ELECTRONICS WORLD

AUGUST, 1960

MAC 8

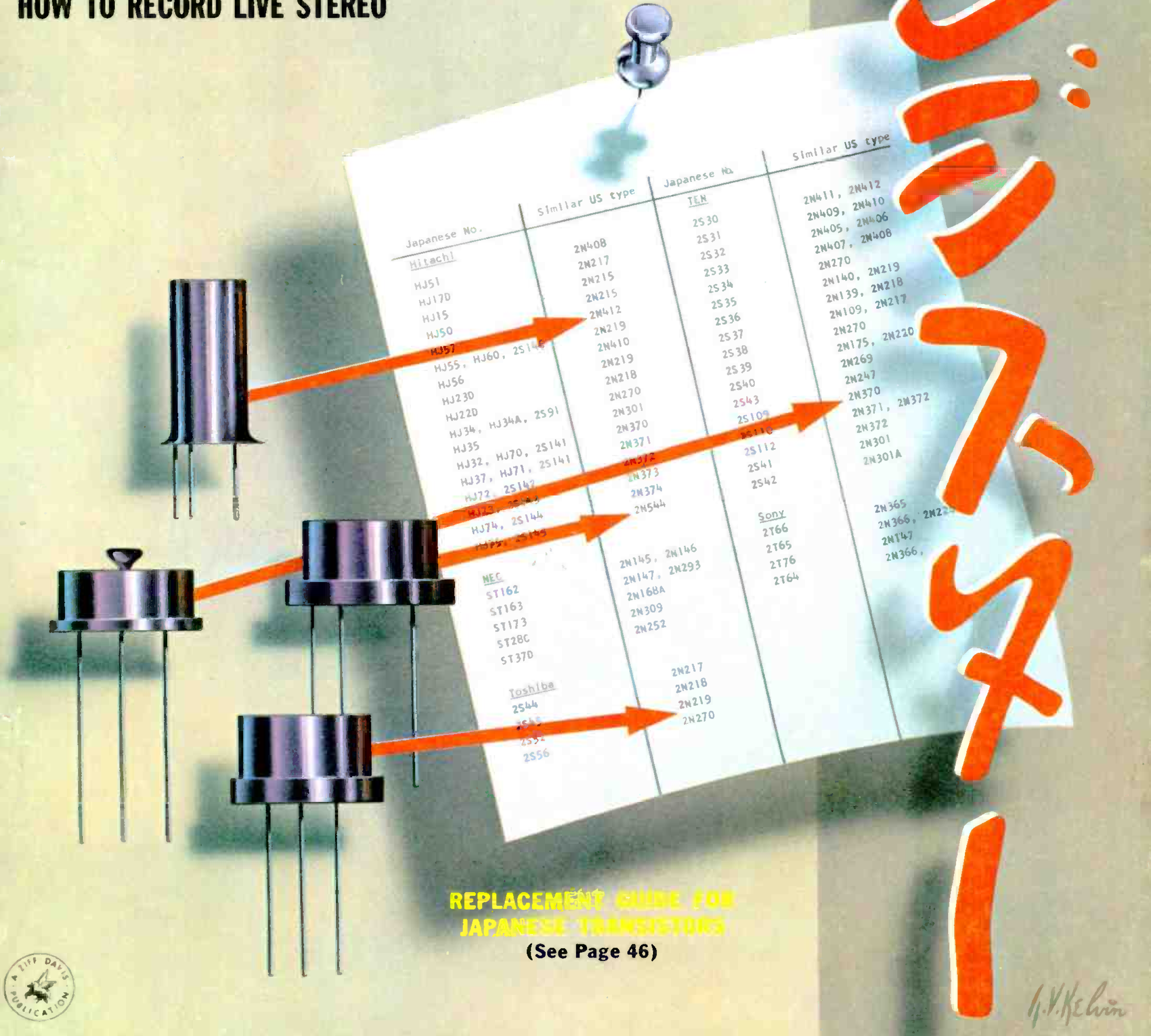
50 CENTS

ELECTRONICS IN CRIME DETECTION

CITIZENS BAND SERVICE PROBLEMS

BUILD YOUR OWN 40- OR 60-WATT HI-FI AMPLIFIER

HOW TO RECORD LIVE STEREO



REPLACEMENT GUIDE FOR JAPANESE TRANSISTORS

(See Page 46)

A ZIFF-DAVIS PUBLICATION

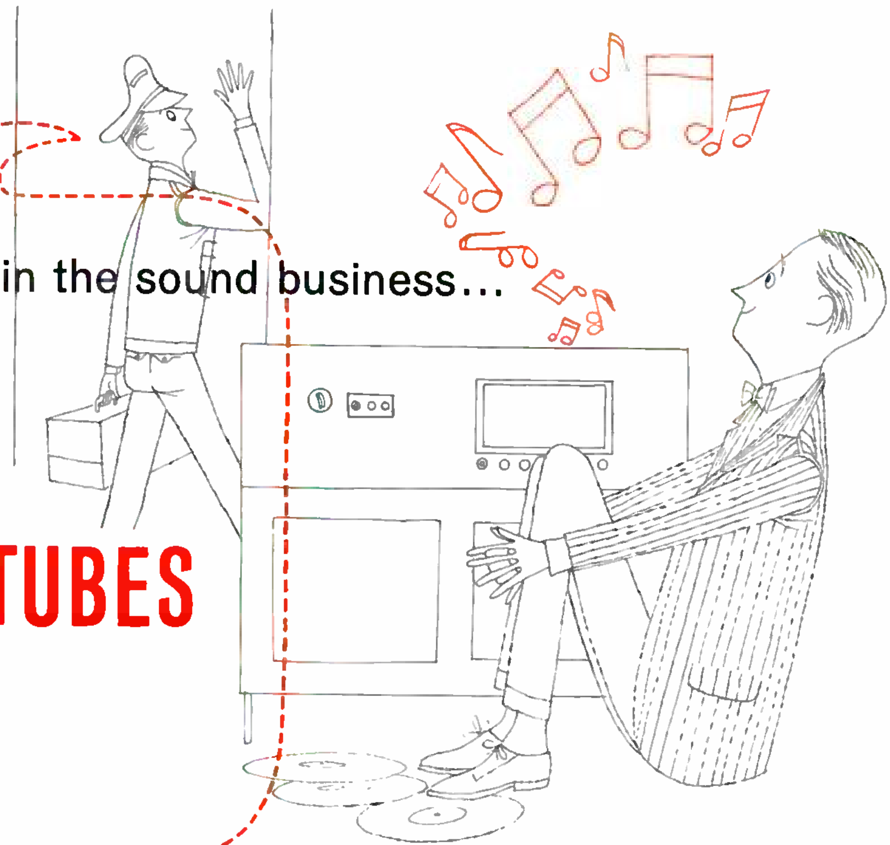
For sound profits in the sound business...

replace defective

audio tubes with

SYLVANIA TUBES

FOR HI-FI!



Hi-Fi set owners are a "finicky" lot. Won't compromise with audio quality. It's easy to help them get the fine sound reproduction they want. When the trouble is a tube, do what profit-minded dealers have been doing for years with radio and TV sets. Replace defective tubes with SYLVANIA superior-quality TUBES.

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SYLVANIA 6973... power pentode popular in medium-to-low power output stages.

SYLVANIA 12AX7... high-mu twin triode used in many high-gain preamplifiers.

SYLVANIA 7025... a "sophisticated" 12AX7, featuring exceptionally low noise and low microphonics.

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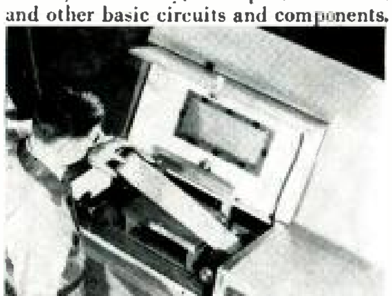

KIT 1 Get practical experience measuring voltage, current, building circuits.

KIT 2 Build d'Arsonval type Vacuum Tube Voltmeter. Test power line frequencies, high audio, radio frequency signals, resistances.

KIT 3 Practice with resistors, capacitors, coils. Work with half-, full-wave, bridge, voltage doubler and pi-type filter circuits.

KIT 4 Build circuits with pentode tubes, selenium resistors, transistors. Build oscillator, check signal phase shift with oscilloscope.

KIT 5 Experiment with thyratron tube circuits, Lissajous patterns. Study basic amplitude detector circuits, modulation, demodulation.

KIT 6 Get practical experience with magnetic amplifiers, learn to use modified Prony brake; determine motor torque. Use strobe disc to measure motor speed.

KIT 7 Learn effects of positive and negative feedbacks (used in analog computers). Practice varying polarizing voltage and illumination.

KIT 8 Experiment with multivibrators used as timing generators in binary counters, and as frequency dividers. Learn to use blocking oscillators, thermistors.

KIT 9 Practical experience in telemetry circuits used in earth satellites, remote control devices. Work with basic circuits used in digital and analog computers.

KIT 10 Assemble circuits in electrical and electro-mechanical systems, make valuable practical electronic circuits.

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ELECTRONICS WORLD

AUGUST, 1960
VOL. 64 ■ NO. 2

First in radio-television-audio-electronics

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GENERAL ELECTRONICS AND INDUSTRIAL

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TEST EQUIPMENT

COMMUNICATIONS AND AMATEUR

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DEPARTMENTS

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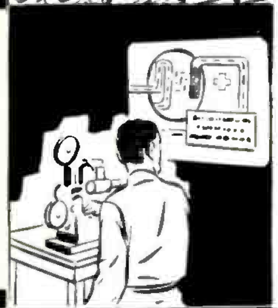

Thanks to this exclusive home training aid, many important fundamentals quickly become "movie clear." Now you can actually see electrons on the march and other "hidden actions"—a wonderful advantage that is almost like having a teacher at your side.

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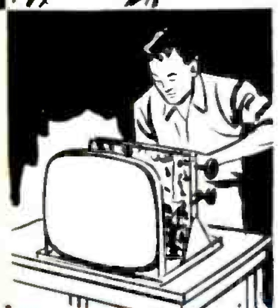

For added practical experience, you can also build and keep this quality 21-inch TV SET that provides TV reception at its finest (DeVry Tech also offers another home training without the TV set).

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NEW Space-Saving Shelving Units help you make use of space over doors & windows, under counters.

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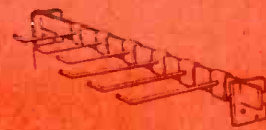
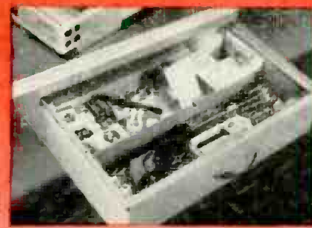


NEW RCA Special Drawer Unit provides a three-way benefit. Attaches under counter as **utility drawer** in service shop, **cash drawer** in sales area; or several drawers can be stacked together as a separate stand-up unit.



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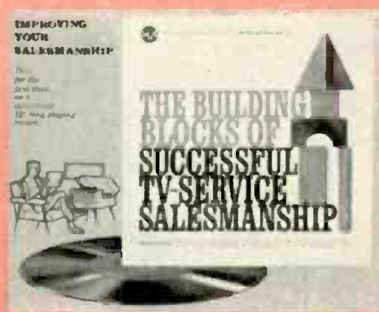

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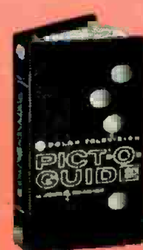

speed YOUR SERVICE

Make your home service calls faster, easier. This new lightweight, compact "Quick Call" Tube Caddy has a rugged wooden construction with two-color leatherette covering. This perfect mate to the big RCA "Treasure Chest" is just the thing for service calls that don't require a full tube complement.

New Lightweight "Quick Call" Tube Caddy

Standard "Treasure Chest" Tube Caddy

...for the Record

By **W. A. STOCKLIN**
Editor

THE STRATEGIC AIR COMMAND (SAC)

SOME may find SAC's slogan "Peace Is Our Profession" a bit strange. Yet, after our most interesting two-day visit to Offutt Air Force Base Headquarters of SAC, and after actually seeing all their facilities and talking to key officers, one can get a much clearer picture of the reasons behind this slogan. The "deterrent concept" is followed, and this is to maintain a force so capable of quick, devastating retaliation that no nation would dare to attack. The two main requirements are strength and readiness.

SAC's operation is global in nature. It has over 1500 B-47 and 450 B-52 bombers. In addition, its force consists of over 1000 refueling planes. SAC aircraft alone consumed 228,000 gallons of fuel hourly last year.

Our interest, of course, was directed towards electronics, and particularly the communications system. There is no doubt that theirs is one of the most comprehensive and reliable nets in all the world. Every intercontinental cable terminates at their home base, and these are available to them on emergency basis. We saw acres of antennas of almost every conceivable type at their nearby receiving station, and similarly at their transmitter base some 20 miles away. Single-sideband is widely used as it is, in their opinion, the most reliable of all communication techniques. Ionospheric skip is one of their main problems. We saw a TV-like piece of equipment which is used to determine the best operating frequency to use to communicate with any point in the world.

At their control center at Offutt Base, we saw the famous red telephone. It is nicknamed "hot line" and is used to alert SAC's entire combat force in seconds. This phone is a direct wire to each of their attack bases throughout the world. And, when an alert is given, all bases receive the instructions simultaneously. In a test made during our visit, each base was to acknowledge receipt of the message, and it was interesting to note that some 35 bases throughout the world, after a countdown of 5, acknowledged receipt simultaneously. All lines connecting every base are pulsed every three seconds in both directions and, if any particular line misses three pulses, an automatic signal is received indicating an inoperative condition.

Included at this base are a tremendous number of teletype machines and an *IBM* 704 computer. SAC's entire attack plan is in readiness on *IBM* cards and if, for example, Guam were to be knocked out, the computer can advise within seconds what planes are in flight and scheduled to refuel at Guam, or even what planes still on the ground are scheduled to refuel at the same place.

Even with the most formidable electronic and communications system that science can produce today, it was evident to us that all SAC officers realize that this may be inadequate in years to come. With this thought in mind, they are constantly improving systems and planning improvements in their attack force. SAC will, as quickly as possible, convert its force to a true aerospace operation. "Atlas" and "Snark" missiles are already operational and the "Titan" and "Minuteman" missiles will be incorporated. In time, it is hoped the B-70 supersonic strategic bomber will be added to their jet fleet.

SAC is strictly an attack force. For warning, it is dependent on early warning networks that are under the jurisdiction of the North American Air Command (NORAD). This Command is currently strengthening its operations. The most recent announcement in this regard pertains to plans for erecting a third Ballistic Missile Early Warning System (BMEWS) Station at Flingdales Moor, Yorkshire in England. Other such installations are at Clear, Alaska and Thule, Greenland. (See page 33 for more details on this development.) All three of these bases will employ the most powerful radars in the world, which will feed information to SAC to increase the effectiveness of our retaliatory capability. Information of any enemy ICBM's will be supplied by digital computers, and such information will be projected on graphic visual displays at SAC Headquarters within seconds. In addition to this, the first of a series of early warning satellites—the experimental "Midas II," which is equipped with infrared sensors to detect missiles upon take-off—has been successfully launched from Cape Canaveral.

Although SAC officials can send their entire attack force aloft headed toward foreign bases, there is only one man who can make the final decision to attack. And that man is, rightfully, the President of the United States.

Our sincere appreciation to all officers and men at Offutt Base who made our trip interesting, and particularly to Lt.-Gen. Francis H. Griswold, Vice-Commander and Chief of the Strategic Air Command and to one of his communications experts, Lt.-Col. Joe Beler. Both men are familiar personalities to a good many members of the amateur fraternity. —30—

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Ultra-selective, highly sensitive dual-conversion superhet receiver features built-in adjustable squelch and noise limiter. Sensitivity (manual) is better than 1 μv for 10 db S/N; crystal, ½ μv. Includes built-in AC power supply. Easy to assemble; has dependable printed circuitry and pre-aligned IF transformers. With distinctively styled high-impact case, 5 x 12 x 12". Complete with all parts, wire-type doublet antenna, and one transmitting crystal (available for any channel from 1 to 22—specify preference). FCC application form is included (license is available to any citizen over 18—no exams to take). See below for DC mobile supply, vertical antenna, etc. Wt., 20 lbs.

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Y-769L. Optional Receiving Crystal (specify frequency) .. 1.99
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Now have your own private 2-way radio system at an amazingly low cost! Consists of easy-to-assemble superregenerative receiver and 5-watt transmitter. Readily fits car, boat or desk. Single, one-switch operation permits talk or listen. Receiver tunes all 22 channels continuously. Built-in AC power supply. Handsomely styled case, 7x10x8". With mike, doublet antenna, and transmitting crystal (specify channel—1 to 22—if you have a preference). See below for antenna, mobile power supply, etc. Shpg. wt., 10 lbs.

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Within the Industry

LELAND W. AURICK has been appointed Manager, Advertising and Sales Promotion, Industrial Market, *RCA* Electron Tube Division. In his new post, Mr. Aurick will be responsible for all phases of the advertising and sales promotion programs of the Division's industrial products. Mr. Aurick joined *RCA* in 1957 as Administrator, Industrial Advertising, and has been engaged in directing industrial advertising in both the renewal and original equipment markets.

Active as an amateur radio operator for many years, Mr. Aurick is the author of many technical articles. He is a member of the American Radio Relay League and was issued his present call letters, W2QEX, in 1946. He also has directed the founding of many Civil Defense Communications organizations throughout New England.

* * *

NEWARK ELECTRONICS CORPORATION is the new name of the electronic parts and equipment firm formerly known as **NEWARK ELECTRIC COMPANY.** The company will retain its headquarters at 223 W. Madison Street in Chicago under the management of Sam and Abe Poncher, the founders . . . **JAMES VIBRAPOWR COMPANY** has changed its name to **JAMES ELECTRONICS INC.** to more accurately reflect its product diversification . . . **GENERAL TELEPHONE & ELECTRONICS CORPORATION** has announced the formation of a wholly owned subsidiary, **GENERAL TELEPHONE & ELECTRONICS LABORATORIES INCORPORATED,** which will engage in a wide range of scientific research activities in the communications and electronics field. Headquarters will be in Bayside, N. Y. . . . Merger of the corporate management of **UNGAR ELECTRIC TOOLS, INC.** into the **ELDON MANUFACTURING COMPANY** group has been announced as a step designed to strengthen the tool company's research and product development position . . . **RCA INSTITUTES** has opened a new permanent school in Los Angeles to train technicians for the rapidly growing electronics industry in California. The school started operation March 1st and is located in the Pacific Electric Railway Building in downtown Los Angeles. Irwin A. Shane is director of the LA school . . . **HATHAWAY INSTRUMENTS, INC.** announces the formation of a new special products division which will develop, design, and manufacture transistorized inverters and converters and special purpose filters. The new division will make its headquarters in Denver, Colorado.

* * *

SUPERSCOPE, INC., exclusive distributor of *Sony* stereo tape recorders and professional sound equipment, has moved into a new 25,000-square-foot building at 8150 Vineland Ave., Sun Valley, Calif. . . . **TRIPLETT ELECTRICAL INSTRUMENT COMPANY** is now building a new addition to its Bluffton, Ohio plant which will more than double meter production when completed in early Fall . . . **ELGIN MICRONICS** has broken ground for a new 15,000-square-foot research and engineering laboratory in Rolling Meadow, Ill. . . . **RADIO SHACK CORPORATION** has opened a new 15,000-square-foot distribution center in Stamford, Conn. Located on High Ridge Road at Bull's Head, Stamford, the new center is the company's fourth in New England . . . **SUPREME PUBLICATIONS** has acquired new and larger warehouse facilities at *Western Warehousing Co.*, operated by the *Pennsylvania Railroad* in Chicago . . . **LAFAYETTE RADIO ELECTRONICS CORP.** has opened a store in Paramus, N. J. Located on Route 17, less than a mile north of Route 4, in the heart of Bergen County, the 8000-square-foot store offers a complete electronic product line . . . **ACOUSTICA ASSOCIATES, INC.,** with main offices and plants in Los Angeles, has opened an eastern marketing and engineering division at Roosevelt Field, Long Island. The address is 600 Old Country Road, Garden City, Long Island . . . **MACHLETT LABORATORIES, INC.,** a division of **RAYTHEON COMPANY,** is building an expandable 120,000-square-foot plant at Winsted, Conn. . . . **SPRAGUE ELECTRIC COMPANY** is adding 20,000 square feet of space to its main factory building at Lansing, North Carolina.

* * *

L. BERKLEY DAVIS, vice-president of *General Electric* and general manager of its Electronic Components Division, has been elected president of the Electronic Industries Assn., succeeding David R. Hull, a vice-president of *Raytheon Co.* Mr. Hull was first elected to the EIA presidency in 1958 and served two terms.

The president-elect has been a member of EIA's board of directors, a director of the association's tube and semiconductor division, and a member

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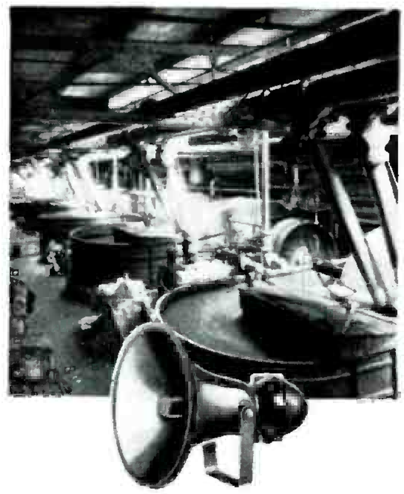
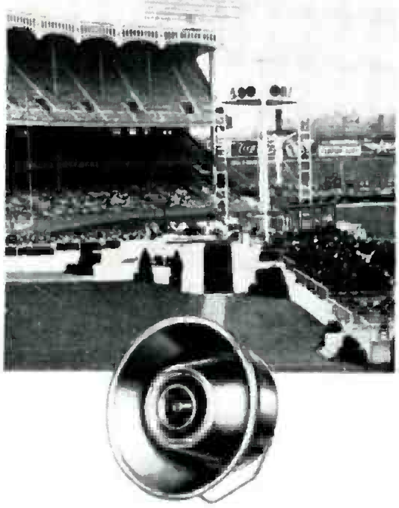


EXPLOSION-PROOF . . . *Underwriters Laboratory approved* for industries otherwise unable to enjoy advantages of sound paging systems. 100% safe for use in locations near volatile or flammable liquids, gases, dusts or other combustibles, either in air or on surfaces. *(Shown: Model 7101,2 which complies with all government safety regulations)*



OUTDOOR WEATHERPROOF HIGH FIDELITY . . . genuine dual range systems with separately driven woofers and tweeters for highest quality reproduction of voice and music, indoors or outdoors. Three exceptionally efficient models: for small areas such as patios; general coverage as in shopping centers; heavy duty use as in concert halls and stadiums. *(Shown: Model WLC, widely used for full-range reproduction at higher levels)*

SUPER-POWER PROJECTORS . . . deliver the greatest possible concentration of output from a single compact unit. Widely used in church and municipal towers, carillons, race tracks, stadiums, aviation, electronic warning devices. Three models give you a choice of 4, 6, or 12 drivers in one mixing chamber . . . a total range of power from 120 to 1200 watts! *(Shown: new Model B-6P, which takes six 25-60 watt drivers)*

MULTI-DUTY . . . MM-2 series for completely reliable and trouble-free operation under frequent or constant exposure to dampness, live steam, salt spray, dust, fungus, shock, vibration . . . even occasional submergence *under* water. Wide choice of standard models for mounting on walls, swivels, bulkheads, ceilings. Also, high power models for electronic warning devices. *(Shown: new Model MM-2FUW, specifically designed for underwater installations)*

University public address speakers, drivers, trumpets and accessories are approved for Civil Defense applications. All are fully described, complete with technical data, in the new Spring-Summer 1960 edition of the University Product Catalog. Write for your copy today. Desk S-1, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

A Division of Ling-Altec Electronics, Inc.

of the membership and scope committee. He will serve as the 28th president of the 36-year-old association.

* * *

DR. VICTOR J. YOUNG has been elected vice-president of *Hazeltine Electronics Division*. He has been with the firm since 1949 . . . **HERBERT W. CLOUGH**, vice-president of marketing for *Belden Manufacturing Co.*, has been elected to the company's board of directors . . . **EDWARD MEAGHER** has been promoted to the post of product manager, entertainment tubes and semiconductors, for *Amperex Electronic Corp.* . . . **JOSEPH F. WITKOWSKI**, electronics consultant and technical writer, died recently following a heart attack. Before his retirement in November, 1958, following 38 years of service, he was director of the school of electrical communications, *International Correspondence Schools*, Scranton, Pa. . . . **LESTER L. KELSEY** has joined *Trav-Ler Radio Corporation* as vice-president and merchandising manager . . . **DR. STEWARD S. FLASCHEN** has been promoted to the post of manager of research and advanced development for the semiconductor products division of *Motorola Inc.* He was formerly associated with *Bell Telephone Labs.* . . . **ROBERT C. SPRAGUE**, chairman of the board of *Sprague Electric Company*, has been elected a fellow of the American Academy of Arts and Sciences . . . **WILLIAM DJINIS** has been appointed chief engineer in charge of all scientific activities of *Electro-Sonic Laboratories, Inc.* of Long Island City, N. Y. . . . **RONALD G. DAVIS** has been named senior design engineer by *International Resistance Co.* He was formerly associated with *Curtiss-Wright Corp.* . . . **IRA MOLAY** has been named product manager, audio components, for *CBS Electronics Div.* of *Columbia Broadcasting System* . . . *Elgin Electronics* has named **ERIC FIRTH** to the post of national sales manager with headquarters in Burbank, California . . . **ALEXIS BADMAIEFF** is the new chief engineer, acoustics-tranducers, and **WILLIAM H. JOHNSON** is manager of engineering and technical information for *Altec Lansing Corp.* . . . **WALTER A. KIRSCH** has joined *Telechrome Mfg. Corp.* as defense products manager and assitant to the vice-president and director of sales . . . **HENRY MANDLER** has been named to the newly created post of assistant general sales manager of *University Loudspeakers, Inc.* . . . *Vocaline Corporation of America* has appointed **T. H. BLANER** works manager. He was formerly with *ITT* . . . **HILMER LINDAHL** is the new vice-president in charge of radio broadcast equipment at *International Radio & Electronics Corp.*

* * *

DR. WOLFGANG W. GAERTNER, a well-known figure in the field of semiconductor materials and devices, has joined the staff of *CBS Laboratories* as manager of electronic semiconductor research and development.

A native of Austria, Dr. Gaertner received his Ph.D. in Physics from the University of Vienna in 1951. He completed additional graduate engineering studies in Vienna in 1955.

Before joining *CBS*, he served as chief scientist of the Solid State Devices Division, U. S. Army Research and Develpment Lab. at Fort Monmouth, N. J. He is the author of a number of papers in the field of solid-state physics and a book.

* * *

VEGA ELECTRONICS CORPORATION has been established in Cupertino, California and will specialize in the electro-acoustical and electro-mechanical fields with emphasis on digital and analogue magnetic recording equipment. Heading the new firm is Russell J. Timkham a long-time *Ampex* executive. Joining him in the new venture are seven other former *Ampex* personnel: Walter C. Hironimus, A. Arthur Foy, R. Z. Langevin, F. A. Dicus, R. L. Brown, R. S. French, and W. E. Magnie . . . **JBL INTERNATIONAL, INC.** has been organized to market component hi-fi equipment for both *Lansing* and other firms. Headquarters are at 3249 Casitas Ave., Los Angeles . . . **PACKARD BELL SALES CORP.** has been organized as a wholly owned subsidiary to handle the products of the parent company's home products division. The firm will have quarters in a modern 7200-square foot

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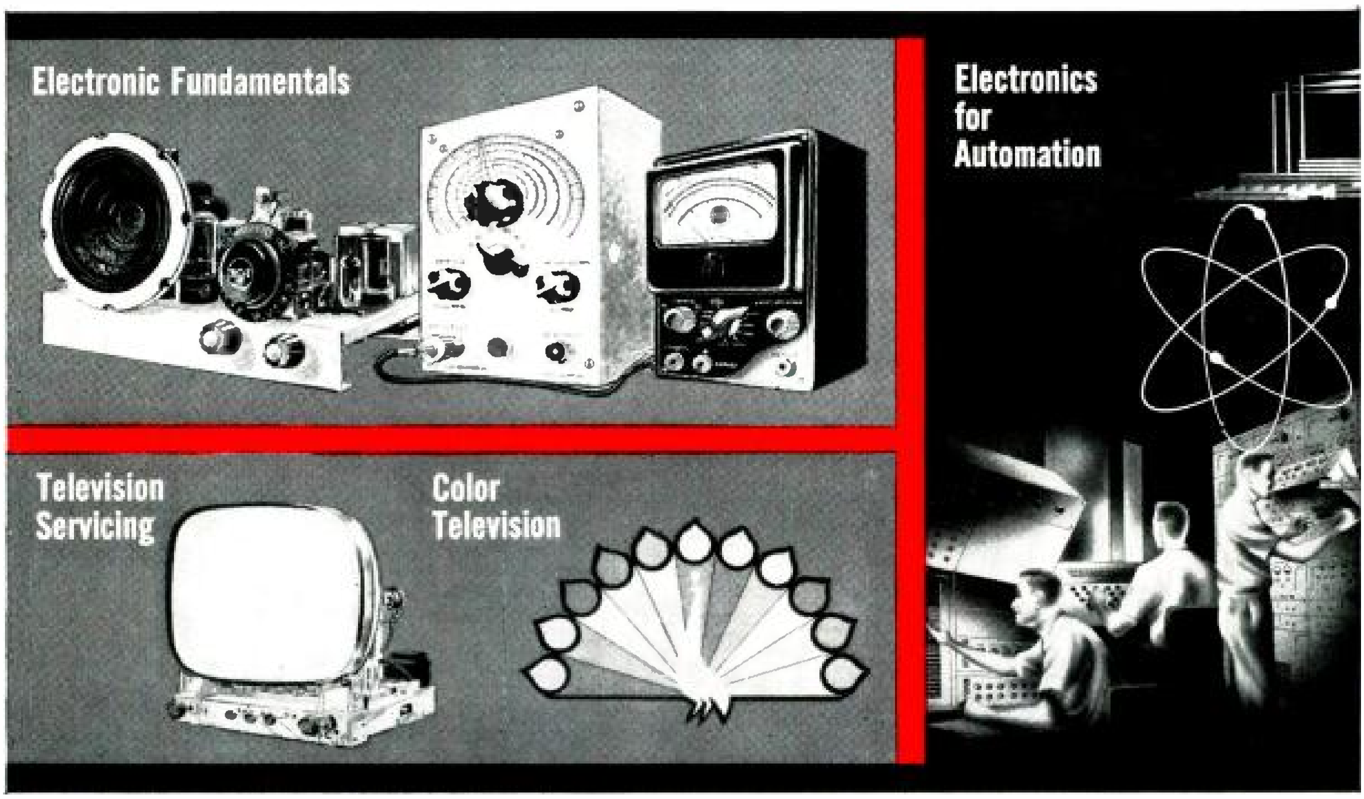

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office building at 8745 W. Third St. in Los Angeles where all marketing, advertising, and promotional activities of the firm will be grouped . . . **LORAL ELECTRONICS CORP.** has acquired **ALPHA WIRE CORP.**, which will operate as an independent subsidiary. Peter Bercoe continues as president . . . **NATIONAL ELECTRONICS, INC.** has been consolidated with **INDUSTRIAL TUBES, INC.** The two companies will operate under the name of **NATIONAL ELECTRONICS, INC.** The organization is a wholly owned subsidiary of **EITEL-McCULLOUGH, INC.** . . . **TRANSITRON ELECTRONIC S.A.** has been formed as a European sales subsidiary of **TRANSITRON ELECTRONIC CORP.**, with headquarters in Zug, Switzerland, subsidiary sales offices in London, Paris, and Munich, and warehouse facilities in Amsterdam, Holland. Two additional sales offices are planned in Dusseldorf, Germany and Milan, Italy . . . **CLEVITE CORP.**, Cleveland, Ohio has acquired the assets of the **SHOCKLEY TRANSISTOR CORP.**, Palo Alto, Calif., a subsidiary of **BECKMAN INSTRUMENTS INC.** Terms of the transaction were not disclosed . . . **ALLIED RADIO CORP.**, Chicago, has extended its operations to the West Coast with the acquisition of **ELECTRONIC SUPPLY CORP.** of Pasadena and Long Beach, Calif., which now becomes a wholly owned subsidiary with Don Dressen continuing as president and general manager.

* * *

WORKMAN TV PRODUCTS, INC. of Sarasota, Florida has moved into its new 20,000-square-foot, air conditioned plant which has enabled the firm to increase its production by 25 per-cent . . . **INTERNATIONAL RESISTANCE COMPANY** of Philadelphia will expand the space it occupies in the 11-story building at 401 N. Broad Street by some 27,000 square feet to give it a total of 281,000 square feet for the manufacture of a complete line of resistors . . . **GOULD-NATIONAL BATTERIES, INC.** has completed a 27,500-square-foot facility at 831 N. Vandalia St., St. Paul, Minn. The factory will be used for the production of miniature, hermetically sealed and rechargeable nickel-cadmium cells and batteries to be sold under the "Nicad" tradename . . . **CHEMTRONICS INC.**, manufacturer of a line of chemicals for the electronics industry, has moved to a new plant-site at 870 E. 52nd Street, Brooklyn, N. Y. The new building doubles the space formerly occupied by the firm . . . Ground has been broken on a 26-acre site near Santa Cruz, California for a 32,000-square-foot computer component manufacturing plant to be occupied by **SYLVANIA ELECTRIC PRODUCTS INC.** . . . **LITTON INDUSTRIES** has opened a new 43,000-square-foot addition to its electron tube division facilities at 960 Industrial Road, San Carlos, California . . . **MILO ELECTRONICS CORP.** of New York City has established a New England sales office at 18 Button Ball Drive in Newtown, Conn. —30—

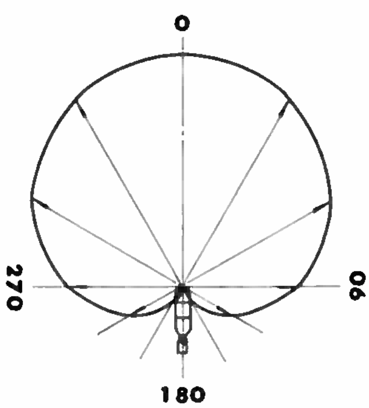
AIWA INTRODUCES A NEW SMALL-SIZE

UNI-DIRECTIONAL RIBBON MICROPHONE MODEL VM-18

Features:

* Small size and slim shape facilitate handling.
* Comparatively high sensitivity and fine response characteristics.
* Sturdy construction with short ribbon diaphragm.
* Humming minimized.
* Equipped with a low frequency attenuation circuit.

VM-18



VM-18

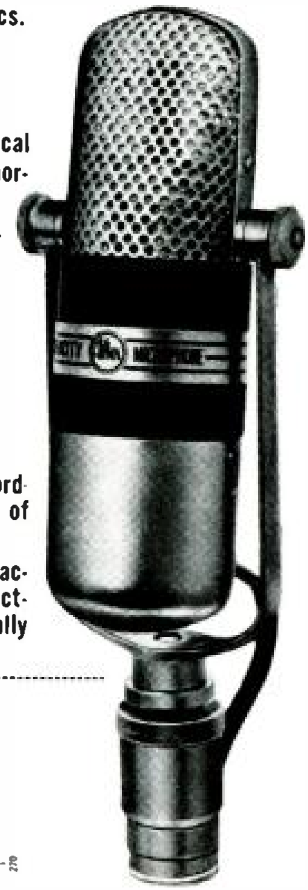
Specifications:

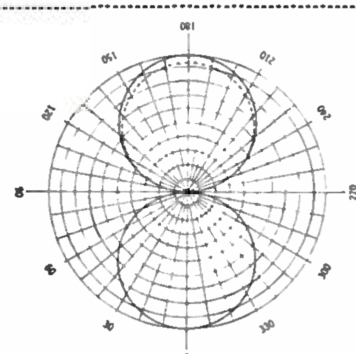
* Type: Ribbon Microphone
* Impedance: 600 ohm ± 20% (At 1000 c/s at 0 point of the switch)
* Sensitivity: 75 db (0db = 1V/m bar 1000 c/s)
* Directionality: Uni-directional
* Noise Level: Below 30 db
* Dimensions: 9 5/8" (length) 1 1/2" (dia.) Weight 2.2 lbs. (9 feet-cord & plug included)

BI-DIRECTIONAL RIBBON MICROPHONE MODEL VM-16

Features:

* Superlative high quality response characteristics.
* Engineered in collaboration 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.





VM-16

Directional Characteristic
— 500 c/s, 1000 c/s, ··· 8000 c/s

Specifications:

* 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 Characteristics: Bi-directional
* S/N 20 db or below (in parallel field at 1 m gauss)

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The fact that new positions must be filled by men with an up-to-date education is evidenced by the experience of the CREI Placement Bureau, where the demand for graduates and advanced students has far exceeded the supply for several years. It is of interest to note that many leading companies regularly visit CREI strictly for the purpose of recruiting CREI graduates and students.

Many CREI students have learned that they do not have to complete the program to realize considerable increases in their status and income. Their own employers realize that if you are ambitious enough to pursue this college-level program, you are a better candidate for rapid promotion. Professional people in supervisory positions recognize the value of CREI education.

HOME STUDY IS CONVENIENT AND TIME SAVING. You will find more than 20,500 CREI students working in most every phase of electronics in all 50 states and in most foreign countries of the free world. Just like them, you can pursue the CREI

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The International Traveler . . . a new ALL transistor portable transceiver especially engineered to meet the most demanding requirements where "truly" portable short range communication is required. Compact: 4" x 6" x 7¾". Weighs less than 5 lbs.

The Traveler's 15 transistors provide maximum "talk power" and "reception." Built-in speaker plus separate phones jack. Dual conversion receiver. Truly effective noise limiter and squelch. Two channel crystal controlled receiver and transmitter. Push-to-talk operation. Powered by built-in nickle cadmium battery and charger.

Complete with battery, charger, microphone, 2 sets crystals, whip antenna, carrying strap, and mobile mounting bracket. . only **$249.50**

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The EXECUTIVE, complete with one channel 9 transmit crystal, AC power cord, microphone, and operating instructions
. . . . only **$169.95.**

The International Executive . . . ideal for a fixed base station or mobile use.

Push-to-talk operation, 3 crystal controlled transmit positions, two crystal controlled receive positions, dual conversion superhetrodyne receiver tuning all 23 channels.
Five watts plate input. Series Gated automatic noise limiter. Fifteen tube performance. The Executive has 10 tubes and 1 diode. Four tubes are multi-purpose.
Universal built-in power supply for 6 VDC, 12 VDC, and 115 VAC. Size: 5½" x 8½" x 9". Weighs 12 lbs.

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Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON EDITOR

SPACE SUNLIGHT-COMMUNICATIONS SYSTEM ENVISIONED BY AIR RESEARCH TEAM—In some future year when cruising space vehicles communicate with other space vehicles or orbiting stations, a beam of light may be used instead of conventional radio. So predicts the Air Research and Development Command's Wright Air Development Division. The Division is now developing an experimental system—operating on the heliograph principle—which will collect sun rays, run them through a modulator and direct the resultant light wave in a controlled beam to a receiver. There the wave will be put through a detector, transposed into an electrical impulse, and be amplified to a speaker either as a dot-dash or voice message. The theoretical aspects have already been worked out.

EXPERIMENTAL TIMING CODE ADDED TO WWV BROADCASTS—An experimental timing code has recently been added to the regular broadcasts of the National Bureau of Standards' radio station WWV. This code provides a standardized timing basis for use when scientific observations are made simultaneously at widely separated locations. The code designates the day, hour, minute, and second (Universal Time) and will indicate the broadcast accuracy (at the WWV transmitter) within one-thousandth of a second. As the code is experimental, details of its transmission are subject to change. Currently, the code is broadcast for one-minute intervals, ten times per hour. It immediately follows the standard audio frequencies of 440 and 600 cps except at the beginning of each hour. The standard frequencies are given alternately as before but their duration, when the code is given, is two minutes instead of three. The code is a thirty-six bit, 100 pps, binary coded system. A complete time frame is one second. Nine binary groups per second appear in the following order: 2 groups for seconds, 2 groups for minutes, 2 groups for hours, and 3 groups for day of year. The code also contains blank spaces which may be used to transmit additional types of information in the future.

TRANSISTORIZED SONAR DEVELOPED FOR NAVY FROGMEN AS UNDERWATER "EYES"—A completely transistorized sonar, powered by standard flashlight batteries, has been developed for Navy frogmen. Jointly designed by the U.S. Navy Electronics Laboratory and Stromberg Carlson, the new system will be particularly valuable to divers and underwater demolition teams operating in dark or murky waters where visibility is zero. Designated the AN/PQS-1, the object locator is a 20-pound sphere, has an aluminum casing and is a cubic foot in volume. Earphones provide operator with audio information on objects detected by the searching sonar beam.

WORLD'S LARGEST RADIO TELESCOPE TO BEGIN OPERATION IN FALL—A radio telescope, 600-feet long, 400-feet wide, and 62½-feet deep—specially designed to pick up faint sources outside our own Milky Way galaxy, will go on the air early in the Fall near Danville, Illinois. The telescope, to be operated by the University of Illinois for the Navy, covers 5½ acres and has 160,000 square feet of receiving area, more than twice that of the Jodrell Bank installation in Manchester, England. Unlike the British instrument, however, this unit is non-steerable.

ELECTRONIC RUSSIAN TRANSLATOR DESIGNED—The answer to the age-old problem of international tongue-twisting appears to have been resolved by Air Force engineers who have developed an electronic translator that can turn Russian into English at a rate of 35 wpm. Heart of the translator is the photoscopic memory—a transparent disc 10 inches in diameter—that can store 550,000 Russian-English words in an area the size of a postcard.

ALL-WEATHER ELECTRONIC LANDING SYSTEM TO BE BUILT—An electronic aircraft landing system, employing a combination of radar, radio, and computers, to provide all-weather, including heavy fog and rain, operation for the U.S. Navy's Task Forces, has been ordered from Bell Aircraft. Two radar antennas mounted on the superstructure of a carrier will serve to track an incoming plane. Two visual displays will provide precise information about the location of the plane with respect to the carrier deck, and electronic computers will be used to determine whether a plane is on the proper descent course. The new system is said to have the capability of flying a plane to touchdown on deck without pilot control.

-30-

atures with consistency invariably were rather expensive as compared to vacuum diodes. Lately there have been a few diodes announced which approach in price the cost of half a vacuum tube and still do a good job.

One very important consideration not covered by Dusina is the advisability of taking the control voltage from the screen of the first i.f. stage when more than one i.f. stage is employed. If this is not done, strong ignition pulses will feed into the audio system *via* the squelch circuit and cause difficulty unless additional decoupling circuitry is employed.

I have always been somewhat proud of the simplicity of this circuit and, therefore, was rather dismayed to find that someone else recently "invented" it.

W. W. Smith
Gonset Div.
Young Spring & Wire Corp.
Burbank, California

Regardless of who used the diode squelch first, the circuit is still a good one and worthy of coverage. Thanks to Woody Smith for giving us the above additional information.—Editors.

* * *

MULTIPLEX WITH ONE RECORDER

To the Editors:

The article entitled "Multiplexing Music with One Recorder" in your April issue is of special interest to me. But where does point "Y" on your schematic diagram get oscillations to feed to the erase head? According to the article and diagram, it seems that when I remove the old mono erase head for replacement, I would have the two leads feeding it just left hanging out in open space.

David M. House
Dallas, Texas

Regarding point "Y" in Fig. 2, actually a lead should have been shown connected here. This lead is the one that previously went to the erase head. Such a connection is actually described in the text (at the bottom of the first column on that same page) as well as being shown in Fig. 1. However, it was unfortunately omitted from Fig. 2.—Editors.

* * *

CITIZENS BAND BEAM

To the Editors:

I would like to congratulate your magazine, and especially Mr. Hartland B. Smith, for the article "A Compact Beam for the Citizens Band" in your November issue.

My main purpose in using the 11-meter Citizens Band was to establish contact with another station in Gardena, California, which is 22.8 airline miles distant and line-of-sight. Using a ground-plane antenna at both ends, we were unable to establish any communications. The other station purchased a commercial 3-element beam, which didn't help.

Upon seeing Mr. Smith's article, I constructed his beam. Well, we now have 100 per-cent contact at any time of day or night between these two stations. This is not an easy trick considering the low 5-watts input allowed on the 11-meter Citizens Band, plus the added handicap that about 75 per-cent of the 22.8 miles is directly over the heart of downtown Los Angeles, which is perhaps one of the noisiest cities for radio communications, and line-of-sight puts us no more than 300 feet above the city. I hope the foregoing answers the question of your reader's letter in the March, 1960 issue.

Even with the complete and detailed instructions, plus making sure the materials purchased were exactly as outlined in the article, I was unable to solder the droopers to the elements and had to fall back on Mr. Smith's alternative of using bolts. If this alternative is an "inferior one which should be accepted only as a last resort," I would be amazed to see how well this beam would work soldered.

Robert L. Shannon
Altadena, California

Our readers are quick to let us know when they are having problems with some of the projects that we run, but it is not too often that they take the time to let us know how pleased they are with some of them. Therefore, the above letter is especially welcome.—Editors.

* * *

NOVEL NEON-LAMP OSCILLATORS

To the Editors:

In the May, 1960 issue is an article entitled "Novel Neon-Lamp Oscillators." There is an old proverb which says: "There is nothing new under the sun."

I found an identical schematic including the patent number in a publication "Die Glimmlampe und ihre Schaltungen" by Dr. Fritz Schroeter. This publication is dated 1932. The same booklet also deals with two-lamp and three-lamp intermittent arrangements, similar to the arrangements in Figs. 4, 6, and 7. This little booklet is very old, but it even gives the formula for these circuits.

When (around 1930) the neon lamp came to be appreciated, there were many more uses. Many of these are still in my scrapbooks. To name a few, one neon lamp with a long cylindrical glass envelope had a rod cathode of 100 mm and a graduation on the outside. It could be used on 60 cps a.c. to give direct readings of *R* and *C*. Another lamp in conjunction with rotating mirrors was used in demonstration of the sinoidal curve of the alternating current.

As a young engineer, I built an installation for auctions. Each bidder had his own press button, corresponding to a neon lamp on a wall. The circuit was such that only one lamp could be energized revealing the bidder, but excluding all others.

H. E. Wolf
San Bruno, California

Brand new or not, the novel circuits described should certainly be of considerable interest to our readers.—Editors.

—30—

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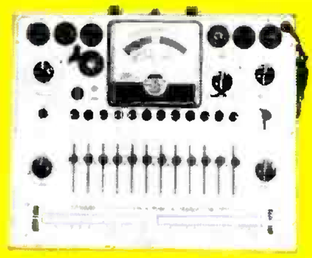

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TUBE & TRANSISTOR
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Complete with steel cover & handle

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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.

B Entirely electronic sweep circuit with accurately-biased increductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum and leakage eliminated. 5 fund. sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 xtal marker osc., xtal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

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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Portable Radio RA-6
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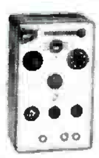

NEW Tube &
CRT Fil.
Tester #612
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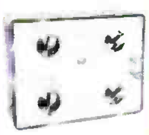
Wired $5.95
Fast-checks
radio/TV tubes,
pilot lamps, etc.



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Wired $19.95

Tube Tester #625
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Wired $49.95
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series string type
tubes
• illuminated
roll-chart
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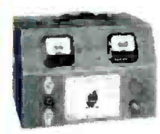

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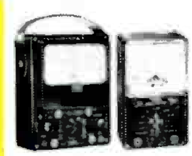

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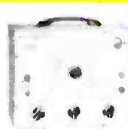

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Electronics in Crime Detection

By **WALTER H. BUCHSBAUM**
Industrial Consultant, Electronics World

Phone taps, "bugging" equipment, drunk testers, and lie detectors are some of the electronic tools provided by present technology to aid the modern crime fighter.

SHERLOCK HOLMES and his present-day counterparts—the sleuths of fiction, the movies, and TV—would hardly be a match for the sinister characters who often grace the police blotter today. The truth is like with rhinoceros hunting and polar exploration, technology has converted a romantic and haphazard procedure into a systematic scientific effort. Chasing the rhino in a truck and crossing the poles by plane and submarine have replaced the native beaters and the dog sled respectively.

In crime detection, too, technology has supplanted older methods and electronics, especially, has been applied to good advantage. Probably the most obvious is the use of the two-way radio police cruiser in place of the beat-pounding patrolman. But this is only one aspect of electronics in police work. Many more electronic devices are used. They range from the complex equipment of the police lab which can analyze unknown materials to the subminiature surveillance equipment which can be carried on the person of the "wireless stool pigeon" (in a situation such as is depicted in the drawing below).

A recent survey indicates that in the City of New York over 30,000 phone taps are made annually. The police dispute that any more than the about 3000 legal taps (with court order) were made, but even this number indicates a technical achievement. Actually, over 60% of all arrests for prostitution, gambling, and conspiracy to defraud are the direct or indirect result of phone taps. Since streetwalkers in New York have been hunted down like the buffalo at the turn of the century, most of the vice in the city is arranged by phone and in such cases wiretapping is invariably a prelude to the raid. Gambling similarly depends on the phone, especially the arrangements connected

A concealed miniature radio transmitter carried inside the coat pocket of the "wireless stool pigeon" sends the suspect's words to receiver in a nearby police car.

A B C D

with improving the breed of horses running at some distant track. Where suspicion of a fraudulent scheme of some sort exists, wiretapping serves to establish the extent of the fraud and helps to pinpoint individuals connected with it.

Before going into technical details, a brief classification of the various applications of electronic equipment is indicated. Because of the general knowledge and familiarity of our readers with the communications applications, we intend to skip over two-way radiotelephone, teletypewriter, and facsimile transmissions. These fields are not peculiar to police work although their use is of great importance. Nor will we go into details on the use of closed-circuit TV in jails, because it is technically the same as the system used in department stores and steel mills. The unique applications of electronics can be divided into surveillance, investigation of clues, questioning, and countermeasures against surveillance.

Surveillance includes the tapping of phones, "bugging" of rooms, planting of listening devices, the "wireless stool pigeon," and the infrared night-time viewing device. The countermeasures to this activity generally consist of checking out phone lines, locating hidden microphones, and detecting concealed transmitters.

Clue investigation involves electronics in the form of x-ray machines, infrared and ultraviolet analysis, and the many electronic devices the police laboratory uses to identify unknown substances. The questioning of suspects by means of the "third degree" is often replaced by the lie detector or polygraph—as the professionals prefer to call this instrument.

Since "degree" of intoxication is often a point of law, electronic equipment is now available to determine impartially just how drunk a suspect is. All of these electronic devices will be described here but the reader must understand that law enforcement officers are naturally reluctant to have some of their tricks publicized. For this reason we have had to use some discretion and must keep some of the information received in confidence.

The author is indebted to New York City's Deputy Commissioner Walter Arm, Lt. Paul Walker, and Lt. J. Finney for their cooperation in obtaining access to the police laboratory and learning how clues can be analyzed scientifically. Some of the material on surveillance and countermeasures was obtained from equipment manufacturers and newspaper sources.

Surveillance Equipment

Until the advent of electronics, surveillance was carried out either by having a suspect shadowed or else by trying to plant detectives in places where conversations could be overheard. The "tail" is still used, but less frequently since the suspects' phone calls and conversations in "bugged" rooms are usually sufficient to reveal his criminal schemes. But even the "tail" can use a pocket transmitter to direct other officers without losing sight of his quarry.

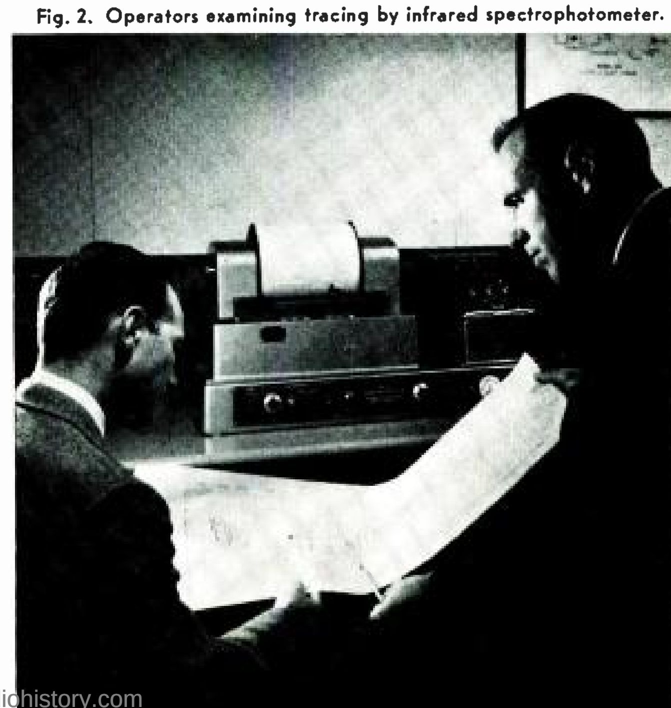
Listening in on phone conversations is technically very simple. Legally, however, it is not so simple since phone companies forbid any foreign attachments to their lines whether or not a direct electrical connection is made. Police authorities may, however, upon presentation of additional evidence, obtain a court order permitting a legal tap to be made.

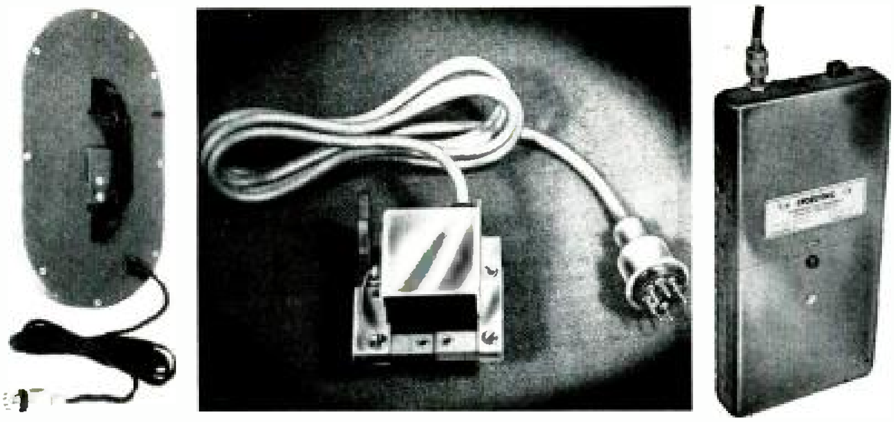
Every reader of radio supply house catalogues has seen the telephone pickup coils offered for a few dollars. They pick up the electromagnetic radiation from the phone itself and, with suitable amplification, reproduce both parts of the conversation. Naturally, police officers cannot attach such devices to the phones of suspects, but the same principle will work anywhere along the phone wires. Most legal phone taps are made by connecting a set of earphones or a tape recorder direct to the wires going to the suspect's phone. This is usually done with the knowledge of the phone company and the tap can be made at an exchange or at some convenient junction point.

In some cases all that is required is a spare set of wires in the cable and these are then connected in parallel so that the eavesdroppers can be "staked out" at a distance. Illegal wiretapping is often done by electromagnetic pickup or, in some cases, by splicing additional wires into the tapped line at some place difficult to spot. Investigators looking for taps always watch for the place where two wires go into a wall and four come out, because the extra wires are very likely going to a secret listening post. It is possible to check out the resistance of phone wires between points and determine from that if a tap is present, but where a pickup coil is buried in the wall, possibly taped right to the wires, such a tap is difficult to locate.

Only earphones and a recorder are needed in the way of electronic equipment or, where pickup coils are used, a sensitive audio amplifier is added to the equipment lineup. Such an audio amplifier must have a low hum level and

Fig. 2. Operators examining tracing by infrared spectrophotometer.





E F G

Fig. 1.

A Concealed transmitter and microphone.

B Miniature audio amplifier.

C Radio-frequency detector.

D Contact mike and vibration pickup.

E Metal detector.

F Clamp-on induction coil for phone taps.

G Pocket-sized FM transmitter.

provide a good impedance match with the pickup coil used.

A typical amplifier is shown in Fig. 1B and this is a completely self-contained unit. The meter shows the signal strength and can also be switched to indicate the operating voltages. Either earphones, a small speaker, or a tape recorder can be connected to the amplifier output, while its input can come from an induction coil like the one shown in Fig. 1F. This coil has a hinged core so that one of the two phone wires can be slipped through without any need to cut or strip the wire. Actually, the amplifier can be used for other surveillance work as well and is part of a complete kit offered by the *C. H. Stoelting Co.* of Chicago, one of the major suppliers of police and intelligence equipment.

A recent refinement in phone taps is a tape recorder which automatically turns on whenever the ringing signal of the tapped phone is detected. This is done by using the listening amplifier to actuate a relay which controls the tape transport. Another refinement is an audio amplifier and FM transmitter which can be hidden in the wall or in a closet and transmit the tapped phone conversations to a nearby receiver.

Next to eavesdropping on telephone conversations the "bugging" of rooms is the most widely used method of electronic surveillance. A "bug" is simply a hidden microphone which transmits the sound in the room to a remote listening post. This may be done with concealed wires to an adjoining room or by radio transmission to a nearby building or vehicle.

Naturally, such a transmitter has to be properly concealed. For only $100.00, the *Fargo Company* of San Francisco sells a complete microphone and transmitter concealed in a regular picture frame. No wires show since the unit is battery-operated and, unless a receiver is tuned to the correct frequency, no indications of the "bug's" presence can be detected.

Here we should point out that most of the transmissions by commercially available police apparatus take place in the 40-mc. band set aside for this purpose. Transmitters operate on narrow-band FM, with crystal control. Often battery-type receivers are not necessary because there is access to a power line. Where this is the case, the miniature transmitter shown in Fig. 1G can be used, possibly concealed in the wall with the antenna wire well hidden. While some of the miniature surveillance equipment uses transistors, most of the transmitters still use tubes and therefore require both "A" and "B" batteries. Output power is in the milliwatt range, but this is usually sufficient for reliable transmission within a few miles.

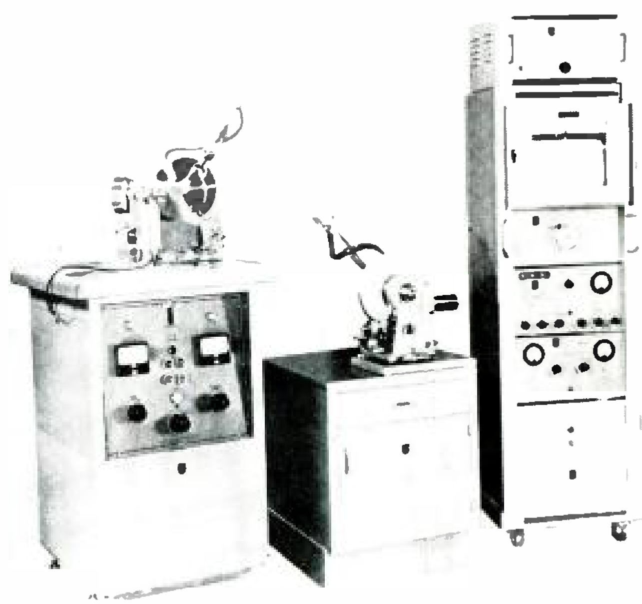
When it is impossible to secrete a microphone successfully, conversations can still be overheard by means of a vibration pickup and contact microphone of the type shown in Fig. 1D and the audio amplifier of Fig. 1B. The proper size pickup is held against either an inner wall, door, or other vibrating surface, but a good spot must be found if extraneous noises are not to drown out the conversation. Actually, there is a great deal of technical "know-how" involved in "bugging" a room since the directivity of the microphone, the room acoustics, and the location of noise sources all play an important part. A picture-frame microphone, for example, should be almost non-directional, but locating the picture over a steam radiator or next to a radio or TV set would not provide good surveillance. A lamp-concealed microphone should be fairly directional, but well isolated from its case since the jarring of furniture can give really horrible sounds. The audio amplifiers used are mostly transistorized—with low hum but limited frequency response. Wide-band response would be a drawback since this would amplify such noises as the rustle of clothing and the squeaking of shoe leather. Most voices are pitched in the 200-4000 cps region and this bandwidth is sufficient to reproduce clearly identifiable speech.

