern the spread of

rental business, as it ties up considerable capital and produces the gnawing fear that a sudden rush of contract terminations could land a lot of unsalable used sets back in the shop.

The Radio Setup

The 100% share of the television market by British firms has never extended to the sound radio field. Before World War II, American receivers were imported in considerable numbers while more recently models from the European countries (mainly West Germany) are regularly seen in British shops despite import tariffs. Small transistor portables from Japan are also on sale.

One factor which has always inhibited transatlantic imports (apart from the 200-240 power line voltages) is the European long-wave allocation of 1053-2000 meters (150-285 kc.). This band is particularly important in the UK with many areas dependent on the 400 kilowatt Droitwich transmitter on 200 kc. for the reception of the *BBC* "light program" service.

Since the introduction of the v.h.f. frequency modulated transmissions in the so-called "Band II" (87.5-100 mc.), a number of manufacturers are dropping the long-wave band from combination AM-FM receivers. The British FM standards are 75 kc. deviation, 50 microseconds pre-emphasis. Despite the far better v.h.f. service now available in most areas of the UK, there has been no rush to change over from AM-only sets. The chaotic conditions of the 525-1605 kc. "medium-wave band" in Europe—especially after dark—have to be heard to be believed. The official 9 kc. separation between stations is honored mainly in the breach. Primary —but not only—cause is the East-West propaganda war.

Some typical radio prices are: AM-FM table receiver $70 (including $17 tax); small AM table receiver for a.c.-d.c. operation $40 (tax $9.50); AM battery portable (tubes) $35 (tax $8.50); AM battery portable (transistors) $55 (tax $14).

Auto Receivers

Automobile radios have never been as popular in the UK as in the States but at last sales curves are soaring upward. With some 400,000 sets installed, annual production for the home and overseas markets now totals 250,000 units. Most current models are of the "hybrid" type with 12-volt tubes in the early stages and one or more power transistors in the output stage. Five pre-selected stations are frequently available by push-buttons as well as free tuning on medium- and long-wave broadcast bands. The cost is around $55 (including $13 tax).

Short-Waves

Although the *British Broadcasting Corporation* has maintained around-the-clock short-wave services for more than 25 years, the average Britisher seldom tunes to short-wave stations—and this despite the inclusion, for many

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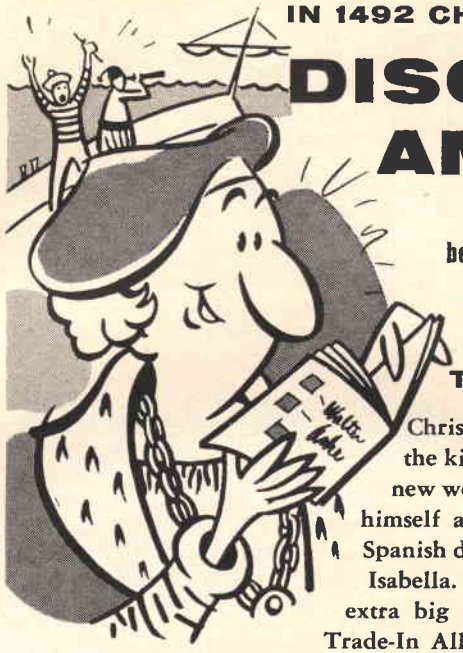

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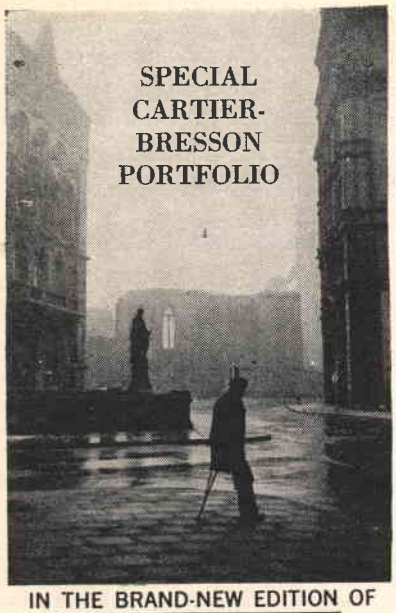

