NOVEMBER

Radio-Electronics

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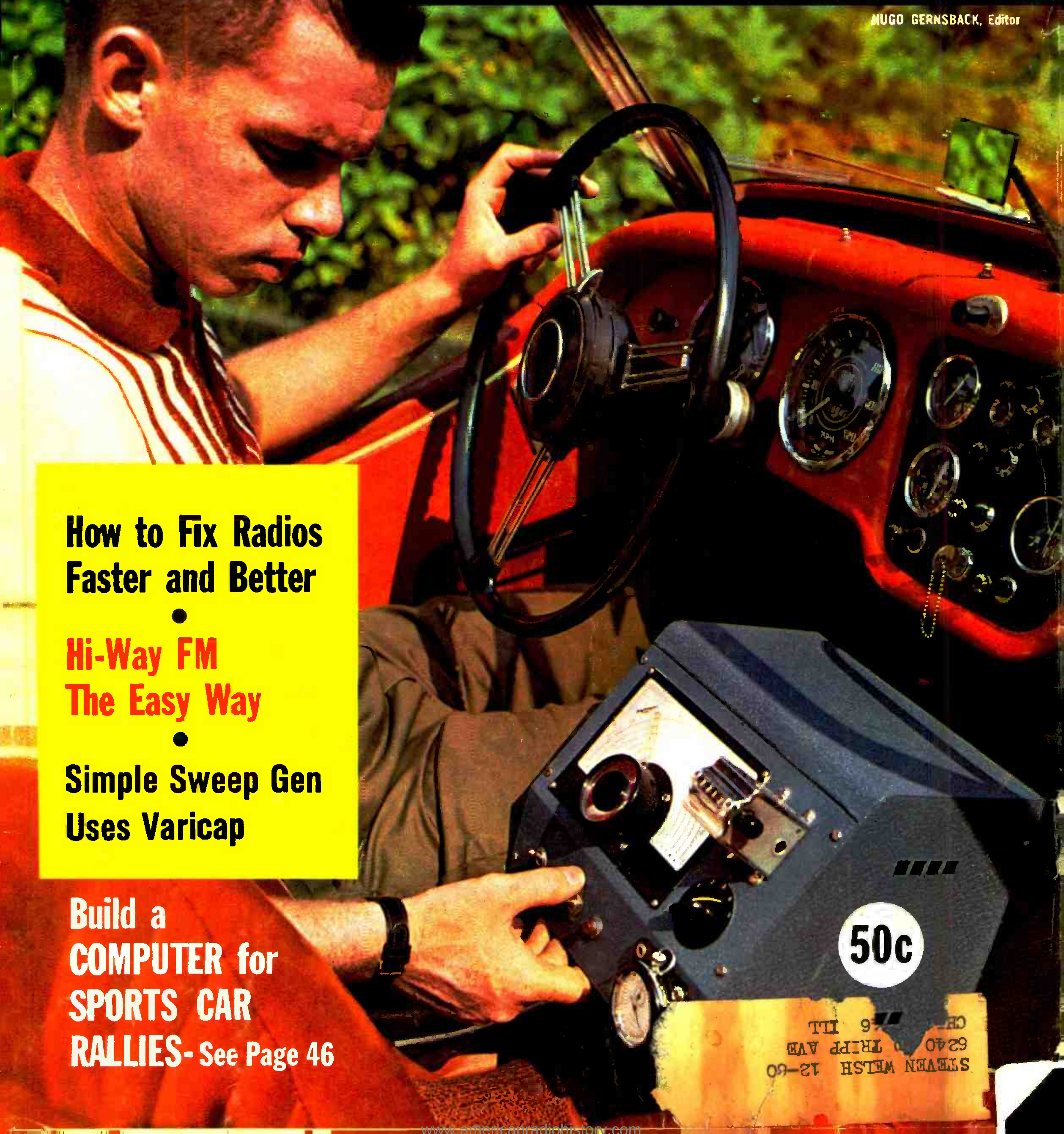
HUGO GERNSBACK, Editor



How to Fix Radios Faster and Better

•

Hi-Way FM The Easy Way

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Simple Sweep Gen Uses Varicap

Build a COMPUTER for SPORTS CAR RALLIES- See Page 46

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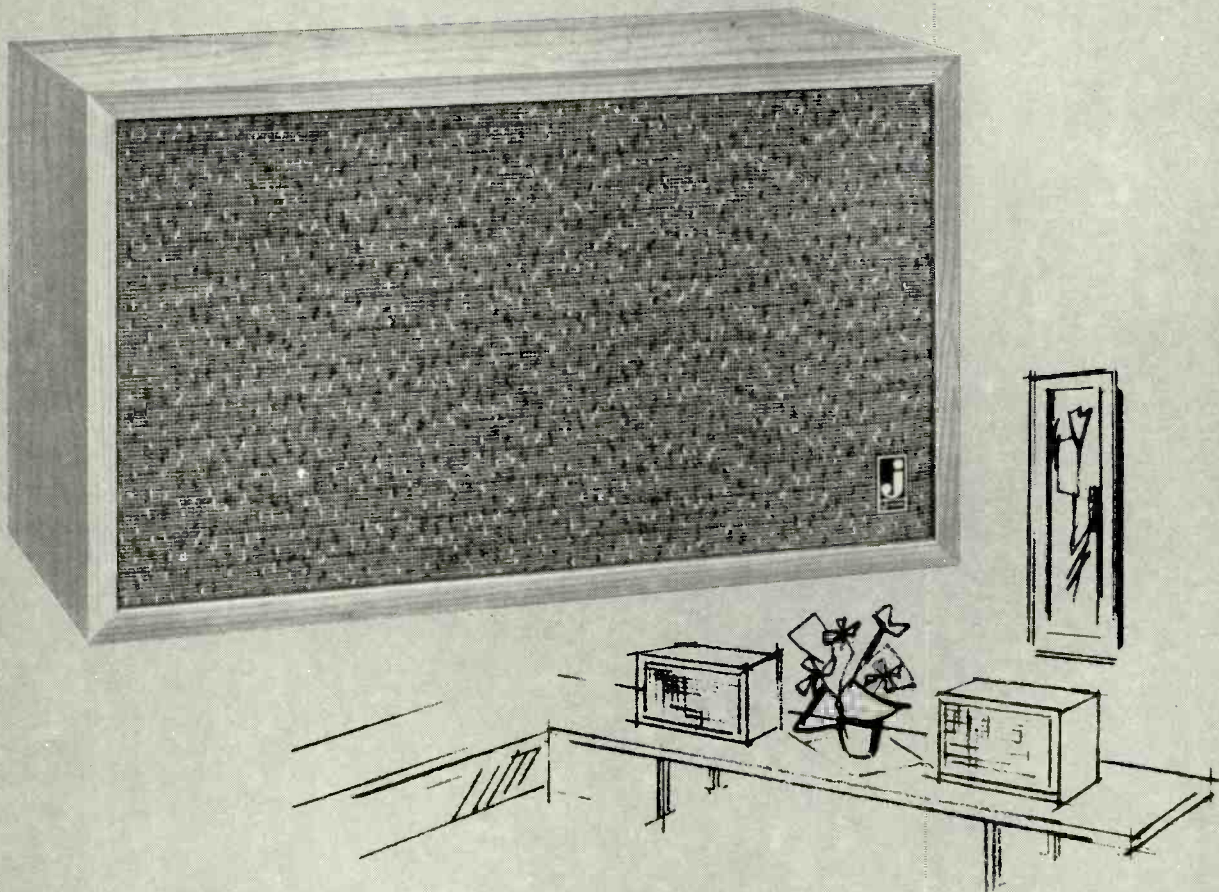

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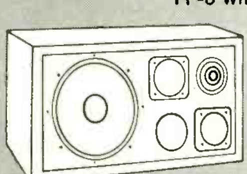

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ON THE COVER

(Story on page 46)

Behind the wheel and ready to begin a sports car rally, the driver sets up his home-made electronic computer. The device will help him to be in the right place at the right time—vital if he is to be a winner.

Color original by Jack Allison.

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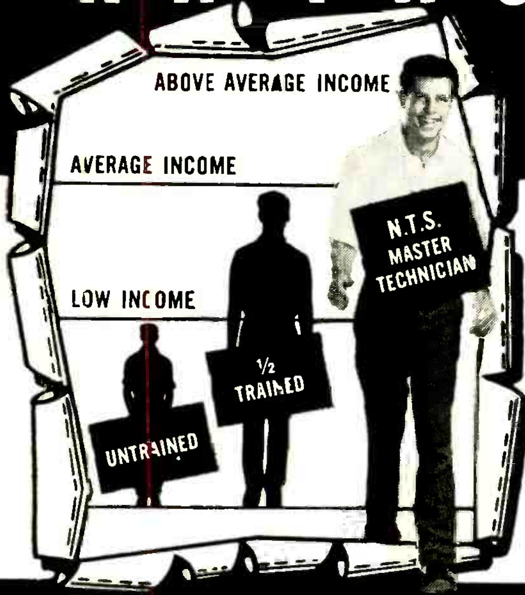

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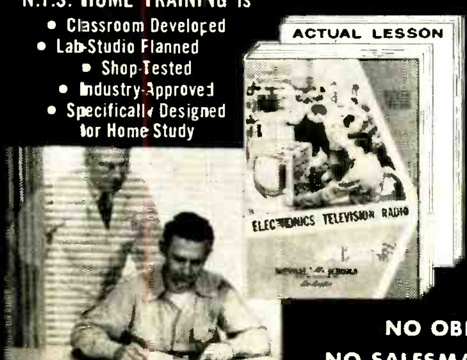

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News Briefs

Power Converter on Market

Thermionic power converters, producing electricity direct from heat, are now being turned out commercially by General Electric at the company's power-tube plant at Schenectady. The devices, somewhat similar in action to a two-element vacuum

tube producing "contact-potential" current, are about the size of a silver dollar. They will produce at least 1 watt apiece, according to K. E. Wilson, who is in charge of marketing the new converters. They operate at a cathode temperature of 1100°C. Efficiency is 2.5%. Since electricity is required to heat the cathode, the chief applications of the new converters will be for special and experimental uses.

Short-wavers Cooperate

Plans to reduce interference in the short-wave broadcast bands have been put into effect by the International Frequency Registration Board (IFRB) pursuant to decisions made at the Geneva Conference last year. Administrations concerned with short-wave broadcasting are to submit their schedules to the IFRB four times a year. The IFRB compares schedules and, where stations would interfere, proposes improvements to the parties concerned. At the end of each period, the IFRB will publish a "High Frequency Broadcasting Schedule" which includes the schedules of the various broadcasters, to which the notified changes have been applied, and indicates those changes that the administrations did not consider satisfactory. It is hoped that this system will substantially reduce short-wave interference.

Electronic Medicine Meet

Electric and electronic techniques in biology and medicine will be discussed in more than 50 papers to be presented at the 13th Annual Conference on Electrical Techniques in Medicine and Biology. The conference is being held in Washington, D. C., on Oct. 31, Nov. 1 and 2.

Authorities from both the medical and electronic fields, including the US Department of Agriculture, the National Institutes of Health and a large number of American universities and medical, scientific and electronic concerns, will take part in the eight sessions of the conference. Main subjects are grouped under analytical methods and instrumentation, electroanalytical methods, instruments, digital computers, telemetry of physiological data, analogues and system analysis and general discussion.

California Amateur Honored

Raymond E. Meyers, W6MLZ, of San Gabriel, Calif., was awarded the Edison Radio Amateur Award for 1960. The plaque is given each year by General Electric to an outstanding amateur.

Meyers' award was given, in the words of the citation: "For promoting international good will through his skillful planning, organizing, establishing and operation of extensive world-wide radio communications during the Ninth Plenary Assembly of the Consultative Committee on International Radio (CCIR) held in Los Angeles in April, 1959. The special radio station, K6USA, handled more than ten thousand important communications during the conference."

W6MLZ, Raymond E. Meyers (left), receives Edison Award from B. S. Angwin of G-E.

W6MLZ was assisted in setting up the radio service extended by K6USA by Herbert Hoover, Jr., W6ZH, son of the former President who, as Secretary of Commerce, contributed greatly toward the recognition of the American amateur radioist and to his present status.

Voice of Africa?

The Voice of America has contracted for construction of a powerful station to be built near Monrovia, Liberia. It will consist of six 250-kw and two 50-kw transmitters. It will give the Voice of America coverage of Africa, parts of central Europe and the middle East.

The Voice will operate under international rules and will not interfere with other African broadcasts. Completion is expected in 1962. The engineering design of the new station is being handled by Page Communications. Contracts for the actual construction of the transmitters has not been let at the time of writing.

Jap Radios Self-Limited?

In an attempt to maintain the prestige of Japanese transistor radios, the Ministry of International Trade and Industry has been clamping on restrictions and obtaining information looking toward an export quota. First step of the MITI was to ban export of all radios containing less than three transistors. This was softened slightly to permit export of such radios only if plainly labeled as toys. The ministry explained that the little radios have been hurting the market for six-transistor or bigger sets.

American manufacturers pointed out that the move would have little effect on Japanese competition, as no American manufacturers make two-transistor radios.

Humans Telemetered

A new manned vehicle monitor that can tell at a glance the immediate condition of a pilot and the craft he is flying has been designed for the Air Force Flight Test Center, International Telephone & Telegraph Laboratories announced.

The new device, to be manned by ground personnel, will give for the first time direct readout or "real-time" safety reports on the physiological and environmental conditions of the pilot, in addition to telemetered "how goes it" information on the vehicle itself.

According to Paul Sehnert, proj-

(*Continued on page 10*)

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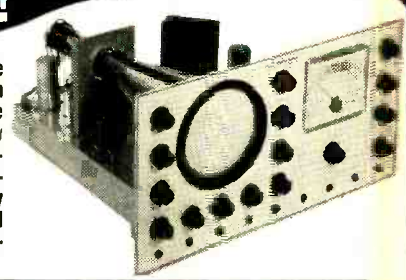

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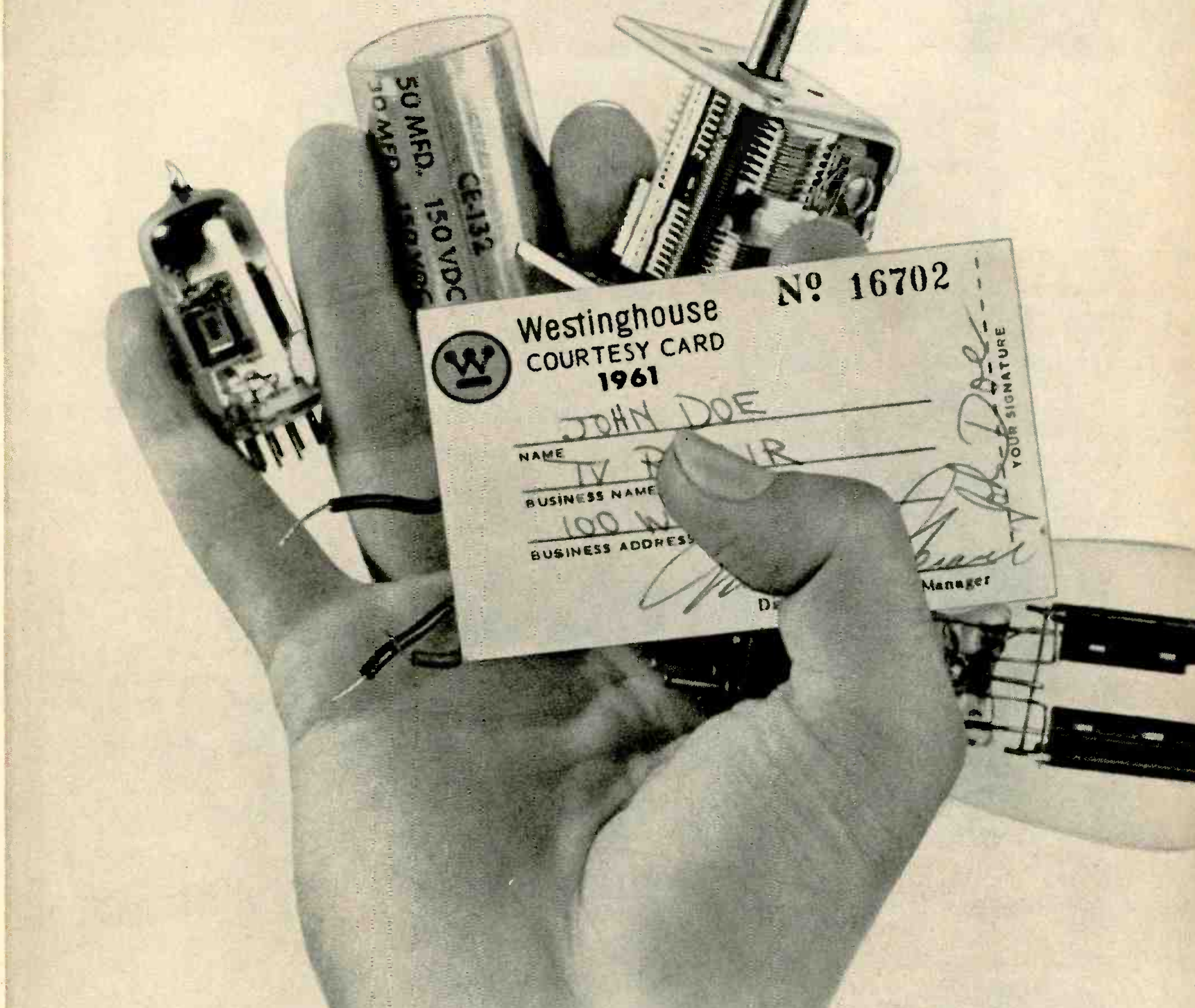

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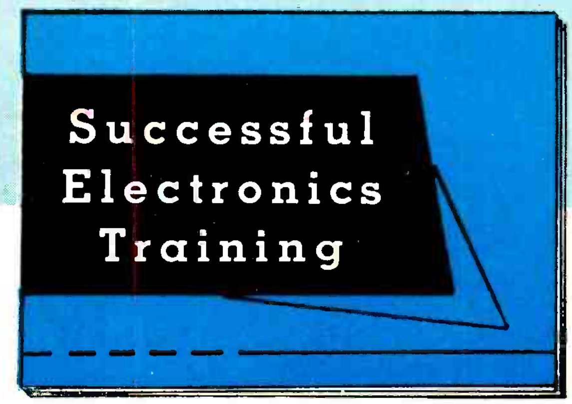

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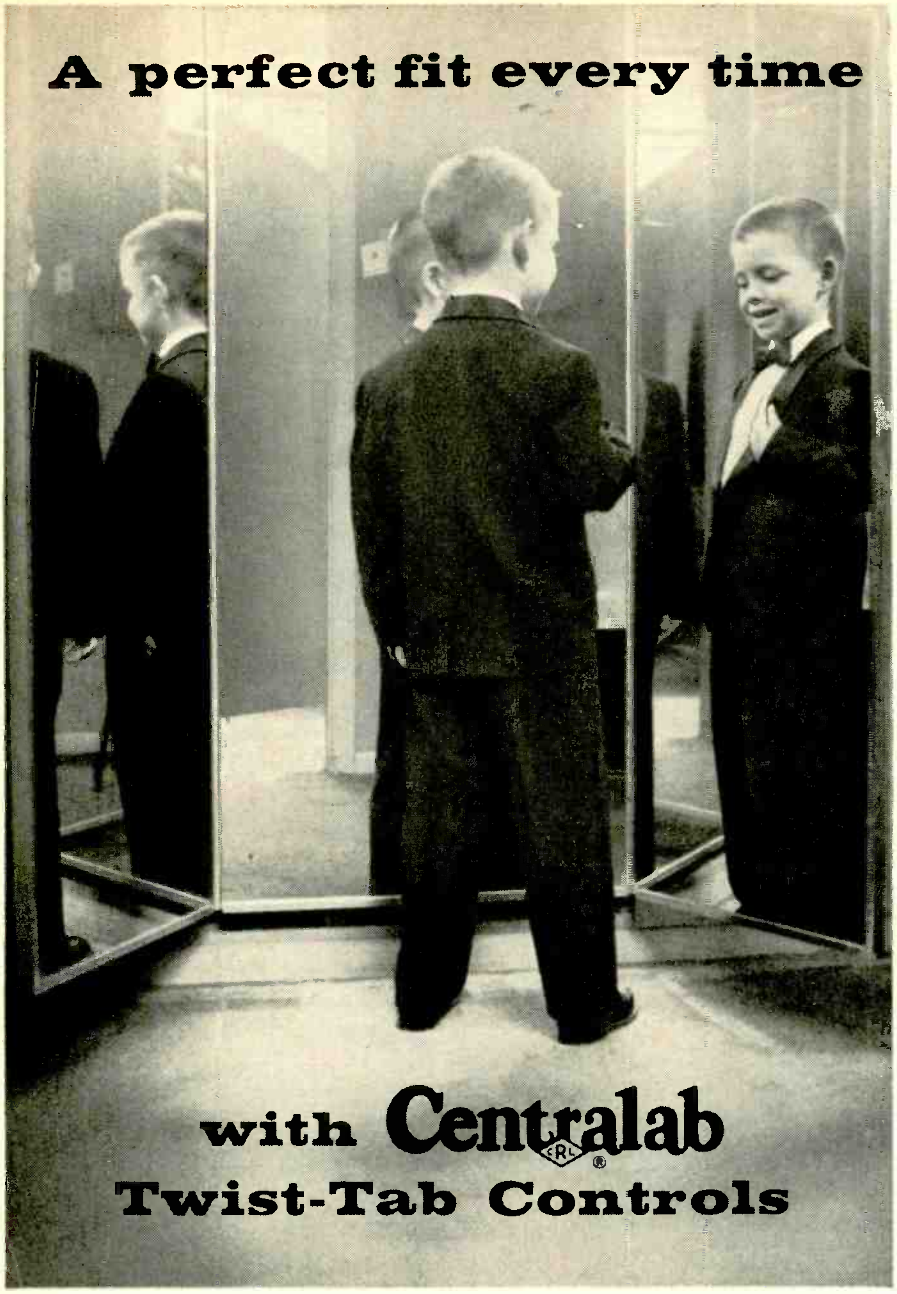

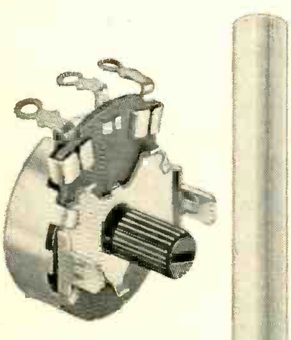

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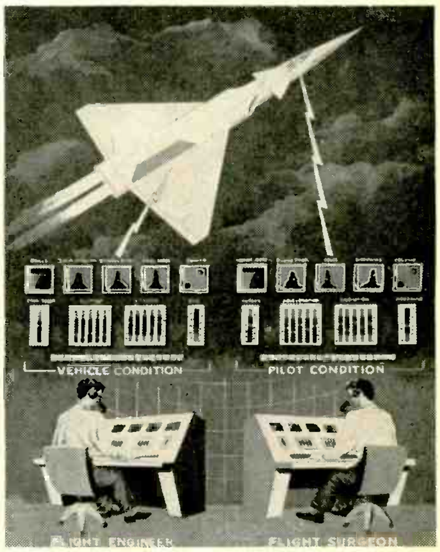
(*Continued from page 6*)
ect initiator of Edwards Air Force Base, and Carlos Miller, executive engineer of ITTL, the "real-time" console will keep abreast of man's conditions within fractions of a second and can indicate immediately when he is undergoing or entering an unsafe condition. No computation of data, graph or gauge analysis is necessary.



The information displayed on the vehicular panel includes various stability and aerodynamic parameters, structural strains, flutter, powerplant behavior, and other data such as skin temperature, fuel, fire warning and electrical equipment.

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The cathode-ray displays will present a green color indication of the OK condition. It changes to a harsh orange when either the actual value or the rate-of-change becomes unsafe. For the plot displays of interrelated parameters, the green spots of light are located inside "safety-envelope" areas which have been previously determined for the particular parameters for both the man and the vehicle. The spots of light change their color to orange when the parameters move outside these areas.

Bell Begins Paging System

The New York Telephone Co. announced the opening of their bellboy radio signaling service covering Binghamton, Endicott, Johnson and an area surrounding these cities. The system has also been put into use in areas around Columbus, Ohio, and Allentown-Bethlehem, Pa., the company reported.

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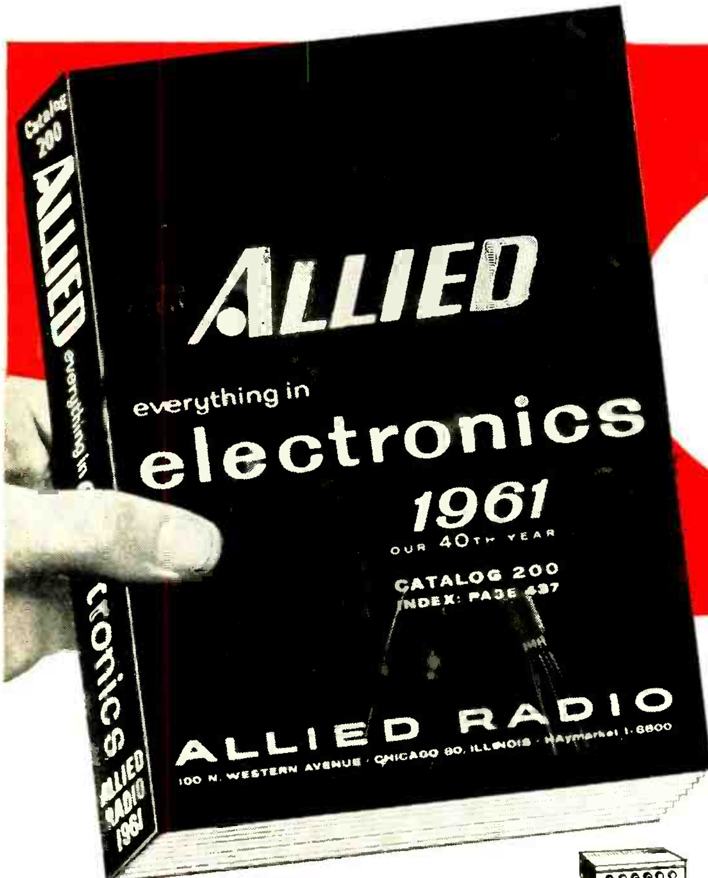

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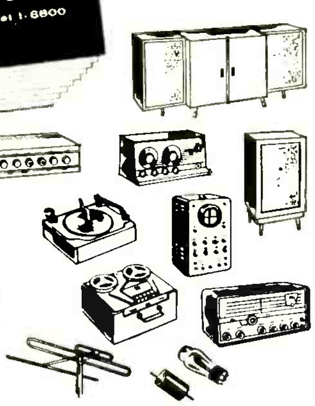

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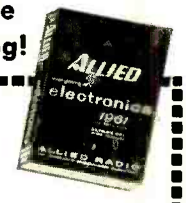

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Imagine, the 9T boasts all these "professional" features...yet sells for less than half the price of the least expensive "professional" cartridge. Simplify your inventory...cut call-backs—increase sales and profits—with Sonotone's great new 9T cartridge...unsurpassed for performance—and for value.

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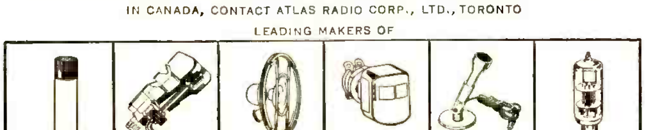

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office or other contact from the nearest telephone.

The telephone company said the cost of installing the Bellboy equipment was more than $100,000. It can handle a maximum of about 3,000 receivers. Customers are charged $15 a month if one receiver is used. A second receiver costs $12.50 a month. The rate is for a maximum of 80 signals a month.

De Forest Award to N.M. Student

Dwight Jaeger, 17, a Los Alamos, N.M. high school student, was awarded a $1,000 de Forest Scholarship awarded annually by the Western Electronic Show and Convention (WESCON). Jaeger's experiment, which was displayed at the Future Engineers Show (a feature of WESCON), was called

"Gravitational Pit" and simulated the gravitational pull of satellites as they orbit around the earth.

Dr. de Forest, at the time invalided at his Hollywood home, sent a message to be given to the recipient of this year's and future awards.

Second place in the awards, a $600 scholarship, was given to Donald Shapero, a student at Cubberly High, Palo Alto, for his work on "Precession Magnetrometry." Third place, a $400 scholarship, went to Melvin Rosowski of Clayton Valley High School, Concord, Calif., for an experiment called "Cloud Chamber Research."

Fourth place, a $300 scholarship, was awarded to Edward Longe of Santa Barbara High for "Gaseous Discharge Phenomenon," and fifth place, a $200 scholarship, went to Steve Walther of Punahou School, Honolulu, for a display titled "Seeing with Sound."

Booster Operators Cooperate

Results of a series of meetings in the United States Northwest to explain the new FCC booster rules to booster operators have been excellent, according to engineer McIvor Parker of the FCC. The long-banned boosters are permitted to go into legal operation, provided their stations meet FCC requirements. The chief requirement is that they create no harmful interference to other services, including other TV stations.

Booster operators queried the FCC representatives on a number of subjects, the most commonly asked questions being on the FCC stipulation

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What Does F.C.C. Mean To You?

What is the F.C.C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress to regulate all wire and radio communication and radio and television broadcasting in the United States.

What is an F.C.C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses—commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams"—people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the Grantham *correspondence course*, the average beginner should prepare for his *second class* radiotelephone license after from 200 to 250 hours of study. This same student should then prepare for his *first class* license in approximately 75 additional hours of study.

In the Grantham *resident course*, the time normally required to complete the course and get your license is as follows:

In the DAY course (5 days a week) you should get your *second class* license at the end of the first 9 weeks of classes, and your *first class* license at the end of 3 additional weeks of classes. This makes a total of 12 weeks (just a little less than 3 months) required to cover the whole course, from "scratch" through *first class*.

In the EVENING course (3 nights a week) you should get your *second class* license at the end of the 15th week of classes and your *first class* license at the end of 5 additional weeks of classes. This makes a total of less than 5 months required to cover the whole course, from "scratch" through *first class*, in the evening course.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and pre-examination you are given constant practice in answering FCC-type questions, presented in the same manner as the questions you will have to answer on your FCC examinations.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand—choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test so you can discover daily just which points you do not understand and clear them up as you go along.

HERE'S PROOF that Grantham Students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Neil W. Michel, 402 E. Jefferson, Owensville, Mo.	1st	12
L. Gordon Combs, RR#3, Box 279A, Hemet, Calif.	1st	11
Daniel A. Ruch, Station KVOZ, Box 1498, Laredo, Texas	1st	12
George H. Sanderson, 128½ W. 4th Street, Marysville, Ohio	1st	8
Donald F. Teneyck, 58 Brighton Road, Worcester, N. Y.	1st	12
Richard Scherzer, Apt. 5, 1175 S. Franklin Ave., Los Angeles, Calif.	1st	13
Jerry Miller, P. O. Box 1253, Charleston, West Virginia	1st	11
David M. Tarter, 1174 Hilltop Road, Kansas City 4, Kansas	1st	12
Verne S. Melton, Jr., 1014 Canyon Road, Santa Fe, New Mexico	1st	8
Gerald T. Bullock, 613 Keefer Place, NW, Washington, D. C.	1st	12

Resident Classes Offered at Four Locations

To better serve our many students throughout the nation, Grantham School of Electronics maintains four separate schools—located in Hollywood, Seattle, Kansas City, and Washington, D.C.—all offering the same resident courses in F.C.C. license preparation. (Correspondence courses are conducted from Hollywood.)

For further details concerning F.C.C. licenses and our training, send for our FREE booklet, "Careers in Electronics". Clip the coupon below and mail it to the School nearest you.

Get your First Class Commercial F.C.C. License Quickly by training at

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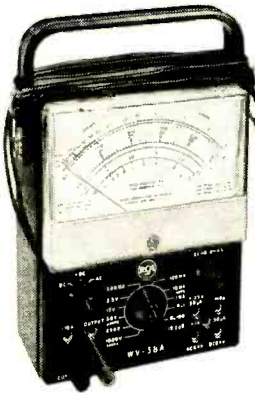

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only **$29.95*** *(includes batteries, probe and cable with slip-on alligator clip, ground lead and clip, assembly and operating instructions) (available factory-wired and calibrated—only $43.95*)*

Exclusive features make this RCA VOM kit the buy of a lifetime! Extra 1-volt and 0.25 volt (250 mv) ranges for wider usage in transistor servicing—new handle clip accommodates probes and test leads for extra carrying convenience. Assembles in a breeze!

FEATURING: ohms-divider network fuse-protected • easier-to-read scales • extra-large 5¼ inch meter • polarity reversal switch • excellent frequency response • full-wave bridge rectifier • low circuit loading • standard dbm ranges.

SPECIFICATIONS: Input Resistance—20,000 ohms per volt on DC; 5,000 ohms per volt on AC • Accuracy—± 3% DC, ± 5% AC (full scale) • Regular Scales—2.5, 10, 50, 250, 1000, 5000 volts, AC and DC; 50 μa 1, 10, 100, 500 ma, 10 amps (DC) • Extra Scales—250 mv. and 1 volt (dc) • Frequency Response—AC-flat from 10 cycles to 50 Kc (usable response at 500 Kc) • Ohms—3 ranges: Rx1—(0-2,000 ohms); Rx100 (0-200,000 ohms); Rx10,000 (0-20,000,000 ohms) • Dimensions—W. 5¼", H. 6⅞", D. 3⅛"

RCA WO-33A (K)

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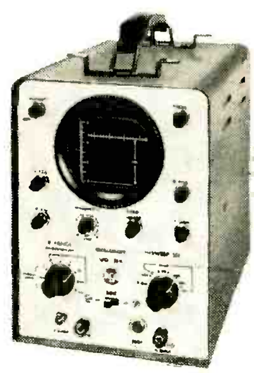

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The first 'scope kit with "get-up-and-go!" Use it for practically everything—video servicing, audio and ultrasonic equipment, low level audio servicing of pickups, mikes, pre-amps, radios and amplifiers, troubleshooting ham radio, hi-fi equipment, etc.—and you can take it with you, on the job, anywhere!

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SPECIFICATIONS: Vertical Amplifier (Narrow Band Position)—Sensitivity, 3 rms mv/inch; Bandwidth, within —3 db, 20 cps to 150 Kc • Vertical Amplifier (Wide Band Position)—Sensitivity, 100 rms mv/inch; Bandwidth, within —3db, 5.5 cps to 5.5 Mc • Vertical Input Impedance—At Low-Cap cable input... 10 megohms, 10 μμf (approx.); At Direct-cable input... 1 megohm, 90 μμf (approx.) • Sweep Circuit—Sawtooth Range, 15 cps to 75 Kc; Sync, external, ± internal; Line Sweep, 160° adjustable phase.

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Think of it—an RCA VoltOhmyst Kit at this low, low price! You get famous RCA accuracy and dependability, plus the easiest to assemble kit you've ever seen!

FEATURING: ohms-divider network protected by fuse • ultra-slim probes and flexible leads • sleeve attachment on handle stores probes, leads, power cord • separate 1½ volts rms and 4 volts peak-to-peak scales for accuracy on low ac measurements • front-panel lettering acid-etched.

SPECIFICATIONS: Measures: DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges; AC Volts (RMS)—0.1 volt to 1500 volts in 7 overlapping ranges; AC Volts (peak-to-peak)—0.2 volt to 4000 volts in 7 overlapping ranges; Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment • Accuracy—± 3% of full scale on dc ranges; ± 5% of full scale on ac ranges • Frequency Response—flat within ± 5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14, and 40-volt peak-to-peak ranges • DC Input Resistance—standard 11 megohms (1 megohm resistor in probe).

*User Price (Optional)

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ELECTRON TUBE DIVISION HARRISON, N.J.

that the TV station's permission to rebroadcast its signals must be obtained. The provision that boosters must be so designed that they can be turned off immediately—from a remote point if unattended—also came up for discussion.

It is likely that many boosters will require additional equipment before they meet with FCC standards as to quality of signal, according to engineer Parker. Some of the pictures, he pointed out, were of such quality that one might get a headache watching them.

Stereo Standards Coming Soon

A strong feeling that FM multiplex stereo standards will be set by the FCC before the end of 1960 pervaded the New York High-Fidelity Show held early in September. The results of the field tests conducted from Pittsburgh were to be filed with the FCC Oct. 28. According to *Television Digest*, five of the systems tested gave results that observers considered "good stereo."

Knee Noise Signals Arthritis

Sound patterns from the knee joints indicate rheumatoid conditions, states Dr. Herbert Fisher of Ohio State University. Speaking before the International Congress of Physical Medicine at Washington recently, Dr. Fisher reported on records made of 75 subjects, of whom 25 were patients with rheumatoid involvements and 25 had been diagnosed as suffering from degenerative arthritis.

"Normal knees produce a relatively regular pattern," he said. "In rheumatoid arthritis, the entire pattern is distorted, while in degenerative joint disease, there are high amplitude spikes superimposed on a normal pattern."

Japanese TV's Coming

Television receivers from Japan, now being seen in a few American stores, are expected in quantity for the Christmas trade, according to *Television Digest*. Those reaching the counters first were 8-inch units, some portable and some ac-operated. Contrary to previous experience with small-screen sets, sales have been good, according to the few dealers who have handled them. Sets were selling at $100. A 19-inch receiver was expected by the beginning of this month, to sell for something less than $200, and a 23-inch set early in 1961.

Elevator + TV = Safety

A closed-circuit television system has been installed at the Ansonia residential hotel in New York City solely for the purpose of observing a self-service elevator. Users of operatorless elevators are particularly vulnerable to robbery and attack. To protect them, a remote-controlled, 10-lb vidicon camera is mounted on top of the elevator, with a special

(*Continued on page* 20)

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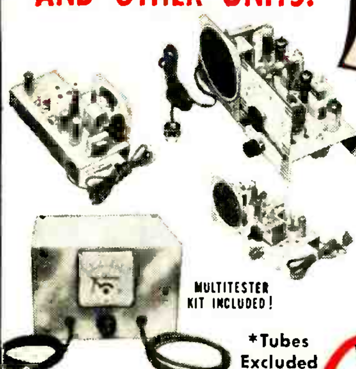

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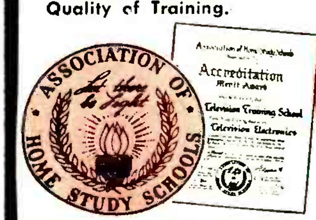

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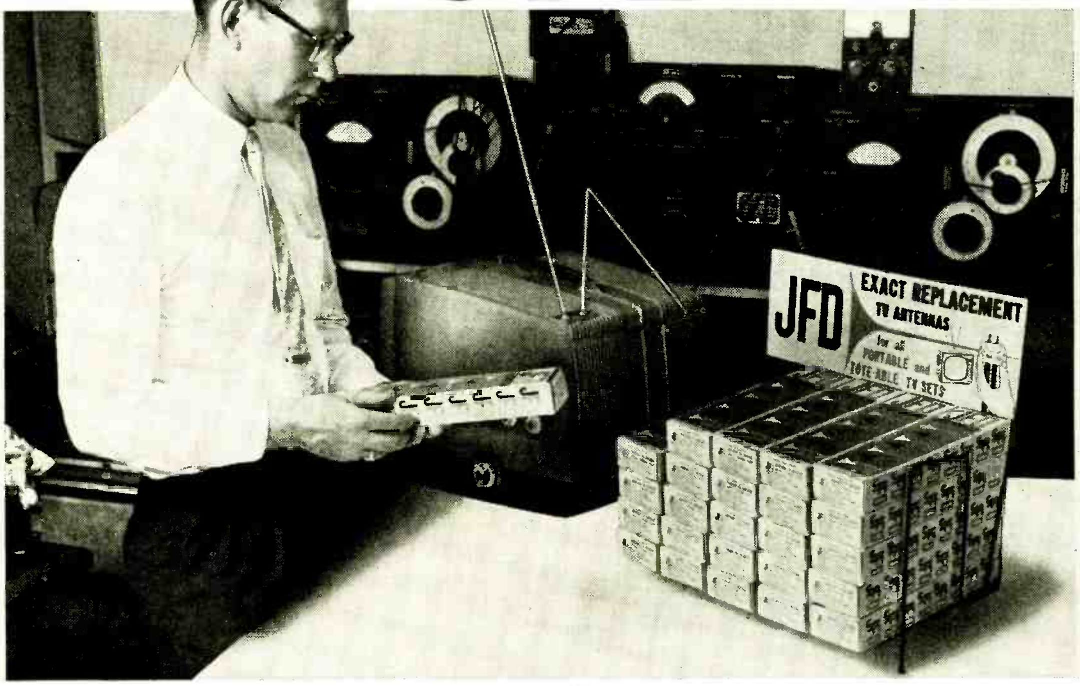

because

50 per cent of all TV sets made in the last 4 years are portables—sending *more* antenna replacement business to service-dealers every day.

because

with the JFD PA500 and PA515 Exact Replacement Kits, dealers are ready and able to service *90%* of antenna replacements for portables and tote-ables.

because

as JFD Exact Replacement Specialists, service-dealers can get out of the unprofitable "rabbit-ear" business—earn a *profit* on the antenna *sale* (at full mark-up) *and* on the *installation*.

because

with JFD guides, streamers, and sales helps, service-dealers get the merchandising *know-how* that nets them a bigger slice of the *3,500,000* dollar portable antenna replacement market.

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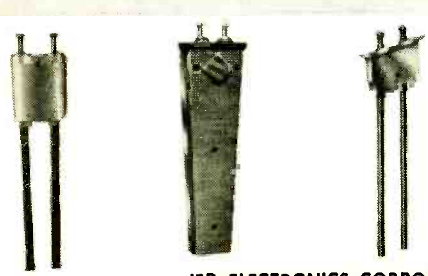

Only JFD keeps you up-dated with the 1960 Portable TV Antenna Guide covering every portable TV set made since 1956 (compiled and edited by Howard W. Sams & Co., Inc.)

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they know 5 *million* antennas need replacement—that *JFD* HI-FI TV antennas assure them a *bigger* share of this profitable market.

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JFD all-out advertising *sells* for them in powerful national mass media—such as Look, TV Guide, Successful Farming, Farm Journal, Progressive Farmer.

because

JFD is the *total* antenna line with the *right* model, at the *right* price for every location—does the *most* for them in mile-shrinking *performance* and customer *confidence*.

because

JFD sales stimulators such as cloth patches, decals, mobiles, banners, displays and direct mail give them the *complete* package to *sell* new customers.

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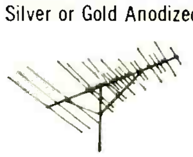
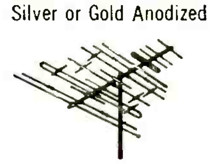


HI-FI FIREBALL
Silver or Gold Anodized



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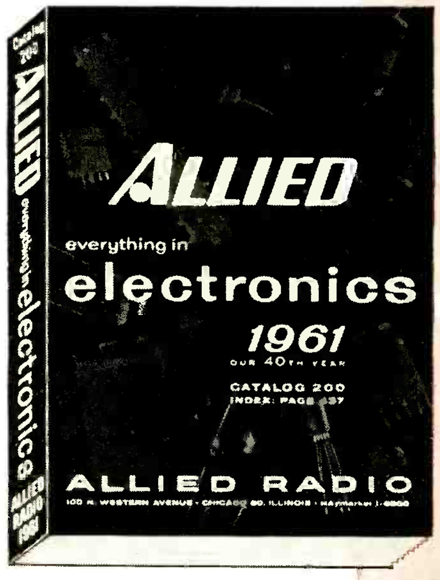

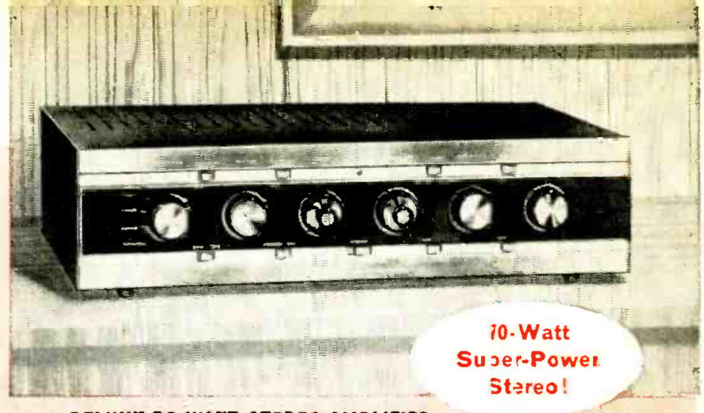

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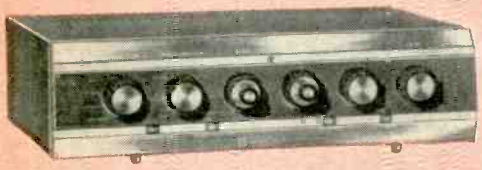

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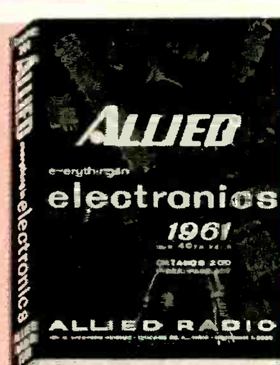

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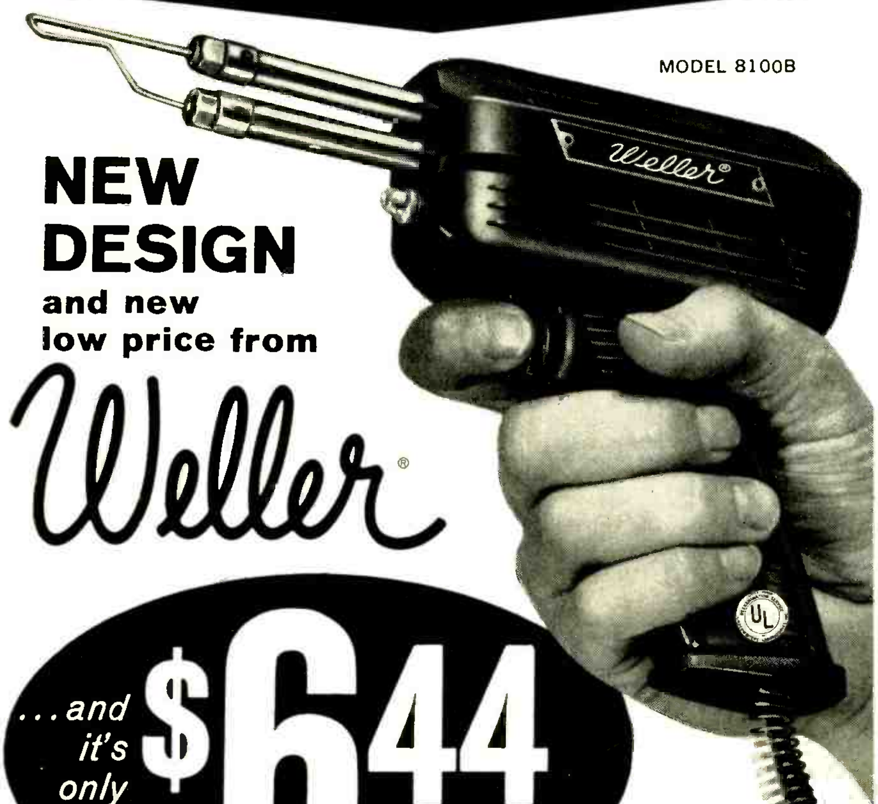

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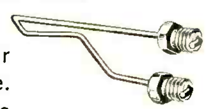

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(*Continued from page* 14)

wide-angle lens looking through an opening in the top of the cab. A 24-inch monitor is set so that it can be viewed from any part of the lobby. Two 17-inch monitors are placed at opposite ends of the 16-foot main desk so that they will be in direct view of the desk clerk at all times.

CALENDAR OF EVENTS

Conference on Electronic Techniques in Medicine and Biology, Oct. 31–Nov. 2, Sheraton Park Hotel, Washington, D.C.

IRE-EIA Radio Fall Meeting, Oct. 31–Nov. 2, Syracuse Hotel, Syracuse, N.Y.

Conference on Magnetism & Magnetic Materials, Nov. 14–17, New Yorker Hotel, New York, N. Y.

Mid-America Electronics Conference (MAECON), Nov. 15–16, Muehlebach Hotel, Kansas City, Mo.

Northeast Research & Engineering Meeting (NEREM), Nov. 15–17, Commonwealth Armory and Sheraton Plaza Hotel, Boston, Mass.

Northwest Hi-Fi Show, Nov. 25–27, Leamington Hotel, Minneapolis, Minn.

EIA Winter Conference, Nov. 29–Dec. 1, Fairmont Hotel, San Francisco, Calif.

Third Annual Futuronics Exposition, Nov. 30–Dec. 2, Roosevelt Raceway Exhibit Hall, Westbury, N. Y.

Vehicular Communications Meeting, Dec. 1–2, Sheraton Hotel, Philadelphia, Pa.

URSI-IRE Fall Meeting, Dec. 12–14, NBS Boulder Laboratories, Boulder, Colo.

Eastern Joint Computer Conference, Dec. 13–15, New Yorker Hotel and Manhattan Center, N.Y.

Radio Signals from Saturn

The Navy reports receiving "the first conclusive signals" from the planet Saturn. They were picked up by scientists at the University of Michigan, using that university's 85-foot radio telescope. This may make possible a study of the temperature and density of Saturn's rings, and of the distribution of gases in its atmosphere.

Signals were also picked up from a nebula so distant that the radio waves took 3,000 years to reach the receiving antenna.

World TV's up to 94 Million

The number of TV receivers in the world took a more than 10% jump during the 12 months preceding Aug. 1, 1960, to reach nearly 94,000,000, reports *Television Digest*. TV stations are now operating in 66 countries, with a total of 1,383 stations on the air in foreign countries, (plus 570 in the United States). First of the foreign countries in TV set ownership is Britain, with 10,900,000 sets, followed by Japan with 5,000,000, then by West Germany and Russia, with over 4,000,000 each.

Electrons Weld Metals

An electron gun is being used to weld molybdenum alloys and pure tungsten, according to Republic Aviation Corp. The metals are considered very useful for space-vehicle work because of their resistance to high temperatures.