The "wired stool pigeon" is commonly used to obtain convictions in narcotics and extortion cases. A likely looking detective will make a contact with a dope addict or pusher and will then arrange for a purchase. At the appointed time he carries a miniature pocket transmitter like the unit shown in Fig. 1G while an associate in a nearby car receives and tapes the entire conversation. When the suspect later hears himself describing the quality of the "snuff" and arguing about the price, a full confession often follows.

Countermeasures

Just as in warfare, each measure has a countermeasure and each countermeasure can have a counter-countermeasure. Since some criminals might use wiretapping and "bugging" to snoop on other criminals or on law enforcement officers, the same companies which make surveillance equipment also manufacture a variety of countermeasure

Fig. 3. Example of laboratory-type x-ray diffraction equipment.



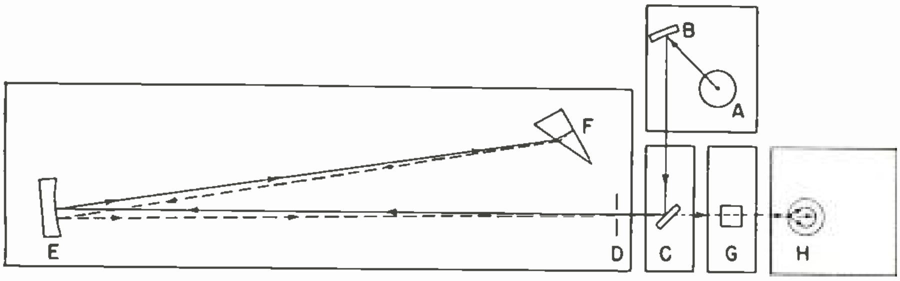


Fig. 4. Principle of the spectrophotometer. Source of light (A) may be tungsten lamp whose light is reflected and collimated through set of special mirrors (B, C, E). Prism (F) is aluminized at back surface and breaks up light into different wavelengths. By rotating prism only the desired wavelength can pass through slit (D) and be absorbed to some degree by unknown substance (G). Phototube (H) registers light passing through unknown substance and the output of the phototube is then amplified and recorded.

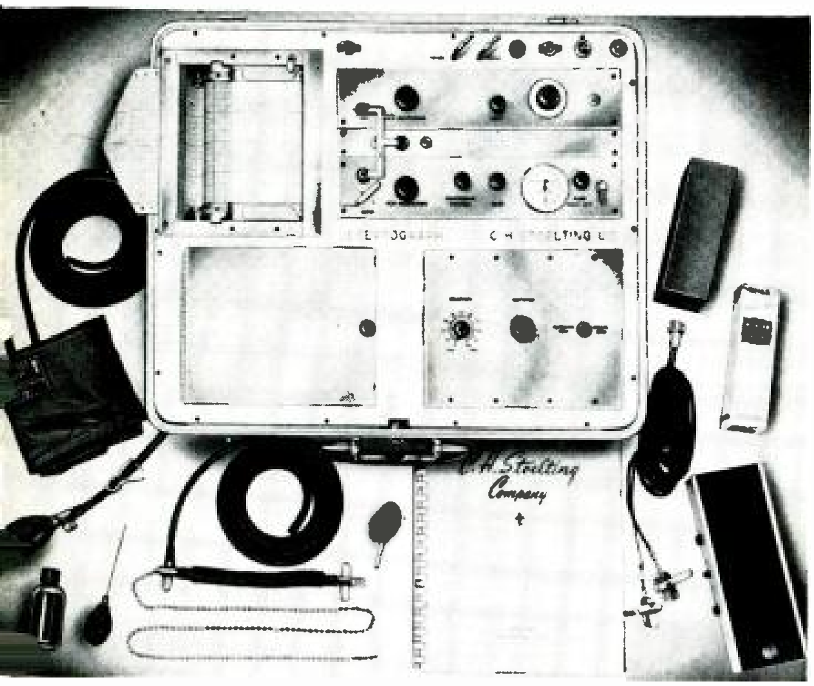


Fig. 5. A portable polygraph, or lie detector, along with its accessories.

devices. The *Mosler Research Corporation* of New York City, for example, sells a special communications cable which is wiretap-proof. The inner group of wires is surrounded by an electrostatic and magnetic (Mu-metal) shield and this, in turn, is surrounded by a ring of wires which carry a white-noise signal and are connected to a bridge circuit. The entire assembly is molded in plastic and covered with steel braiding. Any tampering with the outer wires sets off the bridge circuit alarm. Induction coupling is not possible since the white-noise drowns out any of the radiation which might leak through the double shield.

The most widely used countermeasures, however, depend on locating a phone tap or a bug. An experienced detective equipped with the latest electronic devices can usually establish the presence of any surveillance gear. Phone taps are located by bridge measurements of resistance. Induction coils are found either by visual search of the phone wires or else, if they are buried in the wall, by using a metal detector of the type shown in Fig. 1E, connected to the audio amplifier. This unit also helps to find microphones or other metallic objects hidden in wood or plaster walls. Transmitters are located by means of a small r.f. detector, connected to the basic audio amplifier. One such r.f. detector is shown in Fig. 1C and this unit covers from 50 kc. up to 410 mc. in nine bands. Nine tuned networks and a variable capacitor select the frequency. A long clip lead or r.f. probe serves as the antenna. Accurate frequency or high sensitivity is not needed since only the presence of an illegal transmitter in close proximity must be indicated. Other

Fig. 6. Instrument to check drunkenness.

r.f. detecting receivers are available which can be concealed on the wearer. Small direction-finding receivers are also available for locating illegal transmitters.

Clue Investigation

The heart of any investigation of clues is the police laboratory which provides the technical experts and the necessary equipment to track down and analyze even the simplest and most casual clues. A visit to the New York City police lab proved to be a real eye-opener. In addition to an elaborate photographic arrangement and complete chemical laboratory, such advanced devices as an electron microscope and a full set of radiation monitors are available.

Basically most investigation of clues centers around the identification of the famous "unknown substance." This may be a suspected narcotics, poison, dried blood, seminal fluid, underpaint of the hit-and-run car, dust from a DOA's trouser cuffs, or literally anything else. The lab's job is to find out what the substance is and, if possible, where it comes from. Chemical analysis may not be sufficient to identify the material and then, if the substance is inorganic, a sample of it goes into the spectrograph. There it is burned in an electric arc while the burning current is observed on a scope and the color spectrum recorded on a photographic plate. The resulting color lines often indicate what basic ingredients the material contains.

Organic substances are tested by an infrared spectrophotometer, like the one shown in Fig. 2. This device indicates the relative absorption of infrared radiation by the unknown material. By comparing the absorption figures with known substances, it is possible to identify at least some of the components of the material under test. Actually, this test is most useful in identifying narcotics because, no matter how the drug has been adulterated, its infrared characteristics will indicate in which group it belongs and its relative dilution.

Gasoline is also often checked by the infrared method. On the other end of the visible spectrum, the quartz spectrophotometer is also very useful in narcotics cases and in particular serves to identify morphine and heroin. Both spectrophotometers use the same operating principle, as shown in Fig. 4. A light of known wavelength is passed through the sample and its intensity measured by a phototube sensitive to that wavelength. The output of the phototube can be presented on a meter or graph and, by using a range of wavelength, a spectrographic picture of the unknown substance is obtained. The absorption characteristics of most commercial substances are known and by comparison the police can determine the composition of the unknown material.

For crystalline materials, such as unknown powders and most narcotics, x-ray diffraction equipment (see Fig. 3) often yields additional identification data. Here the sample is bombarded with x-rays and the result activates a photographic plate. Again certain diffraction patterns are well known and identification is made by comparison.

(*Continued on page* 111)

BMEWS

Ballistic Missile Early Warning System

America's primary early warning system for attacks by enemy missiles approaching over Northern Hemisphere is taking shape.

THE MOST POWERFUL radars in the world, the gigantic detection radars of the U.S. Air Force Ballistic Missile Early Warning System, are now sending their beams out over the polar wastes as part of an exhaustive test program to ready the first of the BMEWS sites at Thule, Greenland for operation this fall. The radars have been designed to have a range up to 3000 nautical miles toward Eurasian skies to detect ballistic missiles aimed at the United States, Great Britain, and southern Canada. Warning of an attack by enemy ICBM's will be flashed to North American Air Defense Command (NORAD) Headquarters in Colorado Springs and to Strategic Air Command (SAC) Headquarters at Omaha. The entire system will provide approximately a 15-minute warning in case of missile attack.

The four huge fixed-surveillance radar antennas already installed at Thule, Greenland and to be installed at Clear, Alaska radiate narrow fans of powerful r.f. energy at two different elevations. When a missile passes through the lower fan, radar pulses will bounce off it and be detected by super-sensitive receivers. From these radar echoes, the position and velocity of the missile will be determined. Seconds later, as the missile passes through the upper fan, radar echoes again will be picked up, and position and velocity will be measured. The missile's trajectory can then be calculated from these coordinates since it will be in "free flight" (unpowered) as it passes through the fans. Calculation of the trajectory will permit prediction of the impact area, impact time, and point of launch. Data processing equipment will rapidly compute this data and flash a warning to NORAD Headquarters in the U.S. So powerful will the multi-megawatt radar beams be that personnel must travel between buildings in the active missile-detecting area through shielded passageways. These are large enough to permit truck passage.

BMEWS Arctic bases will be thriving "small cities" complete with comfortable living quarters, good meals, medical facilities, and a variety of recreational outlets. The Thule site will house about 1000 men, while the Clear site will house about 600 men.

Prime contractor for the over-all system design is *RCA. Western Electric* is supplying the rearward communications. The giant radars at Thule were designed by *General Electric*. The complete installation and maintenance for at least two years will be handled by the *RCA Service Company*.

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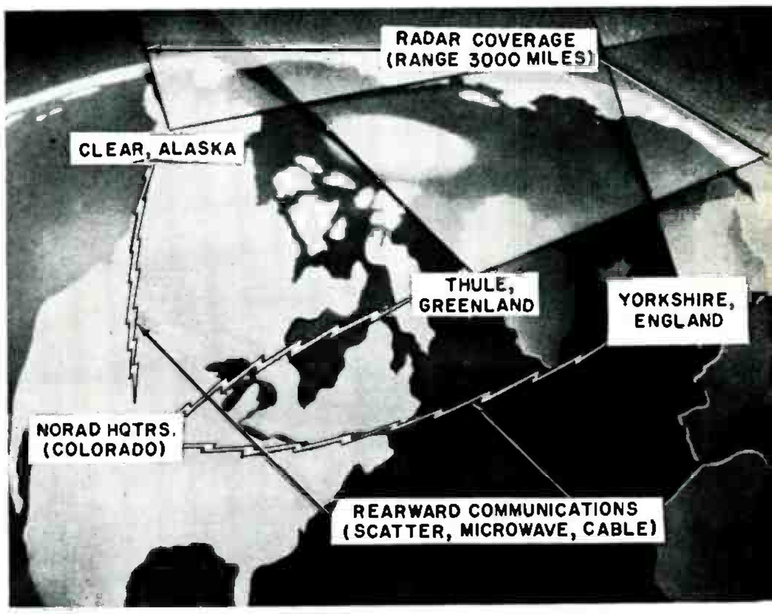
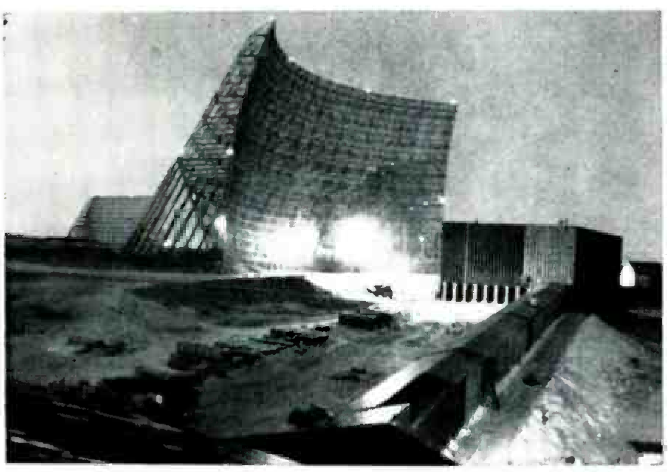
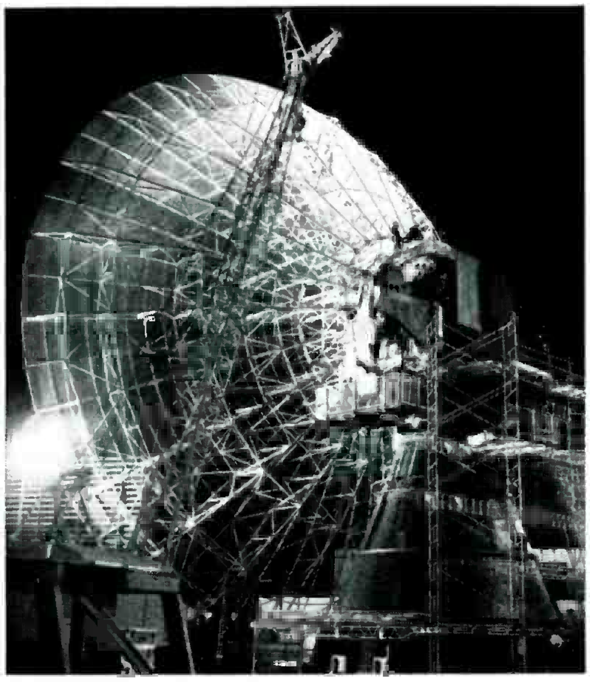


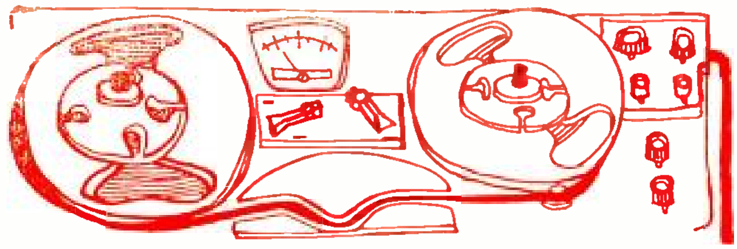
(Top) Powerful radars at these three sites will scan the skies over the polar region and Eurasian land mass. The Thule base is just about ready for full operation; the Alaska base is well along in construction; the Yorkshire base is just being started.



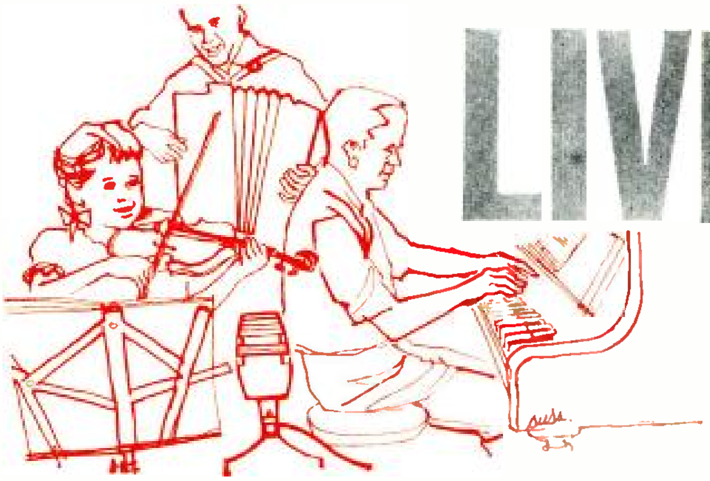
(Left) One of the four huge radar antennas that has been installed at the Thule site. Each of these giant reflectors is 400 feet long and 165 feet high. Two separate feed systems for each reflector produce two fan-shaped radar beams at different elevations. Radar range is up to 3000 nautical miles.

(Below) The radar tracking antenna to be installed at Yorkshire, England, is shown here during final construction. Reflector is 84 feet in diameter and it will be installed in 140-foot radome.





RECORD LIVE STEREO AT HOME



By **NORMAN H. CROWHURST**

Microphone requirements and techniques that may be used to make good stereo tape recordings at home.

MONOPHONIC high-fidelity—and now hi-fi stereo—can bring some wonderful entertainment into your home; a tape recorder can be used to capture permanently stereo broadcast programs but the ultimate realization to be derived from a stereo tape recorder comes from making recordings of a "live" program—your own family and friends performing in your own living room.

Some readers may feel that they do not do anything worth recording. They'd be surprised at the talent which can be unearthed around their own homes. Remember the fun a monophonic tape recorder engendered when each person heard his own voice recorded for the first time! It was good of everyone else, but "that's not me!" was the common reaction. This is nothing to what stereo can provide in the way of surprises.

If you record stereo correctly and reproduce the tape in the same room, the realism is fantastic. It will have you looking at the spot where someone stood when the recording was made—only to discover that he is not there now. His recorded voice is so real you'd think he left his ghost on the spot. If a member of your family or some of your friends are musical—so much the better. You can capture the fun of learning to play, musical evenings, and a host of other memories permanently and so realistically it will be like re-living them.

Don't worry about formalities such as getting everyone to keep absolutely quiet during the recording session. Incidental remarks in the background merely add to the realism. A stereo tape recorder with the proper microphone setup is just like a time machine. With it you can put back the clock and re-live what happened yesterday—or years ago.

The proviso of using proper microphone setups is important—a fact that has not received sufficient attention, in our estimation. Monophonic tape recorders were supplied with an inexpensive microphone which enabled you to record your own voice and anything you wanted with tolerably good quality. However, two such microphones are quite useless for stereo for two reasons: (1) the frequency response is not good enough, and (2) they have little directionality.

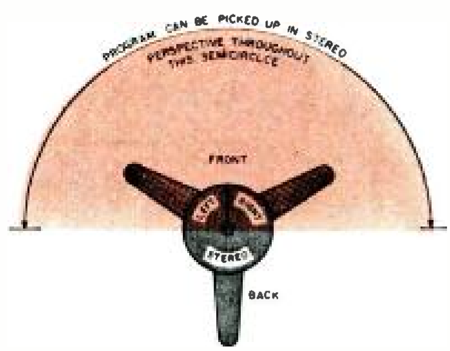
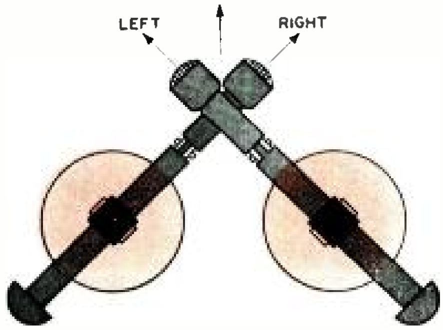


Fig. 1. Range of useful pickup angle in front of the dual-dynamic stereo microphone.

Fig. 2. Method of placing separate cardioid microphones to get the effect of Fig. 1.



Both these items are important if you want to achieve the realism we've just been discussing. You don't have to get microphones of professional quality, costing hundreds of dollars, but you do need microphones that suit the job—something better than the type normally supplied with the single-channel tape recorders, microphones that may cost the recorder manufacturer less than $5.00.

For this reason few of the newer tape recorders, incorporating stereo recording as well as stereo playback facilities, come equipped with microphones. Up until now, at any rate, the cost of the microphones would up the total price of the machine considerably. So they leave it to the user to make his own choice of microphones but this chore has proven to be a real deterrent to getting the fun we're talking about. You need advice about picking the right microphone.

Microphones

Undoubtedly the best recordings are made with the best microphones. While the best microphones generally cost more than inferior ones, a high price, in itself, is no guarantee of quality. There are good buys at low prices and some of the high priced ones perform

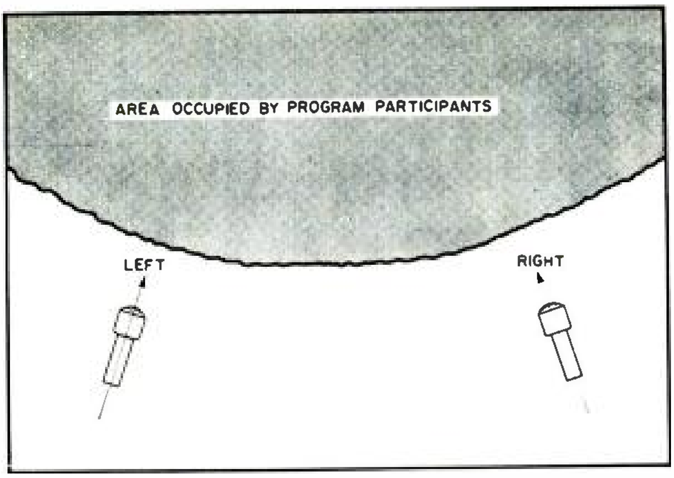


Fig. 3. Alternate placement of separate mikes to record stereo.

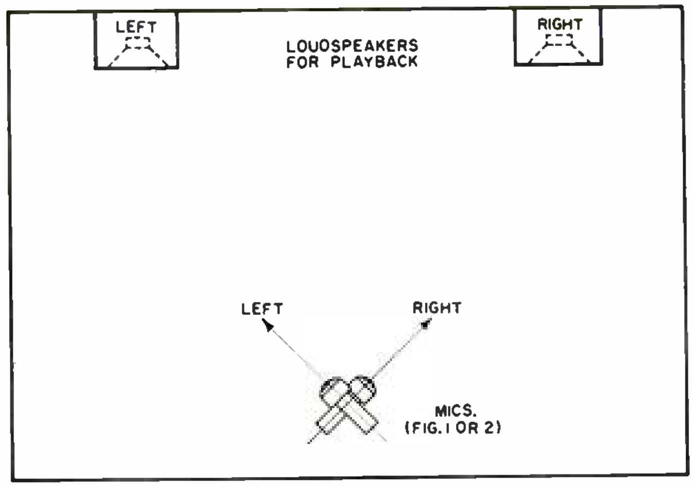


Fig. 4. With close mikes, separated playback speakers are best.

no better. So it is worth shopping carefully for your microphone.

While a good, smooth frequency response is highly desirable and the quality of the recording will directly reflect the uniformity of frequency response of the mikes, it is important to have properly matched microphones and to have the proper directional characteristics, correctly used.

Matched microphones for stereo are now on the market. Recently *Electro-Voice* announced that any of its microphones bought in pairs for stereo applications will be laboratory matched at no extra cost. This is a big help. In addition, *Shure, Turner,* and others are making matched stereo microphones available. Now you only have to decide which type of microphone is best—for you!

If you take enough pains, a pair of any good microphone type can be used for stereo recording. But omnidirectional types (which unfortunately include practically all the lower cost models) are more difficult to use. To achieve realism, everyone has to stand much closer to microphones of this type. You may be able to achieve this "closeness" for deliberate, planned pick-up but incidental sounds will not have realism. Someone making comments over on the other side of the room will sound as if he were out in the kitchen or some remote part of the house. It is surprising how much this falsification of incidental background spoils the whole effect.

This is why it is much easier, as well as giving much more natural and realistic results, to use directional-type microphones. You can use bidirectional ribbons with very good effect if you know how to utilize their unique "figure-8" directivity pattern to best advantage. But it is easier to get natural results without any particular care if you get microphones with a cardioid, or unidirectional, pattern.

Thus far, most of the unidirectional microphones have been in the higher price brackets. However, *Norelco* has recently started importing a moderately priced double microphone incorporating two cardioid elements. It comes with a ring-tip-sleeve jack that fits the stereo mike socket on the company's tape recorder. It can be used on other machines by removing the single jack from the double lead and fitting a pair of jacks to suit the recorder sockets.

Mike Placement

A good feature of the single double-element microphone is that the placement problem is eased considerably. The mike has an arrow pointing toward the front with the words "left" and "right" indicating the directions to occupy so sound will come from these speakers on playback. In trying it out, we found it entirely practical to spread our performers over a semicircle around the front (Fig. 1). And, if someone happens to speak from the back, it comes through realistically as a sound that is in the background.

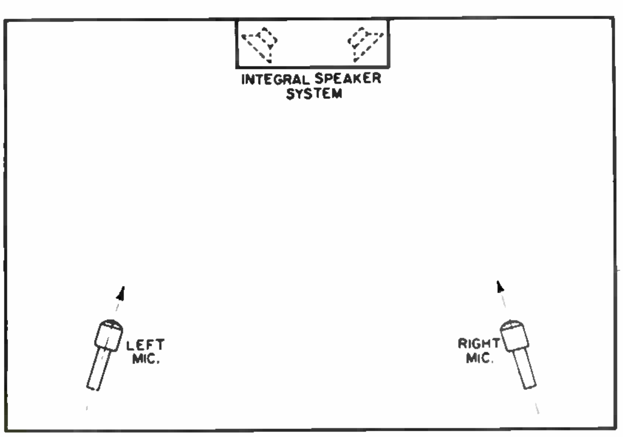
If you use separate cardioid microphones, you have a little more flexibility in placement. You could use an arrangement similar to that built into the *Norelco* (Fig. 2), or you could separate them to cover the spacing, as shown in Fig. 3. The way you place the recording mikes will influence the arrangement of the playback speakers.

If you use the double-element microphone or two microphones close together, the speakers should be spread apart in the conventional fashion (Fig. 4). But if you have your mikes widely spaced, you may find that directional speakers (either in a single or separate enclosures), radiating outwards from a central position, give a better effect, as indicated in Fig. 5. Alternatively, any of the single-cabinet units may provide the solution.

Speaker arrangement for best stereo reproduction depends, to some extent, on room size. All of the previous remarks have assumed an average living room area with dimensions in the range from 12 to 25 feet each way. Rooms smaller than 12 feet or larger than 25 feet each way (somewhat dependent on furnishings too) may need different treatment for best realism.

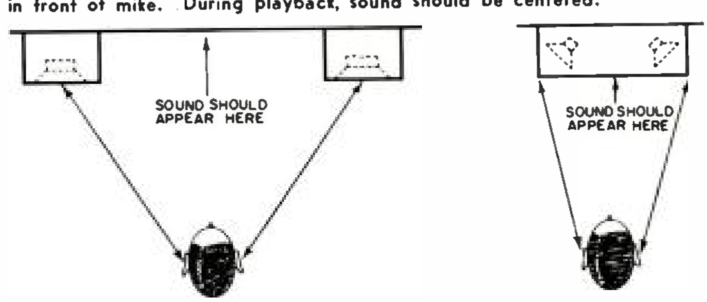
Very small rooms produce best results when both microphones (either a double-element one or two placed together) and speakers are placed close together. Very large rooms yield good recordings when the microphones and

(*Continued on page* 120)

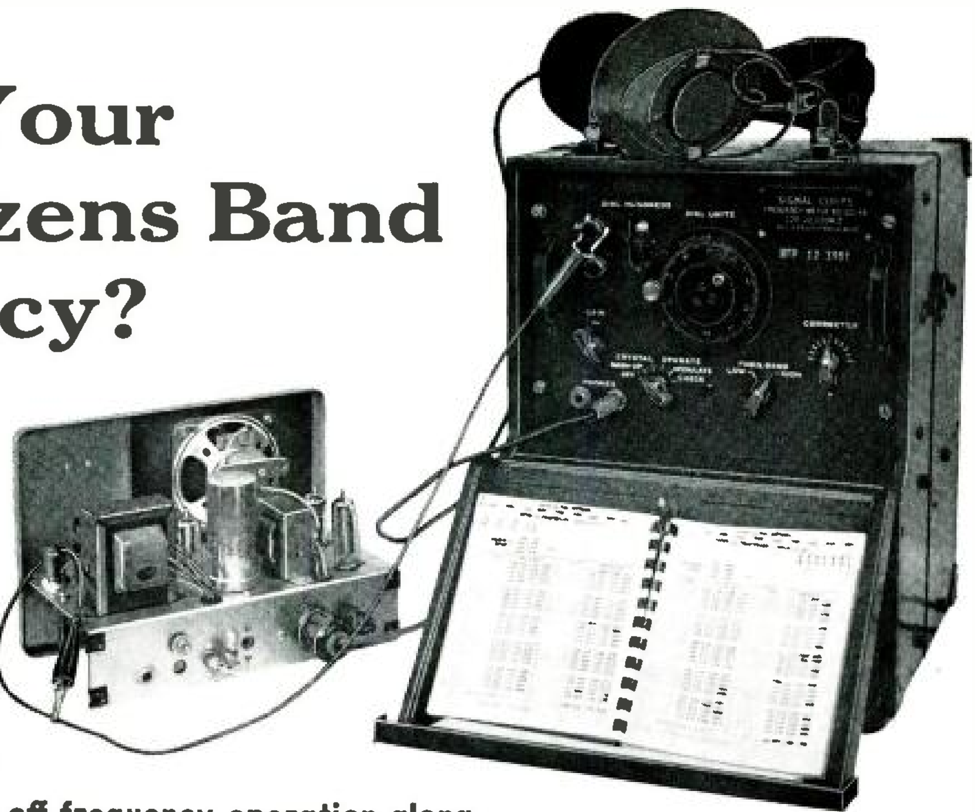


◀ Fig. 5. When widely separated microphones are used to record, closely spaced speakers are usually better during the playback.

Fig. 6. Check phasing with tape made of sound source directly in front of mike. During playback, sound should be centered.



What's Your Citizens Band Frequency?



Set-up used by author to check frequency.

By
DONALD L. STONER, 11W1507

Causes and remedies for off-frequency operation along with tests for frequency tolerance of CB transmitter.

A CONSIDERABLE number of citations have been handed out for violation of frequency tolerance on the class D Citizens Band. Section 19.33 of the Citizens Radio Service Regulations (part 19) specifies that all class D stations must operate within .005 *per-cent* of the assigned channel frequency. This point confuses some, for .005 *per-cent* of the operating frequency is actually .00005 times the operating frequency. As an example, at 27 mc., a carrier frequency tolerance of ±1350 cycles is allowed. Thus a station on 27.005 mc. could operate between 27.00365 and 27.00635 and be just barely legal. The permissible frequency variation, with respect to the adjacent channels, is shown in Fig. 1.

After the initial shock of receiving a citation wears off, the CB operator will probably turn a blazing eye towards his Citizens Band rig and speculate what went wrong.

Well, what did go wrong? If the transmitter is crystal-controlled why doesn't it transmit in the channel stamped on the crystal? At this point let it be stated emphatically that a guaranteed 0.005% tolerance crystal is capable of off-frequency operation, even if the advertisement states that it has been certified, verified, or homogenized!

Assuming that the crystal is not defective, there are two possible sources of error. First, and foremost, the crystal is calibrated for a particular frequency (by etching) and for use in a *specific circuit*. If the crystal is used in any other circuit, it *may be* off-channel. The second point to remember is that even though the recommended circuit is used, it can be misadjusted to produce off-frequency operation.

Crystal Capacity

Fig. 3 shows the schematic of a typical crystal oscillator that might be found in a Citizens Band transceiver. The crystal is connected between grid and ground. A tuned circuit is connected to the plate and energy from this circuit is coupled to the next stage. When the coil is resonated slightly higher than the crystal frequency, the stage will oscillate because of the feedback from plate to control grid. If the coil is tuned to the crystal frequency, or below, the phase angle of the feedback will be incorrect and the stage refuses to oscillate.

During manufacture, the crystal is etched to operate in conjunction with a particular amount of capacity shunting the crystal. This value has been standardized at 32 μμf. In Fig. 3 this capacity is a combination of the tube input capacity and the wiring capacity and the capacitor, *C*, which would be approximately 25 μμf. The sum of all capacities provides a total of 32 μμf., which is correct for shunting most crystals. In some CB units, capacitor *C* is a 3-30 μμf. adjustable device to put the crystal "on the money."

Some transceiver designs do not include capacitor *C* in the oscillator circuit. In these units only the grid and stray capacities appear across the crystal. The crystal, then, must be calibrated for use in this circuit (approximately 8 μμf. shunt capacity) or the transmitted frequency may be outside

Fig. 2. Shown at the right is the calibration curve of the frequency meter employed by the author to check the exact operating frequency of his CB transceiver.

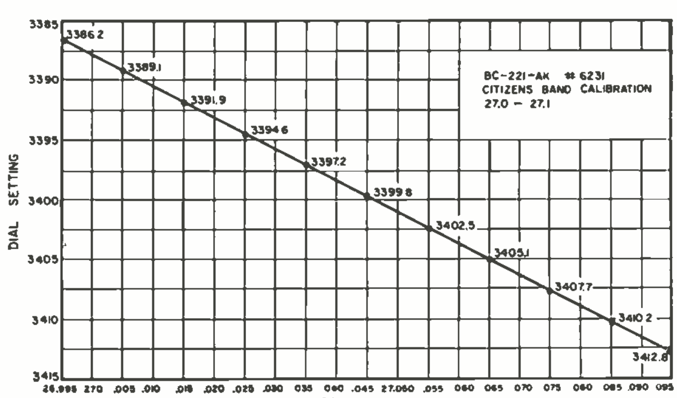
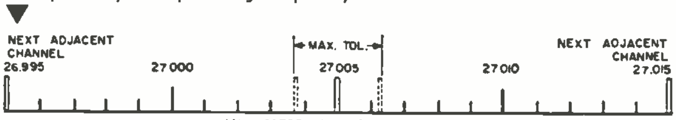


Fig. 1. Chart showing maximum frequency deviation allowed at 27 mc. Remember when making calculations that the .005% tolerance allowed by FCC is actually .00005 multiplied by the operating frequency used.



the tolerance band. If a crystal designed for use in a low-capacity circuit is used in Fig. 3, it will quite likely be off-frequency. By the same token, if you order crystals designed to "see" 32 $\mu\mu$f. shunt capacity, they *may* be off-frequency in the low-capacity circuit as well.

It is safe to assume that when you order a Citizens Band unit it will be in tolerance. But what about changing frequency? You would be wise to order additional crystals from the same firm that sold the transceiver. You are more likely to receive a replacement crystal designed for that unit.

If your unit has capacitor *C*, you can safely order crystals from any company producing crystals for use in "standard" capacity circuits. If capacitor *C* is not included in your oscillator circuit (Fig. 3), you can still order standard capacity crystals by adding an external capacitor, as shown in Fig. 4. This "trick" adds the necessary capacity without making circuit changes. Be sure to use an NPO (no drift) capacitor and insert the crystal so the capacitor is positioned away from heat-producing components. Also be careful when soldering to the pins not to overheat the crystal. Only a small amount of solder is necessary.

Don't be tempted to add too much capacity to the circuit! The classic example of this situation is the fellow repeatedly cited for off-frequency operation. Investigation showed he had modified his transceiver by installing a 10-position crystal switch at the end of a three-foot piece of coaxial cable. The cable alone had almost 100-$\mu\mu$f. capacity!

Pulling

The second reason for off-frequency operation, mentioned earlier, is known as crystal "pulling" and is caused by misadjustment of the oscillator plate coil. Since the tuning of this coil plays a large part in creating the oscillations, it can be expected to influence the frequency of the oscillator. Fig. 5 shows a graph of frequency *versus* oscillator coil tuning for a typical CB transceiver kit. When the slug is properly positioned in the coil (as explained in the instruction manual) the operating frequency will be the same as shown on the crystal. This is indicated as zero, or nominal, in Fig. 5. As the slug is turned counterclockwise (ccw) the frequency increases and the output, or drive to the amplifier, starts to fall off. As the core is turned clockwise (cw), the frequency drops, reverses slightly, then suddenly quits oscillating. If the slug is left between nominal and one or two turns clockwise, the oscillator performance will not be reliable, even though it may be on-frequency. The graph, Fig. 5, plainly shows that a misadjusted oscillator coil can shift the frequency more than 1600 cycles from the nominal and well outside the tolerance of 1300 cycles.

Testing Your Station

Again referring to Part 19 of the rules, section 19.54(b) says in part: ". . . . the Commission may require the applicant to certify that the frequency stability of the crystal-controlled transmitter is within the tolerance specified. . . . ." You may be called on to prove that your station is within the specified 0.005% tolerance at any time.

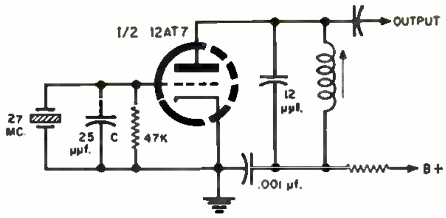


Fig. 3. Typical crystal overtone oscillator found in many CB transceivers. Capacitor "C" may be omitted. Refer to text.

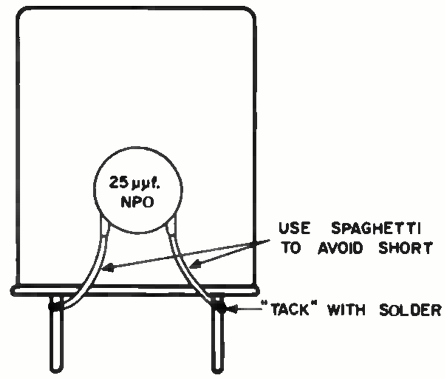


Fig. 4. Standard crystals can be used in low-capacity oscillator circuits by "tacking" capacitor to crystal pins, using spaghetti-covered wire to avoid short circuits.

At the moment there are only a few Citizens Band service shops and only a small percentage of these are equipped to certify a transmitter frequency. How, then, can the Citizens Band operator make sure his transmitter is well within his transmitting channel?

If an amateur radio operator in your area owns a *Collins* 75A series receiver, he can use it to check your frequency on the old 11-meter ham band. When properly calibrated, and in the hands of a skilled operator, this receiver is capable of ± 100-cycle accuracy! The following procedure should be closely adhered to: Warm up the receiver and Citizens Band transceiver for at least 15 minutes. Then check the 100-kc. frequency standard in the receiver against WWV. Wait until an unmodulated period occurs and "zero in" the calibrator. When you can no longer hear a beat note, but the meter swings slowly back and forth, you are within a few cycles and close enough for our purpose. Set the receiver dial at exactly 27.0 mc., turn on the b.f.o. and set the pitch control to zero beat. Then check the calibration accuracy at 27.1 and 26.9 mc. The dial should be within 100 cycles. If it is not you will have to take this error into account when measuring the transmitter frequency. Finally, connect a 52-ohm dummy load to the transmitter, turn the transmitter on, and tune the receiver to zero beat. You can then read the transmitter frequency directly from the receiver dial. If you want to know how many cycles the transmitter is off, set the receiver to the channel frequency and compare the beat difference with an audio oscillator.

Whether the FCC would accept such a test as a "certification" of frequency, the author is not prepared to say. However, this is not the point. The measurement just described should be used before a citation arrives! You will be able to determine your frequency quite closely but more important, the test will tell you if the transmitter is dangerously close to the channel edge.

Enterprising groups of CB operators would be well advised to invest in a surplus BC-221 or LM frequency meter, to check the accuracy of transmitters in the group. Although these frequency meters only go to 20 mc., they will generate super-accurate signals on the Citizens Band by using the second harmonic of a 13.5 mc. signal.

The author uses a late model BC-221-AK for testing Citizens Band transmitters. It was calibrated in the following manner. All frequencies between 13.48 and 13.63 mc. (one half of the CB spectrum) listed in the BC-221 calibration book were plotted on a piece of graph paper with quarter-inch squares. Actually four sheets, with 100 kc. on each sheet, were used for greater accuracy. The points were connected and the result was a graph of frequency *versus* BC-221 dial reading. By making the graph large it is possible to interpret to 100 cycles. A typical graph is shown in Fig. 2 and covers the range between 27.0 and 27.1 mc. (For simplicity, some of the divisions have been omitted from the curve reproduced here.)

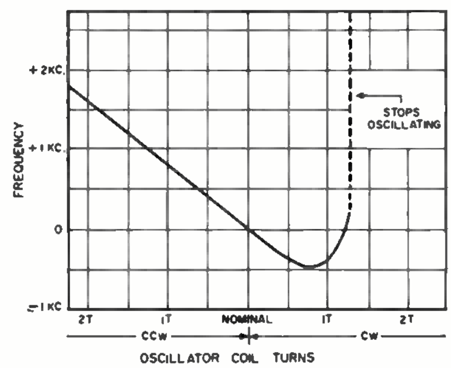


Fig. 5. Curve of frequency plotted against oscillator coil turns for typical transceiver kit. When the coil is adjusted as per the manual instructions, the frequency will be approximately at the nominal point.

Repairing Your Transmitter

What about the CB operator we left dangling with a defective transmitter? He certainly doesn't need to test the transmitter. He knows it is off-frequency, and in writing too!

Section 19.71(c) has this to say about the situation . . . "all transmitter adjustments or tests during or co-

(*Continued on page* 95)

Transistorized Mike Mixer

By **LYMAN E. GREENLEE**

Construction of simple circuit that will handle up to four low-impedance dynamic p.a. microphones.

THE technician who rents sound equipment often has requests for multiple-mike setups. As a general rule, these requests are for coverage of round-table discussions where the mikes are used for speech by persons of widely varying vocal characteristics. Good dynamic mikes have a low output level to start with and when several are coupled together, it is a virtual necessity to have preamplifiers to adjust the volume of each mike to a satisfactory level.

This little 4-channel job is built into a 7" x 7" x 2" aluminum chassis base and powered by 3 penlite cells. *Raytheon* 2N133A low-noise a.f. transistors are used in a conventional preamp circuit. The circuit is shown in Fig. 1 and the layout of parts can be seen from the photographs.

The resistors are connected from the pins on the transistor sockets to eyelets in a 1/16" Bakelite sub-panel. Resistors R_1, R_2, R_3, R_6, R_7, R_8, R_{11}, R_{12}, R_{13}, R_{16}, R_{17}, and R_{18} are mounted underneath the sub-panel with the transistor socket base so that the coupling capacitors, C_1, C_5, C_9, and C_{13}, can be connected through the eyelets. The photograph showing the inside of the mixer should also make this method of assembly clear. All parts are mounted and wired to the sub-panel before it is installed in the case. Wrap all of the electrolytics with cellophane tape for insulation. Note that all ground connections are to be made to a common point.

The four *Mallory* U24 20,000-ohm pots (R_4, R_9, R_{14}, and R_{19}) are mounted on the sub-panel but the shells and shafts should be grounded to the case. Mount these controls on a separate piece of thin aluminum, 1½" wide and 6" long, which will be grounded when the sub-panel is mounted. The whole assembly is mounted in the case on five 6-32 bolts, 1" long with suitable spacing washers which can be cut from scraps of tubing.

(*Continued on page* 119)

R_1, R_7, R_{12}, R_{17}—1500 ohm, ½ w. res.
R_2, R_6, R_{11}, R_{16}—330,000 ohm, ½ w. res.
R_3, R_8, R_{13}, R_{18}—39,000 ohm, ½ w. res.
R_4, R_9, R_{14}, R_{19}—20,000 ohm pot (Mallory U24)
R_5, R_{10}, R_{15}, R_{20}—270 ohm, ½ w. carbon res.
C_1, C_3, C_5, C_7, C_9, C_{11}, C_{13}, C_{15}—5 µf., 6 v. elec. capacitor
C_2, C_8, C_{12}, C_{16}—50 µf., 6 v. elec. capacitor
C_4, C_6, C_{10}, C_{14}—10 to 50 µf., 5 v. elec. capacitor (optional, see text)
S_1, S_2, S_3, S_4—S.p.s.t toggle switch
J_1, J_2, J_3, J_4, J_5—Mike connector
B_1—Three 1.5 volt penlite cells
V_1, V_2, V_3, V_4—2N133A a.f. transistor (Raytheon)
1—7" x 7" x 2" aluminum chassis
1—Base for 7" x 7" chassis
1—4" x 6" x 1/16" piece of linen Bakelite

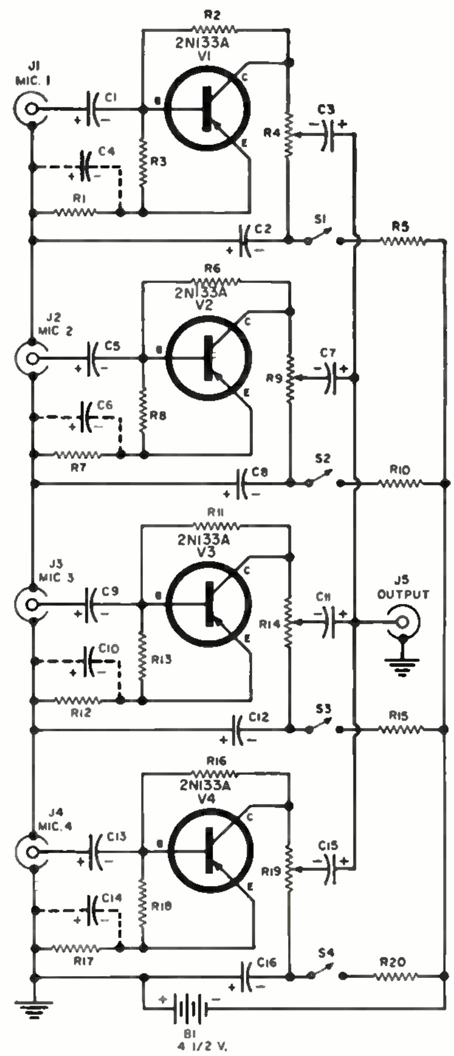
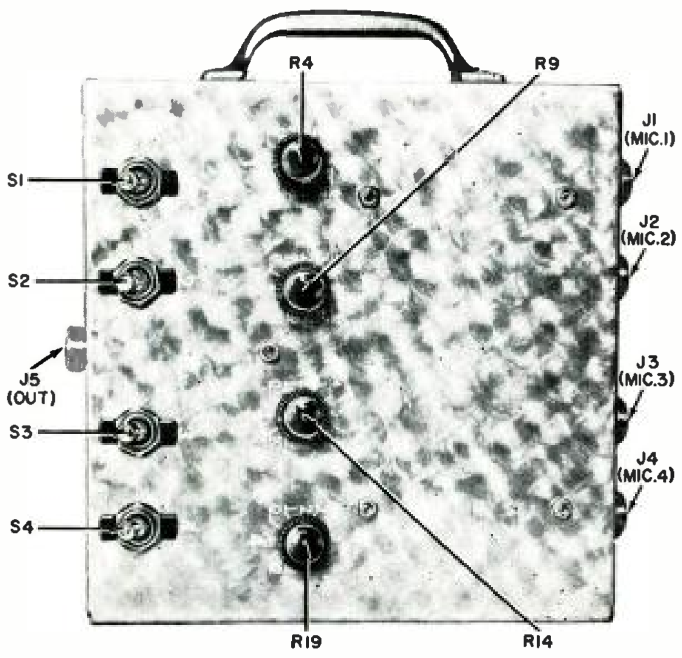
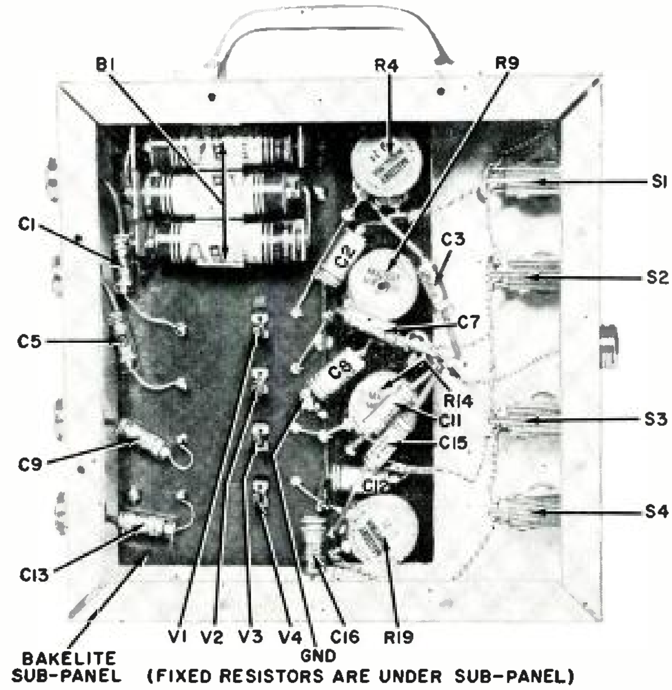


Fig. 1. The circuit employed by the author is seen to consist of four identical microphone preamps. If only speech is to be amplified, then the four dashed capacitors are omitted.

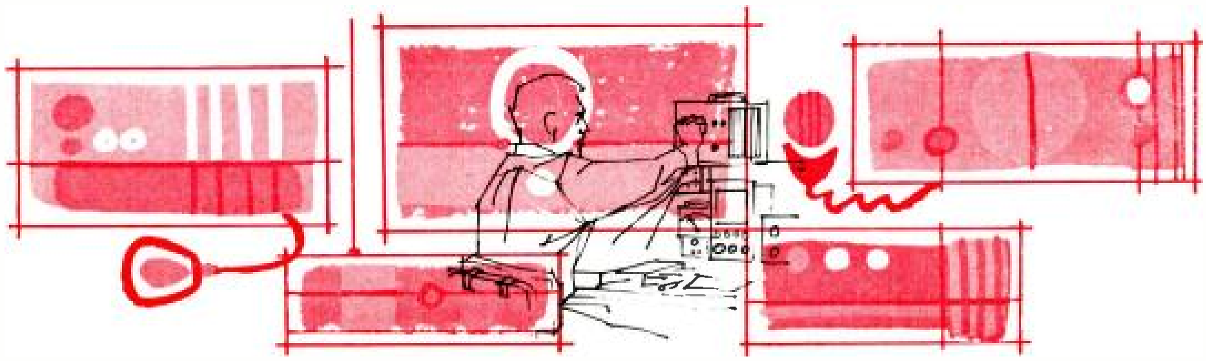


Front-panel view of mixer, showing level controls and switches.



Interior view shows the locations of the components employed.

How to Service CB Equipment



By **LEO G. SANDS**
Author, "Class D Citizens Radio"

Service and maintenance in shop or on field calls: techniques, equipment used for Citizens Band gear.

SERVICE on CB equipment always runs into "extra" requirements. For example, both the customer and the FCC must be satisfied. While the latter might not take direct action against a technician whose work results in unlawful operation of a transmitter, FCC action against the owner would reflect on the ability of the technician who does the work.

We are dealing with receivers that must provide the "extra" sensitivity to work on signals from transmitters that put out only one to three watts, instead of many kilowatts. We are dealing with transmitters that cannot afford to put out much less than their full rated power (but no more), without overmodulation, that must be right on frequency, and must not interfere with other services.

Service will require such conventional procedures as replacing defective tubes and parts. In addition, there are certain chores that must become routine on any set brought to the shop. On the transmitter, these include the measurement of frequency, power input, power output, and modulation percentage. On the receiver, this means a check on sensitivity and also on frequency (with some receivers). In either portion of the equipment, retuning or re-alignment will follow a discovery of frequency error and, if transmitter output or receiver sensitivity is below rated value, it may be necessary to replace tubes that are weak although not otherwise defective.

Where the equipment is not brought into the shop—on field service calls—the technician should be prepared to measure efficiency of the antenna system, tune the transmitter for optimum performance with its antenna connected, and make on-the-air performance tests of both transmitter and receiver, including a check on operating frequency.

The Test Equipment

To carry out the procedures mentioned, the technician should have a minimum complement of test equipment. On field service calls, this will include an r.f. power meter, a tube tester, a v.o.m., and a dummy antenna. In the shop, he might have a battery eliminator (6-12-volt d.c. supply), a v.t.v.m., a v.o.m., at least one dummy antenna, appropriate signal generators (i.f. and r.f.), a frequency meter, an r.f. power meter, a general-purpose tube tester, and a grid emission tester.

As to the shop d.c. source, this could very well consist of a pair of 6-volt storage batteries floated across a charger. However, an adjustable supply will make it possible to simulate more closely the conditions of use encountered in the field. In a vehicle equipped with a 6-volt battery, for example, input to the equipment may vary from 5.5 to 7.5 volts; in a 12-volt system variation may be from 11 to 15 volts. On the bench, it is often important to test equipment at the extremes. For example, while performance should be satisfactory with the lowest input voltages, transmitter output should not be driven above legal limits with the highest input voltages.

Few test instruments will be more important than the frequency meter. It should be capable of measuring in the 27-mc. band to an accuracy of .0025% or better. There are three available types that are suitable. In the heterodyne frequency meter, a tunable oscillator is zero beat with the transmitter signal and frequency is read directly from the instrument dial or a referenced calibration chart. Another type measures the difference between the unknown frequency and a known reference frequency, giving this difference in kilocycles on the scale of the meter. The reference frequency is that of an internal crystal. The third type is an electronic counter that counts the number of cycles per second.

The signal generator (or generators) should cover the range from 450 kc., or less, to 30 mc. to take care of all operating and i.f. possibilities. It should be possible to attenuate signal down to less than 1 microvolt.

A dummy antenna can be made up by attaching a No. 47 lamp to an antenna connector. Better than this is a load consisting of ten 510-ohm carbon resistors in parallel. Still better is the purchase of a professional dummy load like the *Sierra* 160-5N, which is fully shielded to prevent radiation and will handle up to 5 watts.

Transmitter input power can be measured with a v.o.m., but output measurement requires other instrumentation. A termination-type r.f. power meter, such as the *Sierra* 185A-100FN or *Bird* 611, measures transmitter power while also serving as a dummy load. Fig. 1 is a schematic of such a unit.

A directional or bi-directional r.f. power meter has some additional uses. Connected between a transmitter and its antenna (or dummy load), it not only measures output but tells you how

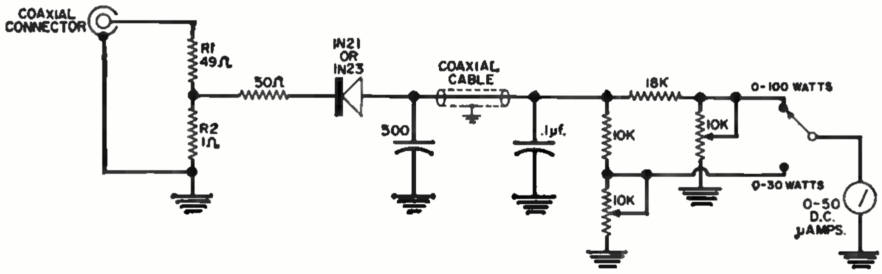


Fig. 1. This schematic of a Sierra termination-type r.f. wattmeter is typical.

much of this power is actually being absorbed by the antenna.

Transmitter Check-Out

One of the principal tasks to be performed in the shop that is different from conventional service procedure is the check on the transmitter. This is begun by connecting the transmitter's antenna jack to a termination-type r.f. wattmeter, or bi-directional r.f. power meter terminated in a 50-ohm dummy load. Use a coaxial jumper cable (RG-8/U or RG-58/U) equipped with suitable connectors at each end. If neither of these instruments is on hand, a relative indication may be had with a field-strength meter placed nearby.

With power applied to the CB unit, turn the transmitter on and note the level of power output on the meter. It should be somewhere between 1.5 and 3 watts. Whistling into the microphone should produce an increase in this reading. At 100% modulation, power output should increase 50% when the modulating signal is a sine wave. Percentage of modulation is approximately equal to 141 $\sqrt{(P_m/P_{cw})}-1$ when P_m is the power output, in watts, during modulation and P_{cw} is the power, in watts, of the unmodulated carrier. Ordinarily, a typical CB transmitter is modulated about 80-85% during speech transmission.

If the transmitter passes the tests made so far, we know that it works, but we do not know if it meets FCC requirements.

Measure transmitter plate voltage with a d.c. voltmeter with the transmitter turned on. Measure the cathode or plate current of the r.f. power-amplifier stage. Multiply the plate voltage by the plate or cathode current (in amperes) and you should come up with a figure between 4 and 5 watts. If it is less than 4, the transmitter may need a new tube or retuning. If it is more than 5, it must be reduced since 5 watts is the maximum allowable input power.

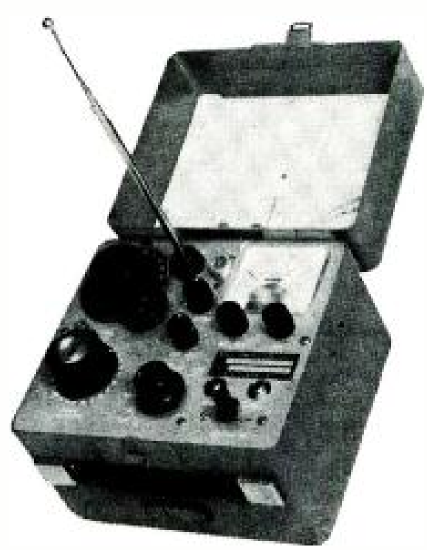
Some sets are provided with a metering jack to enable measurement of r.f. power-amplifier cathode current (combined plate and screen current). If not, it will be necessary to determine plate current by other means. In the circuit shown in Fig. 2, the d.c. voltage drop across R_1 can be measured and translated into current. If this voltage is 75 volts, the current through R_1 is 30 milliamperes since $I=E/R$ or 75/2500 =.03 ampere. But, this also includes screen current. If the measured voltage drop across R_2 is 15 volts, then the screen current is 2.2 milliamperes. The plate current alone is therefore 27.8 milliamperes. If the plate voltage is 175 volts, the power input is 4.86 watts. In multi-channel transmitters, make these checks on each channel.

Before measuring frequency, make sure that the frequency meter has been warmed up for a sufficiently long period as prescribed in the instrument's instruction book. Connect a short piece of wire to the antenna post of the frequency meter to provide adequate pick-up of the transmitter signal. If the frequency meter is of the continuously tunable type, adjust it to zero beat with the transmitter signal. Check the instruction book to make sure you are using the correct beat note. Note the dial reading at zero beat and read the frequency from the dial or the calibration chart.

When using a *difference*-type frequency meter, set the instrument's channel selector and tuning adjustment to the desired frequency. Turn the transmitter on and read the difference between the transmitter frequency and the reference frequency as indicated by the meter. If the meter reads "2 kc.," for example, the transmitter is off by more than the allowable .005%. At 26.965 mc., the frequency must not be more than 1.348 kc. higher or lower. At 27.255 mc. the tolerance is 1.36 kc.

Allowance must be made for error in the frequency meter. If the latter is accurate to .0025%, transmitter frequency should be within .0025% to insure the .005% tolerance. If the set is equipped for multi-channel operation, measure all the frequencies used for transmission.

This frequency meter (A. B. DuMont Laboratories) can also be used as a signal generator. It can be equipped with crystals for all 23 CB channels.



As further insurance that the transmitter will meet FCC requirements under nearly all operating conditions; power output, modulation, power input, and frequency should be checked when operating the transmitter at the highest and lowest power-supply voltages. If a variable-voltage transformer is available, an a.c.-operated transmitter may be checked out with input voltage varied between 100-130 volts. Power input should remain under 5 watts, frequency should stay within limits, and overmodulation should not occur. Battery-operated sets should be checked out at approximately 87% and 120% of rated input voltage.