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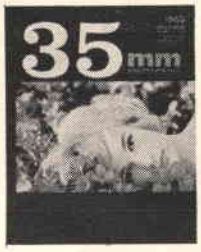

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years, of a 6-18 mc. range in almost all receivers other than the midgets. Because of the lack of interest, little attention was paid to this feature in sets intended for the UK market. As a result, reception on short-wave was generally marred by drift, image responses, and almost impossibly sharp tuning. With an almost audible sigh of relief, makers seized the opportunity provided by the introduction of the FM service to drop short-wave ranges from the majority of their models. Today almost the only regular short-wave listeners are those interested in amateur radio or DX.

Tubes

Components, in general, are cheap in the UK. Replacement tubes form a notable exception, with price levels well above those in the States. Typical first-grade tube prices in the UK are: r.f. pentode (6AM6) $2.80 (including 70 cents tax); sound output (6AQ5) $2.00 (tax 50 cents); horizontal output (50CD6) $4.25 (tax $1.00). Just before World War II, American tubes were being imported in increasing numbers but were up against differences in bases, ratings, and characteristics. Today, even when carrying a different designation, British tubes are very close to American types.

Chains vs Independents

Quite a few large chain stores—some nation-wide—are to be found in most towns and radio and television receivers are often sold by furniture stores which turn over servicing to contractors who also carry out installation work. But the independent small dealer, with his own one- or two-man service department, still figures prominently in the trade setup. Most dealers also handle domestic electrical appliances such as refrigerators and washing machines.

The rapid post-war expansion of television created an acute shortage of skilled service technicians. British rates of pay would seem low by American standards, although it should be remembered that cost-of-living figures are appreciably lower. A recently negotiated agreement between the Radio and Television Retailers' Association and the newly formed Association of Radio and Electronic Engineers provides for a minimum weekly pay check of $40 for a qualified service technician in London. A 16-year-old trainee apprentice would draw $8.50 a week during his first year.

Retail prices are normally fixed by the manufacturer and apply throughout the UK. Makers have legal rights to enforce their prices, although many would be chary of exercising them. A fair amount of disguised price cutting takes place, usually in the form of unduly favorable trade-in terms or discounts for cash payments. There are also many bargain offers on discontinued models. But, by and large, most customers pay full list prices or even—taking "hire-purchase" interest charges into account—above this figure. —30—

Electronics in a Plant

(*Continued from page* 38)

and maximum interchangeability is the objective for all equipment. Replacement in the field followed by service in the shop is the preferred technique. Experience indicates that this is more practical than attempting to undertake extensive field repairs.

Tube caddies are maintained at the shop for each type of equipment. They are always completely stocked with all the tubes and other parts, important to that particular type of equipment, that would be needed for on-the-job repairs. Most field repairs are confined to replacement of a tube or a blown fuse. If this fails to return the equipment to operation and a check of associated circuits outside the instrument itself (cables, switches, primary power, etc.) fails to locate the trouble, the spare unit is substituted and the defective unit returned to the shop. Here the equipment is given a thorough going-over and is restored to original performance standards. This unit may be returned to service or may, in turn, become the spare unit—depending on the equipment involved.

In the case of two-way radio equipment, a defective mobile unit comes direct to the repair shop. Operational cost of heavy industrial mobile equipment is high—as much as $75 per hour in the case of a diesel locomotive—so it is important to return the vehicle to operation as quickly as possible. Great care is taken in the original installation of the equipment to secure and protect all cabling and associated control units—seldom is this part of the installation subject to failure. As with other equipment, repairs are normally not attempted on the vehicle. Instead, a spare unit is used to replace the defective one and, after an on-the-air check with the dispatcher, the vehicle is placed back in service. This usually takes less than five minutes.