A narrow beam of electrons from the gun raises the metal's temperature to the 6,000°F needed for welding. The gun operates in a cylindrical vacuum chamber that allows contamination-free welds. END

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Model 700
TRANSISTOR TESTER Dealer Net $24.25

Model 500
COMPONENT SUBSTITUTOR Dealer Net $29.95

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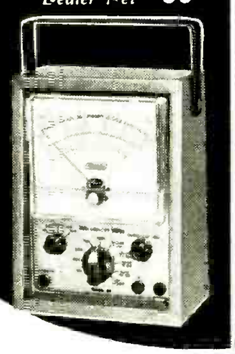
VOM-CAPACITY TESTER Dealer Net $39.95



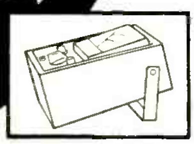
Model 600 **IN-CIRCUIT RECTIFIER TESTER** Dealer Net $27.50

Model 700—Tests all transistors and diodes quickly and accurately • Checks all transistors (RF, IF, Audio, Power Output, Industrial) for leakage and gain • Checks all diodes for forward-reverse current ratio • *No time consuming* reference to data charts necessary • *Positively cannot become obsolete* as the Model 700 will accommodate new transistors as they are introduced • Sturdy hammertone finish steel case • Size, 5⅞ x 7¾ x 3½".

Model 500 — Actually substitutes for 44 different values of resistors, condensers, electrolytics, power rectifiers, crystal diodes, power resistors and bias voltages. Substitutes: 20 values of resistors from 33 ohms to 10 megohms • 10 values of condensers .0001 mfd. to .5 mfd. • 10 values of electrolytics from 4 mfd. to 330 mfd. • Power rectifiers up to 500 ma. • Crystal diodes • Power resistance, continuously variable up to 5000 ohms • Voltages, continuously variable up to 15 volts either polarity • Sturdy hammertone finish steel case • Size, 5⅞ x 7¾ x 3½".

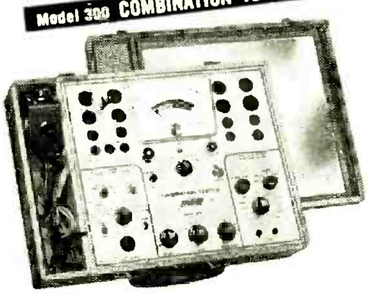
Model 400—A 20,000 ohms per volt VOM and an accurate capacity meter. DC VOLTAGE RANGES: 0 to 15/75/150/300/750/1500/7500 V. • AC VOLTAGE RANGES: 0 to 15/75/150/300/750/1500 V. • RESISTANCE RANGES: 0 to 1,000/100,000 ohms/0 to 10 megohms • RANGES: 0 to 75 microamps/7.5 ma./75 ma./15 amps. • CAPACITY RANGE: .001 mfd. to 80 mfd. • Sturdy hammertone finish steel case • Size, 5⅞ x 7¾ x 3½".

Model 600—Checks all power rectifiers *in-circuit* (whether SELENIUM, GERMANIUM, SILICON, COPPER OXIDE, etc.) rated from 10 ma. to 500 ma. • Checks with 100% effectiveness for quality, fading, shorts, opens, arcing, life expectancy • Simple to use: just clip test leads across rectifier under test *without disconnecting rectifier from circuit.* Press test switch and get an instant indication on the 3-color metal scales • Checks all power rectifiers out-of-circuit with equal effectiveness • Sturdy hammertone finish steel case • Size, 5⅞ x 7¾ x 3½".



New Mercury design projects meter forward . . . metal handle swings back to serve as rest so that instrument can be used in tilted position

Model 300 COMBINATION TESTER

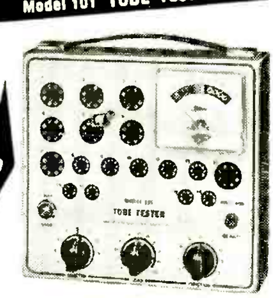


NOW also available in KIT form!

✓ A multiple-socket tube tester ✓ A CRT tester-reactivator ✓ A 20,000 ohms per volt VOM and capacity tester ALL COMBINED IN ONE COMPACT UNIT!

• AS A TUBE TESTER . . . will check emission, inter-element leakage and gas content of over 700 tube types • AS A CRT TESTER-REACTIVATOR . . . will test, repair and reactivate all black and white and all color picture tubes • AS A VOM AND CAPACITY TESTER . . . sensitivity is 20,000 ohms per volt/DC and 5000 ohms per volt/AC . . . Capacity range: .001 mfd. to 80 mfd. • Unbreakable mirror for TV adjustments inside detachable cover • Handsome wood carrying case • Size, 17½ x 13⅛ x 4½". Dealer Net $99.75

Model 101 TUBE TESTER



A versatile economy priced tube tester

• Checks quality (emission, shorts and gas) of over 700 tube types, including the newest series-string TV tubes, OZ4s, gas regulators, hi-fi and foreign tubes • Checks each section of multi-purpose tubes • Easy-to-read 3 color meter scales • 17 long lasting phosphor bronze tube sockets • Positively cannot become obsolete. New tube listing furnished periodically to all registered owners • Sturdy-gray hammertone steel case • Size: 9x 8½ x 2¾".

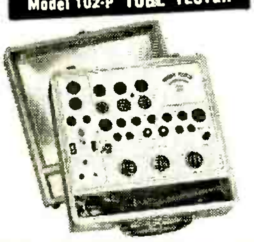
KIT – Dealer Net $31.95 WIRED – Dealer Net $39.95

Model 800 CRT TESTER-REACTIVATOR

✓ TESTS ✓ REPAIRS ✓ REACTIVATES all BLACK and WHITE and all COLOR picture tubes

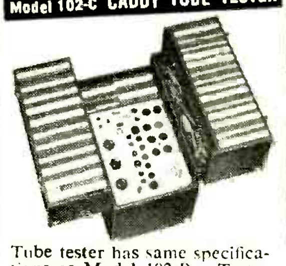
• TESTS . . . emission, inter-element leakage and life expectancy • REPAIRS . . . shorts and open elements • REACTIVATES . . . weak tubes with a controlled high voltage pulse (reactivation is seen and controlled on the emter as it takes place) • Tests the red, green and blue sections of color tubes separately • Also provides the newer 2.35 and 8.4 filament voltages • Unbreakable mirror for TV adjustments inside detachable cover • Handsome wood carrying case • Size 11 x 9½ x 4½". Dealer Net $49.95

Model 102-P TUBE TESTER



Same specifications as the Model 101 • Also tests picture tubes, all diodes, rectifiers, fuses, pilot lamps • Unbreakable steel mirror for TV adjustments inside detachable cover • Handsome wood carrying case. Dealer Net $59.50

Model 102-C CADDY TUBE TESTER



Tube tester has same specifications as Model 102-P • Tester is removable • Extra storage compartment under tester • Drawer for tools and test leads • Unbreakable mirror mounted under tester case for TV adjustments. Dealer Net $74.50

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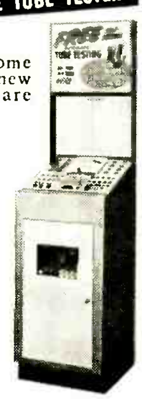

Cannot become obsolete as new tube types are introduced!

Model 201-F (floor model) Dealer Net $158.50

Model 201-C (counter model) Dealer Net $109.50

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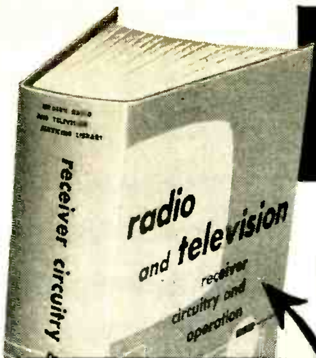

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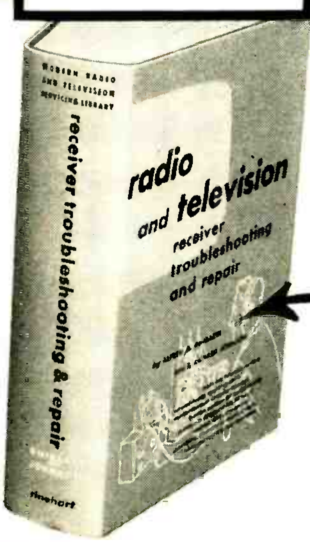

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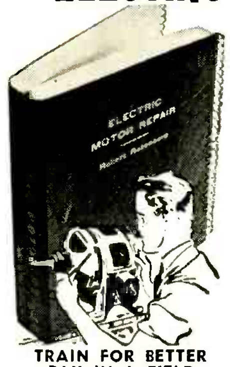

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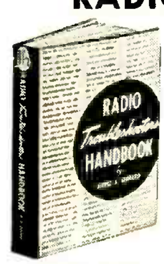

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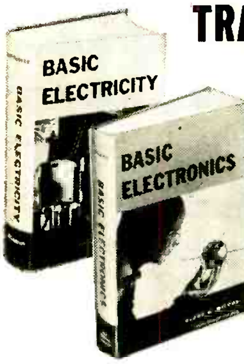

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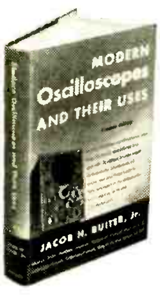

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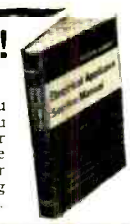

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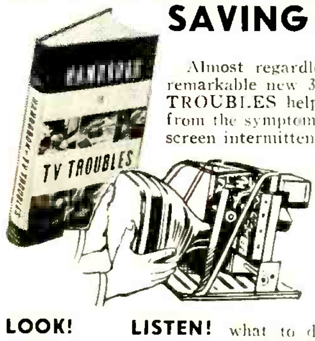

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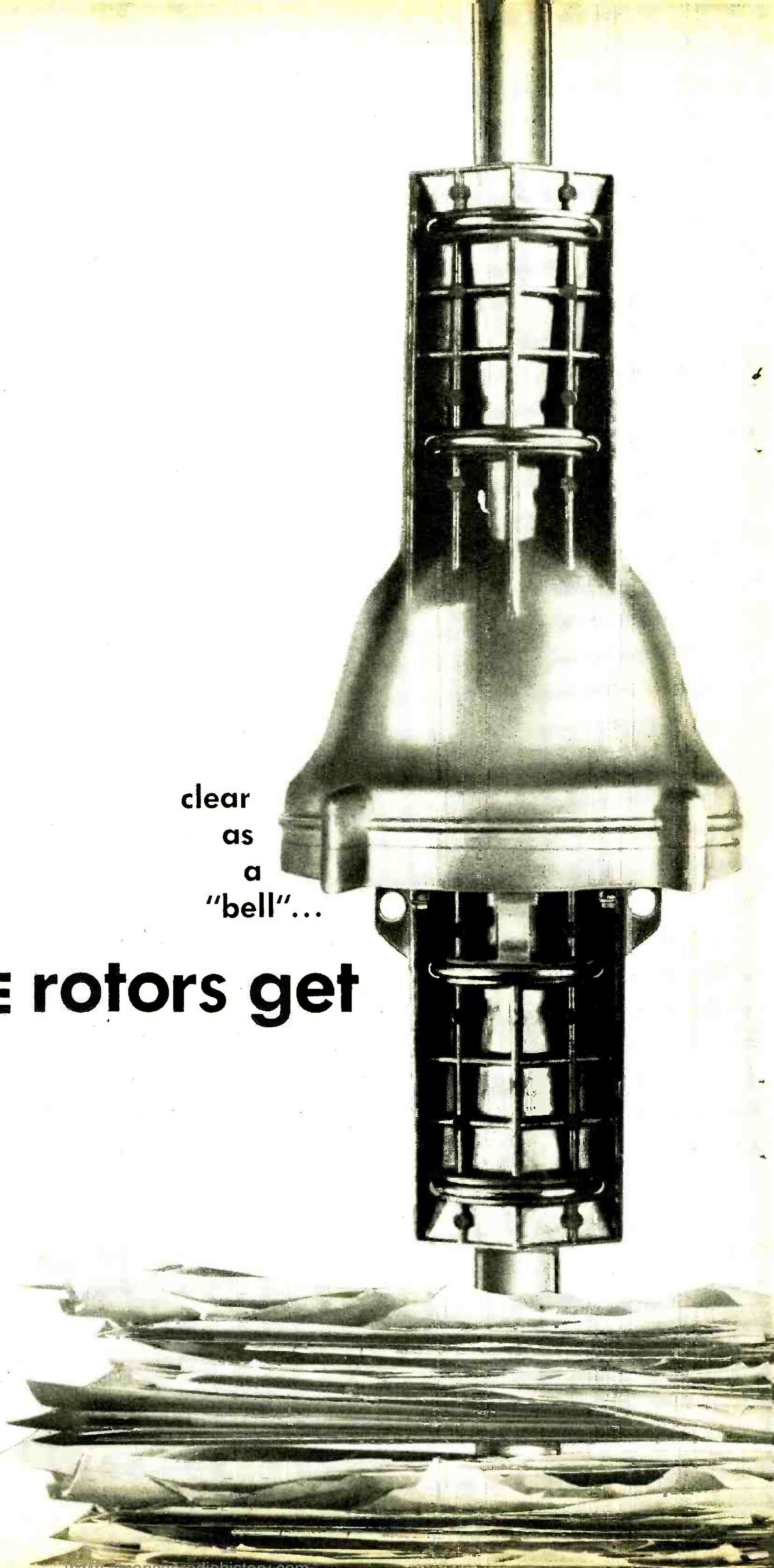

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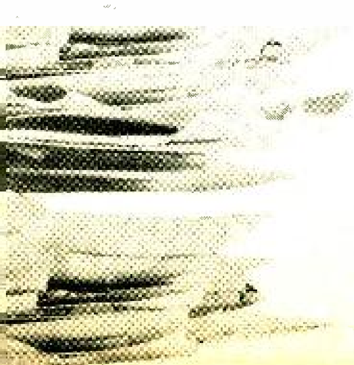

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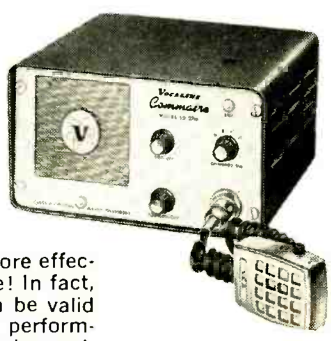

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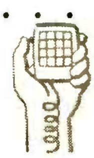

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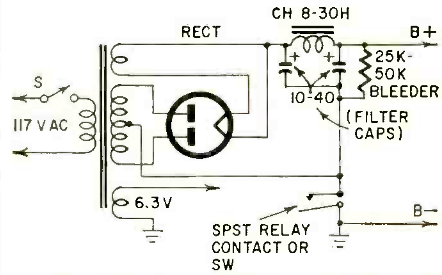
REPORT FROM A USER

Dear Editor:

I was very interested in "How to Obtain Faster Break-in" which appeared on page 137 of the March, 1960, issue. It showed how to remedy the problem of slow recovery in radio receivers when the amateur throws his T-R switch from *Transmit* to *Receive.*

I was having a terrific amount of trouble with this problem and I thought I would give this idea a try. I was amazed at how perfectly the change in circuitry solved my problem. No matter how fast I flick my T-R switch, I don't get any of that annoying leftover signal from the transmitter.



Since I have made this change, a number of other hams in this area have made this modification too and all report equally perfect results.

J. Dante Amorose—K4IIW
Richmond, Va.

[*Thanks for the note of appreciation. And for those readers who missed this item we are reprinting the switching circuit here.—Editor*]

FOR TV TECHNICIANS

Dear Editor:

The "Philadelphia Plan" announced in the August Technicians' News column seems worthy of comment.

How large a portion of the wholesaler's business is involved with the over-the-counter cash sale? It can't be much or the wholesaler would not be willing to relinquish it and take on the added burden of accounting and making the "kickbacks" to the various service shops. Now, then, when this very small portion of the total volume of business is divided between the individual service shops, how much have you really gained?

Then the cost. The cost of the wholesaler has already been mentioned, but now that you are demanding the retail profit you must bear the retail load, that of maintaining a retail stock over and above your bench stock items. This takes space and capital. It can't be circumvented by telling the customer to come back later while you obtain the desired items. And what is the consumer's reaction to all this? He will certainly become incensed at you, the neighborhood service shop, especially when he learns of the "kickback gimmick" on top of the drastic increase in cost.

The TV service industry in general has never done much toward enhancing its customer relations in the past and this latest maneuver is not going to improve the situation. Why did the man take to trying to fix his own TV in the first place if he felt that he was being treated fairly by his local service man?

Consider the auto repair business. It has lived with this problem a long time. It succeeds by rendering service and not through selling parts. The car owner can still buy his own parts and do his own work if he so chooses. But he can usually get the work done better and quicker at the local garage. He goes there.

The "Philadelphia Plan" certainly typifies the type of thinking that has made the TV service industry "sick" in the first place.

MAJOR WILLIAM M. PRICE
Little Rock AFB, Ark.

[Technicians! How do you feel about this?—*Editor*]

DANGEROUS TEFLON

Dear Editor:

Referring to the article "Solder Removal Made Easy" on page 68 of the June issue. The use of Teflon tubing to pick up molten solder can be very dangerous since the decomposition products are highly toxic.

Above 200°C, Teflon gives off fumes which, if inhaled, has caused polymer fume fever. Deaths have occurred when granular or dispersion polymers were heated above 300°C.

Particles of Teflon must not be allowed to contaminate cigarettes and they must not be carried where contamination is possible.

If someone were to apply this method of solder removal with the use of a torch, it is possible that death could result.

LEE E. VANDERVEER
Ludington, Mich.

AUTHOR'S REPLY

Dear Editor:

Mr. VanderVeer's comments concerning toxic products of decomposition of Teflon are well known and do apply for steady-state thermal conditions such as those obtained from heating a solder joint with a torch. However, under transient thermal conditions such as the application described in my article, appreciably higher temperatures can be tolerated without the danger of Teflon decomposition. The system described in the article was developed for use in the removal of solder from terminal connections in complex miniature electronic assemblies, not in plumbing work. A torch of any kind is never used for this kind of work; only low-wattage soldering irons.

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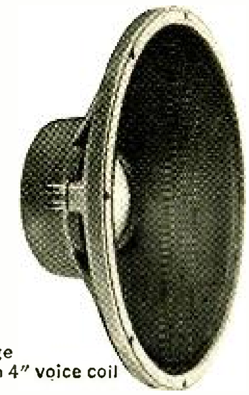

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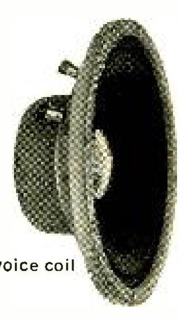

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This technique has been used successfully in many applications throughout the electronics industry for more than 3 years without any reported difficulty.

WILLIAM J. MCGUINNES
Rochelle Park, N. J.

DON'T TRY THIS!

Dear Editor:

The legitimate TV service dealers in our area operate under a hardship today. They're getting a black eye from the malpractices of a few jackleg and back-alley shops and from customers who move here and then complain that their TV goes out more frequently than it did at "home."

"Here" is Sarasota, Fla., a coastal town, and the heat, humidity and salt air are all adverse factors. Even with a new set, a Sarasotan can expect more TV breakdowns than he did in the North.

For this reason, our service operation embraces two factors. We won't accept for repair any set that is 8 to 10 years old, because to do a good job on such a dog would involve the customer in exorbitant costs and bring cries of "gyp."

Also, since customers are madly adverse to "labor charges," we often submit an invoice which, instead of listing $1.50 for parts and $7.50 for labor, lists $7.50 for parts and $1.50 for labor. That keeps the customers far happier than a small amount for parts and a high labor charge.

NAME WITHHELD
Sarasota, Fla.

[Your billing technique sounds nice, but can get you into trouble. What happens when the Better Business Bureau or a local newspaper comes around, traps you with a gimmicked set; and discovers that you are charging for parts you didn't replace? That's the kind of billing that can put you out of business.—*Editor*]

CORRECTION PLEASE

Dear Editor:

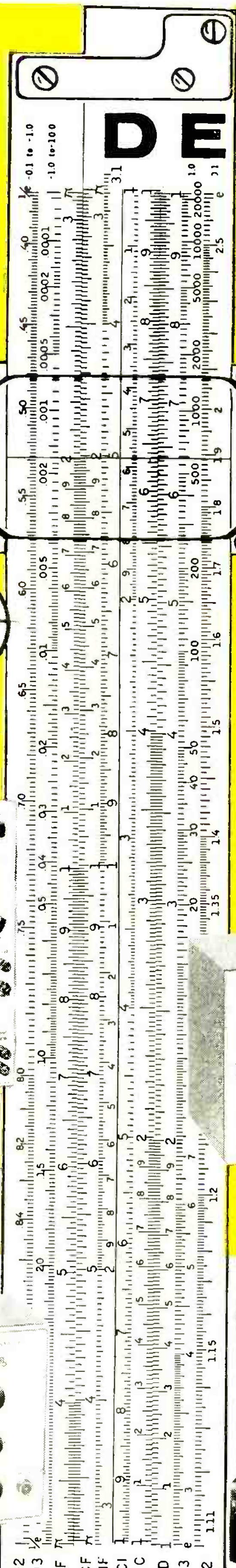
In my article "Radio Waves and Life" (September issue), the third paragraph on page 45 states that the field reduced the stimulation of secretion of digestive juices when atropine had been injected.

This is incorrect as was pointed out by Dr. Jarrett of Phoenix, Ariz. The correct version is:

The field reduced the *inhibition* of digestive juices when these were inhibited by the drug atropine.

TOM JASKI
San Mateo, Calif.

END



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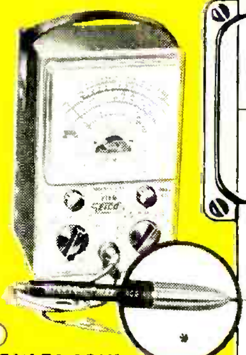

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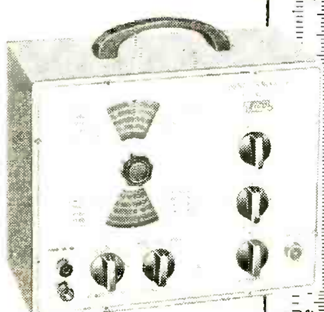

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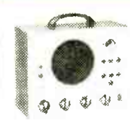

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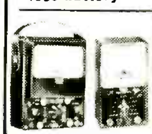

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HF87 70-Watt Stereo Power Amplifier. Dual 35W power amplifiers identical circuit-wise to the superb HF89, differing **only** in rating of the output transformers. IM distortion 1% at 70W; harmonic distortion less than 1% from 20-20,000 cps within 1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

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

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

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

AF4 Economy Stereo Integrated Amplifier provides clean 4W per channel or 8W total output. **Kit $38.95. Wired $64.95.** Incl. cover & F.E.T.

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

HFS3 3-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.) 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26⅜" x 13⅞" x 14⅝". Unfinished birch. **Kit $72.50. Wired $84.50.** Walnut or mahogany. **Kit $87.50. Wired $99.50.**

HFS5 2-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, ⅝" excursion. 8" woofer (45 cps. res.), & 3½" cone tweeter. 1¼" cu. ft. ducted-port enclosure. System Q of ½ for smoothest freq. & best transient resp. 45-14,000 cps clean, useful resp. 16 ohms. HWD: 24" x 12½" x 10½". Unfinished birch. **Kit $47.50. Wired $56.50.** Walnut or mahogany. **Kit $59.50. Wired $69.50.**

HFS1 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. 8 ohms. HWD: 23" x 11" x 9". **Kit $39.95. Wired $47.95**

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

New Stereo/Mono Automatic Changer/Player: Jam-proof 4-speed, all record sizes, automatic changer **and** auto/manual player. **New** extremely smooth, low distortion moisture-proof crystal cartridge designed **integrally** with tonearm to eliminate mid-range resonances. **Constant** 4½ grams stylus force is **optimum** to prevent groove flutter distortion. **No** hum, turntable attractions, acoustic feedback, center-hole enlargement. Only 10¾" x 13". **1007S:** 0.7 mil, 3 mil sapphire, **$49.75.** Incl. F.E.T. and "Magnadaptor."

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

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

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FUTURE SPACE TRAFFIC

. . . Tens of Thousands of Spacecraft will Soon be Aloft . . .

As this is written (at the end of August), 34 space vehicles are in orbit. The United States accounts for 26, the Soviet Union 8. Still transmitting data to earth are 10—US 9, Soviet Union 1. The rest—i.e., 24 space vehicles—either through mechanical malfunction or for electronic reasons, are still gravitating in space, voiceless and signal-less, silent.

This is the short and epic 3-year record of man's first excursion into space, above the earth's atmosphere, since the advent of Sputnik I—the true start of the Space Age, on Oct. 4, 1957. What of the future, immediate and distant?

Columbus and the intelligentsia of 1492 certainly never dreamt what the opening of the New World could mean to mankind—riches beyond imagination, steamships that transport 3,000 people across the Atlantic in a little over 4 days (it took Columbus 70), speaking under and above the ocean, flying over it in 6 hours and less, seeing across the ocean by television (Baird on Feb. 8, 1928). Certainly no one alive in 1492 would have had the temerity to predict such "arrant nonsense"!

Likewise, we of 1960 are often prone to look at the conquest of space now in the making as an enigma, wrapped in doubt and disbelief, that appears of little consequence to humanity at large.

Let us then push aside the thick veils of the future and examine some of the possible scientific predictions of the Space Age. Remember always that space is a new and completely alien and harsh world, never visited by living man before.

Extreme heat and cold, dozens of harmful radiations—many deadly, weightlessness, a variety of gravitational effects, meteorites and other matter flying at the rate of over 10 miles *a second*, a total vacuum—these are only a few conditions in this new world never experienced by man.

Let us stay for a few moments with only one branch of space vehicles, the satellite type that circles the earth in orbit from 250 to thousands of miles above. We mentioned that at this moment there are 34. In time there will be many thousands of every imaginable type. By the end of this century there will certainly be more than 10,000 earth, lunar and other planetary satellites of every description of dozens of nations. Many will be for research, many for communication purposes. They will be of all sizes, from a few feet to thousands of feet in diameter. Most will be automatic, highly sophisticated unmanned ones; others will be manned.

***Hovering observatories* will be "stationed" 22,238 miles above the equator. Seen from the earth, they will appear stationary as they travel at about 6,882 miles per hour, which compares to the surface speed of 1,000 miles an hour at which the earth revolves.* Equipped with *light amplifiers*, three such observatories, spaced equidistant over the equator, can directly view and photograph any part of any country (except the polar regions) and spot any activitiy such as troop movements, intercontinental missiles when launched, weather conditions such as cloud formation and cyclones, ice patrolling and hundreds of other activities.**

All space observatories will also be equipped with the most modern and sensitive infrared receiving equipment. Even with present-day equipment, it would be possible to detect a multitude of heat effects at a distance of 22,238 miles overhead, *even through overcasts*. In the future the stationary space observatories will do vastly more refined observing and detecting of many activities on the earth—particularly for military purposes.

Also connected by cable to every floating observatory will be a huge aluminized plastic ball or sphere from 750 to 1,000 feet in diameter. The three observatories, stationed equidistant around the earth 22,238 miles over the equator, will reflect from their spheres ALL electronic long-distance, national and international communication traffic, be it radio, TV, telegraph or telephone, or other signaling. Signals can be directly bounced from earth against the reflecting balls, then returned to earth. Others, to reach the antipodes, will be relayed between the observatories, then transmitted to their destination.

By the time the observatories are in space by the end of this century, it is almost certain that all spacecraft will be propelled by atomic power. This will be true of satellites as well as interplanetary spaceships.

Won't there be many collisions in space between these tens of thousands of spaceships, satellites, observatories and dozens of other types of spacecraft? Not at all—certainly many fewer than between the thousands of propeller and jet airplanes now crowding the air lanes. All present air traffic moves in a thin space less than 50,000 feet thick. Future space traffic will be dispersed into millions of miles. There could be tens of millions of spacecraft maneuvering in space without fear of collision. The only possible danger will come when thousands of space vehicles descend *en masse* toward the earth to land.

Inasmuch as all landing craft must have permission to alight, exactly as aircraft today, collisions will be a rarity. This will even be more true than now, because future spacecraft will not require long landing strips. *All* space vehicles of the future will descend *vertically* into rather small numbered spaces, many flights terminating on top of city skyscrapers, just as helicopters do now.

Will not our communications spectrum be severely overloaded with all this tremendous traffic between earth and tens of thousands of satellites, observatories, spaceships to and from the planets?

Fortunately not. There is sufficient room in the radio-frequency spectrum to accommodate 300,000 simultaneous separate communications at a minimum.

Incidentally, once thousands of interlunar and interplanetary spaceships are in transit, they probably will *not* communicate directly with the earth at all. There will be an interplanetary communication center on the airless moon, its sole purpose being to clear all distant message traffic, which then will be relayed to earth on special frequencies. Even communications between the various spaceships will be via the moon center, unless the spacecraft are near each other, which probably won't be too often. —*H.G.*

*At an altitude of 22,238 miles, the observatories must travel nearly 7 times as fast as the earth's speed at the equator.

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ELECTRO

By DR. BERNARD S. POST*

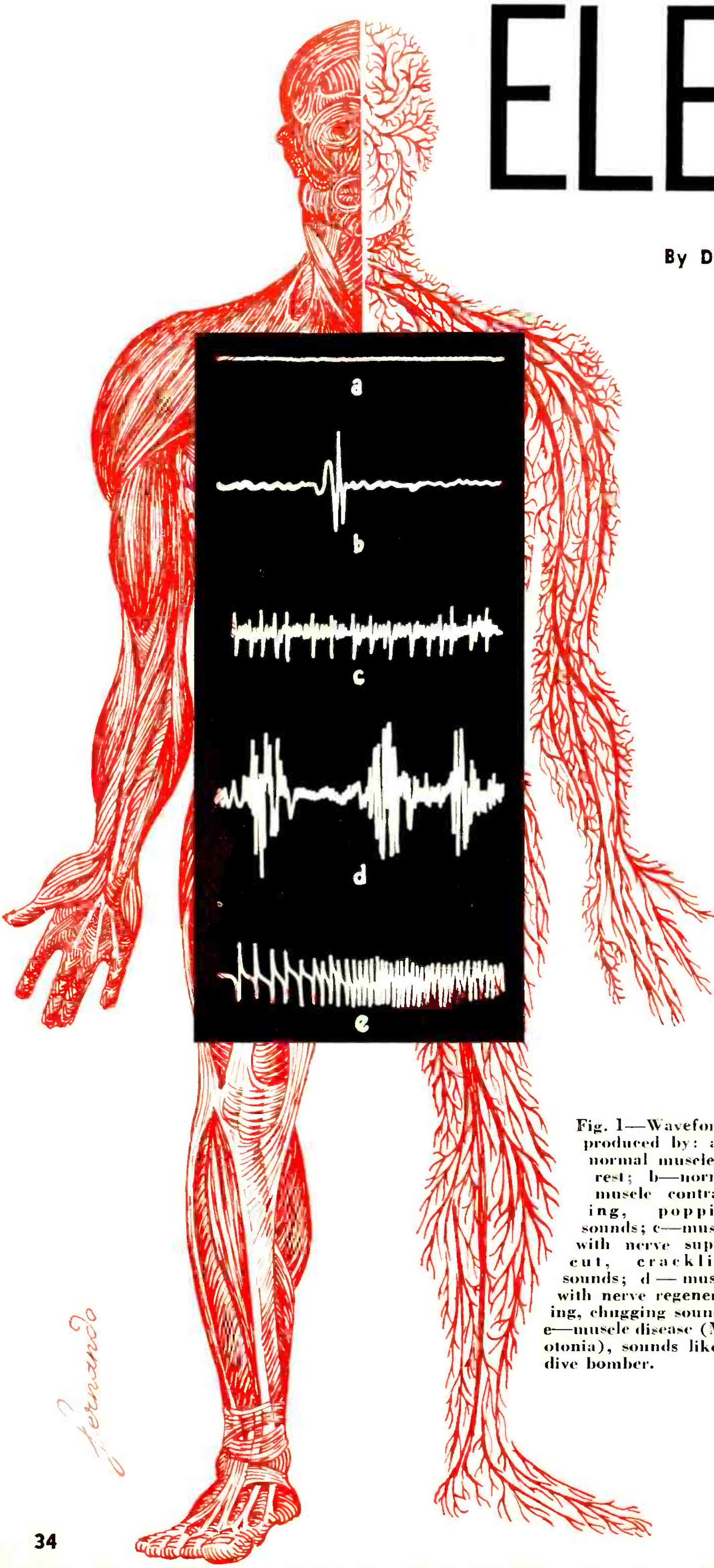

Fig. 1—Waveforms produced by: a—normal muscle at rest; b—normal muscle contracting, popping sounds; c—muscle with nerve supply cut, crackling sounds; d — muscle with nerve regenerating, chugging sounds; e—muscle disease (Myotonia), sounds like a dive bomber.

ELECTROMYOGRAPHY is an electronic method of measuring and recording the electrical activity of muscles. It is a valuable diagnostic tool in the hands of a competent operator. Most often used in physical medicine, neurology, orthopedics and neurosurgery, it has many applications in other fields, including research. The high incidence of muscular and nervous-system injuries during World War II, and more recently during the Korean conflict, served to speed up the development of electromyographic techniques.

A normal muscle at rest emits no detectable electric signal but in action or in certain abnormal states of the muscle (or of the nerve connected to it) waveforms are produced. The shape of these waves varies with the condition that causes them. For instance, a normal muscle contraction will produce a tracing like that of Fig. 1-b. The amplitude of the waveforms varies between approximately 100 and 1,500 μv, with a frequency of 5 to 30 per second or higher, depending on the intensity of the muscular contraction being measured. The average duration of the spike is about 5 to 10 milliseconds. The waveform is bi- or triphasic in character. Other characteristic waveshapes are also shown in Fig. 1. Most are abnormal and are found in disease states or injuries.

Electrodes

The action potentials are picked up with a needle electrode which is pushed through the skin into the muscle being examined. Three types of needles are in use (Fig. 2). The first, a monopolar type, consists of a plain sewing needle passed through a cork and insulated completely except at its very tip. Such an electrode must be used with a reference electrode on the skin to complete the circuit. This reference electrode sets up numerous problems due to skin current and the distance between electrodes. The second and third types are hypodermic needles fitted with either one or two wires through the needle bore and insulated from the needle shaft (and in the two-wire case, from each other). If one wire is used, it is called a single coaxial electrode. If two

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MYOGRAPHY

Waveforms produced by contracting muscles are helpful in diagnosing muscle and nerve disorders

are used, it is referred to as a double coaxial electrode. Again the shaft of the needle is insulated except at its tip.

The advantage of the coaxial electrode is that it makes it possible to contact individual muscle fibers, since the tip of the needle electrode is a complete circuit unit only a fraction of a millimeter in size. This is approximately equal to the size of the individual muscle fiber or collection of fibers (known as a motor unit), which are controlled by only one nerve fiber. When a double coaxial needle is used, the shaft of the needle is connected to ground, since the second wire inside the bore acts as the reference electrode. Ground electrodes are used to minimize the effect of stray pickup and interference.

The signals from the needle electrode are fed to the input grids of a preamplifier having a very high noise-rejection ratio, flat low-frequency response and high-frequency-cutoff circuitry. The preamplifier output is fed into a multistage differential amplifier with gain enough to produce an increase in signal strength of at least 100,000. This amplifier is designed to produce the absolute minimum of waveform distortion. The output stage of this amplifier is coupled to the vertical amplifier of an oscilloscope and a tape recorder (for restudy when convenient). Pictures of the waveform may be taken later during the tape playback by arranging a triggering mechanism in the oscilloscope sweep circuit. This synchronizes the opening of the camera shutter with the sweep. Note in the block diagram (Fig. 3) that a calibration circuit is also built into the system. Also shown is a separate audio power amplifier (Fig. 4) of standard hi-fi quality which allows the low-frequency impulses to be heard through a loudspeaker. This is possible because all the muscle impulses fall within the lower end of the audio spectrum.

The different sounds produced by the various waveforms are very useful to the examiner because each is characteristic of a particular condition. After some experience with the electromyograph, an individual can recognize an abnormal condition by sound alone. Some muscle impulses produce sounds like static noise in a radio, others like a diving airplane, still others like machine-gun fire or a diesel locomotive or the chugging of an old model-T Ford.

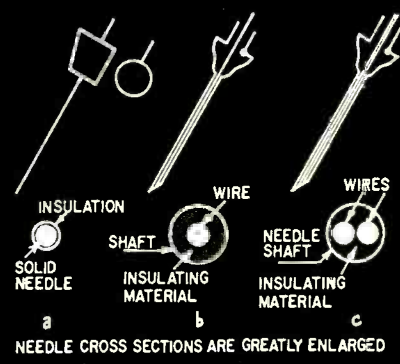

Fig. 2—Various needle electrodes and their cross-sections: a—monopolar (single wire) with reference electrode; b—single-wire coaxial (most commonly used); and c—two-wire coaxial.

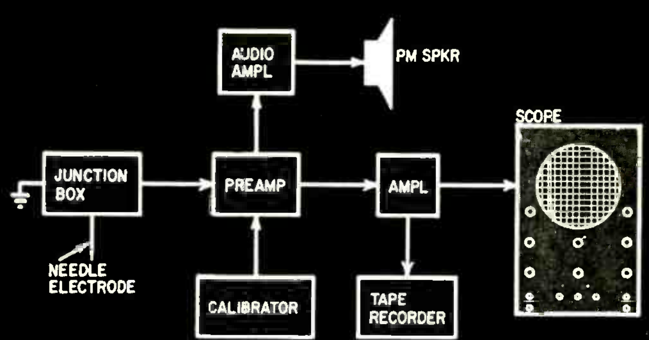

Fig. 3—Block diagram of an electromyograph.

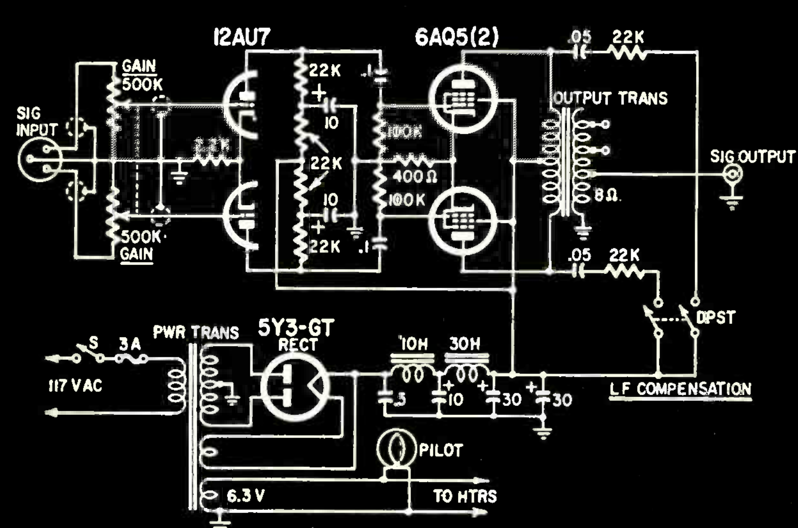

Fig. 4—Audio amplifier used to reproduce the sound of muscle contractions.

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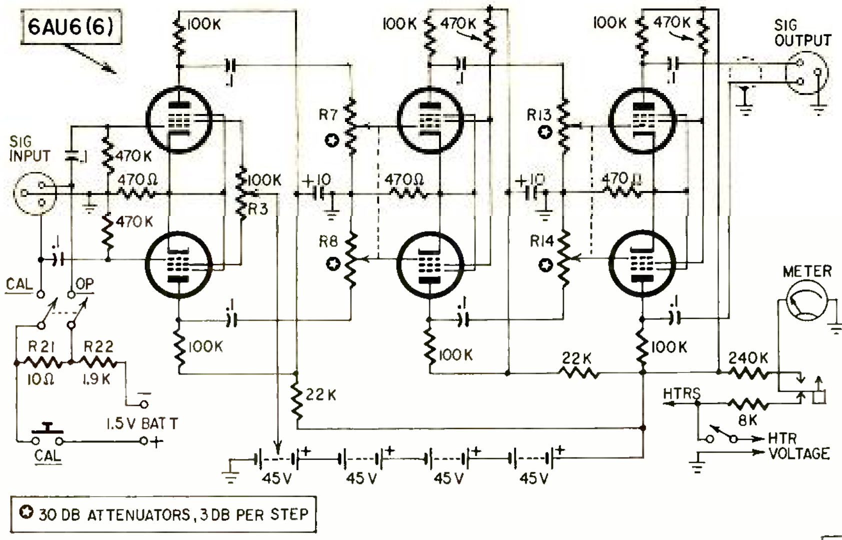
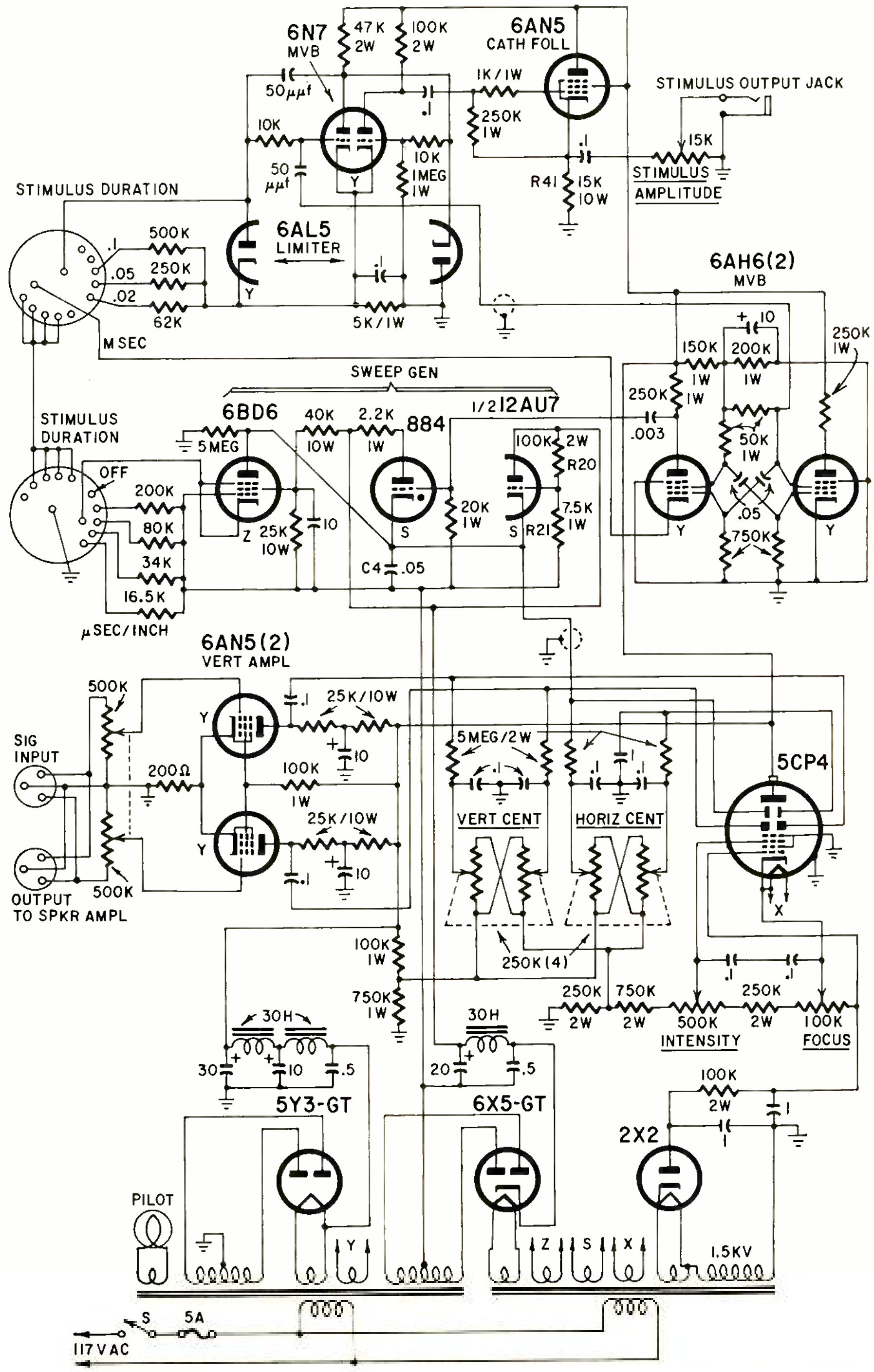


Fig. 5—Schematic of combination preamplifier, amplifier and calibrator.

Fig. 6—Schematic of oscilloscope and muscle stimulator.



This is not the whole list; there are many others.

Circuitry

The basic circuitry of the electromyograph is shown in Fig. 5. (Since manufacturers tend to object to having the diagrams of their particular instruments published, this is a generalized schematic.) It consists, first, of a high-gain, low-noise, balanced push-pull preamplifier with a built-in calibrator. There are three stages of push-pull R-C coupled voltage amplification. Because of the tandem balance attenuators R7, 8, 13 and R14, linear amplification of all input voltages can be obtained. Each attenuator has a loss of 3 db per step. The frequency response is flat ±1.5 db from 10 to 4,000 cycles.

Extraneous electrical interference is reduced without shielding by the screen-grid balancing potentiometer R3. Since most of such interference appears as a grid-to-ground signal, R3 can be varied to make the unwanted signals equal in amplitude. Since they are already 180° out of phase, they cancel each other out. Tubes are shock-mounted to prevent vibration. Precision wire-wound resistors in the first stage plus careful shielding reduce inherent noise still further.

The calibrator circuit consists of a 1.5-volt battery, R21, 22 and a push-button. When the OP–CAL switch is turned to CAL, depressing the CAL button introduces an 0.8-mv square-wave pulse. The vertical gain on the oscilloscope can then be adjusted to the desired deflection height. A well filtered power supply may be used in place of the batteries.

The preamplifier output is fed into the vertical amplifier of the scope (Fig. 6). This consists of two 6AN5's which, because of their high transconductance and high plate current, deliver a high voltage across a low plate-load impedance. This produces linear deflection because the beam leaves the face of the scope before the tubes are driven past the linear portion of their characteristic curve. The sweep generator

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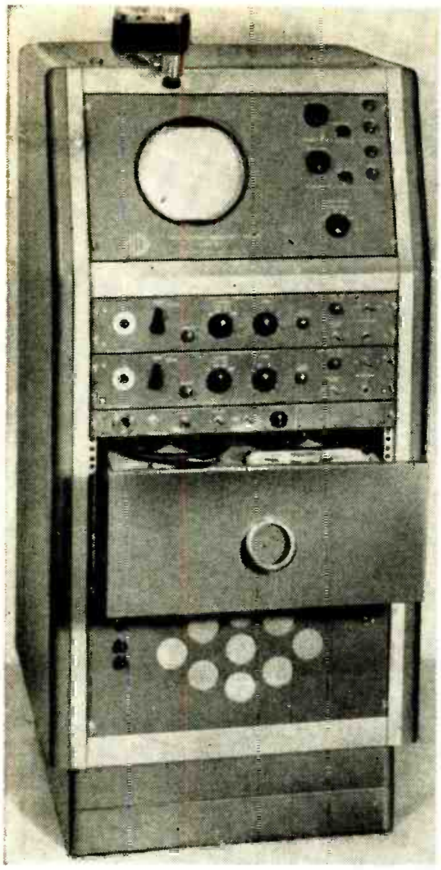

TECA Corp. two-channel electromyograph model TE-2-7.

employs an 884 thyratron, a 6BD6 constant-current pentode and half of a 12AU7 limiter. Normally the 884 thyratron is biased to cutoff and is prevented from flashing or conducting by the 12AU7 limiter connected in parallel with it. However, a positive pulse from the multivibrator raises the grid bias of the thyratron, causing it to conduct and thereby charging C4. This capacitor is then discharged at a linear rate through the 6BD6 constant-current pentode. When the potential across C4 drops to a low value, the grid of the 12AU7 limiter is driven positive with respect to the cathode (since the cathode is made more negative than the bias on the grid by R20 and 21). As a result, the 12AU7 conducts heavily, preventing further conduction by the thyratron until the next positive trigger pulse arrives from the multivibrator.

The multivibrator itself consists of two 6AH6 pentodes in which the screen grids are used as plates for the switching action. The circuit provides positive pulses for triggering the sweep generator and negative pulses to trigger the muscle-and-nerve stimulator circuit. The frequency is set at 7.5 cycles. The square-wave pulse from the appropriate plate of the multivibrator is passed through a differentiating network to produce the sharp, positive trigger pulse for the sweep generator. The negative trigger pulse is obtained from the grid of the nonconducting tube of the multivibrator as it suddenly swings negative. The output of the stimulator circuit is a negative square-wave pulse with a frequency of 7.5 cycles. The duration of each impulse may be set at 1, 0.5 and 0.2 millisecond. The amplitude can be varied from 0 to 90 volts. The stimulator employs a 6N7 one-shot multivibrator triggered by the negative pulse just described. The output, a negative square wave, is passed through the 6AN5 cathode follower. This arrangement minimizes distortion of the square-wave stimulus. Plate current of 6AN5, which is normally conducting heavily, is reduced by the negative square-wave input from the 6N7. The current decrease through R41 results in a negative square-wave output. Stimulus duration is kept constant by the 6AL5 duration limiter which stabilizes the grid-voltage excursions of the two triode sections of the 6N7.

The power amplifier (Fig. 4) is a two-stage resistance–capacitance-coupled circuit, with frequency compensation in the plate circuit of the first stage. The output is flat from 10 to 10,000 cycles, but the lows may be accentuated and the highs attenuated by switching in the low-frequency booster. The output is 6 watts undistorted. Careful attention to power-supply design is responsible for the very low hum level.

Commercial equipment

It is worth mentioning at this point that a number of commercial pieces of equipment are available for electromyography. One of these is seen in the photo. This is a two-channel unit with a twin-gun scope and a two-channel tape recorder (using both halves of a standard ¼-inch tape). This machine also incorporates a muscle-stimulator circuit for use during the examination. The two channels give the advantage of being able to compare one side of the patient with the other. The second channel may also be used for simultaneous display of any other related physical parameters such as force, pressure or rotation by means of suitable transducers. The dual-beam 7-inch cathode-ray tube used has a P7 screen (a short-persistence blue spot followed by a long-persistence yellow-green afterglow).

The tape recorder will record any pattern which can be displayed on the cathode-ray-tube screen. It has a bias-and-erase oscillator and a recording amplifier for each channel. The electromyographic amplifiers are used for tape playback to obtain good low-frequency response and a low noise level. Relays in each amplifier switch the amplifier input to the tape playback heads and also insert correction networks within the amplifiers to compensate for the nonlinear frequency response of the tape. Information stored on tape during electromyography may be played back through the loudspeaker and the cathode-ray display system for study or photorecording as well. The tape-recorder mechanism uses three motors and electrodynamic tensioning in its design, eliminating slip clutches and mechanical complexities (and a need for critical adjustment).

The technique of electromyography is still in its infancy and there will no doubt be many changes in instrumentation in the near future (since most of the larger institutions are now beginning to use this important diagnostic tool). Extremely important information is being obtained with this technique in the research on such diseases as polio, muscular dystrophy, myasthenia gravis and many others. It is hoped that some of the answers being sought lie in electrical abnormalities in muscle and nerve tissue. This is what makes medical electronics so important (beyond pure instrumentation). Other phases of its application will be discussed in future articles. END

Nobody gets fooled in RADIO-ELECTRONICS!