Transmitter Troubles

When plate and filament voltages are normal, inadequate power output can be caused in either the oscillator or r.f. power-amplifier stage. If the oscillator stage is not functioning properly, grid drive to the r.f. amplifier will be below normal. In the circuit shown in Fig. 2, grid drive can be measured at point *A* with a volt-ohmmeter or v.t.v.m. Its normal value should be noted in the set's instruction book. If it is known or suspected to be below normal and tuning of L_1 does not produce enough drive, the trouble could be due to a weak oscillator tube or an insufficiently active crystal.

The r.f. power-amplifier plate current (or cathode current) should drop sharply as the plate tank circuit is tuned to resonance at the operating frequency, particularly when an antenna or dummy load is not used. If it doesn't and grid drive is adequate, try a new tube. With the transmitter output terminated in a dummy load, the dip at resonance may not be as sharp, depending upon the setting of the antenna loading capacitor (C_2).

If the transmitter output varies or is intermittent, the trouble could be due to oscillator instability. Try adjusting L_1 for somewhat lower grid drive, leaving it set at the point where the oscillator takes off every time that the transmitter is keyed.

Receiver Check-Outs

Although the FCC isn't particularly concerned, it is always important that a receiver be tuned to the right frequency for satisfactory reception, and this is particularly critical with fixed-tuned units. A frequency meter should be used for this check rather than a signal generator, which is less accurate. Even a tunable receiver should be checked to make certain that it can pick up the frequency extremes of 26.965 and 27.255 mc.

To check a fixed-tuned superregenerative receiver, set the frequency meter to the appropriate frequency and trim the receiver detector tuning slug for maximum quieting of background noise. To check a fixed-tuned, crystal-controlled receiver, set the frequency meter and then rock its tuning dial while metering a.v.c. voltage to determine that maximum a.v.c. voltage is obtained at the correct frequency. For multi-channel sets, repeat for each channel.

It is imperative, because of the low power, that receiver sensitivity be up to rated value. To measure, connect the output of a signal generator through a 51-ohm resistor to the set's antenna socket. While metering audio-output voltage, and with the receiver's volume control set to maximum and its squelch control (if there is one) set for fully unsquelched condition, tune the signal generator to the receiver frequency. Turn on the signal generator modulation (30% AM) and rock its tuning dial until maximum audio output is indicated, keeping the signal generator output low enough to prevent overloading. While alternately turning the signal generator modulation on and off, adjust the signal generator output until a level is found where the audio output voltage drops 50% when modulation is turned off.

When modulation is off, the meter indicates noise level. When modulation is on, the meter indicates signal level. When signal voltage is twice as great as noise, we have a 6-db signal-to-noise ratio. At this point, note the setting of the signal generator output attenuator. If calibrated in microvolts, the sensitivity of the receiver can be said to be 50% of the indicated microvolts for 6 db signal-to-noise ratio. (Because of the 51-ohm series resistor, the signal at the receiver antenna input is approximately 50% of the actual output of the signal generator.)

There is nothing difficult about aligning the receiver of a CB unit. If it is a tunable superregenerative type, there are usually no alignment adjustments to make, except possible trimming of the broadly tuned r.f. stage. Both the r.f. amplifier and detector fixed-tuned superregenerative receivers, of course, should be aligned for maximum audio output (modulated signal) or noise quieting (unmodulated signal) against a very weak signal from a signal generator or frequency meter.

Procedures for alignment of a single-conversion superheterodyne receiver are the same as for any AM broadcast receiver. When the receiver employs dual conversion, however, there are two intermediate frequencies.

Remove the receiver crystals at the start of the alignment procedure to disable the local oscillators. Connect the output of the signal generator through a .001-μf. capacitor to the grid of the second mixer, and tune the signal generator to the i.f. (usually 455 kc.). Either a.v.c. voltage (d.c.) or audio-output (a.c.) may be monitored. Turn down the signal-generator output so that only a little a.v.c. or audio voltage exists. Adjust the i.f. transformers, working back from the secondary of the last transformer toward the second mixer, to obtain a maximum reading. (When monitoring audio-output voltage, it is a good idea to ground the a.v.c. bus during the alignment for clearest indication.)

After the i.f. and detector stages have been aligned, re-install the second-oscillator crystal. Connect the signal generator (through a .001-μf. capacitor) to the grid of the first mixer and tune it to the second i.f. Now adjust the i.f. transformer between the first and second mixer for maximum output indication.

Re-install the first-oscillator crystal (or crystals). Feed the signal-generator output to the antenna terminal through a 51-ohm series resistor. Tune the signal generator carefully to the operating frequency and reduce its output so that only a very small signal is present. After determining that the signal generator is set correctly (check with a frequency meter if not sure), tune the first mixer and r.f. amplifier trimmers for maximum output indication. In the case of multi-channel, fixed-tuned sets, these trimmers are usually average-tuned so that the sensitivity on all channels to be used is about the same. Tunable receivers may be aligned at some channel near the high end of the band. If sensitivity at the high and low ends of the band differs greatly, try re-aligning the receiver front end at some frequency near the middle of the band. Procedures for aligning single-conversion superheterodynes are similar except that there are fewer steps.

Squelch sensitivity determines the effective sensitivity of a receiver for most applications. Since most users of squelch-equipped CB sets operate their receivers with the squelch control set to eliminate background noise between incoming signals, the full sensitivity of the receiver will not be utilized. The squelch threshold is variable, as determined by the adjustment of the control. To check squelch sensitivity, apply a modulated signal to the receiver, increasing the level of the signal until the squelch opens (the modulating tone is heard through the loudspeaker) and note how many microvolts (50% of indicated value) of signal are required to trip the squelch. In the reverse direction, reduce the signal level until the squelch closes. Usually, the squelch requires a bigger signal to open it than to close it.

Other Receiver Checks

With the signal generator connected as for sensitivity checks, the *selectivity* of a receiver can be measured. Tune the signal generator 10 kc. above the operating frequency and advance the output-level attenuator until the audio-output voltage is the same as for an on-frequency signal. If, for example, the reference output level is obtained with a one-microvolt signal at the operating frequency, but a 10-microvolt signal is now required to produce the same output indication, it can be said that the receiver attenuates signals 10 kc. above the operating frequency by 20 db. Now set the signal generator 10 kc. below the operating frequency. The amount of signal to produce the identical output at +10 kc. and −10 kc. off the operating frequency should be the same. If not, the receiver should be re-aligned to obtain a symmetrical selectivity pattern.

Receiver performance should be checked at the highest and lowest anticipated supply voltages to insure customer satisfaction.

Service Calls

While it is more convenient to service equipment in a shop, it is often necessary to tune up the equipment so it will work at maximum efficiency when connected to the customer's antenna.

To obtain maximum range, the transmitter should be tuned with the customer's antenna connected. Here is where a bi-directional r.f. power meter comes in handy. Connect the instrument between the set and the set end of the antenna transmission line. Set the meter to read *incidental* power and tune the transmitter for maximum power indication. Then set the meter to read *reflected* power, which is the energy that is produced by the transmitter but which is reflected back from the antenna. Subtract the reflected-power reading from the incidental-power reading and you will know how many watts are being absorbed by the antenna.

Of the complaints from customers (which include noisy reception, insufficient range, interference from other stations, and distortion), the most common is usually noisy reception. Sometimes there is very little, if anything, that can be done about it. The trouble may be caused by excessive signal absorption (by foliage, for example) or

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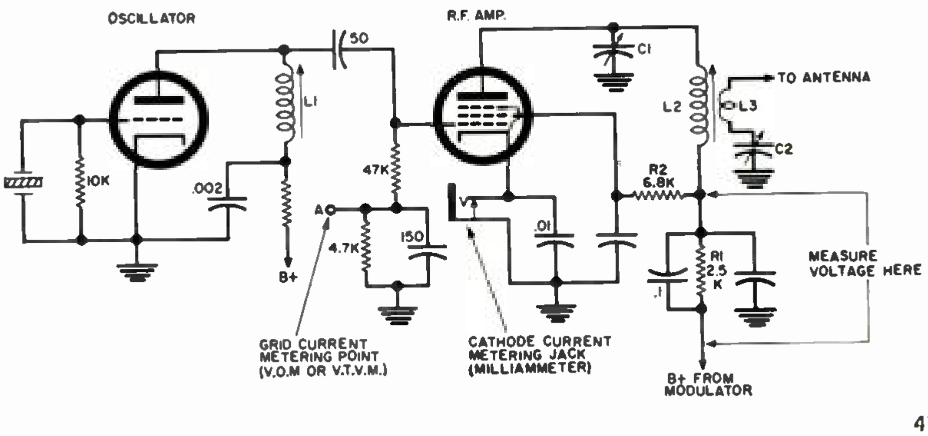
Fig. 2. Portion of a hypothetical transmitter circuit shows key check points.



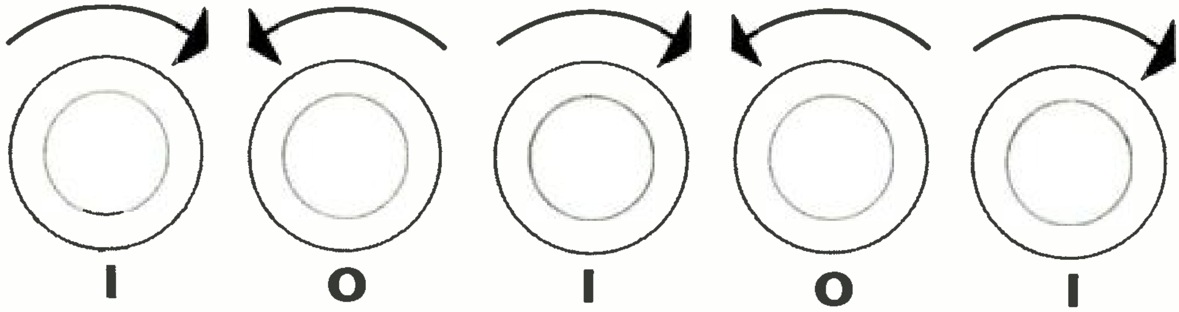


Fig. 11. Direction of core magnetization determines whether binary 1 or 0 is stored.

Computer Memory Devices

By **ED BUKSTEIN**
Northwestern TV & Electronics Inst.

Not limited by mechanical delays, magnetic cores provide speedier access time than tape or drums.

PART 2

OF THE VARIOUS means for magnetically recording and storing data in the "memory" sections of electronic computers, two were described in the first portion of this article. These two, magnetic tape and magnetic drums, were found to complement each other. While the former provides the greater storage capacity, the latter permits quicker access to any desired portion of the information being held for use.

Because of these characteristics, many computers use these two in combination, with the drum serving as the main memory and the tape providing back-up storage. Blocks of information are transferred from the tape to the drum at some time prior to the need for that data in the computer. After the computer has made use of this data, other blocks of information can be transferred to the drum. However, there are some applications where it is desirable to have even shorter access time than that provided by drums. In these, magnetic cores are used for the main memory. In fact, the drum may then become the back-up storage device.

The magnetic core is a ring-shaped piece of magnetic material. Since the core can be magnetized in either of two directions (clockwise or counterclockwise), it can be used to store a bit of binary information. Magnetization of the core in one direction can be used as a representation of binary 1, and magnetization in the opposite direction can represent binary 0. The binary number 10101, for example, can be stored in five magnetic cores as shown in Fig. 11. Here the arrows indicate direction of magnetization.

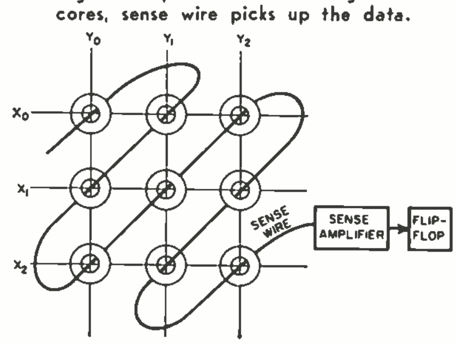
Physically, the magnetic cores are small—0.08 inch outside diameter is representative—and are placed on an array of perpendicular sets of wires, as shown in Fig. 12. For simplicity, a 3-by-3 array of cores is shown here, but 32-by-32 and 64-by-64 arrays are commonly used in practice.

Information is written into a core by passing currents through the wires on which the core is mounted. Assume, for example, that all of the cores in Fig. 12 are initially magnetized in the 0 direction, and that it is desired to store a 1 in the core located at the intersection of wires X_1 and Y_2. This would be accomplished by passing currents through wires X_1 and Y_2 simultaneously. The values chosen for these two currents are such that either one individually is not sufficient to reverse the magnetization of the core, but the combined effect of both at the intersection X_1Y_2 is sufficient to reverse the core at this location.

The individual currents are frequently referred to as *half-currents* because each has a value equal to half of the total current required to reverse the magnetization of the core. This technique, known as *coincident-current switching,* makes it possible to write a 1 in any selected core by passing half-currents through the appropriate *X* and *Y* wires.

The process of reading a core is somewhat similar to the writing process, except that the currents are passed through the *X* and *Y* wires in a direction opposite that used for writing. Assume, for example, that the core at X_1Y_2 is to be read. This would be accomplished by passing half-value "read" currents through wires X_1 and Y_2 simultaneously. These read currents are always in such direction as to switch the selected core to the 0 direction of magnetization. The read currents will therefore switch core X_1Y_2 to the 0 direction, and the reversing magnetic field will induce voltage in the sense wire. This output, which is a few millivolts in amplitude, is amplified (by the sense amplifier in Fig. 12) and then used to trigger a flip-flop stage. As a result, the flip-flop stage is now switched to the 1 condition, and the 1 which was previously stored in core X_1Y_2 has now been transferred to the flip-flop.

Fig. 12. Perpendicular wires magnetize cores, sense wire picks up the data.



If core X_1Y_2 had been in the 0 rather than the 1 condition, the read currents would not have reversed this core's magnetization. Under these conditions, there would have been no output from the sense wire and the flip-flop would have remained in the 0 condition. The read currents therefore cause the flip-flop, in either case, to assume the condition (0 or 1) of the core being read.

Since reading a core which has a 1 stored in it causes this core to switch to the 0 condition, the read-out process destroys the information in the core (although the information is still available in the flip-flop). For this reason, the reading operation is followed by a writing operation to switch the core back to the 1 condition, so that it may retain stored data.

In addition to the wires shown in Fig. 12, one other wire, not shown, is threaded through all of the cores in the array. This is known as an *inhibit* wire and is used during the process of writing. As explained previously, a 1 can be written into a selected core by passing currents through the associated *X* and *Y* wires. If however, a 0 is to be written into the core, something must be done to prevent the write currents from switching this core to 1. This is accomplished by passing a half-current through the inhibit wire at the same time the two half-currents are passed through the *X* and *Y* wires. The inhibit current is in such direction that it opposes the write currents and therefore prevents the selected core from being switched to 1. At first consideration, it may seem more reasonable to write a 0 into a core simply by preventing the write currents from passing through the *X* and *Y* wires. It happens that the associated circuitry, however, is much simpler if the write currents are used but nullified by an inhibit current.

Since the cores in an array are selected for reading or writing on a one-at-a-time basis, this type of storage would be relatively slow if all of the bits of a given number were stored in the same array. Under these conditions, a number would have to be written (or read) one bit at a time. For this reason, each bit of a number is stored in a separate array of cores. Each of these ar-

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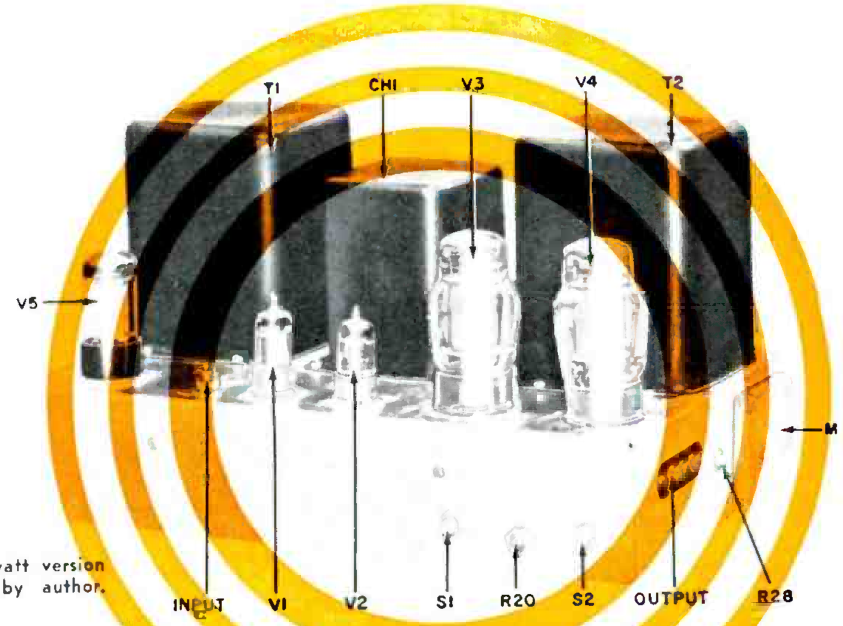


Over-all view of the 40-watt version of hi-fi amplifier built by author.

40- or 60-Watt Hi-Fi Amplifier with Tertiary Feedback

By THOMAS F. BURROUGHS / **Complete construction details on a stable, high-power audio amplifier with output-stage cathode feedback.**

FOR years the most popular power amplifier circuit design was based on the famous "Williamson." Some of the factors leading to its popularity are its low distortion, simplicity, straightforward design, and the rising interest in high-fidelity reproduction. Even today a "Williamson" amplifier that is carefully constructed and tested with the speaker with which it is to be used will give top quality results.

Of late the trend in amplifier design has been toward higher power and, as the trend has developed, use of the "Ultra-Linear" output stage has grown with it. In this circuit the primary winding of the output transformer is tapped at approximately 40 per-cent of the primary turns. These taps are connected to the screens of the output, thus providing the inherent advantages which have been adequately covered in the literature.

Some interest has been shown in tertiary feedback, which has been called "super Ultra-Linear." Up to this time, there have been very few circuits published using this type of feedback, but it is believed that its popularity will grow as more transformers become available. Some of the advantages of tertiary feedback are the lack of problems involving instability—which may occur when feedback is taken around three or four stages. In fact, an amplifier with tertiary feedback seems to be more tolerant of an over-all feedback loop. It is very effective in reducing distortion and helps to lower the internal impedance of the amplifier.

While the distortion of present-day amplifiers is very low when measuring a sine wave, it is only of late that attention has centered on the stability of the amplifier. In a feedback amplifier instability will occur when the feedback becomes regenerative. This regeneration takes place when the phase shift reaches 180 degrees at some point where the gain of the amplifier has not dropped by an amount equal to the feedback. Sometimes instability will appear when a transient signal is fed to the amplifier. This transient instability is one of the reasons why an amplifier often shows up on test in-

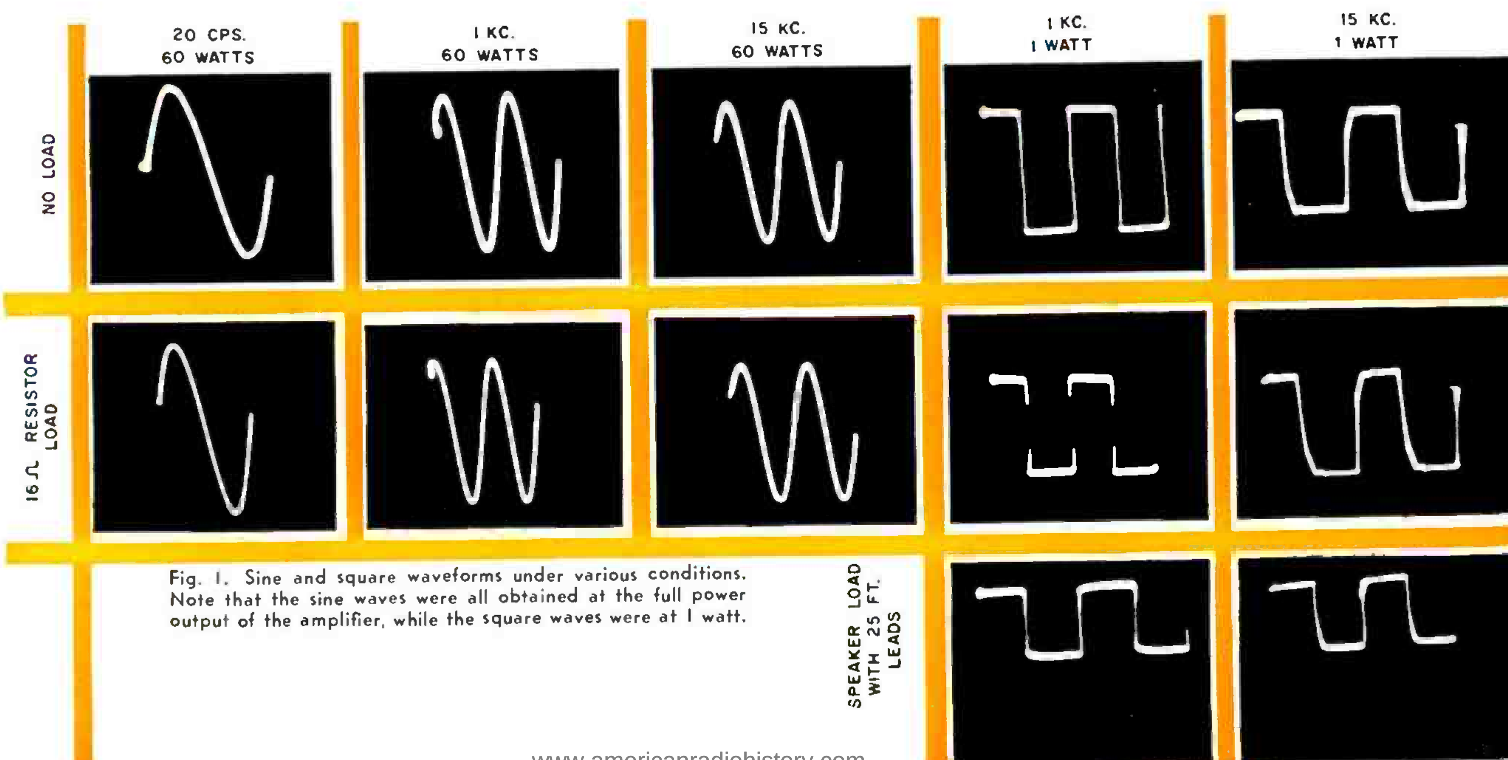


Fig. 1. Sine and square waveforms under various conditions. Note that the sine waves were all obtained at the full power output of the amplifier, while the square waves were at 1 watt.

struments a lot better than it actually sounds.

Circuit Used

The circuit of Fig. 2 is a very stable 40-watt amplifier (or a 60-watt amplifier with the higher voltage power supply in Fig. 4), using a new transformer made by *Chicago Standard Transformer Corp.*—the BO-15. This transformer was designed for 6550's, EL34's, or KT88's using screen taps plus 11 db of tertiary feedback in the output stage. There is also 12 db of feedback taken around the whole amplifier. Many configurations were tried and discarded for one reason or another before the present design was arrived at.

The first problem which arose was the high signal needed to drive the 6550's when using tertiary feedback. The required signal is 135 volts r.m.s. grid-to-grid. The need for this high signal arises because the voltage must be increased by the feedback factor in the output stage. This ruled out the use of a 6SN7 as a driver. The tube found best suited for this purpose was the 5687, a dual-triode used extensively in electronic computers. It is capable of exceptional output into the low impedance necessary when using fixed bias. When used in the *Mullard* circuit as a phase-splitter/driver, as it is here, it will deliver 180 volts r.m.s. grid-to-grid into a 50,000-ohm load. The outputs from the plates are almost perfectly balanced and the impedance looking back into the tube is the same. This stage is quite degenerative and very little distortion is introduced by it.

The EF86 is a low-noise pentode used as a voltage amplifier. This is direct-coupled to the phase-splitter/driver, thus eliminating some phase shift that would be introduced by a coupling capacitor.

Stability of the amplifier is very good under practically any type of load, as can be seen by the oscillograms of Fig. 1. Over 20 db more of over-all feedback could be added before instability in the form of ringing or motorboating sets in. If the amplifier is to be used

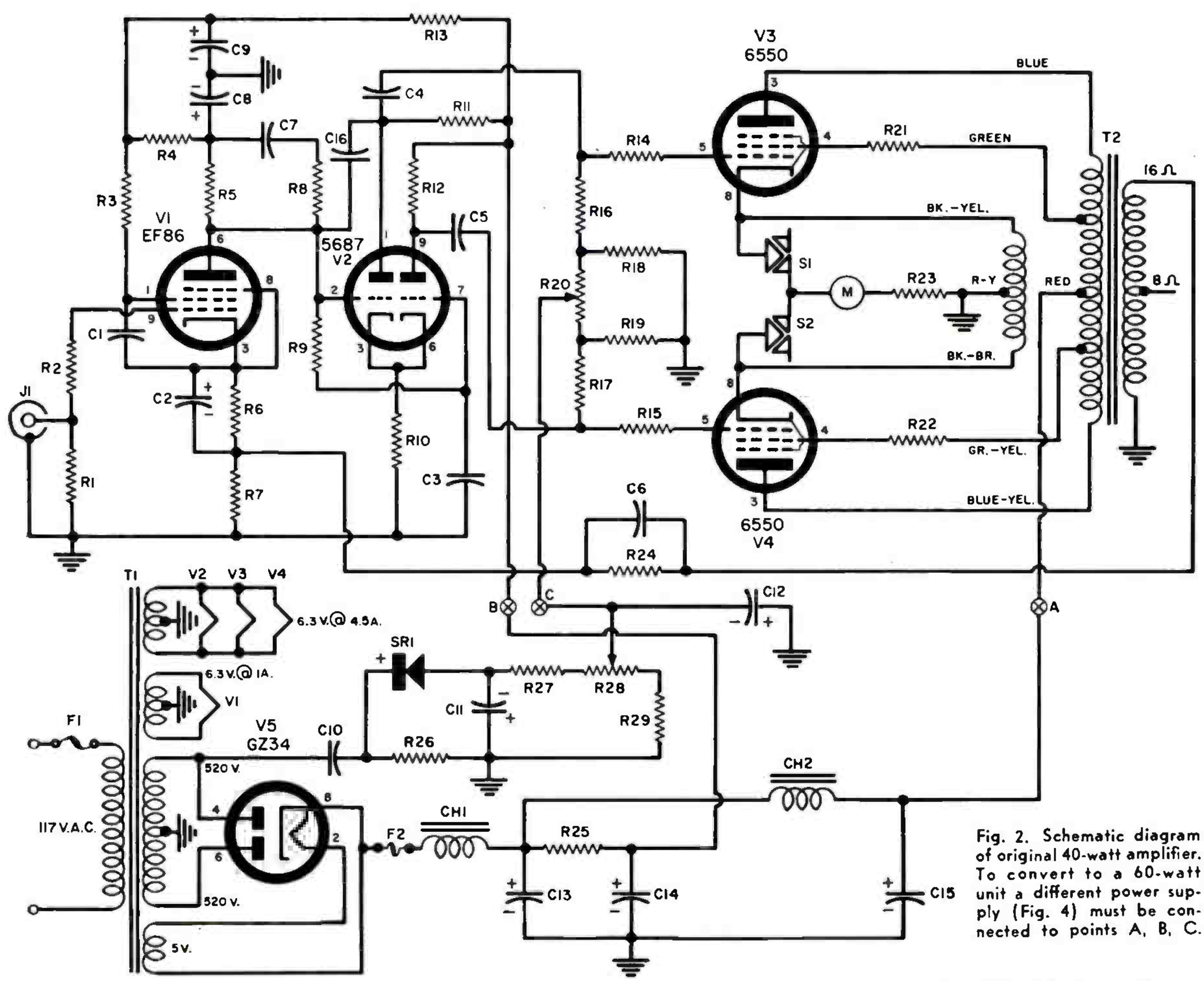


Fig. 2. Schematic diagram of original 40-watt amplifier. To convert to a 60-watt unit a different power supply (Fig. 4) must be connected to points A, B, C.

R_1, R_9—1 megohm, ½ w. res.
R_2—3300 ohm, 1 w. res.
R_3—330,000 ohm, 1 w. res.
R_4, R_5, R_{16}, R_{17}—47,000 ohm, 1 w. res.
R_6—1800 ohm, 1 w. res.
R_7—510 ohm, 1 w. res.
R_8—4700 ohm, 1 w. res.
R_{10}—8000 ohm, 4 w. carbon res. (see text)
R_{11}—25,000 ohm, 4 w. carbon res. (see text)
R_{12}—30,000 ohm, 4 w. carbon res. (see text)
R_{13}—180,000 ohm, 1 w. res.
R_{14}, R_{15}, R_{21}, R_{22}—1000 ohm, ½ w. res.
R_{18}, R_{19}—100,000 ohm, 1 w. res.
R_{20}, R_{28}—10,000 ohm pot
R_{23}—680 ohm, ½ w. res. (see text)
R_{24}—2200 ohm, 1 w. res.
R_{25}—600 ohm, 2 w. res.
R_{26}—25,000 ohm, 10 w. wirewound res.
R_{27}—560 ohm, 1 w. res.
R_{29}—27,000 ohm, 1 w. res.
C_1—.05 μf., 400 v. capacitor
C_2—50 μf., 25 v. elec. capacitor
C_3—.25 μf., 400 v. capacitor
C_4, C_5—.5 μf., 600 v. capacitor
C_6, C_7—50 μμf. ceramic capacitor
C_8, C_9—40 μf., 350 v. elec. capacitor
C_{10}—.04 μf., 1000 v. capacitor
C_{11}, C_{12}—50 μf., 150 v. elec. capacitor
C_{13}, C_{14}, C_{15}—40 μf., 500 v. elec. capacitor
C_{16}—25 μμf. ceramic capacitor
T_1—Power trans. 520-0-520 v. @ 200 ma.; 6.3 v. @ 4.5 amps.; 6.3 v. @ 1 amp.; 5 v. @ 3 amps. (Chicago Standard PCR-200 or equiv.)
T_2—Output trans. 4300 ohms c.t., with screen taps and cathode feedback winding; 8, 16 ohms sec.; 65 watts (Chicago Standard BO-15 or equiv.)
CH_1—8 hy., 200 ma. filter choke (Chicago Standard RC8200 or equiv.)
CH_2—2 hy., 200 ma., 60 ohms d.c. or less filter choke (Stancor C-2325 or equiv.)
SR_1—20 ma., 130 v. selenium rectifier
F_1—2 amp. fuse
F_2—225 ma. fuse
S_1, S_2—S.p.s.t. push-button switch, normally open
M—1 ma. d.c. meter
J_1—Phono jack
V_1—EF86 tube
V_2—5687 tube
V_3, V_4—6550 tube
V_5—GZ34 tube

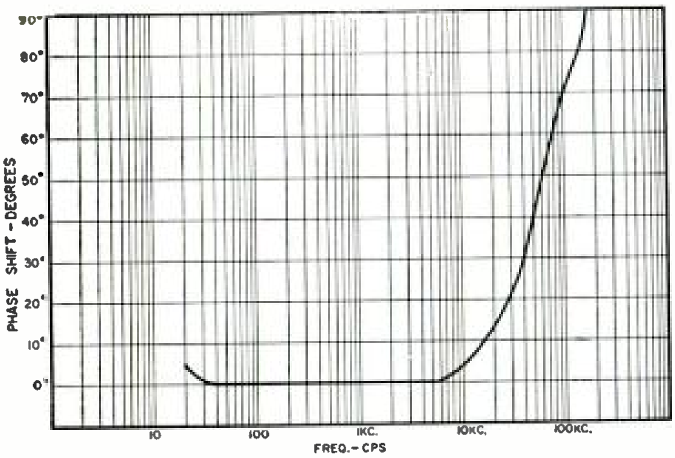
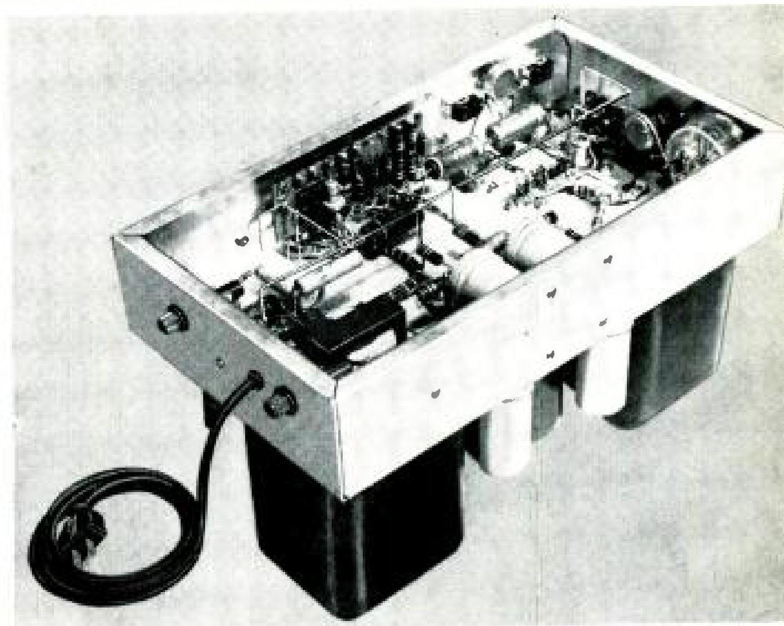
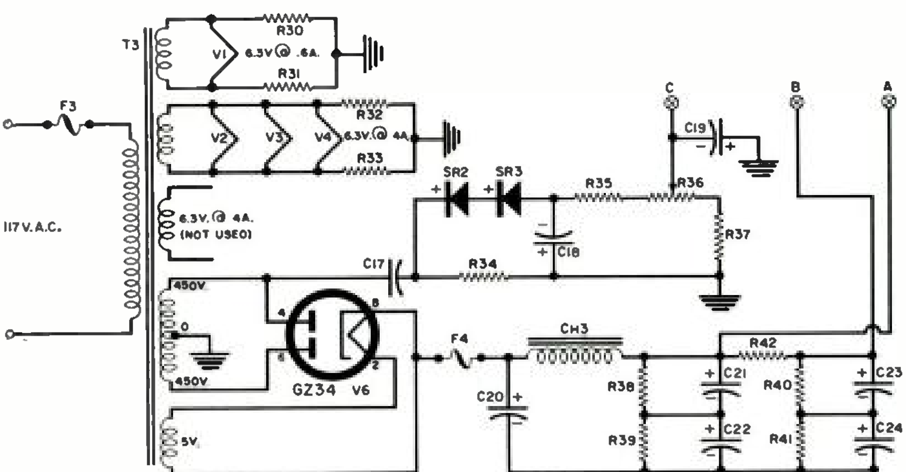


Fig. 3. Phase characteristics of the high-fidelity amplifier as measured between frequencies of 20 cps and 200 kc. by author.



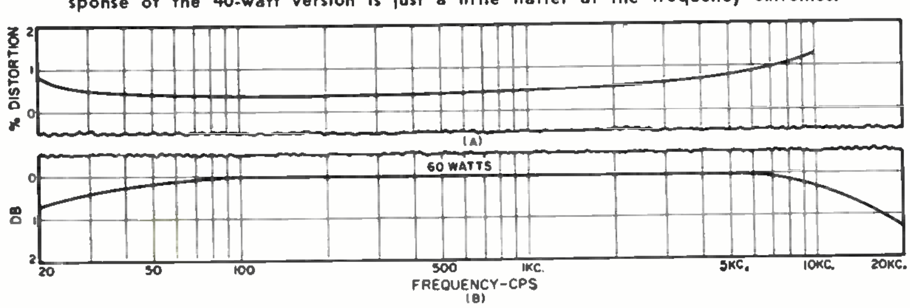
Under-chassis view of the home-built unit showing the use of a ground bus, laced wiring, and the terminal board construction. ▶



R_{30}, R_{31}, R_{32}, R_{33}—47 ohm, 1 w. res.
R_{34}—25,000 ohm, 10 w. wirewound res.
R_{35}—560 ohm, 1 w. res.
R_{36}—10,000 ohm pot.
R_{37}—27,000 ohm, 1 w. res.
R_{38}, R_{39}, R_{40}, R_{41}—68,000 ohm, 2 w. res.
R_{42}—600 ohm, 2 w. res.
C_{17}—.075 µf., 600 v. capacitor
C_{18}—40 µf., 250 v. elec. capacitor
C_{19}—50 µf., 150 v. elec. capacitor
C_{20}—20 µf., 600 v. elec. capacitor
C_{21}, C_{22}, C_{23}, C_{24}—80 µf., 350 v. elec. cap.
CH_3—2 hy., 200 ma. filter choke (Stancor C-2325 or equiv.)
SR_2, SR_3—20 ma., 130 v. selenium rectifier
F_3—2 amp. fuse
F_4—225 ma. fuse
T_3—Power trans. 450-0-450 v. @ 200 ma.; 6.3 v. @ 4 amps.; 6.3 v. @ .6 amp.; 5 v. @ 2 amps. (Chicago Standard PSC 205 or equiv.)
V_6—GZ34 tube

Fig. 4. Circuit of the capacitor-input power supply used to obtain the higher voltage necessary for the 60-watt version of the amplifier. Filter capacitors are series-connected and bleeder resistors are used to equalize voltage drops. Because of this arrangement, the negative terminals (usually the cans) of C_{21} and C_{23} must be insulated from the chassis and these capacitors must be separate units. Also for safety they should be mounted beneath the chassis. The 47-ohm resistors across the 6.3-volt heater windings are required since the windings are not center-tapped.

Fig. 5. (A) Total harmonic distortion of the 60-watt amplifier at an output within ± 1 db of full output. (B) Power-response curve of the 60-watter. Full-power response of the 40-watt version is just a little flatter at the frequency extremes.



with a highly capacitive load, such as an electrostatic speaker and a woofer calling for a low damping factor, it might be advantageous to omit R_{24} and C_6. This leaves out the over-all feedback loop, but there will still be 11 db of feedback in the output stage where it is most needed. This will give a lower damping factor and an amplifier that is very sensitive.

Construction

Construction of the amplifier is fairly standard, being built on a single 8½" x 15" x 3" chassis. Most of the parts are mounted on a terminal strip to facilitate testing and easy access. All signal-carrying leads, including the feedback loop, were kept as short as possible. A ground bus was used and connected to the chassis at one point.

In the top chassis view of the amplifier you will notice a meter mounted on the side panel, with push-buttons by each output tube for balancing the current in the output stage. The meter is connected so as to read the voltage drop across the tertiary winding. A 1-ma. meter is used and R_{23} selected so that with 100 ma. flowing through the tertiary winding the meter will read full-scale. In this way the tertiary winding acts as the meter shunt. The value of R_{23} will vary, depending on the d.c. resistance of the tertiary winding and the meter used. This was an extra "frill" on the original amplifier but can be very handy if you have an old meter in the junk box that can be utilized.

The parts list calls for some 4-watt carbon resistors. The 8000-ohm unit was made up of two 16,000-ohm, 2-watt resistors in parallel. The 25,000-ohm unit is 12,000- and 13,000-ohm, 2-watt resistors in series while the 30,000 ohms is made up of two 15,000-ohm, 2-watt resistors, also in series.

All of the parts are conservatively rated and should give long, trouble-free performance. The "B+" supply bus was fused to prevent damage to the

(Continued on page 91)

COVER STORY

Transistor Replacement in Japanese Radios

Start with the cross-reference given here for similar U.S. and Japanese types, then use in-circuit check-out tests.

By **DON LEWIS**

EDITOR'S NOTE: *As the argument rages over imported electronic equipment from Japan, an important point has been pushed into the background: much Japanese-made gear is already in use here, and it sometimes needs attention. For example, a service dealer is often required to work on a customer's imported transistor radio. He then runs head-on into the problem of obtaining replacement parts that do not have clearly defined domestic equivalents. On this issue, there are no pros or cons. The type of information offered here is needed.*

EXPORTS of electronic products to the United States from Japan in 1959 totaled $75.6 million, according to the U. S. Department of Commerce—an increase of nearly three and one-half times the amount for 1958. Of this amount, nearly 83 per-cent—specifically, $62.4 million—was accounted for by more than six million radios, the great majority of which were transistor types.

To the radio service technician, these figures come as no surprise. Practically everyone engaged in repairing sick radios has encountered these little portables in his shop by now. The quality of these imports is generally good, but they are coming in for service by reason of their sheer numbers.

For replacement purposes, most components or acceptable equivalents can be obtained from local suppliers. Unfortunately this is not true of the transistors themselves. In addition, there are many transistor types used in the imported sets rather than a relative handful.

At this time, manufacturing transistors is big business in Japan and sales are still soaring. As you might expect, the classification system is highly disorganized. Among the large manufacturers—this includes, *Hitachi, TEN, Sony, NEC,* and *Toshiba*—each has its own numbering system. To complicate matters, none of these appears to be related to the domestic JEDEC code, in which all manufacturers use type numbers beginning with the "2N" prefix.

There is a slight exception with respect to *Hitachi*. This company seems to be under license by *RCA*, for many *Hitachi* transistors duplicate the *RCA* line and use the same type numbers, particularly in the "drift" series (such as 2N370 and 2N544). However *Hitachi* seems to have increased confusion rather than reduced it with its other types. This company used to use a code involving two letters followed by two numbers (for example, HJ72). It has recently switched to a system in which the prefix "2S" is followed by three digits. Thus what was formerly designated type HJ72 is now identified as 2S142. Accordingly *Hitachi* listings in Table 1 often carry more than one manufacturer's type number on the same line.

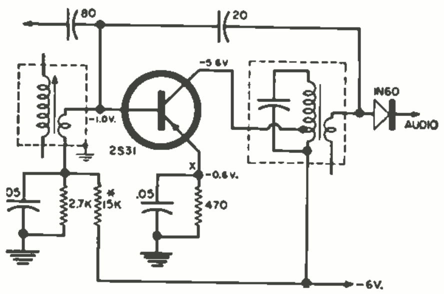


Fig. 1. Typical transistorized second i.f. amplifier (from Toshiba GTR-186).

Selecting a Substitute

In the case of *Toshiba* transistors, the technician may be in a position to obtain a direct replacement instead of finding an equivalent. At least one mail-order electronic supplier in this country (*Lafayette Radio*) lists *Toshiba* transistors in its catalogue. Since these are used in many imported radios under various brand names, are low in cost, and are available to technicians and experimenters here, more complete information on the four popular *Toshiba* units is given in Table 2.

For other transistors, the interchangeability chart of Table 1 can be used. This data was developed in more than one way, but a recent Japanese manual of transistor characteristics was a primary source. Since it is not always possible to find exact American equivalents for all characteristics, absolute accuracy is not claimed for the chart. Accordingly the domestic equivalents of Table 1 should be considered *similar* units. In all cases however, *p-n-p* substitutes are given for *p-n-p* transistors; and, in most cases, the suggested replacement is made by the same process (drift, junction-alloy, etc.) as the original.

To the service technician, this means that the similar unit is the starting point in the replacement process rather than the end itself. He must make sure that applied bias, neutralization, and stabilization used for the original transistor are also satisfactory for the replacement.

Substitution Techniques

The author has worked out his own techniques for checking the validity of American transistors used to replace Japanese types and making adjustments to produce the desired performance. These techniques have been tested in many radios, with uniformly excellent results. (*It might be pointed out that, even on American-made transistor radios, the manufacturers' service literature often indicates circuit changes that may be necessary when transistors are replaced.—Ed.*)

The first technique is predicated on the fact that most r.f., converter, i.f., and first-audio transistors are biased to draw approximately 1 ma. of emitter current. With this initial assumption, the service technician can adjust for correct rebiasing of the replacement easily.

Fig. 1 shows the second i.f. amplifier circuit for a *Toshiba* Model GTR-186 portable. The collector is supplied from the −6-volt source through part of the i.f. transformer primary. Junction current for the stage flows through the 470-ohm emitter resistor and returns to the positive terminal of the battery. Bias is applied to the base from a tap on a voltage divider (15,000 ohms and 2700 ohms) across the 6-volt battery.

Since the emitter voltage (−0.6 volt at point *X*) appears across the 470-ohm resistor, it can be determined by Ohm's Law that the stage is drawing nearly 1.3 ma. This is quite close to our rule-of-thumb 1 ma. of current given earlier.

To see how a substitution is made, let's assume a customer brings in an unidentifiable Japanese radio, on which no service information is available, for repair. Signal substitution or tracing shows the fault is in the second i.f. amplifier. A voltmeter check shows the stage has collector and base voltage, but no emitter voltage. Conclusion? The i.f. transistor is probably open.

To make the example specific, let us say that the defective transistor in the hypothetical receiver is identified as a type 2S31 (*TEN*). Table 1 gives the 2N410 as the nearest domestic equivalent. (This has wire leads, as has the original, but is otherwise the same as the plug-in 2N409.)

Install the substitute, *reduce the supply voltage to one half its normal value,* and check emitter voltage. Then calculate emitter current by Ohm's law. It should be no more than half the estimated, 1-ma. rule-of-thumb current, or 500 microamperes. If this current is less than expected, it means the collector is drawing less current than it did with the original transistor. It is thus safe to restore full supply voltage and again calculate emitter current.

If emitter current is considerably higher than 500 microamperes, it would indicate that the wrong type of transistor (*i.e., p-n-p* for *n-p-n*) was installed or that bias is excessive. Assuming that the replacement has been carefully established to be of the same type as the original, we proceed to change the bias. This is done by adjusting the base circuit.

The base's forward bias resistor (15,000 ohms, shown by an asterisk in Fig. 1) is removed. In this condition, emitter voltage and current drop to very small values, since the transistor draws little current without bias. A potentiometer of considerably higher value than the original bias resistor is used to replace the latter, and it is adjusted so that its full resistance is in the circuit. Adequate resistance must be used to limit base current for, if the latter is permitted to become excessive, the transistor can be destroyed.

The potentiometer is now carefully adjusted with the voltmeter connected to point *X* until emitter voltage is reduced to the value at which emitter current (determined by Ohm's Law) will be 1 ma. In the case of Fig. 1, for example, this would mean −0.47 volt at the emitter. The amount of the potentiometer's resistance that is in the base circuit is then measured, and a fixed resistor of suitable value is used instead.

JAPANESE NO.	SIMILAR U.S. TYPE	JAPANESE NO.	SIMILAR U.S. TYPE
HITACHI		**TOSHIBA**	
HJ15	2N215	2S44	2N217
HJ17D	2N217	2S45	2N218
HJ22D	2N218	2S52	2N219
HJ23D	2N219	2S56	2N270
HJ32, HJ70, 2S141	2N370		
HJ34, HJ34A, 2S91	2N270	**TEN**	
HJ35	2N301	2S30	2N411, 2N412
HJ37, HJ71, 2S141	2N371	2S31	2N409, 2N410
HJ50	2N215	2S32	2N405, 2N406
HJ51	2N408	2S33	2N407, 2N408
HJ55, HJ60, 2S146	2N219	2S34	2N270
HJ56	2N410	2S35	2N140, 2N219
HJ57	2N412	2S36	2N139, 2N218
HJ72, 2S142	2N372	2S37	2N109, 2N217
HJ73, 2S143	2N373	2S38	2N270
HJ74, 2S144	2N374	2S39	2N175, 2N220
HJ75, 2S145	2N544	2S40	2N269
		2S41	2N301
NEC		2S42	2N301A
ST28C	2N309	2S43	2N247
ST37D	2N252	2S109	2N370
ST162	2N145, 2N146	2S110	2N371, 2N372
ST163	2N147, 2N293	2S112	2N372
ST173	2N168A		
		SONY	
		2T64	2N366, 2N228
		2T65	2N366, 2N228
		2T66	2N365
		2T76	2N147

Table 1. Nearest U.S. equivalents of Japanese transistors used in popular radios.

MAXIMUM RATINGS (at 25 C)		CHARACTERISTICS	
TOSHIBA 2S44			
V_c	−25 volts	I_{co} (V_c = −12 v.)	−10 μa.
I_c	−50 ma.	F_α	not given
P_c	30 mw.	Alpha	>0.9
T_j	50° C		
COMMON EMITTER OPERATION			
V_c = −6 volts I_e = 1 ma., R_{in} = 1K, R_o = 30K, P_g = 37 db			
TOSHIBA 2S45			
V_c	−16 volts	I_{co} (V_c = −12 v.)	−3 μa.
I_c	−5 ma.	F_α	3 mc.
P_c	20 mw.	Alpha	0.95
T_j	50° C	C_c	13 μμf.
COMMON EMITTER OPERATION			
V_c = −6 volts, I_e = 1 ma., R_{in} = 500 ohms, R_o = 30K, P_g = 30 db			
TOSHIBA 2S52			
V_c	−16 volts	I_{co} (V_c = −12 v.)	−10 μa. max.
I_c	−5 ma.	F_α	7 mc.
P_c	20 mw.	Alpha	0.985
T_j	50° C	C_c	12 μμf.
COMMON EMITTER OPERATION			
V_c = −6 volts, I_e = −1 ma., R_{in} = 900 ohms, R_o = 60K, P_g = 30 db			
TOSHIBA 2S56			
V_c	−25 volts	I_{co} (V_c = −12 v.)	−10 μa.
I_c	−50 ma.	F_α	1 mc.
P_c	75 mw.	Alpha	0.98
T_j	50° C	C_c	25 μμf.
COMMON EMITTER OPERATION			
V_c = −6 volts, I_e = 1 ma., R_{in} = 2.5K, R_o = 200 ohms, P_g = 31 db (at 250 mw. output)			

Table 2. Some Toshiba transistors are available in this country. Here are characteristics of four popular types for use by service technicians and experimenters.

Audio Output Replacements

The great exception to our stated rule-of-thumb occurs in the widely used class-B push-pull output stages of transistor radios. The collectors almost always have full supply voltage applied and there is little or no emitter resistance. These stages are also very sensitive to the amount of applied forward bias. With too little bias, there will be considerable audio distortion. Excessive bias will drain the batteries prematurely and even destroy the transistors. Although no quicker rules-of-thumb can be followed, the following pointers will be helpful.

Whenever a transistor in a class-B push-pull stage must be replaced, both

(*Continued on page* 86)

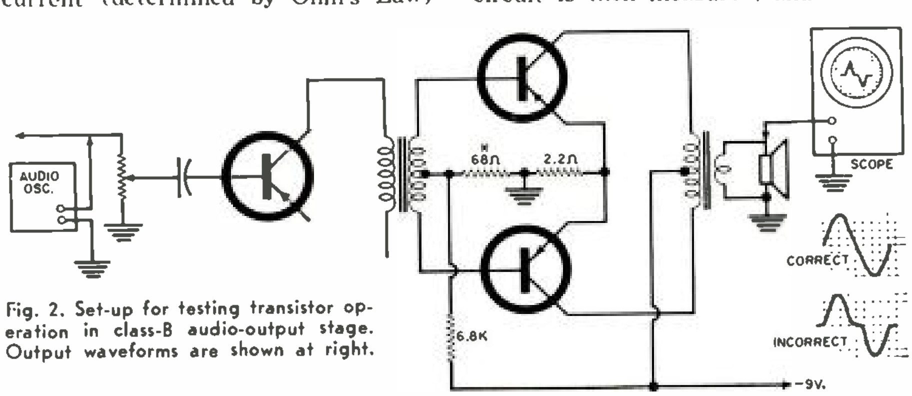
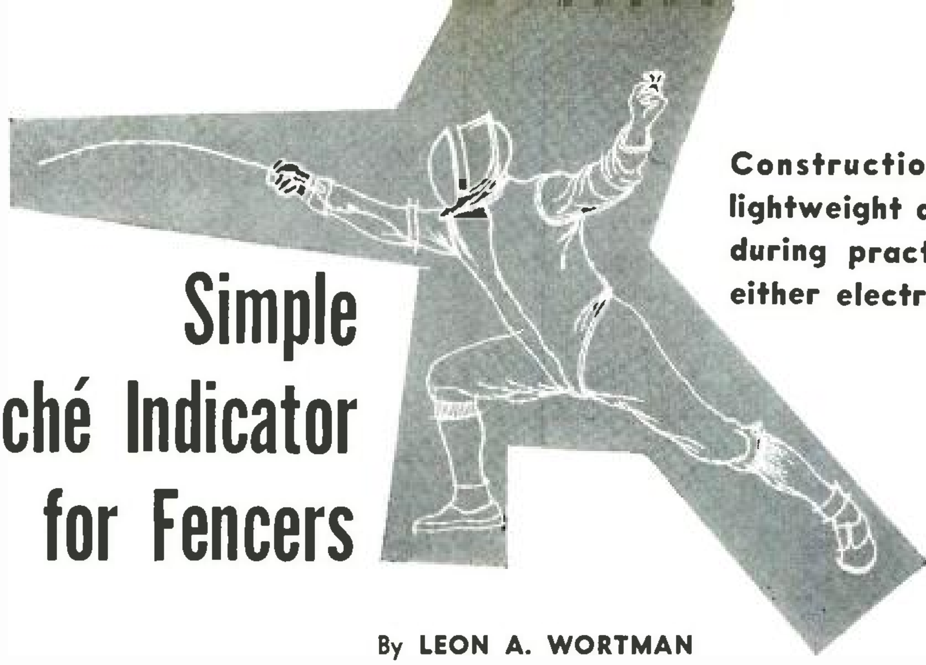


Fig. 2. Set-up for testing transistor operation in class-B audio-output stage. Output waveforms are shown at right.



Simple Touché Indicator for Fencers

Construction of a compact, lightweight device to be used during practice session with either electrical foil or épée.

By **LEON A. WORTMAN**
Chairman, Electrical Weapons Comm. of Amateur Fencers League of America

THE objective in fencing with the foil as the weapon is to "hit" in such a manner that, if the point were really sharp, it would penetrate the opponent's skin. To achieve this "hit," the point must be moving forward at the very instant it contacts the opponent. This is opposed to a lateral or slapping

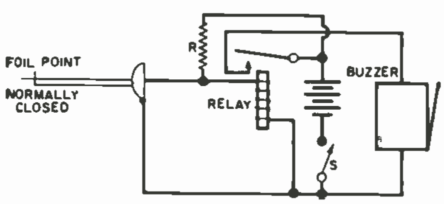


Fig. 1. Basic circuit used with the foil.

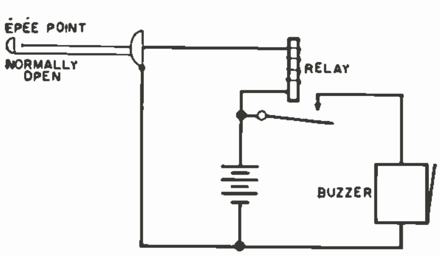


Fig. 2. Basic arrangement with an épée.

movement at the moment of the "hit." It has been determined that the point frequently remains in contact with the target for a duration of mere milliseconds. That's fast, too fast for visual judging of a "hit." Electrical touch-indicators used in championship foil contests, in fact, are required to register a "hit" when the point makes a contact for at least 5 milliseconds. Some commercial units will operate on a touch as fast as 2 milliseconds (.002 second). Electrical touch-indicators for épée must register "touches" that last for at least 10 milliseconds.

Special weapons are used in electrical fencing. They are fitted with plunger points. The points are wired and behave as switches. Only forward pressure, not lateral pressure, will actuate the point-switch. The international and U. S. rules for electrical foil require that at least 500 grams of pressure must be exerted in order to actuate the switch and cause a "hit" or "touch" to be registered. The rules for electrical épée require that the pressure be at least 750 grams. The point of the electrical foil is a s.p.s.t. normally closed switch. The electrical-épée point is a s.p.s.t. normally open switch.

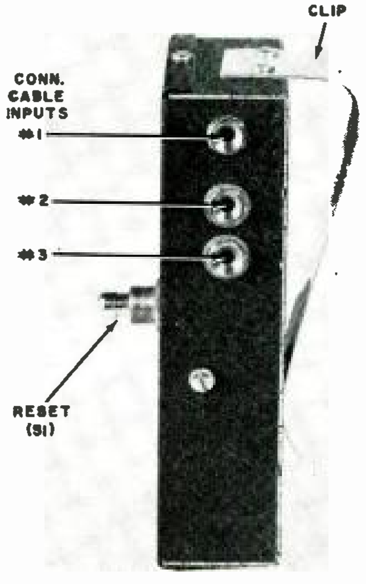
Official touch-indicators are expensive and, because they require storage batteries and spring-loaded reels in their operation, they become a bit unwieldy for practice sessions. But, a competitive fencer must practice proper blade movements to assure that he "hits" with a forward movement. To provide a simple and accurate means of touch-practice the compact, self-contained unit described here was developed. It is used by a number of members of the U. S. Olympic Squad and college teams, including the U. S. Naval Academy intercollegiate championship team. It is being introduced this year in Europe.

Fig. 1 shows the basic circuit of an electrical-foil touch-indicator. In this basic circuit the buzzer sounds only while the point is *open* and held open by pressure against the opponent. Resistor *R* limits the current in the circuit to protect the battery from a short circuit. Because the point-switch is normally closed, and the circuit draws current at all times, switch *S* is required to turn the unit off.

Fig. 2 shows the basic circuit for an electrical-épée touch-indicator. Depressing the point against the opponent gives an instantaneous sound at the buzzer. Again, the buzzer will sound only while the point is depressed against the opponent. The circuit draws current from the battery only when a touch is made.

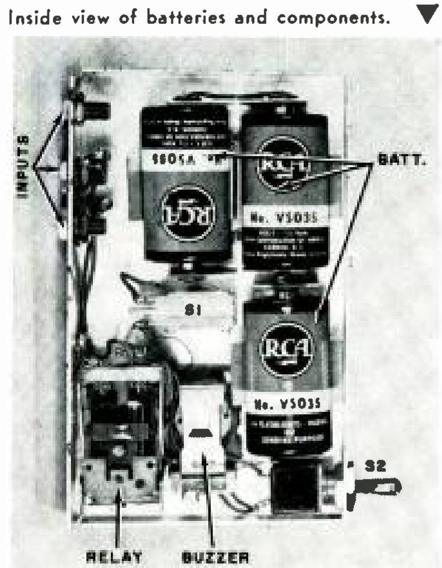
As was noted earlier, the point of the weapon may touch the target for a duration of a few milliseconds. This is hardly long enough for the buzzer to get started. Further, in a *salle d'armes* there often is a great deal of noise caused by the fencers shouting as they "fight," and by the vigorous clashing of steel blades. In order to make certain the buzzer has sounded a touch,

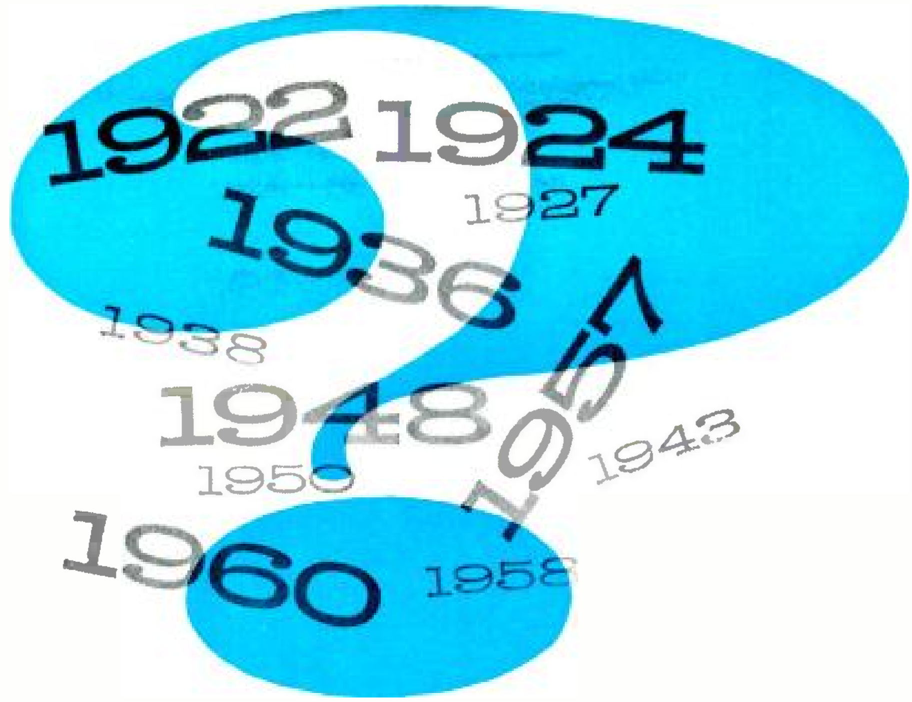
(*Continued on page* 102)



◀ Side view of author's touché indicator.