The defective unit goes on the repair bench at once and is given a complete check, irrespective of how minor the trouble. All tubes are checked, sensitivity measurements are made on the receiver as well as frequency checks. The transmitter is checked for power input, r.f. power output, carrier frequency, and modulation deviation. In most cases, when the equipment is placed back in the spare rack, it will meet or exceed original performance specifications.

No Periodic Maintenance

One hears much talk about periodic maintenance programs for electronic systems in industrial installations. No doubt, there are cases where such programs are necessary or desirable. Nevertheless, no pre-set maintenance schedule is attempted with the firm's electronic equipment. With this equipment in use 24 hours a day, any malfunction is quickly reported and corrected when it occurs. Also, a system

of continuous monitoring quickly reveals departures from standards of performance.

Important to this monitoring are remote-control units located in the repair shop. One facility they provide is that they permit technicians to listen in on the same receivers being used by the dispatchers in the base station, as well as their transmissions. In addition, the repair shop has two receivers of its own picking up all transmissions directly.

Thus, if a base-station receiver should fail, transmissions from the mobile units will continue to come in on the off-the-air receivers, but will no longer be heard on-line from the dispatcher through the remote control. The failure of the base-station receiver is quickly recognized from this. Conversely, if the base-station transmitter should fail, messages will still be heard on the remote line but will not be heard on the off-the-air receivers in the shop. With this arrangement, a technician is often on his way to the base station before the dispatcher himself has realized that anything is wrong.

The FCC requires that transmitter carrier frequencies be within .0005% of assigned frequency. In the 150-mc. band, this means within 750 cycles. Also modulation deviation is kept within five kilocycles. While measurements on each unit are required at periods not exceeding six months, there is no excuse for off-frequency operation during the intervals. As a result, frequency and modulation monitors, kept in constant operation in the repair shop, are arranged so that they can provide off-the-air measurements of all local units. Any abnormal transmissions are quickly spotted and the defective units are ordered to the repair shop at once. The frequency-measuring equipment itself is checked frequently against WWV transmissions. Thus continuous rather than periodic maintenance is the rule.

For those who may still feel that the lack of a prescribed routine for preventive maintenance may be shortening equipment life, there is an interesting point to consider: the service group, in existence for 10 years, has seen more and more equipment added during that period; yet 30% of the equipment it maintains today has been in continuous service for the 10-year period.

The technicians involved are all salaried personnel operating as a plant service group, free to provide service anywhere within the company on request. This may involve anything from repairing a sound motion-picture projector to supplying and setting up a public-address system for a large meeting or banquet.

The company's industrial uses of electronics have grown and continue to grow rapidly. The scope of the system involved demands that the company maintain its own service department. The skilled personnel in this group have found their jobs to be challenging and rewarding. They make every effort, as part of the organization, to turn in top-notch jobs. —30—

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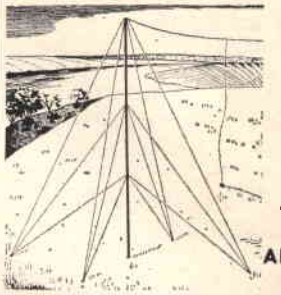

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Vocaline Company of America, 10 Coulter St., Old Saybrook, Conn. is offering a handy, pocket-size reference guide to the most commonly used "10 signals."

Designed especially for Citizens Band operators, the 2½" x 3½" pocket guide lists over 25 of the most popular signals used in CB communication. Because of the limited supply of these guides, those requesting a copy are asked to include their FCC-issued CB call letters in order to authenticate usage.

CONVERSION FACTORS

Precision Equipment Co., 4411E Ravenswood Ave., Chicago 40, Ill. has recently published a reference table in wall-chart form which it is offering without charge to engineers, shop men, technicians, and others.

Included are common conversions such as inches to centimeters, watts to horsepower, as well as many conversions that are difficult to locate in most reference manuals. For a free copy of the "Wall Chart of Conversion Factors," write the company direct at the above address.