Fast operating tube salesmen are not permitted to try their shell game in the advertising pages of Radio-Electronics. Since January 1956 we have insisted that mail order tube advertisers tell you directly if the tubes they were selling were either new and unused, or imperfect if that was the case. It's cost us money in advertising but saved our readers more than just embarrassment.

FINALLY MAKES IT

Radio's "dead dog" now begins to look like the wave of the future

By DAVID LACHENBRUCH

JUST 4 years ago, FM radio was officially "dead" as a broadcasting medium. Its phenomenal rise immediately after World War II was nipped in the bud in the late 1940's by the coming of television. Now there was nothing left to do but call in the undertaker and fight over the will. It seemed that the only legacy FM would leave was the valuable spectrum space between 88 and 108 mc, and the heirs (various nonbroadcast services) were already fighting over it.

But the corpse refused to lie down for the funeral oration. Artificial respiration by about 500 FM broadcasters, a handful of radio manufacturers, several thousand hi-fi enthusiasts and the Federal Communications Commission kept it breathing.

If FM died in 1950—as many people believed at the time—today it's a very lively zombie. And now, for the first time since 1948, its future seems virtually unlimited.

To get an idea of the kind of comeback FM radio has made, look at the charts showing FM stations on the air and factory sales of FM receiving devices (Figs. 1 and 2). In both leagues, you will see that FM is setting an all-time record in 1960.

Immediately after World War II, FM was hailed as "radio's second chance" and the first FM boom was on. By 1946, the FCC had authorized more than 1,000 FM stations—many of them to recently discharged veterans who wanted to get a foothold in this new and superior type of radio broadcasting.

In 1948, when nearly 700 FM stations were on the air, radio factories sold 1,600,000 FM radios and tuners. But things were far from rosy.

A new type of broadcasting suddenly was creating public excitement—broadcasting you could see! Television was here, and as picture tubes got larger, speakers got smaller. Radio became an appliance for the kitchen, the bedroom, the car. Music was just a thrumming noise to beat eggs to or to keep you awake on those new turnpikes.

By 1954, FM radio production had dropped to an annual rate of less than 200,000 sets. There were still about 550 FM stations on the air to provide some programming for the listeners who were stuck with FM sets, but the vast majority merely broadcast the programs carried on their sister AM stations (at just about the same fidelity).

From this low point, let's look at what is happening in 1960. By mid-year, there were already 741 FM broadcast stations on the air—ahead of the record 730 in late 1959. There would be more, except that there weren't enough channels to go around—and applicants were competing with each other to prove their qualifications to operate FM stations in such cities as Los Angeles, New York, Chicago, Philadelphia and Washington.

This year, too, will see FM receiver production and sales exceed 1948's record by perhaps as much as 30%. Our estimate is that factory production of sets designed for sale in the US will total close to 2,000,000 units this year, possibly even more.

At the mid-point of 1960, the FCC had authorized another 169 applicants to broadcast on the FM band—in addition to the 741 already on the air. Of the stations on the air, a large proportion were broadcasting special programs on FM only—even those stations who also owned AM outlets.

And there seemed to be no end to the applications flowing into the FCC for new FM stations. An FM expert at the commission estimates that by the end of 1961 there will be more applications than there are available FM channels in most cities with a million or more population.

The Los Angeles area already has 28 FM stations compared with 21 on AM. In New York City and environs there are 23 FM stations and 24 AM; San Francisco and its suburbs have 19 FM stations to 21 AM outlets.

And people are listening! No reliable set count has been made, but it's estimated that at least 10,000,000 FM sets are now in regular use. That's one out of every four households in the country, even though many rural and small-town areas aren't yet adequately served by FM stations.

Why the big boom now? The common and most obvious answer is that people have become more conscious of good music and high-fidelity sound reproduction. But there's more to it than that.

There couldn't be an FM boom if there were no stations. The 500-odd (and some of them were quite odd) FM stations which hung on during the lean years did it mainly from force of habit. It didn't cost much to keep the FM transmitter operating, repeating AM programs. And there was still a hard core of rabid hi-fi FM fans, who would raise a ruckus if the stations went off the air.

Some broadcasters did deliberately knock their FM outlets off the air for a week or so just to see if there would be adverse reaction. There was. So they knew somebody was listening.

But there was still no way to make money out of FM broadcasting. A few stations tried simplex operation (broadcasting to restaurants and businesses) with special equipment to eliminate commercials in these establishments.

Simplexing was outlawed when FCC established multiplexing rules. Today, 208 FM stations are authorized by the FCC to multiplex (transmit a special program in addition to the normal one, and unheard by the regular listeners) for various purposes, most of them for special storecasting and functional music services. This is providing needed revenue for stations with the courage to program their FM outlets separately from AM—for very few FM stations are yet showing a profit on broadcast

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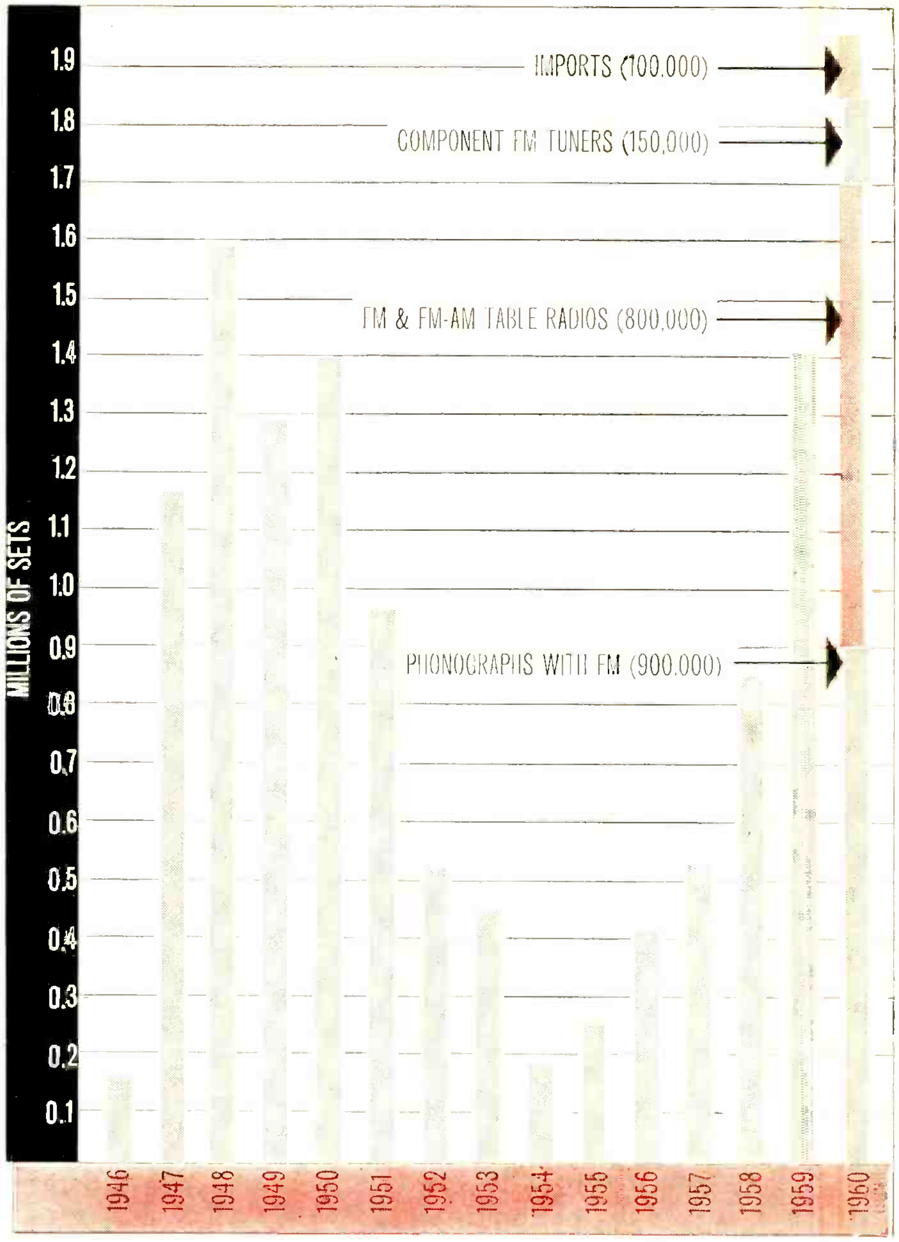
Fig. 1—Estimated factory sales of receiving devices (including foreign units sold in U.S.). Included are TV sets with continuous tuners that receive the FM band, of which 420,000 were produced in 1949 alone.



operations. Madison Avenue ad agencies, by and large, still don't realize how many people are listening.

Hobbyists and sound enthusiasts never abandoned FM. In areas where stations were broadcasting good hi-fi music, there was a small but loyal audience of hi-fi bugs with component rigs.

But the radio makers who went into television production forgot all about FM—with one exception. Zenith kept turning out FM table radios and, because it was virtually the sole manufacturer, did a fairly brisk business in them.

When the LP phonograph record began to arouse real consumer interest with its excellent reproduction, FM's second boom began to germinate.

Among the first high-quality phonographs introduced in this country for realizing the full sound potential of LP records were German-made units.

In Europe, where the post-war AM band was hopelessly overcrowded, FM broadcasting has become standard—strictly from necessity. German phonographs with radios included naturally contained FM tuners. The American purchasers listened, and pricked up their ears.

Then came the "cheap" FM set, pioneered by Granco products, who sold scads of FM-only table models at $29.95. Other manufacturers followed.

When American radio manufacturers began to offer hi-fi consoles in a single package, they took another look at FM —largely because the German units had them. A few dropped in FM tuners as extras or even as standard equipment on some models.

Then along came stereo. Experimental AM–FM stereo broadcasts aroused the interest of set manufacturers. Today, most makers of so-called "packaged" hi-fi offer "drop-in" simulcast AM–FM tuners as an option. Some manufacturers estimate that more than 70% of their stereo consoles now are sold with AM–FM tuners. Industry-wide, it's a good guess that the proportion is more than 50%.

In the field of hi-fi components, manufacturers say sales of FM tuners are increasing, too. The concept of the combination tuner, preamp and amplifier has resulted in added FM sales.

Our estimate of close to 2,000,000 new FM receivers this year includes all types of devices to receive FM broadcasts. It breaks down this way: Table-model FM and FM–AM radios, 750,000 to 820,000 units (up from 540,500 made in 1959); "packaged" phonograph systems with FM tuners, 700,000 to 1,000,000 (from 623,000 last year); component FM tuners, 150,000 to 200,000 (from an esti-

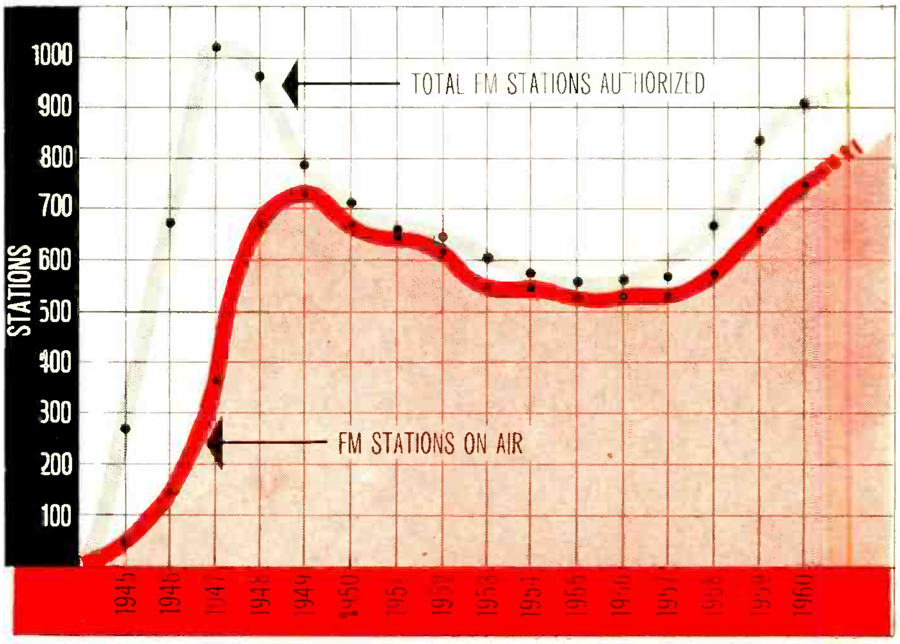


Fig. 2—FM stations actually on the air, by years. Low-water mark came in 1956 after many stations had given up and gone off the air. Some of those silent stations have now been reactivated.

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mated 150,000); imported FM receiving devices of all kinds, 80,000 to 120,000 (from about 100,000).

We have given a high and low figure in each case, because estimates within the industry vary widely. Adding up the "lows" would give a 1960 minimum of 1,680,000 sets (compared with 1,413,-500 last year); the "highs" total 2,140,-000. The best guess is that the final 1960 figure will be closer to the high estimate than the low one.

What of the future? Write this down and paste it inside your hatband: You're going to see more and more FM sets in the coming years, and FM radios will some day rival AM in popularity. Here are some of the reasons FM radio can't go any place from here but up:

FM achieved its sales record this year despite the fact that it isn't yet a nation-wide medium. Many areas have few FM stations—or none at all. This situation is rapidly changing, and FM broadcasting will be transformed in the next few years from a basically big-city service to a type of radio which reaches into every nook and cranny of America.

New types of FM receiving devices are just beginning to come on the market. The one with the biggest immediate potential is the FM auto radio. German manufacturers (including Blaupunkt and Becker) have been offering FM car radios here for several years. Smaller US manufacturers (Gonset, Automatic, and others) have also had FM tuners and converters for cars. But the big-business FM car radio push is just beginning.

It actually started with Motorola's introduction this year of an FM-only car radio at $125, which reportedly has been accepted well by the customers despite its relatively high price.

The race was really on with the debut Granco converter (marketed by Emerson Radio) at $49.95. Granco, which specializes in low-priced FM sets, hopes its converter will do for the auto market what its $29.95 FM table model did for the home market. Its president, Henry Fogel, sees a "reliable market for 100,000 auto FM sets a year" beginning in 1961.

You'll see other FM car radios in the coming months. Sears, Roebuck even has one now in its fall catalog.

The portable FM transistor radio is just in its infancy, too. Zenith is now competing with Japanese manufacturers with a battery-operated set. You can expect many more models—from Japan, Europe and the US—next spring. FM clock radios, too, will be coming into their own soon. Other FM receiving devices are on the way also, including the return of the combination TV and FM set (Magnavox introduced a new one this year).

But FM's biggest push will come from the source that gave hi-fi its largest lift—stereo.

Nobody knows when the FCC will finally establish standards for FM stereo multiplexing. Engineering work and field testing of all proposed FM stereo systems have been completed by the National Stereophonic Radio Committee, an industry-wide group established by the Electronic Industries Association.

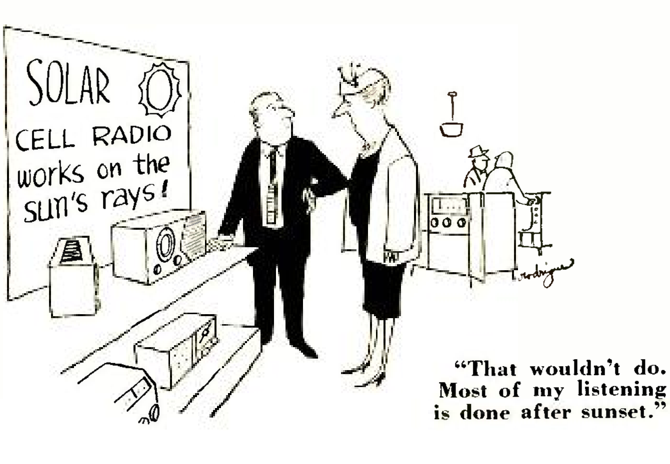
The opening gun for FM stereo broadcasting *could* come very soon. Or it could be delayed for months by legal action and bureaucratic red-tape. But it's coming—and every radio manufacturer is poised to be off and running with the "first FM stereo radio."

The FCC, too, is eager to get FM stereocasting started almost immediately. But delays could result if its decision on a specific multiplexing system is challenged either through the FCC's own rule-making machinery or the federal courts. Because so much depends on the FCC's decision, this is a distinct possibility.

The establishment of FM stereo multiplex standards by the FCC will mean—almost immediately—that FM tuners will be a *must* in all new stereo phonographs; stereo tuners will be added to existing ones; a whole new field of stereo FM table radios will open up; all hi-fi rigs must be equipped with multiplex converters.

Every radio manufacturer now has engineers designing multiplex receiver circuits—even before the FCC itself knows which system will be adopted. Radio makers expect the FM stereo decision to touch off the biggest consumer-electronics boom since TV, and to vastly increase stereo phonograph sales as well.

Will FM ever realize its proponents' long-time dream of replacing AM? We don't think so. But it is being increasingly accepted for what it really is—a far superior form of radio. It's building up real momentum now, and with the introduction of stereo multiplexing there'll be no stopping it. END



"That wouldn't do. Most of my listening is done after sunset."

6DZ7 6DZ7 6DZ7 6DZ7

By ROBERT M. VOSS

THE 6DZ7, recently put on the market, should solve a few space and circuit problems of audio-amplifier designers. It consists of *two* beam-power pentodes in an envelope the size of a 6L6-GB. The sections have a common cathode and internally connected screen grids. With 400 volts on the plates and 250 on the screens, the tube wll deliver 20 clean watts into a 14,000-ohm load.

Naturally, the internally tied screens limits the possible uses of the tube. It obviously cannot be used for Ultra-Linear or triode operation, unless two or more are used in a push-pull-parallel circuit. When powered by a supply that delivers 250 volts at 90 ma, the 6DZ7 will put out 10 watts into a 9,000-ohm load.

Besides using the 6DZ7, the amplifier described here has one other unusual though not unique feature—it uses silicon diodes in the power supply. Having had no experience with silicon rectifiers, I tried to use only two Sarkes Tarzian K-200's in a standard full-wave hookup. Both shorted after about 15 seconds. The moral—*the voltage ratings of silicon rectifiers must be derated considerably when feeding a capacitive load* (see page 40, June, 1960, RADIO-ELECTRONICS). (Even with the 150-ohm resistor the load is essentially capacitive.) Therefore, it is necessary to use four in series—two in each leg of T1's high-voltage winding.

Inspection of the rest of the circuit will reveal nothing unusual. A pentode voltage amplifier is direct-coupled to a phase splitter. The balance control is adjusted for equal ac voltages at the output tube plates. Feedback is, in the conventional manner, returned from the output transformer secondary to the input cathode. The heaters are biased at 10 volts to reduce hum.

A stereo amplifier may easily be built using the same amplifier circuit. It is necessary to change only the power transformer and choke; the rectifiers will easily handle the added current.

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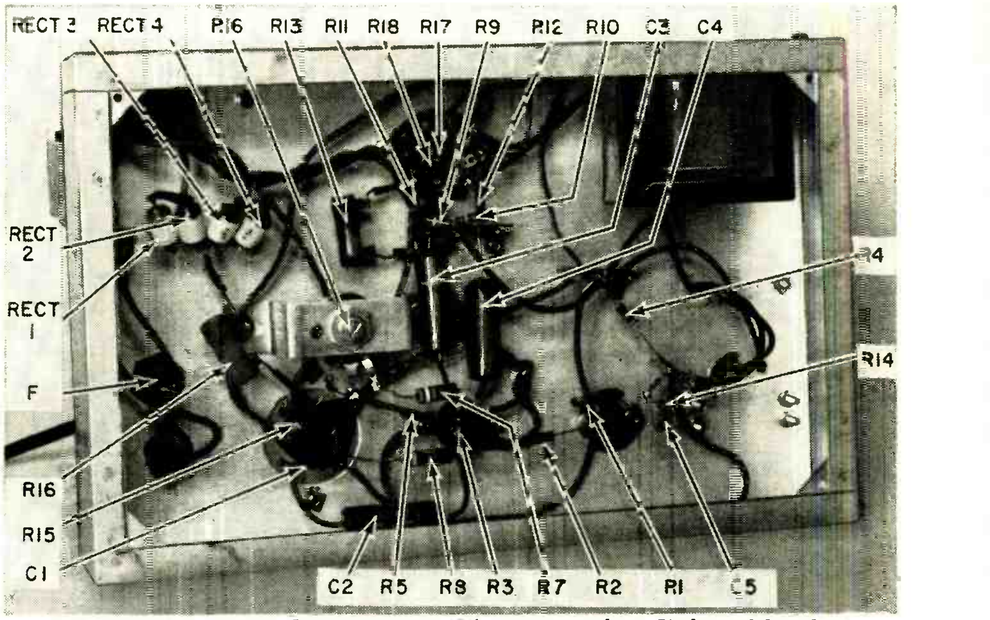
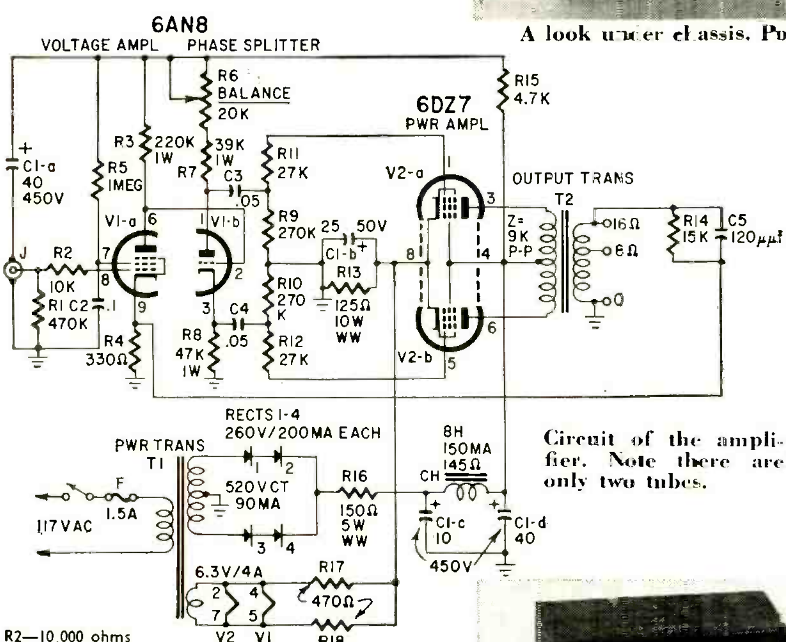
AMPLIFIER

Neat little 10-watt amplifier has a 1-tube push-pull output stage . . . uses a new dual-pentode



A look under chassis. Potentiometer R6 is mounted on U-shaped bracket.



Circuit of the amplifier. Note there are only two tubes.

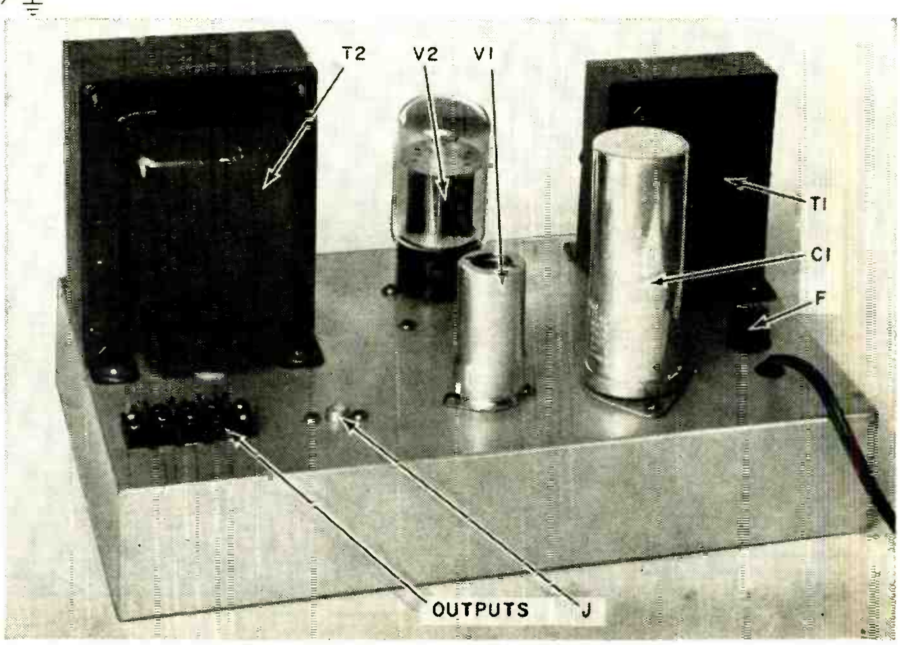
- 10 watts
- Sensitivity: 350 mv input for full output
- 20–20,000 cycles within 1 db
- distortion below 1.5%
- 17-db feedback at 1 kc
- hum and noise 55 db below 10 watts

Unit was tested for frequency response, power output, distortion, hum and noise, and sensitivity. All results verified the author's statements and are summarized above. Conclusions drawn from the tests are: "The Voss amplifier will give satisfactory service as a hi-fi amplifier in low- or medium-cost systems."

BENCH TESTED

R2—10,000 ohms
R3—220,000 ohms
R4—330 ohms
R5—1 megohm
R6—pot, 20,000 ohms, linear
R7—39,000 ohms, 1 watt
R8—47,000 ohms, 1 watt
R9, 10—270,000 ohms
R11, 12—27,000 ohms
R13—125 ohms, 10 watts, wirewound
R14—15,000 ohms
R15—4,700 ohms
R16—150 ohms, 5 watts, wirewound
R17, 18—470 ohms
All resistors ½-watt 10% unless noted
C1—40-40-25-10 μf, 450-450-50-450 volts, can type electrolytic (Cornell-Dubilier DO-65 or equivalent)
C2—0.1 μf, 600 volts, molded tubular
C3, 4—.05 μf, 600 volts, molded tubular
C5—120 μμf, disc ceramic
CH—choke, 8 henries, 150 ma, 145 ohms (Thordarson 20C54 or equivalent)
F—1.5 amps
J—phono jack
RECT1, 2, 3, 4—360 volts, 200 ma (Sarkes-Tarzian K-200 or equivalent)
T1—power transformer: primary, 117 volts; secondary, 520 volts ct, 90 ma; 6.3 volts, 4 amps (Stancor PC-8420 or equivalent)
T2—output transformer: primary, 9,000 ohms plate-to-plate; secondary, 8 and 16 ohms (Stancor A-8054 or equivalent)
V1—6AN8
V2—6DZ7 (G-E or equivalent)
Chassis to suit
Miscellaneous hardware

END



This is how the completed amplifier looks.

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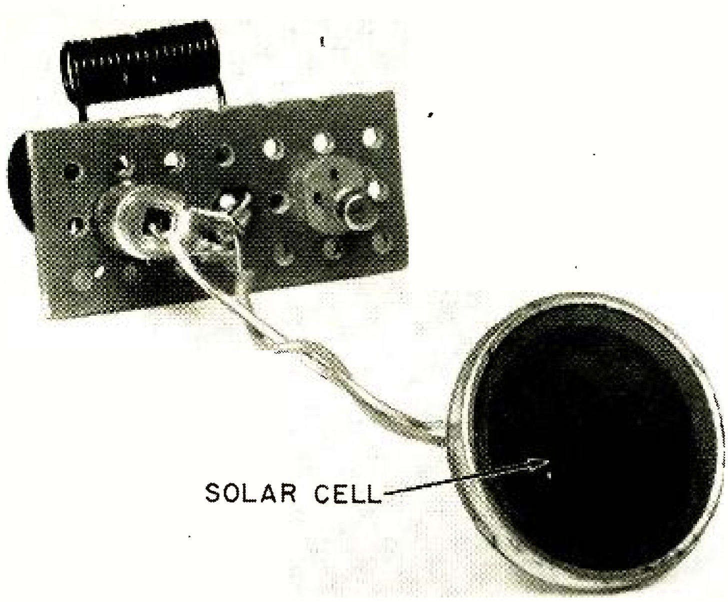
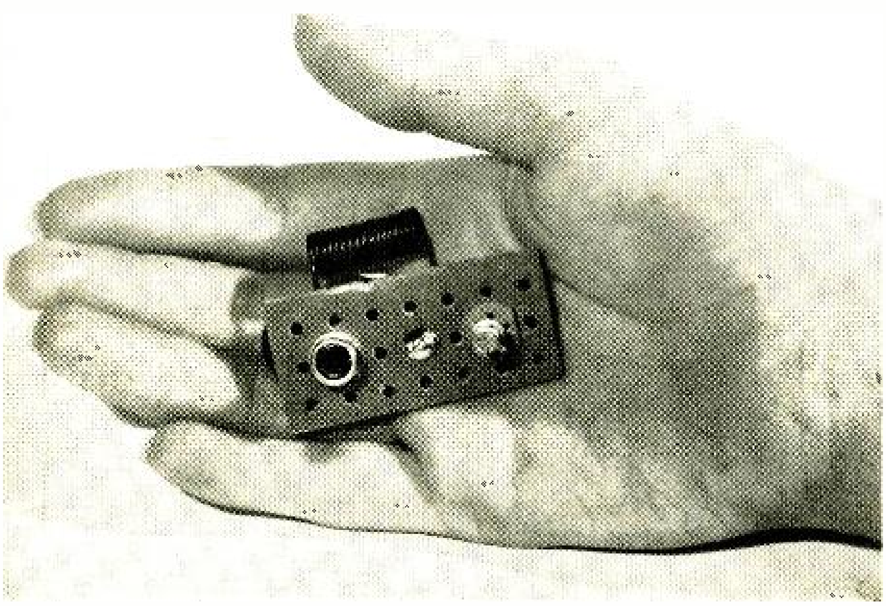


Generator and solar cell power supply.

A TUNNEL DIODE NOISE GENERATOR

Three components and a power source make a useful test instrument



Nothing bulky about this instrument!

By I. QUEEN
EDITORIAL ASSOCIATE

THE newest thing in radio is the tunnel diode. This amazing diode has built-in negative resistance and operates on a few hundred mv of bias. It can oscillate, amplify and switch.

A novel application for the tunnel diode is shown in the schematic. This is an oscillator tuned to about 11 meters by L and C. The diode is a Texas Instruments unit 1N653, now available on the market. It is energized by a Hoffman S-1A solar cell, placed 4 to 5 inches from a 40-watt lamp powered by the 60-cycle line. The 1N653 has three leads, one for the cathode and the other two for its anode.

The rf is modulated by a 120-cycle buzz, from the ac output from the cell when illuminated by an ac lamp. The ac generates many strong sidebands above and below the carrier, resulting in a very broad signal. Measurement shows nearly constant output over a mc or more! For example, with typical coupling to a receiver, an S7 signal was noted throughout the band, and practically zero outside.

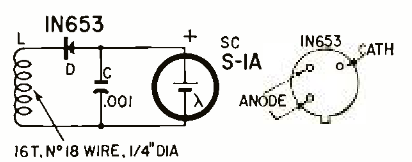
There is a slight variation in frequency with the amount of light falling on the solar cell. Here are some results obtained:

Bandwidth (mc)	*Cell output (mv)*
25.5–27	180
27.0–28.2	200
29.0–29.8	240

The voltage was measured directly across the solar cell. Varying the distance between lamp and cell changed the mv output. Over the bandwidth noted, a loud hum was heard in a nearby receiver.

The output from this simple generator is low; there is little danger of creating interference. A superregenerator will receive the hum signal up to about 10 feet from the oscillator. This signal can serve to check the performance of a receiver or for alignment and adjustment. For example, if the oscillator is adjusted for the Citizens band, you will have a strong signal inside the band, practically nothing outside.

D—1N653
Socket for above
C—.001 μf, disc
L—16 turns No. 18 enameled, 1/4-inch diameter closewound
SC—Hoffman S-1A photocell



Noise generator is inherently simple.

The oscillator requires a low-resistance power source such as the solar cell mentioned above. Other types may not be suitable for this purpose.

Note that the diode must be biased in the conduction direction.

This circuit is a good start if you want to experiment with the tunnel diode. The solar cell output is so low that it cannot damage the diode. END

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HOW TO FIX RADIOS FASTER *(and make more money)*

By JACK DARR

THE two figures, one tall lanky and balding, the other shorter and crew-cut, came out the back door of the drugstore and went down the alley. From the amount of arm waving and jaw flapping, it was apparent some kind of discussion was going on! As they drew nearer, the Old-Timer could be heard to insist, "Five minutes, I said!"

"FIVE MINUTES!" howled the Young Ham. "Why you can't even get a radio warmed up in that time!"

They came in the back door of the shop and down the long hall. "Five minutes," repeated the Old-Timer firmly. "If you can't get a firm diagnosis on *any* radio in 5 minutes, you sure need your procedures re-examined! Theoretically this is a money-makin' business, right? Right. Well, now, radios are an important part of it! Look there. A flock, seven or eight of 'em, came in this morning! All right, if we can fix 'em fast enough, we can make money. If it takes us all day, we lose money. Why? 'Cause radios don't cost too much nowadays. They're either new low-priced sets or older ones that have depreciated. We jist can't git a $19.95 service charge on a $12.95 radio and that's all there is to it!

"Your *diagnosis* is th' most important part. Fixin' th' set'll take maybe 20 minutes or so. That's O.K. We can let 'em off for a couple or three dollars service charge. But, if you spend 2 or 3 hours tryin' to find out what's wrong with it and another hour fixin' it, we're in th' hole!"

"Yes, but—," yes-butted the Young Ham. "But *only five minutes!*"

"All right, I'll have to show you," said the Old-Timer wearily, settling himself creakily on the stool at the radio end of the bench. "Gimme one of them sets."

The Young Ham handed him a small radio from the unfinished work bench. "You watch th' time. Holler when th' hand gits to 60."

The Young Ham watched the shop clock, then called, "Go!"

The Old-Timer plugged the set into the bench wattmeter, watching the needle—it didn't move. Removing the back, he pulled the tubes and plugged them one at a time into a small battery-powered continuity tester. One failed to light the indicator lamp. Hopping up, he grabbed a tube from the shelf and inserted it in the socket. The wattmeter needle now showed about 30 watts and the set began to hum softly, then play. Turning the volume control wide open, the Old-Timer ran up and down the dial, listening to the different stations. He turned the volume control several times, then took the chassis out of the cabinet. Turning it upside down, he squirted fluid from a spray can into the control. Flipping it over again, he sprayed the tuning capacitor. Then, tuning in a station near the high end of the dial, he adjusted the trimmers on the gang for maximum volume.

Picking up a rag, he wiped the inside of the dial glass, and the dial scale itself. Slipping it back into the cabinet, and replacing the screws and knobs, he ran the dial over its full scale. Turning it off, he whirled around on the stool. "There she is," he cried. "How much time did that take, now?"

"Four minutes, 45 seconds," said the Young Ham. "But, hey! That ain't fair! There wasn't anything wrong with it! Just had a dead tube!"

Just a dead tube?

"Whoa-up!" demurred the Old-Timer. "For your information, young feller, this set had a dead tube, a noisy volume control, a noisy tuning capacitor, the dial was off calibration and I cleaned it up too. Now she's back in good shape again, and I'm gonna charge the customer a bit extra for takin' care of all those little things. Result: she gits a better-playin' radio so she's happy, we make more money so I'm happy! However, that ain't th' point I was tryin' to make. *That* was easy, yeah. But, if you'll check back in your memory, you'll remember that near 90% of th' radios we service ain't got anything but a dead tube wrong with 'em, plus little stuff like this. So, if you can git th' easy ones playin' quick, you'll have a little more time to spend on th' harder ones."

"Th' darn trouble is, most of 'em are either real easy or real hard!" complained the Young Ham.

"They ain't any of 'em real hard if you use th' proper procedure on 'em," returned the Old-Timer. "You might not have noticed, but I used quite a few shortcuts there while I was checkin' that set. F'rinstance, by the way it played and the volume I had, and th' number of stations it got, I knew that the power supply and th' rest of th'

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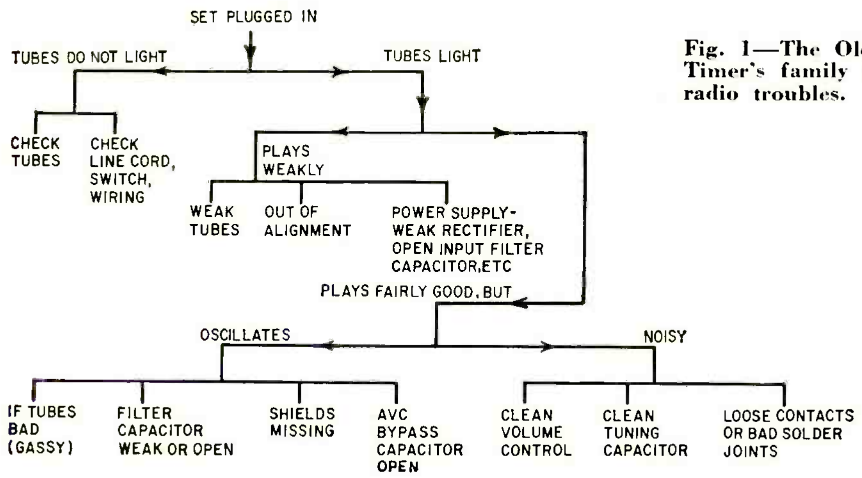

Fig. 1—The Old Timer's family tree of radio troubles.

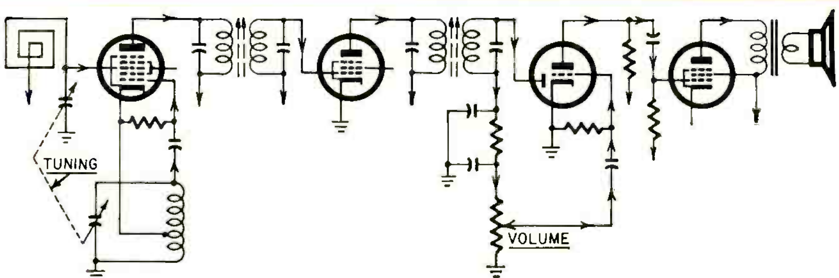

Fig. 2—Signal path through any vacuum-tube radio.

tubes were OK. Why? Because it played as good as the average set of that size oughta—got as many stations, played as loud, an' so on. If it'd been weak, I'd have checked voltages and tubes while I had it out of th' cabinet. See?"

"Yes, I do," said the Young Ham. "But it sure takes a lot of experience to recognize all of those things!"

"Son, experience is what you're gettin', right here." The Old-Timer grinned.

"That's for sure, Pappy," laughed the Young Ham. I sure ain't gettin' rich on the salary you pay me! Why didn't I get a paper route like the other kids?"

"'Cause you couldn't git up that early in th' mornin'," said the Old-Timer, with a straight face. "Now, looky here. Lemme show you once more, an' see if you can't remember it, this time. Here's what you might call a 'Family Tree' of radio troubles." He sketched rapidly on a piece of paper (Fig. 1). "Now, if you'll follow this outline for quick-checking every set, you'll be surprised how much you can cut down your diagnosing time!"

The Young Ham studied the drawing. "Yeah," he admitted, "I can see how it would."

"It will, it will," affirmed the Old-Timer. "Just remember that chart, an' learn it by heart. Hmm, poetry already! No kiddin', if you've got that up here," rubbing the Young Ham's burr head, "it'll always help you out! Say, didn't I give you something like this quite a while ago, in a different form? What happened to that notebook you used to keep that stuff in?"

"It's here somewhere," answered the Young Ham, scrabbling in the litter at the back of the bench. "Here it is," and he pulled out a medium-sized notebook, blowing the dust off it.

"That's about what I thought," laughed the Old-Timer. "There's quite an accumulation of dust on that material, meanin' it ain't been used for some time, huh?"

"Awww," said the Young Ham, "I ain't needed it much till now."

"Junior," said the Old-Timer seriously, "you always need that stuff, preferably up here between th' ears, but if not then somewhere where you can git at it. Gimme." He took the notebook, and leafed through it. "Yeah, here it is. Now, here's something you want to remember. This signal-path schematic here (Fig. 2). This is nothin' but the parts of th' set that actually handle the signal! It'll fit all radios, I don't give a dern what kind they are! Don't you remember how I used to hammer this into your head when you first started out? It can be thought of as a series circuit—th' signal starts at the antenna and keeps on goin' on a single path until it gits to the speaker! Anything that causes a break in the path stops th' signal! To find it, all you gotta do is feed th' right kind of signal into each stage and see where it stops!"

"Yeah, but it ain't always as easy as that," demurred the Young Ham.

"Yes, 'tis," argued the Old-Timer, "If you know what a normal response is, you can always find a stage that ain't got it, if you know what I mean."

"Well, it's a little mixed up, but I think I'm beginnin' to get it."

"Well, I hope so," said the Old-Timer. "Now here is the more detailed check list that I worked out for you a while ago (page 45). You follow this all the way through, an' I'll guarantee you'll find your troubles right quick-like!"

"Well, sir, I jist bet you're right," said the Young Ham, in an exaggerated imitation of the Old-Timer's drawl. "I'll bet you what I know you'll like better."

"What?" said the Old-Timer, in mock innocence.

"A cuppa cawfee!" said the Young Ham, making a dash for the door. "Right!" agreed the Old-Timer, following him out. END

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THE OLD TIMER'S CHECK LIST

1. Tubes, check. For continuity.

2. Voltages, check. Since the majority of radios now are ac-dc, the voltages are given for them. Others can be checked from service data.

a. Audio output	90–100 v
b. Audio output screen	90–100 v
c. 1st audio plate†	40–50 v*
d. if amplifier plate	90–95 v
e. if amplifier screen	90–95 v
f. mixer-oscillator plate	90–95 v
g. mixer-oscillator screen	90–95 v

h. avc voltage. Measured at diode plate, and on if or mixer grid. On strong local station, should be 8-10 volts, negative.†

i. Oscillator grid. Measured on oscillator grid. Should read 10–12 volts negative, varying as dial is tuned from high to low end. Highest voltage at high-frequency end of dial.†

* Watch this one: If it's too much, the tube may be very weak! Should never be over about 50 volts. Too-high voltage indicates tube not drawing enough plate current.

†Measured with vtvm.

3. Signal path. As voltage measurements are made, listen for 'pop' when probe touches plates and grids. Pop should get louder as you go toward the antenna.

4. Signal injection. Use signal generator. Put audio signal on audio output grid, then 1st audio grid. If signal on if amplifier grid, then on mixer grid. Rf signal on mixer grid, then on antenna. Signal should get louder as you go toward the antenna.
(Shortcut: touch center connection (slider) of volume control with finger or screwdriver—volume full up. A good loud buzz should result. This means audio stages and power supply OK. No buzz, trouble in audio stages.)

5. Alignment. Feed signal at specified if into if grid, tune last transformer. Move signal generator to mixer grid, tune first transformer. Tune signal generator and set dial to about 1400 kc. Feed signal into antenna by laying output cable on bench nearby or clipping it to edge of loop. Tune antenna trimmer for maximum.

Output indicators: What you need is something to read the amount of signal coming out of the set. Connect ac voltmeter across voice coil to read demodulated signal. A vtvm can be connected anywhere in the if network, except the grids themselves, and the avc voltage used for alignment indication. Avc voltage will increase (go more negative) as set is tuned up. Always keep signal generator output low, to prevent blocking. Should use meter reading of 1 to 2 volts.

Audio distortion: Hum: leaky or open filter capacitors. Symptom: hum will not be reduced as volume control is turned down. Heater-cathode leakage in audio output tube. Open loop antenna; this hum will decrease as volume control turned down.

Distorted tone: Speaker-cone dragging. (Turn set off, move cone with fingers very carefully, listening for rubbing.) Leaky coupling capacitor on grid of power amplifier tube. Measure grid voltage. Should be zero, or slightly negative. If 2 to 3 volts positive, replace capacitor. Also check output tube for grid emission.

Hum while station tuned in: Leaky or gassy mixer-oscillator or if amplifier tube. Check by substitution.

Oscillation: Weak or open filter capacitors. Open avc bypass capacitor. Open screen bypass capacitor.

Don't Miss these Highlights NEXT MONTH

Three Ignition-Operated Tachometers

No sports car fan would be without a tachometer. They're very useful too for checking engine speed on cars, outboard motors, racing models or other engine driven equipment. Here are three dependable transistor - operated units that are easy to build.

Electronic Timer Integrates Light

A unique all-transistor device that is controlled by the amount of light it receives instead of remaining "on" a given number of seconds. Invaluable for electronic photoflash operation and other applications where ordinary timers just won't do.

Ultra-Sensitive 3-Transistor Regenerative Radio

For those who want more sensitivity than usually found in 3-transistor radios (and good selectivity too). A special input circuit controlled regeneration, larger-than-usual antenna loop and careful choice of components do the trick. An ideal project for the hobbyist.

Electronic Strain Gauge and its Uses

This versatile instrument is used to check the design of all kinds of equipment and structures from airplanes to bridges. It plays a vital role in engineering progress in many fields. This illuminating article tells how strain gauges are made and how they're used in industry.

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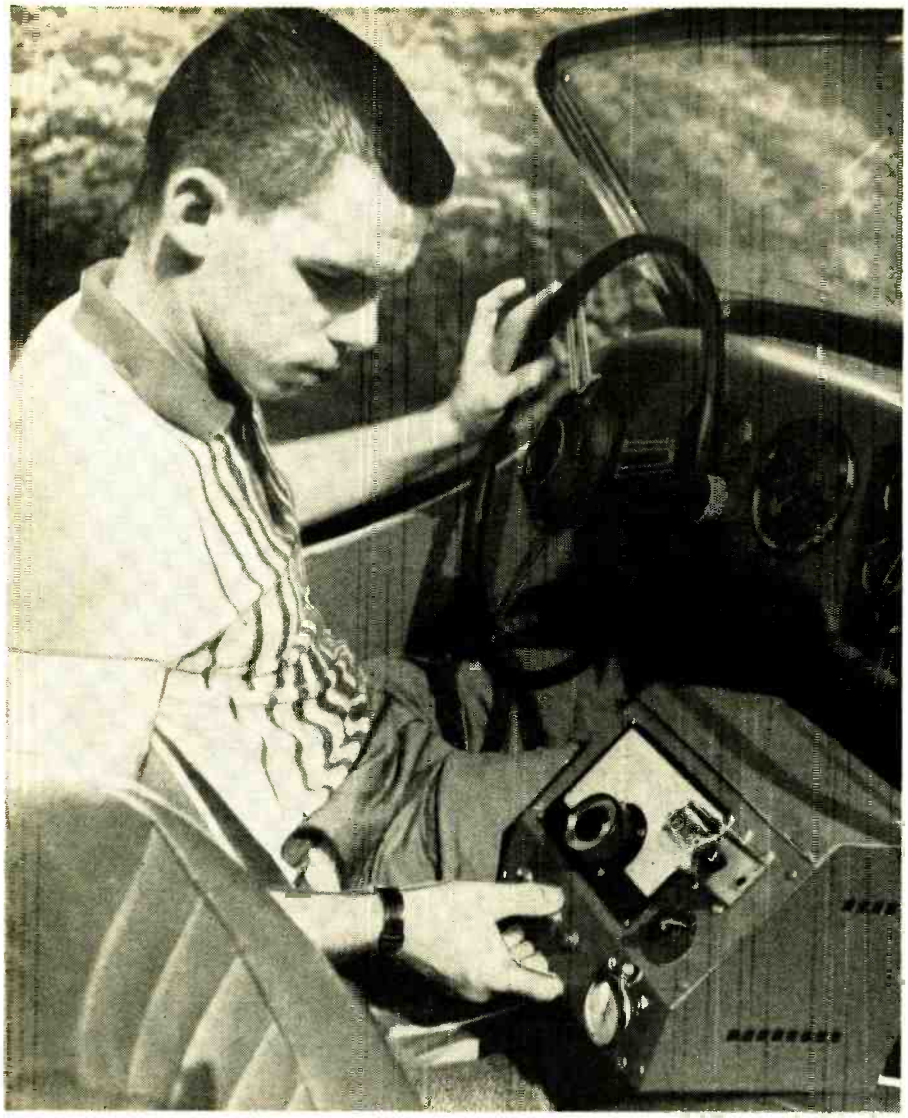

COVER STORY

build the RALLY-PAL COMPUTER

The counter tells you how far you should have gone at any given instant

By JACK ALLISON

IF you are one of those unrepressed souls who still think driving is fun, then rallying is the sport for you.

In spite of what some people think, rallying is *not* racing. Far from it. A rally, or "rallye" as some purists would have it, is an individual competition in which drivers try to find their way over an unfamiliar route. At the same time they attempt to maintain a prescribed speed (always less than the posted speed limit). Check points are set up along the route at locations unknown to the driver. When he comes to one, he pulls in and his time of arrival is recorded. This makes "being at the right place at the right time" a continuous challenge. Hundreds of motor-sports clubs all over the country run rallies as regular features of their programs.

The complexities of rallying make a navigator a must. He (or she) does the mathematical gymnastics necessary to see that the car is properly located on the route (and everything else the driver can't do while driving). This often means husband and wife teams. This point alone makes rallying popular.

Navigating is done on one simple premise. At an even speed you can cover a certain distance in a precise time. For example, if you travel 30 minutes at 30 mph (most rally speeds are to the nearest tenth of a mile per hour), you will cover exactly 15 miles. However, little annoyances such as other cars, stop lights and turns make it impossible to keep the even speed called for.

The rallyist turns our equation around. He knows that if his clock shows 30 minutes have elapsed and his odometer (mileage indicator) turns up just 15 miles he has done this "leg" of his route at a precise 30 mph. Rallying can be done several ways. Some competitors use a book of rally tables to help them figure out their time–distance ratio. These are usually accurate to the nearest minute. You can successfully compete in a rally with nothing more than a stop watch and one of these books, provided not too many other cars are fitted with more elaborate gear. More advanced rallyists use a stop watch for reference only. They prefer to have a short-wave receiver in the car picking up WWV or

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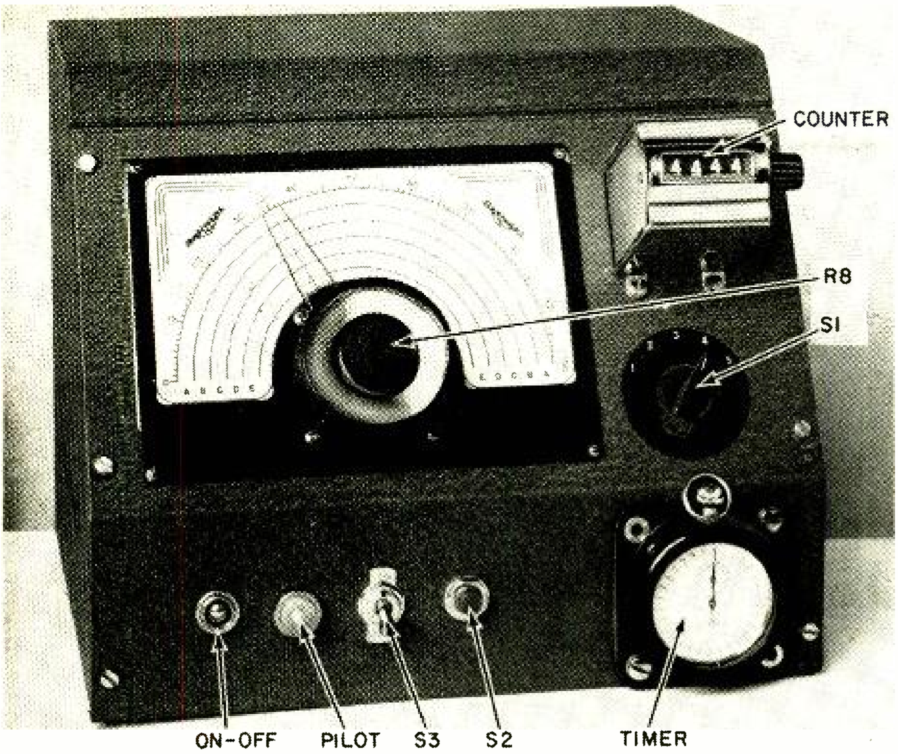

On–off switch on computer controls power supply. S2 is used to advance the counter to any desired reading (to match odometer).