Inside view of batteries and components. ▼





Has Ham Radio Construction Improved?

By **HOWARD S. PYLE, W7OE**

This "old timer" answers "yes" to this question and gives some interesting reminiscences on early ham gear.

IN THE era of handle-bar mustaches, button shoes, high starched collars, and derby hats, Guglielmo Marconi set the scientific world afire with the transmission of three dots (the letter "S" in the "wireless telegraph code") across the Atlantic Ocean. Not only did this offer a challenging field to scientists and "wire" communication companies, but a spark was struck in the breasts of hundreds of private experimenters . . . forerunners of the radio amateur or "ham" of today. If Marconi could transmit intelligence through space with no visible means of connection—so could they!

Old-Time Equipment

Marconi's equipment was composed of individually mounted items. Hertz' spark coil was self-contained on its own independent base. The "condenser" of Faraday was enclosed in a rack or perhaps a box or cabinet; the "jars" of Leyden—the Dutch version of concentrated capacity—were just that . . . individual jars sometimes "racked" together, often just lined up in a convenient row. "Spark gaps" were frequently an integral part of the induction coil . . . just a couple of rods mounted between the secondary terminals. More often they were simply a pair of bars independently mounted and connected by wire to the secondary.

The "tuning coil," if any, was a helix of wire or metal tubing also mounted on its individual supporting form, generally of wood. The early ham stations followed suit. Transmitting inductances were air-wound coils of heavy wire or tubing formed around wooden dowel uprights and fitted with wooden end plates. Later, they became spirally wound, air-spaced coils of flat edgewise metal ribbon. "Loose" coupling soon followed; it called for *two* such coils, one of which could slide within the other or, by ingenious mechanical means, could be moved closer together or farther apart on a hinging principle. Rotating spark gaps appeared before long; they, too, were independent pieces of equipment connected by wire or metallic tubing to other components in the set.

Wireless receivers followed the same pattern—first a "tuning coil," breadboard mounted and wired, together with a crystal detector and a fixed condenser. A short time later "loose-couplers" replaced the tuning coil; they too were initially mounted breadboard style, with other components, on a common wooden base. Meanwhile, a few manufacturers had appeared on the horizon offering several items of amateur wireless equipment. These caught the fancy of those hams who were tiring of the tedious task of winding coils and performing other relatively intricate operations to produce acceptable loose couplers, transmitting helixes, and similar items. Soon the more professional appearing, commercially produced equipment spurred the home constructor to take more pride in the appearance of his own "home-brewed" equipment. Woodwork was stained and varnished; mounting bases of the breadboard type were beveled, sanded, and finished. Using factory-made equipment as a criterion, early amateur stations began to take on a more "professional" and a more finished over-all appearance.

Meanwhile commercial wireless operating companies were waging a losing battle in their attempts to squeeze their massive transformers, helixes, condenser banks, and similar bulky items of equipment into the confines of the "closets" which served as "wireless rooms" on many vessels. They then were forced to give serious consideration to the problem of "compacting" their equipment. Receivers, then scattered items requiring considerable space on the operating table, were given priority. *United Wireless* was first in the field with a compact re-

Fig. 1. Ham construction in pioneer days was crude with few commercial parts. This receiver, with "two-slide tuner," used a carborundum crystal detector, home-made fixed capacitor, and single 75-ohm "watchcase" telephone receiver. A hand-sawed breadboard base mounted all the components.

ceiver, self-contained in a small cabinet. *Wireless Specialty Apparatus Co.* developed and marketed its IP-76 receiver, also cabinet contained. Other commercial interests soon followed suit.

What About the Ham?

What about the amateur while all this was going on in the commercial field? Were they to allow commercial design developments to pass them by? Soon the few current periodicals devoted to the amateur hobby began offering construction articles embodying the cabinet type of receiver assembly and it was not long before the up-to-date amateur station was expected to be equipped with such compact receiving equipment. True, the battery, headphones, antenna, and ground had to remain external accessories but all of the radio-frequency detection and tuning circuits were soon combined in one compact, self-contained unit.

Transmitters, though, were another problem to both commercial users and the amateur. The *United Wireless Company's* 2- kw. open-core transformer, floor-mounted individual items of rather impressive weight and bulk.

It was not too long, however, before the *Marconi Wireless Telegraph Co.* of America, in tackling this problem, designed and introduced the P-8 2-kw. marine transmitter for shipboard use. "Pancaking" of the oscillation transformer and loading coils, the recent development of the "quenched" type of spark gap, and reduction in the physical size of Leyden jar condensers all contributed to "compacting." An even smaller *Marconi* type, in ½-kw. size, appeared next. *Kilbourne and Clarke Mfg. Co.* followed suit with marine transmitters; *Federal Telegraph Co.* did likewise. All of these offerings were assembled on a floor-mounted angle iron frame with an insulated front panel which served to mount the various meters, switches, and controls.

And the amateur? Always attuned to technical developments, soon wooden frame racks and often wooden front panels began to appear in "modern" ham shacks. Oscillation transformers, following the commercial lead, were fine style. Those who *could* lay it on the line for a 500-cycle alternator soon found that they also required a 60-cycle a.c. motor to drive it. These, too, were costly and beyond the reach of most hams. Consequently, the familiar rotary spark gap was often squeezed into the remaining space behind the panel or, in many instances, the driving motor was mounted behind the panel through which the motor shaft extended to drive the rotary disc on the panel face. This was not the final answer, though; rotary gaps were noisy, bulky, and, to a large extent, dangerous with their exposed spark and high voltage. The solution, however, was forced to wait. The ominous war threats, which had been rumbling for some time, materialized and the United States became a combat nation in World War I.

World War I

Thousands of amateurs joined the armed services in radio operating and technical capacities, with the closing down of all amateur stations for the duration of hostilities (and for a l-o-n-g

Fig. 2. This receiver, built in 1922 by Author Pyle, employed a wooden cabinet with a hard-rubber front panel. Machine engraving had come into vogue and enhanced the set's appearance.

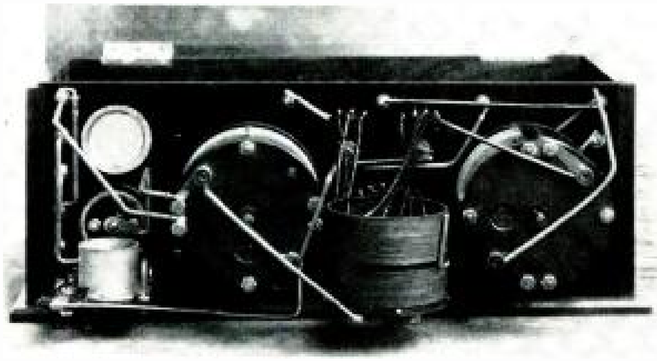


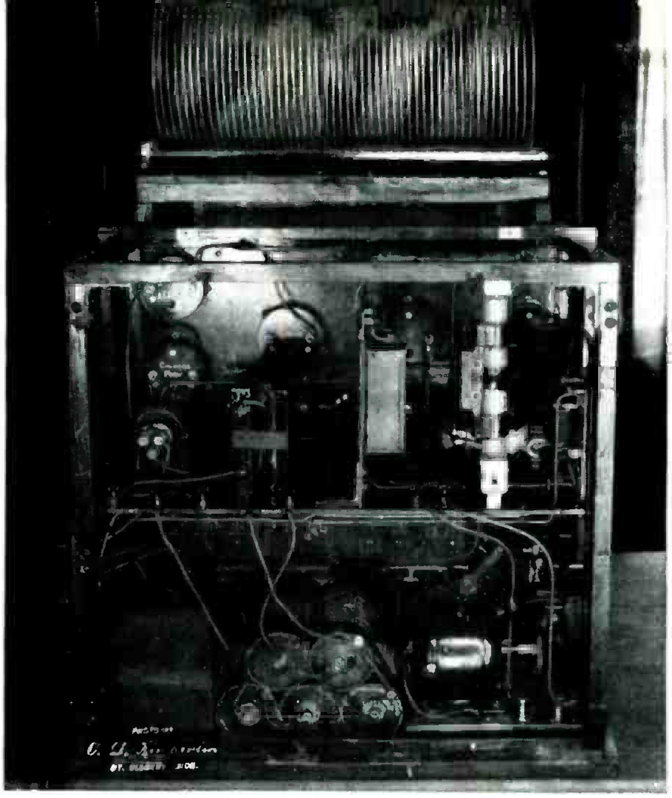
Fig. 3. Interior view of the receiver shown in Fig. 2. Heavy bus-bar wiring, covered with spaghetti sleeving, and coils hand-wound on large-diameter Bakelite tubing, were in very common use.

weighing several hundred pounds and of a size approaching that of a small "coffin" (which incidentally became its nickname), the copper tubing helix some two cubic feet in size, the bank of Leyden jar condensers almost as large as the transformer, hardly lent themselves to confinement within a single, compact cabinet. And the twenty- to thirty-thousand volts running around these weird devices offered a real challenge to confinement. Amateurs as well, despite their traditional ingenuity, were in the same boat. The heavy, bulky high-voltage transformers, the rotating spark gaps, glass-plate condensers, and the helixes, and later "oscillation transformers" simply could not be squeezed into a box. For some time transmitters, both commercial and amateur, remained as wall, table, or pancaked and placed behind the panel; the Leyden jar condensers in commercial use were costly but alternate glass plates and tinfoil, compressed into a compact bundle, enclosed in a wooden box and immersed in melted paraffin, made an excellent condenser which could easily be contained within the rack.

The spark gap was another story. While a few quenched gaps were being offered on the amateur market, it was soon found that with the 60-cycle current supply available in most homes, the resulting tone or note of the signal was almost unbearable. Few hams could afford the intricate motor-alternator sets used by the commercial companies to produce the 500-cycle note which was pleasing to copy and cut through static and interference in time afterward). The impetus given to radio development by reason of combat activities had resulted in unbelievable scientific progress in the art—developments to which the military hams were thoroughly exposed. Perhaps the most significant development was in the greatly expanded use of de Forest's little audion. Among other uses, it was found that with proper circuitry and components, the "Aladdin's Lamp" of radio was a most effective generator of radio-frequency oscillations and that they were so confined to narrow channels as to make their use unbelievably more effective than any existing "spark" type of radio transmission. Improvement in audio characteristics made even radiotelephony a practical matter.

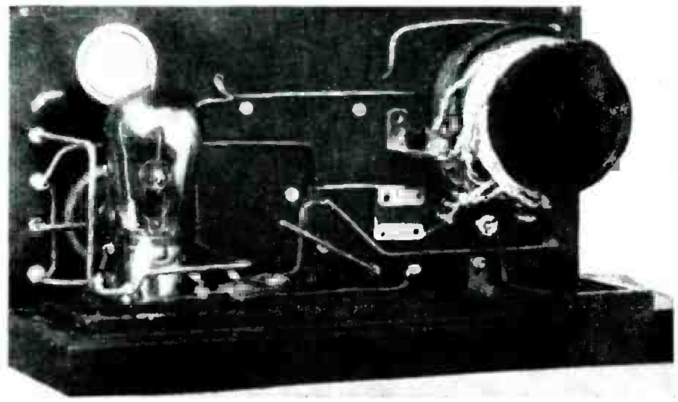
With the restoration of amateur radio operation on October 1, 1919, the avalanche started. No longer were huge, cumbersome, high-voltage transformers and great banks of Leyden jars or glass-plate condensers essential for radio transmission. Gone were the rotary spark gaps; *any* kind of gap was no longer a requirement. The tiny glass "bottles" with their small transformers, condensers, and modest-sized coils

Fig. 4. Ham phone transmitter built by author in 1924. This 5-watt rig used "loop modulation," produced by wrapping single turn around tuning coil and connecting it to microphone through a mike battery.



◀ Fig. 5. Early rack-mounted 200-meter phone and c.w. transmitter. Rack frame was made of wood. Dry cells were used for the mike and relay circuits. Small motor beside dry cells was used to drive a "chopper wheel" then employed to transmit interrupted c.w.

Fig. 6. Here is an internal view of the 5-watt radiotelephone transmitter shown in Fig. 4. Rig used a 200-meter coil wound on Bakelite tubing with taps taken off to switch contacts on the front panel. Heavy bus-bar wiring was employed throughout.



which, properly connected, would provide previously unheard of transmission range, could all be easily dropped into an apple box.

Much smaller, table-mounted "rack and panel" equipment was possible. Neat angle-iron racks and Bakelite panels replaced the awkward, oversized wooden frames in pre-war use. Small nameplates, as well as equipment accessories, became available from radio manufacturers. The amateur began to dress up his gear and more professional ham stations began to replace the "horse and buggy" installations.

Receivers, too, came in for their share of attention. No longer did receiving components occupy an exposed place on top of the wooden cover of a cabinet which enclosed inert items such as fixed condensers, the body of variable condensers, and such gear but *everything* except actual shafts, knobs, dials, and switches was concealed. Rather than mounting these on a *top* cover plate, which made for awkward adjustment and reading, the controls were now placed on a *vertical* front panel, directly within the operator's line of sight.

Construction continued to improve. It could not go backward in such a progressive nation as the United States. Many and ingenious were the modifications and improvements introduced into amateur construction practice. Commercial development had progressed as well but due to the peculiar nature of the requirements could not make the rapid strides which the versatility of amateur operation made possible.

In Recent Years

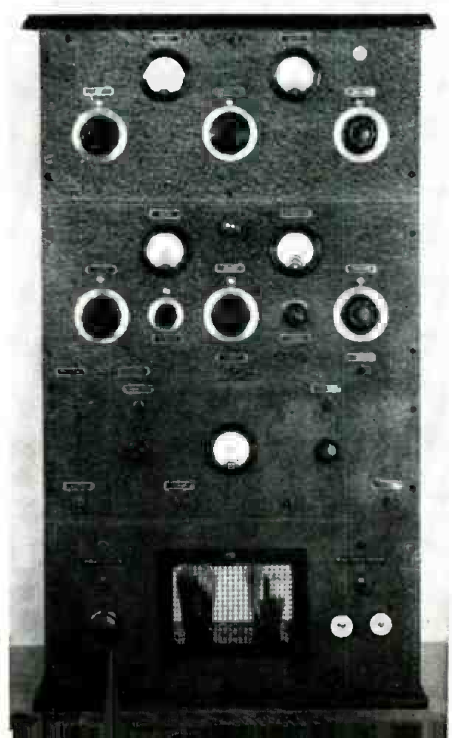
In recent years, perhaps the greatest contribution to improvement in amateur construction methods has been the introduction of the "kit" by a number of national manufacturers. Embracing not only radio transmitters, receivers, and accessory items but test equipment, hi-fi and related apparatus, such kits come to the purchaser with all of the hard work done. Chassis are formed, drilled and punched; coils are wound; panels and cabinets—all of metal—nicely finished and labeled; and all of the components, down to the last screw and nut and including tubes are supplied. Detailed pictorial diagrams and step-by-step assembly and wiring instructions are included. It is almost impossible for a careful home constructor, even with no previous electronic construction experience, to do a *poor* job.

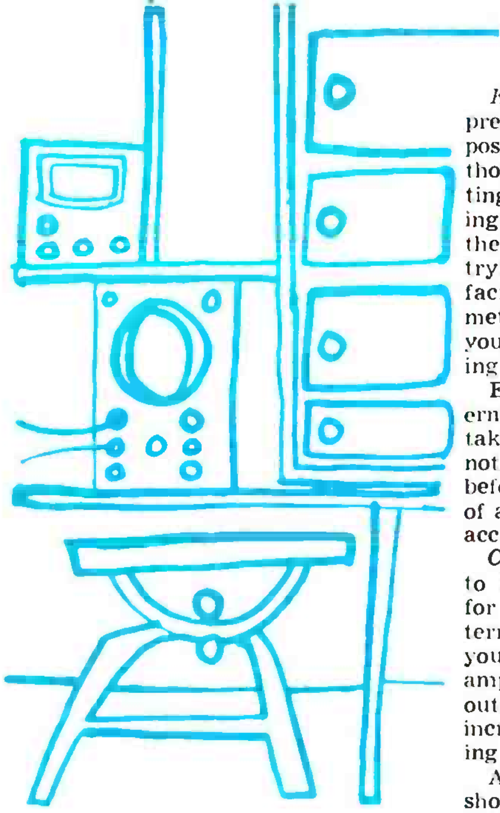
It is of course true, as in everything else, that a hastily assembled, carelessly wired job can result unless the builder is willing to perform his operations carefully and conscientiously. By so doing, assembly and wiring of the kit will not only be fun but the builder will realize a substantial saving by eliminating the largest item of cost in factory wired equipment . . . labor. Nevertheless, for those who would rather not tackle the job, most companies supply factory wired versions of their kits at a commensurately higher cost.

Not only is great improvement evident in amateur radio construction by reason of the introduction of kits but so-called "home-brew" equipment has been vastly improved as a result of the challenge offered by commercial kits and wired units. Most home-brew builders accept this challenge and meet it but some "hedge," it's true. The author has seen many a piece of ham gear hurriedly constructed and carelessly wired in the builder's haste to get on the air. This is especially true of the newly licensed novice. Too much eagerness to "make it work" and "get going" has literally butchered even a well-designed kit to say nothing of "home-brew" constructions. It is far better to take a few extra days and do the job *once;* it will probably save countless heart-breaking hours of troubleshooting in the future. Your time is *well* spent in properly mounting your components and in routing and forming your wiring. Not only will such action result in a piece of equipment in which you can take justifiable pride but should you someday wish to trade your gear in for new equipment, you will find that the resale or trade-in value has been enhanced considerably by time well-spent.

Amateur radio construction *has* improved, definitely! May it continue to do so! —30—

Fig. 7. Progress toward more professional-appearing ham gear is illustrated by this home-built transmitter of 1936. "Unit" construction, with various parts of the transmitter made of separate chassis and panels, was employed in this transmitter.





Remodeling Your Shop? Plan Ahead

By **ERNEST W. FAIR**

Before you go ahead, make sure you know exactly why you are seeking changes and what these should be.

IS THE remodeling of your shop's layout long overdue? Do you feel that you can't put the job off any longer? Go ahead, but don't be one of those many shop owners who wish, after the work is completed, that they could tear everything down and start all over again. Unable to meet the costs of a dual remodeling job, you will probably be forced into the unhappy position of having to live with your mistakes for quite a while.

If you are going to meet the individual requirements of your own operation as well as the general ones, and if you are going to take care of present needs as well as future ones, you will have to plan carefully before a single nail is driven. The suggestions given here include recommended steps and also point up pitfalls that, based on the experience of others, you are most likely to run into.

Plan for the future, too. One of the leading mistakes made in a modernization program often results at the same time that careful attention is given to current needs—and current needs only. It can happen that, in another year, changes are again badly needed but are out of the question because there has not been sufficient economic recovery from the previous alteration.

Present requirements, of course, must be carefully worked out at the start. But they have come into being because there have been changes in your business during the past year or two. Try to understand the direction of these changes so that you may project them another year or two ahead. What sort of equipment will you be servicing and for whom next year? No matter how carefully the new layout is planned, enough flexibility should be allowed so that equipment and fixtures can be changed about somewhat, without great expense, to take care of the unknown.

Know your objectives. Is your major, present problem the fact that you can't possibly handle more customers although you would have no trouble getting them? Is it a question of expanding your facilities to enable you to do the same work at less cost? Are you trying to reorganize already adequate facilities to streamline your work methods? Are you remodeling because you expect that business will be growing larger?

Every item that goes into the modernization plan should be the result of taking into account the factors just noted and any others that apply. Long before you have decided on the location of a single shelf, you should have been accumulating a list of definite goals.

Consider operating costs. In addition to the substantial, immediate outlay for the alteration, you must think in terms of how the changes will affect your continuing overhead. For example, you may end up by cancelling out any advantages you hope for by increased costs for such items as heating and lighting.

Actually, for many reasons, you should be trying for the opposite—a reduction in operating costs made possible by the introduction of greater efficiencies. One reason for reducing overhead is the fact that this will help pay off the expense of remodeling. Another reason is that the cost of doing business will probably continue to rise, as it has for the past several years. Protect yourself against the possibility of marginal operation with this built-in safety factor, especially in areas where there is good reason to believe that costs will go up. For example, if local utilities are pressing for rate boosts, you might do well to consider the most efficient use of lighting (type and location of fixtures) rather than just getting more of it. More efficient heating systems or changes in the type of fuel used, for example, may be considered.

Put it on paper. Many a business man has fallen into a pitfall by "mentally" visualizing how he will change around one section of the shop or another without realizing how the changes in this area will adversely affect some other important section. Work it all out on paper first. Be sure that, in incorporating needed changes, you are not taking away facilities that are needed just as much but that may be getting overlooked because it is easy to take for granted what is already there. In expanding work space to handle more jobs, for example, are you taking away the area where you should be accommodating the customers who must provide this extra business?

Planning on paper will also give you a better chance of visualizing how the completed job will look, aside from efficiency. Appearance and atmosphere are an important part of any business. So are arrangement and convenience for the customer as well as for yourself. Don't forget the location of every item of equipment and stock with respect both to its appearance and its frequency of use.

Get expert advice. If word gets out that you are planning to modernize, you will not have to look for advice. It will come at you from every direction, and much of it will be from armchair experts. This will be the time not to listen to anyone but men who know what they are talking about. Even if it takes a little more time and money, make sure you are paying attention to experienced people.

This applies to contractors, architects, and other shop owners in and out of the service business. If you are going to have outside builders do your work and help you plan it, take a look at some jobs they have already handled. From other shopkeepers, you may get

(*Continued on page* 115)

A Solder-Gun Temperature Control

By **PETER VOGELGESANG**

Plug-in regulator permits continuous soldering on bench, protects transistors and printed wiring.

BECAUSE of the speed with which it heats or cools, the soldering gun has become one of the technician's handiest tools. For soldering just one or a few connections, or for carrying about on service calls, it has many advantages. It is hot enough to use almost immediately, yet it can be packed up in the tool kit or deposited on such a surface as a carpet without danger of burning just a short time after use. Also the danger of damage due to overheating by forgetting to pull the plug when the job is done is eliminated, since the gun is off when not in use.

In spite of these advantages, the soldering gun is seen less often than the iron on the benches of service shops or laboratories. Lately, with the increased use of semiconductors and printed circuits, the guns have suffered additional restrictions. The drawbacks result from two principal problems—temperature overshoot and heating time.

Transistors and diodes can be damaged by excessive heat applied during soldering, as is borne out by the familiar admonition to use an adequate heat sink on the lead between the component and the point being soldered. Although this is a good general rule, it is essential only when the temperature of the soldering instrument is considerably above that needed to make the solder flow. If temperature is controlled, the precautionary techniques are generally unnecessary. Thus the soldering gun is risky because the low mass of its tip can easily overshoot the safe temperature range if its trigger is held a moment too long. A similar problem is encountered with printed wiring, where excessive heat may lift or dissolve the deposited pattern.

As to heating time, the few seconds required to bring the tip to operating temperature, while insignificant in the total time taken in a repair job, must be repeated constantly during an assembly procedure or other task requiring extensive soldering. Here the iron is generally preferred. Thus many technicians find they must have both a gun and an iron.

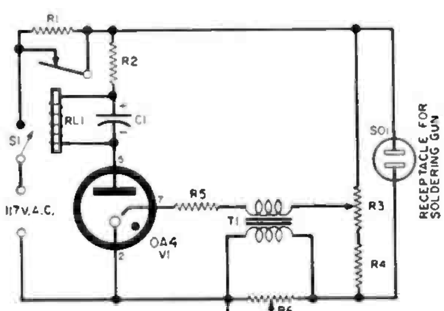
Both problems that prevent the gun from being used as a universal instrument can be solved by automatically stabilizing temperature of the gun's tip. If this is limited to a pre-determined value without regard to how long the trigger is depressed, it will also be possible to lock the trigger of the gun to keep the tip hot for long periods without exceeding the recommended duty cycle of the instrument.

Although this sounds like a complicated requirement, it can be accomplished with a simple and inexpensive circuit for the bench. An important feature of this circuit is the complete avoidance of any additions, attachments, or modifications to the soldering gun itself. The control unit plugs into the a.c. line—and the soldering gun plugs into the unit. Thus the gun can be removed at any time for independent use in the regular fashion, as on service calls, without delay.

Control is based on the fact that the resistance of a soldering gun's tip varies directly with temperature: as the latter rises, so does the former. This is true of both the copper and steel tips in general use. Thus at any specific temperature the tip has a specific resistance, and draws a specific current from the gun's transformer. In fact, if the primary current of the transformer is monitored, a variation of more than 25 per-cent can be observed between the cold and hot conditions. Temperature stabilization can be effected, then, by sensing and controlling this primary current. A circuit that does this is shown in Fig. 1.

When the trigger of the gun is depressed, current through R_6 causes a voltage drop that also appears across the low-impedance winding of transformer T_1. The high-impedance winding steps up this voltage and uses it as a control voltage to prevent the gas-discharge tube, V_1, from firing by bucking out the triggering voltage. Relay RL_1 remains unenergized, and a.c. power is applied through its normally

(Continued on page 94)



R_1—5000 ohm, 10 w. wirewound res.
R_2—1000 ohm, 1 w. carbon res.
R_3—10,000 ohm linear-taper pot
R_4—10,000 ohm, 1 w. carbon res.
R_5—47,000 ohm, 1/2 w. carbon res.
R_6—2 ohm linear-taper pot (IRC #WP2, 4-watt or equiv., see text)
C_1—40 µf., 150 v. elec. capacitor
T_1—Audio output trans., 5000 ohms to 4 ohms (any power rating)
RL_1—S.p.d.t. plate-circuit type relay, 10,000 ohm coil (Leach #1032 or equiv.)
S_1—S.p.s.t. toggle switch
SO_1—A.C. receptacle
V_1—0A4 or 5823 tube (see text)

Fig. 1. Gas-discharge tube with relay keeps gun within its rated duty cycle.

Fig. 2. The compact control. Gun unplugs for separate use.

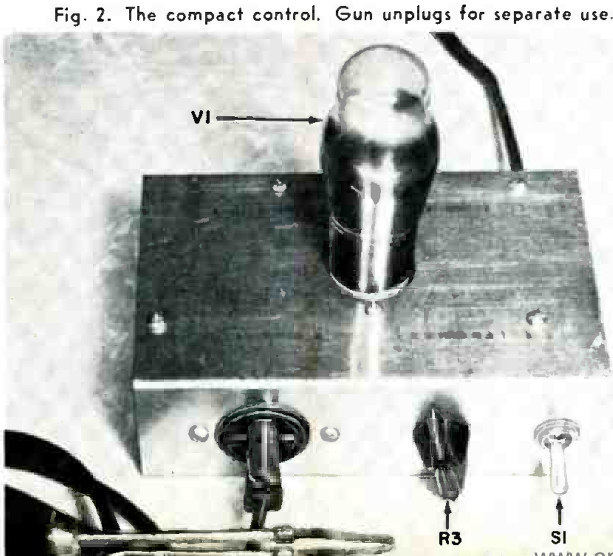
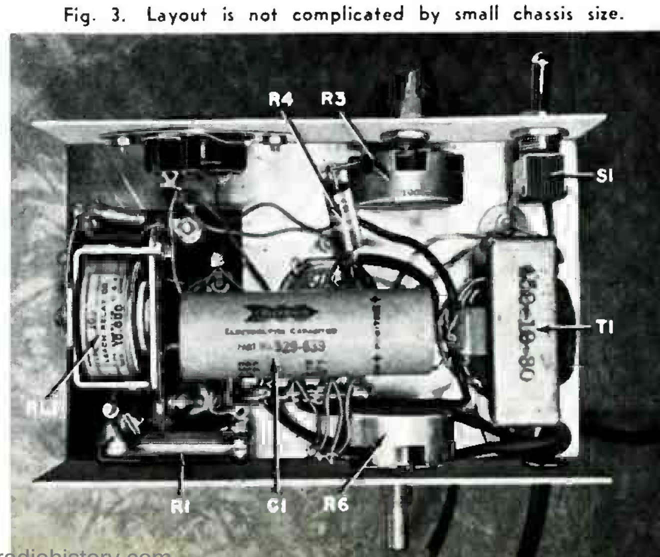


Fig. 3. Layout is not complicated by small chassis size.



Ultrasonic TV Remote Controls

By WILLIAM FEINGOLD

Variety notwithstanding, popular types have enough in common so that they can be studied as a group.

ALTHOUGH many types of remote-control devices for television have come into being during the past few years, those using ultrasonic signals seem to have done the best job of capturing the public fancy. Attesting to this is the fact that most remote units in current production are ultrasonic and they seem to sell best. Despite many variations within the type, there is enough "family resemblance" to make a general description of operation possible. This is fortunate for the service technician, who may run into enough problems in remote systems even when he is not handicapped by the lack of a general picture of how they work.

As the term is employed here, ultrasonics refers to the use of acoustical energy (mechanical vibration transmitted through the air) above the hearing range, rather than electromagnetic radiation. Normally, frequencies in the region of 40 kc. are used. Why should controls relying on such signals be preferred to wired, r.f., or photosensitive light-beam devices? As to wires, there is little question that any scheme freed of connecting cables trailing about the floor is neater and more convenient.

Some r.f. systems do very acceptable jobs. The difficulty here is that operating frequency and transmitted power level have to be selected and maintained carefully to stay below FCC limits on radiation from "unlicensed transmitters" and avoid interference with other services. Also, since walls are not effective barriers to r.f. energy, it is possible for two sets in adjacent apartments to suffer from undesired mutual control.

The light-beam system, in which a hand-held lamp is directed toward photosensitive cells at the receiver, suffers from sporadic operation due to uncontrolled ambient illumination. It also requires a degree of marksmanship that is annoying for unsteady hands.

Ultrasonics reduces these problems. Relatively non-directional, it avoids the need for careful aiming; yet, severely attenuated by ordinary walls as are all acoustic waves, it has almost no interference potential. In addition, a system can be designed that has virtually no susceptibility to interference.

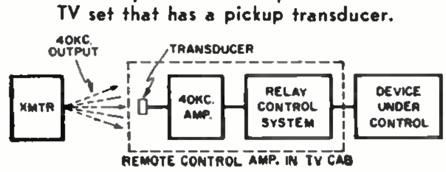
In this discussion, little attention will be given to the various mechanical means for executing the specific functions at the receiver end once the remote signals have been picked up and detected. Individual systems vary greatly in how they use relays, one-way or two-way motors, clutches, gears, and other devices. Despite such differences, they adhere to the basic plan of Fig. 1. Pressing a function button on the transmitter releases a burst (or continuous wave) of energy in the 40-kc. region. This "sound" is picked up by the transducer on the remote-control receiver in the TV cabinet, amplified to a useful level, and used to operate a tube-controlled relay. The latter controls the device that produces the functional change desired.

Functions Provided

Most plans provide some type of remote control over station selection, volume, and "on-off" switching. At the economy end of the line, some set makers offer single-button controls that change channels and usually also turn the set on and off. This is done by rotating the channel selector in one direction only and turning the set off each time the tuner goes through the 13th position, which would otherwise be used for u.h.f. reception. This scheme is obviously not applicable where u.h.f. reception is desired.

The next step up the line is a two-button control offering channel selection, volume adjustment, and "on-off" switching. One button is for the unidirectional tuner selector. The other one usually operates a step-type ratchet relay that goes through a sequence of perhaps four positions. These may include three positions of "TV-on" at low, medium, and high volume, plus a "TV-off" position. There are some sophisticated arrangements, with perhaps four buttons, that offer such added conveniences as rotation of the channel selector in either direction (two buttons) and a separate button for the "on-off" function. Some deluxe units offer gradual increase or decrease of volume to any desired level by ultimately controlling a motor that rotates the shaft of a volume control. In fact, some even offer a "permanent-off" feature, which is not quite the same as the usual switch-off arrangement. More of this later. Different functions are usually controlled by signals of different frequency but within the same fairly narrow range.

Fig. 1. All systems use a compact transmitter with acoustic output, followed by a receiver-amplifier at the TV set that has a pickup transducer.



Transmitter Types

As a rule, the transmitters fall into two design categories. One uses resonant bars or rods, which function in the manner of tuning forks, to produce the output tones directly. Depressing a button causes an impact hammer to strike the end of the rod, setting it into vibration for a short period. Carefully cutting a rod to a prescribed length will make it resonant at the desired pitch, usually in the range from 38 to 41 kc. *Zenith* and *Admiral* use such systems.

In the second group, electrical output is provided by carefully tuned oscillators, usually transistorized, and fed to an output transducer, which may be a small loudspeaker of either the ceramic or capacitor type. For linear operation, the capacitor-type tweeter requires a polarizing voltage. It is interesting to note that a manufacturer can deliberately omit the polarizing voltage (as does *RCA*), drive the transducer with electrical energy in the 20-kc. range, and thus obtain harmonic, acoustic output in the 40-kc. band.

Receiver Systems

Broadly speaking, there are three types of remote-control receiver-amplifier designs now being produced for use at the TV set. All use another transducer, functioning as a microphone, to sense the "sound." The simplest receives, amplifies, and rectifies the transmitted signal to obtain a d.c. control voltage, as in Fig. 2A. However, this system has the poorest immunity to the one problem that may occur with ultrasonics: "sounds" or their unheard harmonics from door hinges, rattling keys, rocking chairs, spray cans, and other sources may accidentally trigger the receiver at the wrong time.

Two schemes of more refined design have been conceived to minimize this possibility. One uses two oscillators in the transmitter that operate simultaneously when a button is depressed. The two frequencies are always a specific distance from each other, say 2-kc. apart. As in Fig. 2B, they may be 40 kc. and 42 kc. The receiver accepts and amplifies both signals, demodulates both (usually by simple diode action), separates the 2-kc. difference frequency, and rectifies the latter to obtain a control voltage. Since the receiver input will not accept a direct acoustic output at this low frequency, spurious triggering is avoided.

Another method relies on a single tone (Fig. 2C), but applies it to a frequency discriminator after amplification. The response of such a discriminator, which is similar to the types used in FM reception, is an "S" curve like the one shown in Fig. 3. This one is so aligned that its peak output at one end of the curve is at 40 kc. A signal at this frequency can then be used to operate a tube-controlled relay. Note that, with a balanced discriminator exhibiting this type of response, the same detector can be used to separate another signal at 39 kc. The two outputs can be used to control different functions or rotate the same motor in two different directions in connection with the same function. For example, signals for increasing and decreasing volume level, or for turning the tuner clockwise and counterclockwise, can be differentiated in this way.

"On-Off" Switching

It must be recognized that all of these systems involve the addition of a control-amplifier chassis to the TV receiver itself and that, unless this added circuit is on and operating, there can be no remote operation—including that of turning the TV set itself on. Obviously, the user must either turn the amplifier on manually, at the TV set itself, *prior* to using the remote control and turn it off afterwards, or he must leave it on 24 hours a day. Although the cost of power consumed in following the latter procedure may not be considered high, the continuous-duty life of components is a limiting factor.

One manufacturer approaches the problem by transistorizing the control receiver-amplifier. The low power consumption and absence of significant heat renders continuous operation acceptable. Others feature a partial solution by requiring the user to turn the circuit on at the set before use, but allowing him the privilege of remotely turning the TV set itself on or off while retaining the option of leaving the amplifier on or turning it off also. This involves an extra "off" position sometimes called the "Permanent Off." Using it, however, means that the amplifier must again be turned on at the receiver before remote operation can be resumed.

One way of achieving this is to mount two power switches on the shaft of a motor-driven volume control. One switch, as is the case with ordinary, combination "on-off"-volume controls, is actuated by the extreme counterclockwise rotation of the shaft. The other is operated about 45 degrees before this extreme is reached. The extreme switch controls power to the remote amplifier; the other, power for the TV chassis.

In use, the remote transmitter controls volume continuously. The user keeps the "Volume-Decrease" button depressed until the volume control's counterclockwise rotation turns off only the TV set. If he now releases the button, he can again turn the set on by calling for an increase in volume. He can also call for decreasing volume until the remote amplifier is turned off along with the TV set.

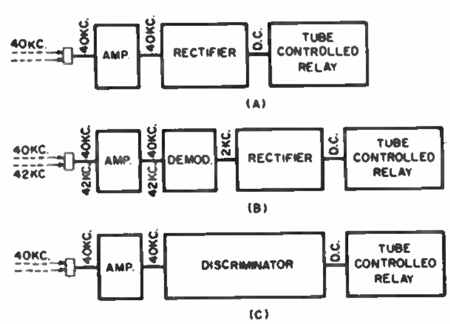
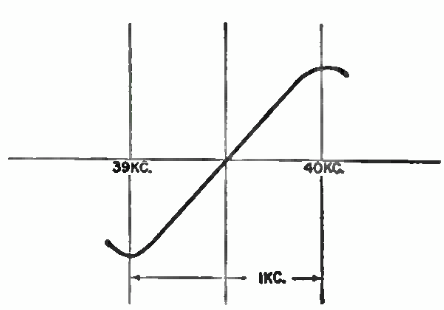


Fig. 2. All receivers convert signal to electrical energy. Simplest ones (A) rectify this signal directly for d.c. control voltage. Others (B) use beat note between two transmitted signals. Some (C) use frequency discriminators to distinguish between tones.

Fig. 3. The response curve of a discriminator type receiver is an "S" curve like that found in FM detectors.



Other Features

This type of continuous variation from the remote position brings up an interesting point. Such smooth operation is possible only when the user can maintain a steady output tone by keeping a button depressed and stop at any desired point by releasing the button to interrupt the tone. (In this arrangement the receiver continues to operate a motor as long as it receives a signal with which to develop a control voltage.) This type of c.w. operation is achieved with transmitters using electronic oscillators. Where mechanical-rod transmitters are used, as a rule, the short-duration bursts they generate operate step-type controls at the other end.

Many variations of the techniques outlined here are possible. For example, it is possible to obtain some sort of continuous operation even with bursts. In one method, an instantaneous signal could be used to start a motor that drives a channel selector which continues to operate as long as it passes inactive channels. When an active channel is reached, one of several possible sensing methods is used to stop the motor. Detected signal or a mechanically pre-set indexing arrangement can do this. However, the many possible mechanical and electro-mechanical devices used to carry out functions at the TV set are beyond the scope of the present discussion.

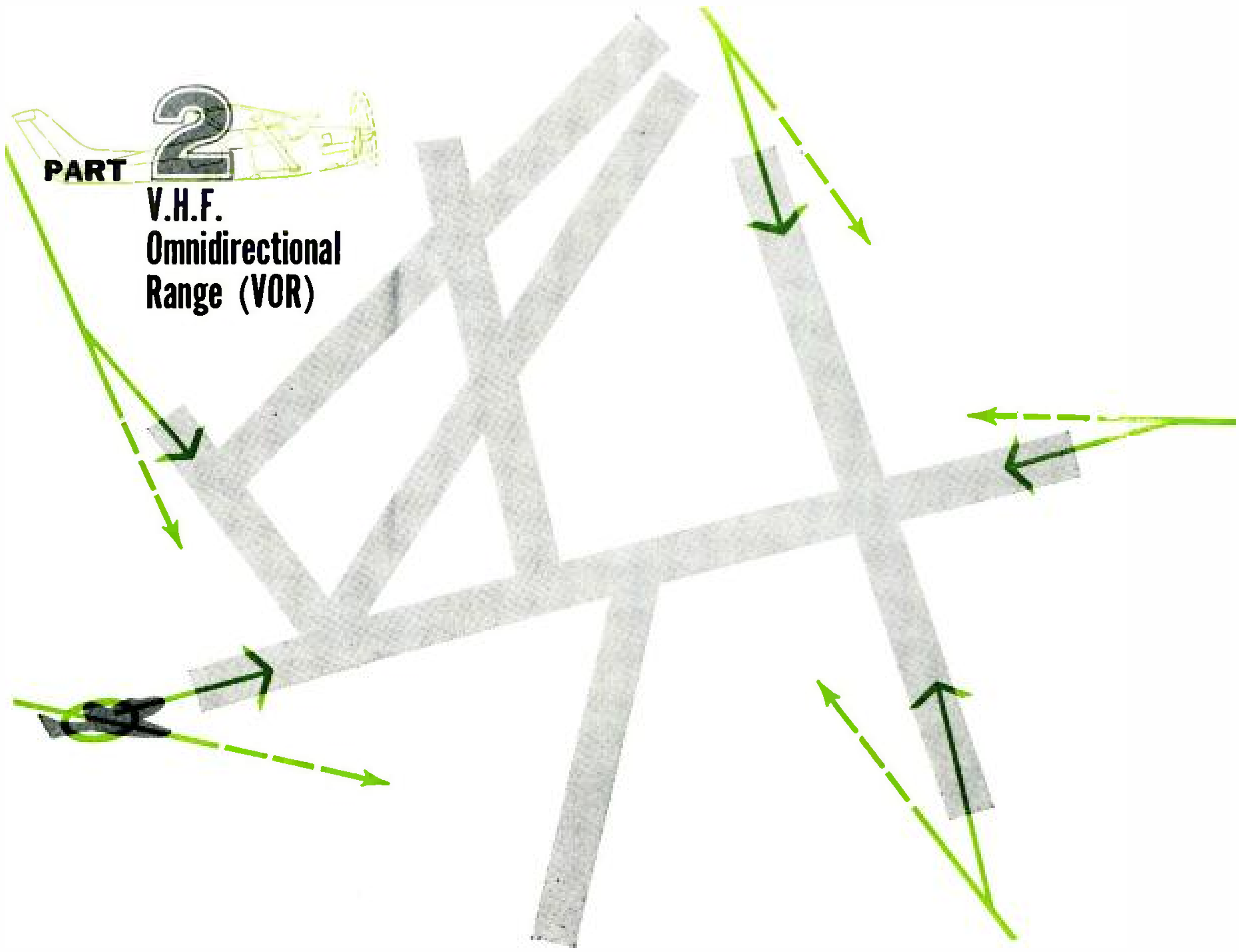
Ultrasonic remote-control systems offer many advantages. For the consumer, they offer light, rugged, hand-held transmitters that may require no power at all, as is the case with the tuning-bar units, or operate on inexpensive batteries that require replacement only infrequently because of the low drain by the transistorized circuits they power.

In addition, the problems involving radiation of interference, mutual interaction of different units, and susceptibility to interference are kept to a minimum.

For the technician, although he may lack enthusiasm about remote controls in general, he will find that his difficulties with acoustic-output units are fewer and simpler. —30—

PART 2

V.H.F. Omnidirectional Range (VOR)



Radio Aids to Aircraft Navigation

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

Description and use of the most flexible, accurate, and simple widely used navigation system for planes.

LAST month we discussed the two low-frequency systems of long-range navigation. The low-frequency radio ranges and direction finding are capable of guiding an airplane along the civil airways, but not without some serious disadvantages and limitations. Radio ranges are limited by their inability to provide more than four navigational courses. Direction finders and the radio ranges both suffer from the poor propagation characteristics of low frequencies which causes navigation errors due to static and atmospheric bending of the beams.

The radio-range and direction-finding systems of aircraft navigation were developed at a time when low frequencies were the only frequencies practical for broadcasting. As time passed and higher frequencies became usable it was obvious that v.h.f. transmissions for navigation would be highly desirable since v.h.f. is relatively static-free and not susceptible to bending as lower frequencies are. Engineers could have developed a v.h.f. radio-range system similar to the low-frequency ranges, but they realized that the four-course limitation was a serious one. They felt that whatever system they developed for v.h.f. navigation should be similar to ADF and include 360 radio courses, a course for every degree on the compass.

The result was VOR, short for *V*.h.f. *O*mnidirectional *R*ange, sometimes also known as "Omni." Without a doubt, VOR is the most flexible, accurate, and simple widely used navigation system. The receiver is relatively simple and inexpensive and is generally a part of v.h.f. communications equipment.

VOR

In order to understand the operation of the VOR system, it is first necessary to understand the operation of a VOR transmitter. In essence, the operation of a VOR transmitter can be likened to that of a light beacon rotating at a uniform rate. If the beacon revolves at 1 rpm and if a fixed red light atop the beacon is flashed as the beam points North, an observer with a stopwatch can determine his bearing from the beacon merely by starting the watch when the red light flashes and stopping it when the beacon's beam flashes past him. The azimuth angle measured from North is then directly proportional to the elapsed time measured by the stopwatch.

A VOR transmitter functions in a manner similar to the rotating beacon and flashing red light. In the VOR transmitter, the rotating beacon is replaced by a signal whose phase rotates from zero to 360 degrees as the signal is beamed and rotated clockwise in a narrow beam from magnetic North. When the electronic beam points North the phase is at zero degrees, as the electronic beam passes East the phase is at 90 degrees, and so on for all points of the compass. Every degree of the compass corresponds to an equal amount of phase shift in the beacon signal.

The reference flashing red light is electronically replaced by a reference signal whose phase remains at zero degrees irrespective of direction. In order for a pilot to determine his azimuthal angle from the transmitter it is only necessary to measure the phase shift of the beacon signal in comparison to the phase of the reference signal. The number of degrees of phase shift measured corresponds exactly to the number of azimuthal degrees from North referred to the transmitting station employed.

VOR receiver. "Left-Right" meter with "To-From" indication, is at left. The course-selector dial is at the bottom.

For example, if an airplane is located due North from the station, it will receive the beacon and reference signals in-phase. If the pilot somehow measures the phase difference between these two signals he will find it to be zero degrees. The pilot then knows he must be on a line at zero degrees, or due North, from the station. If the airplane is located due South from the station, it receives the beacon and reference signals out-of-phase. If the pilot again measures the phase difference he finds it to be 180 degrees. The pilot knows he must now be on a radial at 180 degrees, or due South, from the station. In a similar manner, a pilot can determine his position along any radial from the station.

The purpose of a VOR transmitter is to broadcast the beacon and reference signals as well as voice communications. A complex antenna array transmits this information in the v.h.f. band of 108 to 118 megacycles. The v.h.f. carrier is first amplitude-modulated at 30 per-cent with a 10 kc. (actually 9960-cycle) signal. In turn, this 10 kc. signal is frequency-modulated with a 30-cycle reference signal with a maximum deviation of ±480 cycles above and below 10 kc. This 30-cycle signal which has been coded onto the 10 kc. subcarrier forms the reference signal of the VOR system and remains fixed in phase.

VOR and TACAN transmitter site. The main VOR antenna array is housed in the base of the cone on top of the building. It is a four-loop antenna assembly. The cylinder on top of the cone is the antenna for the Air Force-developed TACAN navigation system. The vertical antenna on the pole to the right of the main building is a distance-measuring equipment (DME) antenna. DME is currently being discontinued.

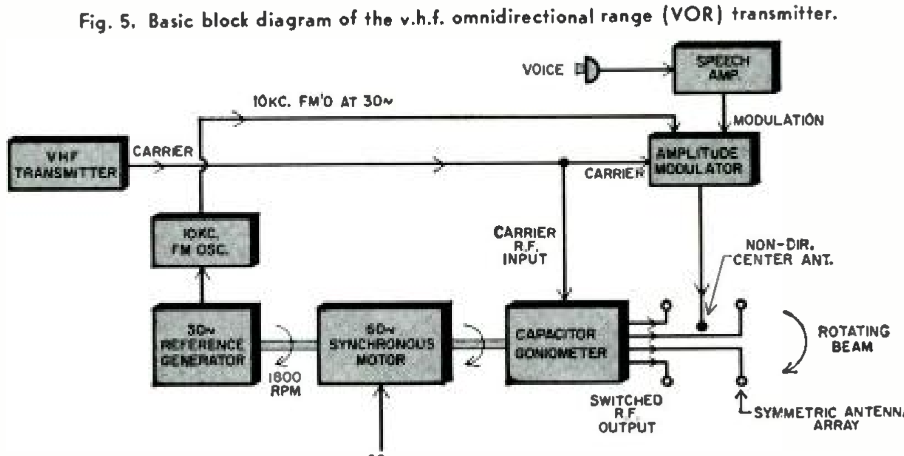
The beacon signal could be created by transmitting the unmodulated v.h.f. carrier from a highly directional antenna and then rotating this antenna 30 times each second. This would, in essence, amplitude-modulate the v.h.f. carrier at a 30-cycle rate whose relative phase varies as a function of antenna position. When the antenna points directly at an observer, the v.h.f. signal which he receives has maximum strength. However, when the antenna is pointed directly away from the observer, the signal is received with minimum strength. The amplitude of this received signal, then, varies as the antenna rotates and the signal detected by the receiver is identical to one amplitude-modulated at a 30-cycle rate. Note, however, that the amplitude maximum always occurs when the antenna is pointed directly at the receiver, irrespective of the receiver's azimuthal position from the transmitter. The result is that the phase of the amplitude modulation with respect to a fixed phase reference signal varies with azimuth around the station.

It is apparent that it would be extremely difficult to physically rotate a heavy antenna 30 times each second, which corresponds to 1800 rpm. The solution to this problem is shown in Fig. 5, which shows a simplified block diagram of a VOR transmitter. A complex antenna array is used to create the rotating v.h.f. radiation pattern. This antenna array consists of a series of directional antennas spaced evenly around the transmitter site. These antennas are connected to a rotating goniometer which, in turn, is connected to the v.h.f. transmitter output. The goniometer is essentially a capacitative switch which successively switches v.h.f. carrier energy from antenna to antenna. This goniometer is rotated at 1800 rpm by a synchronous motor in order to effectively rotate the beacon signal at a 30-cycle rate whose phase varies as a function of azimuth. A central non-directional antenna transmits the 10 kc. frequency-modulated reference signal and voice modulations.

VOR Reception

Fig. 6 is the block diagram of *National Aeronautical Company's* "Mark II," a popular, low-priced VOR receiver. The r.f. section of the "Mark II" is

Fig. 5. Basic block diagram of the v.h.f. omnidirectional range (VOR) transmitter.



a fairly conventional v.h.f. superheterodyne receiver plus v.h.f. transmitter for communications. The VOR converter section begins at the detected audio output of the receiver. Remember that the reference 30-cycle signal is coded as frequency-modulation on a 10 kc. subcarrier which, in turn, is amplitude-modulated on the main v.h.f. carrier. Since the audio detector of the v.h.f. receiver detects all amplitude modulation present on the carrier, the 10 kc. subcarrier is detected by the receiver and appears as a 10 kc. audio signal. In order to recover the 30-cycle reference signal which is frequency-modulated on this subcarrier, it is first necessary to separate the 10 kc. subcarrier from other audio frequencies present in the audio output of the receiver. A 10 kc. high-pass filter achieves this separation. The clean 10 kc. signal is then amplified and limited in amplitude to remove all stray amplitude modulation present. The limited signal is then applied to a ratio detector which frequency detects the 30-cycle reference signal from the 10 kc. carrier. In this manner, the fixed-phase reference is extracted.

The 30-cycle variable-phase beacon signal is already present at the audio output of the receiver since it was simply amplitude-modulated on the v.h.f. carrier. The variable-phase, or beacon, channel of the "Mark II" consists first of a 60-cycle rejection filter. The purpose of this filter is to remove 60-cycle components present in the audio output which are generated by single-blade propellers rotating at approximately 1800 rpm. Unless removed, this 60-cycle spurious signal can cause errors in the final readings and cause slow oscillations of the meter needles. Following the rejection filter, a 30-cycle bandpass filter removes voice frequencies and the 10 kc. reference subcarrier from the beacon channel. After amplification and further filtering, the beacon signal is applied to a phase-splitter which generates two equal voltages 180

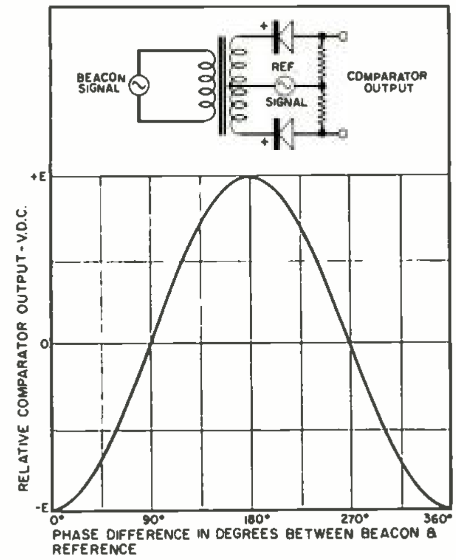


Fig. 7. Phase comparator characteristics.

degrees out-of-phase. These push-pull voltages then drive a phase-splitting bridge which produces four output voltages, each delayed an additional 90 degrees in phase than the previous voltage. This circuit consists of two resistors and capacitors connected in a bridge and arranged so that each corner of the bridge has equal beacon signal voltages, but at exactly 90-degree intervals of phase. These four voltages are connected to four cathode-followers in order to obtain four low-impedance beacon signal sources.

Since azimuthal position will be determined by measuring the phase of the beacon signal in comparison to the reference signal, the remainder of the circuits are designed to measure this phase difference. In the "Mark II," the four cathode-followers feed a symmetrically tapped potentiometer known as the "Course Selector." Since each tap of this potentiometer is connected to the four beacon signals which are each 90 degrees out-of-phase, the course selector functions as a continuously variable phase shifter. The output of the course selector is the beacon signal whose phase can be continuously varied through 360 degrees depending upon the position of the potentiometer arm.

Following amplification of the 30-cycle beacon signal, it is applied to two phase comparators. Each of these comparators consists of two diodes which are switched on and off by the 30-cycle reference signal. When conducting, these diodes allow the beacon signal to pass through. When non-conducting, the diodes reject the beacon signal. Since this action occurs in synchronism with the reference signal, which is also at 30 cycles, the phase comparator performs as a rectifier of the beacon signal. However, the magnitude and polarity of the rectified d.c. voltage thus produced is a function of the phase differ-

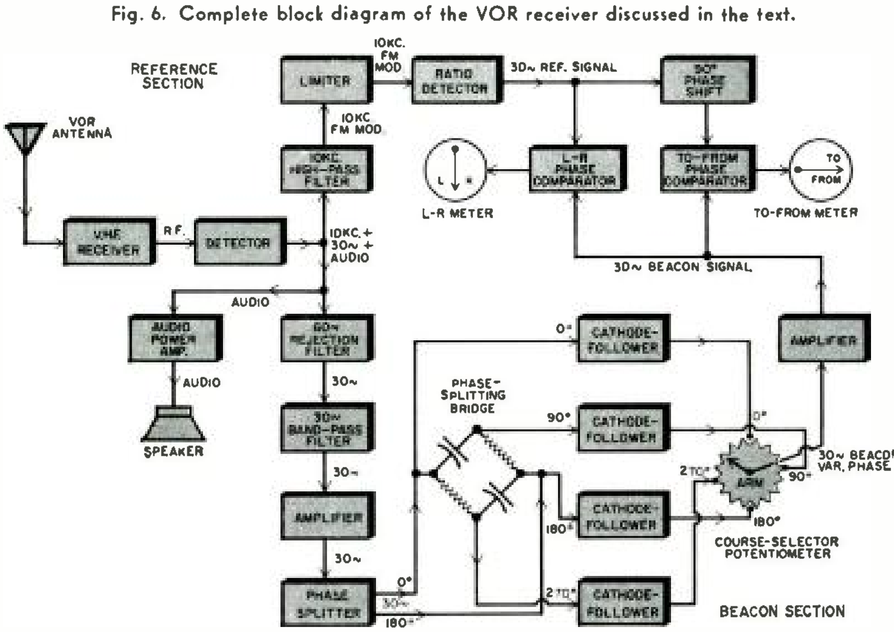

Single-unit VOR indicator/course selector.

ence between beacon and reference signals. If the two signals are exactly 90 or 270 degrees out-of-phase, no d.c. voltage is produced. If the phase shift is between 91 and 269 degrees, a positive d.c. voltage is produced which reaches maximum amplitude at 180 degrees. If the phase shift is between 89 and 271 degrees, a negative d.c. voltage is produced which reaches maximum amplitude at 0 degrees. Fig. 7 shows the d.c. produced by a phase comparator as a function of phase difference between the two voltages.

Consider the "Left-Right" phase comparator of Fig. 6. This is driven by beacon and reference signals. When a VOR signal is received, an azimuthal phase difference will exist between beacon and reference signals which produces a d.c. voltage proportional to this phase difference from the phase comparator. This d.c. voltage is applied to a "Left-Right" meter which is deflected by this voltage. If the course selector dial is rotated, the phase of the beacon signal can be adjusted until it is 90 degrees out-of-phase with the reference signal. At this point, the output of the phase comparator is zero and the "Left-Right" meter centers.

If the course selector dial is calibrated in degrees of phase shift introduced, then the course-selector dial in-

Fig. 6. Complete block diagram of the VOR receiver discussed in the text.

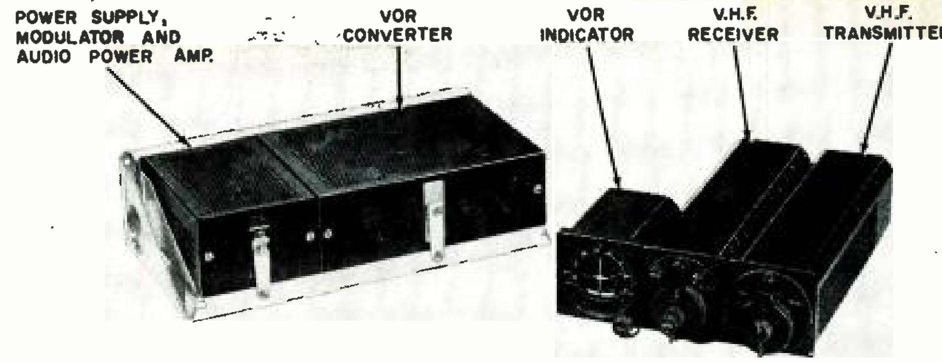


dicates directly the azimuth radial along which the aircraft is located. Unfortunately, the reading is ambiguous since the "Left-Right" meter will center at a phase shift of 270 degrees, as well as 90 degrees (refer to Fig. 7). The purpose of the "To-From" phase comparator and meter is to resolve this ambiguity.

Note that the reference signal that is used for the "To-From" phase comparator is shifted in phase so as to lag by 90 degrees the reference of the "Left-Right" comparator. Assume that the beacon signal has been adjusted to lag the standard reference signal by 90 degrees thereby centering the "Left-Right" meter. Since the "To-From" reference lags the standard reference by 90 degrees, the "To-From" comparator sees two signals which are exactly in-phase. This produces maximum negative d.c. voltage and deflects the "To-From" meter fully into the "To" region. If the beacon signal has been phase shifted 270 degrees rather than 90 degrees, again centering the "Left-Right" meter, the "To-From" comparator now sees that the two signals are exactly 180 degrees out-of-phase. This produces maximum positive d.c. voltage which fully deflects the "To-From" meter into the "From" region. In this manner, the "To-From" meter indicates which of the two possible "Left-Right" zero meter readings has been selected.