SEMICONDUCTOR DIRECTORY

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has announced publication of the second issue of its "Semiconductor Directory."

Expanded to 36 pages, the listing provides the engineer and scientist with a comprehensive, easy-to-use listing of the lastest in diodes, tunnel diodes, rectifiers, germanium and silicon transistors, with selected semiconductor schematics for industrial circuit applications.

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A copy of Form Z-44-A is available without charge by writing *Daystrom-Weston Sales Division*, 614 Frelinghuysen Ave., Newark 12, N. J.

EIA RESISTOR STANDARD

The Engineering Department of Electronic Industries Association, 11 West 42nd St., New York 36, N. Y. has just issued a new standard covering fixed, wirewound, and precision resistors.

Designated as EIA RS-229, this new 11-page manual is available for $1.10 a copy direct from the EIA. Payment must accompany all orders.

REPLACEMENT RECTIFIERS

The Semiconductor Division of *Sarkes Tarzian, Inc.*, 415 N. College, Bloomington, Indiana has just issued a data sheet covering its "condensed" line of selenium rectifiers for replacement applications in radio and TV sets.

The data sheet lists and gives details on four rectifier types which will cover the range from 50 ma. to 500 ma., thus substantially reducing parts inventory on this item. The new types described in the folder are stock items and immediately available.

Write the company for a free copy of this "Condensed-Stack" selenium rectifier folder.

RAYTHEON HARDWARE LINE

Raytheon Company has issued a two-color, four-page catalogue sheet describing its line of control knobs, components, and panel hardware. In addition, the publication pictures knob locks, shaft locks, test jacks, subminiature fixed-contact test jacks, subminiature snap-in contact test jacks, printed circuit test jacks, etc. All items are pictured and shown in specification drawings with dimensions.

Free copies of the catalogue are available from William H. Weed, Mechanical Component Sales, Industrial Apparatus Division, *Raytheon Company*, 100 River Street, Waltham 54, Mass.

REPLACEMENT KNOBS

G-C Electronics Co., 400 S. Wyman St., Rockford, Ill. is now offering a new illustrated wall chart which is designed to make it easy to identify exact replacement knobs for the TV receivers of eight leading set makers.

The chart shows 97 different knobs and includes full information on each TV set for which they can be used. Copies of the chart, No. 1-3106, are available without charge on written request to the company.

TUBE TESTER CARD DATA

The Electron Tube Division of *Radio Corporation of America* has published a new 44-page booklet providing card-punching information for testing over 1000 receiving and industrial tube types with the company's automatic electron-tube tester.

Entitled "Card Punch Data for Your



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will make easy profits showing the TV LIFE-SAVER ® on Service calls. Sells automatically—just show it. $4.95 List. See your jobber.

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3. ***Color Codes Chart:*** Gives you coding for capacitors, resistors, transformers, resistance control tapers—all in easy-to-use form.
4. ***Bass-Reflex Design Charts:*** Complete data on building own bass-reflex enclosures for any speaker, including ducted-port enclosures.
5. ***Radio Amateur Great Circle Chart:*** For Hams and short-wave listeners—gives complete listing and map of amateur prefixes by calls and countries.
6. ***Sound:*** Fundamental data on all phases of Sound: frequency ranges, sound levels, equal loudness curves. A must for all audiophiles.

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WT-110A Automatic Electron-Tube Tester," the booklet also includes data on popular foreign types in a separate listing. The first section of the booklet contains step-by-step instructions for preparing new punched cards to test tube types not included in the file supplied with the instrument.

The booklet is currently available from the firm's test equipment distributors or the Commercial Engineering Department of the company at 415 S. Fifth Street, Harrison, N. J. The price is $1.00 per copy.

ELECTRONIC FILING

The Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. has issued a comprehensive list of references prepared for engineers and librarians under the title "Bibliography on Filing, Classification, and Indexing Systems for Engineering Offices and Libraries."