CHU, the American and Canadian time standards. Since nearly all rally officials use these stations to time the rally, if you have this signal beeping away in your car, at least your time factor cannot be in error.

The computations for time and speed to give you distance are often done with little grenade-size cumulative adding machines. The machine is fed the distance you *should* cover in 1 minute at any given speed. The navigator then faithfully cranks the little handle *every minute* and you find out the total distance you should have traveled at the end of that minute. You then speed up or slow down until you zero in and everything is fine.

Other devices that do the same job are available. They are all rather costly. The little Curta, from Lichtenstein, of all places, costs $125 to $160, depending on the model. Kearfott has the fanciest outfit I've seen and it costs $250! With it, you just turn a little handle until the speed you want reads out on a drum dial. With a flip of a switch, you keep another dial reading the right time and your correct distance shows on the third dial.

These are very fine, you say, but what does rallying want with all these fancy gadgets? The answer is simple. You are traveling a route following instructions which take you along only step by step. You have to be extra alert *or you may get lost!* If this occurs, no calculator or anything else can save you. This is why computers are so widely used. It allows more freedom to make sure you stay on course, and maybe even enjoy a little scenery.

The computer described in the following paragraphs is a poor man's approach. If you calibrate the unit carefully, it can do the job as well as or better than the high-priced instruments, because it incorporates its *own* time factor.

Construction

You may follow the photo or you may want to try out another layout (such as mounting the counter only near the driver). This is up to the individual. The basic, simple, circuit (Fig. 1) can be adapted to any housing with little trouble. The most important factor is reliability. Use strong connections and mount the parts so they can't give trouble. A Heathkit power supply (model VP-1-12) was used.

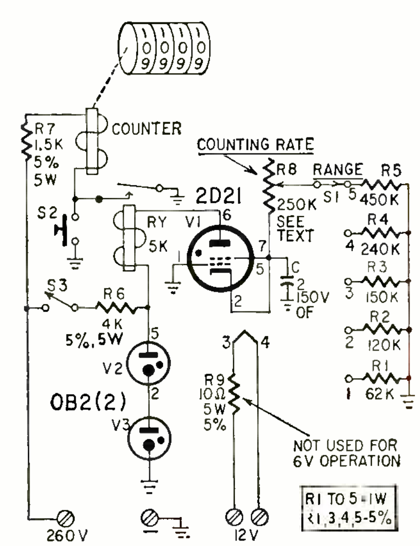

Fig. 1—Schematic of computer using thyratron. Separate power supply is needed.

The components are not critical, but this information is worth noting: The heart of the unit is the potentiometer. It should have a resistance of 60,000 ohms over a 180° shaft rotation. Standard units go 270°, so check the unit you select with an ohmmeter. I used an Ohmite AB 250,000-ohm clockwise-taper (type CA 2541) unit and found it gave the required 60,000 ohms over the first 180°. A linear pot might be easier to calibrate. Use a good unit and see that it is securely mounted. Any movement of the pot after installation will ruin your calibration.

The counters are available from Allied Radio (100 N. Western Ave., Chicago, Ill.) or Power Instrument Co. (254 Canal St., New York 13, N.Y.). The type shown on my model and a somewhat neater looking flush-mounting model (MD6-54-115A) both sell for about $14 and change.

The 0B2 regulators may, if desired, be replaced with a Motorola 10M200Z silicon Zener diode. Simply use one diode in place of the two 0B2's. The dropping resistor (R6) remains the same, 4,000 ohms.

The relay may be almost any 5,000-ohm unit. A check of the local surplus outlet may save you quite a few dollars.

R5 is made up of a 270,000- and a 180,000-ohm resistor in series.

Calibration

Calibration is the next step. Here, accuracy is essential. You are setting the unit's timing and this cannot be changed without an entire recalibration. *Do it right the first time.*

Stability is easy to check. Run the unit at slow speed for 10 minutes, note the counter reading. Do it again, the reading should not vary more than one digit. A check at a higher speed is also advisable.

Set the RANGE switch on 5, the dial at zero (or 100, whichever is faster) and the counter at 9,999 (it will flip to 0,000 as soon as the counter is started). Start the computer and the timer (stop watch) simultaneously. After a 10-minute interval, stop the watch and computer *at the same time.*

Make a record of the counter reading, dial setting, switch setting, time elapsed and number of counts per minute. The time elapsed should be exact-

R1—62,000 ohms, 5%, 1 watt
R2—120,000 ohms, 10%, 1 watt
R3—150,000 ohms, 5%, 1 watt
R4—240,000 ohms, 5%, 1 watt
R5—450,000 ohms, 5%, 1 watt (see text)
R6—4,000 ohms, 5%, 5 watts
R7—1,500 ohms, 5%, 5 watts
R8—pot, 250,000 ohms, Ohmite CA2541 or equivalent, see text
R9—10 ohms, 5%, 5 watts (for 12-volt operation only)
C—2 μf, 150 volts, oil filled
V1—2D21
V2, 3—0B2 (or Zener diode, see text)
RY—spst, 5,000-ohm plate-circuit relay
S1—single-pole 5-position switch (Mallory 3215J or equivalent)
S2—spst pushbutton switch
S3—spst toggle
Counter—4-digit resettable, 117-volt ac coil (Production Instrument Corp. MDA-S4-115A or equivalent)
Case—8 x 10$\frac{1}{16}$ x 8 inches, sloping panel (Bud C-1588 or equivalent)
Knob—5-to-1 vernier with 0-to-100 logging scale (National ACN or equivalent)
Power supply, 260 vdc at 60 ma; 6 or 12 volts dc input as required (Heathkits VP-1-6 or VP-1-12 or equivalent)
Stop watch
Miscellaneous hardware, sockets, etc.

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ly 10 minutes, so dividing the counter reading by 10 gives you the number of counts per minute. This may be marked directly on the dial or later entered on a sheet of cross-section (graph) paper.

Repeat the process with a new dial setting, five points lower than before. Continue until the entire range is covered. Move the switch to position 4 and calibrate that range. Do the same for the remaining ranges.

If you are going to use graph paper rather than marking the figures on the dial, number the bottom of a sheet (holding it horizontally) from 0 to 100. Number the side of the paper according to your count-per-minute determination. Now, plot your findings on the paper (make one graph for each range). You should have a neat arc traced by 20 points (Fig. 2). Join these (using a French curve). The vertical scale of the graph may be calibrated in miles per hour to save time in the rally.

The number of counts per minute is equivalent to the number of 100ths of a mile you will travel per minute. For example, if you are moving at 12 miles per hour (average), at the end of one minute, you should have traveled 0.20 mile. If your counter is clicking away at 20 counts per minute, at the end of that minute it will also read 00.20 (the last two digits on the counter read 100ths of a mile).

Transistor version

For those of you who want a unit of greatly increased accuracy, the transistor version in Fig. 3 should be suitable. This unit is used by my friend Joe White, of Toronto, Canada. The separate 9-volt (dry-cell) source for the multivibrator improves stability. The cost of this version will be higher than that of the thyratron unit. No range switch is needed as the one control will vary the count-per-second rate from about 0.6 to 3.3 (10 to 60 miles per hour). The low-voltage counter required is somewhat higher priced.

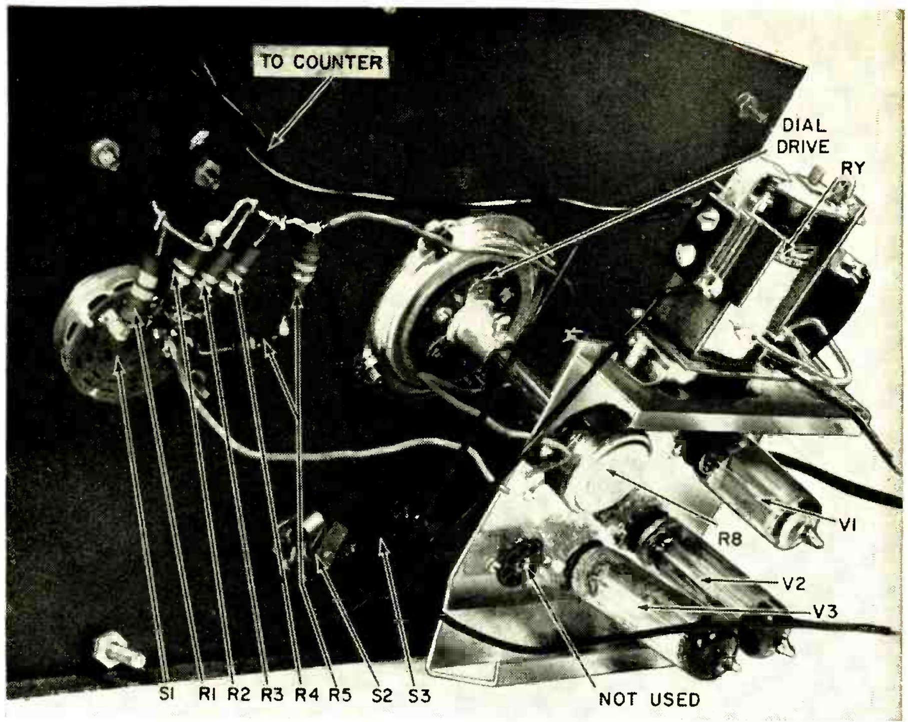
Calibrating the transistor computer is similar to calibrating the 2D21 version except that only one graph must be plotted.

Using the computer

When you receive your rally instructions, the navigator looks up the speed on a table and converts it to counts per minute (or skips that part if the graphs have already been calibrated in mph). He or she finds the desired count rate (or speed) on the side scale of the graph. He then draws a horizontal line across the paper to intersect the arc. From the intersection, a vertical line is drawn to the logging scale at the bottom of the page. This is the computer setting.

END

R1—pot, 100,000 ohms, linear taper
R2—8,200 ohms, 10%, 1/2 watt
R3—510 ohms, 5%, 1/2 watt
C—40 μf, 10 volts, tantalum
V1—2N256
V2—2N170
V3—2N489
RY—spst, 6- or 12-volt coil
S1—spst pushbutton switch
S2—dpst toggle switch
Counter—4-digit, resettable with 6-volt (or 12, depending on auto voltage) coil
Miscellaneous hardware, case, sockets, etc.



Rear view of computer. R5 is actually two resistors in series.

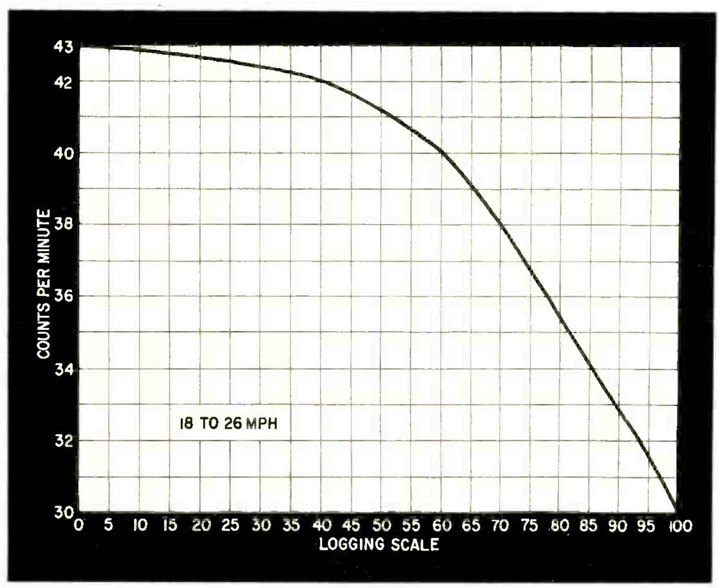


Fig. 2—Sample graph produced when calibrating computer. Find counts-per-minute (or speed desired) at left, go across to intersect arc and then drop line to logging scale at bottom. This gives setting for computer.

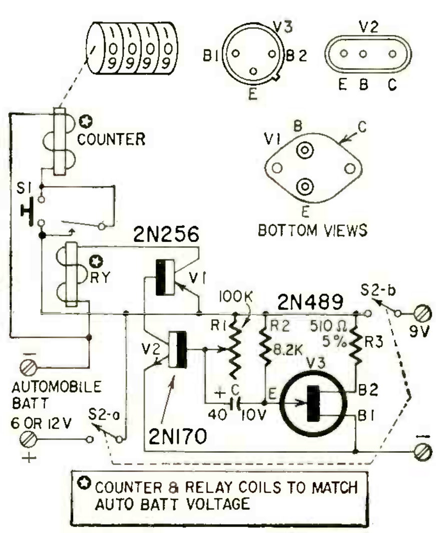


Fig. 3—Transistor version of computer uses Unijunction transistor.

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Subcarrier Techniques for TELEMETRY

By ED BUKSTEIN *

Systems can be designed to measure almost any quantity and transmit the figures any desired distance

BY definition, *telemetering* means measuring at a distance. Remote measurement is used when the quantities to be measured are inaccessible or when it is not practical to have an operator "take the readings." Telemetering apparatus is used extensively in missile and satellite equipment to *radio back* information on temperature, pressure, acceleration, fuel-flow rate, vibration, and other variables. Each of these variables is converted to an electrical signal and used to modulate a transmitter. A system of subcarrier oscillators is used, so that all of the telemetered information can be transmitted within a single radio channel.

Transmitting systems

The block diagram of a typical telemetering system is shown in Figs. 1 and 2. Only three subcarrier oscillators are shown, but many more may be used. Each of these oscillators operates at a different center frequency. The frequency of each oscillator varies in accordance with changes in the quantity to be telemetered. The first subcarrier oscillator in Fig. 1 (SCO 1) is used to telemeter temperature information. A thermistor (negative-temperature coefficient resistor) is used as a temperature-sensing component. Since the resistance of the thermistor varies with temperature, and since the thermistor is connected in series with a voltage source and a fixed resistor (R1) the voltage drop across R1 varies with temperature changes. If the temperature should increase, for example, the resistance of the thermistor would decrease and a higher voltage appears across R1. This voltage controls the frequency of SCO 1. The frequency of the oscillator at any given instant may therefore be 400 cycles, or above or below this value, depending upon the temperature (assuming SCO 1 is a band-1 oscillator. See table.). The thermistor in Fig. 1 is connected as part of a voltage divider, but frequently it is used as an arm of a bridge circuit.

SCO 2 responds to changes of humidity. The humidity-sensing element is a coating of lithium chloride on a glass or plastic base. The coating absorbs moisture from the surrounding air and its resistance changes accordingly. The voltage drop across fixed resistor R2 therefore depends upon the humidity and controls the frequency of SCO 2.

Information regarding air pressure is also telemetered. An increase of external pressure (or decrease of internal pressure) compresses the bellows. A decrease of external pressure (or increase of internal pressure) allows the bellows to expand. The arm or slider of a variable resistor is mechanically coupled to the bellows so that the voltage across resistor R3 is a function of air pressure. This voltage controls the frequency.

The subcarrier frequencies are so selected that the maximum allowable deviation (7.5%) will not result in overlapping adjacent subcarriers. Table I shows the standard subcarrier bands, allowable deviation and upper and lower limits. These standards are variously referred to as RDB, IRIG or IRTWG standards. The initials designate the organizations which contributed to the establishment of the standards (Research and Development Board, Inter-Range Instrumentation Group and Inter-Range Telemetry Working Group). As shown in the table, five optional bands (A through E) permit deviations of ±15% if adjacent bands are not used.

The frequency-modulated outputs of

* Northwestern TV & Electronics Institute, Minneapolis, Minn.

Subcarrier Bands and Limits

Band	Center Frequency (cps)	Maximum Deviation (percent)	Band Limits Upper	Band Limits Lower
1	400	±7.5	430	370
2	560	"	602	518
3	730	"	785	675
4	960	"	1,032	888
5	1,300	"	1,398	1,202
6	1,700	"	1,828	1,572
7	2,300	"	2,473	2,127
8	3,000	"	3,225	2,775
9	3,900	"	4,193	3,607
10	5,400	"	5,805	4,995
11	7,350	"	7,901	6,799
12	10,500	"	11,288	9,712
13	14,500	"	15,588	13,412
14	22,000	"	23,650	20,350
15	30,000	"	32,250	27,750
16	40,000	"	43,000	37,000
17	52,500	"	56,440	48,560
18	70,000	"	75,250	64,750
A	22,000	±15	25,300	18,700
B	30,000	"	34,500	25,500
C	40,000	"	46,000	34,000
D	52,500	"	60,380	44,620
E	70,000	"	80,500	59,500

Bands A through E are optional and may be used in place of numbered bands by omitting adjacent bands as follows:

Band Used	*Omit Bands*
A	15 and B
B	14, 16, A, C
C	15, 17, B, D
D	16, 18, C, E
E	17 and D

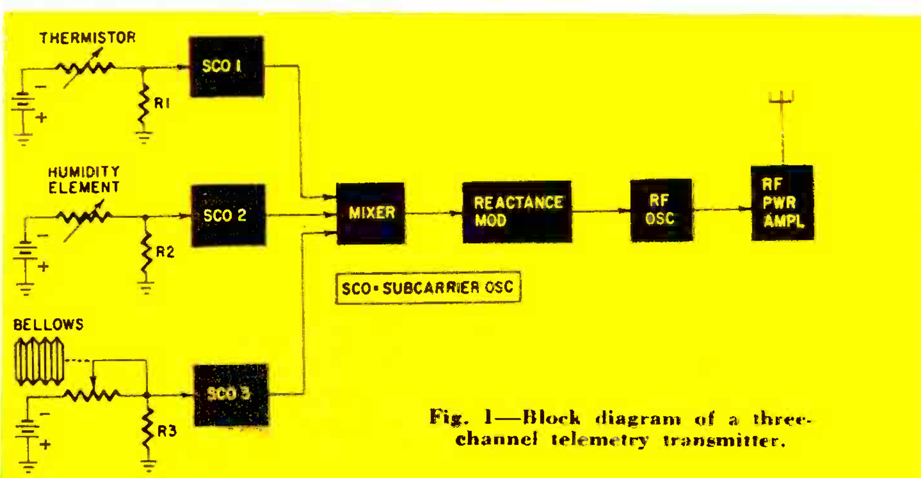

Fig. 1—Block diagram of a three-channel telemetry transmitter.

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Geotechnical Corp.

Channel 5 voltage-controlled oscillator.

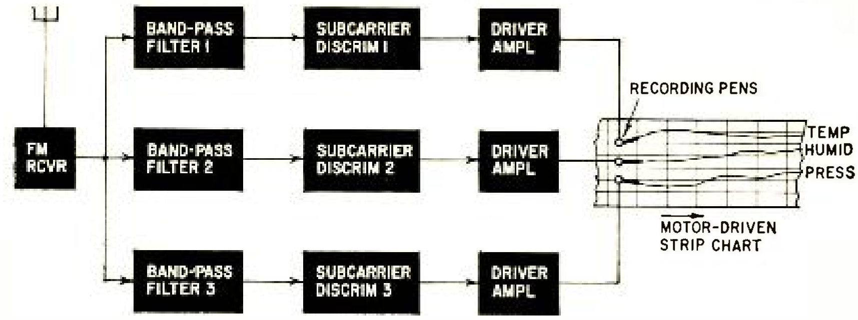

Fig. 2—Block diagram of a three-channel telemetry receiver. The output from each channel is recorded on a paper tape.

the subcarrier oscillators are mixed and applied to a reactance modulator stage. The main carrier is therefore frequency-modulated by the frequency-modulated subcarriers. For this reason, the technique is sometimes referred to as FM/FM telemetry. Transmission is generally in the 216- to 235-mc band and power output of 3 to 50 watts.

The receiving (ground-station) equipment (Fig. 2) includes an FM receiver. The output of the second detector (discriminator) consists of the varying subcarrier frequencies. Bandpass filters are used to separate the individual subcarriers which are then amplified and applied to the subcarrier discriminators.

Since a discriminator is a frequency-to-voltage converter, each subcarrier discriminator produces a dc output that varies with changes of the telemetered quantity. The dc output of discriminator 1, for example, will vary with changes of temperature; the output of discriminator 2 with humidity; etc.

The discriminator outputs control recording pens. These resemble ordinary meter movements except that the pointers have been replaced by small lightweight pens. Writing on a motor-driven paper chart, they indicate variations of temperature, humidity, etc.

Transducers

As a first step in the telemetering process, the quantities to be telemetered must be converted to some type of electrical signal. The components used for this purpose are referred to as transducers, data pickups, pickoffs, end instruments or sensing elements.

In Fig. 1, for example, the thermistor functions as a temperature-to-resistance transducer, the bellows-controlled rheostat serves as a pressure-to-resistance transducer, and the humidity element provides humidity-to-resistance conversion. Several other techniques are illustrated in Fig. 3.

As shown, a bellows responding to pressure changes can be used to control the spacing between two metal plates, one fixed and the other movable. The capacitance of this two-plate capacitor will therefore vary with pressure changes. If this capacitor is used in the tank circuit of an oscillator, pressure changes will be converted to frequency changes.

Alternatively, the bellows can be used to control the position of a core with respect to a coil. Pressure variations produce inductance changes. Again, the inductance can be part of an oscillator tank circuit. A Bourdon tube is frequently used in place of the bellows. As shown in Fig. 3-c, this consists of a bent, hollow tube closed at one end. An increase of pressure (in the tube) tends to straighten it and the resulting mechanical motion can be used to vary the value of a capacitor, inductor or resistor.

The accelerometer consists of a spring-supported weight known as a seismic mass. In some models, the accelerometer case is filled with oil to prevent excessive vibration of the mass. The position of the mass with respect to the case depends upon the rate of acceleration. If the accelerometer is mounted in a missile, for example, the mass will move backward when the missile accelerates (for the same reason the driver of an automobile is pushed against the back of the seat when the car is speeding up). When the missile decelerates, the mass moves forward in its case (just as a driver is thrown forward when the brakes are suddenly applied). The mass of the accelerometer may be mechanically coupled to a variable resistor, capacitor or inductor.

As shown in Fig. 3-e, the differential transformer contains a movable core and two secondary windings connected in series. The secondaries are 180° out of phase so that normally their voltages cancel and there is no output. But if the position of the core is changed, the coupling to one secondary is increased and to the other secondary decreased.

Under these conditions, the voltages induced in the two secondaries are no longer equal. The net output voltage will therefore have an amplitude and phase determined by the amount and direction of core movement. The position of the core can be controlled by a bellows, Bourdon tube, accelerometer or any other component providing mechanical motion.

The strain gauge consists of a piece of resistance wire cemented to a paper backing. Strain (dimension change) in the structure to which the gauge is

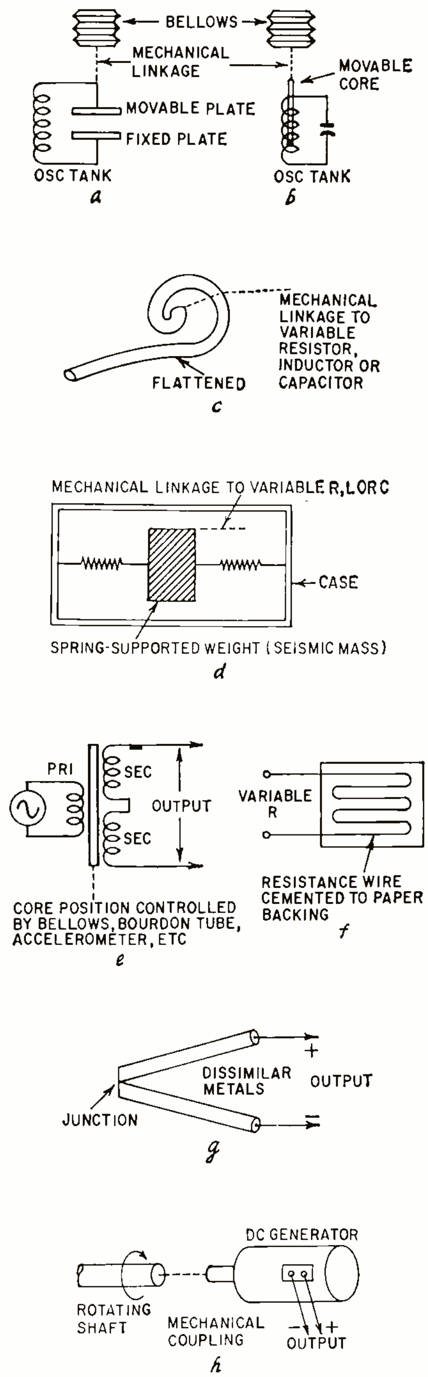

Fig. 3 — Transducers: a — bellows-controlled capacitor; b—bellows-controlled inductor; c—Bourdon tube; d—accelerometer; e—differential transformer; f—strain gauge; g—thermocouple; h—tachometer-generator.

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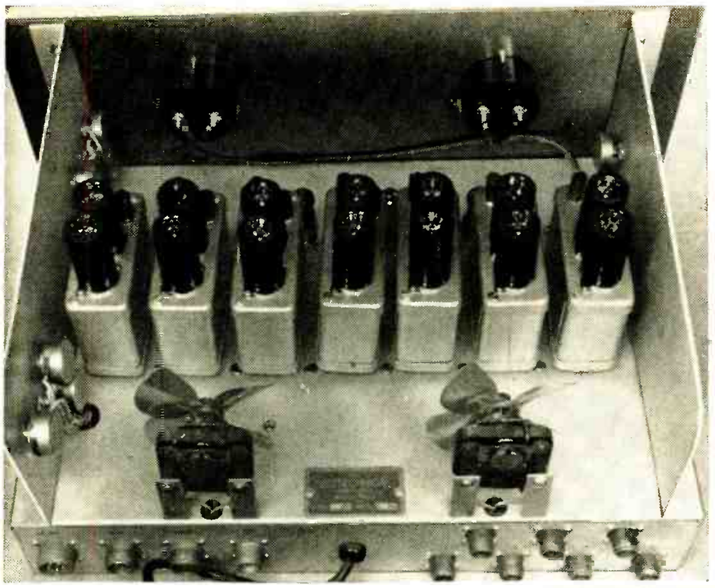

Geotechnical Corp.

Multiplexer containing seven plug-in subcarrier oscillators.

attached causes the wire to stretch. As the wire becomes longer and thinner, its resistance increases. The strain gauge is connected as part of a bridge circuit so that the degree of unbalance of the bridge is a measure of the mechanical strain in the structure being tested. Strain gauges are often mounted on the skin and structural members of a missile.

The thermocouple is a temperature-to-voltage transducer. Consisting of two dissimilar metals, it produces a voltage whose amplitude is determined by the junction temperature. This voltage is relatively small so the thermocouple must be followed by several stages of amplification. As compared to the thermistor, the thermocouple has the advantage of responding faster to temperature changes.

The tachometer generator is a small dc generator used for measuring the rate of shaft rotation. The generator is mechanically coupled to the shaft whose speed is to be telemetered, and the output voltage of the generator is therefore a function of the rpm of the shaft. An ac generator may be used if rpm-to-frequency conversion is desired.

Subcarrier oscillators

Subcarrier oscillators are classified according to the method used to control the frequency—voltage-controlled, resistance-controlled, inductance-controlled or capacitance-controlled.

The resistance-controlled subcarrier oscillator generally employs an R-C tuned circuit such as the Wien bridge or phase-shift oscillators. The oscillation frequency is determined by the time constant of a resistance–capacitance feedback network. A variable-resistance transducer (thermistor, bellows-actuated rheostat, etc.) can therefore be used as a frequency-determining element of the circuit.

Inductance- and capacitance-controlled subcarriers are usually generated by a Hartley oscillator circuit. The transducer controls either the inductance or capacitance of the tank circuit and varies the output frequency.

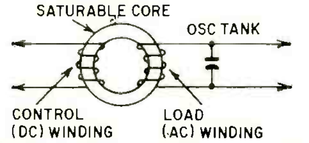

Fig. 4—Saturable reactor used as a variable inductor.

A variation of the inductance-controlled oscillator uses a small saturable reactor as the tank coil. The saturable reactor, as shown in Fig. 4, has two windings: the *control* or *dc* winding and the *load* or *ac* winding. Passing dc through the control winding will saturate the core to an extent determined by the magnitude of the current flow. Since the degree of core saturation determines the inductance of the ac winding, the saturable reactor can be used as a variable inductor. When the ac winding is connected in the tank circuit of a subcarrier oscillator, the oscillation frequency depends upon the current flow through the control winding.

The voltage-controlled oscillator, as the name implies, oscillates at a frequency determined by the voltage applied to its input terminal. As shown in Fig. 5, this type of subcarrier oscillator employs a multivibrator circuit. The grid resistors of the multivibrator are connected to the plate of the control tube rather than being grounded as in the conventional multivibrator. The plate voltage of the control tube therefore varies the bias of the multivibrator and consequently controls the frequency of oscillation. The control tube is in effect a dc amplifier for coupling the transducer to the multivibrator. A small change of input voltage (from the transducer circuit) can therefore produce a relatively large variation of multivibrator frequency. Trimmer capacitors are sometimes shunted across the coupling capacitors of the multivibrator to serve as center-frequency adjustments. As an alternative, controls (R1 and 2) such as those shown in Fig. 5 may be used. The two potentiometers are interacting in effect and are used to set the center-frequency as well as the deviation limits of the oscillator.

Characteristically, the multivibrator produces a square-wave output. The harmonic components of the square wave contribute nothing to the telemetered information and may interfere with higher subcarrier channels. A low-pass filter is therefore used to attenuate the harmonics while allowing the fundamental sine-wave frequency to pass through. The filter is followed by an amplifier stage, sometimes connected as a cathode follower (shown) to provide a low-impedance output.

A commercial model of a voltage-controlled subcarrier oscillator is shown in one photo. An input of ±2.5 volts to this unit will produce a frequency shift of ±7.5%. The control knobs shown are used to adjust the center-frequency and the deviation limits. A multiplexer containing seven of these subcarrier oscillators is shown in the other photo.

A transistor version of the voltage-controlled oscillator is shown in Fig. 6. The transducer circuit is coupled to the multivibrator through an emitter follower. By controlling the bias of the multivibrator, the emitter-follower stage determines the frequency of oscillation. END

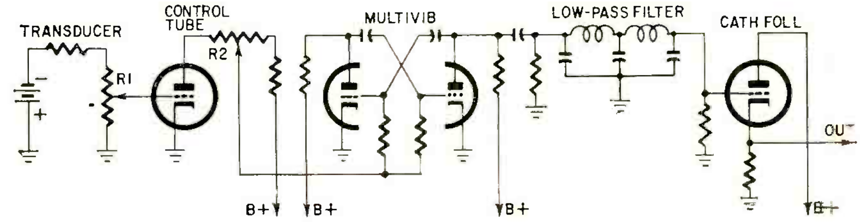

Fig. 5—Voltage-controlled oscillator. Control tube varies bias and therefore frequency of multivibrator.

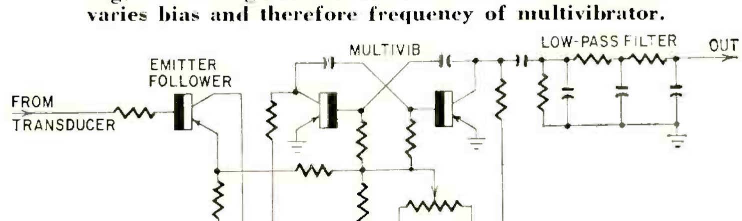

Fig. 6—Transistorized voltage-controlled multivibrator schematic.

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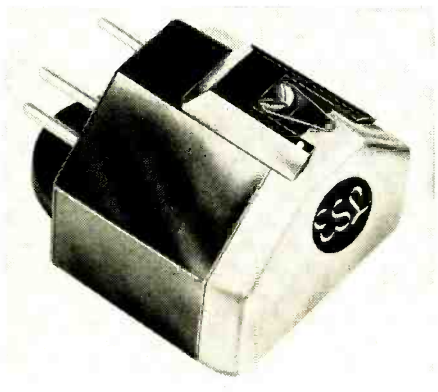
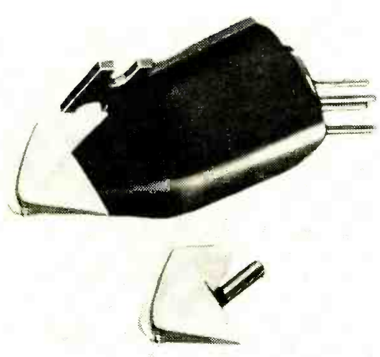
NEW stereo PICKUPS

Part III—The ESL C99 Micro/Flex, Empire 88, Pickering 380, Shure M212/M216, Stereotwin 210/D and Fairchild SM-1

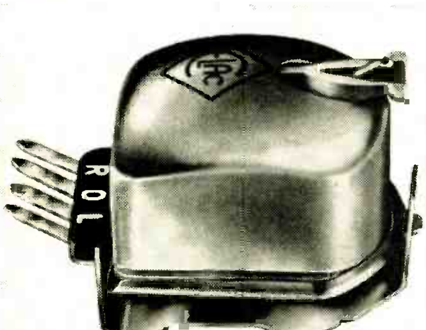
By JULIAN D. HIRSCH



ESL C99 Micro/Flex Cartridge.



Pickering 380 and its slip-in stylus assembly.



Stereotwin 210/D. Stylus assembly is designed for simple replacement.

TWO moving-coil stereo cartridges were described in last month's installment of this series. Since that article was prepared, information has been released on another new moving-coil cartridge, the ESL C99 Micro/Flex.

In many ways this unit resembles the ESL C100 Gyro Jewel (October 1958, page 48). It incorporates the D'Arsonval type of moving coil which has characterized all ESL cartridges. The C100 employed an ingenious gimbal structure which allows each coil to rotate independent of the other. The delicacy of this design is reflected in its relatively high price ($69.50).

In the C99, the basic operating features of the C100 have been retained, with a simpler mechanical design which permits a lower selling price.

One of the photos shows the ESL C99 stereo cartridge. The cantilever stylus shoe is made of a black plastic material. The curved portions visible at the base of the stylus shoe are part of the Micro/Flex coupling system.

Fig. 1 shows how the Micro/Flex separating system couples the stylus to the two coils, each wound with 20 turns of very fine precious-metal alloy wire (only a fourth the diameter of a human hair). The long, narrow coils are positioned between a pair of magnetic pole pieces located in front of and behind each coil. Each end of each coil form (armature) is supported by a latex holding block, which also serves as a damping element.

The Micro/Flex separating system is a molded plastic piece which is split down the middle. At the bottom, the two sections are joined by a thin flexible plastic lever to which the base of the stylus shoe is attached.

Modulation of the inner wall of the record groove moves the stylus up and to the right. The flexible lever bends so that no motion is imparted to coil B, which is held at both ends by the latex support blocks. The left side of the Micro/Flex system rotates with the stylus, causing coil A to rotate in the magnetic field passing through it. This generates a voltage in coil A proportional to the stylus velocity. Similarly, modulation of the outer groove wall generates a voltage only in coil B.

Although this coupling system functions very much like that of the C100 Gyro/Jewel, it is more rugged and simpler to manufacture. The improved ruggedness makes the C99 suitable for use in good record changers.

The compliance of the moving system of the C99 is 5×10^{-6} cm/dyne in both vertical and lateral planes. Its dynamic mass is 2.5 mg. The recommended tracking force is as low as 2 grams in a well designed arm, though somewhat higher forces may be required in some arms.

The output of the ESL C99 is very low (0.6 mv at 10 cm/sec stylus velocity) and a stepup transformer is re-

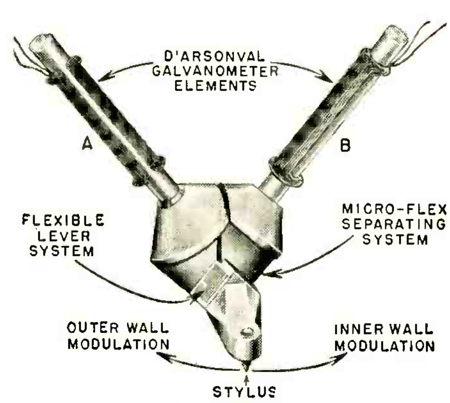


Fig. 1—The Micro/Flex separating system used in the ESL C99.

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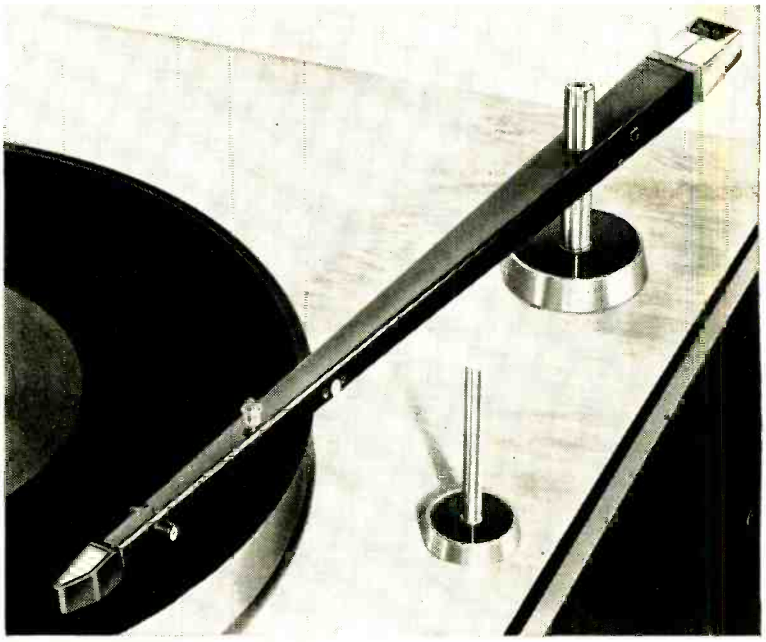
quired for practically all installations. A pair of the ESL TM-100 transformers is recommended. The frequency response is 18–20,000 cycles, ±2 db, and the channel separation is 20–25 db over most of the audio range. The price of the ESL C99 is $49.50.

A moving magnet is the generating element in the cartridges described below. Most moving-magnet cartridges have relatively high output voltages, and rugged moving systems which usually allow the stylus to be replaced by the user. All except the Fairchild SM-1 use a rectangular bar magnet made of a ferrite material which has low mass and good magnetic properties. Although the various cartridges differ in details of coil and pole-piece design, as well as specific materials and stylus support structures, they are similar to the first unit to be described, so its assembly drawing will suffice to explain their operating principles.



The Shure M212 arm and pickup.

Empire 88

This cartridge has a bar type moving magnet, with mass concentrated close to the pivot axis, giving a low moving mass when referred to the stylus tip. Fig. 2 is an assembly drawing of the Empire 88. The rectangular bar magnet is mounted in an elastomer damping material which positions it between the four pole pieces. Its entire length is fastened to the light aluminum stylus shoe, which is angled for stiffness. A fine support wire runs to the front of the stylus assembly to hold the shoe and magnet in a definite position, and to provide the compliance for the moving system.

When the stylus is moved by modulation of one or the other of the groove walls, the magnet rocks about a pivot point located approximately halfway between the front and rear coils. This varies the flux through the corresponding pair of coils generating a voltage in them. In Fig. 2, modulation in the inner groove wall produces an output in the coils nearest the stylus; the outer groove wall controls the output of the rear pair of coils.

The Empire 88. Remove screw to replace stylus.

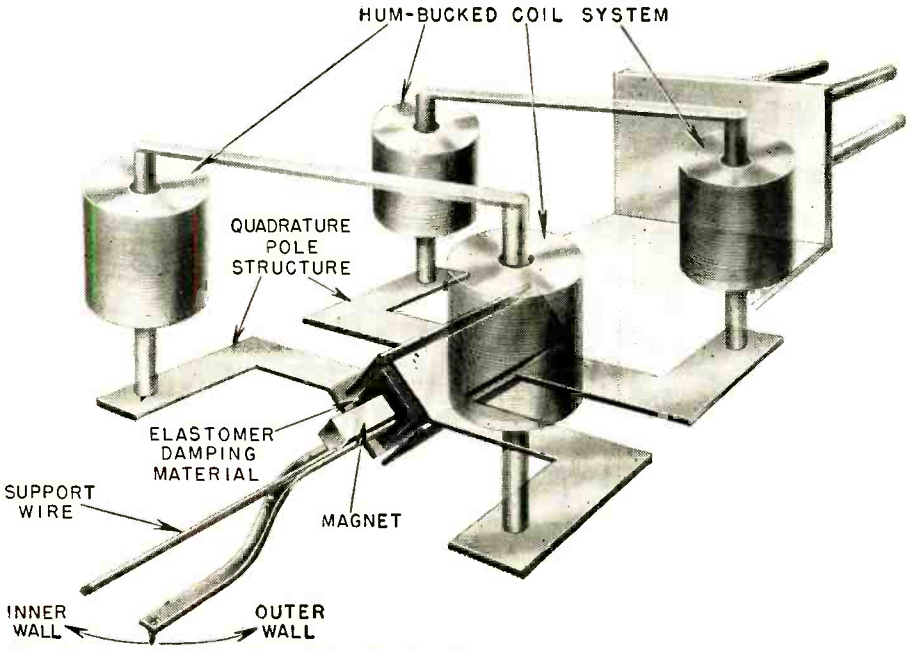


Fig. 2—Assembly drawing of the Empire 88.

A pair of coils is used for each channel. The coils are so interconnected that the effects of external hum fields are cancelled. In addition, a mu-metal shield encloses the front of the cartridge, where the coils are located.

An interesting feature of the Empire 88 cartridge design is that the replaceable stylus assembly contains the quadrature pole-piece structure shown in Fig. 2. The four cylindrical pole pieces which pass through the coils protrude slightly from the cartridge body and contact the flat pole pieces when the stylus assembly is mounted to the cartridge body. This design insures that all critical portions of the cartridge are fully protected and are replaced as a unit when the stylus is replaced. The stylus assembly is held in place by a single screw, visible in the photo.

Compliance of the Empire 88 is 5 x 10^{-6} cm/dyne, in both vertical and lateral planes. The moving (dynamic) mass is claimed to be only 0.7 mg. Its output is 5 mv per channel at average recording levels. Channel separation is greater than 20 db. Frequency response is 20–20,000 cycles ±2 db. The recommended tracking force is 2 to 5 grams. The price of the Empire 88 is $24.50.

Pickering 380

Unlike previous Stanton Fluxvalve cartridges (made by Pickering), which were variable-reluctance types, the new 380 Collectors Series use moving magnets. Although the principles of operation of the Pickering 380 are identical to those of other moving-magnet cartridges, several unique design features which are not immediately obvious are incorporated.

The photos include a Pickering 380 cartridge and one of the plug-in stylus assemblies. The stylus assembly consists of a brass tube containing a rectangular bar magnet, surrounded by a

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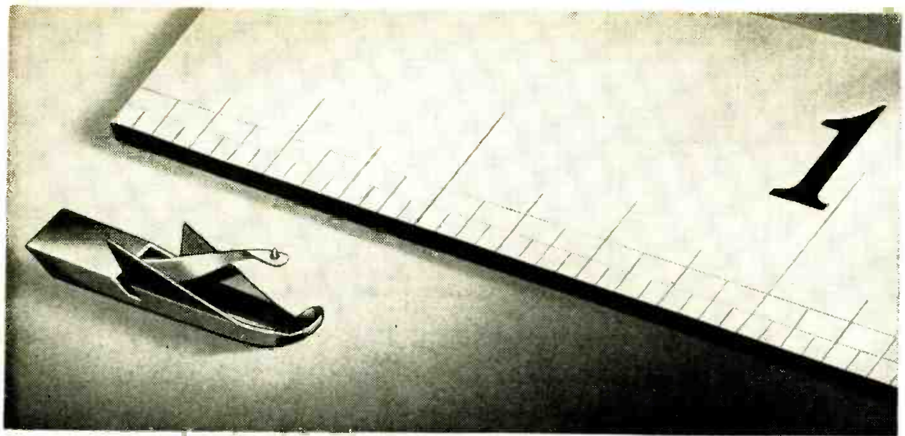

Fig. 3—Replaceable stylus assembly of Shure M212 cartridge.

damping material. A short, stiff aluminum tube extends from one end of the magnet, and carries the 0.7-mil diamond stylus at its far end. The plastic V-Guard cone serves as a handle for inserting or withdrawing the stylus, and protects it if the arm is dropped onto the record surface.

The coils and pole pieces are firmly encapsulated within the body of the cartridge, which is shaped like a completely symmetrical pyramid. At its tip is a small hole into which the brass tube of the stylus assembly fits. Extending along the length of this hole inside the cartridge are the four pole pieces. They are curved to fit the shape of the brass tube, and to obtain maximum magnetic coupling to the magnet within the tube.

The body of the Pickering 380 cartridge is fully enclosed with a one-piece drawn mu-metal shield, and the rear is capped with a piece of mu-metal through which the terminals protrude. The result is virtually perfect shielding against external hum fields, both electromagnetic and electrostatic.

Output is exceptionally high, 20 mv at 10 cm/sec stylus velocity. Frequency response is within 2 db from 20 to 20,000 cycles. Channel separation is 25 db or better through most of the audio range.

The 380 is available with a choice of two styli, for transcription arms or for record changers. The 380-A, designed for transcription arms, tracks at 2 to 5 grams. The 380-C stylus has less compliance and tracks at 3 to 7 grams. Pickering does not publish compliance figures, but experience with the 380-A shows that it will track very well at 2 grams, indicating a very high compliance. The Pickering 380-A sells for $34.50, and the 380-C sells for $29.85.

Shure M212/M216

The Shure M212 is the stereo counterpart of the well known Studio Dynetic pickup, model M12. The M216 is identical to the M212 except for the length of the arm, which will accommodate 16-inch records.

Shure introduced monophonic moving-magnet cartridges to the American hi-fi scene a few years ago, and have continued the same approach to the design of stereo cartridges. The Shure M3D (November 1958, page 83) is widely recognized as one of the finest stereo cartridges, and the M7D (March 1959, page 84) is a lower-priced version of this cartridge.

The integrated pickup, M212, uses the same internal structure as the M3D and M7D, packaged in a very compact form and designed to operate only in a special snakelike arm. It is straight, with the necessary offset angle built into the cartridge (the stylus is mounted at an angle to the axis of the arm). The arm is free to move laterally, but is constrained vertically. Only the extreme forward portion, containing the cartridge, can move vertically. It is raised from the record surface by pressing

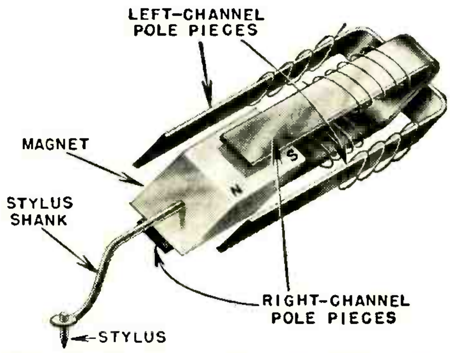

Fig. 4—Moving-magnet assembly used in the Shure cartridge.

down on the plastic button protruding from the top of the arm.

Fig. 3 shows the replaceable stylus assembly of the M212. The thin aluminum member holding the stylus is fastened at its other end to the rectangular cross-section bar magnet. The magnet is surrounded by an elastomer damping material. A fine wire (not visible in Fig. 3) extends from the end of the stylus shoe to the body of the stylus housing, to provide stiffness for the moving system.

The internal structure of the Shure cartridge is shown in Fig. 4. It is very similar to most of the moving-magnet cartridges we have described. The pole pieces are within the body of the cartridge, while the stylus shank and magnet are in the removable stylus assembly.

The frequency response of the Shure M212 pickup is rated at 20–20,000 cycles ±2.5 db, with more than 20-db channel separation at 1,000 cycles. Its output is fairly high, about 9 mv at 10-cm/sec stylus velocity.

Stylus compliance is very high, 9 x 10^{-6} cm/dyne in both lateral and vertical planes. The needle-tip mass is 1.3 mg. Tracking force is adjustable between 1.5 and 2.5 grams. The price of the complete Shure M212 Stereo Studio Dynetic pickup is $89.50.

Stereotwin 210/D

The Stereotwin 210/D is an improved version of the Stereotwin 200 (November 1958, page 88). The original Stereotwin 200 had three solder lugs for its output terminals. The new 210/D has four terminals which accept clip-on connectors as do most other cartridges. The stylus structure has been refined and made more rugged.

The Stereotwin 210/D is fully encased in mu-metal and has extremely low hum pickup. Its output is also very high, about 13 mv per channel.

The cartridge assembly features a simplified mounting system. The cartridge is removed from its mounting clip, which can then be mounted in an arm without difficulty. The cartridge then snaps into the clip.

The stylus assembly, visible in the photo, includes the moving-bar magnet and damping material common to most moving magnet cartridges. It can be slipped in or out of the cartridge without tools.

The design of the mounting clip allows the cartridge to be positioned for correct stylus position in both changers and transcription arms. Slots in the clip permit sliding it forward or backward to obtain the correct stylus overhang for minimum tracking error. Not visible in the photo are two slots in the end of the clip, which permit adjusting the angle the stylus makes with the record surface.

The Stereotwin 210/D will track at 3 to 4 grams in a good arm, or 5 to 6 grams in a record changer. The price

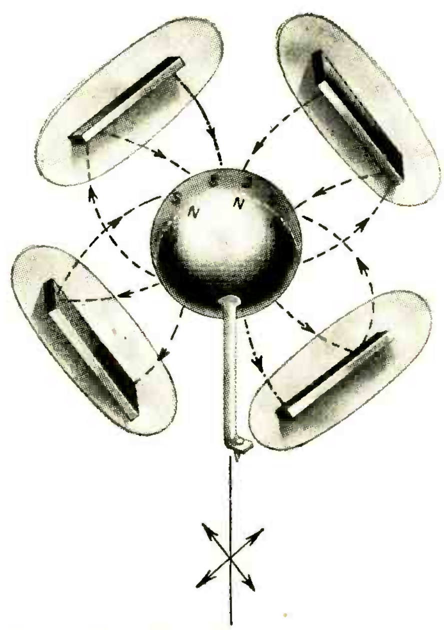

Fig. 5—How the spherical magnet in the Fairchild SM-1 works.