VOR receivers have been designed so that when the "Left-Right" meter is centered and the "To-From" meter reads "To," the course selector indicates the magnetic heading that will lead the aircraft towards the VOR station. Conversely, a "From" reading indicates the heading which will lead the aircraft away from the VOR station. In following a course to a VOR station, the "Left-Right" meter is arranged so that it will deflect in a direction that indicates which direction to fly in order to stay on course. Assume that a VOR station is to be approached along an 80-degree radial. The VOR receiver is tuned to the station and the course selector dial set at 80 degrees. The "Left-Right" meter will center and the "To-From" meter indicate "To" when the plane is on course. If the "Left-Right" meter reading drifts off center towards the left, this indicates that the pilot must execute a turn to the left in order to stay on course. In this manner, a pilot can easily remain on course by merely keeping the "Left-Right" needle centered. If the pilot is approaching the VOR station on an 80-degree radial as just described, as the flight goes on the "To-From" needle will flicker and finally swing to "From." At this point, the station has been passed and the airplane is now heading away from the VOR station.

The operation of the "Mark II" just described helps indicate the great versatility of the VOR system of navigation. In contrast to its closest relative, ADF, any radial can be flown and is indicated directly in degrees on the course-selector dial. ADF cannot achieve this without resort to a magnetic compass for proper heading. Furthermore, the "Left-Right" meter indicates directly the plane's deviation off its planned course. As can be seen in the photo (page 55), the "Mark II" VOR receiver is small and compact. The course selector dial is horizontal and at the bottom of the receiver. The "To-From" meter is arranged to show either the word "To" or "From" at the center of the "Left-Right" meter.



VOR receiving and communications system. Indicator, receiver and transmitter are installed on the cockpit flight panel.

The *Lear* "Navcom 100" VOR navigating system is unique in its presentation of navigation information. A single 3-inch-square meter contains the course selector dial, "Left-Right" meter, and "To-From" indicator. The course-selector variable phase shifter uses a servo resolver rather than a tapped potentiometer. A rotating coil in the resolver picks off the proper phase beacon signal from two fixed coils electrically 90 degrees out-of-phase. A resolver is more accurate as a phase shifter than a tapped potentiometer, but it is more expensive. Since the "Mark II" was designed for absolute minimum cost, it uses the tapped-potentiometer type of phase shifter.

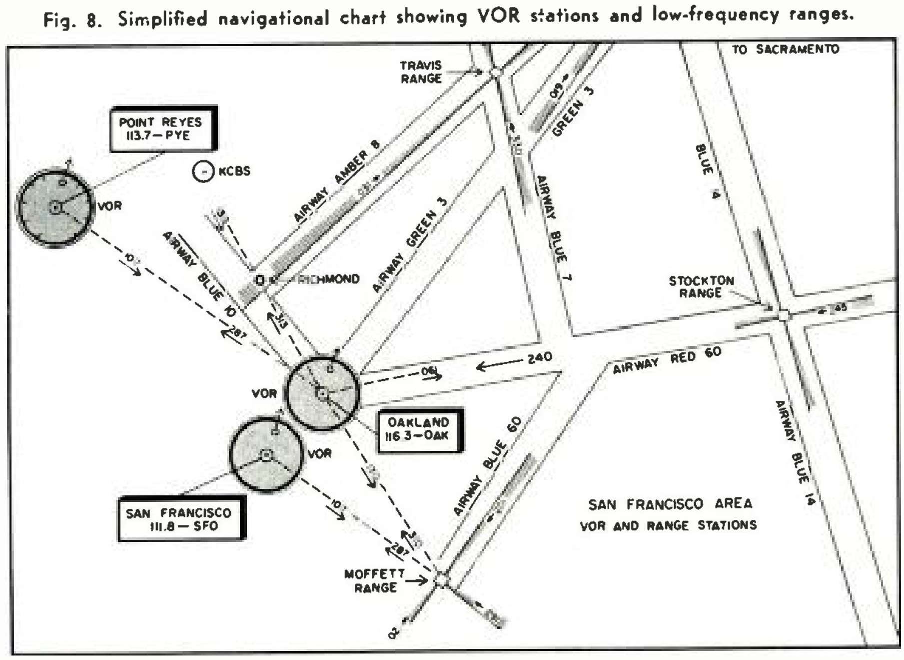
VOR is accurate. The maximum angular error permitted by the Federal Aviation Agency is plus or minus four degrees. Most VOR receivers are far more accurate than this, generally better than two degrees. Ironically, the principal weakness of VOR is due to its very use of v.h.f. frequencies. Although v.h.f. is static free, it propagates by "line of sight." That is, if the transmitter can be seen from the aircraft, the VOR signal can be received. Unfortunately, this means that there can be no obstructions between the transmitter and navigating aircraft to deflect the VOR signals. In turn, this requires that the aircraft fly at an altitude sufficient to guarantee that no mountains or other obstructions intervene. Therefore, VOR is practically useless below about two thousand feet. Since most air navigation is conducted well above two thousand feet, this restriction is not serious except when an airplane must fly low, as it must when preparing to land. All things taken into account, VOR presents less drawbacks than any other system in use and remains the backbone of U.S. long-range navigation.

Navigating with VOR

Fig. 8 shows a simplified radio navigation chart for the San Francisco area similar to that of Fig. 4, Part 1, but in-

(*Continued on page* 114)

Fig. 8. Simplified navigational chart showing VOR stations and low-frequency ranges.



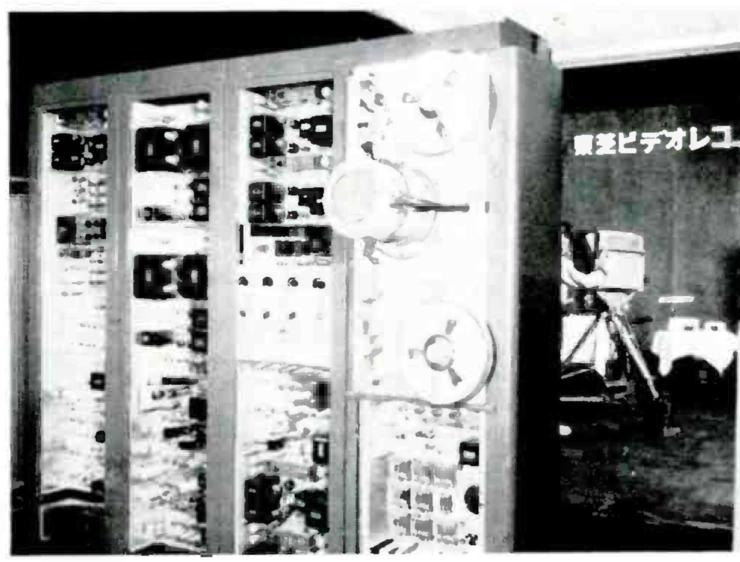
Recent Developments in Electronics

Largest Three-Axis Antenna

This precision antenna, built for the U. S. Air Force by *Philco*, is to be used for reception of telemetered information and other data from satellites and missiles in any phase of their flight. The antenna is the largest three-axis structure and boasts exceptional rigidity and high performance. The aluminum reflector is 60 feet in diameter and weighs about 15 tons. The unit responds to tracking commands to an accuracy of plus-or-minus two milliradians (about 0.11 degree). More than 30,000 aluminum alloy blind rivets are used in the assembly.

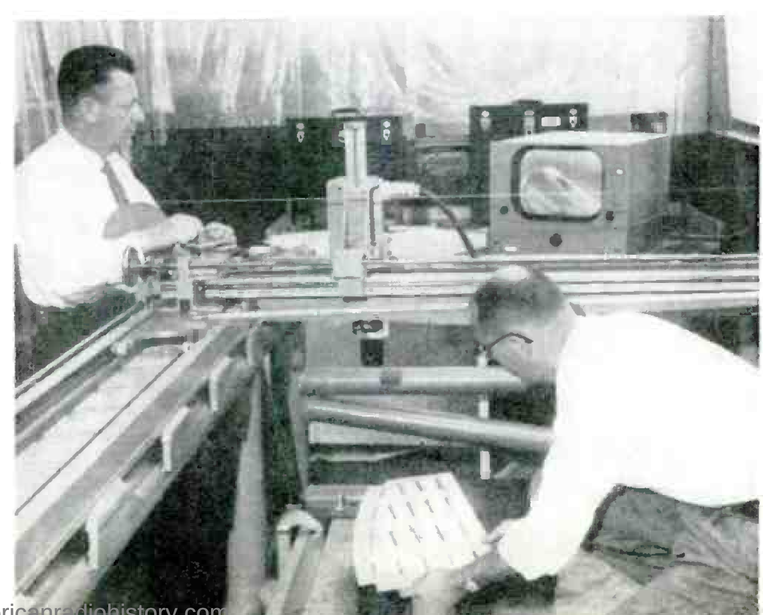
Japanese Video Tape Recorder

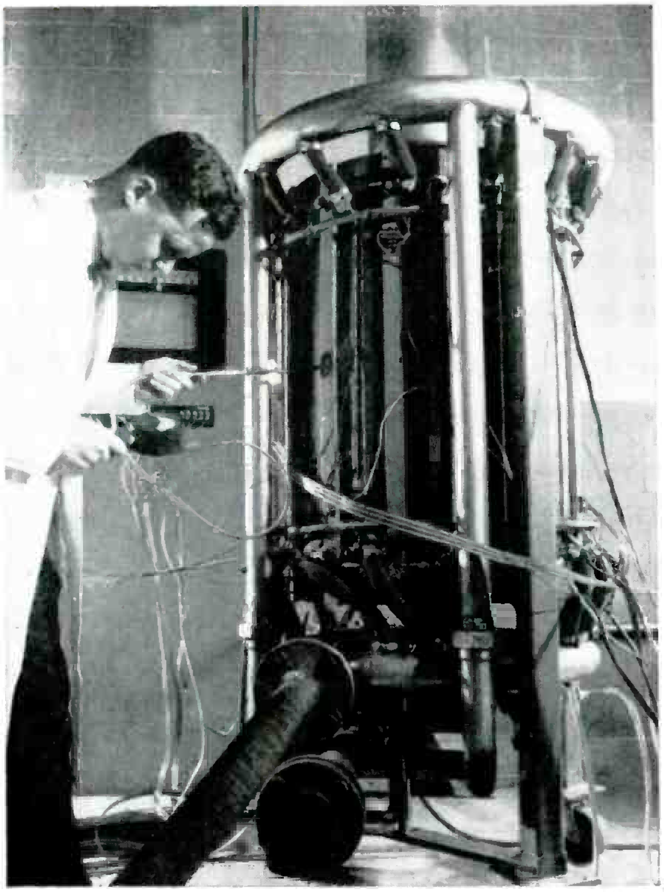
At the recent convention of the Society of Motion Picture and Television Engineers, a technical paper was given by Dr. N. Sawazaki of the *Tokyo Shibaura Electric Co.* describing the features of the *Toshiba* video tape recorder. This recorder won the "Japan Best Ten New Products Prize" for 1959. A unique feature of the *Toshiba* system is that it records the whole picture of one television field in one long track on the tape, using only one rotating head. The tape is made to run in a helical loop around a cylinder against which a high-speed rotating head operates. A tape speed of 15 inches-per-second is employed, and the signals are recorded on 2-inch wide tape. The video tracks are recorded at an angle of a little more than 4 degrees with respect to the tape edge, while the audio track is recorded in the conventional manner near one edge and parallel to it. Along the other edge a control track is recorded to maintain speed and synchronization. An experimental model of the tape recorder has a video frequency response flat up to about 1 mc. at which point a gradual roll-off occurs to a level that is down 6 db at 4 mc. Video signal-to-noise ratio is said to be 35 db. A filmed demonstration was also shown in which the performance of the video tape recorder was illustrated.



Precision Inspection Via TV

A new inspection method that greatly reduces the time required for making a complete dimensional check of aircraft parts is being used by *Convair*. A "universal inspection machine," built around a closed-circuit TV system made by *Kin Tel* (Div. of *Cohu Electronics Co.*), is used. The inspection machine has an open interior so that aircraft sections can be placed on a table within it. A movable carriage holding a TV camera is over the table. The distance the camera travels as well as its position can be determined very precisely. A TV monitor is used to show the exact position of the camera over the part to be inspected.





Military Video Tape Recorder

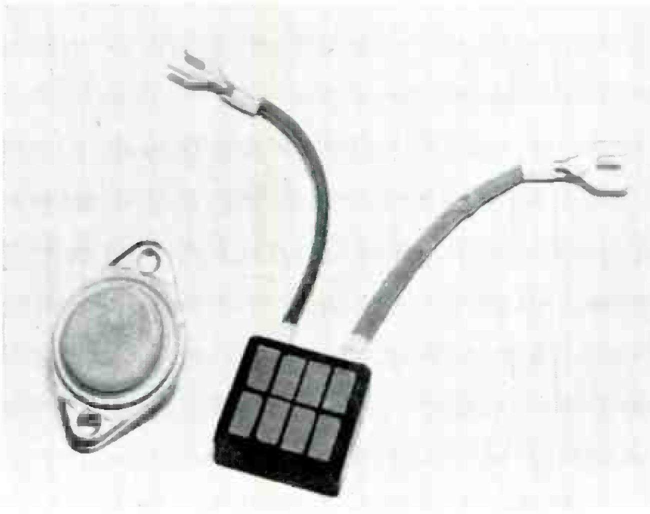
The Air Force is receiving militarized versions of the *Ampex* video tape recorder to be used by the Air Reconnaissance Laboratory. Both airborne and ground units are involved with a bandwidth of 10 cps to 4 mc. (±3 db). Commercial video tape recorders have an effective response out to 3 mc.

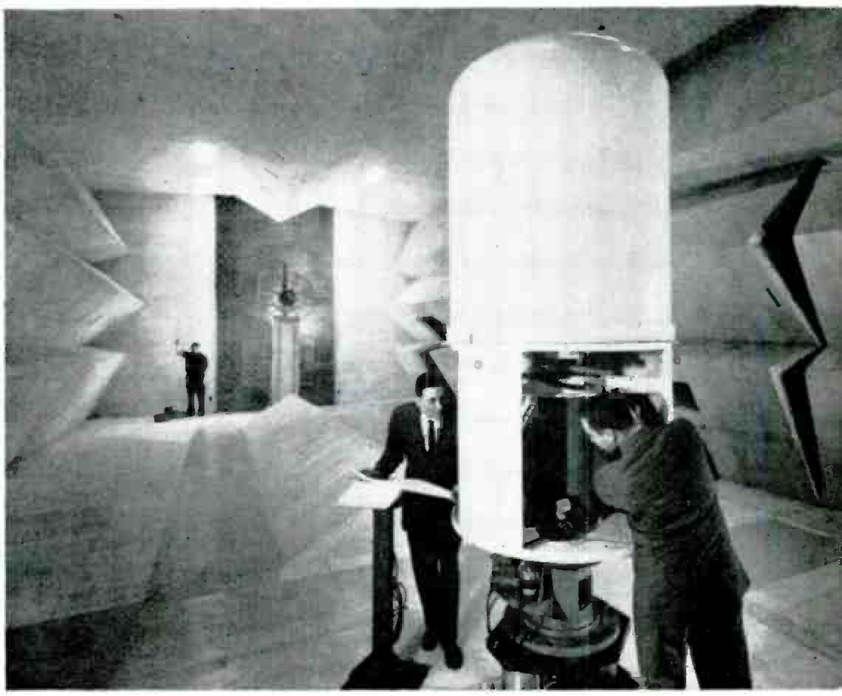
Giant Thermoelectric Power Generator

One of the two 2500-watt sub-generators which make up the largest thermoelectric power plant ever constructed is shown under test at the *Westinghouse* new products laboratories. Developed for the Bureau of Ships, U. S. Navy, the generator is intended as an experimental unit for materials evaluation and generates enough electric power to carry the full lighting load of 8 to 10 average homes. No major moving parts are used and the electric power is produced by direct conversion from heat.

"Frigistors" For Electronic Cooling

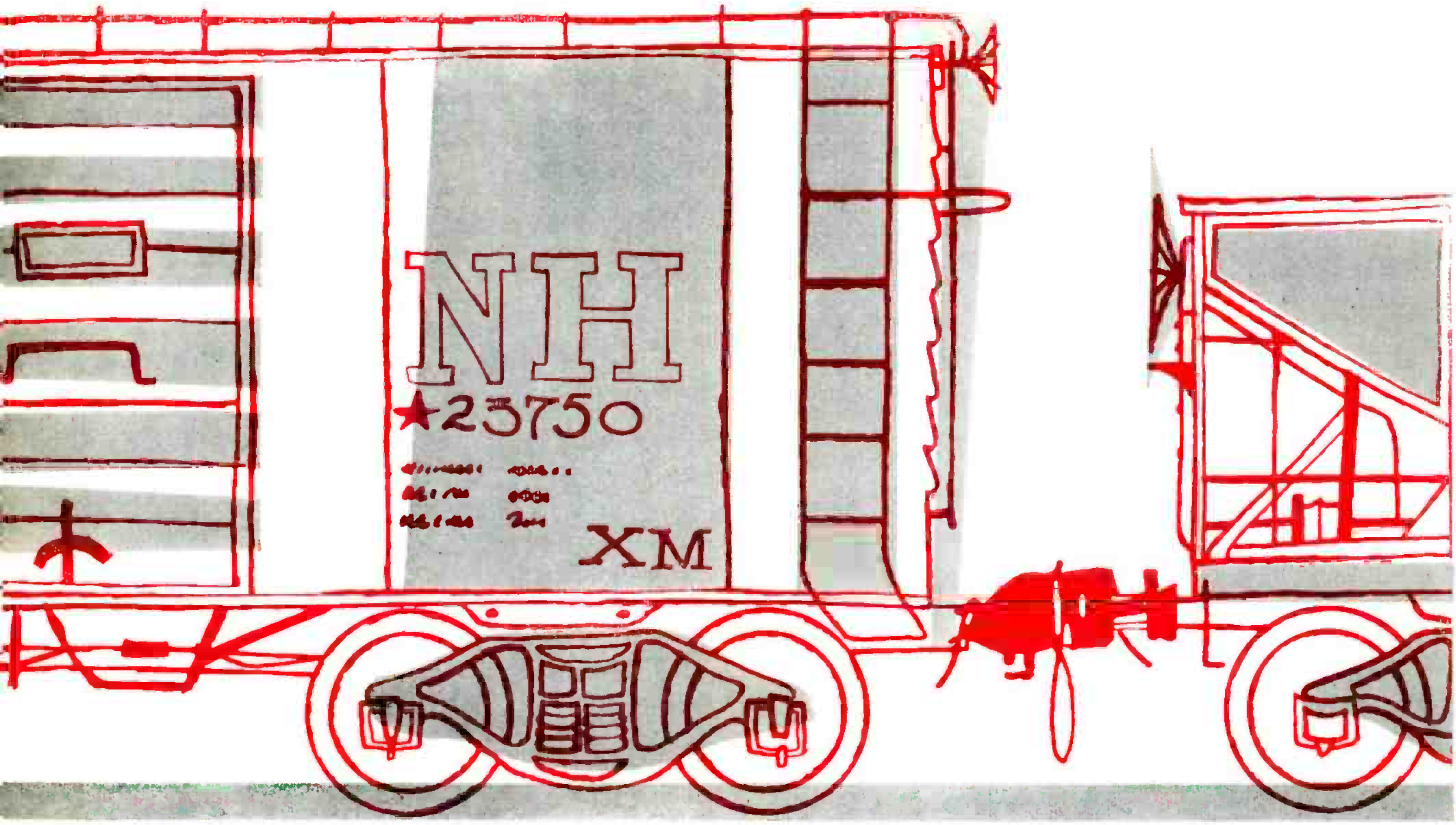
An eight-thermocouple "Frigistor" module is compared in size with a typical power transistor. The "Frigistor," which uses a new highly efficient semiconductor material being marketed by *General Thermoelectric Corp.*, Princeton, N. J., can produce effective cooling without moving parts when current is passed through the material.





R.F. Anechoic Room For Antenna Tests

Electronics engineers in this bizarre room simulate outer space in order to test the capabilities of an air navigation antenna. A specially constructed anechoic room at *ITT Federal Division* reduces radio reflections to a minimum so that only signals beamed at the receiving antenna affect the highly accurate measurements being taken. Porous plastic material covering the walls, ceiling, and floor, combined with sharply angled interior baffles make unwanted signal reflections and other interference negligible. The baffles, running the length of the 60-foot room, are designed so that random reflected radio waves take at least three bounces before reaching the detecting antenna.



RAILROAD

RADIO has not obsoleted the lantern. The lantern is still a very useful tool in railroad operations but radio has made life much more pleasant for railroad personnel and has contributed much to the more efficient operation of railroads. It is radio plus the diesel-electric locomotive which made it possible to haul longer trains, faster. It is in freight service, not in the operation of passenger trains, that railroads earn most of their income. And, it is in the operation of freight trains and the handling of freight cars that radio is of the greatest value to the railroads.

The most important application of radio in railroading is on freight trains to enable crews in the locomotive and the caboose to communicate with each other. Before radio, if the conductor wanted to stop the train he had no means of notifying the engineer. His only recourse was to open an air valve which applied the brakes. This often resulted in damage to the train. The engineer could communicate one way by tooting his whistle if the conductor could hear it. If you have ever ridden in a caboose, you can understand why this is an almost impossible feat.

Today, the conductor picks up his microphone to tell the engineer to "high ball" (go ahead) as soon as the flagman is back on board after protecting a standing train. When the engineer has a mechanical problem, he too can pick up his microphone and tell the conductor of his troubles. Before radio, the conductor might have had to walk a mile or more to the head end of the train to talk things over with the engineer.

Now, when a defect such as a "hot box" occurs, the defective car can be set on a siding and the train can get under way in minutes compared to sometimes several hours in pre-radio days. Train crews are often provided with "walkie-talkies" which are extremely valuable in coordinating such tricky maneuvers. And the lucky flagman who has a walkie-talkie won't get left in the wilderness, which has often happened in the past. He can use his radio to tell the engineer to get ready to go but wait until he is actually on board.

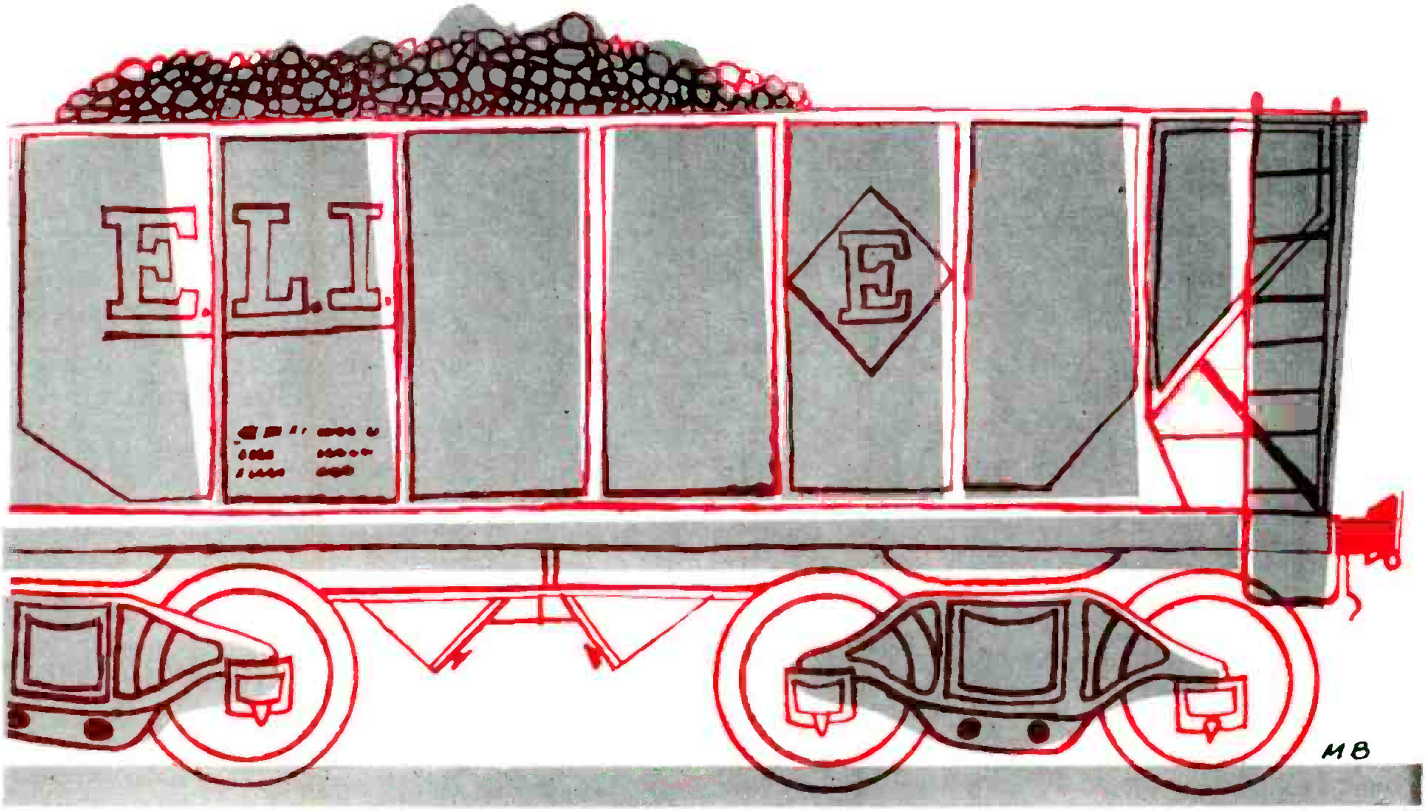
Before radio, train crews were out of touch with the outside world except when they picked up written messages as they passed wayside towers. Radio has not obsoleted the written train order, but radio has certainly simplified the passage of vital information.

Railroad radio received its initial impetus when the *Rock Island Line* applied for a permit to experiment with two-way operation. This application, filed in April of 1944, was granted in February 1945. The first permanent authorization for railroad radio service was issued to the *Denver & Rio Grande Western* in February 1946. Permission for hump-yard communications was granted in August 1946 to the *Baltimore & Ohio* for its New Castle, Pa. yards.

Now thousands of miles of railroad trackage are covered by radio communication with base stations spaced 10 to 50 miles apart along the right-of-way. Train crews can now keep in touch with wayside tower operators and sometimes directly with the dispatcher many miles away. And, when wire lines are down, wayside towers can use their radio stations for communicating with each other.

Main Line Radio

A decade ago, radio was installed by the short but progressive *South Shore Line* which operates high-speed electric passenger service as well as freight trains between Chicago and South Bend. It was a newsworthy event because it was a case of the tail wagging the dog. This short-line railroad was the first in the United States to provide radio communication from one end of its system to the other. The installation was also significant because it was the first to use automatic relay stations to



RADIO

Communications by radio is increasing the speed and efficiency with which our rail freight is handled.

extend coverage. No wire lines were required for interconnecting the three base stations, as is ordinarily the case in such installations.

The example set by the *South Shore Line* probably had an effect on the thinking of some of the larger systems who saw how valuable radio could be to a railroad. Today, many of the major roads have extensive right-of-way radio systems. While these radio stations are often controlled locally or from a nearby telegraph tower, many roads use wire lines for interconnecting wayside radio stations with the dispatcher's office. Various techniques are used for selecting wayside radio stations individually from the dispatcher's office. The dispatcher may push a button or dial a number to select a radio station nearest the train with whose crew he wishes to communicate.

One of the first long-haul, right-of-way radio systems utilizing selective control of base stations was installed by the *Northern Pacific Railway*. The *Erie* was the first to install a radio system on the run between Chicago and New York.

Yard Communications

Communication within a railroad marshalling yard before the electron era consisted of direct word of mouth, sometimes augmented by colored light

This railroad yardmaster has complete communications at his finger tips. From his perch high above the Air Line Yard in Milwaukee, Wis., he can see freight yard operations. By operating switch keys on the console before him, he is able to talk with personnel on foot by means of two-way loudspeakers. He also has radiotelephone equipment for talking with crews on the engines. In addition, telephone lines are interconnected with the control console. At the left of the desk is a teletypewriter unit used to type out important messages. The over-all system thus represents an integration of radio, loudspeaker, telephone, and teletypewriter communications, all of which make for most efficient operation.

Yardmaster's tower in Barr Yard of B & O railroad near Chicago with its intercom, radio, and complete paging facilities.

The modern train dispatcher can keep in touch with commuter trains as well as profit-making freights with two-way radio.

signals. Electronics first made its appearance in the form of loudspeaker paging systems. This was one-way communication. However, two-way communication is required in order to affirm that an order has been received so telephones were used by yard personnel for replying.

Today's modern railroad yard is a maze of electronic gear. The one-way loudspeaker paging system is still there but personnel now reply through tiny hand-carried portable radio transmitters called "Dick Tracy" units by railroaders. The yardmaster switches on the paging loudspeakers in the specific area where he expects to locate the desired individual. Or, if he is apt to be almost anywhere, the yardmaster might page over the entire yard area.

When a yard employee hears his name called over the paging system, he merely holds the "Dick Tracy" unit near his lips and acknowledges the page. The feeble radio signal is picked up by a nearby remote radio receiver whose audio output is fed to the yardmaster's office. Thus, a two-way conversation may be held, using audio to talk out and radio to talk in.

In addition to a paging system, the modern railroad yard is provided with a gigantic intercom system, some consisting of as many as 200 or more remote talk-back loudspeakers. These remote talk-back speakers are connected through underground cables to one or more control consoles, which resemble a pipe organ.

The yardmaster may page over the intercom system too. He flicks selector keys which group several talk-back speakers together, permitting low-level paging over selected areas. The paged person, in replying, merely steps up to the nearest talk-back speaker and pushes a signal button. This lights an identification lamp on the yardmaster's control console. The yardmaster then flicks the key associated with that lamp, switching that specific talk-back speaker into the circuit. The yardmaster talks out by speaking into a microphone and stepping on a foot switch under the console. To listen, he relieves the pressure on the foot switch.

The yardmaster can locate crews working in the yard area by flicking talk-back speaker selector keys on his console, one at a time, judging the location of the crew by listening to the incoming sounds.

There are several base radio stations in a typical, modern rail yard. One may be used for supervision of operations at the northbound hump, another at the southbound hump, a third for communicating with trains approaching or leaving the yard and still another for communicating with work crews and motor vehicles.

Generally, each of the base stations has its own control point since each is used in its own individual operation. However, in order to give the yardmaster complete control of all operations, the control console in one or more yard towers may also serve as an additional control point for all of the radio stations.

In the modern yard, the yardmaster has his own office on the top floor of a tall tower, not unlike an airport control tower, from which vantage point he can see the entire yard. He sits at a giant console which opens avenues of communication to yard personnel *via* a paging system, intercom system, two-way radio, and telephone circuits. Each group of paging speakers, individual talk-back speakers, base radio stations, and several telephone circuits all terminate in the console and may be activated by merely flicking the appropriate selector key.

Checking Cars

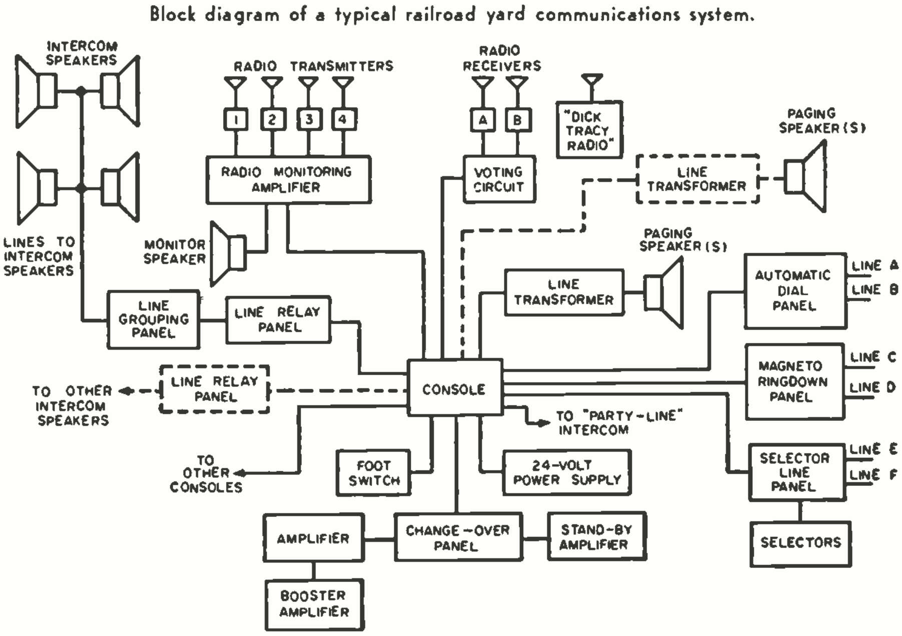
A few years ago, the car checker, who notes the numbers of all freight cars entering a yard, often had a miserable time trying to write down numbers in the rain or snow. Today, he carries a walkie-talkie with him and reads off the numbers which are taken down by a clerk inside a warm, cozy office, who sometimes tape records them for future reference. Here again, a separate base station is used for car checking so as not to clutter radio channels that are needed for other operations.

Equipment

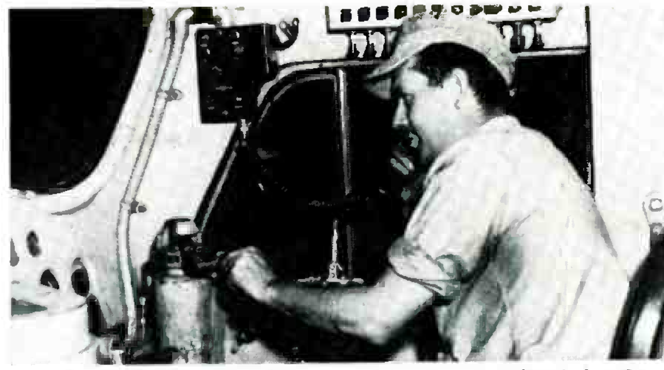
Railroad radio equipment is packaged in single-unit as well as in three-unit assemblies. The single-unit combines transmitter, receiver, and power supply in a single enclosure. The three-unit sets consist of a separately housed transmitter, receiver, and power supply.

While electrically similar to mobile radio equipment for use in motor vehicles, railroad radio equipment has to be more ruggedly constructed. The audio power output of a vehicular ra-

Block diagram of a typical railroad yard communications system.




Train engineers can keep in touch with wayside towers and can summon aid when needed if they have two-way radio installation.


Radiotelephone handset being used by engineer of diesel-electric freight locomotive on the B & O's radio traffic control system.

dio unit is about one to two watts, whereas railroad radio units deliver from five to ten watts of audio, required to override the ambient noise encountered in cabooses in particular. The modern diesel locomotive, on the other hand, rides almost as smoothly as a Pullman car and is very quiet compared to the obsolete "iron horse."

Power Sources

The typical diesel locomotive is equipped with a 64-volt battery which is used as the source of power for radio equipment. Early locomotive installations used radio units designed for operation from 117-volts a.c. A rotary or vibrator type converter is used for converting the 64-volts d.c. to 117-volts a.c. Later, railroad radio units were introduced which contain a vibrator power supply that permits direct operation from the 64-volt battery, eliminating the need for a converter.

The *Erie* railroad equipped its cabooses with 32-volt batteries of the same type as used on passenger coaches. An axle-driven generator keeps the battery charged. Because of the high cost of 32-volt batteries, the *Gulf, Mobile & Ohio Railroad* experimented with 6-volt automobile batteries kept charged by an ordinary automotive generator which was driven by the wheels of the caboose. Later, most of the railroads settled on using a 12-volt truck battery and an axle-driven rectifier-alternator.

Passenger cars and baggage cars are generally provided with a 32-volt battery and an axle-driven generator. Some cars, however, are equipped with 64-volt or 110-volt batteries.

Communicating Frequencies

Most of the railroad radio systems in service operate in the 152-162 mc. band where 91 channels have been allocated to the Railroad Radio Service. Four channels are available in the 450-460 mc. band for use by the railroads and five channels are available in the 27 mc. band, but as this is written, so far there have been few takers. The reason for this is that the railroads prefer maximum interchangeability of equipment and do not want to mix brands or types. For example, a railroad that installs one brand of equipment generally sticks with the same brand when expanding.

While the railroads have been extremely fortunate in having so many channels assigned to them, the 152-162 mc. band does not offer a wholly satisfactory solution under all conditions. In some mountainous, densely wooded areas, for example, the range achieved when operating in the 152-162 mc. band is inadequate. Police radio systems operating in the same areas in the 25-50 mc. band enjoy much greater coverage. Sometimes such special installations are impractical because of cost and incompatibility with 152-162 mc. systems in use on the rest of the railroad.

Some railroads are, however, making use of the 450-470 mc. band in freight pick-up and delivery operations. Trucks, operated by railroad subsidiaries, are equipped with conventional, vehicular-type 450 mc. mobile radio units for communicating with dispatchers and expediting the handling of freight that is less-than-carload-lot.

The walkie-talkie radio permits freight train conductor to remain in constant touch with the train's crew when the train stops.

Maintenance

Most railroads buy their own radio equipment which is installed and maintained by railroad personnel. A few have leased equipment from telephone companies or independent distributors of radio equipment. While most railroads handle their own radio maintenance, even those with extensive communications departments sometimes farm out radio servicing in certain areas to independent service dealers.

Radio equipment is seldom serviced on board a train. Instead, spare equipment is installed and the original equipment is brought into a shop for overhaul. Field servicing is generally limited to checking of the antenna system and electric power source.

Now that the railroads are making wide use of electronic devices, there are opportunities within the railroad industry for electronic technicians and engineers. The pay rate is good compared to many other industries but the biggest attraction is the security offered by the railroads. There is a pension plan which has deterred many from leaving railroad jobs for other fields. Those interested in railroad employment should get in touch with the superintendent of communications of the railroad with which they would like to become associated.

The Future

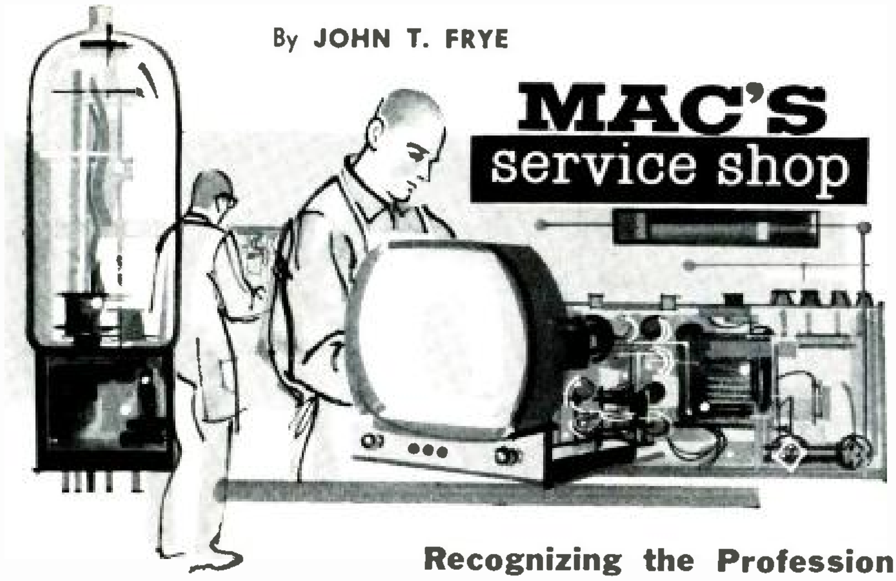
In the not-too-distant future, crews of terminal switching locomotives will be able to dial a number on an ordinary telephone dial when approaching a siding protected by a gate. When dialing, the radio transmitter in the locomotive sends out a combination of pulses which are picked up by a radio receiver near the closed gate. The pulses unlock a decoder which starts an automatic gate opening mechanism. The locomotive moves into the plant area through the open gate without first having to stop and wait until the gate is opened manually. Upon completion of the work in the plant area, the crew dials another number and the gate closes automatically.

Closed-circuit television is already being used in some yards, obviating the need for having a car checker stand out in the weather to read car numbers.

(*Continued on page* 83)

By **JOHN T. FRYE**

MAC'S service shop



Recognizing the Profession

MAC was just back from his Florida vacation, and he had the sunburned, peeling skin to prove it. He was already whistling cheerily at the service bench when Barney, his red-headed assistant who had kept the store in his absence, came down to open up the shop.

"Hi, boss," the youth greeted him. "I'm glad to see you back, but I didn't expect you to be so eager to hit the ball. It's only a quarter of eight."

"Hi, Flame-head," Mac returned affectionately. "I just couldn't wait another minute to find out if you had run me completely out of business in two weeks. How did everything go?"

"Just like downtown," Barney said cheerfully. "I'll not lie and say we didn't miss you, especially when the dogs were giving me a hard time; but Matilda and I kept the doors open anyway, and the shop still has a few dollars in the bank. But where did you get that transistor set you're working on? It wasn't here when I closed up last night."

"I brought it back with me, and there's kind of a story goes with it if you have time to listen."

"I got all the time in the world," Barney said promptly as he hopped up on the bench; "but you know something? When I was in charge, I couldn't enjoy loafing at all. I felt *guilty*. But now you're back, goldbricking is just as much fun as ever. Tell me about the radio, and take your time."

Mac favored him with a fierce scowl before he continued: "A few days before I got there my cousin's husband was fishing over at Sebastian Inlet and had this receiver playing on the front of the boat. In the excitement of landing a large fish, the set toppled over and fell into two or three inches of salt water accumulated in the bottom of the boat from waves and spray. It soaked there unnoticed for at least thirty minutes before it was rescued. The owner, not knowing what else to do, took it home and dried it out for an hour or so, but the transistor set still didn't play.

"When I arrived, he placed it trustingly in my hands and asked me to 'fix' it. After all, I was a radio man, wasn't I? When I took off the back, I saw a very sorry sight. That sea water is about the most corrosive stuff you ever saw, and it had really gone to work on the inside of this receiver. Batteries, printed circuit conductors, shield cans—in fact, every metallic surface—was covered with a thick and growing furry green coat of corrosion. I explained this was something technicians in our area never encountered and suggested I talk with a local technician to see what the treatment and prognosis was on a receiver dunked in salt water.

"I picked a radio and TV shop at random from the Orlando phone book and asked for the service manager. He was out to coffee. So were the service managers of the next four shops I called! Apparently the mid-morning coffee break is a flourishing institution in Southern service shop circles. The manager of the next service store was in. I started to explain to him that I was a service technician down there on vacation and would appreciate a little advice on a problem peculiar to the area. He interrupted me to say that I was not fooling him one bit! He knew I was just leading up to an attempt to sell him something and that if I wanted to talk business with him I could call at his shop; and he slammed down the receiver. Apparently my 'dam-yankee' accent made him suspect me.

"By this time I was growing a little discouraged, but I made one more call to *Dodson's Radio & TV Service* on E. South Street. I was connected to Mr. Royal Dodson himself, and he listened patiently to my story. Then he told me that salt water soaked radios were a very common service problem in the area. He went on to say that if the radios were thoroughly cleaned with carbon tetrachloride within a very short time after the immersion, they usually could be restored to playing condition; but if they were allowed to lie around for several days with that hygroscopic, corrosive salt in them, the possibility of their ever playing again was small. He was most pleasant and cordial and invited me out to see his establishment. I explained my Orlando relatives had almost every minute of the vacation planned and that it was doubtful if I could break away; but we did have a nice chat about mutual problems and those peculiar to our respective localities. His warm friendliness made me truly sorry I did not get to meet him and see his shop.

"The experience carried me back to when I was a small boy in Weiner, Arkansas, and my dad operated a pioneer movie house. By modern standards, it was certainly crude. The customers sat on long benches instead of individual seats; we had only one projector and had to stop at the end of each reel and put in a new one; and, of course, there was no sound except the enthusiastic advice or criticism given the actors by the small boys occupying the front rows. Mom sold tickets; I took them in; my brother operated the projector; and dad kept the 32-volt d.c. *Delco* generator going to provide power for the theater. (As you can see, the Gem Theater was a family operated affair.) But it was the only public entertainment for miles around, and it was regarded with far more affectionate awe than even the scientific marvel of color television can inspire in the blasé audiences of today.

"One day a small travelling circus with a mangy lion and a moth-eaten camel pitched its tent in our little town. That night mother suddenly saw a pair of small grubby hands appear at the edge of the ticket window, and a very small and dirty boy pulled himself up to where she could see him. 'Can I see the manager?' he asked gravely.

"Mom summoned dad with a buzzer, and the little boy looked him straight in the eye and asked, 'Do you recognize the profession, mister?'

"'We certainly do!' my father instantly replied. 'Go right on in—no, wait a minute. Take this box of Crackerjack with the compliments of the house. We hope you enjoy the show.'

"'Thank you kindly, mister; and we'd be mighty proud to have all of you as our guests at the circus tomorrow,' the little fellow said as he walked into the show. We went, too, and were treated as though we were the salt of the earth.

"That incident made a deep impression on me, and it always pops into my mind when I see a demonstration of professional courtesy between service technicians. I do not hold with the idea we are supposed to regard our competitors with jealousy, suspicion, and contempt. I am very proud of the fact that we are on good terms with all our competitors. As you know we often get calls from them asking to borrow a component temporarily out of stock; and we do not hesitate to call them under the same circumstances. On several occasions I have had service technicians from another area drop into

(*Continued on page* 98)

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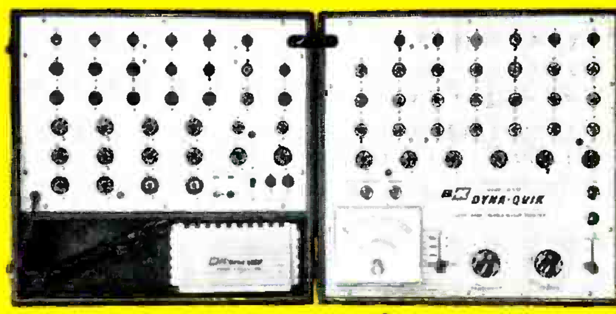

MODEL 650. Fastest and most complete portable Tube and Transistor Tester. Checks over 99% of the tubes most widely used in television receivers. Tests each section of multiple tubes separately for Gm, Shorts, Grid Emission, Gas, and Life. Includes spare sockets and filament voltages for future new tube types.
Tests transistors, too. Net, $179^{95}

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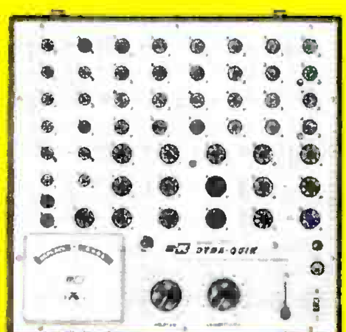

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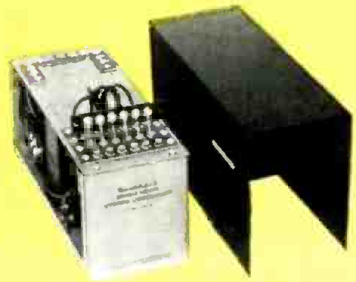

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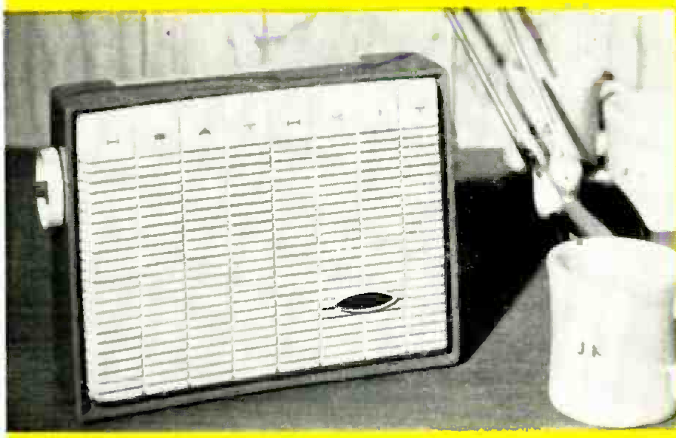

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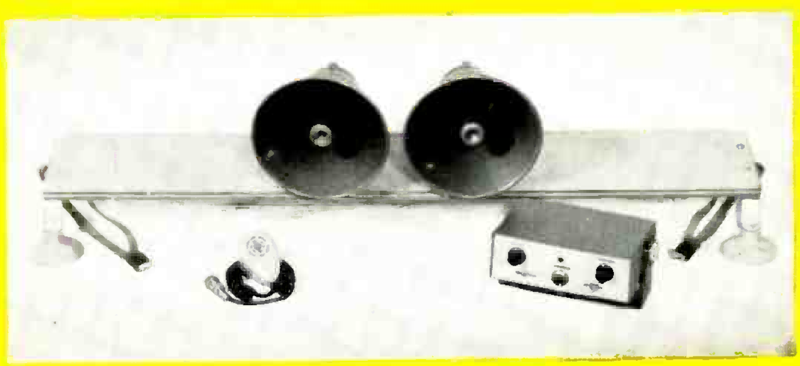
EXTRA HORN SPEAKERS (401-38): As described above. 6 lbs. **$19.95**



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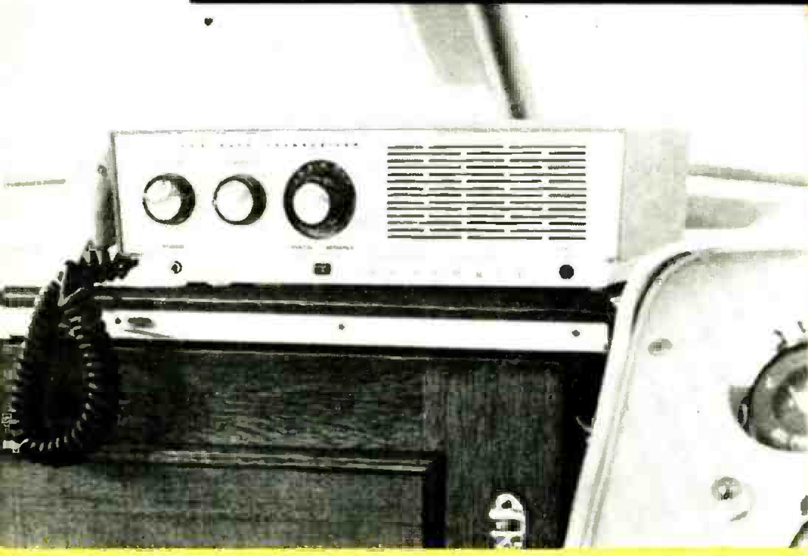

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DF-3 99^{95}

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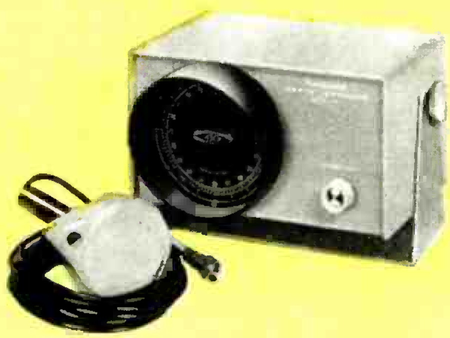

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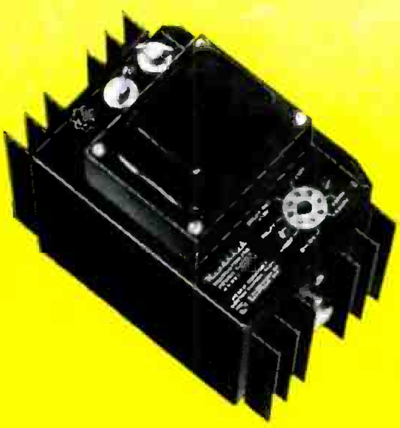

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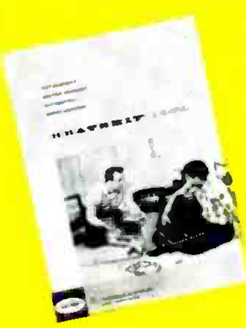
HW-19 (10 meters)
HW-29 (6 meters) $39.95 ea.

Less crystal



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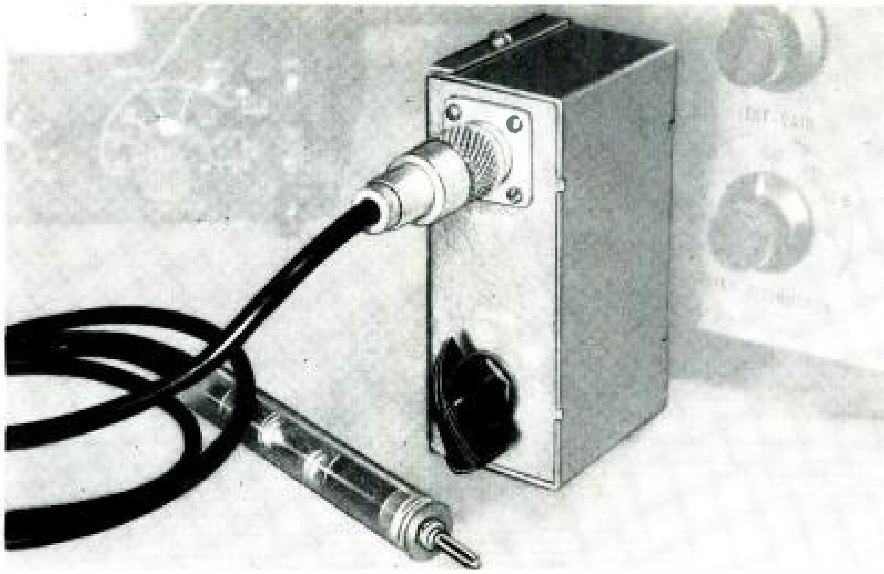


Fig. 1. The hand-sized signal booster with the probe that houses the first stage.

A Transistorized Instrument Preamplifier

By **CHARLES CARINGELLA**

Avoiding tubes eliminates many of the problems that occur with these low-level test accessories.

THE OCCASION for measuring a.c. signals that are very low in level, in the millivolt range and sometimes even in microvolts, is not an unusual one in the service shop, on the experimenter's bench, or in the laboratory. This is borne out by the fact that preamplifiers to bring these low-amplitude signals up to a sufficient level so that they may be handled by oscilloscopes and v.t.v.m.'s of ordinary sensitivity are always being described in print.

Despite their number, these signal boosters are generally built to use tubes. Developing a transistorized amplifier for such use presents problems, but the potential advantages make the effort worthwhile. The problems chiefly involve obtaining a reasonably high input impedance and adequate frequency response. The obvious advantages are reduced size, lower power requirements, and the flexibility in use permitted by the fact that a line cord to be plugged into an external power source is not involved. Perhaps more important than any of these is another advantage. Tube microphonics are always a serious handicap where low-level signals are involved, as is the possibility of hum, and tube selection is not a permanent solution. Transistors get away from microphonics. Battery power eliminates hum. The preamp described here has proven itself, in use, as a satisfactory reconciliation between advantages and disadvantages.

The plug-in preamp along with a companion input probe is shown in Fig. 1. The schematic diagrams for both probe and preamp are in Fig. 2. The probe consists of an emitter-follower circuit, which is somewhat analogous to a cathode-follower. The emitter-follower, V_1, is essentially a common-collector amplifier having a high input impedance and a low output impedance. The voltage gain is nearly unity.

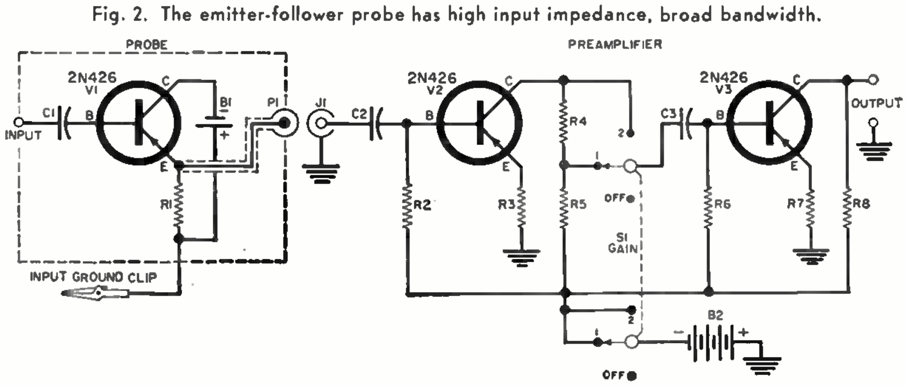
The common-collector configuration was chosen in order to raise the input impedance of the system to a useful value. Thus the input impedance of the emitter-follower probe is .5 megohm as compared to 15,000 ohms for the amplifier itself. The output impedance of the emitter-follower is 1500 ohms, and the frequency response for this part of the circuit is flat from 10 cycles to 2.5 megacycles.

The probe is powered by its own small 1.34-volt mercury battery. The latter was soldered directly into the circuit, since the current drain is only 125 microamperes and the cell should therefore last the equivalent of its shelf life. Transistor V_1, capacitor C_1, emitter resistor R_1, and the battery are all mounted in the probe housing.

Succeeding the emitter-follower is a two-stage *RC*-coupled amplifier employing two transistors in a common-emitter configuration. A voltage gain of either approximately 100 or 400 is attained by the amplifier depending on the position of "Gain" switch S_1. S_1 also serves as the power switch for the amplifier.

Emitter resistors R_3 and R_7, which are not bypassed, provide degenerative

Fig. 2. The emitter-follower probe has high input impedance, broad bandwidth.



R_1—4700 ohm, 1/2 w. res. ± 5%
R_2, R_6—1.6 megohm, 1/2 w. res. ± 5%
R_3, R_7—47 ohm, 1/2 w. res. ± 5%
R_4—680 ohm, 1/2 w. res. ± 5%
R_5—6100 ohm, 1/2 w. res. ± 5%
R_8—6600 ohm, 1/2 w. res. ± 5%
C_1, C_2, C_3—1 µf., 200 v. metallized paper capacitor
J_1—Coax chassis connector (Amphenol 83-1R)
P_1—Coax cable plug (Amphenol 83-1SP with reducer for small coax)
S_1—D.p. 3-pos. rotary switch (Centralab PA-2002)
B_1—1.34 v. mercury cell (Mallory RM-401R)
B_2—4 v. mercury cell (Mallory TR-233R)
V_1, V_2, V_3—2N426 switching transistor (Motorola)
1—1 3/8" x 2" x 4" chassis box

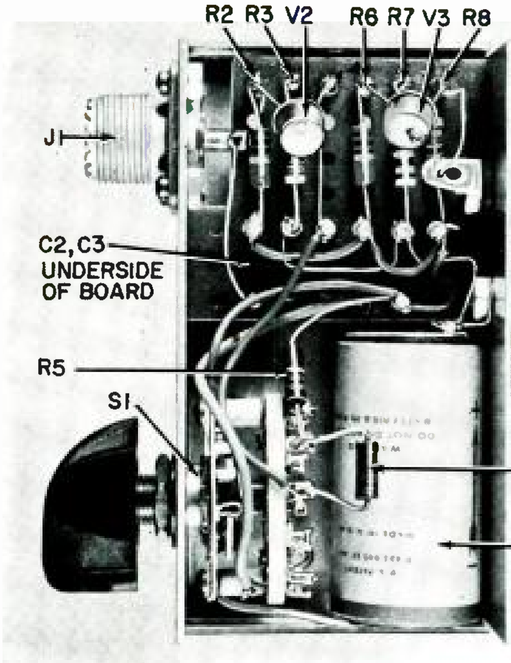


Fig. 3. Despite the exceptionally small housing, the two stages of the main amplifying circuit can be laid out without overcrowding with the use of a section of perforated chassis board. The location of all components except two is indicated clearly here.

feedback. This stabilizes each transistor and prevents thermal runaway when the junction temperature rises. This feedback also results in uniform voltage gain throughout the bandwidth of the amplifier. The response of the amplifier is thus flat from 50 cycles to 100,000 cycles. Coupling capacitors C_1, C_2, and C_3 can be increased in value if coverage below 50 cycles is desired. Total current drain from the amplifier section is 1 ma. Thus the power provided by a 4-volt, 2200-ma.-hour mercury battery will last for three months even if the amplifier is in constant use.