Catalogued as ESL Bibliography No. 14, this new 33-page multilithed publication carries 155 annotated references. It sells for $2.00 a copy and is available direct from the ESL.

SERVICE POSTER

Sprague Products Company, 51 Marshall St., North Adams, Mass. is offering a public relations poster which has been designed to help promote a better understanding between set owners and TV service technicians.

Captioned "Everyday is Independence Day for you and your Independent TV Service Dealer," the 17" x 22" poster carries out the theme by being printed in red, white, and blue. The poster stresses the importance of independence in TV servicing. A common-sense comparison is made between the way a typical set owner buys and the way an independent TV repair technician buys. The conclusion is that both are guided by what *they* think is best.

The posters are available free from the company's distributors or for 10 cents each from the company direct. Ask for Poster RP-22 when placing a mail order. —30—

The Veteran Wireless Operators Association has named the following officers for 1960 (from left to right): Richard C. Griffiths, Marconi International Marine Communications Co., treasurer; William C. Simon, Tropical Radio Service Corp., secretary; William J. McGonigle, Sr., New York Telephone Co., president; and Raymond F. Guy, National Broadcasting Co., vice-president.



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CALENDAR of EVENTS

APRIL 18-19

Conference on Automatic Techniques. Sponsored by PGIE, AIEE, and ASME. Sheraton-Cleveland Hotel, Cleveland, O. Program information from W. R. Thurston, General Radio Co., West Concord, Mass.

APRIL 19-21

Symposium on Active Networks and Feedback Systems. Sponsored by IRE, U. S. Army Signal Research and Development Labs, Office of Naval Research, and Air Force Office of Scientific Research. Auditorium, Engineering Societies Bldg., 33 W. 39th St., New York City. Program information and registration forms available from Microwave Research Institute, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N. Y.

APRIL 20-22

1960 SWIRECO Conference. Sponsored by Southwestern IRE and National Professional Group on Medical Electronics. Shamrock-Hilton Hotel, Houston, Texas. Program information from the Houston Section of IRE, P. O. Box 22331, Houston 27, Texas.

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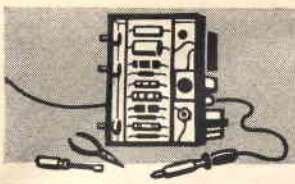

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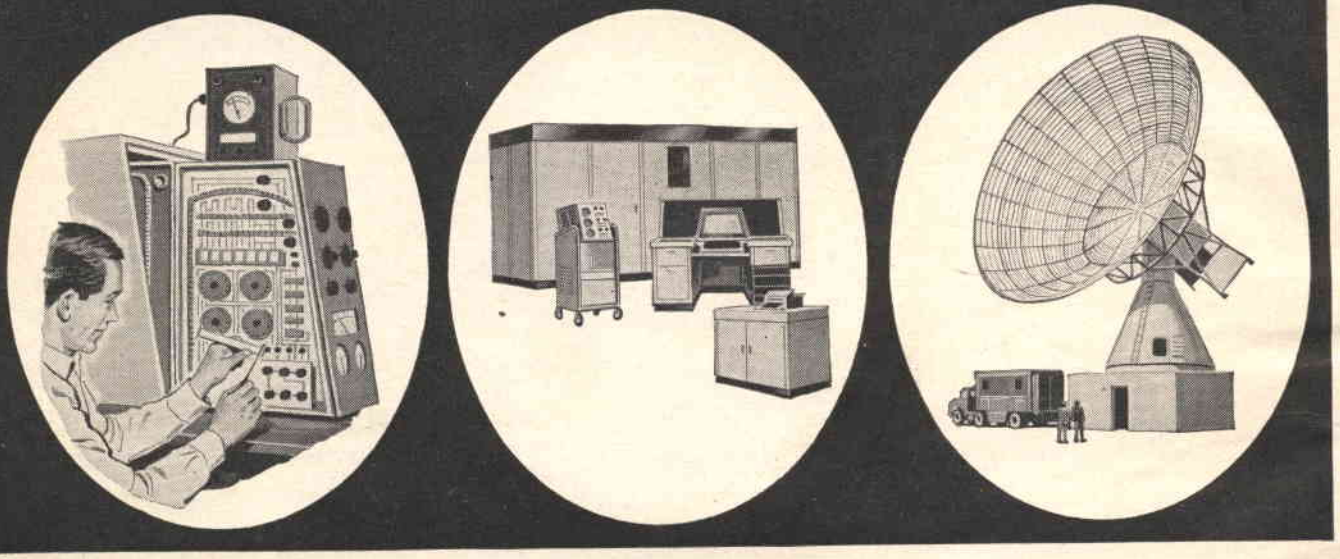