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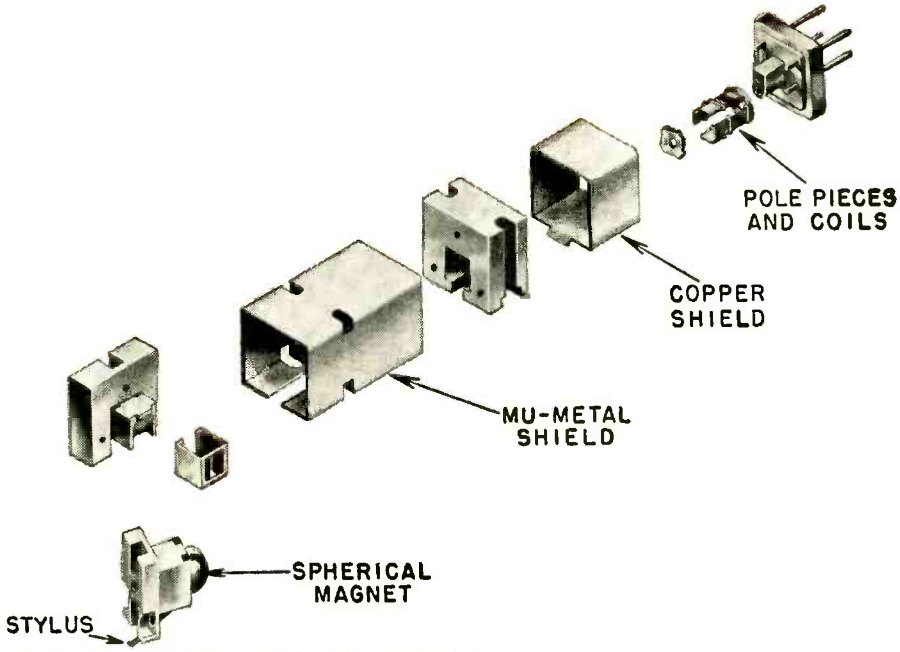


Fig. 6—Exploded view of the Fairchild SM-1.

of the 210/D has been reduced substantially compared to its predecessor. It sells for $34.50.

Fairchild SM-1

The Fairchild SM-1 is a moving-magnet cartridge of radically different design, compared to the ones previously described.

A sphere of Indox V (a magnetic ceramic material) is the magnet in the SM-1. The sphere is magnetized along an axis parallel to the length of the cartridge. Fig. 5 shows the orientation of the magnetic sphere between the four pole pieces, and the distribution of the flux lines. In the neutral position of the stylus, the flux lines pass through the tips of the pole pieces on their way from the front N of the magnet to the rear S. Since the "equator" of the sphere is symmetrical with respect to the four pole pieces, there is no tendency for flux to pass down the pole pieces and link the coils.

If the stylus is displaced from its neutral position, the ball rotates and the balance of flux lines is disturbed. In Fig. 5, the stylus has been displaced vertically, moving the "equator" of the magnet into the position shown by the dashed line. Some of the flux lines, shown as light dashed lines, still bridge across the pole pieces and do not link the coils. Others, shown as dash–dot lines, enter one pole piece and pass down through the coils to return via the opposite pole piece.

The exploded view of the SM-1 cartridge (Fig. 6) shows how the pole pieces pass through the coils and extend forward to the "equator" of the spherical magnet. As the ball rotates slightly due to the stylus following a stereo groove, there is a net change of flux linkage through the four coils and a corresponding generation of stereo output signals.

The ball magnet is mounted in a damping ring which damps vertical motion, and is supported at the sides by damping blocks to control lateral resonances. The damping ring and blocks are shown in Fig. 7.

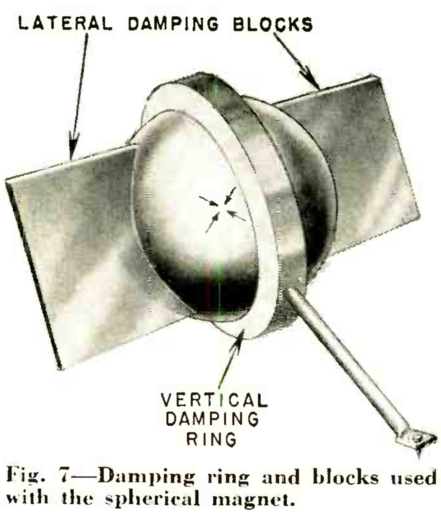


Fig. 7—Damping ring and blocks used with the spherical magnet.

The stylus bar of the Fairchild SM-1 is of tubular construction, for maximum torsional rigidity. Since the ball magnet pivots about an imaginary point at its center, the moving mass referred to the stylus tip is very low. Lateral compliance of the SM-1 is approximately 6×10^{-6} cm/dyne, and its vertical compliance is approximately 4×10^{-6} cm/dyne.

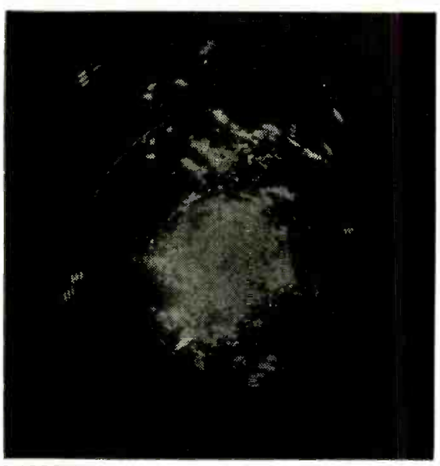
To reduce the effects of external hum fields, a shorted turn of copper surrounds the coils, and the entire cartridge is surrounded by a mu-metal shield. The output voltage of the SM-1 is high, 22 mv for 10-cm/sec stylus velocity. It is designed to track at 3 to 4 grams force. The price of the Fairchild SM-1 cartridge is $34.95.

This sums up our current survey of stereo phono cartridges. As additional units appear, they too will be described. Look for them in future issues. END

NEW for RADAR

TWO accessories that increase the value of radar have recently been announced. One, made by Intercontinental Electronics, Mineola, N. Y., is a new type of indicator system that removes stationary and slow-moving objects from the trace. It uses two storage tubes in cascade as comparison memory gates to eliminate any fixed or slow-moving targets. The difference can be clearly seen in the photos. Photo 1 is a normal radar trace. Photo 2 is a radar picture of the same area, but with the nonmoving targets eliminated. Note how clearly the moving targets appear now.

The second radar aid was announced by Lockheed Electronics, Plainfield, N. J. It is similar to a unit described in the November, 1959, issue of RADIO-ELECTRONICS, page 6. Both are designed to eliminate spurious signals known as "fruit" from radar displays. It is especially useful with radar designed for IFF (*I*dentification *F*riend or *F*oe) and ATC (*A*ir *T*raffic *C*ontrol). The unit assists in locating and identifying aircraft by preventing a display of spurious signals caused by overinterrogation, clutter, weather or other phenomena. In military applications it will separate targets from interference, intentional or otherwise. END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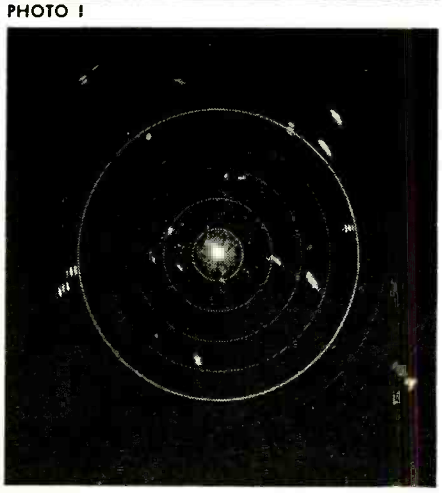
PHOTO 2

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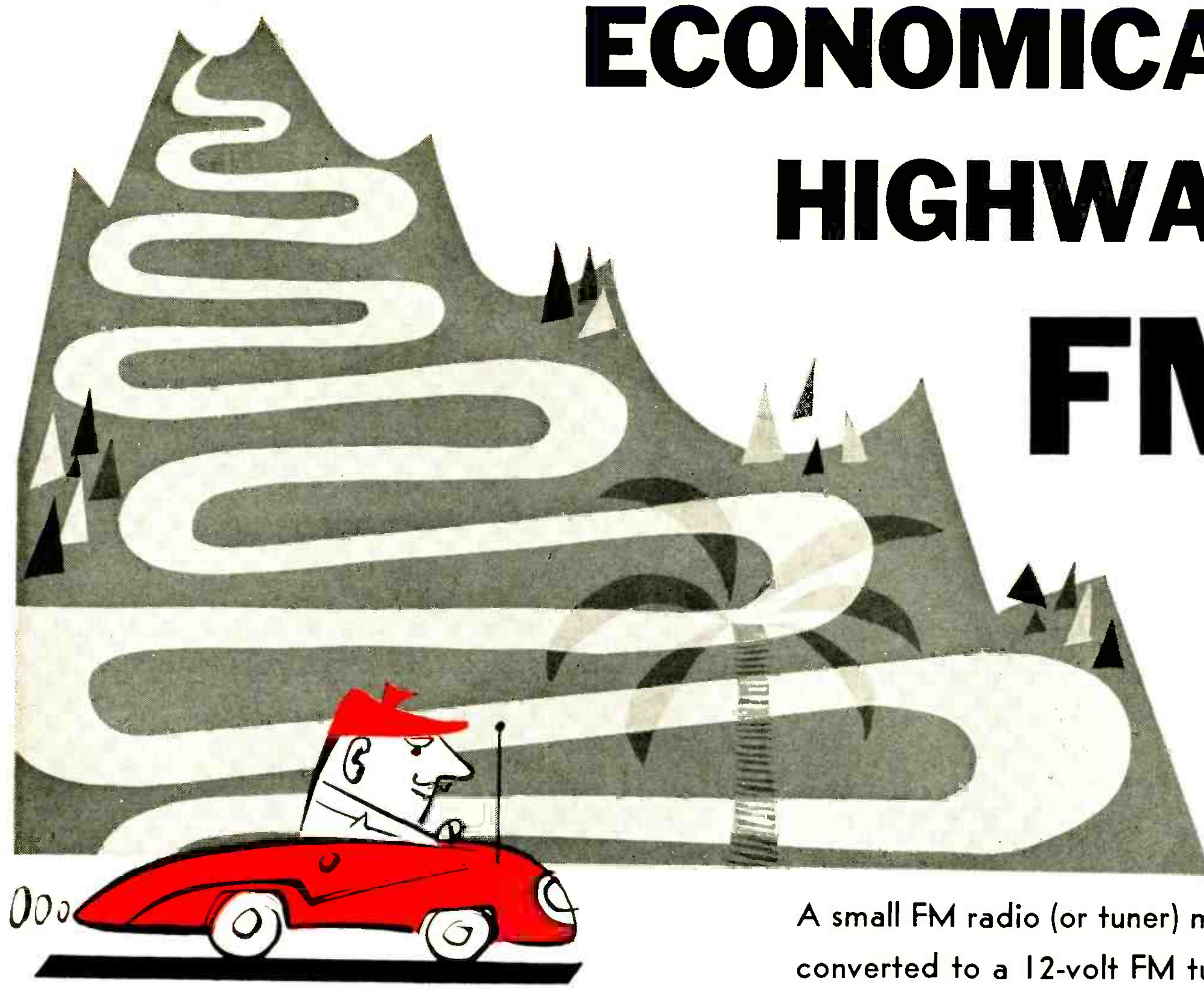
ECONOMICAL HIGHWAY FM



A small FM radio (or tuner) may be converted to a 12-volt FM tuner

By JOHN J. BORZNER

MOST automobiles have built-in AM radio. For the individual who wants to listen to an FM station while driving, there has been just one "choice" (assuming his car does not already have an FM radio): buy a commercial FM receiver. Most commercial sets cost a good deal more than the average man wants to pay. Now, for $40 (much less if you already have a small FM radio), you can add FM to your car.

What are the advantages of FM? Distortion is less, signals are much cleaner, there is much more good music on FM than AM; there are fewer commercials and the audio-frequency range of most FM stations is better than that of AM stations.

I have taken two FM receivers and converted them to 12-volt-powered tuners. One is the Granco 601 FM table radio; the other is the Heathkit FM-3A tuner.

The power supplies of both units were removed and replaced with a transistor-oscillator B-plus supply. Since one is a tuner, few other changes are necessary. The audio output stage and speaker were removed from the radio. The audio signal is fed to the car's AM radio audio system.

Both sets are quite free from drift, especially the Granco. The Heath has agc, which is helpful when driving through areas where signal strength varies—cities with many tall steel-frame buildings.

Both sets are powered by a small, dependable transistorized power supply. It puts out about 125 volts dc for the Granco and 250 volts for the Heath. Granco uses three 12-volt tubes (which present no problem and one 19-volt tube which performs satisfactorily on 12-volts. Later models have a 14-volt tube in place of the 19-volt one). The Heath set uses six 6-volt tubes which can be readily hooked up as three 12-volt strings.

Before building the power supply, decide which radio you are going to use. The supply can be built into either cabinet very neatly. The space used by the rectifier tube and transformer in the Heath is more than adequate for the transistor power supply. In the Granco (which uses a selenium rectifier), the loudspeaker, output transformer and audio output tube are removed to make room for the mobile power setup (see photos).

Granco conversion

The Granco radio is ready to play when received. I suggest that you let it run a few days before the conversion. When you are convinced that it is operating satisfactorily, start the conversion. Remove the loudspeaker, output transformer and the audio output tube (50C5). Snip the two colored leads to the output transformer close to their source. Ground the black lead which runs from the volume control to the output side of the transformer.

In the space previously occupied by the speaker and output tube, mount the transistor power-supply transformer, a Triad TY-68S. Then, in any convenient spot, mount the two transistors. They will not require a heat sink, even under sustained use. The collector in the 2N256 is tied internally to the case so you must insulate the transistors from each other and from the mounting plate. Wire the power supply according to Fig. 1. RECT 3 and 4 are not used for the Granco.

Ground the center connector of the power-supply rectifiers to the chassis. The B-plus lead is simply soldered to the output side of the selenium rectifier (Fig. 2). The power supply output is filtered by the power-supply filter in the receiver.

Now rewire the heaters for 12-volt operation (Fig. 3). There is no need to remove any components. (Watch bat-

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R1—68 ohms, 1 watt
R2—270 ohms, 1 watt
All resistors 10%
V1, 2—2N256 or equivalent
T—transistor oscillator power transformer, 12 volts to 250 volts, 65 ma, centertapped (Triad TY-68S or equivalent)
RECT1, 2, 3, 4—500 ma, 130 volts silicon rectifiers (Sarkes Tarzian M500 or equivalent)
F—SFE 32-volt, 9-ampere fuse and in-line fuse holder

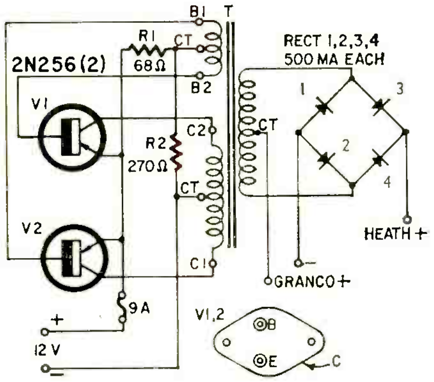


Fig. 1—Power supply schematic. RECT 3 and RECT 4 are not used with the Granco and the secondary center tap is not used with the Heath.

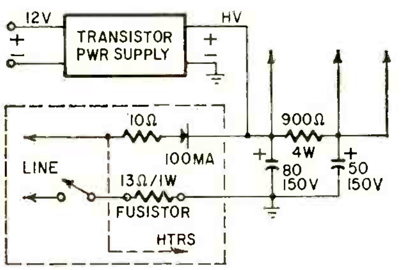


Fig. 2—Method of hooking the power supply to the Granco. Except for the on-off switch, parts in the dashed box are not used.

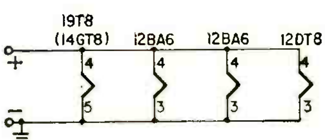


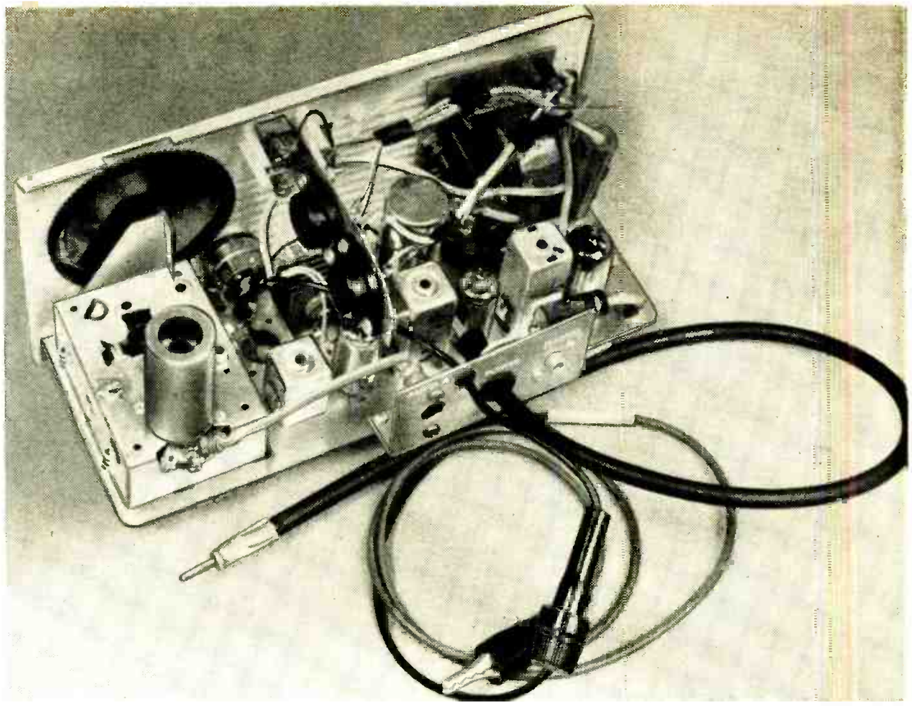
Fig. 3—The Granco heaters are wired in parallel. On late model sets, a 14GT8 replaces the 19T8.

tery polarity. Fig. 3 shows connections for a negative ground. If your car has a positive ground, connect the *positive* battery lead to the grounded side of the heater line.) When you are sure the wiring is correct, attach a lead to the car battery and ground the chassis. Note whether the heaters light properly.

Electrically, all that is left to the conversion is to pick the audio signal off the output tube socket. Run a length of shielded lead from pin 2 through a 0.5-μf capacitor to a phono jack.

Mount a piece of sheet aluminum (bent to a right angle) on the rear of the set. On this plate, mount the phono jack for audio takeoff, the fused power line input, auto antenna input and output.

The 12-volt power line goes through a fuse holder to the switch on the back of the volume control. A *standard auto-antenna jack* is mounted on the plate and connected to pin 8 on the 12DT8 rf oscillator tube *through the existing capacitor*. A length of shielded lead, auto-antenna type with bayonet connector (to fit the antenna input jack on the AM radio) is connected to an spst slide or toggle switch on the front panel (Fig. 4). The other side of this switch goes to pin 8 of the 12DT8. The switch allows us to change over from FM to AM without changing the antenna connections. The .05-μf capacitor from pin 2 on the 50C5 tube socket goes to the phono jack on the plate.



Rear view of converted Granco.

Cut a hole in the cabinet back to accommodate the aluminum plate. Replace the cabinet, secure the bottom screw and the conversion is complete.

Now the AM radio must be converted to receive the audio signal from the tuner. This is usually a very simple matter. In my car, a Motorola model 84MS is used. The audio signal was applied to the base of the driver transistor. A diagram of your particular set should indicate a suitable point. These diagrams are available in many municipal libraries if you do not have one. A shielded lead terminating in a plug to fit the tuner's phono jack completes the conversion.

To operate the set, attach the power lead to any convenient 12-volt source. Make sure that the 12-volt source is

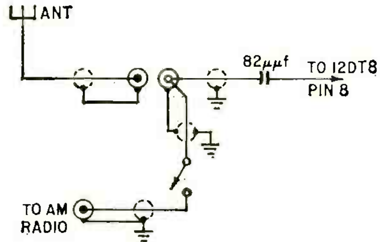


Fig. 4—A spst switch allows the AM radio to be connected directly to the antenna.

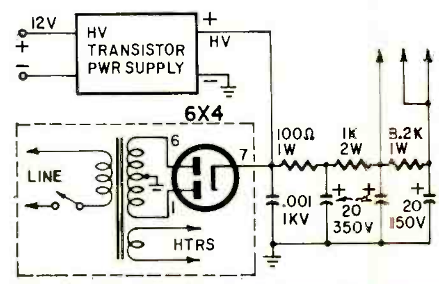


Fig. 5—The B-plus lead from the power supply is connected to pin seven on the 6X4 socket. The boxed parts (except for the switch) are not used.

turned off when the ignition is turned off. If this is not done, there is a chance of leaving the converter on overnight, discharging the battery.

Insert the auto antenna plug (which will also serve as the set's ground), connect the audio plug and turn both sets on. Set the auto radio to a neutral spot on the dial. Control the volume with the volume control of the AM set.

Heathkit conversion

The Heathkit FM tuner must be assembled before the conversion can be attempted. It is advisable to build the set according to the instructions included, using the supplied 117-volt power-supply and heater-string setup. After the set is finished and plays to the builder's satisfaction (scope alignment is recommended), the conversion to a fine mobile car radio can be started.

Begin the changeover by removing the power transformer and rectifier tube (6X4). This will provide adequate room for the transistor power supply. Wire the supply according to the schematic (Fig. 1). The B-plus lead is attached to pin 7 on the 6X4 socket (Fig. 5).

Rewire the heaters according to Fig. 6. Then apply 12 volts to the plus side

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of the heaters and ground the chassis to see whether the tubes light (see previous warning on heater grounds.)

You will not need the aluminum plate described above for mounting the sockets and jacks on the back of the cabinet. Since this set was originally designed as a tuner, the phono output jack is already installed. The antenna coupler can easily be changed to the automotive type jack. Be careful to note polarity.

The antenna changeover switch can be located on the front panel.

With the Heath set, volume is controlled by *both* the AM and FM units, so make sure that both are turned up when testing.

General

Both sets are hooked up to the car in the same manner. The auto antenna lead will serve as a ground (by means of the cable shield. Power is taken from the cigar lighter or ignition switch. Attach the audio output cable to the car radio's input jack and turn on both sets. The power supply in the converted set may appear to race or take off until the heaters warm up; however it will stabilize once operating temperature is reached (usually 1 minute).

If your set showed a tendency to drift while warming up in the preconversion test, you will have to allow some time for the set to settle down. This is usually not over 15 minutes even in the poorest sets. This completes the conversions. These are reasonably simple changes and sets that do not function properly can be usually traced to troubles in the receiver itself.

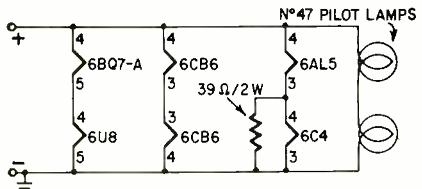

Fig. 6—The Heath heaters are in series-parallel. A resistor is required across the 6C4 heater.

Noise

There should be no interference from the AM radio because the auto antenna is connected to the FM set. When the car radio is not connected to an external antenna, its sensitivity is reduced to near zero. However, it doesn't hurt to set the AM radio to a quiet spot on the dial. If a crackle or ignition noise is heard, better shielding of the FM set or antenna may be required. While FM radios are usually noise free, they are susceptible to motor noise. Proper shielding is the answer to almost all these problems. Your car will pose its own problem which careful custom installation can solve.

By using reasonable care in building and converting, the experimenter will be rewarded with many enjoyable hours of pleasing highway FM. END

SIMPLE SWEEP GENERATOR USES VARICAP

By MORRIS BARRON

A UNIQUE component from the semiconductor family promises to provide a new and better technique for voltage-controlled tuning and for frequency modulation in particular. The Varicap,* a voltage-variable capacitor, should prove useful and effective in building or designing new equipment or modifying older equipments. It is actually a diode whose capacitance changes in accordance with the applied bias voltage. Among its other good attributes, the Varicap voltage-variable capacitor is inexpensive, costing no more than an ordinary receiving tube.

There is a real need for a good but simple and inexpensive FM alignment tool in the service technician's or experimenter's shop. An rf signal generator was modified with the help of this handy component, and demonstrated its aptness and simplicity of use. The 20-$\mu\mu$f voltage-variable capacitor† was used to modify an ordinary signal generator to provide a sweep-signal source for 10.7-mc if and discriminator FM receiver alignment. The photograph shows how the necessary circuit components can fit into an instrument, and how little space they require, making this modification easy. Fig. 1 is the schematic of the sweep frequency-modulation circuit.

In working out the design of this circuit, the details were considered in the following order: first, the sweep voltage frequency of 60 cycles was established. It is the standard used for many other instruments and test procedures used for this purpose. Next, the chart of Fig. 2 was consulted to determine the required modulation voltage. The chart shows the voltage–capacitance relationship for all Varicap diodes regardless of their initial capacitance. It was found that the generator's 6.3-volt filament supply was not only convenient but could provide ample voltage, 17.6 volts peak to peak.

That voltage is more than enough for the required frequency deviation. However, the exact amount of frequency swing of an oscillator is determined by the L-C ratio of the coil–capacitor combination which produces the 10.7-mc frequency. Thus, for a tuning condition

* Trademark for Pacific Semiconductors Inc. voltage-variable capacitor.

† Type V-20, capacitance at −4 volts, 20 $\mu\mu$f.

BENCH TESTED

A simple circuit that will make an AM signal generator into a sweep gen, with a deviation that can be as great as 600 kc.

The unit worked exactly as specified by the author. Sweep patterns as observed on scope screen were sharp with rapidly rising front edges and rapidly falling rear edges.

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where the tuning capacitor of the signal generator is at a minimum, the voltage-variable capacitance produces a relatively large frequency change, up to 600 kc. If the 10.7-mc point occurs at the low-frequency end of the band (tuning capacitor fully meshed), the voltage-variable capacitor produces a relatively small amount of frequency change, no more than 60 kc.

If you wish to use your signal generator without changing its calibration, the circuit of Fig. 1 can be switched in or out very simply. For recalibration of the 10.7-mc point, within the band, using the voltage-variable capacitor, a shorted turn was used to overcome the excess static capacitance of the circuit, even though the calibration trimmer was removed from the tuning band.

Many methods can be used to recalibrate the signal-generator band, and find a good 10.7-mc point. There are also various procedures for FM alignment. These will not be discussed here. The information is available in standard texts, and experienced service technicians, advanced experimenters and technicians will have no difficulty with these problems.

Another very good feature of using a voltage-variable capacitor is that a 60-cycle phase shifter, normally needed for the oscilloscope horizontal sweep, is not necessary. Since the circuit in the signal generator is electronic, with no mechanical device to produce phase lag, it was possible to use the 6.3-volt 60-cycle test voltage, right at the front of the oscilloscope, for the horizontal sweep required for viewing the band-pass response curve of the equipment under test. In this case, only a few degrees phase shift of the sweep pattern on the oscilloscope was noted.

Very good results were obtained without lengthy experimenting or "playing around." Approximately half the ac voltage provided well over 300-kc swing, with the 10.7-mc point at the top of the band. A 7.5-volt C-battery, with taps every 1.5 volts, is ideal for providing bias voltage for any required amount of frequency swing. This circuit will work equally well at 4.5 mc, TV sound channel, or even the broadcast band, where a relatively small (10-kc) frequency shift is needed. Other values of voltage-variable capacitors are available to provide practically any frequency sweep, provided the circuit Q is not brought down so low as to stop oscillation.

(The Varicap must be reverse-biased for correct operation. Forward bias may damage it, so check the manufacturer's instruction sheet carefully for the markings corresponding to the positive and negative ends. Also, the sum of the bias and peak signal voltages should not exceed the maximum operating voltage. Set the bias high enough so the signal cannot swing the diode into the conducting region.—*Editor*) END

R1—150,000 ohms, ½ watt
R2—100 ohms, potentiometer
C1—.005 μf, paper
C2—.002 μf ceramic
V-20—Varicap V-20
S1—switch, spst, optional
S2—switch, spst, toggle
BATT—6-volt, tapped

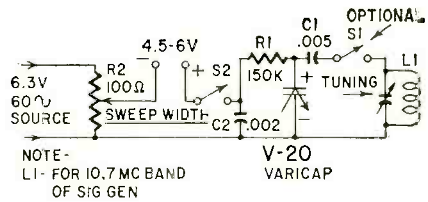


Fig. 1—Schematic of the circuit that modifies a signal generator.

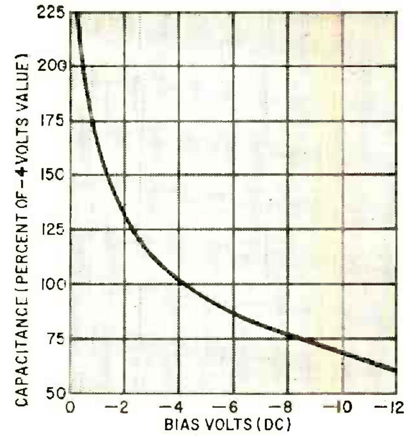
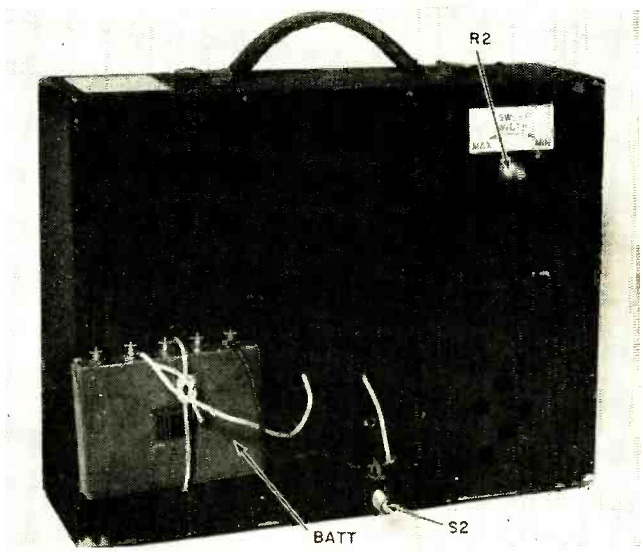
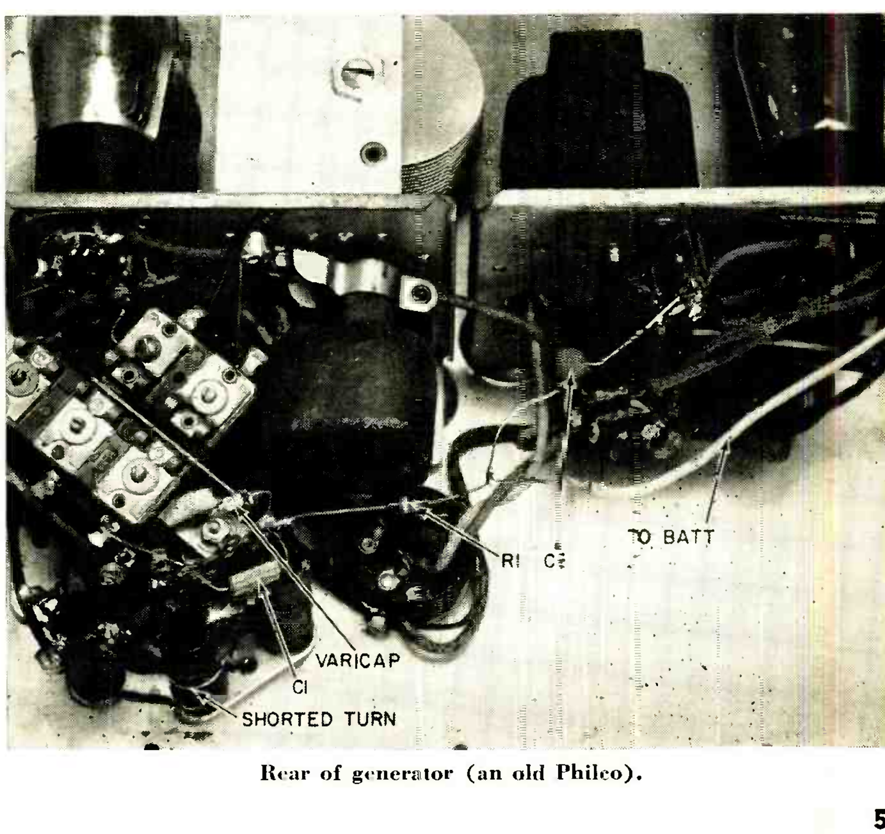


Fig. 2 — How a Varicap's capacitance varies with voltage.



View of the sweep generator, showing added components.



Rear of generator (an old Philco).

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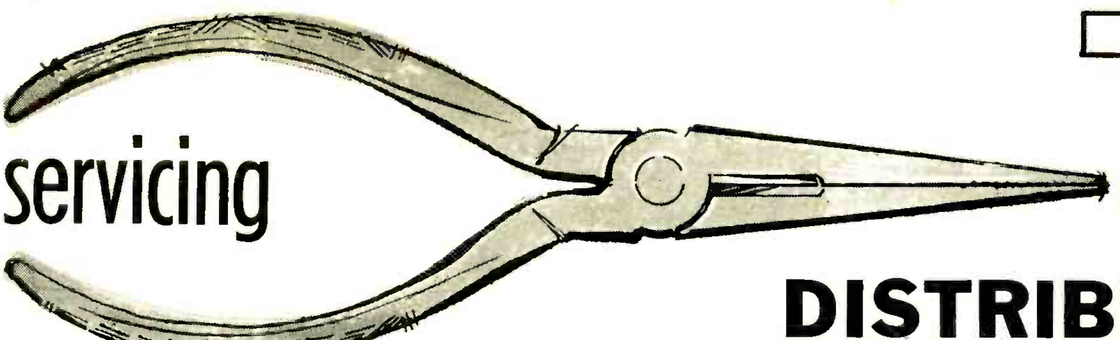

servicing TV DISTRIBUTION SYSTEMS

Part I—TV distribution systems are becoming more common in motels, hotels and apartment houses.

By JACK BEEVER *

TELEVISION distribution systems cannot be successfully serviced unless their workings are understood. The "why" and "how" are essential before difficulties can be intelligently treated. For this reason, it is best to examine first the general requirements of TV distribution systems.

In terms of the job to be done, we must feed a number of television receivers (from 5 to perhaps 2,000) with signals from a single receiving site or perhaps a single antenna. The signals at each set, to quote the usual specifications, must be "equal or superior to those found on a single set fed from a single antenna in the same location."

The systems are similar to PA systems, but are immensely different in detail and in design technique. This is because of the great difference in the frequencies handled. The highest audio frequencies in public-address work rarely exceed 15,000 cycles, but the TV distribution systems handle from 54 to 216 megacycles (216,000 kc). Fig. 1 is a block diagram of a basic system drawn with typical symbols used in the trade.

Components

The components are: an antenna (it may be a group of cut-to-channel Yagis); an amplifier; line splitters; tap-offs to connect television sets to the system; terminating resistors to terminate the lines in their characteristic impedance, and connecting cables. In any system worthy of the name, coaxial cable is used for interconnecting the various components. The cables are standardized to types having characteristic impedances of 75 ohms. The more commonly used types are RG-59/U and RG-11/U (or their polyfoam-dielectric equivalents).

First, we have an antenna delivering signals to an amplifier. The amplifier raises these signals to a higher level, usually by a factor between 20 and 1,000 times depending on the ratio between the antenna signals and those required to drive the system properly. This calls for amplifiers of between 26- and 60-db gain.

From the amplifier on, we have a branched cable system to cover the various points where TV sets will be located. At these points, tapoffs are inserted into the line to allow the set to be connected to the line *without causing undue disturbance in the line or to other sets on the line*. The splitters are devices designed to divide the energy in the input cable between two (or more) output cables and to maintain the impedance match in all directions.

The ends of the lines are terminated in resistors of the same value as the characteristic impedance of the cable, 75 ohms. These are usually mounted in special fittings to provide the smallest possible reactive component.

Basically then, we have a system which consists of a signal source (the antenna, an amplifier or amplifiers) and a distribution system whose most important characteristic is the very large losses "seen" in it. Unlike power or speaker wiring, we cannot ignore these losses. Indeed, the amplifier's major function is to overcome these losses. In the commonly used RG-59/U type coax, the losses at channel 13 will be around 6 db per 100 feet (see table); in other words, the voltage will be down to one half at the end of a 100-foot run. The next 100 feet will reduce it to one-fourth, the next to one-eighth and so on.

Decibels

System calculations are always carried out in terms of voltage (since the system impedance is fixed) and db for convenience.

The db is not as puzzling as it would first appear. It is an expression of *ratio* rather than a multiplying factor. In other words, an increase in *voltage* of six db means the voltage has doubled.

Now this boils down to the fact that when we say 6 db, we mean that we are talking about something which is twice as great as 0 db, since 0 db is 1 times and 6 db is two times. The question always comes, "What's 0 db?" The answer is 0 db is anything you choose to make it! In TV systems you can specify whatever you like as 0 db. It can be the antenna signal, or you can choose (as we at Jerrold do) 1,000 μv read across an impedance of 75 ohms. The great advantage of using db is that you can add and subtract numbers in db when computing a system, and the numbers stay small. Otherwise you'd

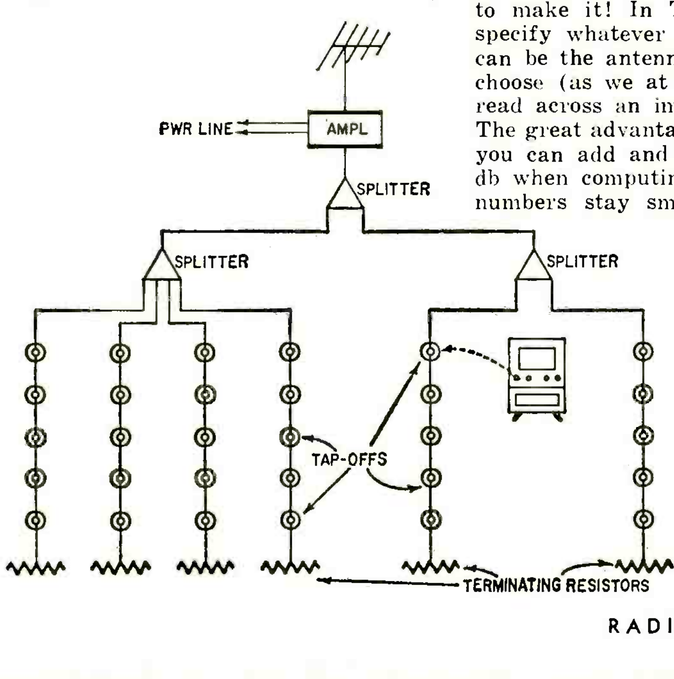

Fig. 1—Block diagram of a typical building system.

* Applications engineer, Jerrold Electronics Corp.

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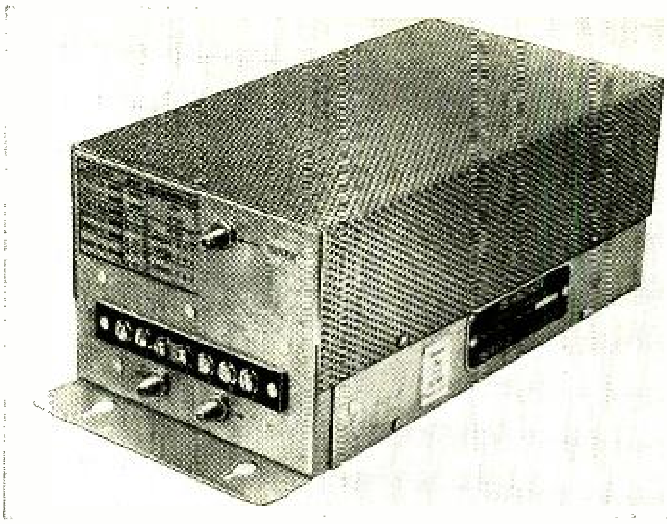
have to divide or multiply at each step, and your computations would involve large, complex numbers.

Here are some examples (in terms of voltage):

6 db = 2×
10 db = 3.14×
12 db = 4×
18 db = 8×
20 db = 10×
30 db = 31.4×
40 db = 100×
60 db = 1,000×

Let's take a more practical example. A particular antenna delivers a 1,000-microvolt signal on channel 7. The channel 4 signal is 6 db higher or 2,000 microvolts (approximately). The signal on channel 2 is 4,000 microvolts, 12 db higher than the channel 7 signal and 6 db higher than the channel 4 signal.



Broad-band preamplifier (Jerrold ABD-1).

System types

Distribution systems are generally either of two types requiring slightly

CABLE ATTENUATION DATA/CHANNEL*

CHANNEL / CABLE	2	3	4	5	6	7	8	9	10	11	12	13
	CABLE ATTENUATION db/per 100' at pix carrier freq.											
RG-59 U	2.8	3.0	3.2	3.4	3.6	5.3	5.4	5.5	5.6	5.7	5.8	5.9
RG-6 U	2.1	2.2	2.3	2.4	2.6	4.0	4.05	4.10	4.15	4.20	4.25	4.3
RG-11 U	1.6	1.7	1.8	1.9	2.0	2.7	2.75	2.80	2.85	2.90	2.95	3.0
RG-35 U	0.52	0.55	0.58	0.62	0.65	1.10	1.15	1.20	1.25	1.30	1.35	1.4

*Maximum attenuation.

Broad-band amplifier (Jerrold 2300).

different service techniques—the broad-band and the strip-amplifier type. The broad-band uses a single amplifier which is capable of accepting and amplifying all (or any) TV channels. Such amplifiers are usually a dual amplifier with a common power supply on a single chassis. One amplifier handles the low-band channels (2 to 6) and the

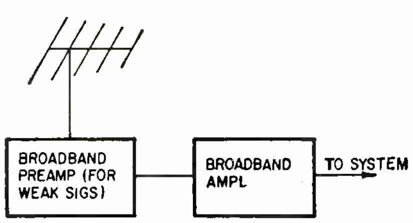


Fig. 2—Head end of broad-band system.

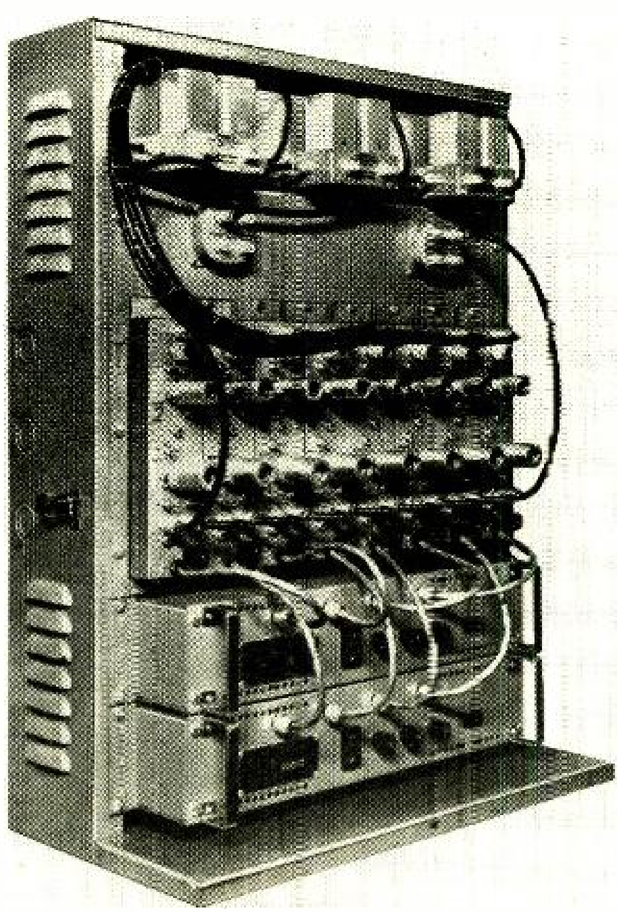
other the high-band channels (7-13). The strip-amplifier type uses a single narrow-band amplifier for each channel.

In general, strip type amplifiers are used to avoid the necessity of reamplifying the signals when high levels are required and broad-bands are used where output requirements are less severe.

Components

The most complex component of a system is the amplifier portion, usually referred to as the head end. A typical broad-band head end is block-diagrammed in Fig. 2.

A strip-amplifier head end is more complex, but provides higher output levels and greater ease of control. Fig. 3 is a block diagram of a four-channel



Strip type head end for 7 channels of TV and 1 FM.

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head end of this type. Strip amplifiers are available with automatic gain control. Preamplifiers, especially designed for a low noise figure, are used in conjunction with such amplifiers where signal levels are too low to drive the strips to the rated output.

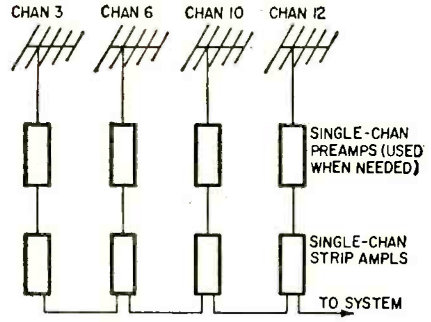


Fig. 3—Head end of strip type stystem.

Coaxial line splitters are made in two general types—reactive and resistive. Reactive splitters are transformerlike devices and have the lowest splitting losses—2-way splitters showing a little over 3-db loss per leg (not really loss, the input power is divided in two halves) and four-way reactive splitters show 6 to 7-db loss per leg. Special types having nonsymmetrical splits are made but they are not commonly used in building systems. Resistive splitters show higher losses: 6 db per leg for two-way splitters and 12 db per leg for four-way splitters, but they have the advantage of improving system impedance matching.

Tapoffs are used to extract a small amount of rf energy from the coax and feed it to a television receiver. They must therefore have a resistance or impedance in the tap line. The energy taken from the line must be kept small so that the tap (and the set connected to it) will not disturb the line impedance to an extent that will cause reflections and ghosts. Two types are in common use—the resistive (Fig. 4-b)

Single-channel preamplifier (Jerrold 406-A).

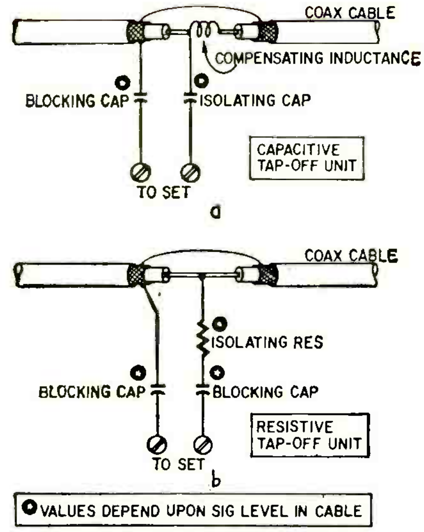
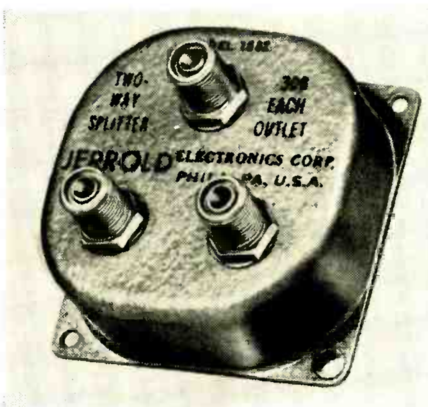


Fig. 4—Tapoffs, capacitive (a) and resistive (b).



Jerrold

Two-way coaxial line splitter.

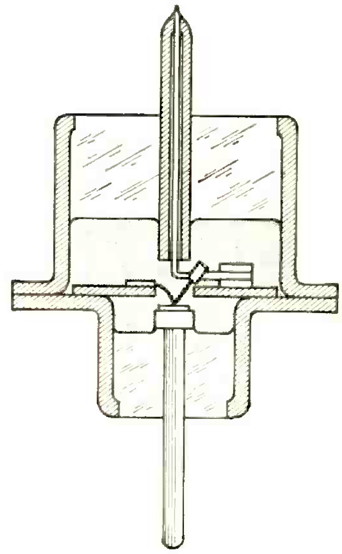
and the capacitive tap (Fig. 4-a). These taps have two important characteristics: a loss from the line to the receiver, called isolation loss, and a loss in the line itself, called feedthrough or insertion loss. The general rule is that the less isolation loss in the tap, the more feedthrough loss.

The two types have different characteristics, resistive taps showing the same isolation loss at all frequencies, but causing more line disturbance than capacitive taps. Capacitive taps show greater isolation at the low channels (2 to 6) and less at the high channels (7 to 13). This tends to offset the loss characteristic of coaxial cables, less loss at the low channels and more loss at the high channels.

Terminating resistors will be found at the end of all coaxial lines. These are usually designed into the modified body of a coaxial-cable connector with the resistor mounted coaxially. It is difficult to connect a resistor to the end of a coaxial cable in such a manner that it will not show inductive or capacitive behavior at vhf, so this is no place to look for economies.

Part II of this series will discuss some of the symptoms (and their causes) that appear in a distribution system when something throws it out of kilter. TO BE CONTINUED

MICROWAVE TRANSISTORS



TWO ways to use transistors at microwave frequencies have been announced. One mode was discovered a few months ago by V. W. Vodicka of Lenkurt Electric Co., San Carlos, Calif. He found that a Philco 2N502 with a 700-mc maximum frequency operated up to 2,500 mc. Further tests showed that other available transistors that have heavily doped bases produce similar results.

The cause of the greater-than-expected frequency range is not completely understood, but Vodicka says it appears to have characteristics that combine tunneling and avalanche effects.

Under the right circuit conditions, transistor bandwidth is radically increased while noise is reduced greatly. Already noise figures approach those of parametric amplifiers.

Another approach toward microwave transistors is used at Bell Labs. They start off with a mesa transistor whose total active area is smaller than the cross section of a human hair. It is a p-n-p unit that has a diffused base and an alloyed emitter. It is designed for use as an oscillator at frequencies up to 3 kmc or as an amplifier up to 1 kmc. The mesa section is only 1.8 mils long and 1.5 mils wide. Three metal stripes, each 0.3 mil wide and 1.5 mils long, are evaporated onto the surface and alloyed into the three parts of the device. Gold wire, 0.2 mil in diameter, is used for the connections. The transistor's diffused base is only 1/50 mil thick.