Construction

The preamplifier was assembled in a chassis box measuring 1⅝ x 2 x 4 inches. Coax connector J_1 and the "Gain" switch are located on the front side. A sub-chassis was fashioned from a piece of perforated chassis board. The components were anchored to tie-points on the sub-chassis, including the transistors, which were soldered directly into the circuit. Caution must be exercised when soldering directly to transistors. It is recommended that the lead being soldered be held with a pair of needle-nose pliers as close to the transistor as possible to conduct most of the heat away.

The location of most of the components in the preamp can be seen in Fig. 3. Capacitors C_2 and C_3 are not visible here, as they are located on the underside of the sub-chassis. The package was designed so as to plug into any of those oscilloscopes having standard 5-way binding posts for input connections. Two banana plugs were mounted on the back side of the chassis box. These plugs, of the stud-mount type, were spaced ¾ inch from each other, as are the binding posts on the scope. While this arrangement was most satisfactory for the author's particular conditions of use, those who own scopes with different input arrangements or who wish to make allowances for connection to meters can alter the output arrangement.

The emitter-follower probe is housed in a piece of plastic tubing which is approximately 5½ inches in length. End caps were fashioned from plastic and cemented to the tubing. A hole was drilled in one of the end pieces for the coax cable. A third stud-mount banana plug is mounted on the remaining end piece, and serves as the input tip for the probe. The inside diameter of the plastic tubing is dependent upon the physical size of the input capacitor, C_1. This capacitor may have to block fairly high values of d.c. if the a.c. voltage being measured is "riding" on such a d.c. voltage. A compromise between physical size and voltage rating is necessary in order to keep the probe to a reasonable size. In most applications, a 200-volt capacitor will be sufficiently large. In that case, the capacitor specified in the parts list can be used and the tubing should have an inside diameter of no less than ⅝ inch. If the need for a larger capacitor is anticipated, then the diameter of the tubing should be increased accordingly. A pictorial wiring diagram of the probe is shown in Fig. 4 to indicate how interconnections are made. After this has been done, it is a simple matter to fit the components into the housing as seen in Fig. 5.

Conclusion

The preamplifier has proven itself as a reliable and rugged instrument on the bench and in the lab. The probe and the preamp both are relatively inexpensive to construct. Standard, readily available components have been used throughout, and construction can be accomplished without the need for elaborate equipment—an advantage to newcomers to transistor work.

Uses for the transistorized booster need not be restricted to the oscilloscope, of course, although the author has found it most valuable for him in that application. When the preamp is used with a v.t.v.m., the voltage being measured can be read directly on the meter scale in most cases. For example, with the v.t.v.m. or v.o.m. set for 1.5 volts full scale and the preamp set for a voltage gain of 100, the actual full-scale reading would be 15 millivolts. The useful range of input voltages to the preamp is from approximately 1 microvolt to 100 millivolts. One closing word of caution: Be careful not to exceed the voltage rating of the probe input capacitor when making measurements. —30—

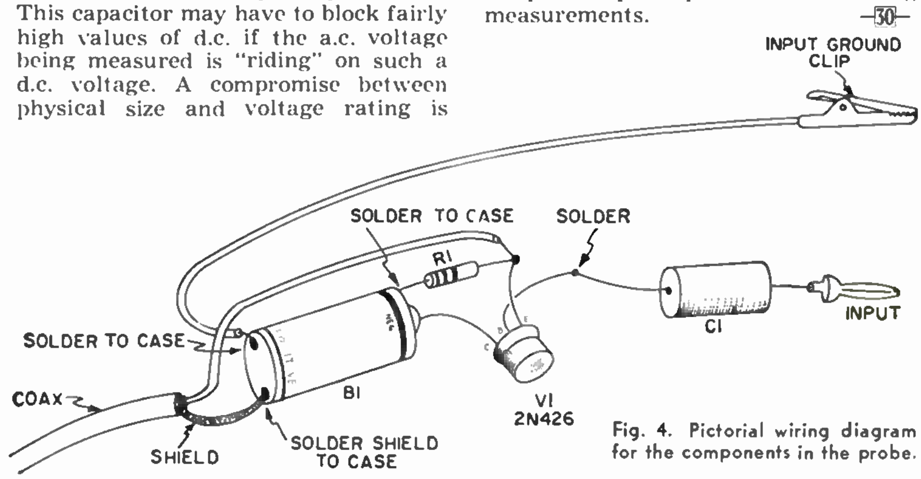
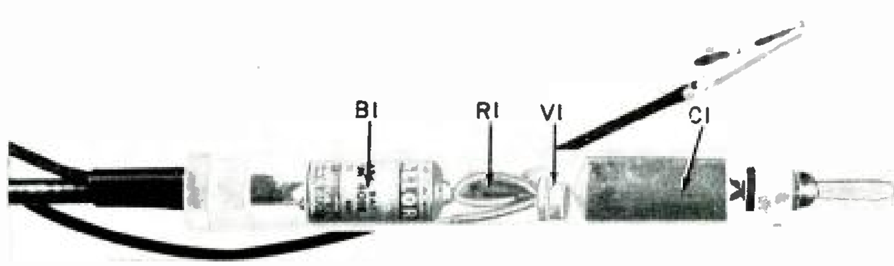


Fig. 4. Pictorial wiring diagram for the components in the probe.

Fig. 5. Once wired together, probe components fit into their housing like this.



Service Industry News

ONCE MORE, as is not unusually the case, service legislation is making news around the country. On the individual level, there is a letter from L. F. of Macks Creek, Mo., who wants no part of government control. To illustrate how a provision in an apparently innocuous bill, acceptable to members of the service industry, can turn into a hooby trap, he points to legislation pending in New York State. (This bill, which is intended to eliminate fraud and misrepresentation in the sale of electron tubes, has since been passed and goes into effect this fall. It does not deal with licensing.)

Among other things, claims L. F., it would become unlawful for a technician to operate or even own a combination CRT tester-rejuvenator. The writer owns such an instrument, which he uses only for testing. He would hate to have to throw away his investment in a useful item of equipment, he says, if he happened to live in New York.

Although his interpretation of the law appears to be wrong, L. F. nevertheless has an interesting point concerning the possible pitfalls of regulation. As to the actual meaning of the law, Mr. Robert Larsen, top man for the Radio-TV Guild of Long Island and the Empire State Federation of Electronic Technicians Associations on legislative matters, says things work this way: Possession of a rejuvenator is entirely legal. Furthermore, use of the instrument to repair a picture tube is also legal—provided the service dealer lets the customer know exactly what is going on. A violation would occur only if fraud were attempted—for example, if the technician were to repair the old tube and then tell the set owner that he had actually put in a new one.

Concerning licensing itself, L. F. has much else to say, including the following: "I would certainly hate to have my continuance in business depend upon a group of my competitors."

Elsewhere on the licensing front, the village of Inkster, Mich. has adopted a TV licensing ordinance. Although the community is not a large metropolis, the move has definite significance. Inkster, west of Detroit, has modeled its bill after the one now in force in the larger city. This appears to be part of a trend for other Michigan municipalities, failing passage of a statewide law, to follow the Detroit lead.

A similar pattern of acceptance of licensing may be evident in Louisiana, where a statewide law does exist. Although communities below a certain size are exempted, service dealers in these areas are reported to be registering voluntarily. There is also some action toward broadening the state law to cover all areas. In the meantime, action to throw out the license bill in Kansas City, Mo., is now going through the courts.

NATESA Directors Meet

Preliminary reports on the meeting of NATESA directors held in Tulsa indicate activity on a number of fronts. There were committee reports on captive and factory service, selective buying, DIY tube testers, licensing, acceptance of employed technicians into membership in addition to shop owners, advertising codes, and other matters. Administratively, there was discussion of an amendment to permit the NATESA directorate to refuse to accept specific directors, and an evaluation of obligations to NATESA directors by membership. There was also some talk of once more considering cooperative buying.

A number of non-members were permitted to sit in on the Tulsa sessions. These included Tilman Babb and Len Smith of TEA-Texas. This will doubtless revive talk of a possible reconciliation of interests between TEA and NATESA, although it was pointed out that Babb and Smith were present on a personal basis rather than as representatives of their state group.

Philadelphia "Retail" Pact

Independent service dealers in Philadelphia have concluded an important agreement with 14 parts distributors concerning distributor sales to the general public. The wholesalers have agreed to discourage sales to retail customers by charging full retail price and crediting the difference between that price and dealer cost to the service dealer nearest the customer's address. All cash purchase slips will carry the name and address of purchaser instead of being made out to "cash." Distributors will continue to sell high-fidelity equipment at prevailing prices, but will charge full retail prices for replacement components for such units. All literature mailed to service dealers by distributors will be in sealed envelopes.

Two-Way & CB Radio

Although there is a trend to letting the independent get more of the service business on two-way mobile communications equipment rather than depending on factory service, equipment manufacturers prefer to "authorize" these independents. For entry into this field, then, the service technician is likely to make the best progress by approaching the manufacturer rather than the equipment owner.

General Electric is now actively disseminating service information on mobile radio to authorized dealers through its "Datafile" system. Data is sent regularly for incorporation into a set of alphabetical file folders provided to cover two main sections. The first section is for information on Antennas and Transmission lines, FCC Regulations, Interference, Service Aids, Test Equipment, Service-Maintenance Techniques, and other subjects. The second section holds details on specific equipment models. The service is available without charge to authorized stations from *G-E's* Communications Products Dept., Lynchburg, Va.

Concerning Citizens Band equipment, although there appears to be no attempt by manufacturers to provide service directly, independents would also do well to begin by making contact with equipment makers. Literature on hand from the *Vocaline Co. of America*, intended for "authorized service stations," illustrates the point. There are complete details on warranty policy, processing of parts under warranty, billing to the manufacturer for service performed under warranty, parts procurement, and other important matters.

Sears "Silvertone" Service

An item from TSA of Delaware Valley proves once more that you can't get results unless you're willing to take action. There has been much resentment throughout the independent industry concerning the service policies of *Sears-Roebuck*, a leading national purveyor of TV sets under its own brand name, "Silvertone." Not only does *Sears* maintain its own service departments, but there has been difficulty getting service data and parts for sets by independents.

After TSA brought the matter directly to the main *Sears* offices for its electronic division in Chicago, a directive from the latter city was sent out to the *Sears* service manager for the Philadelphia area. The letter authorized a 20 per-cent discount on "Silvertone" parts to all independents who registered with *Sears* by written request on their own stationery. While service notes are still not individually available, registered independents are free to examine such data at *Sears* offices and service shops. Although this compromise may not be considered an ideal solution, it represents a distinct improvement brought about by concerted action.

Diversification in Calif.

The California State Electronics Association is surveying members to learn which ones are prepared to handle "plus" service (in addition to radio and TV). It is also compiling a list of manufacturers seeking authorized service shops to install and maintain special equipment. In fact, it already has solicitations on hand from some such companies who are seeking agencies to handle after-sale maintenance. CSEA hopes to serve as a liaison agency. Sounds like a sensible idea. —30—

Hi-Fi-Audio Product Review

MILLER FM RECEIVER

J. W. Miller Co., 5917 S. Main St., Los Angeles 3, Calif. has announced two new kits containing "hard-to-get" parts for building what is termed a high-performance, transistorized FM receiver.

Kit No. 777-1 contains three i.f.

transformers, one ratio detector transformer, a variable capacitor, antenna, r.f. and oscillator coils, complete set of knobs, and six transistors.

Kit No. 777-2 contains all the above parts plus an attractive metal cabinet and panel. The completed receiver has a sensitivity of 2.5 µv. and includes a.f.c., vernier tuning, and a push-pull audio stage. Full instructions are given for alignment and operation.

A bulletin, "The Coil Forum," Vol. 1, describing this receiver, is available at company distributors or direct from the factory.

STROBE AND LIGHT KIT

Robins Industries Corp., 36-27 Prince St., Flushing 54, N. Y. is offering a strobe and light kit designed to check the accuracy of the speed of a turntable. The kit includes a strobe disc, which is placed on the turntable, and a strobe light, for connecting to any household power source. The light, shining on the strobe disc, provides an accurate and easily determined indication of turntable speed.

STEREO RECORDER

Roberts Electronics, Inc., 829 North Highland Ave., Los Angeles 38, Calif., is offering a versatile new stereo tape system. Designated the Model 990 the new equipment provides four-track record/playback, four monophonic tracks record/playback, and two-track playback.

A new head assembly, which provides precise vertical movement of both the erase and the record/play heads, makes it easy to identify and locate each of the four quarter-track recordings. According to the manufacturer, excellent fidelity is assured in recording four-track stereo as well as in the machine's other functions.

The Model 990 includes monitoring stereo speakers, as well as dual outputs from the heads, dual preamplifier outputs, and dual power amplifier outputs. Both channels are equipped with vu meters.

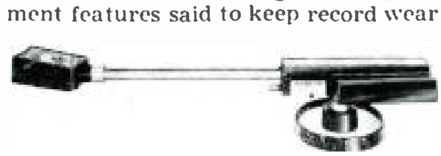
NEW LINE OF ACCESSORIES

Jensen Industries, Forest Park, Ill. has introduced a new line of phonograph parts, including plastic spindle plugs, tone-arm lifters, phonograph oil, record covers, needle inspection microscopes, 45 rpm universal spindles, and metal 45 rpm inserts.

Of interest to dealers, these new items are displayed, along with other *Jensen* items—needles, record brushes, and "Silcloth,"—on a new six-sided, 2-foot high display rack, suitable for placement on store counters.

SHURE STEREO ARM

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill., has announced a new tone arm with design and adjustment features said to keep record wear



to a minimum. Called the "Professional," the arm accepts practically all cartridges now available. A micrometer counterweight and direct-reading stylus force gauge maintain balance and accurate tracking on both monophonic and stereo records. No soldering is required for installation.

The M232 arm is for 12-inch records; the model M236, for 16-inch records.

NEW STEREO EQUIPMENT

Viking of Minneapolis, Inc., 9600 Aldrich Ave. So., Minneapolis 20, Minn. has introduced a low-cost, compact stereo recorder. Known as the "Stereo Compact," the new equipment is available in two models. The RMQ provides quarter-track recording; the ESQ, half-track erase and recording. Both models play quarter-track and/or half-track stereo tapes.

Frequency response of the new line is stated to be 40 to 12,000 cps, flat within ± 3 db. Tape speeds are 7½ or 3¾ ips, selected by front-panel control. The quarter-track head may be used for half-track playback by a shift adjustment provided.

The company has also announced that its 75 series is now adaptable for 4-track tapes with the addition of a new head assembly. One new head assembly adapts the 75 for 4-track playback; another provides playback as well as 4-track erase and record.

NEW SCOTT TUNER

H. H. Scott, Inc., 111 Powdermill Rd., Maynard, Mass., has introduced a moderately priced FM tuner, the Model 314. Incorporating the company's wide-band design, the Model 314 boasts a usable sensitivity of 2.5 µv. by IHFM standards. According to the firm, tuning is drift-free without the need for conventional automatic frequency control.

A silver-plated front end is said to provide minimum circuit losses on even the weakest signals. Temperature-compensated components provide maximum stability. A new wide-band cir-

cuit incorporates 2-megacycle detector and limiter bandwidth. Two effective stages of full limiting insure rejection of AM interference.

Also provided is a multiplex output. An accessory knob kit is available at slight extra cost to make the 314 a perfect match to the Model 299 amplifier. For additional information, write Department P at the company address.

MINIATURIZED ENCLOSURE

Karlson Associates, Inc., 433 Hempstead Ave., West Hempstead, N. Y. announces the "Rocket," a new, patented miniature speaker system. Easily connected, the new system is said to make it possible to hear complete stereo in all parts of the room. Over-all sound is claimed to be "remarkably big and impressive" despite the extremely small size of the unit.

Dispersion pattern is rated as wide as 140°, and the system is considered highly efficient. According to the manufacturer, the "Rocket" is suitable for mounting wherever decor is highly important and wide-range, wide-angle sound dispersion is desired.

TAPE RECORDER CLEANER

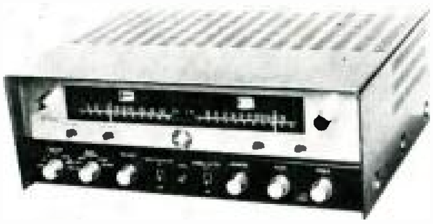
Chemtronics, Inc., 870 E. 52 St., Brooklyn, N. Y. has introduced a new kit for cleaning parts of tape recorders.

Packaged in a 2-ounce bottle, with felt applicator, the fluid is said to effectively clean tape heads as well as capstan and pressure rollers, thus eliminating the wow and squeal that may develop in recorders.

Additionally, the manufacturer claims that use of the chemical, termed TR-2, will increase the life of the tape and the heads, improve fidelity, and reduce distortion. The felt applicator will not stain or mar plastic parts.

45-WATT STEREO AMP-TUNER

Monarch International, Inc., 7035 Laurel Canyon Blvd., No. Hollywood,



Calif. is offering a complete stereo unit featuring dual amplifiers with controls and completely separate AM and FM tuners, including FM multiplex adapter. The entire system, housed in a black and gold cabinet, is designated Model STA-245.

Basic amplifier power is rated at 45 watts. Features include friction clutch tone controls, phasing switch, rumble and scratch filters, mode switch, and other facilities.

The complete unit has 18 tubes, four silicon power diodes, and a germanium diode. FM sensitivity is rated at 1.9 μv./ −20 db. AM range covers 535 to 1605 kc. Its input sensitivity for magnetic cartridges is 3 mv./1 kc.; for tape, 1.5 mv./250 cps.

UNIQUE PHONO ACCESSORY

Duotone Company, Inc., Keyport, N. J. has introduced "Selecto," a combination band selector and record brush. Actually, the new device is made up of two older *Duotone* items, a record brush and the "Magic Finger" cueing device.

The combination unit, fastened to a tone-arm, permits the arm to be set on the record with a very light touch due to spring action, while the brush remains in contact with the record during playing.

NEW GRADO ARM

Grado Laboratories, Inc., 4614 Seventh Ave., Brooklyn 20, N. Y. has announced its new "Laboratory Series"

tone arm to be sold in three versions, as a "universal" arm for use with any make of cartridge, with a matched custom cartridge, and with a matched "master" cartridge.

The arm itself boasts a very small rear overhang for cabinet installation, vertical and lateral balance adjustments, linear tracking force adjustment, interchangeable cartridge shell, and other features. No solder connections are needed in the arm and it may be installed without the use of a screwdriver.

"THIN-LINE" SPEAKERS

Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y. has announced a new "Thin-Line" ceiling and wall-baffle loudspeaker that measures only 2½ inches deep. Designed to

mount in a wall, ceiling, closet, or conventional enclosure, the new speaker, Model SK-175, features an inverted magnet that places the 12-ounce magnet structure in front of the speaker rather than behind it.

The voice coil is 1 inch in diameter. Impedance is 8 ohms. Reported response is 90 to 9000 cps.

MIDGET RECORDER

Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass., has announced a two-speed, pocket-size portable tape recorder. Using five transistors, the new "Realistic" Model TR-730 plays and records at either 3¾ or 1⅞ ips speeds. It operates on low-cost batteries (included), uses 3-inch reels, plays up to 60 minutes, and has a built-in speaker and amplifier.

It can perform its functions, includ-

ing record, play, rewind, and erase, with the lid closed since all controls, switches, and input jacks are externally located. A built-in d'Arsonval vu meter is used for indicating both recording level and condition of the batteries.

Included with this unit is a microphone, zippered vinyl carrying bag, batteries, and reels. Dimensions are 2½" x 7½" x 5½", and the TR-730 weighs less than 5 pounds.

BULK TAPE ERASER

Amplifier Corporation of America, 398 Broadway, New York 13, N. Y. has introduced the "Magneraser," a device that may be used for erasing tape in quantity as well as for demagnetizing tape heads to reduce distortion and background noise.

The "Magneraser," weighing 2½ pounds, may be hand-held when in use. Its power cord must be connected to a suitable a.c. outlet. Model 200C is designed for use on 100 to 130 volts a.c.; Model 220C, for 200 to 260 volts a.c. The unit is furnished with an 8-foot line cord and operating instructions.

CARDIOID MICROPHONE

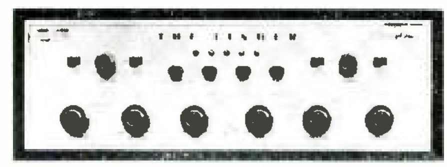
Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. announces "Knight" Model KN-4550, a dynamic cardioid microphone. Employing a directional, heart-shaped sound pickup pattern to obtain a high front-to-back ratio, the KN-4550 is said to reduce the effects of audience noise and other extraneous sounds. Frequency response is stated at 60 to 13,000 cps. Output level is −57 db. Output impedance can be adjusted at the connector for either 150 ohms or high impedance.

The microphone is supplied with "on-off" switch, an 18-foot cable, and a screw-type connector. Length is 7¼ inches.

STEREO MASTER CONTROL

Fisher Radio Corp., 21-21 Forty-fourth Drive, Long Island City 1, N. Y., has introduced a new stereo preamplifier control unit.

Designated as Model 400-CX, the



unit features great flexibility, including a means of balancing channels with an aural null. Also provided is a stereo dimension control for blending signals from both channels. A "center channel" output, for use with a third power amplifier and speaker, is also furnished. The 400-CX may be fitted with a special RK-1 remote control unit for operation from the listener's position.

Eighteen input jacks are provided. Response is claimed to be 20 to 20,000 cps ± ½ db. The unit uses ten tubes and weighs 18 pounds. Dimensions are 15⅛" x 11½" x 4³⁄₁₆".

ELECTRIC ORGAN

American Audion Corp., 200 Fifth Ave., New York 10, N. Y., has announced its new "Caprice," a decorator-styled electric chord organ. The "Ca-

price" has 37 standard, full-size white and black keys, over three chromatic octaves. These, together with the 49 chords (8 alternate, 8 bass, 8 major, 8 minor, 8 seventh's) and basses, are said to provide rich full-bodied organ tones, with rhythm accompaniment. Volume may be regulated by means of a foot pedal.

According to the manufacturer, an exclusive "Audion Key Selector" enables anyone to play this instrument without lessons. A book of 45 musical selections, using this system, is supplied with the organ.

NEW FISHER TUNER

Fisher Radio Corp., 21-21 44th Drive, Long Island City 1, N. Y. has announced the FM-50, a new wide-band FM tuner.

The instrument boasts high sensitivity, broad audio bandwidth, and FM multiplex and recording outputs. Said

to be exclusive with the FM-50 is its dual-purpose "MicroRay" tuning indicator which facilitates tuning and, at the turn of a switch, also serves as a recording level indicator.

The sensitivity of the FM-50 is said to be 1.3 microvolts for 20 db of quieting, with a 300-ohm antenna. It uses four i.f. stages; the last two also serve as limiters. A wide-band ratio detector is used. Frequency response is listed as 20 to 20,000 cps ± 1 db (including standard 75 µsec. de-emphasis). Harmonic distortion is rated at less than 0.8% at full one-hundred per-cent modulation.

Write the manufacturer for additional details.

AUDIO CATALOGUES

SPEAKERS AND ENCLOSURES

Federated Industries, Inc., 4477 Elston Ave., Chicago 30, Ill., is offering an 8-page catalogue describing the "Crescent" line of speakers, speaker systems, and enclosures. The brochure gives details and prices on units for high-fidelity, public address, and automotive applications.

NEW ASTATIC LITERATURE

Astatic Corp., Conneaut, Ohio, announces three new catalogues. Catalogue No. 33-4 deals with cartridges, pickups, and original needles manufactured by the firm. All items are illustrated and vital information is given. Catalogue CRC-60 is a comprehensive cross-reference of cartridges and needles manufactured by *Astatic* and other companies. All stock numbers are listed as well as the numbers of the company's units suitable for replacements.

The firm's line of microphones and accessories is described in Catalogue No. M10. All catalogues have been punched for insertion into binders.

—30—

A.C. Supply for Transistor Preamp

By **DAVID R. STEELE** / Ampex Data Products Co.

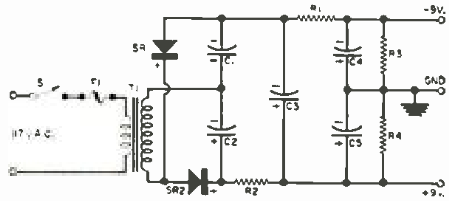
Construction of well-designed low-current supply delivering +9 and −9 volts at negligible ripple.

THE unit described in the author's article, "Low-Noise Transistor Preamp" (February 1960 issue), was originally intended as a battery-powered device. However, in light of a year's experience and comments from friends and associates who have made use of the design, battery power does not seem nearly as attractive as it once did. For one thing, it is inconvenient to check battery condition periodically. The most urgent requests for an a.c. power supply came from those using two of these preamplifiers in a stereo system. The battery supply impedance is such that channel separation is limited to about 30 db due to coupling through the batteries. Presumably, the separation would decrease as the batteries aged and, at best, would be unpredictable.

The amount of power required is nominal. The major problem is achieving sufficiently low ripple content to avoid degrading the signal-to-noise ratio. An electronically filtered and regulated supply seems rather extravagant for a simple low-level preamp application and would, indeed, cost more than the one or two preamps it would power. The voltage supply tolerance of the preamplifier was determined as being 6 to 12 volts for either or both the positive and negative supplies.

The noise and ripple tolerance was established by connecting a 1-volt transformer in series with each battery and using a Variac to control the primary voltage applied to the transformers. As predicted, the negative supply is the most sensitive. However, at least 6 millivolts of ripple must be present in the negative supply before the residual preamplifier noise increases. Approximately 10 millivolts is required before the 60 cps characteristic can be distinguished at the preamplifier output. About ten times as much ripple can be tolerated in the positive supply. If the power supply noise and ripple is maintained 20 db below this threshold, there is little chance of contributing hum or noise to the system.

Fig. 1. Circuit employs a 24-volt transformer in full-wave voltage-doubler setup. Although specifically designed for the author's preamplifier described in our February, 1960 issue, this supply is useful in other low-voltage, low-current applications.



R_1, R_2—400 ohm, 5 w. wirewound res.
R_3, R_4—200 ohm, 2 w. res. ± 10%
C_1, C_2—250 μf., 50 v. elec. capacitor
C_3—100 μf., 50 v. elec. capacitor
C_4, C_5—1000 μf., 15 v. elec. capacitor
SR_1, SR_2—1N537 silicon rectifier
T_1—24-volt trans. (see text)
F_1—¼ amp "Slo-Blo" fuse
S_1—S.p.s.t. switch ("On-Off")

Several different design approaches were investigated. Naturally, it was desired to keep the number of bulky and expensive components to a minimum. Since the output current is on the order of 5 ma. or so, brute-force *RC* filters are effective with a variety of rectifier configurations, providing the voltage drop through the filter is two or three times the output voltage. In order to make the best possible use of the least number of components, a full-wave doubler circuit is used with a 24-volt transformer. The advantages includes: (*a*) 24-volt transformers which are standard items available over the counter; (*b*) only two rectifiers are used; (*c*) the ripple frequency is twice the input frequency; (*d*) half the rectifier output appears across each input capacitor; and (*e*) under load, there is 60 volts at the filter input, allowing a drop through the filter of 42 volts.

Referring to the schematic of Fig. 1, it will be seen that R_3 and R_4 form a divided bleeder, the center of which is grounded so that both positive and negative output is obtainable from the supply. The filter-divider for the negative output is composed of R_1 and R_3. The positive filter-divider is made up by R_2 and R_4. The bleeder current is 50 ma. Load regulation is good by virtue of the fact that the load current is small compared to the bleeder current. The output ripple is on the order of 20 to 50 μv.: low enough to make accurate measurement difficult. The output voltage does vary with the line voltage, but the preamplifier is not voltage sensitive to the extent that operation would be impaired unless the line voltage were to drop below 85 volts.

Several different 24-volt transformers have been used in these supplies. A 300-ma. rating is adequate. The voltage at the doubler output is 2.5 times the r.m.s. input voltage, so a difference of 4 volts at the transformer secondary will result in a change of 10 volts at the filter input. If necessary, the bleeder current may be maintained at 50 ma. by selecting the value of R_1 and R_2 so that 10 to 10.5 volts is developed across R_3 and R_4 with no external load on the supply.

It has been found that even with the large value of output capacitors, occasional transients from the power line will get through. The preamplifiers will produce transients up to 0.5 volt peak if a heavy inductive load such as a 1-hp motor is switched on and off at the same a.c. outlet. Turntable motors are not at all bothersome. If the installation warrants the added cost, line transients can be eliminated by using zener diodes in place of R_3 and R_4. A 10-watt, 9-volt zener, such as the Hoffman 1N1808, should be used, preferably with a small heat sink.

Only one precaution need be observed in the installation of the a.c. power supply. The 24-volt transformer should be located and/or oriented so the 60-cps field from the core is not induced into the magnetic cartridge.

—30—

OSCILLATION IN PORTABLE

By ROBERT JONES

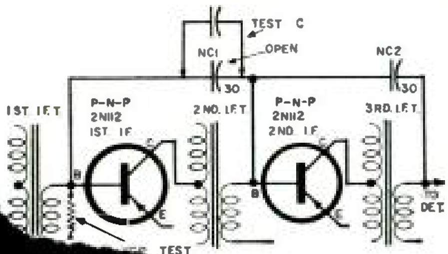
TELL-TALE "birdies" on every station indicated oscillation in a Raytheon portable transistor radio, model FM-101A. The following technique was found to localize the defect quickly:

Jumper tests were made with a 1000-ohm resistor across all i.f. transformer secondaries, as shown in the partial schematic. The damping resistor killed the oscillation at all points from the detector input back to the input of the first i.f. transistor. Consequently, the trouble was in the first i.f. stage, the mixer, or the feedback loop entailed in these circuits.

Rather than perform a "butcher" job by permanently wiring a damper resistor across a secondary, each neutralizing capacitor (NC) was shunted in turn. Shunting NC_2, connected between the base of the second i.f. transistor and the detector, produced no results. Shunting neutralizing capacitor NC_1, between the base of the first i.f. transistor and the base of the second i.f., stopped the birdies and restored normal operation.

To eliminate the possibility that hand capacitance was responsible for a misleading indication, the shunt was temporarily pinched into place around the leads of NC_1, thus avoiding the use even of clips that might contribute a loading effect. Finally, although the defective capacitor had been shunted for testing, it was removed and replaced for the final repair. Although the faulty unit was obviously open, it may have made intermittent contact later on, and circuit gain could have been reduced by too much neutralizing capacitance. —30—

Resistor and capacitor test probes localized a problem in i.f. oscillation.



Two spring-like delay lines (left) and reverb amplifier produce the reverberation effect.

"Reverbaphonic Sound" System

Electro-mechanical reverberation unit to be included in Philco and Zenith packaged phonograph consoles.

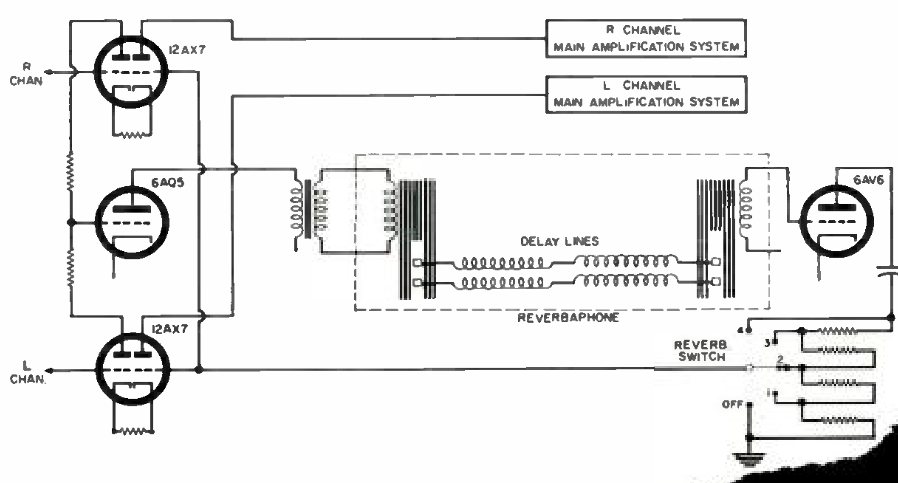
IN an effort to insert some "concert-hall reverberation" into stereo or mono sound that is reproduced in the home, two manufacturers of packaged phonographs are including, in some of their new models, an electro-mechanical reverberation unit similar in principle to the reverb unit used in *Hammond* electronic organs. Both *Philco* and *Zenith* have announced the use of the *Hammond*-designed reverberation unit in some of their new console models under the name of "Reverbaphonic Sound," for *Philco* units, or "Reverba-Tone," for *Zenith* units.

We recently attended a press demonstration of the *Philco* system and were quite impressed at the great difference in reproduced sound when the reverberation unit was switched in. A very definite and noticeable reverberation effect was heard on both stereo and mono signal sources. There may be those who argue that this is really a "gimmick" that compromises the true stereo effect, but it must be admitted that it does make for a very striking demonstration. The phonograph employed for the demonstration had its speakers for both stereo channels housed in the console. In addition, two outboard 4-inch speakers were placed in the corners of the listening room some distance away from the console. If desired, the outboard speakers, which handle signals from 200 to 300 cps and upward, may be placed in the main console. A five-position switch on the phonograph provides four degrees of reverb along with an "off" position.

Close examination of the reverberation unit disclosed what appeared to be two springs somewhat over a foot long and perhaps 3/16 inch in diameter stretched loosely between two supports (see photo above). The springs were anchored at both ends onto a pair of ferrite armatures, around which were wound a pair of coils. One of these is used for the input, and the other is used for the output.

The block diagram of the *Philco* system, shown below, indicates just where the reverberation unit fits into the over-all audio system. The time delay produced by the two springs is on the order of 30 to 40 milliseconds. The two springs have slightly different delays in order to obtain a relatively smooth delay characteristic. Because the lines are not terminated, echo signals continue to bounce back and forth for a period of up to approximately 2 seconds. —30—

The combined left and right signals are applied through a coupling transformer to a coil wound on a ferrite armature. This armature then moves mechanically in accordance with the audio signal. The mechanical motion is transmitted along the length of the two spring-like delay lines, causing the armature at the other end of the springs to be vibrated. This, in turn, produces a signal at the output winding that may then be recombined with the original left- and right-channel signals.



Railroad Radio

(Continued from page 65)

TV is also being used for inspecting the mechanical condition of cars as well as observing the over-all movements in a yard.

Further railroad automation is coming. Still unsolved is the problem of identifying freight cars automatically as they enter a yard. While push-buttons are used for controlling the movements of freight cars as they roll down the hump, it is still necessary to have human beings identify individual freight cars. This is often difficult when the number is almost, if not completely, illegible.

It has been suggested that cars be marked with colored strips in different combinations. The coded combinations are read by a photocell and the information is either stored or displayed by a computer. Another proposed system would provide for coding of cars with radio-active paints using a Geiger counter for reading the numbers.

The use of microwave systems by railroads is expected to expand materially. Much of the open-wire pole line plant operated by the railroads, about 250,000 miles of lines, will require replacement or rehabilitation. Maximum use of these wire lines is being made by many railroads which have installed modern telephone and telegraph carrier systems. One pair of wires, equipped with a modern carrier system, can handle up to a dozen telephone conversations simultaneously. But, even this is not sufficient to accommodate the growing need for communications. Hence, microwave systems which can handle up to 200 voice channels offer freedom from communications congestion.

It is the transistor, however, which is expected to revolutionize railroad communications for the second time since World War II. Transistorized telephone carrier and voice repeaters, which can be operated from batteries, can be installed in remote locations where reliable utility power is not available. Even the smallest yards and some sidings where electric power is not available can be equipped with paging and intercom systems utilizing battery-operated transistorized amplifiers.

Partially transistorized railroad equipment is already available. Transistors are being used in audio output stages and in lieu of vibrators in power supplies. But it is the all-transistorized railroad radio that is being awaited by the industry. Imagine a caboose radio the size of a portable typewriter, perhaps even smaller, which will operate from a pair of lantern batteries or even solar cells. The vibrator, axle-drive assembly, storage battery, and charging generator will then be only memories. Based on observations of the present rate of progress of the electronics art, the all-transistorized railroad radio is not far away.

—30—

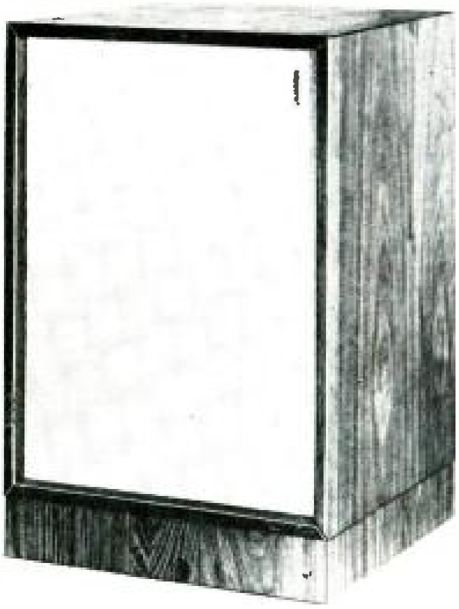
New Audio Test Report

ELECTRONICS WORLD LAB TESTED

Argus Model X-4 Speaker System

University T-202 "Sphericon" Tweeter

Dynaco TA-12 "Stereodyne" Tone Arm and Cartridge



Argus Speaker System

WE have just completed our tests on the *Argus* Model X-4 speaker system which is described by the distributor as "an over-sized bookshelf system designed for floor placement primarily." Although certainly not of bookshelf size, the unit is fairly compact so that a pair of them would not occupy too much space in an average room. The speaker enclosure itself is 2-feet high by 1½-feet wide by 1⅓-feet deep, and this enclosure is mounted on a 3-inch matching base. The system uses a single wide-range 12-inch speaker that employs a special suspension of latex-like material that is claimed to control cone excursion and improve transient response. This speaker has a fairly low cone resonance. The high frequencies are produced by a separate dispersion cone that is attached to the same voice coil. No electrical crossover network is required as this function is accomplished mechanically.

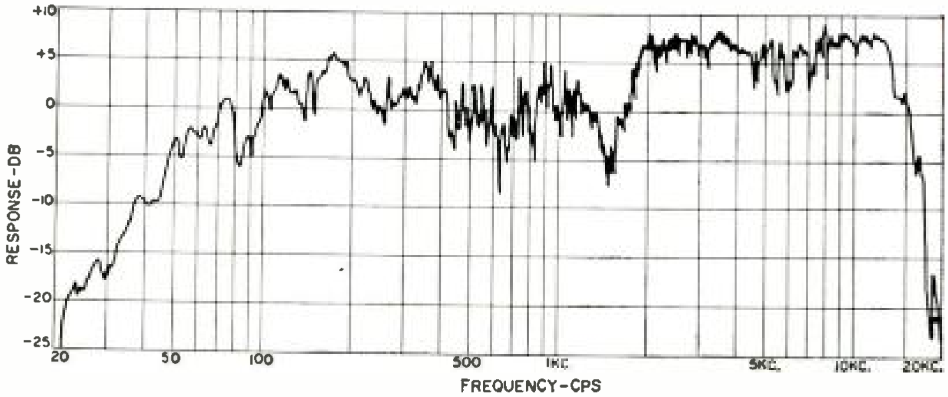
The speaker is mounted in a simple infinite-baffle enclosure, a completely closed box, that is lined on all inside surfaces with a 2-inch layer of fiber glass. Three-quarter-inch stock is used for the enclosure. The inside volume is just over 3 cubic feet and no ducts or ports are employed.

In order to test the speaker system, we employed acoustic measurements and listening tests. Fig. 1 shows the response measured at a power level of 5 watts. The calibrated microphone used was located on the speaker's axis at a distance of 6 feet from the front panel. Averaging out the curve shows that the response is down about 6 db at 48 cps and down about 12 db at 35 cps. At the high end, the woofer section of the speaker begins to fall off at 1500 cps, at which point the tweeter section takes over. However, instead of the high frequencies continuing on out at the mid-range level, a definite high-frequency plateau exists from 2000 cps to 13,000 cps that averages about 6 db higher than the mid-range level. Output waveforms were observed, and within the limits of the system's power rating, there was very little distortion at the low end.

Our listening tests served to double-check our acoustic measurements. We found the mid-range and lows full-bodied and clean. Although the highs were also clean, because of their high level, the system sounded somewhat strident. Had we been able to bring down the high-frequency level, the system would have so inded better balanced. We have been informed by the system's manufacturer that they have taken steps to lower the output level of the high end in order to obtain a more balanced output. The future units with this modification should do a good job as a high-fidelity reproducer. Also worthy of comment is the fact that the speaker system has very good dispersion of the high frequencies and appears to have good over-all transient performance.

The Model X-4 is an 8-ohm system that will handle 30 watts of power. The cabinet is oil-stained walnut and the unit is priced at $180. It is available from the exclusive sales agency *Hi-Fi Supply*, 1069 First Ave., New York 22, N. Y. —30—

Fig. 1. Response measurements at 5 watts with a microphone spacing of 6 feet. Since the curve was taken in a normal listening room, there are many peaks and valleys in response. These should be averaged out to eliminate effects of the room.



University Tweeter

THE problem of adding a tweeter to a speaker system that is deficient in highs is not an easy one to solve. Should the user select the highly efficient horn-type tweeter which is fairly directional, or should he select a much lower efficiency cone tweeter or an electrostatic tweeter with less output and more dispersion? Evidently, *University* has taken a position right down the middle with its new Model T-202 "Sphericon" tweeter. This unit is less efficient than a horn tweeter, but it has better dispersion. On the other hand, the "Sphericon" has considerably more output than do most cone or electrostatic tweeters.

Examination of the tweeter shows that the manufacturer has combined some of the physical features of both horn and cone speakers. For example, the diaphragm is dome-shaped and made of phenolic material just as in many horn tweeters. However, instead of using a fairly long directive horn in front of the diaphragm, a very shallow plastic horn is used. This has the appearance of a small cone on a conventional cone tweeter, except that it is fixed and does not move with the diaphragm. A small diffractor sphere in front of the diaphragm is used to widen the dispersion pattern to approximately 120 degrees both horizontally and vertically.

We checked the tweeter both by listening tests and by acoustic measurements with an audio generator and a wide-range microphone whose output was connected to a high-gain oscilloscope. In comparing the unit with both electrostatic and cone tweeters, the greater acoustic output of the "Sphericon" was clearly evident. When we observed the waveform on our scope, no distortion could be seen over the entire range of our tests. Using as an arbitrary reference the output at 5000 cps, we found that the level dropped at the low end by 6 db at 2500 cps. This was caused not only by the characteristics of the tweeter itself but also because of the built-in crossover network whose nominal cut-off frequency is 3000 cps. When we ran our audio generator up to 20 kc., we were still obtaining output on our scope. However, because of the limited response of our microphone at this high frequency, we did not attempt to measure the output. The manufacturer has obtained a response that is down somewhat less than 4 db at 20 kc. and even specifies output as far up in frequency as 40 kc.

We then swept our audio oscillator throughout the range in an effort to detect any irregularities in response. Of course, the simple method of placing a microphone in front of the tweeter in an ordinary live room, as we did, and observing the response is fraught with many difficulties. For one thing, standing waves within the room and reflections from the room surfaces may permit a sound maximum to occur at a given frequency where the microphone happens to be located. A slight change of mike position may cause this maximum to become a minimum value at this same frequency. Also different room sizes and different room acoustic treatments will alter the distribution of sound materially. In spite of these problems, we went ahead and located our microphone about 2 feet directly in front of the tweeter in order to get some measurable results to report. Under these conditions, we noted acoustic peaks of about 3 db at 3000 cps, 6 db at 3600 cps, and 6 db at 6400 cps with respect to the level at 5000 cps. It should be pointed out here that the manufacturer recommends that the tweeter be mounted on a flat panel with sound absorbing material surrounding it to prevent mounting-surface reflections. For our measurements, we simply used the tweeter's small carton for mounting. Undoubtedly, mounting the tweeter in accordance with the manufacturer's recommendations would alter the acoustic response.

The tweeter is completely enclosed in the back. All that need be done to mount it is to make a 3$^{11}/_{16}$-inch opening in the baffle board. The unit comes with a "brilliance control" which allows the user to vary the level of the high-frequency output from maximum to no output at all. The impedance is 8 ohms so that it may be used in hi-fi systems of from 4 to 16 ohms. The power to the tweeter will be reduced somewhat if the lower impedance value is used, and it will be increased if the higher value is used. The "Sphericon" will handle about 30 watts of integrated program material. It is available with the built-in network and adjustable brilliance control for $24.95. —30—

Dynaco Arm and Cartridge

IN AN effort to augment his excellent line of amplifiers and preamplifiers, Dave Hafler of *Dynaco Inc.* has been marketing a Danish-made stereo cartridge and integrated tone arm. The cartridge is a moving-iron magnetic type using four coils arranged in two push-pull pairs. This design is said to provide equal lateral and vertical compliance along with hum and noise cancellation because of the hum-bucking arrangement. Complete magnetic shielding with Mumetal is also effective in reducing hum pickup.

Although the cartridge can be used in any standard tone arm, the pickup that we tested was mounted in the company's matching arm—the combination is known as Model TA-12. The arm has several interesting features. For example, the main bearing is a low-inertia gyroscope-like gimbal movement which allows free vertical and horizontal movement. Also, there is an adjustable collar that may be slid along the arm to regulate the tracking pressure. This collar pulls on a spring the other end of which is anchored at the bearing assembly. Calibrating marks are on the arm at 1-gram intervals up to 4 grams. In checking this calibration we found that it was necessaryto align the back edge of the collar (nearer the main bearing) to the calibration mark in order to get an accurate adjustment. Recommended tracking pressure with the "Stereodyne" cartridge is between 2 and 3 grams. In making our tests, we used an adjustment of 2 grams. The recommended load is 47,000 ohms.

The curves shown here were obtained using the *Westrex* 1-A stereo test record. Note how closely the outputs of both channels follow each other—being within about 1 db of each other over the entire frequency range of 30 to 15,000 cps. The response is quite uniform above 1000 cps, with a very slight rising characteristic at the very high end. Below this frequency, the response also rises.

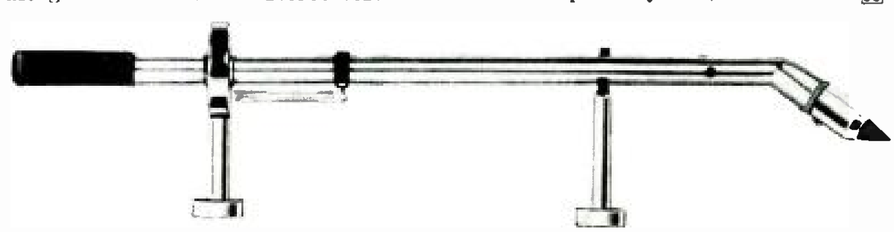
At 30 cps, the response was up approximately 6½ db. We know that the *Westrex* record is up about 2 db at this frequency, which would leave us with a rise of 4½ db. We had an opportunity of visiting *Dyna's* laboratory, and using the same arm, test record, and even the same v.t.v.m., we found that the over-all rise was only 4½ db. The only thing changed was the turntable and the mounting board. Similar tests were made using other turntables and all of them gave us basically the same result. Under these conditions, the actual rise at 30 cps can be considered to be 2½ db.

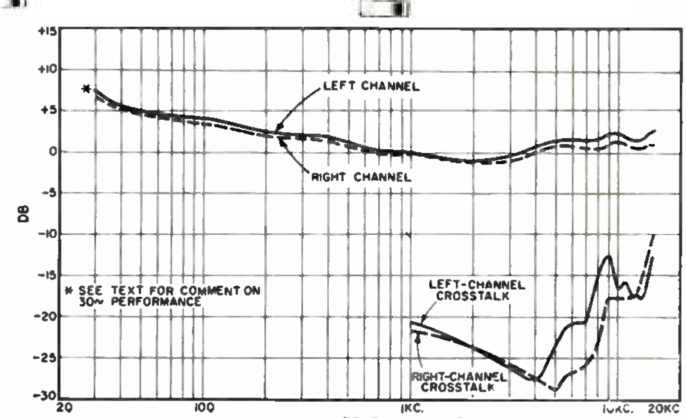
The separation between the channels is quite good over the frequency range we tested. Separation is about 21 db at 1000 cps, and this increases to a maximum of about 29 db around 4000 to 5000 cps. Even at 10,000 cps, the separation averages around 19 db. The output voltage from each channel is 7 mv. at a recorded velocity of 5 cm./sec. at 1000 cps.

The cartridge comes equipped with a .7-mil diamond stylus that may be replaced easily. Although the unit is a stereo cartridge, it may be used on monophonic records by simply strapping together the two hot output leads. This, of course, may also be done by a switch to the preamplifier.

A listening test proved that this new cartridge and tone arm assembly provided a clear, pleasing response that was smooth without annoying peaks. It was able to track extremely loud stereo and mono passages.

The Model TA-12 integrated tone arm and cartridge is available for $49.95, or the cartridge may be obtained separately for $29.95. —30—





Response using the Westrex 1-A test record is up 6½ db at 30 cps. About 2 db of this is caused by the record. Upon checking the same arm and cartridge with same v.t.v.m. and test record at Dyna's lab, but with a different turntable and mounting board, we found only a 4½-db rise. Checks with other turntables showed similar results. Hence, 30-cps response can be considered to be about +2½ db.

Transistor Replacement

(*Continued from page 47*)

transistors should be replaced as a pair for best results. Adjustment of forward-bias resistance can best be achieved by connecting an audio oscillator to the first audio stage and an oscilloscope at the output of the system, as shown in Fig. 2.

The value of the bias resistor (68 ohms in this case, as indicated by asterisk) is adjusted for minimum crossover distortion. High distortion will show up in the form of the waveform labeled as incorrect in Fig. 2. Use as little resistance as possible, consistent with low distortion at adequate volume levels, determined by listening for volume while checking distortion on the scope. This will keep battery drain down. A test tone of 1000 cps is satisfactory.

Neutralization

While the technique for replacing r.f. and i.f. transistors already described will work out right in most instances, there is a possible fly in the ointment, so to speak. American transistors tend to have more gain and less collector-to-base capacitance than similar Japanese types. In some cases, replacement may cause the stage to oscillate.

Here's why: Our typical i.f. amplifier (Fig. 1) has a neutralization circuit to cancel out the r.f. signal fed from the collector back to the base through the transistor's junction capacitance. This loop consists of the 20-$\mu\mu$f. capacitor between the secondary of the i.f. transformer and the base of the transistor. The connection is such that the signal fed back to the base is out-of-phase with signal passed by the transistor junction. Thus, if the two signals are equal in amplitude, the capacitive feedback provides perfect cancellation and the stage is neutralized.

Let's assume that the replacement transistor has less junction capacitance than the Japanese original. Since the amplitude of the feedback signal is greater than necessary for cancellation, the stage oscillates. If the value of the feedback capacitor is slightly off but close, the problem might be even worse. Oscillation itself might not occur in the service shop, but the tendency for it would be increased. Thus, when the stage is operating at increased gain (due to a temperature change or when a weak signal reduces a.v.c. voltage), the set might "take off." The unaware technician could have quite a time of it trying to figure out why the radio oscillated (or quit working) when the customer took it on a trip but worked perfectly in the shop! In any event, neutralization should be checked whenever r.f. or i.f. transistors are replaced with units that are not exact equivalents.

The chief instrument for making this check is a small trimmer capacitor whose range extends above and below that of the original neutralizing capacitor, which is used to determine the correct value needed. Bias is removed from the stage involved (as described earlier) and the radio is driven with a fairly strong, modulated r.f. signal from a suitable generator. The injection point is not particularly important as long as a signal can be forced through the unbiased stage under test.

A means of measuring the signal that passes through the stage is also necessary. An oscilloscope or audio voltmeter connected between collector and ground of an output transistor works very well—but be sure to keep the volume control wide open. With this setup, replace the neutralizing capacitor with the trimmer and adjust the latter while observing the output indicator for minimum signal. When this null is found, replace the trimmer with a suitable fixed capacitor (silver mica or NPO) of the correct value. If an instrument for measuring capacitance is not at hand, a calibrated substitution box or individual capacitors of known value could be used for the test instead of the trimmer.

Some radios use an *RC* neutralizing network to correct both phase and amplitude. In these, it may also be necessary to adjust the value of the resistor for proper nulling of the signal.

In some cases, a part of the primary winding of the i.f. transformer is involved in the neutralizing loop. Procedure here is the same as that already outlined, but the value of the neutralizing capacitor is usually much smaller. The circuit is thus more critical with respect to such factors as lead length and hand capacitance.

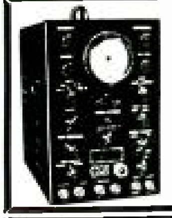
With the steps outlined here, the technician can reduce most problems involving replacement of Japanese transistors to routine jobs. —30—

Computer Memory Devices

(*Continued from page 42*)

rays is known as a *plane*. Each of the cores shown in Fig. 11 would therefore be placed at corresponding locations in five different planes and could be read or written simultaneously. The total storage capacity of a core memory is determined by (1) the number of cores in each plane and (2) the number of planes. A twelve-plane 64-by-64 memory would, for example, be capable of storing 4096 twelve-bit numbers.

Magnetic drum and tapes are *cyclic* storage devices, involving mechanical motion of the recording surface with respect to the heads. Recorded data passes the reading heads in the order in which the data is located on the surface of the drum or tape. By contrast, magnetic cores constitute a *random-access* type of storage. This means that the cores can be read in any order at once simply by pulsing the appropriate *X* and *Y* wires. It is for this reason that the access time is very short as compared to tape or drum storage, and magnetic cores are frequently used in the main memory of high-speed computers. —30—



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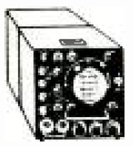

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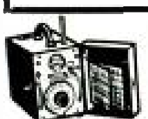

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DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.50
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	7.95	10.50
PE-86	28V 1.25A	250V .050A	2.75	3.85

BD-77 DYNAMOTOR Input 14V @ 39A. Output 1000V @ .350A with starting solenoid, Filter Box and Mounting Base .... Like New $14.95

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

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

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27 to 38.9 Mc. F.M. Two preselected channels crystal controlled. 5 watts. Complete with speaker, tubes. Used **$10.95**
Less tubes, used $5.95
Antenna for BC-659. Telescoping 20" to 8-Ft. $2.95

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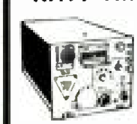

ARB/CRV 46151—190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change. Sharp and broad tuning. AVC, CW. Illuminated dial. Complete with tubes and dynamotor. BRAND NEW .. $34.50
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Model AN-PR6N is 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, phono jack, on-off switch. For 14V or 24V, please specify.
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Consisting of: BC-620 FM TRANSCEIVER, 20-28 Mc., with Power Supply for 6 or 12 Volt DC operation, including all components: Antenna, Mast Base and Sections, Handset, Technical Manual and all other accessories, ready for operation. BRAND NEW, in original packing.
OUR LOW PRICE. While They Last! **$59.50**

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Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.
COMBINATION. Exc. Used **$29.50**

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T-45	Army and Navy Lip Mike		1.25
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TS-11	Handset		3.95
TS-13	Handset		4.25
RS-38	Navy Type		4.75

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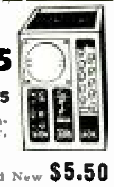
BC-603 FM RECEIVER



20 TO 27.9 MC.
Excellent Used **$14.95**
BRAND NEW $16.95

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
With Tubes. Used $4.95

SPECIAL! BC-603 FM RCVR CONVERTED FOR ANY FREQUENCY FROM 30 TO 50 MEGACYCLES!

BRAND NEW! Checked out, perfect working condition, ready for operation. Specify Frequency desired (between 30-50 Mc) when ordering. **$27.50**

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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

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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. Like New, with all tubes **$59.50**
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TU19 .... each $89.50

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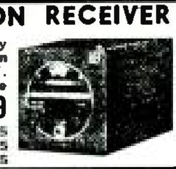
BC-342 RECEIVER 1.5 to 18 Mc. AC only. Exc. Used $69.50
BC-348 SUPERHET Receiver 200 to 500 Kc and 1.5 to 1800 Mc. Voice, tone, CW. Self-contained dynamotor for 24 VDC. Like NEW $69.50

BC1206-C BEACON RECEIVER



195 to 420 Kc. made by Setchel - Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW **$9.99**
Brand New, less tubes . $5.95
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ALL COMPLETE WITH TUBES

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BC-450	3-Receiver Control Box	1.29	1.75

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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!

Transistorized Tachometer Pickup

By **PAUL S. LEDERER**

Construction of simple photoelectric tach that produces indication proportional to shaft speed.

THE tachometer, a device which measures the speed of a rotating shaft, is a very important industrial and laboratory tool. When it is necessary to monitor the rotational speed of a shaft continuously, a tachometer in the form of a generator is usually permanently attached to the end of the shaft. There are many cases, however, where it is desirable to check speed only occasionally. Using a permanently attached tachometer under these conditions would become prohibitively expensive.

Portable, mechanical revolution counters are available commercially. They require direct contact with the rotating shaft, which at times may be dangerous. When applied to low-power devices, such a mechanical tachometer can seriously affect the speed of the shaft. It is possible to devise a tachometer which does not need any mechanical linkage to the shaft whose speed it measures. A magnet radially embedded in the shaft will induce a voltage whenever it passes a coil placed in proximity and radially to the shaft. Another method uses a light shining through a hole drilled in the diameter of the shaft. It impinges on a photocell and generates a pulse whenever all three are in line, thus producing a number of pulses proportional to the speed of shaft rotation.

Another technique, employing a light and photocell, uses light reflected from alternately dark and light colored areas along the shaft's circumference. If half of the shaft's circumference is painted black and the other half white and a light is shining on it, whenever the white area is lighted, most of the light will be reflected. Whenever the light shines on the black area, most of the light will be absorbed and very little reflected. If the photocell is mounted next to the lamp, but shielded from its direct light and facing the painted areas on the shaft, the current flowing will depend on the amount of light reflected from the painted areas to the cell. One complete revolution of this shaft would generate *one* cycle of a (probably squared-off) sine wave at the photocell output. The speed of a slowly turning object can be determined by dividing the circumference into *many* dark and light areas so that one revolution will generate many cycles.

In practice, it is seldom necessary to actually paint adjacent areas black and white. Clean, bright metal reflects sufficient light; a piece of black electrical tape can serve as the non-reflecting (black) area.