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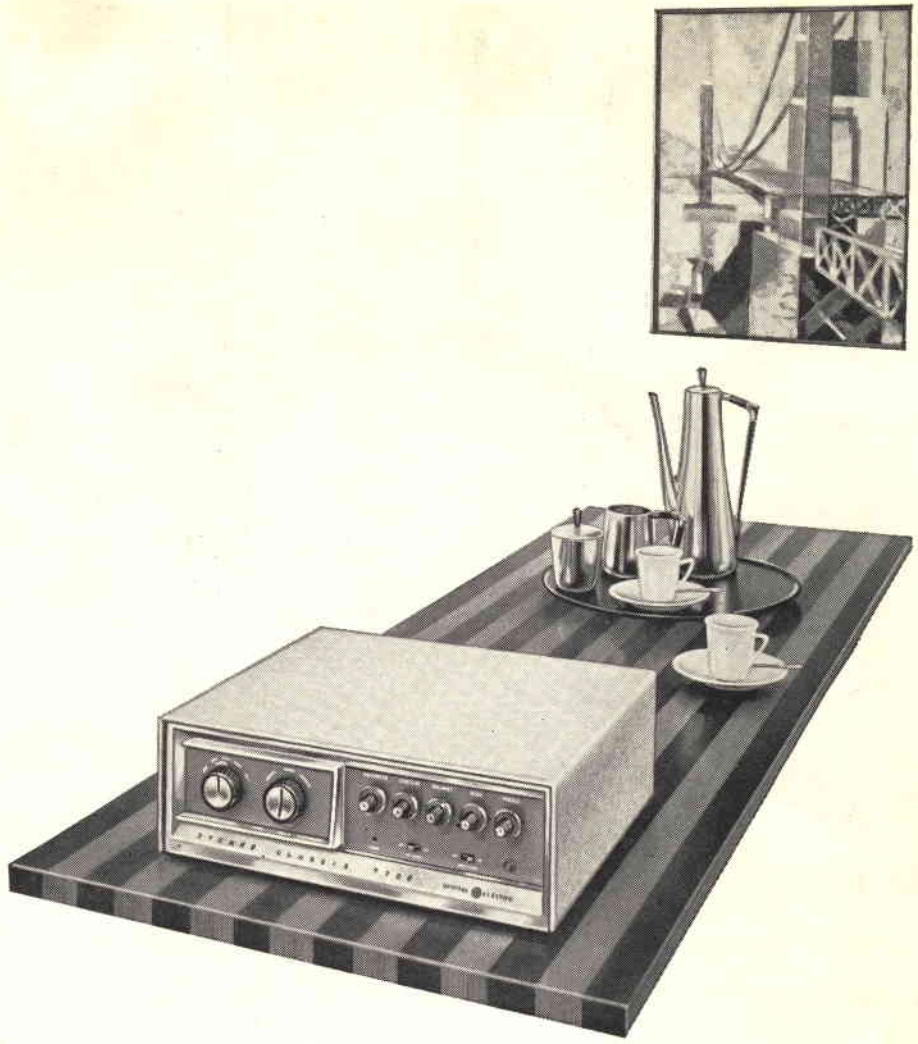

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