The unit is built into a coaxial shell (see diagram) that prevents parasitic capacitance and inductance. The shell itself has an impedance equal to that of a 50-ohm line and is connected to the transistor's emitter. END

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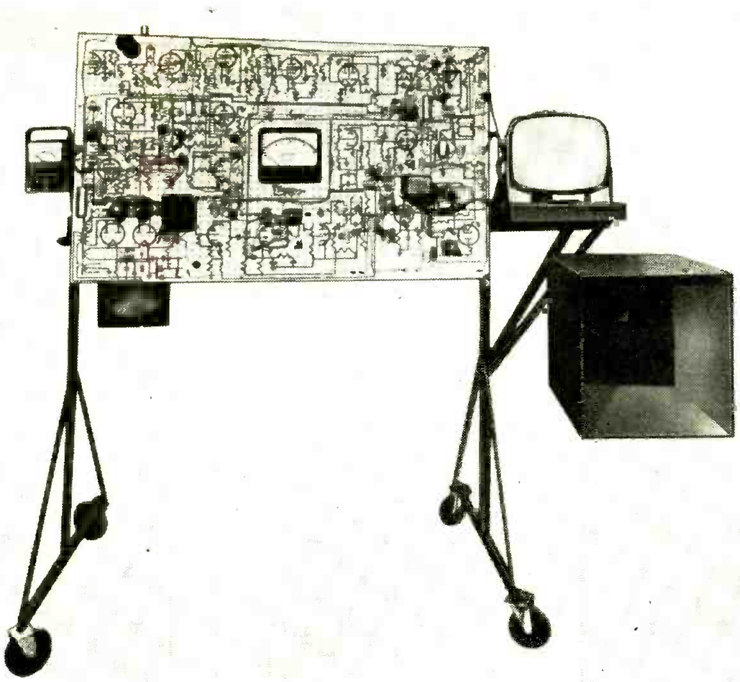
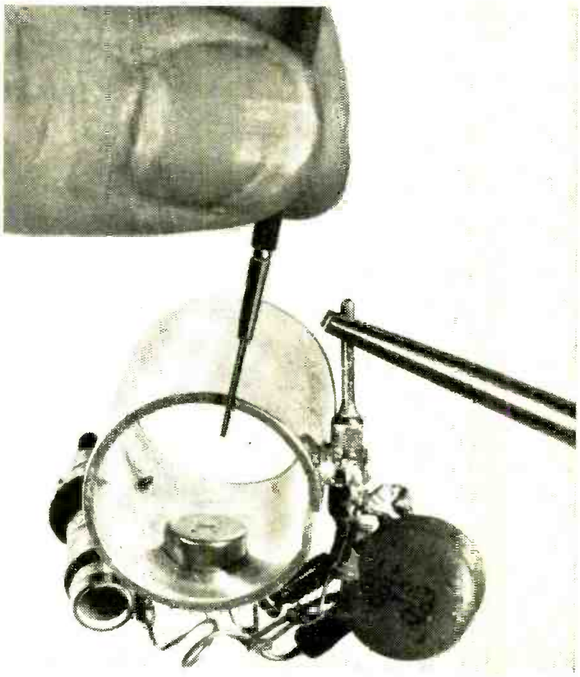
WHAT'S NEW

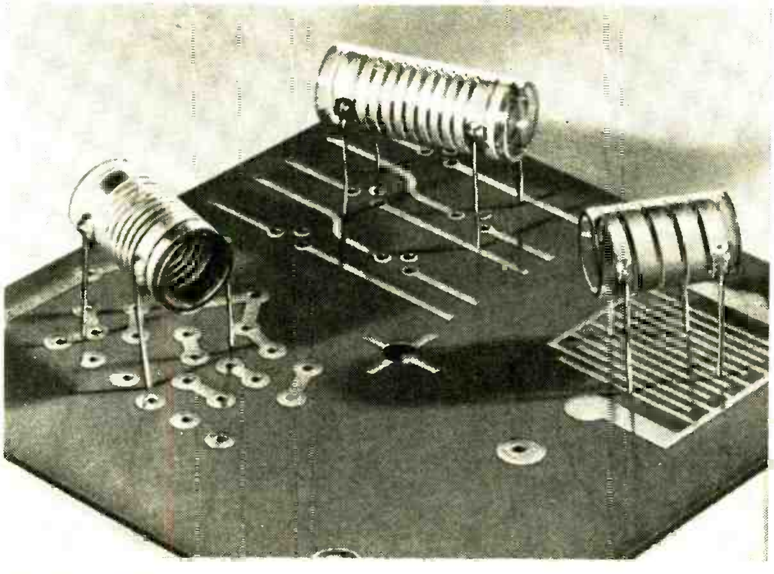


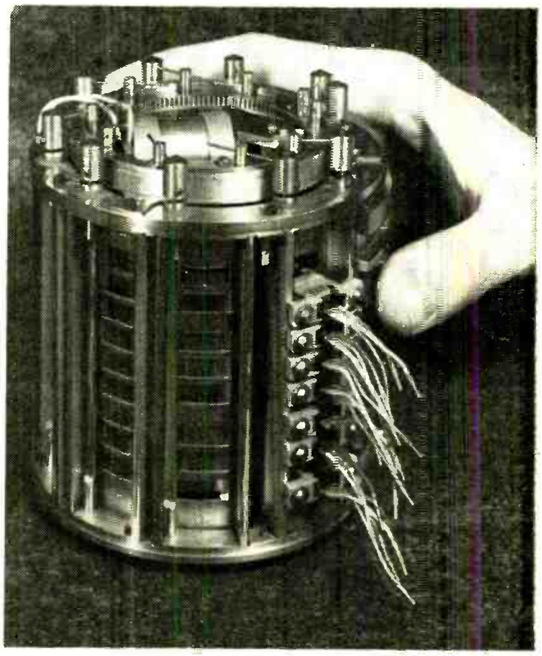


TV DEMONSTRATOR is designed to teach basic principles of electronics from fundamental electronic circuits through television. It consists of a 3 x 5-foot breadboard, 17-inch picture tube, speaker, and test instruments. The unit is assembled and studied circuit by circuit in the class. Completely assembled, it becomes an operating TV receiver superimposed on a large circuit diagram. The unit is made by Transvision.

PARAMETRIC TRANSISTOR has been developed for use in a Vodicka circuit for ultra-high and microwave frequencies. A Hughes transistor has been modified to favor this mode of operation. The transistor is a 3-terminal package in which input and output are easily separated. Also, the unit oscillates and delivers its own pump power. The pointer indicates the transistor mounted in a developmental circuit.

INDUCTORS FOR PRINTED CIRCUITS announced by Corning Electronic Components have wire leads for printed-circuit board mounting. The new units, 26 models, are claimed to have superior stability under physical shock, vibration and temperature changes.





MINIATURE MEMORY DRUM weighs only 6 ounces yet can store 100,000 bits of information. Data are recorded on the magnetic surface of the stainless steel drum (not shown). Measuring 3 inches long and 3 inches in diameter, the IBM unit is designed for airborne computers.

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TV Service Clinic

conducted by

JACK DARR

THERE are many more uses for the oscilloscope than hunting distortion in complex waveforms, measuring peak-to-peak voltages, and the other "regular" jobs. When used right, it can be a very useful timesaver in locating the source of TV troubles.

For instance; no high voltage, screen dark, horizontal output tube *not* running red. Where's the trouble? Grab the scope and very carefully place the probe *close to but not touching* the horizontal output tube's plate. See any pulses? (Should look something like Fig. 1).

If they're *not* there, you can begin looking in the horizontal oscillator stage. There doesn't seem to be any drive at all and the output tube is probably so weak it won't draw enough current for the plate to overheat!

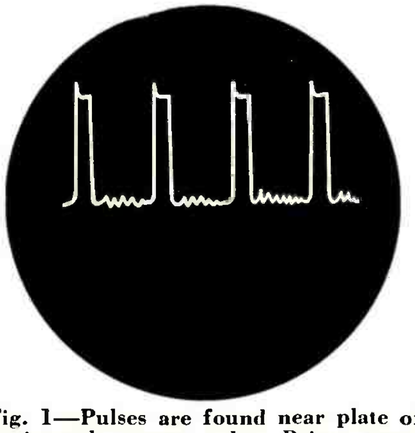

Fig. 1—Pulses are found near plate of horizontal output tube. Bring scope probe near but not touching plate.

If the pulses are there but pretty small (you'll have to experiment a little to get an idea of about how high they should be with the scope gain set at a certain place, etc.), the horizontal output tube's probably weak, again.

Waveforms at the horizontal-output tube plate, but only a very small pip when you hold the probe close to the high-voltage lead indicates a weak or defective high-voltage rectifier tube. Ought to get pretty good sized pips anywhere close to this lead (Fig. 2).

Damper trouble? Hold the scope probe close to the damper tube from the top of the chassis. If you've got high voltage on it, it ought to show up. You should have a pattern something like Fig. 3.

Be sure to keep the probe tip far enough away from exposed points like the 1B3 plate, the horizontal output tube plate and so on. If you'll practice with this a little, you'll find that you can tell pretty quickly just about what's wrong in or around the flyback circuits by just holding the probe close to them in the right places. It will give you an idea of what's going on and, most important, it'll tell you whether the horizontal oscillator is working or not.

Signal circuits can be checked the same way. Got a weak picture with no contrast? Might be a bad picture tube, agc trouble, bad video amplifier tube, video if trouble or tuner trouble. Pull the socket slightly loose on the base of the picture tube and check at the grid (or cathode, whichever the signal is fed to). If you get a nice fat signal at this point (at least 50 volts peak to peak), you can suspect the picture tube.

You can also go through the video amplifier circuits (with a bit more trouble), if you have one of those adapters that brings the tube elements out at the sides for testing. Check the signal at the video amplifier grid and plate to see if you've enough gain. Same thing with sync tubes: this is most useful on some of the vertical chassis sets which are a bit difficult to get out of the cabinet.

Incidentally, for all these jobs, use a calibrated low-capacitance probe of the type used for signal-tracing in video circuits. The probe must be matched to the scope's input impedance and compensated for best results. With the right probe, you can get nice sharp sync pulses (Fig. 4) and clean video. The wrong probe can throw you quite a curve, unless you know its limitations.

So, there you are. You can get some kind of indication in any ac-carrying circuit by just holding the probe close to it (higher-voltage circuits) or by direct contact (lower-voltage circuits).

Inadvisable conversion

I have an RCA KCS-82D TV chassis which I would like to convert to use the 110° 23CP4A picture tube. Would you kindly advise me as to what changes I would have to make to do this?—J. A., Sacramento, Calif.

I'm afraid that your KCS-82 chassis would require a rather extensive working over to use the 23CP4. Although this tube is listed as a nominal 110° type, the actual deflection angle is nearer to 114°, thus requiring a tremendous amount of sweep power.

You see, to alter the sweep circuits of a TV set, you must provide not only more deflection but the large amount of *extra power* needed in the deflection circuits. You have a 70° yoke and deflection system in your present set. If you changed the yoke to a 90°, for example, you would get a full 90° scan only if you increased the *power input* to the yoke. Changing only the yoke would result in scanning the tube only partly; you'd find about an inch or so not covered at top, bottom and sides. On a 70° to 90° conversion, this can sometimes be overcome by adjusting height and vertical linearity, width and

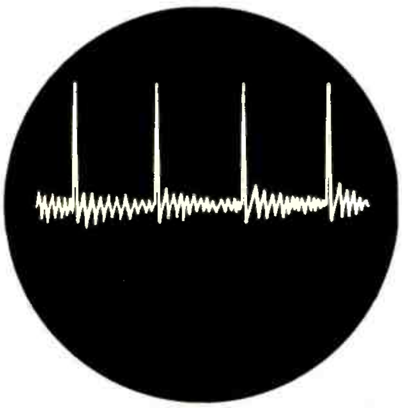

Fig. 2—Scope probe near high-voltage lead to CRT should produce pips somewhat like these.

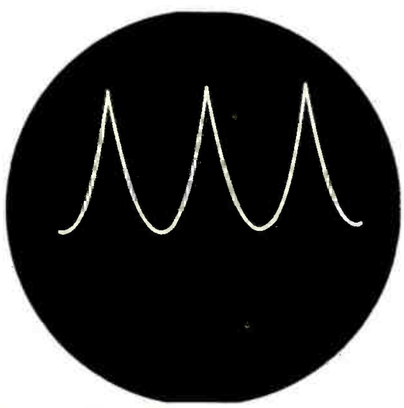

Fig. 3—Near the damper tube these pulses should be found.

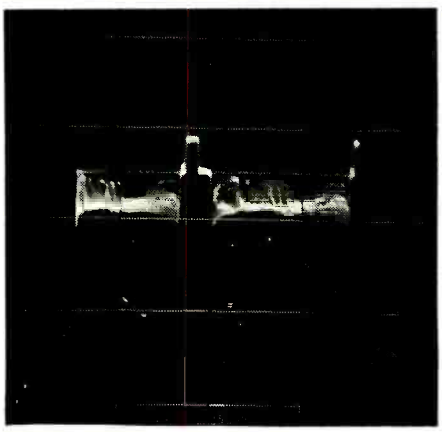

Fig. 4—Sharp sync pulses obtained by using a calibrated low-capacitance probe.

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horizontal linearity, increasing horizontal drive and substituting "hotter" tube types—for example, a 6DQ6 for 6BQ6 replacing 5U4's with special silicon rectifiers. This would demand new filter capacitors, of course, as the increase in voltage might exceed the safe ratings of the originals.

You might check up on such tube types as the 24AEP4, which is a 90° tube with a much lower high-voltage requirement. There are several tubes in that group which could be used with the changes listed.

Out-of-tune traps

We have a Freed-Eisemann set with the traps out of tune. I cannot find any information on this particular model anywhere. The only diagram I can find has one less tube than this one. This is a model 1916 and has one more 6AU6 than the one in the diagram. Can you give me this information?—W. H., Astoria, N. Y.

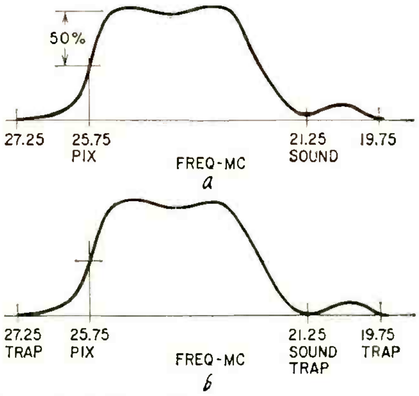

Fig. 5—Video if response curves; a—some sound signal getting through; b—sound trap adjusted for minimum sound signal.

I'm sorry, but I couldn't find any service data on this exact model either. However, there are some generalizations on trap tuning that should help you.

In the first place, I'm going to assume that this is a split-sound circuit, from the age of the set. These sets often had more traps than the others: adjacent-channel picture, adjacent-channel sound and sound if are standard. However, these can be tuned up if you have sweep-alignment equipment.

Set up the equipment and TV set to display the video if response curve on the scope. I am assuming that the set uses a 21-mc if from its age. It might be a good idea to "strap" the traps *all* out at this time to avoid troubles due to their misalignment. Simply tack a short piece of wire across each one. This takes it out of the circuit. Set the picture and sound carriers as shown on the curve of Fig. 5-a.

With this done, find the first trap. This should be the sound trap and will probably be located in the tuner, in or near the converter output transformer. This is tuned for a *minimum* amplitude on the curve at the sound frequency (Fig. 5-b).

The next trap will be in the plate circuit of the first video if and will be the adjacent-channel sound; this is set at 27.25 mc. Remember, all these traps are tuned for *minimum* response. You may have to crank up the signal generator gain to see the results, but always tune for the lowest possible amplitude at the trap frequency.

The next trap will be in the second video if plate and should be tuned to 19.75 mc. You may find cathode traps in this set; they were used in several models. If you have a fourth video if, look for a trap in its cathode circuit. This is tuned to the sound frequency, 21.25 mc.

You may find that the video if adjustments are on the chassis between the tubes. Be sure to check the circuit connections carefully. Your traps will always be "coupled" while the if coils themselves will always be in series with the plate circuits!

Here are the most likely alignment frequencies for the video if's: Converter (in tuner) 21.8 mc; first video if plate, 25.3 mc; second if plate, 22.3 mc; third if plate 25.2 mc, and fourth if plate, 22.4 mc.

As to the exact procedure: With the equipment set up to produce the video if curve, remove the short from one trap at a time and move the adjustment slug. See which section of the curve is most affected (by means of the markers.) For instance, if the left (picture) side of the curve is most affected, the trap is probably the 27.25-mc trap. If the right side of the curve is moved most, this trap is likely to be the 21.25 mc sound or adjacent-channel pix trap, and so on.

Build-it-yourself Yagi

I would like to obtain the plans for a 10- or 16-element Yagi antenna, with the shortest boom, to work on channel 4. If I want to operate it on another channel, would only the length of the elements need to be changed?—D. F., Kingston 11, Jamaica, B. W. I.

To be a true Yagi configuration, not

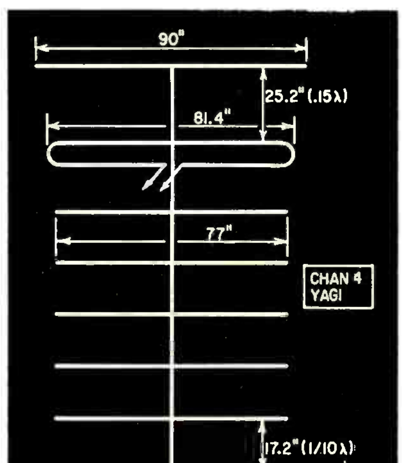

Fig. 6. .Sketch of Yagi antenna with elements cut for Channel 4.

only the length of the elements but their spacing from each other determine the wavelength for which the antenna is built. For instance, the sketch (Fig. 6) shows a channel-4 Yagi with eight elements. The most popular spacing for this type seems to be that shown: 0.1-wavelength spacing for directors, and 0.15-wavelength for the reflector.

To make this antenna work or another channel, you should cut the elements for that channel and also change their spacing.

I do not believe you will gain anything by trying to use more than a total of eight elements: reflector, dipole and six directors. At this point in Yagi design, you have the maximum gain. Addition of more directors will serve to narrow the frontal lobe slightly, but will give you only an imperceptible amount of additional gain. Besides this, the antenna will get so long that it will be most unwieldy to handle!

Hum in Crosley

A Crosley 11-459MU has a severe hum. How can we get rid of it?—W. M., Westville, N. J.

This set has a full-wave rectifier and power transformer. If the hum is 120-cycle (two bars on screen) it's a weak or open filter capacitor in the power supply. If the hum is 60-cycle (one bar on screen), it's heater–cathode leakage in some tube in the signal channel.

Remote uncontrol

We had a Zenith 16C21Q, with Space Command automatic tuner playing on the bench the other day after repairs to the if strip. Suddenly, the set turned itself off. Later on, the tuner started running and the volume went up and down although the control box was not being used. We have checked the control unit in the set several times. Apparently not a thing is wrong with it of a nature which could cause this intermittent false triggering. Do you have any ideas as to the cause of this?—J. D. Q., Big Cedar, Okla.

I sure do! The same thing happened to me not too long ago! Evidently, there were other sets in operation on the same bench, and probably close to the microphone of the Space-Command receiver. If another TV set is operating close by and the horizontal oscillator is turned off frequency (not necessarily enough to cause the flyback to "sing" audibly) enough to generate a harmonic in the range of the Space-Command receiver, the control unit will "fire!" The operating signals of the control unit are in the supersonic range, around 30–40 kc. What is happening here is this: The horizontal oscillator of the other TV set is generating harmonics and causing the flyback or some other part to radiate an actual audio signal. Somewhere in this mess of frequencies, there is a harmonic that is exactly on frequency to operate the tuner or volume control. This is more apt to happen if the other horizontal oscillator is quite a way off frequency. You can even make

(*Continued on page 70*)

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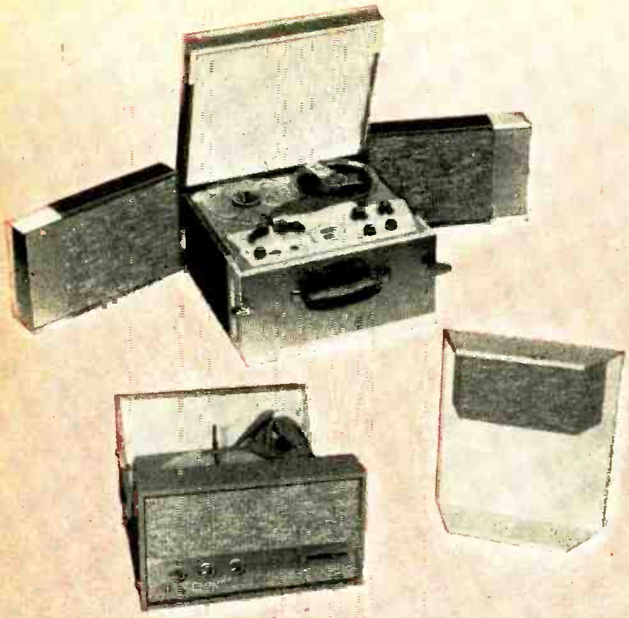

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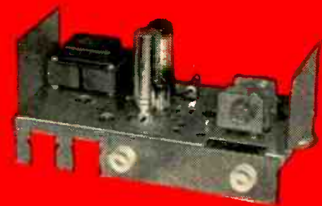

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This Christmas, give the best that money can buy in a Citizens Band Transceiver. The efficient superheterodyne receiver has an automatic "noise limiter" and adjustable "squelch" control, single channel "crystal" or continuous tuning. The transmitter has press-to-talk microphone and can be switched to any of the three crystal-controlled channels. Choose the "under-dash" DC mobile model or "fixed" station AC unit. 11 lbs.

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(specify 117 v AC or 6 or 12 v DC model)

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Almost, but not quite tiny enough for a Christmas stocking, this compact scope saves valuable work-bench space while providing versatile features to fill a multitude of applications in medical, industrial and general service fields. Ideal as a "read-out" for computers; for wave-form observations; and for voltage, frequency and phase shift measurements. Identical vertical and horizontal DC coupled amplifier, transformer operated power supply—and many more outstanding features.

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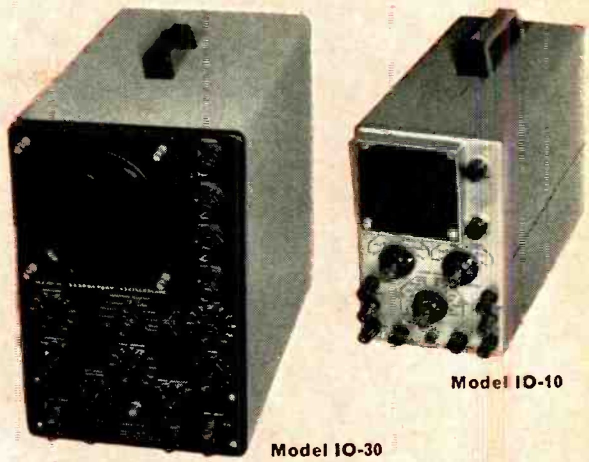
Model IO-30... 22 lbs.... $7.70 dn., $7.00 mo. **$76.95**

2 new scopes . . . just in time for Christmas!



Model IO-10

Model IO-30

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Brand-new in every respect, the DX-60 combines smart styling, top-flight performance and low Heathkit cost to offer the "Amateur rig" value of the season. Ideal for General class Amateurs, the Transmitter may also be run at reduced power for novice operation. Covers 80 through 10 meters. Power input: 90 watts peak, carrier controlled phone or CW. [illegible] lbs.

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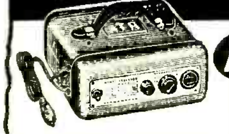

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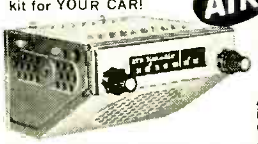

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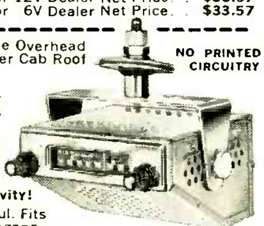
NO PRINTED CIRCUITRY



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Extra-sensitive radio has 6 tubes (2 double-purpose), over-size Alnico 5 PM speaker for full, rich tone. Big, easy-to-read illuminated dial. Fingertip tuning control. Volume and tone controls. 33-in. stainless steel antenna. Neutral gray-tan enameled metal cabinet, 7 x 6½ x 4 in. high over-all. Shipping weight 10½ lbs.
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(*Continued from page 65*)

the controller do this by turning the Zenith's own horizontal oscillator quite a way off the correct operating frequency. Under normal circumstances, in the home, it never happens. We checked for this!

Pulling

A Raytheon model C-2111A, has me puzzled. When the contrast is fully advanced, the top of only the picture pulls to the left, not the raster.

A scope on the plate of the 6AH6 shows (at low contrast levels) that the sync pulses are there. As the contrast control is advanced, a straight horizontal line comes up and "chokes" out the pulses. There is also a loud hum in the sound.—E. J. S., St. Louis, Mo.

Your observation is correct: the horizontal line you saw in the scope pattern is the basic cause of the trouble. This could be the sync tips and you are obviously getting a severe overload somewhere in the video circuits.

Carefully check all components in the video plate circuit, with special attention to the series-peaking and shunt-peaking coils (Fig. 7). This type of choke, with a resistor in parallel, can

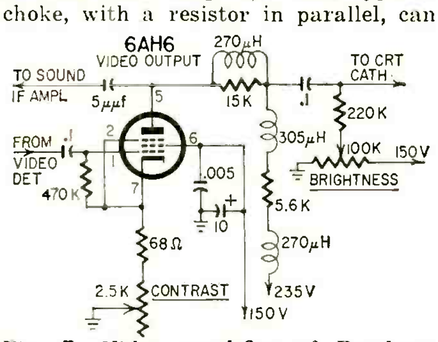

Fig. 7—Video amplifier of Raytheon C-2111A.

cause trouble if it opens, leaving the resistor to provide the plate loading.

If everything checks out (including the 6AH6), go back to the 6BE6 sync-clipper stage and check the operating voltages very carefully. Your pulling is obviously sync trouble as it doesn't affect the raster. It could be caused by an unbalance somewhere in the sync clipper or its circuitry. Check the setting on the agc switch (marked AREA SELECTOR). If you're in a strong-signal location and it's set for fringe operation, you'll get normal overloading from excessive agc.

Drifting sync

What can be wrong with a Trav-Ler portable, chassis 729-17A that goes for a few minutes perfectly and then falls out of sync. If it is turned off and allowed to "rest" for a few minutes, it goes OK, then falls out again. Tubes have been changed with no results. Using the horizontal hold to straighten the picture is no use because turning it left or right won't correct defect.—A. D. C., West Orange, N. J.

This trouble seems to be in the horizontal phase-comparer diodes from the description. Shunt horizontal oscillator input grid to ground, then run a complete realignment on the horizontal oscillator transformer. If you can get a floating picture (floating from side to side, but obviously a complete picture horizontally), then the trouble must lie in the phase-comparer circuit.

Replace these with a Federal K-1616. This is the unit with both diodes "looking the same way." Be sure to install it so that the polarity is the same as in the original. It would also be wise to make resistance checks of all resistors in the phase-comparer output circuit and a scope check for the presence of the comparison pulse from the flyback (also of a horizontal sync pulse).

"Ringing?"

A Sylvania I-523 TV chassis in the shop has bright vertical lines (ringing). I've checked the components in the yoke and horizontal circuit, changed the yoke, changed component values, replaced the 6CD6 with a 6DN6 and ion trap, installed a grid-drive variable capacitor and tried several other substitutions to no avail. All voltages are normal; yoke and flyback are the original.—W. N. S., Sarnia, Ontario.

From the *lack of response* to your cures for yoke ringing, I think your trouble lies elsewhere. You know, sometimes a *negative* result to a test is as valuable as a positive one! There are some other possibilities such as a distorted waveform being fed to the grid of the horizontal output tube, although judging by the thoroughness of your testing, it is very likely you have already covered that possibility. Any tiny traces of ringing here would, of course, be amplified by the output stage.

The most likely cause, it seems to me, would be video pickup of radiated energy from the horizontal circuits. Check the appearance of the raster without signal. If the scanning lines *curve* where the lines are showing up, then it *is* yoke ringing (Fig. 8). If they are straight but vary in *intensity*, then the trouble is due to horizontal pickup in rf, video if, detector, etc. stages. This is usually due to radiation from the yoke connecting leads. Wrap them in metal foil and ground both ends of the foil by wrapping a bare wire around the foil and grounding it under a nearby screw. Dress the lead-in cable, from antenna terminals to tuner, along the side of the chassis or as far away from the yoke leads as possible. END

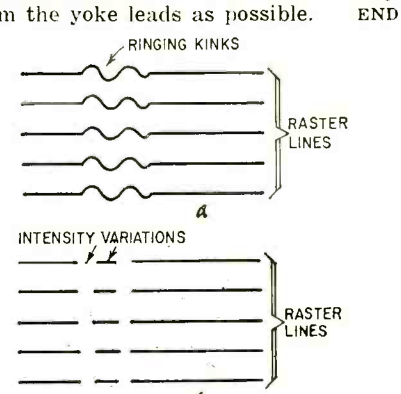

Fig. 8—(a) In true yoke ringing, raster lines bend. (b) When video stage picks up horizontal radiation, they vary in intensity.

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Outdoor PA speaker. Different power drivers are available as well as different-size horns.

improving PA systems

A simple series capacitor can improve the intelligibility of a PA system

By LEO G. SANDS

A PUBLIC-ADDRESS system can be made to sound better by simply connecting a capacitor in series with each loudspeaker (or the speaker feed line). Power requirements are cut and power-handling capacity can be doubled.

In voice reinforcement systems, there is no need for overheating speaker voice coils with unheard audio power. For maximum speech intelligibility, low-frequency response can be cut off anywhere between 200 and 600 cycles.

Horn type speakers which cut off at, say, 300 cycles will continue to consume power at frequencies below 300 cycles but for no good purpose. In fact, most of the available amplifier power is wasted on unwanted (and unheard) low-frequency signals.

By connecting an 8-μf capacitor in series with the voice coil of a 16-ohm speaker, the power-handling capacity of the speaker is doubled. Low-frequency response is cut off at approximately 400 cycles. Since an 8-μf paper or oil-filled capacitor is expensive, the two sections of a dual 16-μf electrolytic capacitor (or two independent 16-μf electrolytic capacitors) can be connected in series opposing as shown in Fig. 1-a.

At 400 cycles, current flow through the voice coil is cut 4 to 1 (12 db); at 1,250 cycles, voice-coil current is halved (6 db); at 3,000 cycles, the attenuation is barely noticeable to the ear (3 db) and at 5,000 cycles, attenuation is only 2 db. At 10,000 cycles, the loss imposed by the capacitor is less than 1 db.

For an 8-ohm speaker, a 16-μf capacitor is used (two 32-μf electrolytics in series) and when a 500-ohm speaker feed line is used, a 0.2-μf paper capacitor may be connected in series with the line (Fig. 1-b).

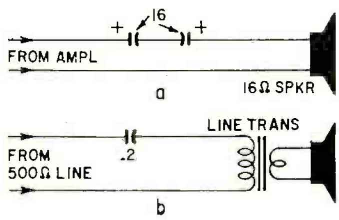

Fig. 1-a—An 8-μf (two 16-μf electrolytics in series) capacitor in series with a loudspeaker keeps unwanted low frequencies out of voice coil; b—a capacitor may be used in similar fashion in a speaker feed line.

Fig. 2 shows capacitor values for various low-frequency cutoff points for different impedances. Find the correct level line by referring to the first and second columns of the table. Next, select a horn cutoff frequency from the scale at the left of the chart and find where it intersects with the level line. From this point, go downwards to the bottom scale. This will give you the capacitor value (in μf) when multiplied by the proper factor which is found in the third column of the table.

IMP (Ω)	LINE	MULTIPLY BY
4	B	100
8	G	100
16	H	100
32	K	10
45	J	10
100	C	10
125	F	10
165	H	10
250	E	1
500	D	1
1000	C	1
2000	A	.1
5000	D	.1

Loudspeakers

The speaker is the most critical part of a PA system. For indoor use, cone type speakers are often used because there is no need for a weatherproof speaker. However, most cone speakers are extremely inefficient (1% to 5%)

(*Continued on page* 74)

Fig. 2—Chart gives series-capacitor values for different impedances and frequencies.
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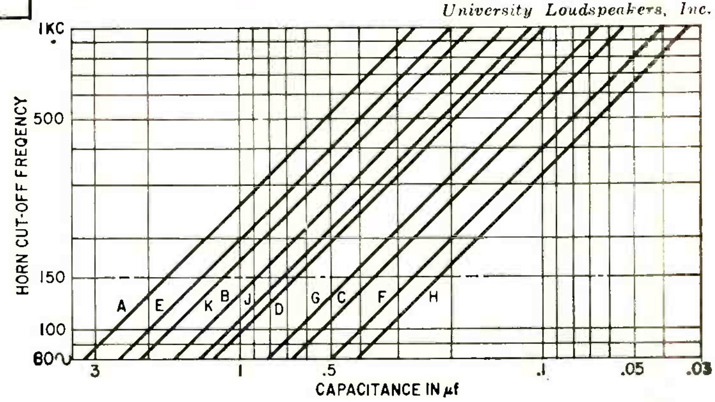

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It's a real money-maker

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Provides grid emission and leakage checks with the same sensitivity as the famous Mighty Mite but checks critical tubes only; 172 types

$28.95

Ask any serviceman who owns one . . . or try one for just one day of servicing. You'll see for yourself how much time the LC3 can save you. Checks for leakage between all elements, whether caused by gas, grid emission or foreign particles. Also checks leakage on all capacitors with voltage applied — including electrolytics. Provides instant filament checks in "Fil-Check" position—no need for a second filament checker. One spare pre-heating socket and new roll chart prevent obsolescence. New charts provided free. For 110-120 volts, 60 cycle AC.

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The Missing Link in TV Service . . .

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IT'S A . . .

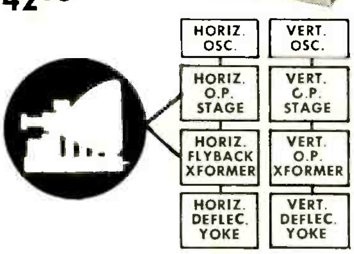
UNIVERSAL HORIZONTAL OSCILLATOR. For direct substitution. No wires to disconnect in most cases. Traces trouble right down to the defective component. Variable output from 0-200 volts, peak-to-peak. Oscillator will sync to TV sync signal giving check on sync circuits.

HORIZONTAL OUTPUT CATHODE CURRENT CHECKER. A proven method that quickly checks the condition of the horizontal output tube and associated components. Adaptor socket prevents breaking wires. Easily replaceable Roll Chart gives all necessary pin, current and voltage data. New Roll Charts are Free.

UNIVERSAL DEFLECTION YOKE. A new, simple way to determine yoke failure accurately—without removing yoke from picture tube. Merely disconnect one yoke lead and substitute. If high voltage (also bright vertical line) is restored, TV yoke is defective.

DYNAMIC FLYBACK TRANSFORMER CHECKER. Merely flip switch to "Flyback Check" and meter will indicate condition of flyback transformer, in degrees of horizontal deflection. Extremely sensitive and accurate; even shows up one shorted turn on flyback.

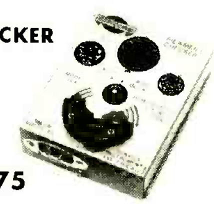
VOLTMETER. For testing bootstrap, screen and other voltages. Direct-reading voltmeter, 0-1000 volts.



UNIVERSAL VERTICAL OSCILLATOR. Checks oscillator, output transformer and yoke. Merely touch lead to component and check picture on screen. ***SS105 is completely self-contained, nothing else is needed.***
New, improved Circuit.

FC4 FILAMENT CHECKER

The ideal tool for servicing series string filaments.



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Instantly tells you whether or not it is safe to replace fuse resistors, fuses, or circuit breakers. Separate red and green scale for each commercially available fuse resistor used in radio and TV. Eliminates guesswork, wasted time. Also handy for wattage checks up to 1100 watts at 115v.
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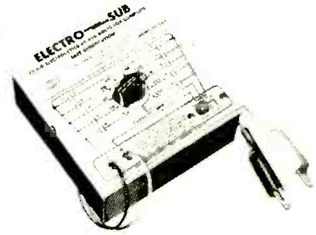

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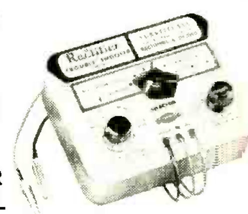

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(*Continued from page* 71)
whereas horn type speakers are much more efficient, some running as high as 50%.

If a cone speaker has an efficiency of only 1%, it requires 10 watts of electrical power to get 100 mw (0.1 watt) of acoustic power. A 50% efficient horn speaker on the other hand delivers 5 watts (or 50 times as much acoustic power) when driven at 10 watts.

The sound from a cone speaker is dispersed in a 180° pattern, the high frequencies being directed forward in a narrow beam and the low frequencies being dispersed over a wide area. Horn speakers are available in various designs, some providing wider coverage than others (Fig. 3). A cone speaker

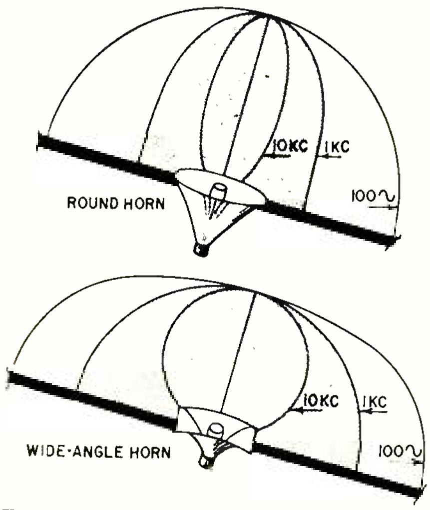


Fig. 3—Round horn provides greater distance and noise penetration, while wide-angle horn provides much broader coverage.

can be likened to a fluorescent lamp covered by a translucent lens whereas a broad coverage horn is like a floodlight and a narrow beam horn is like a spotlight (in terms of coverage).

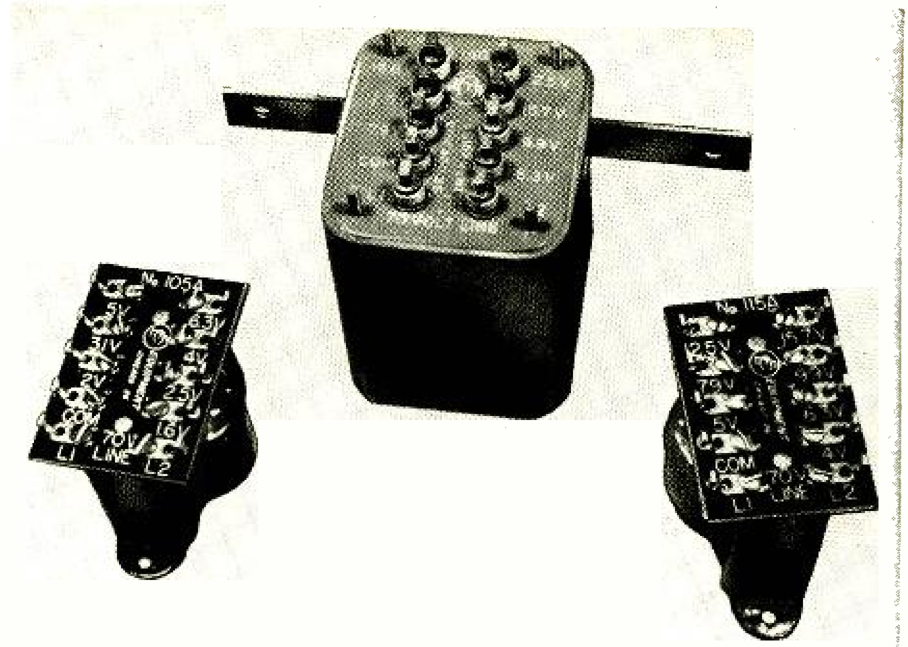
Today, there are many types of speakers, enabling the installer to select the type (or types) most suited for a particular installation. For speech reinforcement, the speakers have two objectives: 1—cutting through noise; and 2—covering the desired area with sounds which are pleasant to the ear. Cutting through noise requires narrow-beam horns (spotlights) and broader coverage is obtained with speakers having wider dispersal patterns (floodlights).

If we look at speakers as we look at communications and TV antennas, it becomes apparent why some speaker manufacturers find it necessary to manufacture up to 74 speaker combinations to meet all PA-system requirements.

To squirt a vhf radio signal to cover a narrow area, we would use a dual Yagi array or some other highly directional antenna. If noise is heavy or the distance is great we would increase the transmitter power or use an even higher-gain antenna. In the sound business, we add more driver units to the trumpet-type horn to send more acoustic power in the desired direction.

To cover a fairly wide area straight ahead, we might use a single Yagi array. For sound, we would use a folded horn with the required dispersal pattern or a battery of horns. To transmit in two opposing directions, we could specify a figure-8 antenna or connect two corner reflector antennas back to back. Similarly for sound, we would use two horns back to back.

For omnidirectional radio coverage, we use a ground plane, coaxial or turnstile antenna. For sound coverage we could use cone speakers but, to avoid power waste, we would use a battery of horns arranged to provide 360° horizontal coverage.



E-C Equipment, Inc.

Line transformers for 70-volt systems. Small transformer on left is rated at 5 watts, center one at 50 watts and the one on right at 15.

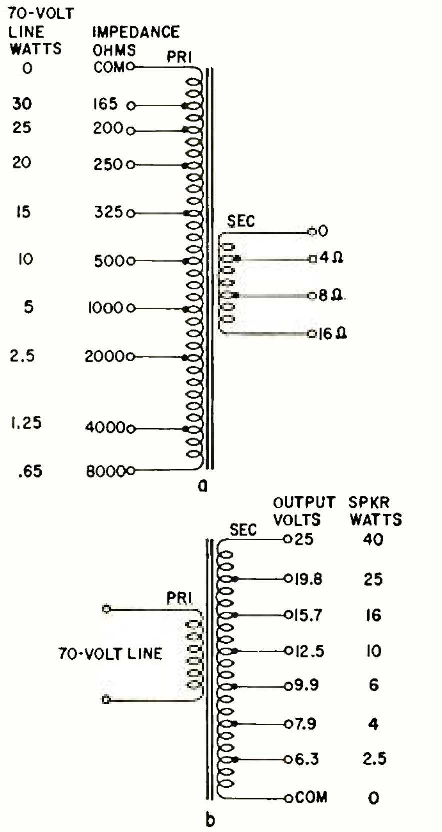


Fig. 4—Line-matching transformers: a—power level is controlled by choosing different primary taps; b—primary is connected to 70-volt line while power is controlled by choosing correct secondary tap (wattages given are for 16-ohm speaker).

Feeding the speakers

Considerable power can be wasted in the speaker feed lines. It is feasible to feed speakers at voice-coil impedance through 50- to 100-foot lines with a separate line to each speaker. If we attempt to feed four paralleled speakers through a single, long line, four times as much power is wasted in the line. (Line losses increase as the square of the current and only the first power of line resistance.)

Commonly, speakers are fed at 250 or 500 ohms. Each speaker (or speaker group) is fed from a common line or through individual lines. An impedance-matching transformer is necessarily used at each speaker location.

The impedance-matching technique has some disadvantages which are overcome by the constant-voltage technique. Instead of worrying about impedance, we can deal with Ohm's law instead. The output of the amplifier is fed at a nominal level of 70 volts to the speaker feed line. The speakers look upon the line as a power line. To them it simply means 70 volts ac, not so many ohms. (Systems with over 100 watts output use 141-volt lines and there are some 25-volt distribution systems.)

A stepdown transformer is used at each speaker. The volume level at each location is controlled individually by tap selection. The transformers are calibrated in two ways—impedance and voltage (Fig. 4). Using the first (Fig. 4-a), the speaker is connected to the proper tap on the secondary. One side of the 70-volt line is connected to the common tap on the primary, the other side to the appropriate tap (which may be marked in impedance or wattage)

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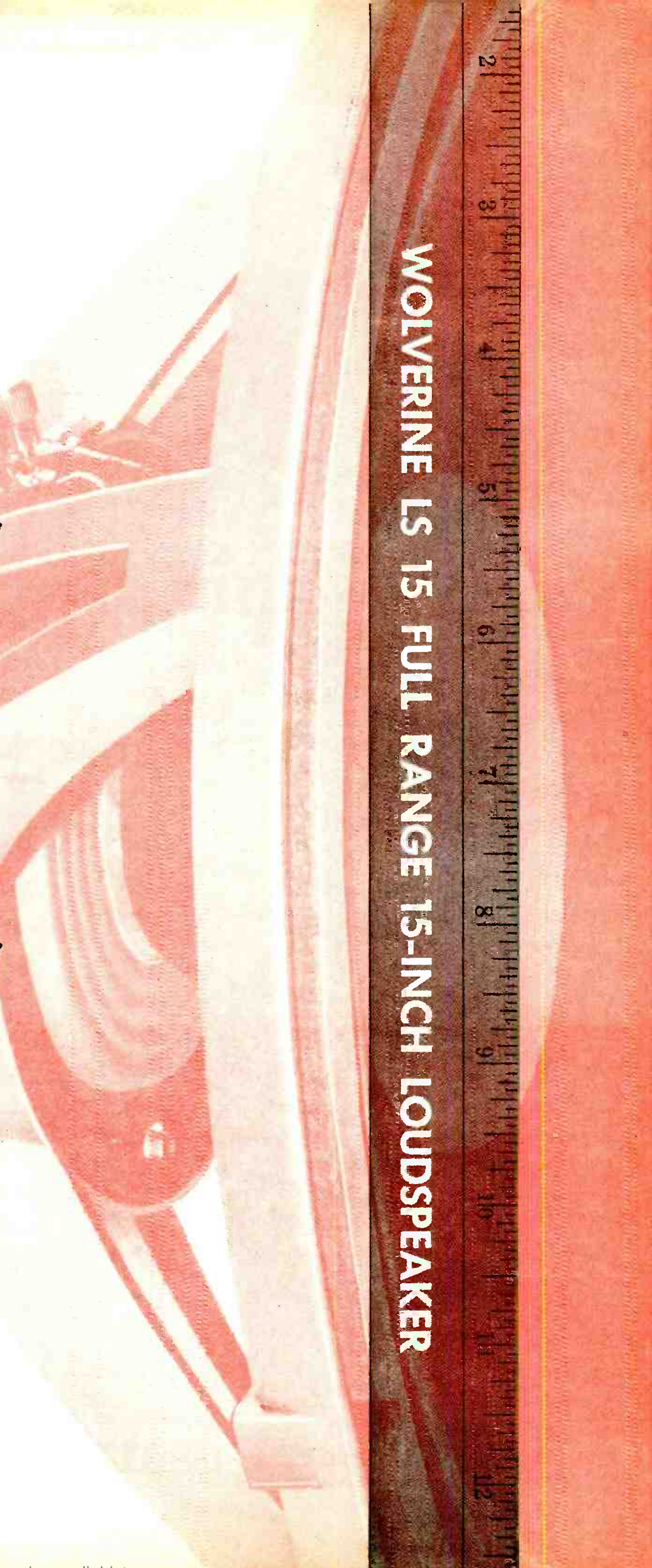

Model LS15 — Specifications — Frequency response 35 to 13,000 cps; EIA sensitivity rating 46 db. Free-space cone resonance 35-45 cps. Power-handling capacity 20 watts program, 40 watts peak. Impedance 8 ohms. Mechanical crossover 4500 cps. 15⅛ inch diameter, 6 11/32 inch depth, 13⅞ inch baffle opening: mounts with four holes 9/32 inches equally spaced on 14 9/16 inch circle. Net weight 11 pounds. Shipping weight 12 pounds. Net each $24.50.

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for the power level desired. In 25- and 141-volt systems, required primary impedance equals

$$\frac{(\text{Output voltage})^2}{\text{Desired power to speaker}}$$

The other type of stepdown transformer has its primary connected to the 70-volt line. The speaker is connected to the common terminal and the terminal that will give the desired power level. The taps are marked in terms of volts. Wattage ratings are for 16-ohm speakers. Ohm's law will give the output power available at each tap (Fig. 4-b).

When the amplifier has good output voltage regulation characteristics, we can connect (and disconnect) speakers from the line without significantly affecting the level of other speakers on the same line. This is particularly advantageous from the servicing angle.

Overall efficiency

A 10-watt amplifier can be made as effective as a 100-watter by using more efficient methods. A 10-watt amplifier feeding 33⅓% efficient horn speakers will deliver more than three times as much sound as a 100-watt amplifier feeding a like number of 1% efficient cone speakers.

Power waste can be reduced by using more efficient line-matching transformers. If we feed 10 speakers through 10 line transformers of 80% efficiency in a 100-watt system, we will be wasting 20 watts in the transformers. If 95% efficiency transformers are used, only 5 watts will be wasted.

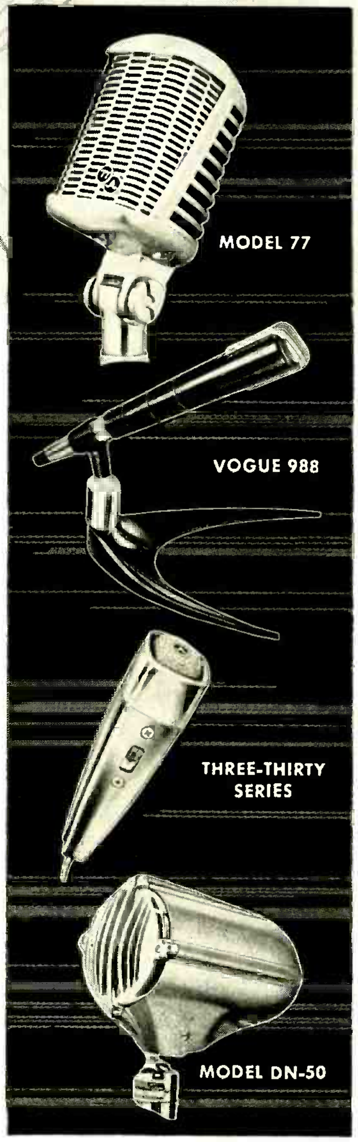
By selecting the right speaker (or speaker combinations) for a specific application, we can use less power for a given sound level and put the sound where we want it. When directional loudspeakers are used, the correct illusion (sound appears to be coming from microphone location) can be preserved and acoustic feedback problems can be minimized.

But, the biggest jump in efficiency, speaker life and speech reproduction quality can be made by keeping unwanted low frequencies out of speakers by adding a series capacitor. END

[The capacitance tolerance of an electrolytic capacitor may vary from −20% to +250%, depending on the type and voltage rating. The actual cutoff frequency of the speaker will then vary inversely as the capacitance in the circuit. For example, the chart shows that a 4-ohm speaker will cut off at 150 cycles with a 90-μf capacitor in the circuit. If this unit has a +100% tolerance, its actual value is 180 μf and the actual cutoff frequency is 75 cycles. If the capacitance is 20% low, the cutoff rises to around 190 cycles.