A number of commercial tachometers operate on this principle. Most are designed to operate with electronic frequency counters from which they derive their power. They are fairly big and expensive.

The transistorized tachometer pickup to be described is self-contained in a 2¼" x 2¼" x 4" aluminum box. It employs a cadmium selenide photocell operating as a reflected-light pickup. A pre-focused flashlight bulb supplies the light and a grounded-emitter amplifier completes the device, which is powered by two small batteries.

The photocell used in this circuit is a photoresistive device. Its resistance decreases when light impinges on the face of the photocell. The unit used by the author is the *Clairex* CL-3 which has a diameter of approximately ¼" and is about ½" long. It nets for $3.50. The cell is mounted in a piece of copper tubing about one inch long and with an i.d. of about ¼", sufficient for the photocell to slide in. The front face of the photocell is recessed about ⅝" inside the tube. The tube, besides keeping the photocell aligned, also serves as a light shield. This makes it possible to operate the tachometer pickup under adverse ambient light conditions.

The copper tube is attached to a bracket fastened to and protruding through the 2¼" x 2¼" surface of the box. The other end of the bracket carries the socket for the light bulb. This light bulb is a pre-focused "penlite" bulb (*G-E* #112) designed to operate from a 1.2-volt battery. The copper tube and the light bulb socket are inclined toward each other and to the box surface at about a 60-degree angle. Their axes intersect about 1½" in front of the box surface. This means that for optimum operation, the portable tachometer pickup should be held so that its front surface is about 1½" away from the surface of the rotating object whose speed is being measured.

The circuit of the transistorized tach is shown in Fig. 1. The switch turns on both the lamp battery and the battery-energizing photocell and transistor amplifier. When light strikes the front of the cell, its resistance decreases and the battery pushes more current through it and the 82,000-ohm resistor, R_1, into the base circuit of the transistor. The amplified signal generates a voltage across the 47,000-ohm load resistor, R_2, which is picked off at the collector of the grounded-emitter transistor amplifier. It is fed to the output cable through a 0.1 µf. paper capacitor, C_1. It is not possible to give much information on the output voltage obtained because it will depend on such factors as distance from the rotating object, frequency of light variation, ambient light, and light reflecting qualities of the rotating surface.

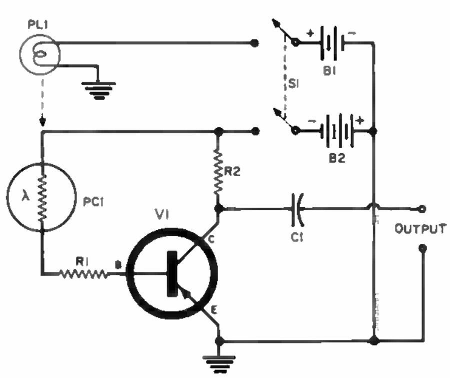
In the case of a rotating anodized aluminum disc, half of which was covered with black electrical tape, the output was 1 volt peak-to-peak at about 110 cps (corresponding to a rotational speed of 6600 rpm) at a distance of 1½ inch. The output increases at lower frequencies. This is a characteristic of many of the crystal-type photocells. The output is adequate for frequency measurement by Lissajous figures on an oscilloscope (using a calibrated audio oscillator to feed the scope's horizontal amplifier). For industrial use, the output appears sufficient to drive the electronic counters of many frequency meters.

This tachometer can be used to measure rotational speed of electric fans if it is recalled that there will be as many cycles put out per revolution as there are fan blades.

Total construction cost of this unit is less than $10.00. The batteries are held against the inside of the box by means of a home-made bracket. The switch serves to hold the 15-volt battery by pushing it against a spring-loaded screw in the end of the box which serves as ground terminal for the battery. A small plastic block holds the 1.5-volt cell against a similar spring-loaded screw. The d.p.s.t. switch, S_1, is the only control.

—30—

Fig. 1. Single transistor amplifies output of photocell. This output may be applied to an oscilloscope, to a sensitive a.c. voltmeter, or to a frequency-meter circuit.



R_1—82,000 ohm, ½ w. res.
R_2—47,000 ohm, ½ w. res.
C_1—0.1 µf., 100 v. paper capacitor
S_1—D.p.s.t. switch
B_1—1.5-volt "C" cell
B_2—15-volt hearing-aid battery (Burgess V-10 or equiv.)
PC_1—Cadmium selenide crystal photocell (Clairex CL-3)
PL_1—1.2-volt pre-focused screw-base bulb (G-E #112)
V_1—"p-n-p" germanium transistor (Raytheon CK722)

NEW LAFAYETTE HE-15 CITIZENS BAND 11 METER 2-WAY SUPERHETERODYNE TRANSCEIVER

COMPLETELY WIRED NOT A KIT!

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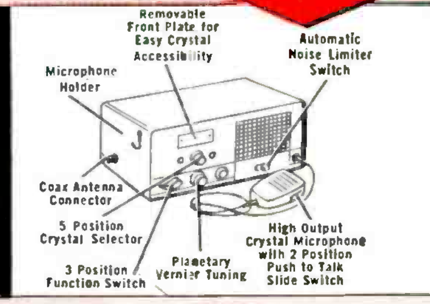

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The Superheterodyne receiver is tuneable over the full 22 channel band with 3 watts audio output. Controls include a 3 position function switch (transmit, receive, and transmit with spring return), planetary vernier tuning plus squelch noise limiter control switch. All coils are ferrite tuned. Output impedance matches 52 and 72 ohm antenna with Amphenol type coax connector for operating into dipole, ground plane or rod antenna. Has large 4" PM speaker; input jack for crystal or ceramic microphone; power receptacle in rear for AC line and 6 or 12 volt external power supply. Transceiver is supplied with single transmitting crystal for channel 9. Complete high output with crystal microphone, and brackets for easy mounting of unit in auto, boat, etc. Operated on 115 volts AC. Addition of 6 or 12 volt power supply (separately supplied) adapts transceiver for mobile operation. Size 5½"H x 6⅜"D. Shpg wt., 11 lbs.

HE-15 Factory Wired and Tested (Less antenna). 5.00 Down........Net 64.50
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- SUPERHETERODYNE TUNEABLE RECEIVER OVER FULL 22 CHANNEL BAND
- 4 DUAL FUNCTION TUBES, PLUS 2 SINGLE FUNCTION TUBES, PLUS 2 RECTIFIERS FOR 12 TUBE PERFORMANCE
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- UNEXCELLED RECEPTION ON LAND AND SEA... COMPARES WITH UNITS COSTING 3 TIMES AS MUCH

NEW! LAFAYETTE TELESCOPIC CITIZENS BAND WHIP ANTENNA

3.95

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- Telescopes From 16½" to 40"
- Mounts Vertically or Right Angle

An outstanding antenna value. This high quality three section telescoping antenna is designed for attachment directly to your citizens band transceiver. Ideal for point to point service over short distances. Molded base loading coil has a threaded stud with a PL-259 plug—connector for vertical or right angle mounting. Shpg. wt.; 1 lb.
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With this rugged, new radio field indicator you can check performance of your marine, mobile or fixed transmitter . . . actually measures the RF field generated by any transmitter between 100KC and 250MC regardless of power. Features a 200 ua meter movement with a variable sensitivity control. Phone jack at rear of indicator accepts earphones thus providing an aural check of transmitter output. Antenna extends from 3¼" to 10¾". Powerful magnet on bottom plate allows easy mounting on car dashboard or metal surfaces. Use anywhere . . . requires no electricity or batteries. Dimensions: (less antenna) 3⅛"W x 2¼"H x 2" D.
TM-14........Net 7.95

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FS-208 "Tiny" 6-Transistor Radio....Net 19.95

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Hams, TVI, and Technicians

Amateurs and CD officials in New Rochelle call local service dealers to interference symposium in response to wrath over scrambled TV reception.

THERE IS nothing new in the fact that the radio amateur is made the popular scapegoat, usually with little justification, when TV set owners encounter any sort of interference problems. In fact, even when the interfering signal can be clearly identified as originating from a ham transmission, the chances are that the amateur himself is not at fault. What is new is a recent educational program undertaken in New Rochelle, N. Y. to clarify the TVI problem, in the face of strong, local feeling against amateur broadcasting.

The situation's background begins with the fact that New Rochelle has a goodly number of active amateurs and a goodly portion of the local population found their TV viewing hopelessly scrambled when hams were on the air. Matters reached the unhappy stage where pressure developed for local regulations to restrict ham activity. The legality of such restrictions is open to question, considering the fact that the FCC is already in the business of regulating broadcast activity, but the unfavorable public attitude convinced local amateurs that they had to do something.

Principals in this drama included the members of the Communications Club of New Rochelle, 281 Washington Ave., New Rochelle, N. Y. Also concerned were local Civil Defense officials, who value highly the voluntary CD efforts of some 40 amateurs in the community. Those involved got together in organizing a TVI symposium, conducted this past spring, to which all local service dealers and technicians were invited.

The decision to work through the service industry was made because most consumer difficulties with TVI result in a call for service. While many service people, especially those who themselves hold FCC licenses, know exactly how to handle such complaints, others do not. As a result, the technician may end up by advising his customer "There's nothing I can do about it," "Call the ham and tell him to cut it out," or "Tell the FCC to run the guy off the air."

The symposium consisted of lectures and demonstrations on TVI, including films showing actual cases and their solutions, literature on the subject, and lists of available materials for relieving problems. Mr. George Bartels, former CD director and incumbent assistant city manager of New Rochelle, presided. He was assisted by a panel that included CCNR members Alan Mason (president), Graham Berry (secretary), Al Hook, and Tom Heaton. Dave McAlley, also on the panel, is New Rochelle's CD radio director. The lecture and demonstration were followed by answers to specific questions from the audience. The symposium stressed several points not always completely understood, with supporting evidence:

1. As FCC investigations of interference complaints show, it is seldom the amateur himself who is responsible for the interference. As a rule, he transmits in a completely legal manner that would not cause interference. In fact, he is an amateur only in the sense that he obtains no direct monetary gain from his activity. In knowledge and ability, he is of professional caliber, having passed difficult tests to obtain licenses and being under the constant, strict control of the federal government.

2. The conditions that result in TVI from "clean" amateur transmissions generally exist outside the ham's equipment or method of operation, and are generally outside his direct control. As often as not, these conditions involve deficiencies or outright defects in the TV receivers.

3. With proper repair or with the use of proper filtering and shielding techniques, TVI can be eliminated successfully.

4. The job of suppressing interference belongs to the service industry. The amateur himself may be completely capable of handling the problem, but he does not wish to undermine the livelihood of the service professional. However, he will cooperate with a service technician on a TVI problem.

5. As a rule, TV manufacturers will supply service technicians (frequently at no cost) with materials needed to eliminate interference that were not incorporated in the original design.

The demonstration involved an operating ham transmitter set up near an operating TV set that had been rendered TVI-proof. Despite the proximity, there was no interference. As the added protection was progressively removed, the resulting deterioration in TV reception was noted. Specific points raised included inadequately shielded TV i.f. systems using the old 21-mc. i.f. (right in an authorized ham band), and the absence of suitable high-pass filtering of TV antenna inputs. Nonlinear action in and out of the TV receiver that produced interfering harmonics from "clean" amateur transmissions were also covered, as were effects blamed on hams though totally unrelated to amateur activity, such as oscillator-radiation interference caused by another TV set or an FM tuner, oil-burner motors, kitchen appliances, passing cars, and others. —30—

Hi-Fi Amplifier

(*Continued from page* 45)

6550's if anything goes wrong with the bias supply. An *RC* voltage divider was used to obtain the bias voltage. It is a simple, yet effective, method of obtaining the desired voltage and one that dissipates very little heat. A choke-input power supply was chosen for the 40-watt version because of its excellent voltage regulation as compared to a capacitor input. With a swing in current from 165 to 220 ma., the d.c. voltage will drop less than 20 volts. In the case of the 60-watt version, capacitor input was used to get the higher voltage needed for the extra 2 db of power output.

The bias adjustment (R_{28}) should be such as to produce a cathode current for each output tube of about 75 ma. for the 40-watt amplifier and about 55 ma. for the 60-watt version. The balancing pot (R_{30}) should be adjusted for equal currents in both output tubes.

When connecting the output transformer, careful attention should be paid to the color coding of the primary leads. When the winding is connected properly, it will take approximately 70 volts r.m.s. on the grids of the 6550's for 60 watts of output. When the over-all feedback loop is connected, the output should drop by some 12 db. If motorboating or oscillation occur, you can correct the phasing by reversing the transformer leads or transposing the connections of the coupling capacitors at the driver.

A word might be said here about how the amplifier sounds, since the final word on any amplifier is whether it pleases the ear and sounds good after prolonged listening sessions. The highs sound clean and the instruments well delineated. The bass is solid and well damped. A large measure of the quality obtained with this circuit should be attributed to the outstanding characteristics of the output transformer and its ability to reproduce full output over such a wide frequency range. —30—

D. C. VOLTAGES

PIN	1	2	3	4	5	6	7	8	9
V_1	110	—	2.5	—	—	82	—	2.5	—
V_2	240	76	92	—	—	92	82	—	250
V_3, V_4	—	—	410	410	−48	—	—	.5	—

Table 1. Voltages measured by author in 40-watt unit. Voltages in 60-watt version are fairly similar except for somewhat higher "B-plus" and bias on tubes V_3, V_4.

Table 2. Important specs of both versions.

Output	40 watts	60 watts
Sensitivity	.7 volt for full output	1 volt for full output
Response	Down .1 db at 20 cps; down .5 db at 20,000 cps (at 40 watts)	Down .7 db at 20 cps; down 1.3 db at 20,000 cps (at 60 watts)
Feedback	12 db over-all 11 db tertiary	12 db over-all 11 db tertiary
Feedback Stability Margin	20 db	20 db
Damping Factor	10	10

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.

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

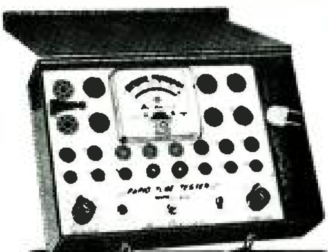
★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the 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



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.

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER

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

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more — and as proof, we offer to ship it on our examine before you buy policy.
To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch — THAT'S ALL!.Read quality on meter. Inter-element leakage if any indicates automatically.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only $36.50

Model 83—C.R.T. Tube Tester
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS AND REJUVENATES ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES
From 50 degree to 110 degree types —from 8" to 30" types.

ALL COLOR TUBES
Test ALL picture tubes—in the carton—out of the carton—in the set!

● Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
● Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
● Model 83 employs a 4" air-damped meter with quality and calibrated scales.
● Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

● Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
● Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only..... $38.50

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A Solder-Gun Control

(Continued from page 53)

closed contacts to the soldering gun. As the soldering tip heats, current through it decreases, reducing the voltage drop across R_6, and thus reducing the control (bucking) voltage to the tube.

When the tip reaches the desired temperature, V_1 is permitted to fire and pull in the relay. This places R_1 in series with the supply voltage to the gun, reducing current and voltage in the latter to a negligible value. Conduction of the tube also charges capacitor C_1. The relay remains pulled in until the capacitor discharges, which takes about half a second.

If, during this brief interval, the tip has cooled sufficiently so that it draws more current, the relay will de-energize and its closed contacts will again permit full supply voltage to reach the gun to bring tip temperature back to the desired level. However, if the tip has not cooled, the tube will fire again immediately to remove power from the tip. Thus, in actual use, the gun goes through repeated cooling cycles when the relay keeps turning off the gun for half-second intervals. The spacing of the "on-off" action not only controls tip temperature closely but also keeps the gun within its rated duty cycle.

The temperature at which the relay will open is dependent upon the settings of R_6 and R_3. Potentiometer R_6 is adjusted to calibrate a particular make and size of soldering gun, and need not be re-adjusted unless a different gun is used. After calibration, R_3 is adjusted to the specific temperature desired. Less than one volt is usually dropped across the combination of R_6 and the low-impedance winding of T_1. Thus the maximum heating capability of the soldering gun is not noticeably impaired.

When the trigger of the soldering gun is not depressed, virtually no current flows through R_6, and an electrical condition similar to that of a hot tip prevails. In this case, the relay would open and close continuously, just as though the tip had been sufficiently heated. This effect would not be undesirable except for the irritation of continuous clacking of the relay. The problem is solved with R_1 which, when the gun trigger switch is open, supplies sufficient current to the tube circuit to keep the relay energized, but will not sustain this current when the trigger switch is closed to place the gun in the circuit.

The starter anode of the gas-discharge tube (pin 7) is actually triggered by the a.c. voltage appearing on the wiper of potentiometer R_3. To prevent triggering when the soldering-gun tip is cold, the voltage developed on the high-impedance winding of T_1 has to be out-of-phase with this triggering voltage to cancel the latter. If the relay continues to operate even when the soldering-gun tip is cold, then either the primary or secondary leads of T_1 must be reversed in polarity.

The unit illustrated was tried with three different soldering guns—a 100-watt *Weller*, a 250-watt *Weller*, and a 100-watt *Wen* gun. After calibration by adjustment of R_6, the three guns performed almost identically. Temperature was found to be adjustable from a value just slightly above the boiling point of water to the maximum temperature capability of the gun.

Temperature calibration of the unit could be accomplished in a variety of ways, but the melting point of solder is probably as good a gauge as any. To calibrate, first place temperature control R_3 about 90 degrees from the minimum resistance position. Hold down the trigger of the soldering gun and adjust R_6 until solder touched to the tip of the gun just melts. From this starting point (which may be marked), higher temperatures can be obtained by additional rotation of R_3.

The unit illustrated (Figs. 2 and 3) is considerably larger than required, principally because of the rather large relay used. A smaller relay would facilitate smaller packaging, but the relay contacts should be capable of handling several amperes to withstand the continuous operation. Also, the 0A4 gas discharge tube could be replaced by the 5823, which is the 7-pin, miniature counterpart of the larger tube. A second unit was constructed using the 5823, and identical performance was observed.

Because line voltage within the unit is not isolated by a transformer, no connections should be made to the chassis, and the latter should be sealed to prevent bench objects from contacting any of the parts of the circuit. The unit illustrated, an experimental model, has since been replaced by one contained in a closed box.

Most circuit components can be found in the junk box or at the surplus counter, or adequate substitutions can be made. For example, although R_6 is not expensive, other available parts may serve the purpose. A tubular adjustable resistor with the same ratings will be less convenient to set, but this adjustment is not required regularly. Such a resistor will be especially feasible if the control is intended for use with only one gun or guns of similar characteristics.

If only a high-resistance (100,000 ohms to 1 megohm) potentiometer is on hand, a slight modification accommodates it. A fixed, 2-ohm resistor (a 2-watt carbon unit will do in most cases) is used in place of R_6, and the potentiometer is connected with its full resistance directly across the high-impedance winding of T_1. The connection to V_1 through R_5 is then made to the wiper of the potentiometer. As to T_1 itself, many widely used audio-output transformers meet the requirements.

For those who prefer the soldering gun, or require safe control of temperature, the small cost at which this unit can be built will be quickly recovered in the prevention of possible damage to transistors and printed wiring. —30—

Citizens Band Frequency

(*Continued from page* 37)

incidental with the installation, servicing, or maintenance of a radio station, which may affect the proper operation of such station, shall be made by or under the immediate supervision and responsibility of a person holding a first or second-class commercial radio operator license. . . ."

Fortunately the current interpretation of the rules will allow oscillator adjustments to be made to a transmitter *providing a dummy antenna load is used*. Unless you have such a license never tune up the transmitter "on the air." Always use a dummy load, such as a #47 pilot lamp, or better yet, two 100-ohm, 2-watt resistors connected in parallel.

When servicing an off-frequency transmitter, first check the tuning of the oscillator plate coil. If the frequency is still "out" make sure the correct type of crystal is being used. A defective capacitor coupling the oscillator to the amplifier can also cause trouble. If everything seems to be normal, try a "known-to-be-good" crystal and again check the frequency. Another defect to be on guard against is the *drifting* crystal. During measurement tests, the author found a crystal that was "on the money" for approximately 45 seconds of each transmission. After three-quarters of a minute the frequency took off for the hills and wound up about 6 kc. *outside* the tolerance! Moral—always leave the transmitter on for at least three minutes during a frequency test.

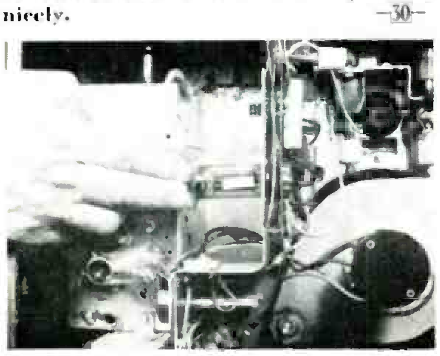
Weak or defective tubes can also cause off-frequency operation. A gassy tube has been known to pull the frequency about 2 kc. A weak tube will only pull the frequency a few hundred cycles, but should be changed "on general principles." Tube defects can also cause the frequency to drift. —30—

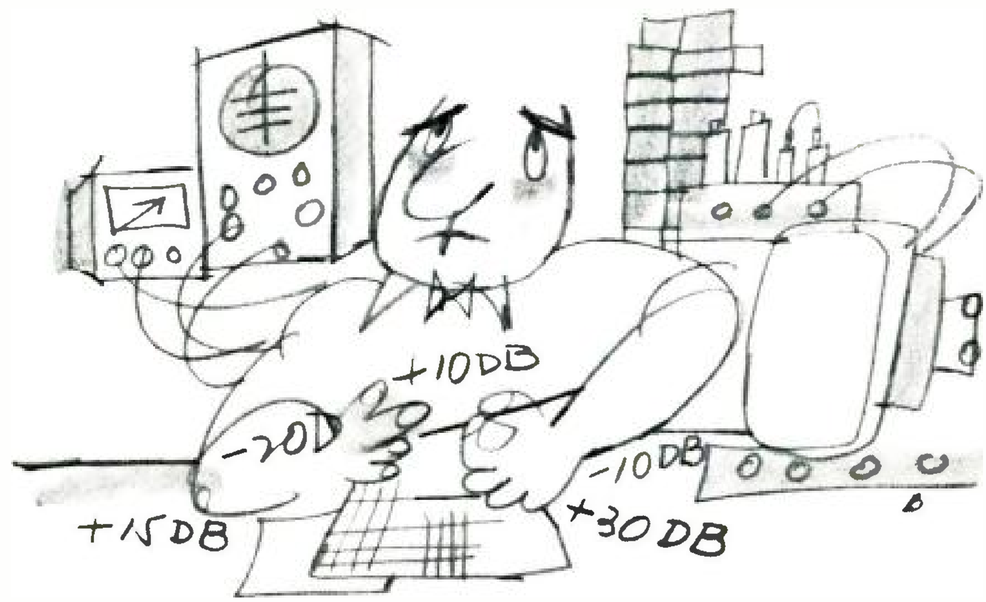
TUBE HELP

By ROBERT HERTZBERG

A SMALL strip of tape of any kind, positioned on a miniature tube to indicate the indexing space between pins 1 and 7 or 1 and 9, is of great help in getting the tube into its socket without mashing the pins. Leave it there; it might be useful again some other time.

Masking tape, friction tape, or even the end of a Band-Aid serve the purpose nicely. —30—





The Decibel Without Pain

By **BOB ELDRIDGE** / **Practical hints on understanding and using these strange units, by someone who actually likes them.**

BY NOW, we are all supposed to know that the decibel is a *ratio* between two quantities of power (or voltage, or current), not a quantity of power, voltage, or current itself. Thus we should not express any known electrical quantities as being simply "so many db"—unless we are in the advertising business. The copywriter may state, "Sudso is 20 per-cent faster" and get away with it before anyone asks, "Faster than what?" However, if a technician should state, "The power at this point is 30 db," someone will invariably want to know, "30 db above or below what?"

In other words, there must be a reference level.

Sometimes this level may be understood. In the telephone industry, for example, this reference is the input level to the switchboard from a subscriber line. Other levels throughout the system, expressed simply in db, are referred to this input, with the telephone engineer primarily concerned with the magnitude of the losses in the various portions of the path between the microphone of one telephone and the receiver of another.

He is also interested in the gain in db of each amplifier in the chain that will restore the losses: what goes down must be brought back up again if Mom in New York is to hear Johnny's plea from camp for just another few dollars. In the detailed engineering of the circuit, he also becomes interested in the actual rather than relative power present at various points in the path, but that is a matter for db's twin brother, dbm, of whom more will be heard later.

For the moment, let's consider only that the db is a ratio. An amplifier that produces 100 watts of output when 1 watt is fed into it is a 20-db amplifier. But so is another that produces 100 milliwatts out from 1 mw. in. From this comparison, we see that a 20-db amplifier is one that has a power gain of 100 times without regard to its actual power-handling capacity.

What About Logs?

The key to the whole db business, as many technicians unhappily acknowledge, is a working familiarity with logarithms. A great deal can be done in handling decibels without using logarithms, as will be noted later. However, those practical men who have been getting along without logs for years just don't realize what they are missing. Logs are very easy to use—they make multiplication and division less of a chore. In fact, logs literally *turn* multiplication *into* addition, and division into subtraction. This same great advantage is present in the use of db. Although a full discussion of the use of logs in general calculations will be avoided, it will be useful to review some facts concerning the logarithm to the base 10 before getting to the meat of the dog biscuits (db).

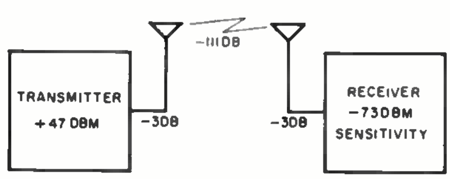
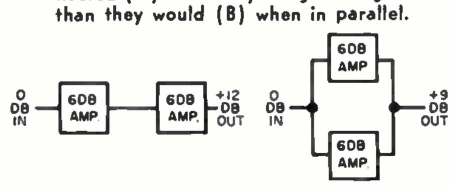


Fig. 1. Gains and losses in a transmission link are represented as shown to determine adequacy of signal level.

Fig. 2. Two identical amplifiers connected (A) in series yield greater gain than they would (B) when in parallel.



The logarithm of a number is the power to which 10 must be raised to obtain that number. 100 is 10 squared (10^2), or 10 to the power of 2. Therefore, the power to which 10 must be raised to make 100 is 2; so the log of 100 is 2. To take another example, 2 is 10 to the power of .3 (to be precise, .3010, but who wants to be precise at a time like this?). To find this value, or to convert a number to a log or the reverse, either a table of logarithms or a slide rule may be used.

To multiply several numbers together, we merely find their logs, add these together, and translate the new log thus obtained back to a number again. Thus, using the two logs we have already examined, let us multiply 100x100x100x2x2. With logarithms, this becomes 2+2+2+.3+.3, which quickly adds up to 6.6, the new logarithm. An antilog table or a slide rule tells us that the number of which is 6.6 is the logarithm is $4x10^6$, or 4,000,000.

Now for tying up logarithms with decibels—in formula: $db=10 \log P_1/P_2$.

"Which means?" as the straight man might say to his partner.

"A decibel is ten times the log of the ratio between two power levels."

"Why ten times?"

"Because the bel, the first unit for measuring the relative level between two sounds, was too large to handle; so they chopped it into ten parts and called each a decibel ($1/10$ bel)."

From the formula it is obvious that the db is logarithmic. In this fact lies many great advantages. Power ratios of millions to one can be expressed in simple numbers and vast products can be obtained by merely adding simple numbers together. If you think that this is rarely necessary, consider that a difference of only 60 db represents a power ratio of a million to one.

Table 1 shows some of the easily remembered and frequently used power ratios, expressed as numerical ratios and in equivalent db. With these figures, many complicated calculations can be reduced to mental arithmetic. For example, whenever a given power level is multiplied by 10, we add 10 db (or, when it is divided by 10, subtract 10 db). To double any power, add 3 db. Since quadrupling a power is doubling it twice, this comes to 6 db (3+3). Just by manipulating this table, many other ratios can be deduced. For example, to increase a power ratio 20 times, we must increase it 10 times (10 db) and then double it (3 db). Calculation will show that a power increase of 20 times is indeed a change of 10+3, or of 13 db.

Other examples: To obtain 5 times a power, we can find 10 times that power and then halve it. In db, this would be +10−3, or +7 db. To increase by 50 times, we could increase by 10 times (+10 db) and then by 5 times (+7 db). The answer would be +17 db. To find 25 times (half of 50 times), we know that +17−3=+14 db.

The Dbm

The standard test tone used in the telephone industry is a 1000-cps signal with a power of 1 milliwatt. Since this is a convenient reference level, the term dbm, meaning "db with reference to 1 milliwatt," is now in widespread use. Since there is a specific reference point (1 milliwatt is always zero dbm), any figure given in dbm is *not* a ratio. It is a definite quantity of power. Thus 1 watt (1000 mw.) can be written as +30 dbm; and 1 microwatt is −30 dbm.

The dbm is very useful in system calculations. For example, let us take an imaginary u.h.f. link that must be set up. We have the following: 1. a 50-watt transmitter, 2. a receiver that requires an input of 50 microvolts of signal for efficient operation, 3. antenna feeders and connectors that entail a loss of 3 db at each end, 4. a required safety margin of 20 db to allow for fading, and 5. attenuation of the signal in the air path between transmitter and receiver shown to be 111 db. We draw a block diagram, as in Fig. 1.

A 50-microvolt signal across the 50-ohm input impedance of our receiver tells us we need a power here of −73 dbm. This is another way of stating the receiver's sensitivity. The transmitter output, already given in watts, can be restated as +47 dbm. If we forget everything else (losses) in between transmitter and receiver, the *ratio* between the transmitter output and the power required at the receiver input is 120 db (not dbm). This is the *difference* between transmitter output and receiver input, which is +47−(−73).

This 120 db is called the system gain, and represents the maximum amount of attenuation that could be tolerated

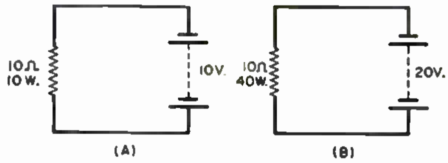


Fig. 3. Doubling voltage (B) applied across a circuit (A) also doubles current. Thus the power drop quadruples.

between transmitter and receiver without degrading performance. Now, on the debit side, we have: 3-db loss in the transmitter antenna feeder system, 111-db loss in the air path between these stations, and 3-db loss in the receiver antenna feeder system. These losses add up to −117 db.

Thus, if the antennas used show unity gain (such as conventional dipoles), the system will work with 3 db to spare. However, we are looking for a 20-db safety margin to allow for fading. We must therefore use antennas that will give us a total gain of 17 db. Antennas at each end with a gain of 8.5 db each will do the trick.

Now here is a point worth thinking about: If we left the unity-gain antenna at the transmitter and stacked two 8.5-db antennas at the receiver without losses, we would fall short of the gain requirement. We would get, not 17 db, but only 11.5 db! Let's consider this statement in a more familiar form—the case of the two amplifiers in Fig. 2. In series, with one amplifier *multiplying* the output of the other, the logarithmic increase is such that, expressed in db, we get twice the gain of one amplifier. In parallel (Fig. 2B), we only double the power. This (Table 1) is a gain of only 3 db over the use of one amplifier or antenna. In the case of the amplifiers, this could easily be measured.

To return to the dbm—it is so useful precisely because it indicates a definite power and yet can be manipulated in a logarithmic manner along with ordinary decibels. Transmitters, amplifiers, receivers, microphones, and loudspeakers can all be rated, as to sensitivity or output, in dbm, even though the impedance of each type of unit may be different. Other units similar to the dbm include dbw (referred to a level of 1 watt), dbk (in reference to a kilowatt), and dbx, a unit of crosstalk between two circuits. There are also others.

Voltage, Current Ratios

So far, we have talked about the ratio between two powers. The ratio between two voltages, or between two currents, can also be expressed in db, where these are the quantities that are known—but the formula is different. This stems from the fact that, when you relate a given power to the voltage or current that is involved with it, the relationship is not linear. There is always a square involved (power, in watts, is I^2R or E^2/R). Again, we look at the matter in practical terms, with the help of Fig. 3.

If we put a 10-ohm resistor across a 10-volt supply, 10 watts of power (Fig. 3A) will be dissipated in the resistor. If the voltage is doubled (Fig. 3B), the power in the resistor is not doubled—it is quadrupled. This is because, following the rule made public by Mr. Ohm, the current is doubled as well as the voltage.

This brings us to another principle in the use of logarithms: to square any number, multiply its log by 2, then find the antilog of this product. Since a square is involved when we go from a power to a voltage or a current, we go back to our old db formula (Ugh! There he goes again!) for power ratios and multiply the logarithm by 2. Thus, for converting two voltages to a db ratio, the formula is $db=20\ log\ E_1/E_2$. However, a db is a db. If you compare two specific signals, the respective powers will be different from the respective voltages, but the db ratio will always be the same.

The point may be further illustrated by reference to Table 2, where the db equivalents for many voltage ratios are given. If the voltage across a given load is doubled, there is an increase of 6 db. Note that doubling the voltage across the load will have quadrupled the power. Thus a 4-time increase in power (Table 1) is a gain of 6 db.

Reading a Db Meter

A word of caution is necessary when reading db directly on a meter. The latter is actually a voltmeter, not a power meter, and is therefore calibrated for readings across a specific impedance. For relative readings, this is not much of a problem. For instance, if one should start out with a reading of +5 db across any circuit, and this reading should change to +3 db during tests across the same impedance, the change will always be a difference of 2 db.

For reading dbm however, the impedance for which the meter was calibrated must be known. In most cases, this is "0 db—1 mw. in 600 ohms," usually printed on the meter face. However some older meters are calibrated to make zero db equal to 6 mw. in 500 ohms. In either case, this direct reading is obtained on one range,

POWER RATIO	DB	POWER RATIO	DB
One thousandth	−30	One eighth	−9
One hundredth	−20	One quarter	−6
One tenth	−10	One half	−3
Unity	0	Unity	0
Ten times	+10	Doubled	+3
One hundred times	+20	Quadrupled	+6
One thousand times	+30	Eight times	+9

Table 1. Common power ratios in db.

Table 2. Common voltage ratios in db.

VOLT. RATIO	DB	VOLT. RATIO	DB
One hundredth	−40	One fourth	−12
One tenth	−20	One half	−6
Unity	0	Unity	0
Ten times	+20	Doubled	+6
One hundred times	+40	Quadrupled	+12

and direct readings on other ranges are corrected by adding or subtracting so many db. as specified by the manufacturer, where separate db scales are not used.

If the impedance at which the db scales have been calibrated is in doubt, a check can be made against the voltage scales. For example, if .775 volt corresponds to zero db, the meter has been calibrated to the modern standard, and powers in a 600-ohm circuit can be read directly off the meter in dbm. Such readings can be made across other impedances too, simply by applying a correction factor. For example, let us suppose the meter is calibrated for 600 ohms. In reading across a 1200-ohm circuit, one would simply subtract 3 db from the scale reading to obtain the power in dbm. Across a 300-ohm circuit, add 3 db to the reading; across 150 ohms, add 6 db; and across 75 ohms, add 9 db. Correction factors can be worked out for any impedance.

The important thing is to start using db wherever possible, even when they are not needed. The familiarity thus acquired will simplify matters when db becomes essential. —30—

Mac's Service Shop

(Continued from page 66)

the shop and explain they were visiting relatives in town and had been forced into 'just looking' at a radio or TV set. They usually wanted to look at a diagram or to buy a resistor, capacitor, or tube. Invariably, I sold them the wanted item at cost, for I felt deep sympathy for them. The technician who has never been put in this spot while visiting has either not been a technician very long or has some peculiarly considerate relatives and friends. In this shop, we 'recognize the profession,' and we'll keep right on doing so as long as we're in business."

"How did you come out with the salty little radio?"

"Since it had already been out of commission several days, I suggested to the owner I bring it home with me to where I would have something to work with; but I was careful not to hold out much hope. Last night at home I gave it a good going over with carbon tetrachloride out on the cook-out table in the back yard where the breeze would carry off the poisonous fumes of the chemical—and I was darned careful not to get the stuff on my skin or in my eyes. With a toothbrush dipped in carbon tet, I scrubbed all the corrosion off the printed circuit wiring and the other metal parts. Then I squirted the chemical very liberally into the i.f. and oscillator cans with an eye-dropper. Contact cleaner was used on the volume control, the battery contacts, the earphone jack contacts, and the wiping contacts of the tuning capacitor. New batteries were installed, but the thing still wouldn't play. The oscillator in that little monster just would not take off.

"I suspected that the salt was shorting out the tuning capacitor; so this morning I removed the capacitor from the printed circuit board and measured the resistance between the stator sections and ground. In both instances, the resistance was only a few dozen ohms. I washed the tuning capacitor very thoroughly in warm, soapy water, squirted some more carbon tet between the plates, and then dried the capacitor under the heat lamp. I've just finished putting it back; so let's see what gives. The resistance between either set of stator plates and the frame of the capacitor is now infinite at any position of the rotor plates—which is as it should be."

As he said this, Mac turned on the receiver, and it instantly began to play with good volume and surprisingly good clarity.

"Well now! The patient is responding to treatment!" he said with a pleased grin as he tuned in several different stations. "Naturally I'll re-align all the tuned circuits and spray a new protective coating over the printed circuit. We'll keep the radio playing for a week or so and see if anything else shows up. If not, I'll send it back with a warning to the owner not to be surprised if trouble does pop up later. I hate to be so pessimistic, but I'm afraid it's next to impossible to get all the salt out of the thing; and a minute amount of that stuff will draw dampness and form a corrosive, short-circuiting solution that can put the set

Operating Mobile in Canada

By **J. E. KITCHIN** * / Inspector, Telecom. Canada

Here are the simple requirements to be met by the ham who wants to operate mobile across our northern border.

OPERATING mobile in Canada may include a flat tire on highway 999 and a picnic where the ants and mosquitoes win the battle, as well as a few other pleasantries, but it also must include a Canadian mobile permit.

Perhaps your own vacation plans aren't settled as yet but inquiries are received at Canadian Radio Inspection offices all year round and some of the points outlined here may assist you in case of projected visits to Canada. Inquiries range all the way from a telephone call from a harassed amateur at a border point with a car full of kilowatts to a QSL card from the "deep south" stating: "I am leaving tomorrow for Canada, please send me a Canadian license COD."

To start at the beginning, it is necessary to consider the agreement between the United States and Canada covering mobile radio, known as a "Reciprocal Agreement." This means that each country agrees to extend the privileges specified in the Agreement to the citizens of the other country. Reciprocal agreements also exist with regard to other things and, in general, if one country wishes to terminate such an agreement then, naturally, the other country withdraws the privileges extended to citizens of that country. The radio agreement which is now in force specifies in Article 2: "The respective countries agree that mobile radio stations properly licensed in one country are permitted to be operated in the territory of the other country (except that the provisions of this Article do not apply to ship or aircraft stations and are not intended to change or modify the terms of any agreements or treaties relating to such stations) subject to local operating conditions. . . ."

Note that only *mobiles* are specified so there is no use applying for a permit to operate a portable or a fixed station in Canada. A mobile station is defined in the International Convention Radio Regulations as: "A station in a mobile service intended to be used while in motion or during halts at unspecified points." Under Canadian regulations a licensed amateur may have his mobile station either in his car or his pleasure boat and Americans visiting Canada may possibly wish to take advantage of the "amateur maritime mobile" aspect. An amateur station on a pleasure boat is still an amateur station and not a "ship station" as such. With regard to automobiles, a much discussed point is whether or not an auto is a mobile vehicle or a fixed station while the car is on a ferry! So, if ferries are part of the highway system, as they usually are, the vehicle retains its status as a mobile and the fact that the wheels are not turning has no bearing on the matter because a mobile may be operated while stationary.

Telephone calls from border states sometimes ask an Inspector to mail a permit to a border crossing point "as I am leaving home now." This cannot be done as mobile permits are obtainable only from the Department of Transport in Ottawa, Ontario (for Americans), and from the Federal Communications Commission in Washington (for Canadians wishing to mobile in the U.S.A.). The proper procedure is for the amateur to plan at least a month ahead and write to Ottawa or Washington, as the case may be, and ask for a mobile permit card—FCC form 410-1, DOT form 2190. There is no charge for these permits so do not enclose postage stamps —which cannot be used in the other country anyway. The cards are in two parts, both of which must be filled out by the applicant and mailed back to the office from which the card was obtained. The following information is required: Name of licensee; home mailing address and also any semi-permanent address in the country for which the permit is requested; radio station license number and date of expiration; call sign (don't just put "ZZZ," use the prefix too!); authorized communication service (for this simply put "amateur"); proposed area of operation, and approximate dates you will be visiting the other country.

The two parts of the card are then mailed back to Ottawa or to Washington, as the case may be, where one part is retained on file. The other part is "validated" and returned to the applicant and constitutes his border crossing permit. Customs officers at the border may seal the equipment unless the permit is produced and if you haven't one you may be unable to talk your way out of it—either the gear may have to be unloaded or sealed, at the option of the Customs officials. Neither will your offer to "report to the nearest Radio Inspector's office" be accepted.

That's all there is to it. Mobile operation can be a lot of fun but, amateur radio being what it is, there are regulations and this is one of them if you intend to go mobile in the other country. And, speaking of regulations, don't forget that both the United States and Canada have their own separate regulations and they are not identical in all respects. Consequently, in accordance with the agreement which specifies "local operating conditions and regulations," you must observe the regulations of the country you are visiting as soon as you cross the border. This may entail a frequency change and it would be well to consider this before starting out. As a hint to American amateurs, you might ask for form AR-5-80 when writing to Ottawa for the permit card. This form outlines the Canadian frequency bands, permissible powers, and types of emissions as well as general operating conditions. However, the portion of the form dealing with "portable" operation applies only to Canadian stations in Canada and should otherwise be ignored. The Canadian amateur writing to the FCC for a permit will find it profitable to also write to the Superintendent of Documents, Government Printing Office, Washington, D. C., and ask for the FCC rules, part 12, governing the amateur radio service. The price is ten cents which should be sent either by money order or United States coin. Stamps are not acceptable.

One more point—about Certificates, which are called "Operator's Licenses" in the United States. It is required that a prospective visitor to Canada who wishes to operate amateur mobile shall have an operator qualification equal to Canadian, therefore holders of Novice and Technician licenses are not eligible for Canadian mobile permits. This is because the minimum Canadian amateur operator qualification calls for ten words per minute in code speed. The Novice and Technician class licenses are, of course, below this standard in the matter of code speed. Commercial companies may be interested in knowing the same agreement covers car radio telephones which work into a public carrier terminal but, in this case, the type of service will be "public carrier" and as operation is only on fixed phone frequencies no operator's certificate is required.

So happy holiday, much DX, and many QSO's and don't phone the RI from the Customs for a permit! —30—

* 309 Nizel Ave., Vancouver 10, B. C.

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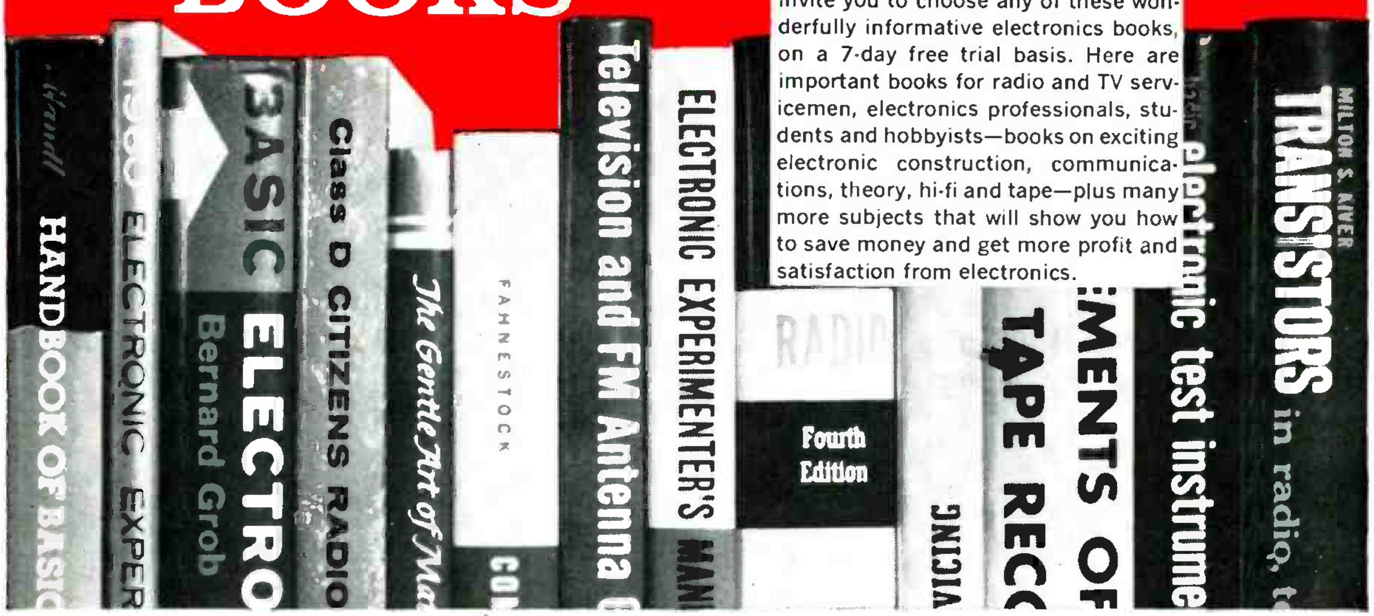

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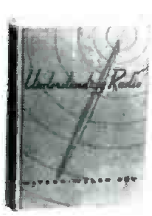

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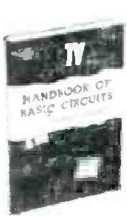

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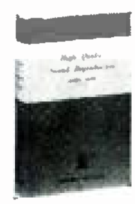

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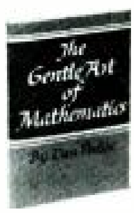

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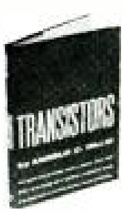

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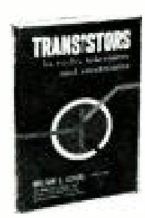

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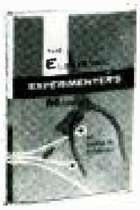

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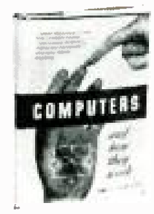

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Manufacturers' Literature

COIL DATA

The J. W. Miller Co., 5917 S. Main St., Los Angeles 3, Calif. is now issuing an 8-page publication entitled "The Coil Forum." Intended for the experimenter, the new house organ supplies timely information on circuits and theory as well as on how to select coils for various uses.

The first issue contains construction information on a transistorized FM receiver, including how-to-build-it data, and hints on testing and alignment. Copies of the new publication are available free at the company's distributors or direct from the manufacturer.

PRODUCT DATA

Schweber Electronics, 60 Herricks Rd., Mineola, New York has issued two 4-page brochures covering two electronic components.

The first is a buyers' and engineers' guide to *Advance Elgin* relays and provides detailed information on applications, performance, and specifications. The second brochure describes *Vitramon* capacitors. Included are details and illustrations of axial and axial-radial series as well as new micro-miniature types.

For copies of either or both of these brochures, write the company direct.

TRANSLATOR TV SYSTEMS

Trio Manufacturing Co., Griggsville, Ill. has issued an 8-page booklet entitled "Translator Television Systems", a guide to better TV reception in "shadowed" communities.

The booklet defines translator stations, discusses who can own and operate such stations, translator station advantages, costs, TV set requirements, comparative costs between translator systems and other methods of improving TV reception, the importance of a good antenna, and the application of an efficient u.h.f. converter. The text material is illustrated by line drawings.

Copies of this booklet are available without charge upon direct application to the company.

FILM RESISTORS

Daystrom, Inc., Weston Instruments Div., 614 Frelinghuysen Ave., Newark 12, N. J. has announced Bulletin 04-101-A, which gives technical data on the "Vamistor," a precision metal film resistor. This resistor is said to combine the best features of both wire-wound and film types and to meet every requirement where either type is specified.

DEALER DISPLAY

Saxton Products, Inc., 4320 Park Ave., N. Y., N. Y. announces the availability of a new display card to the trade, showing a complete line of u.h.f.-v.h.f. 300-ohm transmission wire. Samples of line are attached to the card, alongside a description. For information, contact the company.

TRANSISTOR HANDBOOK

Sylvania Electric Products Inc., P. O. Box 37, Buffalo 9, N. Y. has issued a handbook that contains construction information on 30 circuits using battery-powered transistors.

Included are high-frequency, audio, instrumentation, and entertainment equipment. According to the company, the transistors specified are low enough in cost to permit hobbyists to build the circuits at an average cost of $5.

Copies of the new handbook may be obtained at 50 cents a copy from company distributors or direct from the manufacturer.

PACKAGED CIRCUIT GUIDE

Centralab, Division of *Globe-Union Inc.*, 900 East Keefe Ave., Milwaukee 1, Wis. has published the sixth edition of its "PEC Packaged Circuit Guide." The 16-page booklet contains complete replacement data covering over 250 equipment brands and over 1400 replacement applications.

In addition to the data on packaged circuits in the line, the Guide includes a cross-reference chart showing the appropriate *Centralab* part number corresponding to units of other packaged circuit manufacturers.

Copies of the Guide are available free from distributors or direct from the manufacturer.

"STANCOR" COILS

Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill. has issued a new 28-page catalogue describing the complete line of *Stancor* coils. The book gives detailed electrical and physical specifications on over 600 units, as well as complete application information.

A special feature of the catalogue is the inclusion of 79 schematic diagrams covering every coil type in general use. Copies are available free at *Stancor* distributors or direct from the manufacturer.

SELENIUM RECTIFIERS

Radio Receptor Co., Inc., subsidiary of *General Instrument Corp.*, 240 Wythe Ave., Brooklyn 11, N. Y. has released a new catalogue, EL-316, covering all product lines of selenium diodes and rectifiers. The 8-page bulletin describes units that are designed to meet applications in the electronics, entertainment, and special products fields.

Included is technical data, circuit diagrams, and other information. For a copy, write to Dept. EL at the manufacturer's address.

TUBES AND TRANSISTORS

The Electron Tube Information Council, 554 Fifth Ave., New York 36, N. Y. has issued a fact book, "Tubes and Transistors: A Comparative Study." This 64-page treatise discusses the advantages and limitations of both components and is intended to assist manufacturers and design engineers in selecting one or the other in specific applications.

Formed in March 1959, the Council is composed of representatives of *CBS Electronics, General Electric, Radio Corporation of America, Raytheon, Sylvania, Tung-Sol Electric Inc.,* and *Westinghouse*.

According to the Council, copies of the fact book have been mailed to engineers, purchasing agents, and distributors.

TV XFORMER REPLACEMENTS

Chicago Standard Transformer Corporation, 3501 W. Addison St., Chicago 18, Ill. has published a new *Stancor* "Part-to-Part TV Transformer Replacement Guide." The 52-page, pocket-size volume contains a complete listing of all TV set manufacturers, their transformer part numbers, and the part numbers of *Stancor* equivalents. Also included are nine pages of descriptive data on the *Stancor* units mentioned.

Copies are available free from company distributors or by writing direct to the manufacturer.

TWIST-PRONG CAPACITORS

Cornell-Dubilier Electronics Division, South Plainfield, N. J. has made available a new edition of its "Television Twist-Prong Capacitor Replacement Guide." Listed in the 56-page guide are over 3500 original part numbers used by 100 TV set manufacturers. A *C-D* replacement part number is given for each listing.

The Guide also contains complete data covering *C-D* twist-prong and "Blue Beaver" tubular electrolytic capacitors. Copies of the Guide (CDE Bulletin TVR-7C) are available from dealers or direct from the manufacturer.

CAPACITOR DATA

Aerovox Corp., New Bedford, Mass. has issued a 4-page catalogue, No. 215/B2.-1, detailing technical and engineering information on "Aerotan" solid tantalum capacitors.

Included are curves, reference tables, and a listing of standard stock values in all capacitance and voltage combinations presently available. Copies may be had by writing direct to the manufacturer.

REPS ROSTER

Electronic Representative Association, 600 So. Michigan Ave., Chicago 5, Ill. has issued its Membership Roster which contains names and addresses of chapters of the Association, as well as an alphabetical listing of individual members.

U.S.-FOREIGN TUBE CHART

General Electric Co., Schenectady 5, N. Y. has issued a wall chart listing interchangeability information for American and foreign receiving tubes. The chart, No. ETR-1916B, is 11 inches wide and about 28 inches long. Approximately 300 American tube types, interchangeable with about 100 foreign types, are listed.

The chart is available through *G-E* distributors as an aid to service and maintenance technicians who may not have an exact replacement on hand when immediate service is required.

PILOT LIGHTS

Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y. has issued the "Dialco Handbook of Pilot Lights," a comprehensive manual to aid in the selection of the pilot lights to accommodate the required lamps. The handbook contains 256 pages, measures 8½ x 11 inches, is printed in two colors and bound in hard covers. Detailed text and life-size illustrations cover all aspects of this subject.

According to the company, the limited publication of this manual necessitates a review of prospective recipients. To apply for a copy, write to the manufacturer, attention: "Handbook Dept."

EIA 1960 FACT BOOK

The Electronic Industries Association, 1721 DeSales St. N.W., Washington 6, D. C. has published its "1960 Fact Book," copies of which have been mailed to about 350 member companies of the EIA. Individual copies may be obtained by sending 75 cents to the Association.

The book provides an annual statistical review of the industry, surveying in detail production and sales during 1959. The present edition is the sixth in the yearly series issued by the Marketing Data Department of EIA. New material, not included in earlier editions, covers important historical, technological, and market developments.

"TANTALYTIC" CAPACITORS

General Electric Co., Schenectady 5, N. Y. announces Bulletin GEA-7065, a four-page brochure describing this company's new lightweight, high-voltage "Tantalytic" capacitors for both 85°C and 125°C applications in computers, missiles, ground support equipment, and airborne electronic systems.

The bulletin gives mechanical and electrical specifications, performance characteristics, and curves for the new line. "Tantalytic" is a registered trademark of *General Electric*.

MILLER COIL GUIDES

J. W. Miller Co., 5917 S. Main St., Los Angeles, Calif. has published a new 176-page general catalogue and coil replacement guide. A consolidation of four catalogues in one, the book is divided into the following sections: general catalogue, listing nearly 1500 items; TV coil replacement guide, which cross-references TV set part numbers with corresponding *Miller* numbers; auto radio replacement guide; and home radio guide. —30—

TRANSISTOR MOUNT

By HOWARD S. PYLE

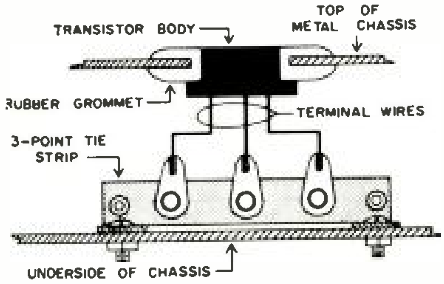
VARIOUS methods for mounting transistor types with circular body shapes, such as the G-E 2N107, Sylvania 2N68, and others, have been devised in both the commercial and amateur fields. The majority of such mountings have consisted merely of leading the three wires to a terminal strip and soldering them in place. "Forming" of the wires then provides a method of support, of sorts.

While such an arrangement does offer some measure of shock mounting by reason of the natural tendency of the wires to absorb any abrupt motion, such as might occur in mobile equipment, it is most unworkmanlike. With even slight vibration of equipment, one or more of the terminal wires soon breaks either at the tie-point or on the base of the transistor body itself.

The accompanying sketch illustrates a substantial, neat, and all-around satisfactory mounting for these little semiconductors. A simple rubber grommet of appropriate size, inserted in a suitably sized hole in the equipment chassis, makes an ideal mount and provides a good measure of protection to the body itself. Standard size grommets available at any radio parts distributor or amateur radio supply house, are a "natural" for such a cushion mount. Normally, with proper choice of grommet size, a snug fit will result between the body of the transistor and the standard grommets available. Should the occasional one be a bit on the loose side, a drop or two of clear fingernail lacquer placed in the seam between the transistor body and the grommet will effectively seal it. Such a seal is readily broken should occasion arise for replacement of the transistor.

A conventional "tie-point" should be mounted on the underside of the chassis and the three wires from the transistor soldered to it. Place the tie-point in close proximity to the transistor so that some slight slack will remain in the wires after connection. The usual precaution of holding each wire with pliers while soldering, to divert heat from the transistor body, should be observed.

This mounting can be used to support various types of crystal diodes as well, by proper choice of grommet size and by using a two-terminal tie-point. —30—



Electronics in Crime Detection

(*Continued from page 32*)

The electron microscope has been described in detail in the literature and its function as a crime-fighter is that of magnification. The *RCA* unit installed in the New York City Police Lab is capable of magnifying 50,000 times and is used frequently to observe crystalline structures, paint samples, cell structures, etc. One of the instruments which is also found in medical laboratories is the colorimeter. This device analyzes the colors of the unknown substance and is largely used for blood samples, narcotics, and the materials used to dilute the narcotics.

Among the portable clue-detecting devices which can be taken to the scene of the crime are the "black light," or ultraviolet lamp, and the x-ray machine. The latter is especially helpful in examining suspected packages and suitcases but is also used occasionally to detect loaded dice and other crooked gambling equipment. A "soft x-ray" machine is used in homicide cases where it shows the unburned powder particles in the wound and this permits a surprisingly accurate determination of the distance from which the shot was fired.

Needless to say, the men who operate the various equipment in the police lab are highly trained experts and, in difficult cases, consultants from various universities are called in to add their knowledge to the problem of combating crime.

Questioning

One of the questions most frequently asked of a suspect, especially in accident and traffic cases, is "how much have you had to drink?". Walking the chalk line at the station house is outmoded. Today's drunken-driver suspect merely breathes into a plastic tube and the alcoholic content of his breath is clearly shown and can be recorded.

The "Breathalyzer" shown in Fig. 6 depends on the discoloration due to alcohol's chemical reaction with potassium dichromate and the exact amount of discoloration is measured with a phototube. Because all of the test conditions such as temperature and actual discoloring are electronically regulated, the precision of this device is beyond question and the resultant answer in per-cent of alcohol is rarely challenged in court. Previous methods involved blood analysis which required the services of a physician or else the breath analysis was so inaccurate it was often thrown out as evidence. Electronics now pins down the degree of drunkenness beyond the shadow of an argument.

Many of our readers are aware of the device popularly known as the "lie detector." Actually there are a number of different polygraphs available and their application appears to be a science in itself.

Space does not permit us to describe polygraphs in detail, but basically all of these instruments measure one or more body characteristics. The galvanic skin response (G.S.R.) is the original electric "lie detection" criterion but blood pressure, breathing, and skin temperature changes are also important details which are recorded. In most polygraphs the changes in G.S.R. are amplified which drives the recording pen while the breathing and blood pressure are recorded through a bellows linkage on the other pens. The amplifier is usually a chopper-stabilized, high-gain circuit since it must amplify the small voltage variations due to changes in G.S.R. as the subject responds to questions. Skin temperature changes of as little as 1 degree F can be detected in some instruments by means of a thermistor and bridge circuit.

Fig. 5 shows one of the available portable units which records G.S.R., breathing, and blood pressure. It takes a lot of technical "know-how" to operate such equipment because good results can only be obtained if all of the characteristics are properly set up at the beginning. Each of the pens has to be balanced out since only changes are recorded and, in galvanic skin response, for example, different people have different basic skin characteristics.