If the size of the capacitor makes it necessary to select an electrolytic, you can select the unit on a capacitance bridge or hand-pick the unit with the help of using an audio signal generator and an output meter. Try capacitors of approximately the correct value until you find one that drops the output 6 db at the desired cutoff frequency.—*Editor*]

SPEAKING OF LINES . . .



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THE TRANSIENT CAPACITOR

What's It For?

By DELLROYE D. DARLING *

ANY good technician knows the secret of troubleshooting is the ability to analyze a circuit and puzzle out how it works. However, most types of electronic equipment have some component parts that always seem to be there, yet don't seem essential to the operation of the circuit. A good example is the "fusible resistor" found in most television receivers. The circuit will probably work if it were shorted out, and only a TV technician knows how serious it would be to eliminate it.

The TV-trained man called to service industrial equipment for the first time may be able to figure out how the circuit works, yet the purpose of some items may puzzle him.

For example the "transient capacitor," a ceramic or mica of about .01 μf usually found across the grid–cathode socket lugs on thyratron timer tubes, and often on thyratrons used in other applications, such as power control.

The need for this capacitor stems from the fact that the grids of gas-filled tubes have a very different control action than those of vacuum tubes. Most TV technicians know that a thyratron can be held blocked as long as its grid is sufficiently negative. It will suddenly come to full conduction when the negative bias drops below a certain level.

But few realize how sharp this "threshold" is. When a thyratron is about to conduct, a change in grid bias of a very small fraction of a volt can push it over the edge into full conduction. If this small push comes from an external source such as a transient voltage, the tube may fire sooner than it should.

In timer circuits, this transient firing can cause serious trouble. It may shorten a timed interval and upset the accuracy of the whole timer.

Most thyratron timers operate on 60-cycle ac taken from the plant supply lines. Theoretically, these lines should always be at their rated voltage, 230, 460, etc. However, large motors, welding machines and many other types of heavy equipment are often connected to the same lines. When these inductive loads are switched on and off, they cause large pulses of transient voltage across the line. These transients can be as high as thousands of volts, and may travel hundreds of feet along the supply lines to upset the operation of thyratron tubes. Although an isolation transformer is usually used in the timer, the transient may be coupled almost as well as the supply voltage, and will appear across the cathode–anode of the tube (Fig. 1).

*Director, Industrial Electronics, Radio Electronic Television Schools, Detroit, Mich.

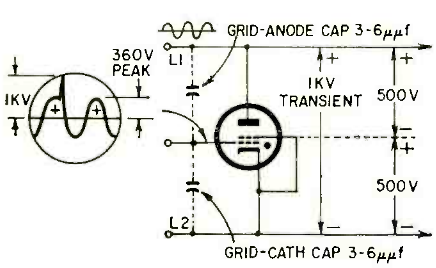
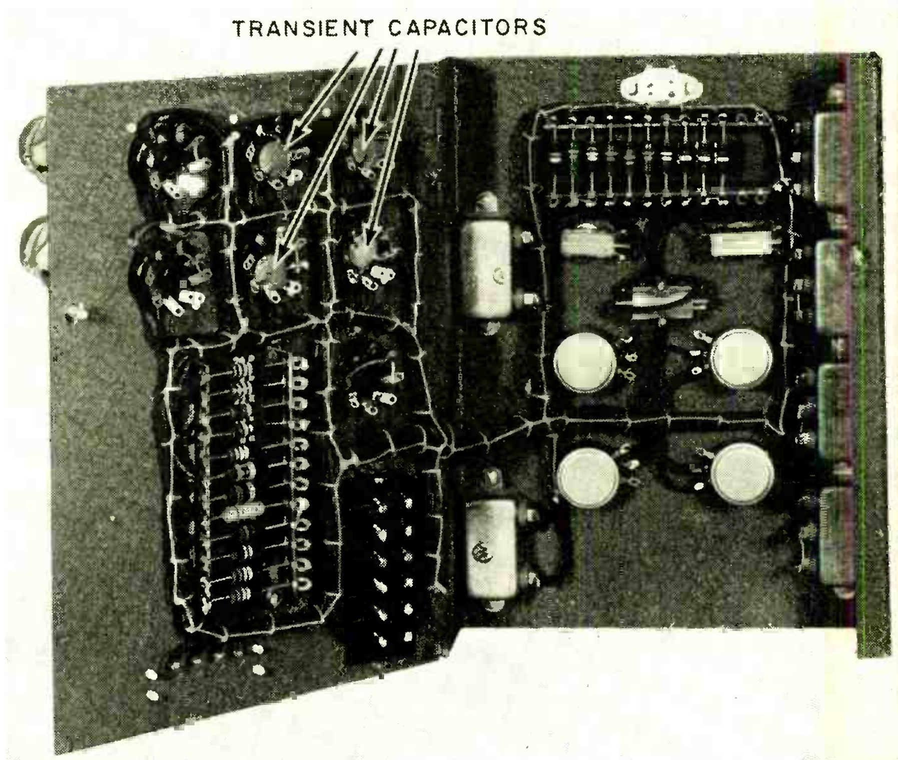


Fig. 1—Internal capacitances of tube form voltage divider (in dashed lines) that may drive grid 500 volts positive.



Underchassis of weld-timer, "brain panel," showing transient capacitors.
Robotron Corp., Detroit, Mich.

Even though the interelectrode capacitances of the tube are small, at the high frequency of the transient they may have enough reactance to form a capacitive voltage divider, and—since the cathode–grid and anode–grid capacitances are approximately equal—a transient that is positive to the anode of the tube can cause the grid to go positive by half or more of the transient voltage. If this occurs near the start of a positive half-cycle on the anode, the tube will fire for the remainder of that half-cycle, energizing the load.

When the transient capacitor is added between grid and cathode, it upsets this voltage divider as shown in Fig. 2. It causes practically all of the transient to appear between the grid and anode, where it does no harm, since it only makes the grid more negative for an instant.

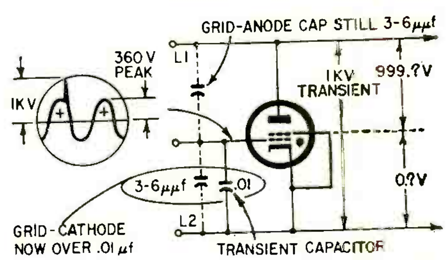


Fig. 2—Transient capacitor upsets voltage-divider effect—hardly any of transient appears on grid–cathode circuit.

These capacitors don't fail often. Still, it does happen. If the transient capacitor shorts, the grid will be tied to the cathode, and the trouble will be obvious. If it opens, the circuit may appear to work normally, but transients on the line will cause an annoying "intermittent" of the sort that occasionally drives good technicians to drink. END

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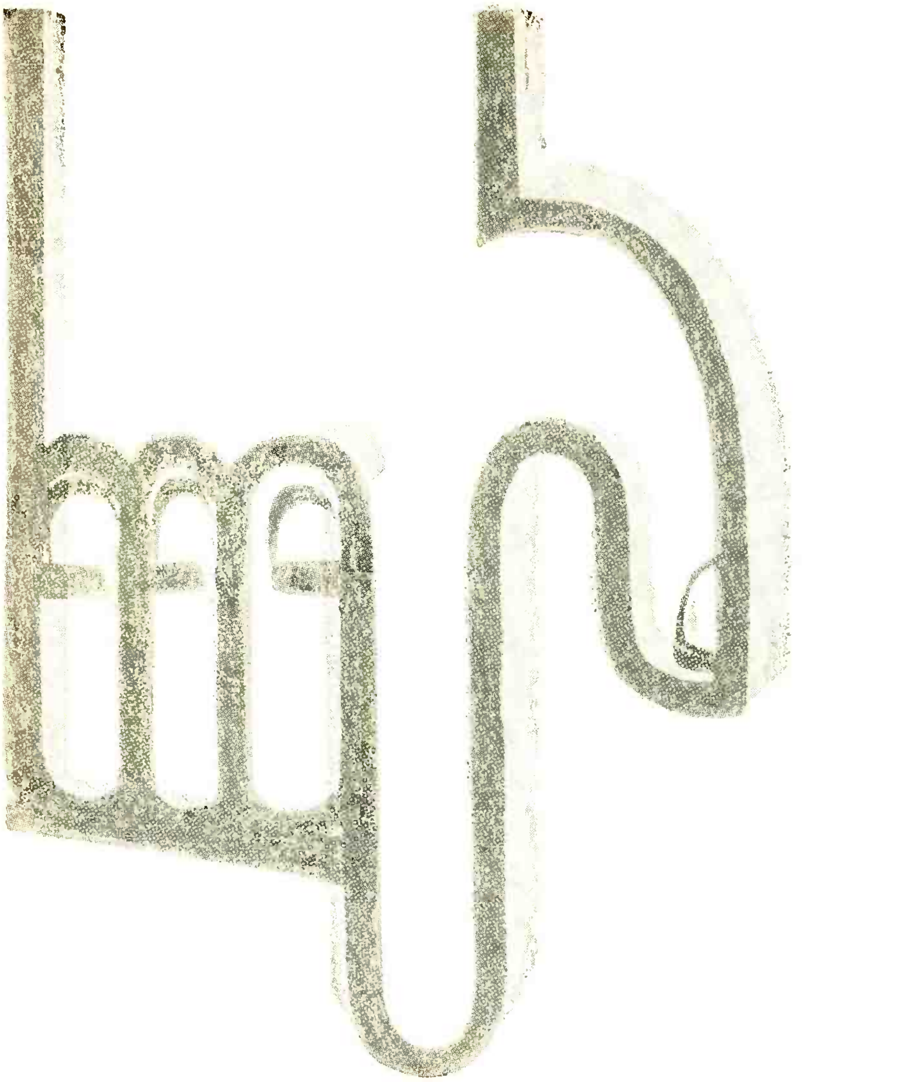

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SIMPLE FM CONVERTER FOR TV

By JONATHAN VANDERWALL

ONE day recently, I wished to listen to a local FM station. Unfortunately, the only FM set in the house was not working—the ratio-detector coil was defective. Since it was Sunday, no coil could be obtained and I faced the prospect of missing a good program. However, with a grid-dip oscillator, an intercarrier TV receiver and an old copy of RADIO-ELECTRONICS, a simple but effective converter was devised.

Before going further, let me mention that the principle involved here has been "borrowed" from the description of the Regency RC-103 FM Televerter given on page 33 of the April, 1958, issue of RADIO-ELECTRONICS.

It is common knowledge that an intercarrier TV set requires not only the sound signal but also an additional signal (usually the picture carrier) displaced 4.5 mc from it. When these two signals reach the video detector, they produce a 4.5-mc beat signal which is fed to the sound if amplifier and then the ratio detector or quadrature detector or what have you. Note that the additional signal need contain *no modulation* and, further, that it may be either 4.5 mc above or below the sound signal.

The trick is to use the fundamental and a harmonic from a single oscillator to do two jobs. The fundamental combines with the given FM signal to produce a difference frequency lying somewhere in the lower TV band. The second harmonic of the oscillator must lie 4.5 mc away from our difference frequency. We choose the frequency of our local oscillator by using the formula: $f_o = \frac{FM + 4.5}{3}$ where FM is the frequency of the FM station that you wish to receive and f_o is the oscillator frequency. Both are in megacycles.

For example, let's say we have an FM signal at 92.1 mc. The oscillator frequency is: $\frac{92.1 + 4.5}{3}$ or 32.2 mc.

This is then beat against the 92.1-mc signal to produce a signal at 59.9 mc which is in reach of the set's fine tuning on channel 3. The second

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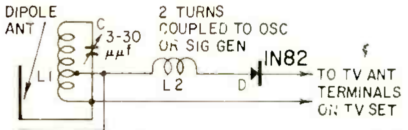
harmonic of the oscillator signal is 64.4 mc, just 4.5 mc from our sound-carrying signal. These two signals are fed to the TV set, which does the rest.

The simple circuit (see diagram) may be used with a grid-dip oscillator or conventional signal generator. The local oscillator (grid-dip or generator) is coupled by a two-turn link to the tuned circuit. The tuned circuit shown is not critical; I simply set it to resonate at 95 mc. As it is loaded heavily, its Q is low.

C—3 to 30 μμf, variable
D—IN82
L1—4-turn 5/8-inch-diameter air-wound coil tapped at 1 turn, No. 20 wire wound 16 turns per inch (Air-Dux 516T or equivalent)
L2—2-turn link



Detail of circuit connected to TV; grid-dip oscillator couples to L2, antenna is cut to FM band.

Therefore, changing the tuning does not make much difference.

There are two tips about using this unit which I would like to pass along. First, use channel 3 for stations between 88 and 100 mc and channel 4 for stations between 100 and 108 mc. Second, juggle the TV's fine-tuning control and the frequency of your local oscillator for best sound. Other possible uses for this circuit are monitoring local airport, fire department, police department or taxi frequencies. END

BRITISH DEAF WANT VISIBLE SOUND

The Associated Press reports from London, England, that an organization called "The Campaign for Television for the Deaf and Dumb" has sent a resolution to British Prime Minister Harold Macmillan recommending:

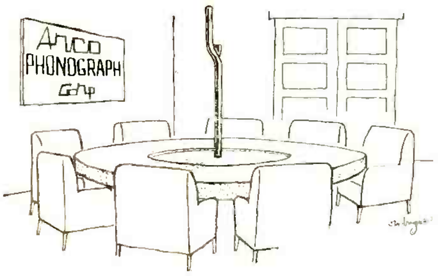
Translating the most important news bulletin each day into sign language.

Transmitting one play a month with an interpreter giving the lines to the deaf.

Presenting at least one sports event a month accompanied by a sign-language description.

One televised church service each month with the pastor's sermon translated into sign language.

The request is understandable since British viewers, whether they can hear or not, pay a license fee of three pounds ($8.40) per year.



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The N-34H is a symphony of crisp, clean lines accentuated by the unusual deck design. Mated with the new tapered base, the N-34H becomes one of the proudest and most beautiful components ever to grace a home music system. See it at your dealer's.

N-34H STEREOTABLE only—**$79.95** net. Shown with new Rek-O-Kut Micropoise Stereo Tonearm, Model S220, **$29.95** net. Tapered base in hand-rubbed, oiled walnut, **$14.95.**

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SPECIFICATIONS: *Noise Level:*—53db below average recording level; *Wow and Flutter:* 0.15% *Drive:* Nylon, neoprene-impregnated endless belt. 2 Speeds, 33⅓ and 45 rpm.

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LEGAL PITFALLS

What can you do when you finish a service job and the owner tells you to charge it?

The answer to this and other questions appears below.

By LEO T. PARKER *

SERVICE technicians engaged regularly in servicing TV sets and other electrical appliances are confronted daily with legal problems that could add up annually to a substantial sum of money.

For example, recently I received an interesting letter from Mr. W. C. White, who owns and operates a TV service shop. He says in part: "Yesterday I went on a call to a private home to service a TV set. I had had no previous business with this home owner. After I had made proper repairs on the set, including putting in two new tubes, I made out a bill for $18.50 and handed it to the home owner. He told me to 'charge it.' I told him that I operate strictly on the cash basis and have no charge accounts. He said I should have told him that before I started to work on his set, and that if I had told him that I operated on a cash basis he would have told me that he would not pay the bill until 90 days. I did not know what to do, so I told him to pay me in 90 days. Maybe he will pay me and maybe he won't, as I have no credit approval on him. What do you suggest that I do in cases of this kind?"

The answer is: The higher courts very consistently hold that unless the testimony shows conclusively that before a serviceman rendered services, or a seller delivered merchandise to a purchaser, an agreement was made whereby the serviceman or seller agreed to extend credit, cash payment is implied.

For illustration, in *Zeff v. Harvey Company, 315 Pac. (2d) 371*, it was shown that a service technician took a cutomer's note for certain equipment, when the latter told the service technician that he could not pay cash.

In subsequent litigation, the higher court held that a note is not cash payment.

This higher court also held that there can be no substitute for cash, and, if a contract or agreement for service fails to clearly state that credit is extended, cash is always implied. In other words, unless the service technician clearly and distinctly agrees to credit or time payment, cash must be paid by the customer.

Furthermore, the service technician is not obligated to inform his customer before he does the work that cash must be paid.

Therefore, where a home owner refused to pay cash after a service technician has repaired his TV set, the technician can do one of two things: First, he may at once sue the home owner for the amount due and positively recover a court judgment against

* Attorney at law, Cincinnati, Ohio

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The Analyst enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, *and make more money*.

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the home owner for this amount. Second, he may at once remove from the repaired TV set all the new tubes and like appliances that he installed and then later sue the home owner and recover a court judgment for the labor and service call.

In *Havas v. Ray Lundy, 276 Pac (2d) 727*, the testimony showed that an appliance was taken to a service shop for necessary repairs. The appliance was not fully paid for. On completion of the repairs, the service technician retained possession of the appliance because his bill remained unpaid.

The higher court held that the service technician could remove the newly installed parts from the appliance before the holder of the conditional contract could repossess it. The court held that the conditional vendor was not entitled to the parts which had been installed in the appliance by the repairman.

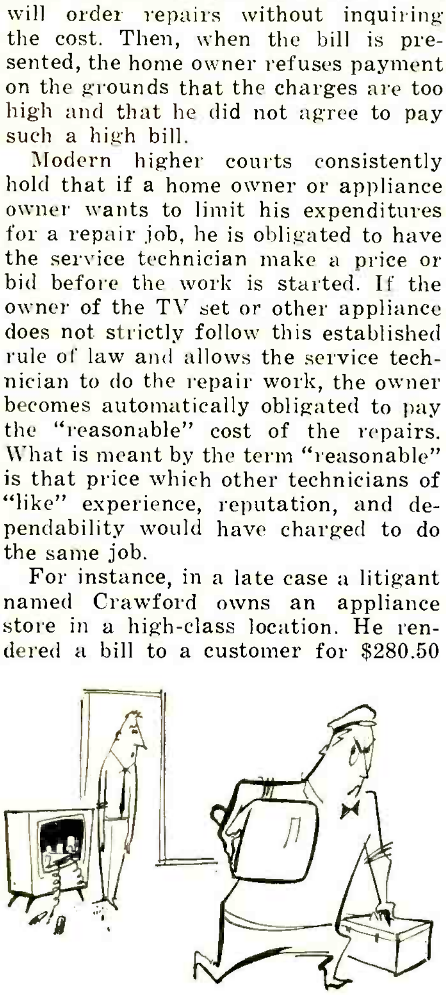
For comparison, see *Clarke v. Johnson, 187 P. 510*. Here a service technician installed parts and repairs in a mortgaged appliance. The court held that the conditional seller who later repossessed the appliance must pay the repairman for the new parts and labor.

Reasonable bill is collectable

Another important point of law was brought up to the writer recently by the owner and operator of a TV service establishment. He explained that in many instances the owner of a TV set will order repairs without inquiring the cost. Then, when the bill is presented, the home owner refuses payment on the grounds that the charges are too high and that he did not agree to pay such a high bill.

Modern higher courts consistently hold that if a home owner or appliance owner wants to limit his expenditures for a repair job, he is obligated to have the service technician make a price or bid before the work is started. If the owner of the TV set or other appliance does not strictly follow this established rule of law and allows the service technician to do the repair work, the owner becomes automatically obligated to pay the "reasonable" cost of the repairs. What is meant by the term "reasonable" is that price which other technicians of "like" experience, reputation, and dependability would have charged to do the same job.

For instance, in a late case a litigant named Crawford owns an appliance store in a high-class location. He rendered a bill to a customer for $280.50



"He may at once remove. . . ."

". . . the reasonable cost . . ."

for a repair job. The customer refused to pay the bill. Crawford sued the customer who had, as a witness, a man who owned a repair shop located in a disrespectable and cheap neighborhood. This witness testified that he would have done the same repair job for $125.

The higher court held that the home owner must pay Crawford's $280.50 bill because the testimony showed that other proprietors of repair shops in better-class, respectable neighborhoods considered Crawford's $280.50 bill reasonable.

This higher court explained that men located in cheap neighborhoods naturally will do service and repair work for less money than those in better or high-class neighborhoods where rent is higher and probably service technicians are paid higher wages.

Jury will decide

Here is another interesting legal question: "Recently a service technician went into a home and after inspecting a TV set told the home owner that he could put it in good condition for $87.50. The TV owner told him to go ahead with the job. When the technician finished the job, the owner of the set refused to pay $87.50, saying that he understood the service technician to say that he would do the job for $27.50. The question is what can the service technician do to collect this $87.50?"

The answer is: He should file suit against this home owner and let the jury decide the case. The jury will listen to all testimony and decide whose testimony is truthful and render its verdict accordingly.

Bad check is no payment

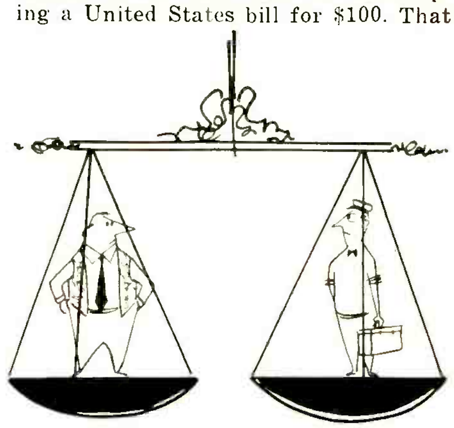
Some time ago I talked personally with a man named Wilson who is the owner and operator of a TV repair shop that employs about 26 service technicians. He told me that a few days ago a customer gave a bank check in payment for a repair job, demanding a receipt stating that the account was "paid in full." Later the check was returned from the bank marked "insufficient funds." Wilson said the bill remains unpaid because the customer states that he cannot be compelled to pay because he has in his possession the receipt showing that the bill was paid in full.

Quite obviously, Wilson can easily win a favorable court judgment against this customer. All he need do is file a suit and at the trial show the unpaid bank check to the court, which will immediately hold the "paid in full" receipt void and with no legal value. At the same time, the court will render a judgment against the customer in favor of Wilson for the full amount of the repair bill plus court costs.

At this same meeting Wilson asked me whether he can sue a customer and recover a court judgment for a TV repair bill on which he issued a "paid in full" receipt, but part of which the customer paid with a counterfeit bill.

The answer to this question is: Yes, under ordinary circumstances, Wilson can sue and the court will issue a judgment against the customer who paid the repair bill with counterfeit money. This is so because—generally speaking—payment with counterfeit money is not a valid payment. However, this is not so in all instances, as the following anecdote will show:

A man named White is said to have registered in a hotel, and to have deposited in the hotel safe for safekeeping a United States bill for $100. That



"The jury will decide."

day the hotel proprietor used the $100 bill to pay a long overdue debt to a real estate broker, who in turn used the bill to pay off an overdue debt owed to a TV service technician. The latter was pleased with the settlement and, thereupon, used the $100 bill to pay the balance he owed a funeral director. The latter gave the bill to one Ellis who had furnished services to the funeral director. Then Ellis, in response to urgent requests for payment of past due debts he owed to the hotel, gave the hotel proprietor the $100 bill. The hotel proprietor immediately placed it in the safe.

A few days later White requested delivery of his previously deposited $100 bill. The hotel proprietor produced the bill from the safe and gave it to White who thereupon lighted a match to it, saying that it was counterfeit.

The important point is that the counterfeit bill was satisfactorily used to pay off valid debts, and everybody connected with the transactions was satisfied and happy.

How good a witness?

Another rather unique legal problem was presented very recently by an

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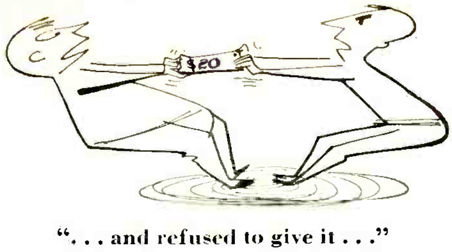


"... and refused to give it ..."

acquaintance. He said that when he goes into a home on a service call he is alone, whereas the home owner has members of his family who may be used as witnesses in future litigation and legal controversies. He wants to know what chance he has to win a suit for $68.50 he now has on his hands against a TV set owner. The owner says he has witnesses to prove that the service technician told him that he would do the job for $39.50 because of past favors the set owner had rendered the technician.

Obviously, such a case is farfetched and hardly worth this space for consideration. Nevertheless, it borders on an unusual case where a TV repairman was making change in the home of a customer. He laid a $20 bill on the TV. Later the home owner picked up the $20 and refused to give it to the technician, saying that he, the home owner, had put it on top of the TV set.

All these unusual and unsatisfactory occurrences breed personal combat. However, it is advisable in such cases to present the facts to a jury, who will listen to all testimony and render a verdict in favor of the litigant whose testimony it believes to be true. The jury may make its own decision, irrespective of faked testimony intended to favor the owner of the TV set. In other words, the jury may believe or disbelieve a part or all the testimony given by the TV set's owner and his witnesses, who contest a repair bill. The courts give little or no weight or consideration to testimony of relatives or close friends of a litigant. This holds whether the suit involves payment for service, merchandise or in suits for damages by injured persons. Generally speaking, if a customer fails to introduce witnesses before the court to prove that the service technician promised to do a job for less than the amount for which he sued, the jury will decide the verdict in favor of the service technician.

For example, in *Reeves v. Child, 194 Pac. (2d) 919*, a workman sued a home owner to recover a bill amounting to $372.41. The property owner testified that the man had orally promised to do the job for considerably less than the $372.41. On the other hand, the workman testified that his oral agreement was to complete the job for about $375.

Since the jury believed the workman's testimony, the court held him entitled to full recovery of this amount.

Quite obviously, all service technicians can avoid legal controversies over the price for repair work by having any stranger sign a printed agreement to pay a named price for work to be done on his television set or other appliance.

Law of minors

It is certain that a minor is not obligated on any ordinary contract or promise he makes. Hence, service or repair work for a minor is a financial loss unless the minor voluntarily pays the bill.

For illustration, in the late and leading case of *Doenges v. Gillen, 328 Pac. (2d) 1077*, the higher court said:

"An infant lacks capacity to make a firm and binding contract; in all such contracts lies the inherent weakness and condition that the infant may disaffirm the contract during his minority or within a reasonable time after reaching his majority. The right to disaffirm is not lost by reason of the fact that the infant has induced the making of the contract by deliberate misrepresentation of his age."

Law of mechanic's lien

A great deal of discussion has arisen from time to time over the legal ques-

"... a minor is not obligated ..."

tion: "If a conditional contract of sale of a TV set contains a clause to the effect that the conditional buyer will not encumber the set, does this render a service technician's lien void?"

The answer is no.

For example, in *Champa v Consolidated Finance Corporation, 98 N.E. (2d) 925*, the testimony showed that a man named Barnett purchased an appliance, paying part cash. He signed a conditional sales contract which provided that Barnett would not attempt to sell or "encumber the appliance during the life of the contract."

Sometime later, Barnett ordered the equipment repaired at a service shop but he did not notify the finance company that it was being repaired. After the repairs were completed Barnett decided that the costs were more than he could pay, and he so notified the finance company.

In later litigation the higher court held that the technician could keep possession of the equipment to solve payment of his bill. The court said:

"The vendor, by entrusting the vendee (Barnett) with possession ... impliedly clothed him with authority to contract for necessary repairs, so that such repairs were as though made by vendor's request or direction."

On the other hand, some higher courts have held that where a chattel mortgage or conditional sale contract on a TV set is properly recorded, a service technician has only a secondary lien to secure payment for his work. [See *Allied v. Shaney, 74 N.W. (2d) 723*; and *Lincoln v. Netter, 253 S.W. (2d) 260*.]

An important point of law is that *once a service technician has given up possession of a set* on which money is due for repair work, his mechanic's lien is forfeited. In other words, the instant the owner takes his set out of possession of the service technician, the lien automatically becomes void.

Law of service guarantees

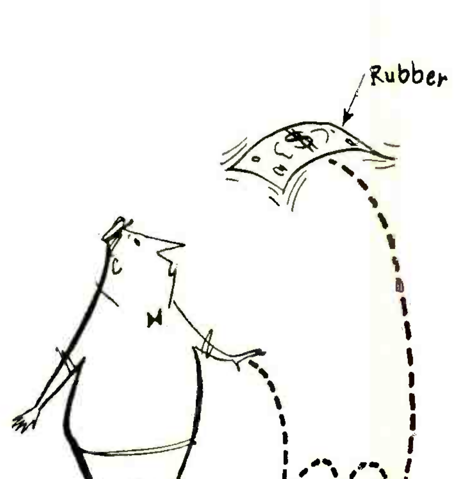
Modern higher courts consistently hold that after the purchaser of a TV set puts it in operation, the seller is bound by any and all reasonable provisions and guarantees relating to the service he has agreed to give. However, the courts will not permit any purchaser to impose on a seller, unless such imposition is clearly expressed in the contract.

For illustration, in one case a contract of sale contained a clause in which the seller "guarantees that the purchaser shall be satisfied."

Although the TV was reasonably good and worth the purchase price, the purchaser continually and at unreasonable frequency requested the seller to supply an unnecessary amount of service in adjusting, repairing and otherwise performing work on the set.

At last the seller refused to supply more service. Then the purchaser notified the seller that he was not satisfied, and since the seller had guaranteed "satisfaction" the purchaser demanded that the seller take back the set and refund the amount paid. He notified the seller that he would not make other monthly payments when they became due.

The seller filed suit and proved that the set had given reasonably good service, notwithstanding the complaints registered by the purchaser. In view of this testimony, the higher court ordered the purchaser to pay the balance due on the set. END



"... counterfeit money is not valid ..."

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". . . a single speed (33⅓-rpm) turntable with an integrally mounted arm . . . employs a somewhat unconventional drive system which results in a totally inaudible rumble level, and low wow and flutter. The arm is simple yet effective, with a mounting system which makes the unit relatively insensitive to shock and vibration."

"The arm tracks well at the lowest stylus forces recommended by the cartridge manufacturer."

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"The PR-500 is an excellent value at **$69.95.**"

Hirsh-Houck Laboratory—
High Fidelity Magazine, May '60

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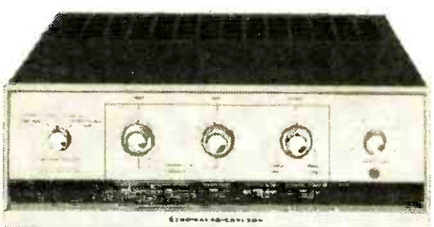

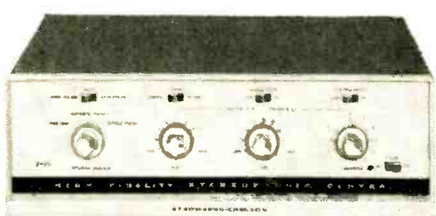

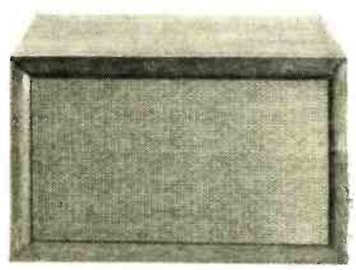

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ASR 660—an extremely clean, beautifully designed stereo amplifier • **Continuous power:** 36 watts (18 watts per channel) • **Music power:** (IHFM standard): 44 watts (22 watts per channel) • **Total harmonic distortion:** 0.6% at 18 watts per channel • **Intermodulation distortion:** 1% at rated output (4:1 ratio, 60 and 7,000 cps) • **Frequency response:** ± 0.5 db, 20-20,000 cps • Separate channel, **clutch-type bass and treble controls** • **Scratch filter** (18 db/oct); **Rumble filter** "Twin T" filter, null at 20 cps • Loudness contour switch; Balance control; Channel reverse switch; Program selector; Master gain control • DC on pre-amp heaters for low noise; A plus B center speaker terminals.

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"The sensitivity measurement of the FM-443, according to IHFM standards, is amazing. Its usable sensitivity is 3 microvolts, a figure not usually found in tuners in this price range. This high sensitivity has not been obtained at the expense of IF bandwidth."

"The tuner sells for **$79.95**."

Hirsh-Houck Laboratory—
High Fidelity Magazine, June '60

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". . . a compact integrated stereo amplifier rated at 32 watts per channel. Noteworthy . . . it exceeds its rated power substantially over most of the audio range, has excellent power-handling capabilities at both ends of the spectrum."

"Each channel delivered 50 watts at 2% harmonic distortion, or 48 watts at 1% distortion. This is unusual in an amplifier rated at 32 watts . . ."

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"Only 0.6 or 0.7 millivolts at the phono inputs will drive the amplifier to 10 watts output per channel. At normal gain settings . . . the hum level is better than 70 db below 10 watts even on phono input. This is completely inaudible."

"With a listening quality matching its laboratory response, the Stromberg-Carlson ASR-880 must be considered a very good value at its **$199.95** price."

Hirsh-Houck Laboratory—
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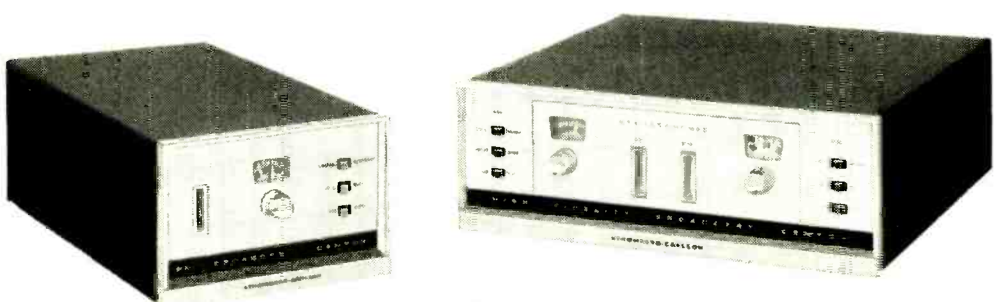

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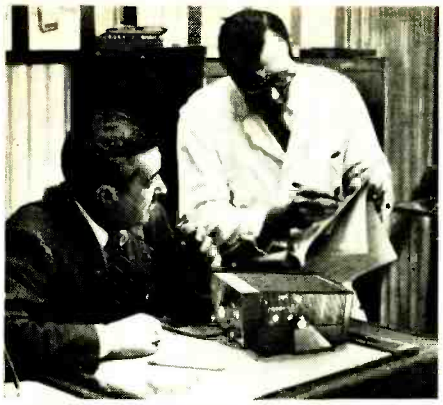

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Built for rugged "industrial-type" service where dependability is essential!

Two models available: G-12 four-channel unit, and lower cost G-11 single-channel unit. Ideal for making up 2-way industrial communications systems for buildings . . . yards . . . warehouses . . . aviation . . . branch businesses . . . contractors. Also for fishing, boating, hunting—special events. 11-meter Citizens Band radio offers virtually unlimited business or personal usage in vehicle, office, boat or plane. Simple licensing—no exam or special skills . . . merely fill out simple FCC form.

G-12 CITIZENS COMMUNICATOR

Every feature for dependable operation under heavy business and commercial use! Trans/rec channels are crystal-controlled for highest stability, ease of tuning. Features press-to-talk operation, front panel channel selector, ANL, adjustable squelch, transmitter tuning indicator, built-in speaker.
FCC type accepted.

Compact! fits into tight Quarters—only 4½" H, 7" W, by 10" D, weighs only 11 pounds. Built-in power supply is universal 12VDC/117VAC (optionally available with 6VDC/117VAC) operates from power mains or vehicular battery.

G-11 CITIZENS COMMUNICATOR

Similar to G-12 except for single-channel operation, and mounting arrangement (3 models: 6VDC, 12VDC or 117VAC).

G-12 .... **149.95** per unit
G-11 .... **124.50** per unit

SUGGESTED PRICE INCLUDES P-T-T MICROPHONE AND TRANS/REC CRYSTAL FOR ONE CHANNEL.

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Sawtooth Sticklers

This quiz will show how good you are at associating waveform distortion with the distortion of a circle on a TV screen

By ROBERT P. BALIN

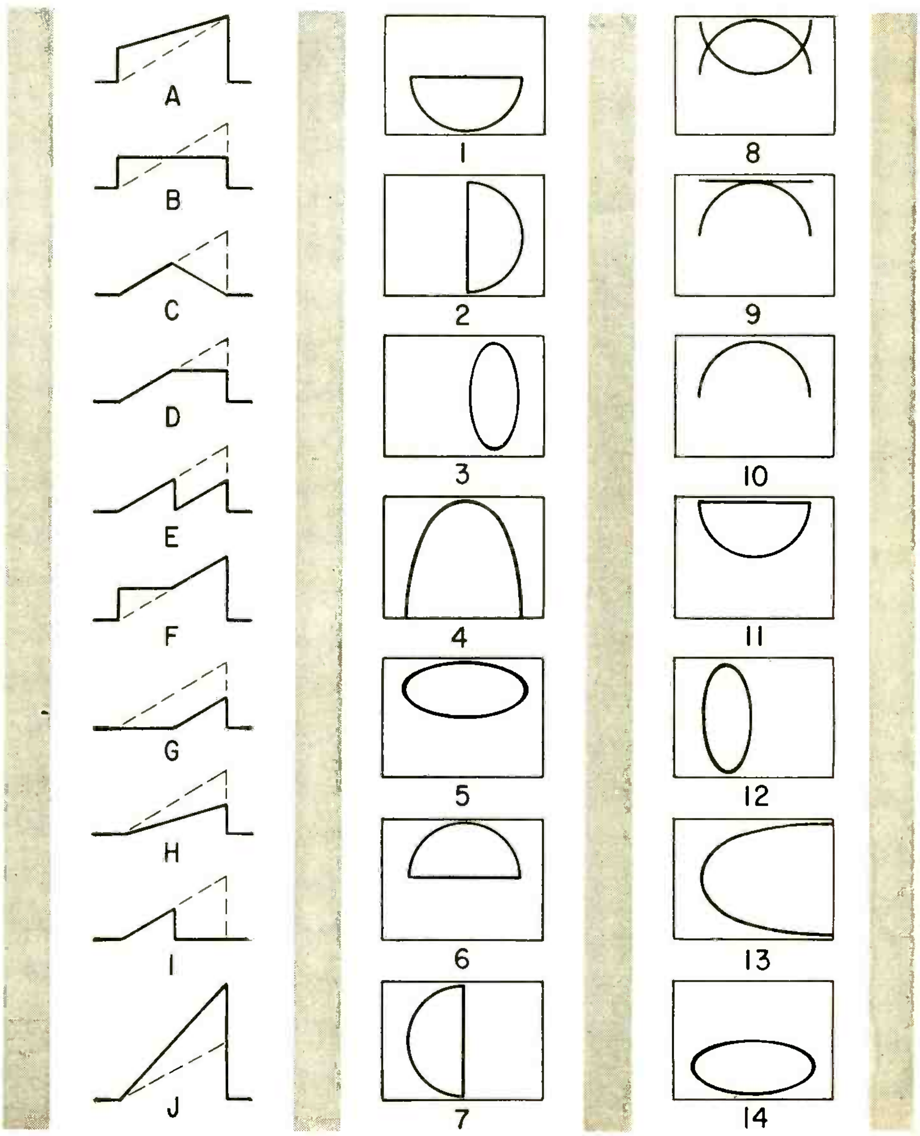
SAWTOOTH vertical and horizontal deflection waveforms in your television receiver control the picture's appearance. A sawtooth with a straight slope beginning and ending with the correct amplitude produces a linear sweep. This, in turn, will reproduce a circle, for example, that not only looks perfectly round but is also centered correctly. If the sawtooth is distorted because of defective components, the circle becomes distorted and displaced.

Fortunately, every waveform distortion produces a predictable change in the shape of the circle. A good troubleshooter can tell what one will look like by looking at the other.

Can you match the distorted waveforms shown by solid lines with the resulting circles they will produce on the TV screen? It is to be assumed that a linear sawtooth (such as that shown by the dotted lines) will produce a normal centered circle on the screen. When the distortion pictured is in the vertical waveform, the horizontal waveform is assumed to be normal. The reverse is also true. In either case, however, video reception (required to produce the circle) is not affected in any way. The deflection waveforms shown can represent either *vertical or horizontal* waveforms.

The problem: find the distorted waveform that will produce a circle having the appearance shown. For each circle, there is a corresponding waveform.

If you got stuck answers are on page 134. END



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PNP-NPN TRANSISTOR OSCILLATOR

Need a 100-kc signal source? This oscillator uses no tuned circuits and almost any complementary pair of transistors may be used

By F. T. MERKLER

THIS simple oscillator is a construction must for service technicians, experimenters or anyone else who needs a precision signal source at a reasonable cost. It can also be used to power an rf bridge, drive flip-flops, logic circuits or a square-wave generator.

Complementary transistors make for a stable, easy-starting crystal oscillator designed to use a minimum of parts. The crystal forms the feedback path from emitter to emitter, making the circuit the dual of the vacuum-tube cathode-coupled crystal oscillator. Direct coupling between the p-n-p and n-p-n transistors insures stability over the temperature range of −5° to +55°C. The p-n-p transistor, V1, is connected in the common-base fashion. The n-p-n transistor, V2, is connected common-collector. (Fig. 1). This method of coupling makes V1's collector current stabilize V2, eliminating the possibility of thermal runaway.

The high stability allows large transistor-parameter variations ("Predictable Design of Transistor Amplifiers," R. B. Hurley, *Tele-Tech & Electronic Industries*, August, 1955).

Almost any combination of p-n-p and n-p-n transistors in this circuit will result in close to sine-wave output. Audio types, drift transistors, converter or if amplifier types will all work. Just be sure that one is a p-n-p and one is an n-p-n. The ones shown in the schematic were used in the original oscillator. If you have none in your parts box, buy these types.

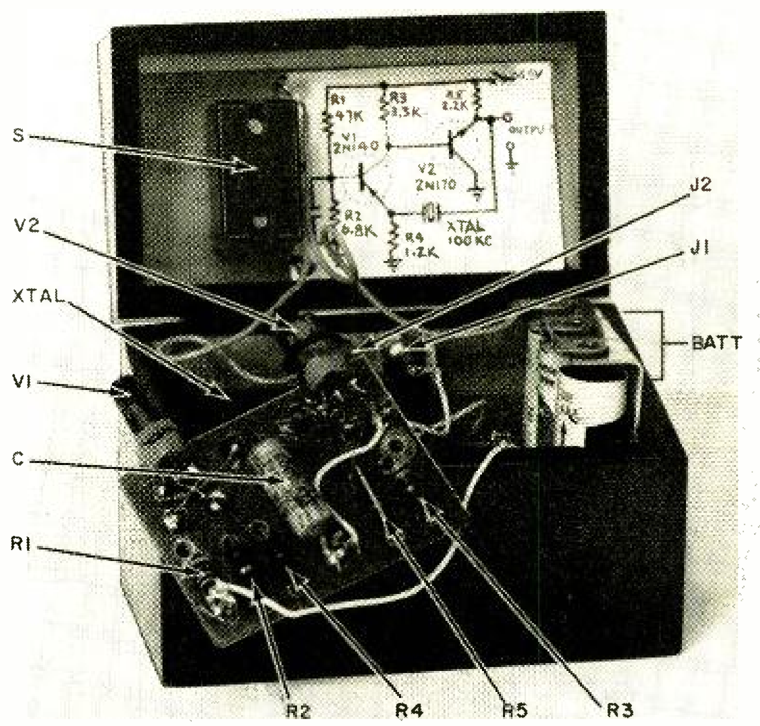
The size and shape of the original oscillator was based on the size of the crystal used (Bliley AR 23-W) and the small wooden box that was available. The AR 23-W is a surplus crystal no longer manufactured, but the KV-3 by the same company is quite suitable. This unit mounts in a standard octal socket. James Knights Co. also makes a 100-kc crystal, type H-9. This unit is 2 inches high by 1⅛ inches in diameter. The crystal you use will determine the size of your osclator.

Construction

Any reasonable parts layout will do. There are no critical leads or circuit dress to worry about. Barring an actual wrong connection, the unit will perform as designed.

Five ½-watt 10% tolerance carbon resistors and one paper capacitor are mounted on a small phenolic board (photo). In the model, the parts were run point to point, with leads through small holes in the board. The transistor sockets were glued to the top edge of the board with service cement. Carefully solder all connections. Follow the schematic (Fig. 1).

CAUTION! Remember one of the transistors is p-n-p, the other n-p-n;



Interior view shows parts layout. Crystal just visible behind chassis.

BENCH TESTED

Unit is small and compact. When tested by a member of the staff of RADIO-ELECTRONICS, it produced the 100-kc waveform specified by the author. When the oscillator is brought close to a radio receiver, oscillation is heard at 100-kc intervals. Almost any transistors can be used as long as they make a p-n-p n-p-n pair. Several combinations were tried and all worked well, with only slight variations in the waveform.

There is no fine-frequency trimmer in this unit, so it may not be exactly on frequency. For any exact calibration work, the oscillator would have to be calibrated first. Don't forget, any error is additive. 1 kc off at 100 kc becomes 10 kc off at 1 mc.

- Two-transistor crystal oscillator.
- Uses almost any pair of complementary transistors.
- Useful range—100 kc to well into the megacycles (on harmonics).
- May be used without crystal as sawtooth generator or code oscillator. Compact and inexpensive.

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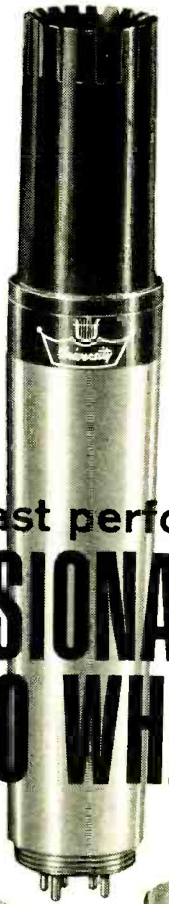

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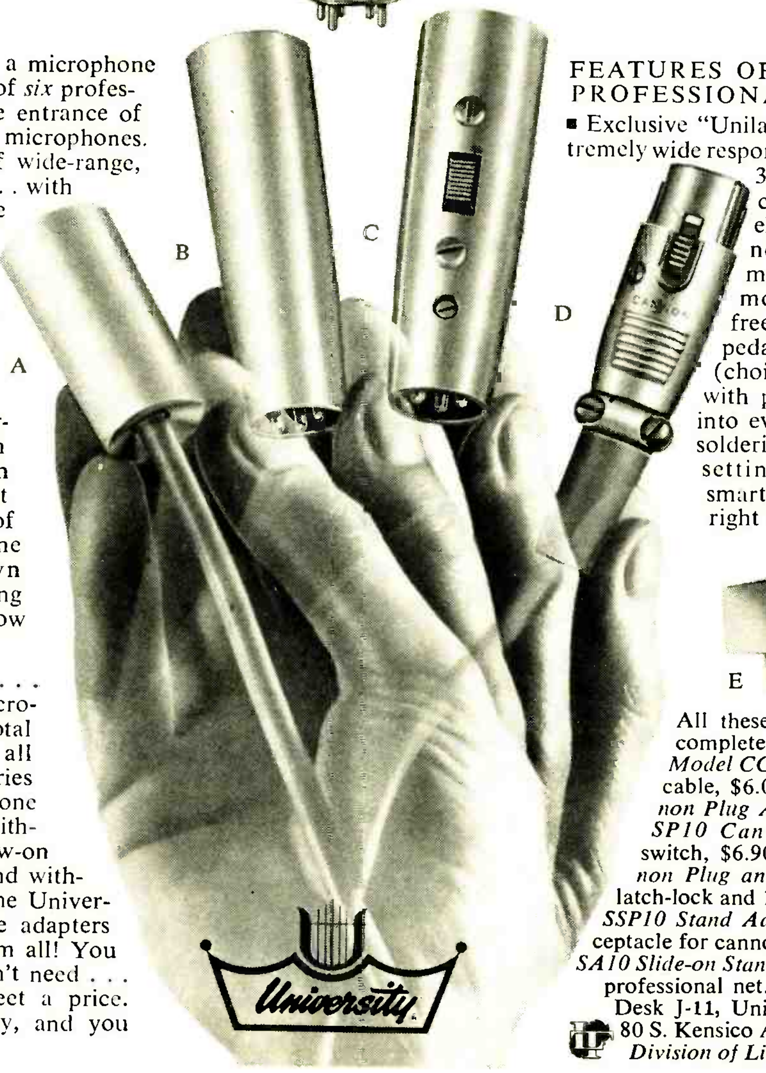

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E F

All these accessories available for complete modular flexibility: [A] *Model CC10 Cable Adapter* with 18' cable, $6.00. [B] *Model PA10 Cannon Plug Adapter,* $6.30. [C] *Model SP10 Cannon Plug Adapter* with switch, $6.90. [D] *Model CA10 Cannon Plug and Cable* with push/action latch-lock and 18' cable, $6.00. [E] *Model SSP10 Stand Adapter* with switch and receptacle for cannon plug, $11.10. [F] *Model SA10 Slide-on Stand Adapter* $4.20. All prices professional net. For further details, write Desk J-11, University Loudspeakers, Inc. 80 S. Kensico Ave., White Plains, N.Y. *A Division of Ling-Temco Electronics, Inc.*

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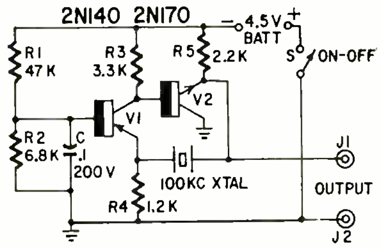
double-check your polarity at the transistor sockets. The p-n-p transistor (V1) collector pin connects to load resistor R3, and R3 connects to the negative voltage source. The n-p-n transistor (V2) collector pin goes direct to ground (which is positive). Reverse



R1—47,000 ohms
R2—6,800 ohms
R3—3,300 ohms
R4—1,200 ohms
R5—2,200 ohms
All resistors ½ watt, 10%
C—0.1 μf, 200 volts
XTAL—100 kc
V1—p-n-p transistor (2N140)
V2—n-p-n transistor (2N170)
J1, 2—phone-tip jacks
BATT—4.5 volts (3 penlight cells in series)
S—spst toggle
Transistor sockets (2)
Box or case to contain oscillator
Battery holders
Phenolic board (chassis)
Miscellaneous hardware

Fig. 1—Schematic. Green and orange paint is used to color code the transistor sockets.

these connections and the circuit will not oscillate. In the model the sockets were color-coded; V1's socket was given a dot of orange paint, V2's a dot of green.

Oscillator output is taken from the emitter of V2 and ground. A pair of tip jacks serve as the output terminals in the model. Since these terminals are connected to the battery through R5, shorting the output terminals will draw 2 ma from the battery. The oscillator operates at a low power level, 6 mw. This provides a long life expectancy for all components. No adjustments are needed to put unit into operation. Carefully check all wiring, connect a scope across the output terminals and turn on the power with switch S. The approximate waveshape is shown in Fig. 2. If a scope is not available, turn on the oscillator and place it close to a broadcast receiver. Beats and whistles will be heard as the receiver is tuned across the low end of the band. The frequency of the output will be very close to 100 kc. If a crystal which is

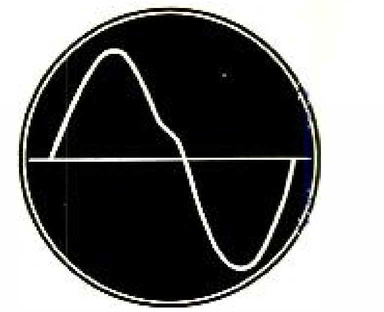


Fig. 2—Output waveform with 100-kc crystal and 2N140 and 2N170 transistors used in the oscillator.