The selection of questions and finally the interpretation of the polygraph results can only be handled by an expert.

In New York City the police department is not allowed to use polygraphs, but in many other locations this method is used on practically any suspect who claims innocence. The subject's full cooperation is required before any lie-detector can be used and in all cases, statements to that effect are obtained.

Private operators give polygraph tests, usually in cases of employees suspected of theft who protest their innocence and offer to undergo a lie-detector test. Studies are now under way to add electrocardiograms (heart-signal measurements) and encephalograph (brain-wave measurements) to the present polygraph characteristics to provide further clues to the subject's reactions to the questioning.

Electronics has brought the precision of scientific effort into many phases of crime detection. In the field of surveillance, electronics now permits law enforcement officers to locate the suspect's accomplices, record his criminal activities, and arrange for arrest at the critical moment. In narcotics cases especially, electronic equipment is a great help. This type of crime has grown in recent years but with the help of electronic surveillance equipment and the clue-analyzing devices in the police laboratory, convictions in narcotics violations have been more frequent. The drunken driver can now be pinned down to the exact degree of intoxication, thanks to electronics. Gambling and vice are fought with electronic devices, suspects are tested as to their veracity, and in many other phases of police work, electronics is lending the crime fighter a helping hand.

EDITOR'S NOTE: *The equipment described and discussed in this article is designed for use by law enforcement agencies and is not available to the general public. We would like to advise our readers that we do not have schematic diagrams and other technical details on this equipment. It is not intended to be duplicated by the layman.* —30—

IHFM COMMITTEE NAMED

THE Institute of High Fidelity Manufacturers has announced the formation of an Industry Promotion Committee, chairmanned by Arthur M. Gasman, Marketing Director of British Industries Corp.

The committee is made up of Thomas Dempsey, Reeves Soundcraft; Sidney Harman, Harman-Kardon, Inc.; Howard Harwood, Shure Bros.; Leon Knize, Stromberg-Carlson; H. L. Morris, Altec Lansing; and Lee Solomon, St. Regis Publishing Co.

According to the chairman, the committee will seek to inform the public of the advantages of component high-fidelity music reproduction in the home. The group hopes to develop means of identifying quality components made by IHFM members so that the public can know what it is buying. It will also undertake an over-all educational program to teach the consumer the finer points of hi-fi equipment. —30—

Radio Aids to Navigation

(*Continued from page* 59)

cluding VOR stations. Three VOR transmitters are shown: Point Reyes VOR (identified by the letters "PYE" on 113.7 mc.), Oakland VOR (OAK on 116.3 mc.), and San Francisco VOR (SFO on 111.8 mc.). Generally, VOR stations are located on the civil airways to allow VOR flight along the airways. Many stations are also strategically located off the airways in order to facilitate short range point-to-point travel and allow the taking of running fixes on the airways.

Suppose an airplane wishes to fly from the east along airway *RED* 60 to Oakland VOR. A magnetic heading of 240 degrees towards Oakland VOR from the east will place an airplane along the center radial of airway *RED* 60. The pilot tunes his VOR receiver to Oakland VOR at 116.3 mc. and sets the course selector dial to 240 degrees. When the "Left-Right" meter is centered and the "To-From" indicator shows "To," the pilot knows he is on the center of airway *RED* 60. However, this will be true irrespective of the aircraft's heading since VOR relays position along a radial from the station and does not indicate heading. Of course, if the plane's heading is away from the radial, the "Left-Right" needle will deflect as the plane leaves the radial. However, it is unnecessary for the aircraft to head aimlessly in the wrong direction since the course selector indicates the magnetic heading which corresponds to the VOR radial.

Thus the pilot will begin approaching Oakland VOR by flying a magnetic compass heading of 240 degrees. After a while, though, the "Left-Right" needle will begin to deflect to one side or the other. Why does the needle deflect if the proper magnetic heading was chosen? The most common cause is wind which is drifting the plane off the radial. When the pilot re-adjusts his heading to center the needle he is heading his airplane into the wind to correct for drift. Thus, VOR corrects for the pilot's biggest navigational problem, wind drift. ADF does not correct for drift since ADF cannot determine along *which* radial the aircraft is flying as VOR can. An aircraft approaching a station with ADF will fly a wide curve to the station as wind pushes the plane off course.

As with low-frequency navigation aids, navigation can be made considerably easier if several types of equipment are used simultaneously. Flying from Travis Range to Oakland VOR *via* airways *AMBER* 8 and *BLUE* 10 can be easily accomplished by an aircraft equipped with a VOR receiver and a radio-range or ADF receiver. The pilot can either home on Richmond beacon with his ADF or use the on-course signal from Travis Range to place him on airway *AMBER* 8.

The inbound radial to Oakland VOR along airway *BLUE* 10 corresponds to a magnetic heading of 133 degrees. Therefore, the pilot tunes his receiver to Oakland VOR and sets the course selector to 133 degrees, the final radial he wishes to fly on *BLUE* 10. As the aircraft flies along *AMBER* 8, the "Left-Right" meter will point to the right indicating that the 133 degree radial is farther to the South, and the "To-From" indicator will indicate "To." As the junction of the two airways is approached the "Left-Right" needle will start centering until it finally centers at the junction. At this point the pilot turns his plane inbound to a magnetic heading of 133 degrees and follows the VOR signal to Oakland VOR.

As can be seen, ADF and the radio ranges are good navigational aids in themselves, but when used with VOR they help make long-range navigation simplicity itself. Today most fliers rely on VOR as their primary navigational aid and supplement VOR with ADF and the ranges to provide fixes along the course which allows exact determination of position along this course.

Unfortunately, long-range navigation is only one of a pilot's many navigational problems. VOR, ADF, and the radio ranges will lead a pilot to his final destination, but they won't get the airplane on the ground. How does a pilot land his airplane when the visibility is less than two miles which is less than twice the length of many runways?

Next month we shall conclude this series by examining the various electronic systems designed to allow an aircraft to perform a safe instrument landing. *(Concluded next month)*

CALENDAR of EVENTS

AUGUST 15-26

Institute on Nondestructive Testing. Sponsored by Sacramento Chapter of the Society of Nondestructive Testing. Sacramento State College, Sacramento, Calif. Details from G. H. Beaumariage, Jr., Asst. Prof. of Engineering, % Sacramento State College, 5000 Jay St., Sacramento.

AUGUST 23-26

WESCON (Western Electronic Show and Convention). Sponsored by the Los Angeles and San Francisco Sections of the IRE, West Coast Electronic Manufacturers Association, and IRE Professional Groups. Ambassador Hotel and Memorial Sports Arena, Los Angeles. Technical sessions, field trips, exhibits. Show office at 1435 S. La Cienega Blvd., Los Angeles 35, Calif., for program details.

AUGUST 24-SEPTEMBER 3

British Radio and Television Exhibition, Earls Court, London. Special preview August 23rd for special guests.

Remodeling Your Shop?
(*Continued from page* 52)

ideas on how certain changes affected subsequent costs and methods of doing business.

Don't copy blindly. It's always a good idea, as just noted, to see what others in your field have done by way of modernization, but it's seldom a good idea to duplicate someone else's arrangement no matter how well it seems to be working out for him. Perhaps you can improve even on a good plan by avoiding a pitfall or two that it contains. Besides, no two shops are exactly alike; nor do any two owners do everything in exactly the same way. What is bringing exceptional success to someone else may flop dismally for you. If you are considering the adoption of unusual features someone else is using, discuss details thoroughly.

Do it all at once. To spread out the high cost, there is always the temptation to go about renovation one step at a time. Here are some of the problems you may run into: By the time you are through, total cost will have been greatly increased, perhaps doubled; your business may end up by being in an indefinite state of confusion and inefficiency, more so than it was under the conditions that prompted the remodeling; and you may never wind up with a carefully planned improvement over existing facilities.

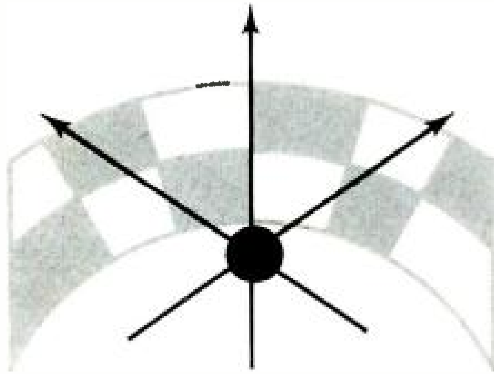
An effective plan, as mentioned, must be a total plan. If you work piecemeal, you will probably plan the same way. Don't try to rationalize this approach to the problem by saying that a partial job gives you a chance to test changes and see how they work out. You can't tell how a change fits into the finished plan until the pattern is complete.

Don't pinch pennies. You cannot plan sensibly if your exclusive yardstick is what the various portions of the plan cost. You will probably do better by waiting until you can afford what you know is necessary. The last few hundred dollars you spend may make the difference between a successful job and one that gives you marginal improvement. Settling for a good layout with a shoddy appearance, for example, can be reflected in your customers' estimates of your skills.

Don't delay. If you are convinced you can profit from the change, know exactly what you want, and can handle it financially, don't save money by putting it off "for another year." This is false economy. After all, the purpose in making changes is to provide increased profits and other benefits. You will be throwing away these benefits for another year, without any reduction in what the change will cost when you do make it.

Once your mind is made up, start to act on your plan. Don't sit around and let a worked-out scheme go stale. After a full evaluation of your situation is complete, don't vacillate. Go ahead, and good luck. —30—

Improving A. C. Voltmeter Accuracy



By

HOWARD Q. DUGUID

Non-linear meter-rectifier action can throw down-scale readings off considerably, but adjustment is possible.

MOST POPULAR voltmeters obtain a.c. readings by using a rectifier system to produce indication with a d.c. meter movement. Accuracy can become very questionable as the readings taken fall away from the full-scale point. This is due to the non-linear characteristics of the rectifier diodes used (Fig. 1A), for which the instrument manufacturer may not always compensate accurately. More will be said about this characteristic later. Our present concern is the fact that the meter owner can detect and correct this error himself.

A preliminary check of part-scale tracking can be made by measuring the same sine-wave voltage at the high end of one a.c. meter range and then again at the lower end of a higher range. A difference in reading indicates room for improvement.

Another check method is to shunt both the rectifier-type instrument and a moving-vane meter (or other type of known accuracy) across a variable voltage source and to compare accuracy. In fact, if it turns out that re-calibration of the rectifier-type unit is desirable, this set-up is the recommended one for the next step. An accurately calibrated, variable-voltage supply or other source of various known a.c. voltages can also be used as the reference.

Before adjustments of the rectifier system are considered, check full-scale readings on each a.c. range. If any of these are in error, range resistors in the voltage divider are probably off-value and must first be corrected. Once these values are known to be accurate, the entire instrument should be re-calibrated in accordance with the manufacturer's instructions. Although meter circuitry may vary from one instrument to another, the procedure is generally the same.

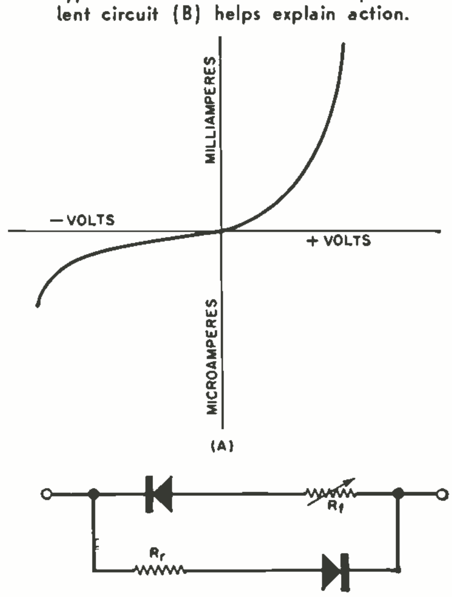
Four common circuit configurations for the a.c. function are shown in Fig. 2. They are (from *A* to *D*) the full bridge, the opposed half-bridge, the series half-bridge, and the half-wave. In each of these, typical re-calibration involves adjustment of meter resistor R_m for accurate full-scale reading on the highest range and of the series resistor in the divider, R_s, at full scale on the lowest range. If these full-scale adjustments cannot be achieved, it may be necessary to replace the rectifier diodes. This will be discussed later, as will the role of R_b (Figs. 2A and D), which is not generally found in these circuits.

The meter manufacturer, when he first drew up the a.c. scales, based them on a particular rectifier system, which includes other components in addition to the diodes. In production, however, small accumulated differences in components within the system may produce different behavior between one sample of a meter model and another. Correction of such deviation may be realized by adjusting resistors, in many cases, rather than the diodes.

Assuming that full-scale readings have been corrected, part-scale readings may now be checked. If these are either higher or lower than the desired accuracy as compared to the reference voltmeter, adjustment of the rectifier system is the next step.

Concerning the copper-oxide or germanium diodes used in meters, no two are exactly identical, but they will all exhibit electrical characteristics roughly similar to that shown in Fig. 1A. In

Fig. 1. Voltage-current curve (A) for typical semiconductor diode. Equivalent circuit (B) helps explain action.



the forward direction (+ volts), they will have little resistance and permit considerable current (in milliamperes) to flow. A voltage applied in the reverse direction (— volts) however, is opposed by high resistance, and a small current (in microamperes) will be passed.

A diode that is theoretically perfect would have no forward resistance and no reverse leakage (infinite reverse resistance). Thus it is possible to represent a practical diode by the equivalent circuit of Fig. 1B, in which two "perfect" diodes are combined as shown with two resistors. R_f, representing the forward resistance of the combination, is shown variable because it decreases as forward voltage and current are increased. Reverse or leakage resistance, which is very large, is shown fixed because it varies little over the range of applied voltages in the systems of Fig. 2.

At some very low applied a.c. voltage, R_f may be as large as R_r. The relationship between these two (R_r/R_f, sometimes known as the *ratio of rectification*) changes in operation. As voltage across a diode increases, forward resistance R_f decreases and the ratio of rectification increases. This is important because the reverse current through a diode offsets a portion of the forward current, and the magnitude of this effect has an influence on another characteristic of the system, the *rectification efficiency*, concerning which more will be said later.

Since the rectification ratio becomes lower and reduces the effective rectification efficiency as applied voltage is reduced, this efficiency will be progressively lower at part-scale voltmeter readings than at full scale. It is this *change* in rectification efficiency across the scale, rather than the fact of rectification efficiency itself, that affects scale linearity. Correcting scale tracking, in practice, involves starting with a relatively high rectification efficiency and adjusting it downward until the *rate of change* of efficiency corresponds with calibration of the meter scales.

Commonly all ranges of a rectifier-type a.c. voltmeter except the lowest follow a single scale, with a separate scale provided for the lowest range. The latter is necessary because, on the lowest a.c. range, the change in forward resistance R_f of the diodes is large compared to the ohmic value of the single, relatively small range resistor (R_s in Fig. 2). The combination of this effect with the progressive loss of rectification efficiency as readings proceed down-scale will result in considerable compression of readings at the lower end of this range. On higher ranges, the total series resistance of the voltage divider is great enough so that the change in forward resistance with respect to this divider resistance has little effect on scale linearity. Hence the non-linearity is less severe, being caused only by the manner in which the changing ratio of rectification influences the efficiency.

For a diode, the rectification efficiency may be defined as the relationship between the direct (average) output current and the alternating (r.m.s) input current. Since the average value of a sine wave is .636 of peak value, and the r.m.s. value is .707 of peak, the highest efficiency obtainable with theoretically perfect diodes is 90 per-cent (.636/.707). The efficiency of an entire rectifying system, including the meter movement, is less than this because not all of the rectifier output current goes through the movement, some being shunted around it.

The over-all efficiency for a system including the meter, at full-scale reading, can be determined by comparing the d.c. sensitivity rating in ohms-per-volt with the rating for a.c. In a unit rated at 20,000 ohms/volt d.c. and 10,000 ohms/volt a.c., this efficiency would be 50 per-cent. If the a.c. rating is 5000 ohms/volt, efficiency at full scale is 25 per-cent. Shunting the meter movement would increase the efficiency required of the rectifier section alone, or decrease the efficiency of the entire system including the movement.

Considering efficiency of the rectifying systems alone of Fig. 2, with perfect diodes, the maximum possible efficiency for the full-wave bridge of Fig. 2A would be 90 per-cent. In the next two systems, bridges are used in which resistors take the place of diodes. Maximum theoretical efficiency would be 72 per-cent for *B* and 45 per-cent for *C*. All arrangements shown load the a.c. source equally on both halves of the sine wave, but arrangement *D* is called a half-wave configuration because only one half of the total rectified current, from one diode, passes through the meter movement. Maximum full-scale efficiency is 45 per-cent for this circuit.

Concerning adjustment of these circuits, Fig. 2A does not generally include the resistor identified as R_b. If part-scale readings happen to fall too far down scale, the progressive change in efficiency with lower readings is too great. If R_b is indeed present, its resistance can be increased to correct down-scale readings. If it is already at maximum or is not present, the bridge of diodes, D_1 through D_4 must be replaced. A smaller rectifier bridge, working at a higher current density, will show less of a change in efficiency as current through it is reduced. Such a change may now shift the part-scale readings too far up the scale, but now it is simple to proceed as though these readings were too high to begin with.

If part-scale readings are too far up scale, the setting of R_b, if originally present, is reduced. If it is not there, it is a simple matter to insert such a resistance to bypass the bridge. This will make it necessary to increase the ohmic value of R_m and also re-adjust R_s for correct full-scale readings. Back-and-forth adjustment of R_m and R_s for proper full-scale reading and R_b for proper part-scale tracking are then performed for highest accuracy.

In Fig. 2B, two equal resistors, R_3 and R_4, replace diodes D_3 and D_4. If part-scale readings are too high, decrease the values of R_3 and R_4, keeping them equal, and increase R_m. If readings are too low, increase these two resistors. If this does not correct the error, it will be necessary to replace the two diodes. In extreme cases, it is possible to replace the opposed half-bridge with a full bridge. This provides a higher basic efficiency that permits more range of adjustment. A change in the value of any resistor requires to be increased in a series arrangement but decreased in a shunt arrangement.

In Fig. 2D, one half-wave of the rectified a.c. passes through diode D_1 and meter movement *M*. The other half-wave bypasses the movement through D_2. To correct tracking, R_b, not usually present, may be added. As shown across D_1, R_b reduces efficiency because it permits part of the unrectified a.c. to flow through *M*. This is equivalent to reducing the ratio of rectification by reducing the diode's reverse resistance (increasing leakage). If an increase in efficiency is needed, R_b can be shunted across D_2.

Variable resistors or calibrated substitution boxes can be used for experimenting with resistance values. Fixed resistors of the values chosen can then be used permanently. However, some voltmeters simplify the problem by making R_m or R_s, or both, adjustable.

If there are two a.c. scales (one for the lowest range), it may be necessary to favor the scale for the upper ranges in obtaining best part-scale tracking. In any case, it may be possible to obtain excellent tracking for all of the scale except the lowest portion of about

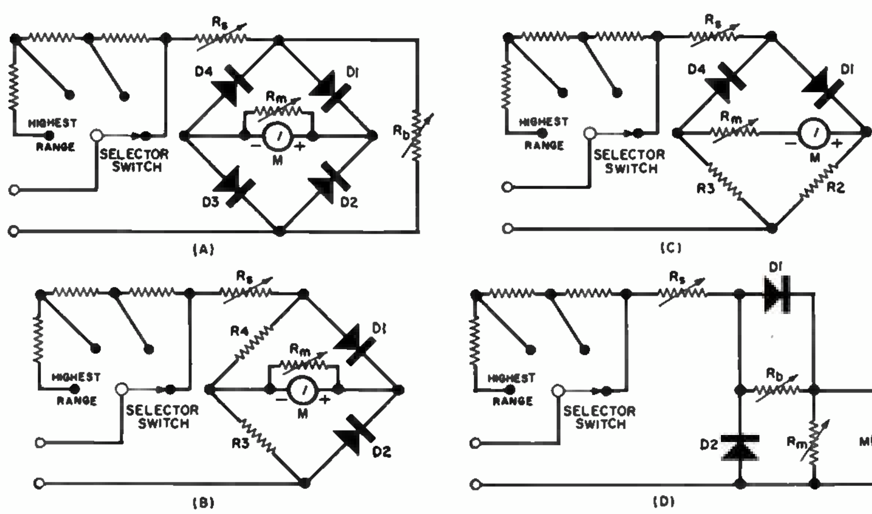


Fig. 2. Common meter rectifier systems include (A) the full bridge, (B) the opposed half-bridge, (C) the series half-bridge, and (D) the half-wave.

re-calibration at full-scale, of course, using R_m and R_s.

The series half-bridge of Fig. 2C, replacing diodes D_2 and D_3 with resistors R_2 and R_3 also involves changes in the values of the two resistors to correct part-scale tracking, with a compensating adjustment of R_m and R_s at full scale. Again, if part-scale readings remain too low, the diodes themselves can be replaced. As in the preceding circuit, the highest initial efficiency can be obtained by removing the two resistors and using four diodes in a full bridge rectifier.

The fact that R_m is in series with meter movement *M* in Fig. 2C, rather than across it, is worth a note. In either case, R_m is used to adjust current through *M*. When a decrease in meter current is desired (as in offsetting high rectifier efficiency for full-scale accuracy), resistance of R_m would have 5 or 10 per-cent. Actually, it is not wise to use this lowest portion for a.c. measurements, as irregularities in the characteristics of the diodes used show up in this area of operation. Wherever possible, use the next lower range. Replacement rectifiers, where they are necessary, should be obtained from the original manufacturer for best results. Although the rectifiers that require replacement may have strayed from their original characteristics, the fresh ones should be close enough to the ones used for the manufacturer's initial calibration so that minimum revision will be needed.

The adjustments described here are time-consuming and painstaking. However, they can bring accuracy at least up to the manufacturer's claim, and perhaps improve on it. If this accuracy is considered important, the effort is worthwhile. —30—

New Tube Tester Data

Supplementary settings for owners of Sylvania tube testers to help keep roll charts up to date.

SYLVANIA MODELS 139 AND 140

TYPE	A	B	C	D	E	F	G	TEST
1DN5	1.4	2	4	48	1	016	49	T
	1.4	2	4	48	7	—	55	T
1J3	1.4	0	2457	0	8	—	69	V
2EA5	2.5	0	2	0	4	36	25	W
2EN5	2.0	0	—	0	1	—	41	T
	2.0	0	—	0	3	—	41	T
3EA5	3.3	0	2	0	4	36	22	W
4DE6	5.0	0	—	0	4	36	22	V
5CR8	5.0	0	9	0	3	35	37	V
	5.0	0	6	0	1	5	32	X
5EA8	5.0	0	—	0	3	36	40	V
	5.0	0	—	0	1	5	22	X
5EH8	5.0	0	4	0	5	3	23	X
	5.0	0	4	0	4	79	85	T
5FV8	5.0	0	—	0	2	2	24	X
	5.0	0	—	0	3	57	40	V
6AF3	6.3	0	3	0	4	—	18	Y
6CA5	6.3	0	5	0	3	26	20	X
	6.3	0	2	0	3	56	20	X
6CY7	6.3	0	3	0	1	6	16	W
	6.3	0	3	0	3	7	64	W
6DE4	6.3	0	7	1	3	—	18	Y
6DN7	6.3	0	678	1	7	5	50	Y
	6.3	0	278	1	3	3	80	W
6DR7	6.3	0	6	0	1	3	29	U
	6.3	0	3	0	1	6	29	U
	6.3	0	3	0	3	7	45	T
6DT5	6.3	0	4	0	4	026	25	Y
	6.3	0	6	0	4	024	25	Y
6DT8	6.3	0	—	0	1	3	24	W
	6.3	0	—	0	3	7	24	W
6DW5	6.3	0	4	0	4	026	20	Y
	6.3	0	6	0	4	024	20	Y
6EA5	6.3	0	2	0	4	36	22	W
6EA8	6.3	0	—	0	3	36	38	V
	6.3	0	—	0	1	5	32	U
6EB5	6.3	0	—	0	1	—	49	T
	6.3	0	—	0	3	—	49	T
6EH8	6.3	0	4	0	5	3	23	X
	6.3	0	4	0	4	79	29	V
6ER5	6.3	0	4	0	4	2	29	X
	6.3	0	3	0	4	2	29	X
6ES5	6.3	0	4	0	4	2	27	X
	6.3	0	3	0	4	2	27	X
6FV6	6.3	0	—	0	4	36	26	X
6FV8	6.3	0	—	0	2	2	24	X
	6.3	0	—	0	3	57	40	V
8BQ5/X684	7.5	0	2	0	6	35	23	Y
8EB8	7.5	0	—	0	4	79	35	Y
	7.5	0	—	0	5	3	47	T

Transistorized Mike Mixer

(Continued from page 38)

The chassis base used as the cabinet was engine-turned to provide a professional look. This was accomplished by mounting a piece of sandpaper on a rubber washer (1½" diameter) glued to a short length of ¼" shaft from an old volume control. This will fit the chuck on a ¼" hand drill. Experiment with a scrap of aluminum before working on the chassis itself.

If the preamp is to be used primarily for speech, C_1, C_6, C_{10}, and C_{11} may be omitted entirely. For music these capacitors may range in value from 10 to 50 μf., 6 volts. The actual value selected will depend on the mikes used and the amount of bass emphasis desired. The preamp, as can be seen from Fig. 1, consists of four identical circuits.

This circuit is designed for use with low-impedance dynamic mikes exclusively. If crystal microphones are to be used, they could be coupled through an input transformer. The output level of high-gain crystal mikes will, however, overload this preamp circuit on loud signal peaks and produce distortion.

The output can feed directly into the mike input on an average p.a. amplifier or into a matching transformer. The signal will feed into a line or directly to the p.a. amplifier. Gain may be varied by adjusting R_1, R_6, R_{11}, and R_{16}. Some noise can be expected in the output if the pots are moved during programming so these controls should be pre-set to the desired level and then left alone.

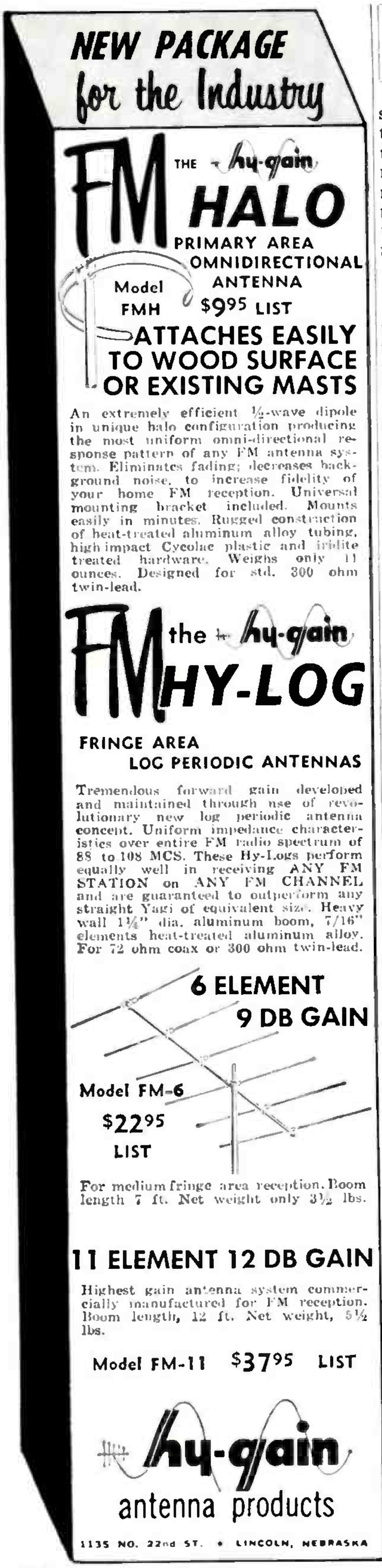
Switches S_1, S_2, S_3, and S_4 may be used to turn off the stages not being used. These switches should not be flipped during the program however because of the noise that would be introduced into the system.

The preamp is very quiet even with all four stages in operation. Operation is hum-free, of course. Current drain is low enough so that the penlite cells have excellent life characteristics even with continuous use although the batteries should be checked and replaced before the end of their expected life.

When wiring the preamp, it is important to observe correct polarity of batteries, transistors, and electrolytic capacitors. Failure to observe proper polarity will result in ruined parts.

For those who have access to a stock of the 2N133A transistors, it is recommended that they be matched for gain. While present production of these transistors runs quite uniform in quality, there is an occasional one not quite up to specs.

This amplifier/mixer has been used for three years without trouble. During that time it has been necessary to replace one transistor. No other trouble or expense has been incurred except for replacement of the batteries. All in all, the unit has proven a worthwhile addition to the author's stock of commercial sound equipment. —30—



Record Live Stereo at Home

(Continued from page 35)

speakers are spaced, but the amount of the spacing will depend on the acoustics of the room. If you have a large room, the only reliable way to determine the recording and playback arrangement is to try different combinations of microphone and speaker placement.

Phasing

If you use a double-element mike with its own recorder or any of the matched pairs with any recorder built to record stereo, you don't need to worry about phasing. In all other cases it is well to check phasing because wrong phasing can spoil stereo completely.

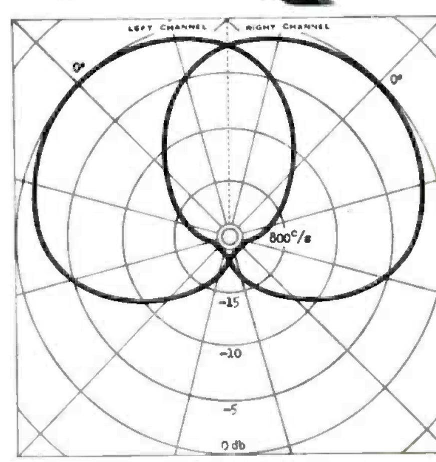
Microphones of the same type should be connected identically but there is no guarantee of this. If they differ, you'll encounter the problem of your system being phased correctly for playing back pre-recorded tapes but wrong for your home recordings. If possible, switch the mike connections (up at the microphone head) so they conform and the whole system is consistent so far as phase is concerned.

If you have to check phasing, the easiest way is to pick a spot representing center-front of your microphone set-up and make a length of test tape with speech. Play it back and stand mid-way between the speakers (Fig. 6) and listen. Correctly phased, and with the balance control properly adjusted, the sound should come from a spot mid-way between the units. Incorrectly phased, the correct setting of the balance control results in confusion of sound—no definite location at all.

If you are uncertain about phasing, try such a piece played back, reversing the connections to one of the speakers. You will soon know which way is right. If your system has a reversing switch, the simplest thing may be to note which is the correct position of this switch for everything you have to play. Without this refinement (and often with it, too), the best thing is to alter the mikes, if necessary, so their phasing is consistent with pre-recorded material.

By exercising a little care in setting things up, you'll get some real surprises at the uncanny realism of such home-recorded stereo tapes. It is a fact that recordings played back in the same room in which they were recorded display a realism superior to anything you have ever heard. —30—

The Norelco stereo microphone is shown here with its dual cardioid response.



HAM RADIO IN RUSSIA / By JOSEPH ZELLE, W8FAZ

According to the "Soviet Union," a picture magazine published in Moscow, there are several hundred thousand radio amateurs who belong to radio clubs in the USSR. They use International Morse Code to establish contacts all over the world.

In 1958 alone, for example, over 854,000 QSL cards were received by Russian hams. Best DX contacts were with radio amateurs in New Zealand, Australia, and Antarctica. Top DX honors for 1958 went to UB5WF, Vladimir Ghoncharskey, member of the Lvov Radio Club.

Radio amateurs in the Soviet Union are allowed a maximum of 200 watts operating power. The amateur bands are as follows: 3.5-3.65 mc.; 7.0-7.1 mc.; 14.0-14.35 mc.; 21.0-21.45 mc.; 28.0-29.7 mc.; 144-146 mc.; and 420-435 mc.

In the 28-mc. band, stations of the III category are allowed 10 watts, II category, 40 watts, and in the I category 50 watts of power. Only 5 watts is permissible in the 420-mc. band. These powers apply to beginners who are also allowed to operate in the 7.0 to 7.1 mc. band.

All the radio clubs of the USSR are affiliated with the Central Radio Club, the address of which is P.O. Box 88, Main Post Office, Moscow. All QSL's and communications with Russian hams should be sent to the Central Radio Club for distribution in the USSR.

The table below lists the Amateur Band frequencies and the types of transmission permitted on each band. This information was obtained from "Radio," the official organ of ham radio in the USSR. —30—

FREQ. (kc.)	TRANSMISSION
3500-3650	Telegraphy, telephony
7000-7100	Telegraphy, telephony
14,000-14,100	Telegraphy
14,100-14,300	Telephony
14,300-14,350	SSB telephony
21,000-21,150	Telegraphy
21,150-21,350	Telephony
21,350-21,450	SSB telephony
28,000-28,200	Telegraphy
28,200-28,500	Telephony
28,500-29,700	SSB telephony
144,000-146,000	Telegraphy, telephony
420,000-435,000	Telegraphy, telephony

Servicing CB Equipment
(Continued from page 41)

just by expecting too much of a 5-watt transmitter. If the trouble is in the equipment, look for off-frequency transmitter or receiver crystals. If there is noise, the receiver is probably fairly sensitive, but perhaps not at exactly the right frequency. Or, if the antenna systems, at either or both ends of the radio circuit, are not effective enough, the signal may be too weak to override the noise. In a vehicle, ignition noise is a major problem and the proper installation of suppressors and bonding is important.

The second most common complaint is "I can't talk far enough." Under some circumstances, one mile is all the customer can cover. Fortunately, the typical range is from 3-5 miles and, under favorable conditions, it can be even more. It is the antenna system, more than anything else, that determines range. There is generally not a great deal of difference in the performance capabilities of the various CB transmitters.

Co-channel as well as adjacent-channel interference can sometimes be reduced in intensity or even eliminated through the use of directional antennas. Adjacent-channel interference, however, is generally caused by inadequate receiver selectivity but, because of the low power, it seldom occurs except when caused by stations in very close proximity to the offended receiver. A possible cure, short of selling the customer a more selective receiver, is to try a directional antenna oriented to minimize pick-up from the offending station. Crosstalk from stations on various other frequencies is sometimes caused by more complex factors, such as intermodulation.

Getting Started

Technical information is available from most of the many manufacturers of CB equipment, who are dependent on service dealers for their own success. Unless customers are kept satisfied, future sales will suffer. Nearly all manufacturers publish comprehensive service manuals and make them available.

Information about test equipment is also available from instrument manufacturers. Some of the specialized instruments needed for servicing CB equipment are not available from parts jobbers and may have to be obtained direct from the factory or through the manufacturer's rep.

The most important information required at the outset is a copy of FCC Rules and Regulations, part 19, governing the Citizens Radio Service. You can get a copy of volume VI, FCC Rules and Regulations, which contains part 19, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for $1.25. At that price, you can't afford to be without it.

—30—

By
BERT WHYTE

CERTIFIED RECORD REVUE

EVERY August presents the same problem . . . what can one report on in the lull before the September and October hi-fi storms? This season there are less rumors than usual, and what things one does hear are more concerned with tape developments than disc. Indeed, there is much talk about "where do we go from here" regarding discs. Some take a defeatist attitude that the disc has just about run its course of utility. Others are hoping for some genius to come up with a truly compatible stereo disc, playable with monaural pickups. The so-called "compatible" discs now on the market have been rejected by the vast majority of engineers as "neither good stereo nor good monophonic."

Actually there are many avenues of improvement on the stereo disc which can be followed, for example, the development of a record pressing material which will possess the properties of being completely anti-static, have less plasticity which would permit wider frequency response and higher recorded levels and at the same time have a wear factor in excess of present materials. I have heard some trial cuts on a similar new material and the results were quite successful, although it is too early to draw any hard and fast conclusions.

Finally, even though it may smack of the impossible . . . some preliminary work has been done on the production of a true *three-channel* stereo *disc*. Thus far, no obstacle to this goal appears to be insurmountable by proper application of known techniques or new techniques if certain practical situations and costs can be controlled.

TCHAIKOVSKY
SUITE FROM SWAN LAKE
SUITE FROM SLEEPING BEAUTY
POLONAISE (Eugen Onegin)
Sinfonie Orkester der Nationalen Philharmonie Warschau conducted by Stanislaw Wislocki. Deutsche Grammophon Stereo 136036. Price $5.98.

This is one of the first new releases from *Deutsche Grammophon*, in which the records are manufactured, pressed, and packaged in Germany. This policy is to be followed in all future *Deutsche Grammophon* records, which will, however, be released as usual through American *Decca*.

Let us take a look at and a listen to these imported recordings. Point one is laudable enough . . . the record is factory sealed in a sort of vinyl plastic that completely protects against dust, etc. Point two . . . not so good . . . the record jacket is rather flimsy, being constructed of a thin cardboard that bends far too easily. Point three . . . the record itself is thicker than most others and is superbly finished.

Now, from the listening viewpoint, there is bound to be some controversy with all *Deutsche Grammophon* records. For one thing their recording philosophy is quite different from that generally espoused in America. They strive more for an actual re-creation of concert hall effects by use of more distant pickups and by the use of longer or more spacious reverb times. Thus detail is rather less than one expects in American recordings. Then they use the M/S stereo recording technique exclusively. This, as you know, affords a very fine middle but somewhat at the expense of left and right stereo directionality. On the credit side, they achieve a superb sense of depth in their recordings.

Of course there are variances between records and many times the type of scoring will dictate a different approach. One quality they have which is absolutely marvelous is their surfaces. These are positively the smoothest, quietest, most "tick" and "pop" free I have ever heard and would that other companies' products were this quiet! Now as to this particular record . . . I have heard from several people whose opinions I value very highly that the Warsaw Philharmonic is one of the finest orchestras in Europe today. This would seem to be borne out in the exemplary playing on this record, particularly in precision of ensemble. I know very little about the conductor, Wislocki, but in these Tchaikovsky works he acquits himself well without achieving any real distinction.

Soundwise this is the broad type of pickup, a pleasant sound, but not as crisp and sparkling as we are accustomed to expect. The bass end was a mite heavy and the top end somewhat restricted. Dynamics were reasonably broad. The M/S stereo here was predominantly middle with directionality, even with the first and second violins difficult to pinpoint. As noted (and it is an enhancement that can make up for a lot of deficiencies) the surfaces were dead quiet.

MOZART
PIANO CONCERTO #20 (K. 466)
Sviatoslav Richter, pianist with Sinfonie Orkester der Nationalen Philharmonie Warschau conducted by Stanislaw Wislocki.

PROKOFIEV
PIANO CONCERTO #5
As above with Witold Rowicki as conductor. Deutsche Grammaphon Stereo 138075. Price $5.98.

Whew! It is titles like this that make a reviewer's life tough. You must admit that is quite a mouthful to say, let alone write. Richter is acknowledged a master pianist by most responsible critics yet oddly enough his reputation is founded entirely on his recordings. This is truly a formidable talent and nowhere is this more in evidence than in his imposing performance of the Prokofiev "5th Concerto." While not as well known as the 2nd or 3rd, its craggy nature and atonalities offer a challenge to the abilities of any pianist and it is immediately apparent from the very opening that Richter is fully in charge. His tone is rock-steady, his phrasing and dynamics are broadly expressive and all other elements of his technique are extremely facile and well thought out.

In the Mozart, the playing is of the same high order, but is just a shade too introspective and intellectual and would benefit from more expressive warmth.

As to sound, this is a fine example of *Deutsche Grammophon* at work . . . the Mozart has the more typical concert hall sound, but faced with an entirely different type of scoring, the Prokofiev is recorded much closer, and the M/S stereo modified so that we have a beautifully clean recording, well detailed, yet with enough reverb to soften the harder contours. Directionality is much more pronounced here and, in general, this is the type of stereo recording that will appeal to American tastes. Now couple this fine clean recording with the fabulous *D-G* surfaces and the result is better than many tapes!

BEETHOVEN
PIANO CONCERTO #3
("Emperor")
Wilhelm Backhaus, pianist with Vienna Philharmonic conducted by Hans Schmidt-Isserstedt. London Stereo CS-6156. Price $5.95.

Joy and Hallelujah! Here is a recording of an old standard warhorse which pleases at once from every aspect. The performance is in the grand old tradition and Backhaus thunders his way through the score with serene conviction and confidence in his approach. The excitement he generates is electric, one is caught up in the swirl and flow of the music and carried along to the triumphant finale.

The stereo sound is magnificent and is the sort which secured *London* its reputation. I have said on a number of occasions recently that *London* seemed to have gone to a new recording technique, and one which I did not think as good as the old. I do not know when this was made . . . possibly before the change to the new technique and they have been holding it. However if this is fairly new and betokens a return to the older techniques . . . I say it is time to rejoice.

Even if you own three versions of this work, be sure to hear this one. It is a real winner!

BEETHOVEN
SYMPHONY #6 ("Pastorale")
PROMETHEUS OVERTURE
L'Orchestre de las Suisse Romande conducted by Ernest Ansermet. London Stereo CS6160. Price $5.95.

When *London* first gave Ansermet some Beethoven to record, many people raised their eyebrows. But Ansermet fooled them by turning in some fine performances, notably the Beethoven 1st and 8th.

Alas, lightning did not strike twice in the same place, for in this "Pastorale" Ansermet is too intellectual and detached and never affords the piece the warm lyricism of a Bruno Walter. Less attention to dotting all the "i's" and crossing all the "t's" would have helped.

But if performance values are not overly important to you, you can find here just about the finest stereo "Pastorale" yet issued. It flows with a lovely clean line and with such felicitous acoustics that one is quite captivated. And the storm here really does storm, with splendidly robust percussion, strings, and brass. Add all the stereo virtues reproduced in just the right balance and you have a great sound. Now if we could just get a performance to match the sound . . . Oh, well! —30—

Sound on Tape

By BERT WHYTE

As you know, I have been complaining that although four-track stereo tape seems well on the way to becoming the standard tape playback medium, comparatively little classical material was being released in this format. I've also complained that what has been issued has been difficult to obtain . . . that four-track production evidently was inadequate.

Now I'm happy to report that the situation has changed for the better. Classical material has been announced by *London*, *Decca*, *Capitol*, and now *Victor* is back in the reel-to-reel tape business with important classical issues. But best of all, four-track production seems to have overcome its initial inertia and tapes are beginning to arrive with something of the regularity and quantity that marked the heyday of the old two-track stereo. So I'll cautiously predict that from here on, there should be tapes to review!

I have been doing a great deal of traveling by boat in the last two years and on making the acquaintance of many of the officers and crewmen, found that they constitute one of the most rabidly enthusiastic groups of "tape fanciers" I've ever encountered. On the super-fast "S.S. United States," there are over 35 crew members with seagoing stereo . . . ranging from the more common popular-priced units all the way to *Ampex* 350-2! On a recent trip to Puerto Rico, on a much smaller boat, I found that over 20 per-cent of the crew had stereo tape outfits. The reasons for all these tape machines are easy to see . . . at sea when the watch system is observed there is plenty of time for listening. In the days before tape, many crewmen had elaborate radio receivers of the *National, Collins, Hallicrafter* variety, which gave them some measure of entertainment but, like any radio, allowed no freedom of choice in the selection of musical material. Then there have been many attempts at seagoing record players. The trouble here of course was the motion of the ship and tendency of the stylus to jump the record groove. Many elaborate systems of suspension on "gimbals" and other systems were devised, and while many worked remarkably well, they were cumbersome and, past a certain point, nothing was entirely satisfactory.

With tape, the problem of ship motion was for all practical purposes, overcome. Providing the tape unit itself was secured to prevent sliding, it would take a frightening roll or plunge to affect the smooth continuity of tape motion.

While stereo tape might appear to be the whole answer to seagoing entertainment, there are a number of things that should be improved upon in present units to make them really "seaworthy". Even though the tape units are used in cabins, a certain amount of exposure to salt sea air is inevitable. You would be amazed how corrosive sea air is to metals! Steel and iron rust with alarming ease and while brass and aluminum oxidize more slowly, it is still a rather fast process. I watched an aluminum idler wheel get crusted with white oxidation in 4 days at sea! Now add to the sea air the dampness and high humidity encountered by ships in the tropics, and the ease with which mold and fungus can grow, and you have another headache. There is a trend towards stereo tape entertainment on private boats, even relatively small ones, and it would seem that some alert manufacturer would turn out a "tropicalized" seagoing model of his unit, made of non-corroding materials. I think there is a big enough market to support such a unit and although the price would have to be higher I don't think the average seafarer would balk for the protection to his investment this would constitute.

What does the seagoing stereophile listen to? . . . his tastes are just as catholic as the landlubber . . . he plays everything from bebop to Bach . . . but, at least according to my observations, he enjoys most the classical repertoire and is especially addicted to Broadway hit shows.

Next month ends the usual "summer recess" in the music business, and I know there will be many important new items that will be released.

FALLA
NIGHTS IN THE GARDENS OF SPAIN
Gonzalo Soriano, pianist with National Orchestra of Spain conducted by Ataulfo Argenta.
RODRIGO
CONCERTO FOR GUITAR AND ORCHESTRA
As above with Narciso Yepes, guitarist. London 4-track Stereo LCL80010. Price $7.95.

This was an outstanding stereo disc in both sound and performance values, and here we have it on tape with considerable enhancement of dynamics and an over-all response that is definitely broader and cleaner. In the piano work, there are much improved transients and a much more sonorous bass line. The same improvement in transient response can be noted in the guitar concerto. The over-all sound in both works is of the moderately close-up variety, well detailed and with a medium reverb time that lends smooth roundness without blur. The aspects of stereo directionality and depth are present to a more heightened degree here than on the disc.

HITS I MISSED
Ted Heath and his Orchestra. London 4-track Stereo LPM70007. Price $7.95.

How a clever band leader like Ted Heath could miss such hits as "Three Coins in the Fountain", "High Noon", Ebb Tide", "Secret Love", and "My Foolish Heart" among others presented on this tape I don't know . . . but that is what the jacket claims.

Anyhoo . . . this is a very choice collection done to a turn in the familiar high-powered Heath style. Plenty of heavy bright brass and smooth saxes along with clean hard drivin' percussion. As with most big band recordings there is not much dynamic variation . . . they just pile level on the tape, and of course this makes for a minimum of tape hiss.

THE MAGIC ISLANDS
Alfred Newman and his Orchestra with Ken Darby Choir. Decca 4-track Stereo ST79048. Price $7.95.

While this tape will undoubtedly be labeled pure corn by many, there will be many others who are just mad about the same thing. This is a pot-pourri of songs and dances mostly of Hawaiian and South Sea origin. There will probably be much doubt cast on the authenticity of some of them . . . be that as it may . . . with the exotic scoring for orchestra and the lilting ministrations of the Ken Darby Choir this makes for good innocuous listening in August. The over-all sound is quite clean. —30—

HAMFESTS SCHEDULED

THE Wabash Valley Amateur Radio Association will again sponsor the Turkey Run VHF Picnic on July 31, just as they have done for the past twelve years.

Last year more than 400 amateurs, representing 13 states, attended the affair and the sponsors are hoping to top the record this year.

Ken Mier, K9EFO, and Charles Hoffman, W9ZHL, are serving as co-chairmen for the affair. Those wishing complete details can call either Ken or Charles or write Ken at 2030 Liberty Ave., Terre Haute, Indiana. —30—

* * *

A HAMFEST has been scheduled by the Radio Association of Erie, Pa., Saturday, September 10th, at the Sportsmen's Athletic Club, Erie, Pa.

Registration will be from 10 to 12 AM at the Club. For advance registrations, contact Dick Millhouse, K3ENE, 1143 E. 40th St., Erie, Pa. —30—

What's New in Radio

DEPTH SOUNDER TRANSDUCER

Clevite Electronic Components, a division of *Clevite Corp.*. 3405 Perkins Ave., Cleveland 14, Ohio, has introduced a new transducer, designed for use with small-boat depth finders.

Designated Model DS-1, the transducer radiates ultrasonic energy in an optimized, conical-shaped pattern. Capacity is 2300 μμf.; receiving sensitivity, minus 85 db with respect to 1 volt/microbar; transmitting sensitivity, plus 90 db with respect to 1 microbar/yard/watt; beam width, 16 degrees at 10 db down; impedance, 340 ohms resistive and 330 ohms reactive; and frequency, 195 kc.

Additional information on this transducer is available from the manufacturer on request.

SOLDERING IRON HOLDER

Ungar Electric Tools, Inc., 4101 Redwood Ave., Los Angeles 66, Calif. has introduced its new Model 8000 soldering iron holder.

Said to protect the soldering iron user against burns from accidentally brushing against an exposed iron, the holder may be attached to the top of a work bench, to a wall or side of the bench, or to the underside of the bench. Additionally, the operator can adjust

the angle of the holder so that the iron will be positioned for ready use. For further information, write to the manufacturer.

CITIZENS BAND MIKES

American Microphone Mfg. Co., 400 South Wyman St., Rockford, Ill. has introduced a new series of microphones designed for use in Citizens Band installations.

Claimed to offer the only "slide-lock" switch available in this field, the new "208" series may be hand held, placed on a table top, or hung on a wall. Six models are offered, including three each crystal and ceramic types.

COLORED CABLE JACKETS

Lenz Electric Manufacturing Co., 1751 No. Western Ave., Chicago 47, Ill. has announced a new line of plastic cable jackets in the standard colors adopted by the industry.

The jackets are available with any size and number of conductors. Color coded in this way, the cables connecting the units of electronic equipment can be identified quickly to facilitate installation and servicing. More complete information may be obtained from the manufacturer.

NIBBLING TOOL

Adel Tool Co., 4730 Ronald St., Chicago 31, Ill. is offering a hand-operated nibbling tool which cuts round, square, or keyed holes of any size or shape over

7/16-inch in radio chassis and other sheet metal.

According to the manufacturer, the metal remains flat and straight after cutting. The capacity of the nibbling tool is stated as 18 gauge (.046-inch) maximum for steel, and 1/16-inch for aluminum, copper, or plastic mat. Further information is available from the manufacturer.

RAYTHEON CB TRANSCEIVER

Raytheon Company, Waltham 54, Mass. has introduced a new Citizens Band radiotelephone for two-way communication on the 27-megacycle band. Known as the "Ray-Tel," the set is a 23-channel, crystal-controlled transceiver for use between fixed or mobile installations.

It operates from a 117-volt or 12-volt source, features a "battery saver" switch that conserves battery power while the unit is on stand-by or listen, and transmits at the maximum legal power of 5 watts.

The receiver section is said to be highly selective for maximum rejection of unwanted signals and includes a full-range a.v.c. to prevent blasting and distortion on strong local signals. Radar-type duplexing circuits are claimed to have eliminated the need for troublesome relays. Included with the "Ray-Tel" is a press-to-talk microphone, instruction manual, FCC license application and regulations, and set of transmitting and receiving crystals.

GLOBE FOR HAMS AND SWL'S

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. is offering a 12-inch, full-color world globe as an accessory for the ham station or shortwave listening post. The globe has indicating devices which tell the user the direction in degrees and the distance of any country being tuned in. A special feature permits "customizing" the globe for this purpose from any location.

The globe also features call letter prefixes for each country, as well as a time-differential disc that tells the user the time anywhere in the world. A special swivel mount permits rotating the globe in either the polar or the equatorial plane. *Allied's* stock number for this item is 77 S 325.

POCKET SIZE CB RADIO

Globe Electronics, Division of *Textron Electronics, Inc.*, 22-30 South 34 St., Council Bluffs, Iowa has introduced the "Pocketphone," a completely portable two-way radio for receiving and transmitting at distances up to one mile on the Citizens Band. Measuring 1⅝" x 2⅜" x 16¼", the "Pocketphone," uses a built-in "Power-Pak" battery as well as its own microphone and loudspeaker, and extendable antenna. It weighs only 13½ ounces.

The 9-volt battery has a life expectancy of one year, based on continuous use 8 hours daily, 5 days a week for 50 weeks. The set is said to meet all FCC requirements. Power input to the final r.f. amplifier in the transmitting mode is just under the 100-mw. limitation for non-licensed operators. Spurious and incidental radiation is claimed to be better than 30 db down. Printed circuits and transistors are used in the design.

COMPACT TUBE TESTER

Service Instruments Corp. (Sencore), 171 Official Rd., Addison, Ill. has announced a compact tube tester. Called the "Mighty Mite," the new instrument measures 8" x 9" x 2½" and weighs less than 8 pounds. It will check over 1300 tubes for cathode emission, interelement shorts, gas, grid emission, and grid leakage as high as 100 megohms. Set-ups are made from a small attached booklet. New charts are pro-

vided free of charge by registering with the company.

The "Mighty Mite" features a 3½-inch d'Arsonval meter that glows in the dark, and a stainless steel mirror in the cover to facilitate TV set adjustments during servicing. The unit has a separate inner chassis so that it may be slipped out of its carrying case and installed in a tube caddy or on a counter or wallboard.

ELECTROLYTIC ASSORTMENT

Sprague Products Co., North Adams, Mass. has made available a specially selected assortment of "Atom" electrolytic capacitors packaged in a plastic job tray.

Known as the "EK-3 Atom Assortment," the new item features 15 tubular electrolytics in the twelve most frequently used ratings for radio and TV servicing.

The trays, which measure 9" x 6" x 1½" each and may be stacked, have built-in card holders to facilitate quick identification of the contents. Trays are free to the service dealer who pays only for the capacitors.

TRANSISTOR TESTER

B & K Manufacturing Co., 1801 W. Belle Plaine, Chicago 13, Ill. is now producing a low-cost transistor tester for servicing, lab, and industrial use.

Designated as Model 160, the new unit is said to provide direct readings in *beta*, giving an accurate indication of current gain, not a relative indication. All transistors are automatically biased to standard 1 ma. collector current. The Model 160 makes tests in the

circuit configuration in which most transistors are used. It will provide direct meter readings on shorted, open, and leaky junctions, as well as test gain and leakage current of power transistors. It also tests tetrodes, automatically providing proper bias for Base 2.

Claimed to be burn-out proof, the Model 160 is supplied with a reference chart listing transistor types, as well as socket and clip leads. For complete information, write to the manufacturer, requesting Bulletin No. 160.

TINY COMMUNICATIONS SET

General Electric Co., Communication Products Department, Lynchburg, Va., has announced a new all-transistor shirt-pocket personal radio communications receiver. Named the "Voice Director," the new set weighs only 12 ounces with battery. It is said to require 35 percent less battery power than previous hand-carried units of its type and, at the same time, boosts audio efficiency. Receiver selectivity and sensitivity is claimed to be comparable to mobile sets many times heavier and larger.

A ferrite-core antenna is built into the receiver's case. The listening "horn" may be clipped to the wearer's lapel. If complete message privacy is desired, an ear-piece may be used. The "Voice Director" operates on a single mercury-cell battery and features a crystal-controlled, superheterodyne FM circuit.

RANDOM NOISE GENERATOR

H. H. Scott, Inc., Investment Division, 111 Powder Mill Rd., Maynard, Mass. has introduced a new random noise generator.

Designated as Model 811-B, the new instrument features high, uniform output and a new "pseudo-r.m.s." metering circuit which reads identically on sine waves and white noise.

The 811-B has an output of at least

2.5 volts r.m.s. on all ranges, and response from 2 cps to 1.5 mc. A meter input jack enables its meter to be used for measuring other signals. For complete technical information, write to the manufacturer.

FILAMENT TESTER

PACO Electronics Company, Inc., Glendale, L. I., N. Y. has announced its model T-5 Rapid Filament Tester Kit, (model T-5W, factory-wired), a portable battery operated unit for locating tubes with open filaments in series-string receivers. The T-5 also can be used for making continuity tests of any low resistance electrical circuit.

The device is equipped to check filaments of all tube types directly. A pair of universal connector "minigator" clips are used for connection to non-standard tubes, or tubes whose filaments terminate in other than the usual pins. Continuity is indicated by the glow of a pilot lamp on the panel. The T-5 is operated by two penlite (1.5-volt) cells.

NEW TOOL KIT

Xcelite, Inc., Orchard Park, N. Y. has announced a 23-piece "Service Master" tool kit (Model 99SM) that is said to provide every tool required by radio, TV, and electronic technicians on 99% of their calls.

The set, housed in a plastic-coated canvas carrying case, contains 12 snap-in nutdrivers, 3 screwdrivers, 2 reamers, a 7-inch extension blade, long-nose and diagonal pliers, and an adjustable 6-inch thin wrench.

Additional information can be obtained from the manufacturer.

CITIZENS BAND RIG

Mirutel, Inc., 1080 Dionne St., St. Paul 13, Minn. has announced a new transmitter-receiver for Citizens Band operation.

Designated as Model CR-117, the

unit includes an 8-tube receiver and 5-tube transmitter. Each has five crystal-controlled channels. The superhet receiver provides an audio output of 5 watts; the transmitter features a front-panel modulation meter. Additional details may be obtained from the manufacturer. —30—

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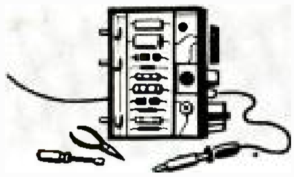

ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words. October issue closes August 10th. Send order and remittance to: Martin Lincoln, ELECTRONICS WORLD, One Park Ave., N. Y. C. 16. N. Y.

FOR SALE

SAMS Photofacts 1 thru 281. With file cabinet $450, without $420. Box 205. Mentone, Indiana.

TUBES—Radio & Television. All tubes individually boxed & guaranteed. at manufacturer's prices. Send for free complete tube list & order blank. Your inquiry will put you on our mailing list. Tel-Vue Electronics, 295 Chestnut St., Camden, N. J.

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TUBES—TV, Radio, Transmitting and Industrial Types at Sensibly Low Prices. New Guaranteed, 1st Quality, Top Name Brands Only. Write for Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N. N. Y.

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DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

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CASH for used Short-Wave Ham Receivers, Transmitters and Accessories. Tregor, W9IVJ, 2023 N. Harlem Ave., Chicago 35C, TUxedo 9-6429.

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CYLINDER and old disc phonographs. Edison Concueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Classified, Box 50, Electronics World, 1 Park Ave., New York 16.

WANT to buy good equipment and accessories? Place a low-cost classified ad in this space.

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WANTED: Surplus Measurement model 78 or 80 signal generators. Also Federal 804 or used Motorola two-way equipment. State quantity, price, and condition. Communications Service, Inc., 3209 Canton Street, Dallas, Texas.

WE will buy your radio and TV receiving tubes. Must be unused and clean, for top price, write Lukacs, Dept. E, Box 353, Jersey City, N. J.

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WANTED: Tubes, Diodes, Transistors. Top prices for Klystrons, Thyratrons, Power, TV, and Receiving Tubes. Must be unused. Wanted: Laboratory-Grade Test Equipment. Oscilloscopes, Bridges, Signal Generators (microvolters) RF & Audio, Recorders, Etc. Commercial (Hewlett Packard, etc.) and military (TS & UPM prefixes). Write us detailed description. Bob Sanett, W6REX, V & H Radio & Electronics, 2053 Venice Blvd., Los Angeles 6, California.

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AUGUST 1960

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pick

the one for your store!

14" x 50" with clock and changeable copy panel

14" x 37" with changeable copy panel

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- STIMULATE STORE TRAFFIC
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- ADD TO THE APPEARANCE OF YOUR STORE

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NOW'S THE TIME TO GET IN ON

RCA's giant new sales promotion program for SILVERAMA PICTURE TUBES

THE BIGGEST, MOST COMPREHENSIVE PICTURE TUBE PROMOTION IN THE INDUSTRY!

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