Front view of unit. Power switch is located on top of wooden box.

ground to be used in a series-resonant circuit is purchased, the ultimate frequency accuracy will depend on the crystal's frequency tolerance and the temperature at which it is operated. For high-order precision, some form of oven with automatic temperature control is needed. Such a system is beyond the scope of this article.

The original oscillator with the 2N140 and 2N170 transistors will work with crystals in the range of 70 kc to 400 kc. If a sawtooth output is required, substitute a paper capacitor for the crystal.

A standard headphone in series with a 0.1-μf capacitor and connected in place of the crystal, makes the unit a handy code oscillator (key the unit at one of the battery leads). Use the unit as a high-gain low-level amplifier by connecting an input coupling capacitor to the emitter of V1 and leaving out the crystal. Take output from J1 and J2.

END

A NEW COMPLAINT

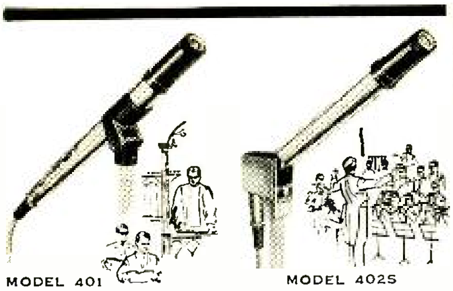
We at Howard's Television (1070 A St., Hayward, Calif.) thought we had heard everything in the nature of complaints from ingenious customers, but this was a new one to be added to a long list.

My husband gave a Mr. S. an estimate of $10 to repair his set. Mr. S. went away happy. He asked for the bill after he had picked up his set. He glanced down at it. Then his face and body bristled. "What's the idea of this bill for $10?" he challenged me.

I was puzzled and reminded him, "I was right here and heard my husband give you an estimate of $10. You knew that the bill would be $10 before you left your set."

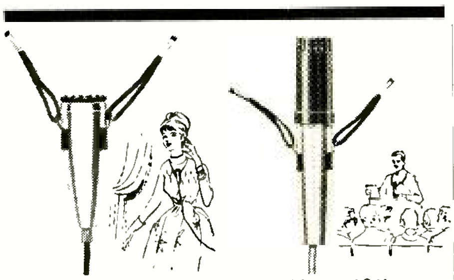
He set his face in harder lines. "Yeah, I know. That was just an estimate. It would never happen in a million years that the bill would come out exactly at the estimate. Might be $9.99, or $10.35 maybe, but $10, never!"

Angry color flooded his face as he grudgingly paid the bill and went away muttering, "$10! Never in a million years!"—*Myrtle Sprackten*



MODEL 401 OMNI-DIRECTIONAL DYNAMIC Professional broadcast microphone for diversified broadcast applications. Also ideally suited for every quality sound system: night club, church, school, commercial and industrial p.a. Exclusive "Unilar" diaphragm. Response: 40-20,000 cps. $43.50 professional net.*

MODEL 402S OMNI-DIRECTIONAL DYNAMIC (SHOCK MOUNTED) Deluxe version of Model 401, shock-mounted to prevent mechanical feedback and pickup of spurious noise. Response: 35-20,000 cps. Otherwise identical in performance to Model 401. Exclusive "Unilar" diaphragm. $47.70 professional net.*



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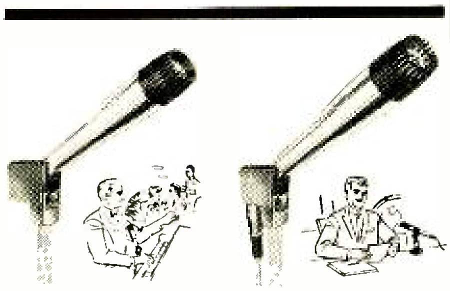

MODEL 501 PROFESSIONAL DYNAMIC CARDIOID Finest quality full-range reproduction under diverse acoustic conditions. Cardioid pattern rejects unwanted background noises and room reverberations, allowing non-critical placement of microphone. Exclusive "Unilar" diaphragm. Response: 35-15,000 cps. $75.00 professional net.*

MODEL 502S PROFESSIONAL DYNAMIC CARDIOID (SHOCK MOUNTED) A deluxe shock-mounted microphone designed to prevent mechanical feedback and pick-up of spurious noise. Response: 30-16,000 cps. Otherwise identical in performance to Model 501. Exclusive "Unilar" diaphragm. $87.00 professional net.*

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Another reason why CREI men are respected and eagerly sought by industry and Government agencies alike is the accreditation and enthusiastic approval accorded the CREI home study program in advanced electronics. We co-founded the National Council of Technical Schools, and we were among the first three technical institutes whose curricula were accredited by the Engineers' Council for Professional Development. Further, the U.S. Office of Education lists CREI as "an institution of higher education."

Of equal importance, we believe, is the appreciation expressed by industry and government for the CREI programs. Dozens of major electronics organizations, ranging from industrial giants to the Government's Voice of America, have agreements with CREI for enrollment of students under company sponsorship. U.S. Navy electronic personnel in the number of 5,240 are enrolled in CREI extension programs. The British Royal Air Force, Army and Navy have approved CREI courses under their tuition assistance plan. The following companies comprise only a partial list of the organizations which not only recommend CREI study but actually, in many cases, pay all or part of the tuition for employees taking CREI courses:

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Columbia Broadcasting System
All America Cable and Radio
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Gates Radio Company
Mohawk Airlines
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6E5 for TRANSISTOR CIRCUITS

Simple dc-to-dc converter lets you add an indicator tube to your all-transistor devices

By RUFUS P. TURNER

YOU don't have to do without an electron-ray indicator in low-voltage, battery-operated equipment such as transistor receivers, amplifiers and test instruments. The indicator can be operated by an all-transistor converter circuit.

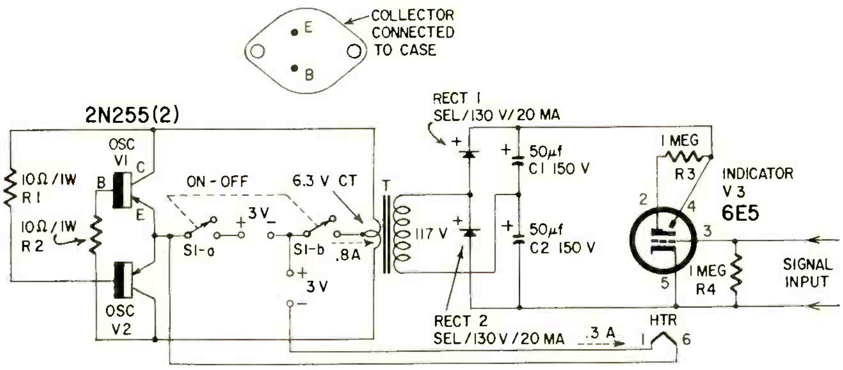
The diagram shows a circuit for operating a 6E5 indicator tube from a 6-volt battery tapped at 3 volts. The tube's heater receives the full 6 volts, while 3 volts drives the converter circuit which supplies the high dc voltage for the plate and target.

The voltage stepup is provided by a 6.3-volt filament transformer, T. Two 2N255 transistors (V1, V2) and two 10-ohm 1-watt resistors (R1 and R2) form an oscillator circuit with the transformer's center-tapped 6.3-volt winding.

The high ac voltage delivered by the transformer's 117-volt winding is rectified and doubled by two miniature selenium rectifiers (RECT 1 and RECT 2) and two 50-μf 150-volt electrolytic capacitors (C1 and C2). The full-load dc output voltage of this circuit is approximately 100.

The battery can be four 1.5-volt dry cells in series. If a storage battery is used, the tap can be at 4 volts (two cells) instead of the specified 3 volts. For short-term use, as in bridge balancing, signal tracing, etc. where the device is in operation only a few minutes at a time, four size-D flashlight cells will do. END

R1, 2—10 ohms, 1 watt
R3, 4—1 megohm, ½ watt
C1, 2—50 μf, 150 volts, electrolytics
RECT 1, 2—selenium, 130 volts, 20 ma, miniature (Federal 1159 or equivalent)
S1—dpst toggle
T—filament transformer: primary, 117 volts; secondary, 6.3 volts ct, 1 amp (Merit P-2944 or equivalent)
V1, 2—2N255
V3—6E5
Sockets, 9-pin miniature, for 2N255's (2)
Socket, 6 pin, for 6E5
Chassis, to suit
Miscellaneous hardware



Indicator circuit for all-transistor instruments.

AMPLIFIER TEST-LOAD BOX

If your shop handles an appreciable amount of audio amplifier servicing, you may find this idea helpful. To save time often wasted looking for the correct resistor with a power rating sufficient to be used as an amplifier output load, I constructed a variable output-load box. I mounted a 25-ohm 100-watt potentiometer (Ohmite K0448) in a small plastic parts box, added a bar knob and calibrated the pot with an ohmmeter for all the common output impedances encountered in audio work. A pair of short leads with alligator clips were soldered to the pot in conventional rheostat fashion. Holes for the leads were made in the plastic box with the tip of a hot soldering iron and the edges smoothed off with a file.

When an amplifier is to be instrument tested, the load box is simply clipped across the output terminals and adjusted for the correct load. Although a noninductive resistance should be used, I have found that the load box is satisfactory for most tests because frequency response is usually not affected until the frequencies of the signal being tested approach 100 kc.—*Warren J. Smith*

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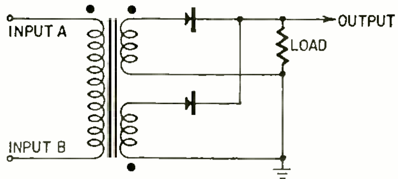
new PATENTS

ADDER

Patent No. 2,937,286

T. H. Bonn and J. P. Eckert, Jr., Philadelphia, Pa. (Assigned to Sperry Rand Corp.)

This adder provides output *only* when *one* of its two inputs is energized. Such a device is useful in binary counting. For example, adding 1 plus 1, or 0 plus 0, should (disregarding the carry) give zero. Adding 1 plus 0 should give 1. This adder requires no operating power. It is comprised of a transformer and diodes.



Assume that a pulse exists at input A only. Current flows through the primary using input B as the return path. The secondaries are oppositely wound (note dots) so one will pass current, depending upon which diode permits it. On the other hand, no output exists when signals are present at both A and B due to cancellation.

V-R TUBE CIRCUIT

Patent No. 2,944,206

Charles B. Brahm, Windsor Locks, Conn. (Assigned to United Aircraft Corp., E. Hartford, Conn.)

The firing voltage of a VR tube is higher than its regulating voltage. For example, the OA3 fires at 105 volts and regulates at 75 volts. In a conventional circuit (Fig. 1), we want R to be

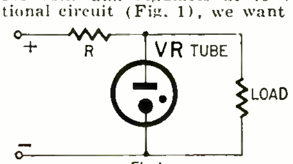


Fig. 1

small to permit firing, but it should be large to limit current to that required by load and tube.

In the new circuit (Fig. 2), R1-R_L form a divider that delivers slightly more than regulated voltage across the load. R2 is chosen for minimum VR current through the tube (5 ma).

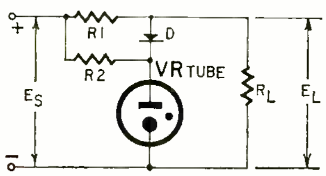


Fig. 2

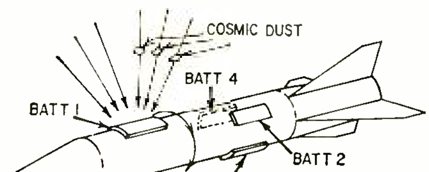
When the circuit is switched on, E_L drops to approximately the regulated voltage, while full E_S is available to fire the voltage regulator through R2. This is possible because diode D remains blocked. After firing, D allows a small current flow through the VR tube. Thus lower supply voltages may be used.

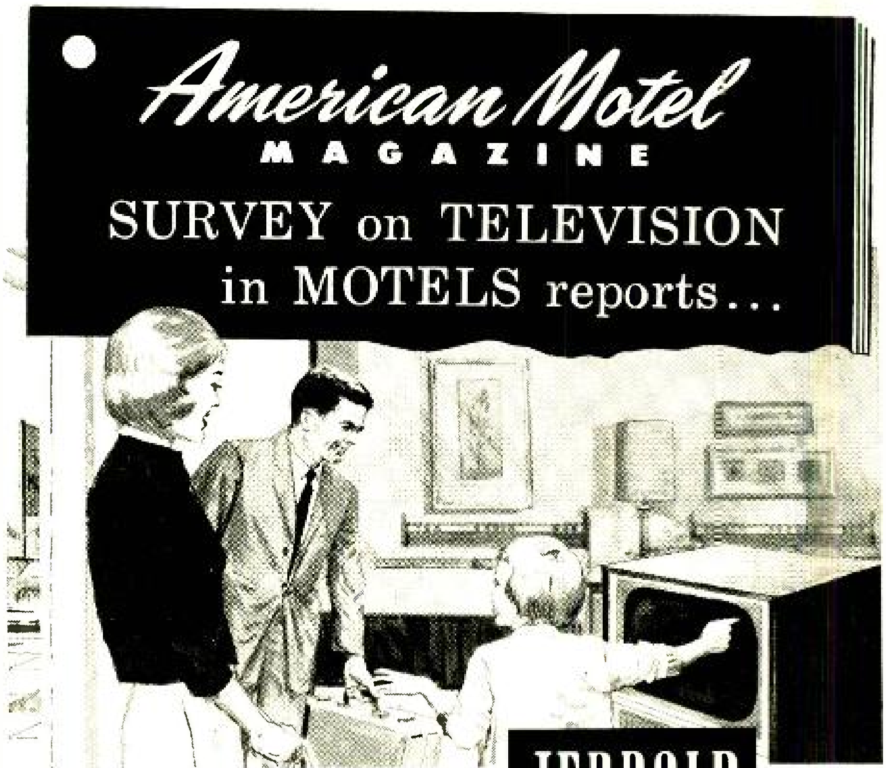
MISSILE MEASUREMENTS

Patent No. 2,944,250

John R. Outt, Malvern, Pa. (Assigned to General Electric Co.)

This invention uses solar cells to study conditions in space. Solar battery BATT 1 is





JERROLD

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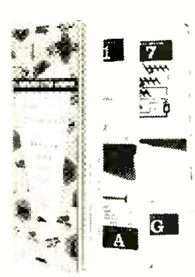

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situated near the nose cone of a high-speed missile. The missile rolls during flight, so the sun's rays reach the cell periodically. Therefore ac is generated, its frequency being equal to the roll rate of the missile.

BATTS 2, 3 and 4 are connected in series, so the sun always shines on at least one. Their output will be nearly constant. However, it gradually decays due to the sandblasting effect of tiny meteors.

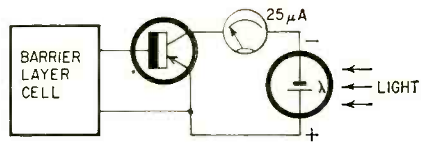
Since cell output is high, no amplifiers are needed. The voltage information may be transmitted by radio as usual, to indicate roll rate and meteor activity.

RADIATION DETECTOR

Patent No. 2,942,110

Kurt Lehovec, S. Williamstown, Mass. (Assigned to Sprague Electric Co., N. Adams, Mass.)

No batteries are used here. The radiation senser is a barrier-layer cell, sensitive to beta



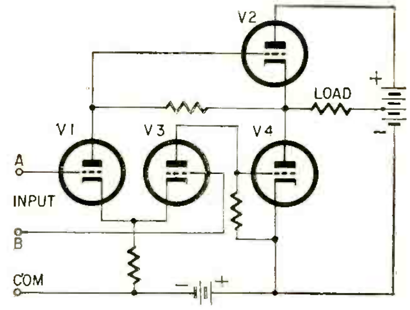
rays. Output is about 1 microamp, which is amplified by the transistor. A solar cell powers the transistor. The meter should have a maximum deflection of 25 ma.

DIRECT-COUPLED AMPLIFIER

Patent No. 2,936,345

John F. Kinkel, Altadena, Calif. (Assigned to Bell & Howell Co., Chicago)

This amplifier handles high power for motors, servos, etc. V1, has a high amplification factor and is coupled to V2, a low-plate-resistance tube. They form one channel. A second channel, made up of V3 and V4, is identical with the first. However, V2 and V4's currents flow in opposite directions through the load.



Normally V1 and V3 are blocked and V2 and V4 are conducting, but load currents cancel. A positive signal at A causes V1 to conduct, lowering the output from V2, and power is fed to the load. Likewise, a positive signal at B reduces V4 conduction and results in power at the load, this time of opposite polarity.

The input signal determines whether V2, V4 or both will conduct and how much. END

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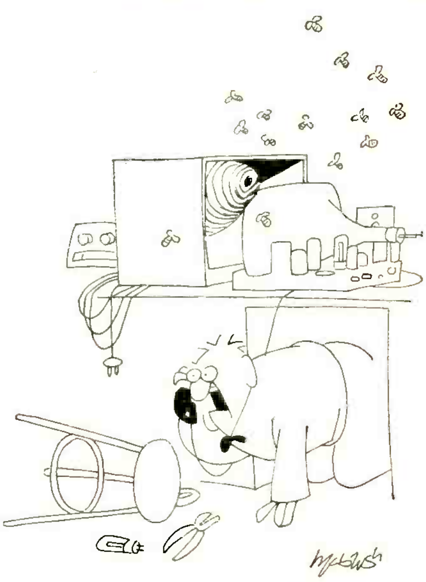

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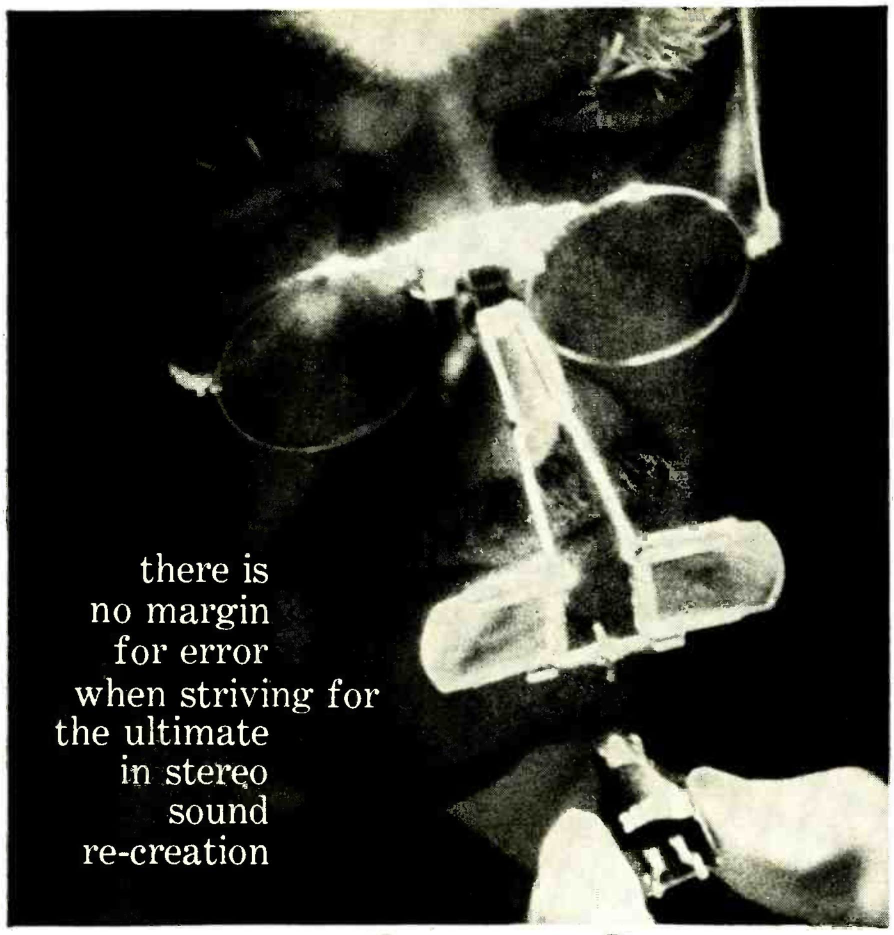

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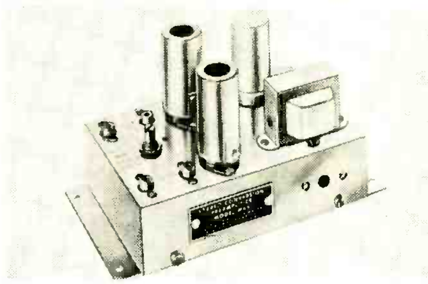
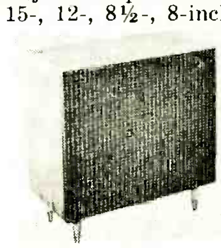


BASS-REFLEX ENCLOSURE KIT *Model 7*. Adjustable port. Mounting cutouts for 15-, 12-, 8½-, 8-inch speakers and most tweeters. ¾-inch birch veneer. Installed acoustic damping material. Fullface grille cloth. 29 x 28 x 16 inches.—**Homewood Industries**, 26 Court St., Brooklyn, N. Y.



SPEAKER SYSTEMS. *TR-30 TRIette*, complete 3-way system: 12-inch Flexair woofer for response to 25 cycles; frequency range 20 cycles to be-

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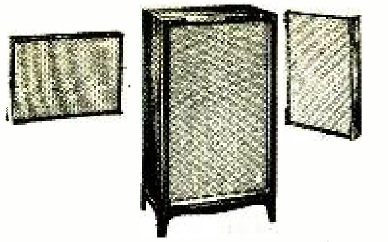

yond audibility with crossover points at 900 and 6,000 cycles; power rating 30 watts (60 peak); impedance 8 ohms. *GALAXY III* (shown), complete stereo speaker system: bass-center unit and 2 satellites; 12-inch Flexair woofer reproduces bass up to 350 cycles from both channels; 2 satellites, each containing special elliptical speaker for 350–4,000-cycle range and compression tweeter for 4,000 cycles to beyond audibility, spaced from 8 to 20 feet. *TF-3*, 4-speaker 3-way system: 10-inch long-travel Flexair woofer for bass response to 25 cycles; 2 mid-range units take over from 2,000 to 10,000 cycles; spherical sector supertweeter extends response to beyond audibility.—**Jensen Mfg. Co.**, 6601 S. Laramie Ave., Chicago 38, Ill.

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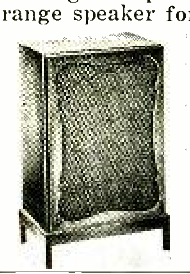
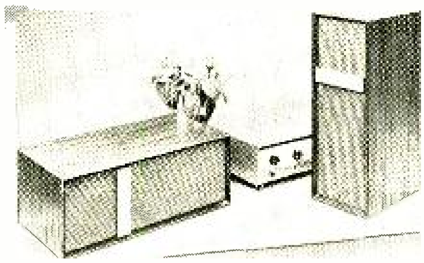
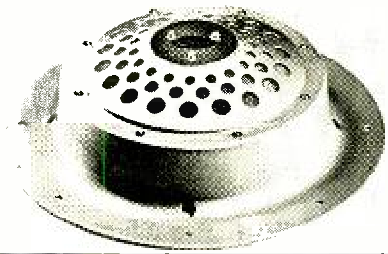


SPEAKER SYSTEM *model SK-181*. Specially designed speaker in rear-loaded reflex type enclosure. Response

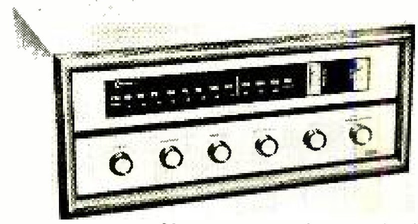


100 to 12,000 cycles. Impedance 8 ohms, rated at 10 watts. Finished in walnut on four sides. 15¾ x 5⅞ x 8¼ inches. 6-foot cable and phone plug.—**Lafayette Radio Corp.**, 165-08 Liberty Ave., Jamaica 33, N. Y.

SPEAKER *model S-394 Thin-Line series*. Mounts flush on wall or ceiling. 60–13,000-cycle response. 8-ohm voice coil. Speaker 6 inches. Overall depth 3 inches. Dull gold.—**Olson Radio Corp.**, 260 S. Forge St., Akron, Ohio.



HI-FI KITS. *Citation III*, professional FM tuner (shown): completely factory-assembled FM cartridge embodies most of critical tuner elements; Nuvistor tube in front end; 2-stage audio circuit; charcoal brown and gold; walnut enclosure. *Citation IV*, stereophonic preamp; separate bass and treble tone controls for each channel; dc on all heaters; low noise resistors in critical places; 0 to infinity balance control; military type terminal boards; charcoal brown and brushed gold; walnut enclosure. *Citation V*, 80-watt stereophonic power amplifier: 40 rms per channel with 95-watt peaks; two 7581's per channel output stage; bias meter for



output tube adjustment; 4 hermetically sealed silicon diodes and heavy-duty electrolytic power supply; charcoal brown and brushed gold; metal enclosure.—**Harman Kardon**, 520 Main St., Westbury, N. Y.

RECORD PLAYER. *Lesa Model SM5/DU2*. 4 speeds. Manual. Stereo-monaural U-type stereo cartridge. Quick-flip switching. Built-in 45-rpm

(*Continued on page 106*)

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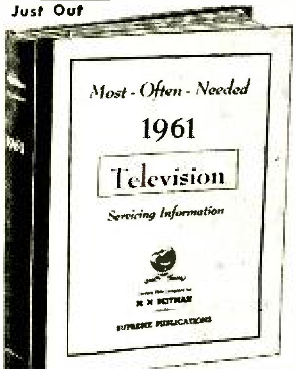

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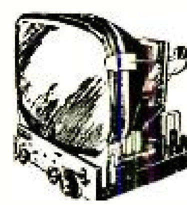

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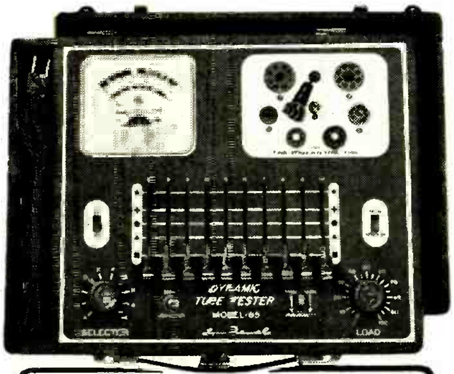

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● **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, +, ●, ▲, ■) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

● **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

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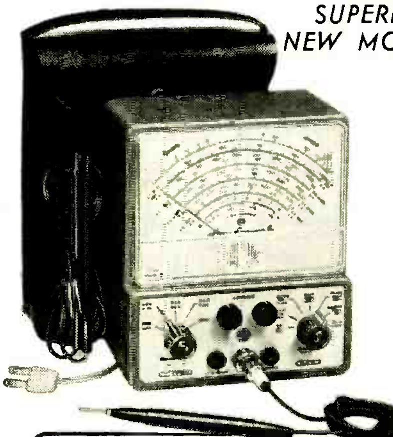

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✔ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.

✔ Model 77 uses new improved SICO printed circuitry.

✔ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.

✔ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.

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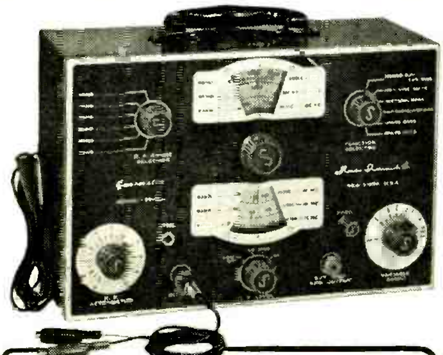

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R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

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

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

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

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

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

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

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

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The Model 88....A New Combination

TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no *adequate* provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices *under dynamic conditions.*

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure — a technique developed specifically for transistor radios and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pinpointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors incuding NPN and PNP, silicon, germanium and the new gallium arsinide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

SPECIFICATIONS:

✓ Model 88 operates on a self-contained 4½ volt battery and is always ready for instant use on the bench or in the field.

✓ ***Signal Injector:***

The signal injector used in the Model 88 is a new departure in signal source design. Previously, signal sources were provided by signal generators operating on a single frequency and requiring retuning. The Signal Injector of the Model 88 employs a transistor in a grounded emitter self-modulating blocking oscillator generating a low R.F. frequency providing stable harmonics to 30 megacycles. A power output of over 2.5 volts peak to peak is provided. An attenuator prevents overload of the receiver or the amplifier under test.

✓ ***Signal Tracer:***

Two high-gain grounded emitter transistors are utilized in a high gain amplifier with sufficient output to operate the built-in 4½" Alnico V Speaker. A diode is used as a "clamp" to prevent overloading of the output stage. A volume control permits attenuation of strong signals. Provision is also made on the front panel for the addition of a meter or an oscilloscope for quantitative evaluation of the signal strength.

✓ ***Transistor Tester:***

The transistor tester used in the Model 88 measures the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 micoamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.

The Model 88 will test all transistor types, including NPN or PNP, germanium, silicon, gallium arsenide and the newer diffused junction and mesa types.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! Only **$38.50**

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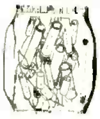

50 assorted tiny capacitors in a variety of mfds and voltages ideal for small electronic assemblies such as transistor sets or other applications. Consists of 35 tiny insulated paper capacitors and 15 ceramic capacitors. All mfds clearly printed on each. Wt.: 3 oz.

SPRING KIT $1.49

200 piece spring assortment consists of 8 different types of springs including compression and expansion types commonly used in TV, radio and phonographs. Shipped in a really useful heavy duty plastic box with hinged lid. Wt.: 8 oz.

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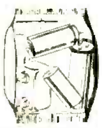
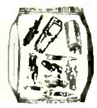
25 postage stamp mica compression trimmers mony with brackets. The 25 different condensers in this kit represent a wide range of capacities from 3 to 280 MMFD. Packaged in a clear plastic bag. Wt.: 8 oz.

CROSSOVER CONDENSER KIT 5 CROSSOVER COND. $1.89



5 non-polarized capacitors ideal for coupling the tweeter to the woofer speakers . . . anyone of which can do the job, ranging from .5 mfd to 10 mfd and priced so low, that one capacitor only would cost more than the kit. You will be pleased. Order now Wt.: 12 oz.

21 MC. TV I.F. KIT 99¢ 10-21 MC. TV I.F.S.

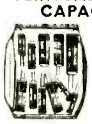


Here's an amazing value!! 10 standard type 21 to 26 megacycle I.F.s — include a liberal variety of shielded and unshielded types . . . All are replaced by popular Stancor-Merti numbers. Use just one and it pays for the entire kit. Order now at great savings . . . Wt.: 4 oz.

TV COIL KIT $1.69

25 assorted TV coils for the repair shop or lab. Contains peaking coils. IF's, width and ratio detector coils in a plastic bag. The use of one or two coils will more than pay for the entire kit. Priced real low! Wt.: 8 oz.

VERTICAL MOUNT CAPACITORS



All Popular Values 20 Vertical Capacitors $1.69

Here is an assortment of plastic cased vertical mount tubulars for all printed circuit chassis today. A wide variety of mfds to meet most demands, ranging from .00 to .1 Twenty all packed in clear plastic bags. This is a must for all servicemen and experimentors today. Order now at our low price! Wt.: 6 oz.

TAB MOUNT CONTROLS $1.99

10 tab mount volume controls. Hard to get items, not normally available in distributor stocks!! Kit includes a wide range of ohmages used in radio phono, and TV work. All controls are designed for direct mount to the chassis. These are the most commonly used controls in modern design automation and printed circuit work.

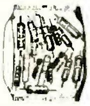
DUAL CONCENTRIC CONTROLS $3.29

10 assorted dual concentric controls used in TV and auto radio. Kit includes 5 each controls with and without switch. All were made for very large TV and auto radio mfgs . . . Wt.: 1 lb. Order now at great savings!

20 METAL CLAD RESISTORS $1.89

Top quality metal clad resistors sometimes called candohms. A wide range of resistance values and lengths from 2½" to 9". Dissipate heat rapidly when mounted to metal chassis Wt.: 2 lbs

100 ASS'T INSULATED RESISTORS $2.89



100 always popular value ½, 1 and 2 watt insulated carbon resistors. Every resistor standard RMA color coded and made by standard manufacturer. Kit includes 70-½, 20-1, and 10-2 watt resistors. Ideal for labs, TV and radio servicemen. Packed in a clear plastic bag. Wt.: 6 oz.

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(*Continued from page* 103)

spindle. 2-tone colors.—**Electrophone & Parts Corp.**, 530 Canal St., New York 13, N. Y.

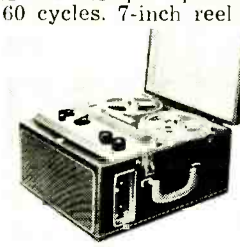
TURNTABLE *Empire 208*. Hysteresis synchronous motor. Belt coupling. Variable 3-speed adjustment. Pushbutton power control. 6-lb. table with double-rim flywheel design. Cushioned

vertical thrust support. Acoustically isolated motor suspension. Satin chrome or gold Swiss finish.—**Dyna-Empire, Inc.**, 1075 Stewart Ave., Garden City, N. Y.

DISC RECORDER, *Imperial II*. Cuts 6- to 13¼-inch master records at 33⅓ and 78 rpm. Idler and adapter for 45 rpm. Recording-head response 30 to

13,000 cycles. Recording and playback amplifier 20-watt output and 20–20,000-cycle response. — **Rek-O-Kut Company, Inc.**, 38-19 108 St., Corona 68, N. Y.

TAPE RECORDER, *RCA MI-35120*. 7½, 3¾ and 1⅞ ips. Operates from 117 volts, 60 cycles. 7-inch reel holds 1,200



feet standard ¼-inch tape recording on half tape's width. 2 built-in speakers with output jack for external speaker. 8½ x 14½ x 16 inches. Charcoal gray grained fabric. — **RCA**, 30 Rockefeller Plaza, New York 20, N. Y.

TONE ARM complete with crystal stereo cartridge *T1 Series*. Plastic with plated finger lift. Compression-type or solid rear mounting post. Wired from cartridge plug through arm with approximately 13 inches additional wire

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WITHOUT ADDING HIM TO YOUR PAYROLL!

Tie in locally with the national Sylvania Silver Screen 85 TV Tube promotion featuring you, the independent service dealer

Arthur Godfrey, America's Number One Salesman, is selling — the Sylvania Silver Screen 85 TV picture tube—*and* Sylvania quality small tubes—in a dynamic national advertising campaign. Just look where you're being promoted . . . twice each week on 200 CBS Radio Network stations across the country ... *The Saturday Evening Post* ... and lots more!

To make the most of this sales-getting promotion, be sure you use all the local tie-in aids Sylvania now offers:

GIANT WINDOW DISPLAY—colorful, 3-dimensional ... features you and Arthur Godfrey. (Order #1139)

3-PIECE DECAL KIT—Sparkling glassine signs with Arthur Godfrey saying, "Stop Here For Quality TV Service." (Order #1138)

GIANT WINDOW POSTER—Big 20″ x 26″ poster promotes your service. (Order #2095)

Each and every promotion piece is designed to help you sell Sylvania Silver Screen 85 TV tubes plus Sylvania quality small tubes. For your supply—and helpful hints on how to make the best use of these selling aids—contact your Sylvania distributor. Do it today!

Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, New York

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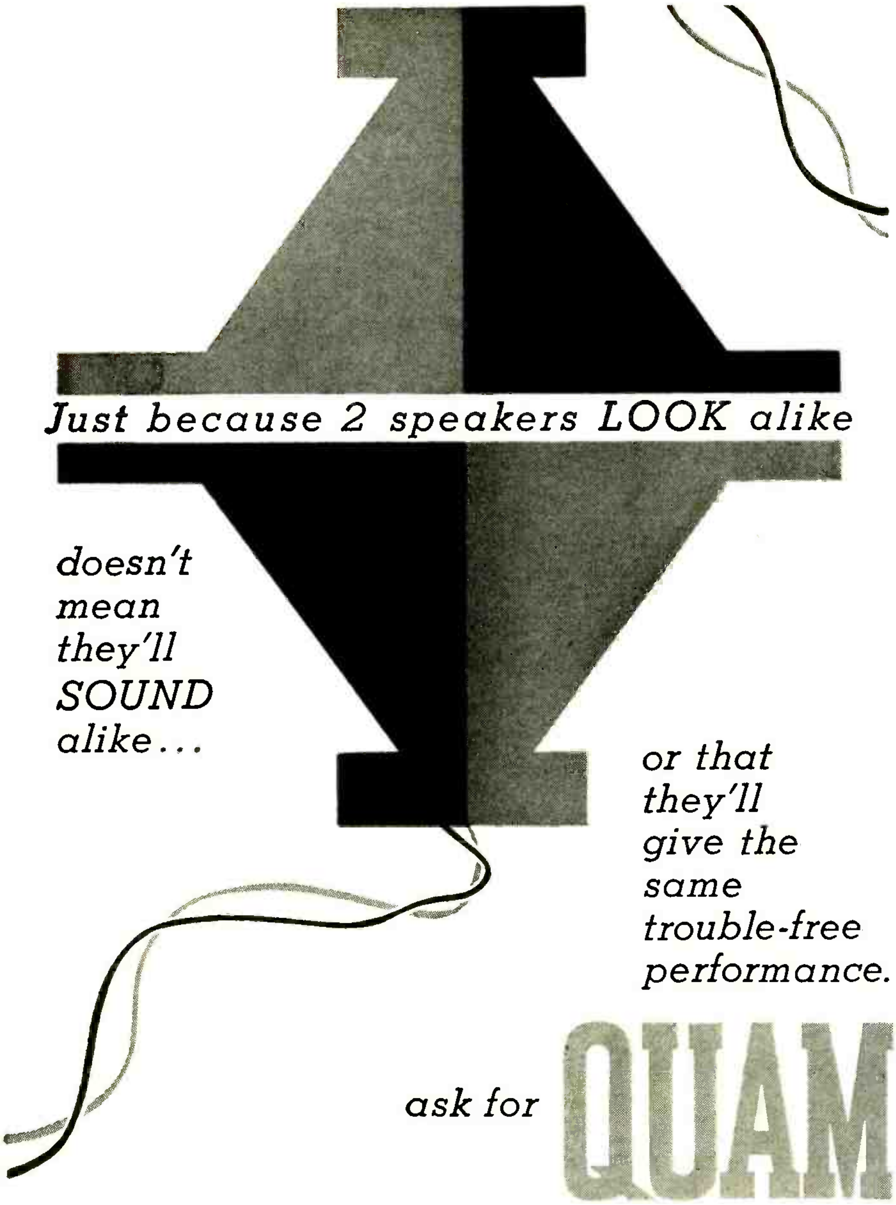

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The MULTI-HEAD incorporates:
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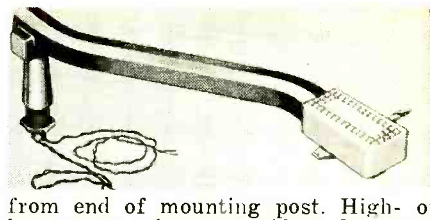
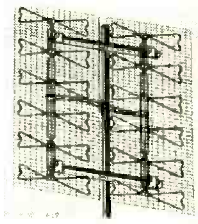


from end of mounting post. High- or low-output voltage cartridges. Turnover lever snaps out for replacement. Brown or gray. — **Sonotone Corp.,** Elmsford, N. Y.

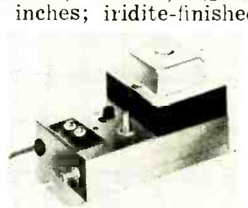
FM ANTENNA, *Lark*. S-type all-direction design. Available as individual antenna or complete kit. Golden anodized.—**Technical Appliance Corp. (TACO)**, Sherburne, N. Y.

UHF ANTENNAS. *TR604*, 4-bay for primary uhf translator locations; *TR-606*, 6-bay for near-fringe uhf; *TR612* (shown), 12-bay for fringe and far-fringe. For improved broad-band response on channels 70–83. Highly rigid, heavy-gauge, galvanized, welded wire



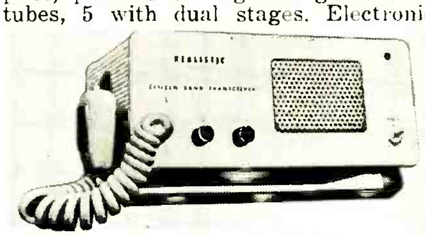
rod construction. Oversized precision-formed cardioid dipoles of corrosion-proof solid aluminum rod. Half-wave horizontal and vertical spacing of bays. Solid busbar multistage phasing transformers for constant 300-ohm impedance over uhf translator spectrum.—**JFD Electronics Corp.,** 6101 16th Ave., Brooklyn 4, N. Y.

BOOSTERS, TV and FM. *DSA-202* preamp (shown): remote power supply; mast-mounted; 2 tubes; 5½ lbs, 8½ x 6¼ x 4 inches; iridite-finished alumi-



num case. *HSA-43*: 3-set coupler; single tube; special circuitry; 4½ x 4½ x 3 inches; die-cast case; brown and beige finish.—**Jerrold Electronics Corp.,** 15th and Lehigh Aves., Philadelphia 32, Pa.

TRANSCEIVER *TRC-27* for Citizens band. Meets FCC requirements. Completely wired, ready to operate. 117 vac and 12 vdc transistorized power supplies, positive or negative ground. 10 tubes, 5 with dual stages. Electronic



switching. Crystal-controlled transmitter and receiver each with 22 possible channels. 4½-inch PM speaker. Push-to-talk dynamic microphone. Light gray enamel finish, 5 x 13 x 7 inches.—**Radio Shack Corp.,** 730 Commonwealth Ave., Boston 17, Mass.

CONTACT CLEANER, *Formula BC-*

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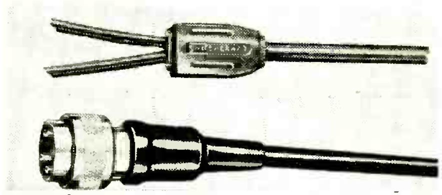
44. Lubricates and conditions. 6-oz push-button spray can with 5-inch plastic extender.—**Electronic Chemical Corp.**, 813 Communipaw Ave., Jersey City 4, N. J.

ILLUMINATED MAGNIFIER. 5-inch-diameter 4-power magnification ground and polished lens surrounded by

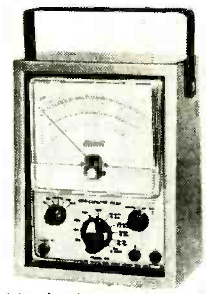
22-watt circular fluorescent tube. Reflector swivels for rotating in complete circle or up and down tilting.—**Glidelite**, 11 Moonachie Rd., Hackensack, N. J.

CONNECTORS. Molded cable assemblies. Y-type junction *ST-90* for headphones, binaural and stereophonic headsets. *ST-26*, 4-contact type for electronic and portable equipment. *ST-25* (not shown), single-contact type for microphones, amplifiers, transmitters, tape



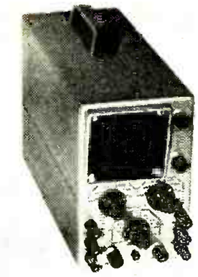
recorders, headphones. — **Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

DUAL PURPOSE TEST INSTRUMENT *model 400*. 20,000-ohms-per-volt vom and capacitance meter. Slope front



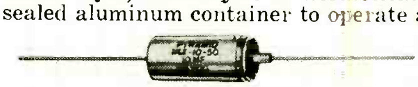
projects 4½-inch meter forward. 3 knobs and 3 jacks. Wide range of operation. — **Mercury Electronics Corp.**, 77 Searing Ave., Mineola, N. Y.

OSCILLOSCOPE KIT for general-purpose, medical, industrial use. *Model*



IO-10 has identical dc vertical, horizontal amplifiers. 3-inch CRT. Bandwidth dc to 200,000 cycles (2-db point). Sensitivity 0.1 volt (peak to peak) per ¼ inch. 3-position attenuator, continuously variable gain control. Multivibrator type sweep generator cover 5 to 50,000 cycles in 4 ranges. Low relative phase shift between channels.—**Heath Co.**, Benton Harbor Mich.

CAPACITORS *MLE* (shown) subminiature electrolytics. Temperature range −40°C to +85°C for critical circuits. *CQM*, electrolytic in hermetically sealed aluminum container to operate at



−20°C to +65°C; *TAK-H*, wet electrolyte tantalum meeting specifications MIL-C-3965; *TAD*, solid tantalum in varied sizes and values hermetically sealed for −40°C to +85°C. 125°C range—**Pyramid Electric Co.**, 1445 Hudson Blvd., N. Bergen, N. J. END

All specifications on these pages are from manufacturer's data.

Replace improper equipment with the only microphone designed specifically for citizen's band

THE TURNER 350C

This reasonably priced, mobile-type ceramic microphone is the perfect replacement for the many improper, tape recorder-type microphones now being used on CB equipment. Has DPST switch wired for relay operation with easily reversible terminals to allow modifications (if necessary); wiring diagram enclosed with each microphone; hanger button and standard dash bracket for mobile rig mounting; and an 11" retracted (five foot extended), plastic-jacketed, coiled cord. Response: 80-7,000 cps. Output: −54 db. List price: $16.80 complete. See your Turner Distributor, listed below, he has the 350C in stock.

THE TURNER MICROPHONE COMPANY
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Cedar Rapids, Iowa

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Texarkana: Lavender Radio & T.V. Sup.
CALIFORNIA
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Hemet: Gil Severns
Hollywood: Pacific Radio Exchange
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The Sound Foyer
Oakland: Elmar Electronics
Sacramento: Selectronics
San Francisco: Market Radio Sound Dept.
San Pedro: Marine Radio Service
DISTRICT OF COLUMBIA
Washington: Electronic Wholesalers
FLORIDA
Miami: East Coast Radio & TV
Tampa: Kinkade Radio Supply
GEORGIA
Atlanta: Specialty Distributing
ILLINOIS
Chicago: Nationwide Radio
La Salle: La Salle Electronics
INDIANA
Anderson: Seybert's Radio Sup.
Bloomington: Stansifer Radio Co.
Evansville: Hutch and Son, Inc.
Ohio Valley Sound
Fort Wayne: Pembleton Laboratories
Indianapolis: Brown Distributing Co.
Graham Electronic Sup.
Van Sickle Radio Supply
Kokomo: George's Electronic Sup.
Michigan City: Tri-State Electrical Sup.
Portland: Buck's Hi-Fi
Richmond: Fox Electronics Company
Terre Haute: Midwest Supply Company
IOWA
Cedar Rapids: Iowa Radio Supply
Des Moines: Radio Trade Supply Co.
KANSAS
Topeka: Acme Radio Supply
KENTUCKY
Lexington: Radio Equipment Co.
Louisville: Arcby Electronics
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LOUISIANA
Baton Rouge: Davis Electronics Sup.
New Iberia: Brooks Electronics
MASSACHUSETTS
Boston: A. W. Mayer Company
Radio Shack Corp.
Lawrence: Alco Electronics
MICHIGAN
Ann Arbor: Purchase Radio Supply
Detroit: High Fidelity Workshop
Lansing: Offenhauer Company
MINNESOTA
Minneapolis: Schaak Electronics
MISSOURI
St. Louis: Radonics
NEW JERSEY
Berlin: Midstate Radio Supply
Jersey City: Nidisco-Jersey City
Mountainside: Federated Purchaser
NEW YORK
Buffalo: Radio Equipment Corp.
Farmingdale, L.I.: Gem Electronics
Forest Hills: Beam Electronics
Mt. Vernon: Davis Electronics
New York: Harvey Radio Company
Acme Electronics
OHIO
Cleveland: Pioneer Electronic Sup.
Columbus: Whitehead Radio Company
Mansfield: Wholesaling, Inc.
Toledo: Lifetime Electronics
OKLAHOMA
Oklahoma City: Johnson Wholesale
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Lebanon: George D. Barbey Co.
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Pottstown: George D. Barbey Co.
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TEXAS
Houston: Sound Equipment Inc.
VIRGINIA
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- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

TRAINING ELECTRONICS TECHNICIANS SINCE 1946

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools needed
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- ★ School Inquiries Invited
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Technotes

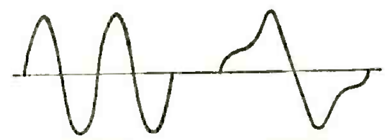
PRINTED CIRCUIT GROUNDS

The ground circuit of a printed-circuit board should connect to the main chassis securely, adequately and permanently at all ground points. Some circuits will perform with only one such ground, but many printed boards carry high-frequency signals and the loss of a ground may cause instability and other undesired effects.

When renewing a board, or replacing the ground screws after service, put a small star washer under each screw. Tighten securely enough so the teeth of the washer bite into the plating, but not enough to tear or break it. A solder lug with shakeproof teeth does the job too and provides a handy place to clip a vtvm ground lead in the future.—*Lawrence Shaw*

USING SINE WAVES

A sine wave, viewed on a scope, will reveal certain types of distortion. (The diagram shows the appearance of a sine wave, before and after harmonic distortion.) The sine wave at the output of an amplifier should look just like the sine wave applied to the input. A sine-wave check will also show overall amplifier gain or stage gain or loss.



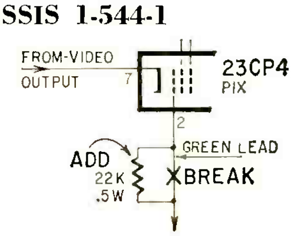
A sine-wave test *will not* show up frequency distortion (loss of highs or lows) since only one particular frequency is amplified at a time (use square waves if you are looking for loss of high or low frequencies). IM distortion also will not show up since it is produced by the hetrodyning of two or more frequencies and cannot be detected by using a single-tone sine wave.—*W. C. Warren*

SNIVET INTERFERENCE

Occasionally, dark irregular lines may be seen on the right side of the television picture in weak and moderate signal areas. This trouble (snivets) originates in the horizontal output tube and is caused by a very rapid change of plate and screen current when the tube operates near the knee of its plate characteristic. The sudden change of plate and screen current may cause rf radiation which often appears on low- or high-band vhf or uhf channels.

To reduce this kind of interference, try dressing the antenna line away from the deflection circuit. If this doesn't work, try making small adjustments of width, linearity and horizontal drive. These adjustments may change the operating condition causing the snivets. The third thing to do is replace the horizontal output tube. You may have to try more than one replacement before finding one that will eliminate the trouble. The "bad" tube can be used in stronger signal areas or sometimes in another TV receiver without causing any trouble.—*M. L. Leonard*

SYLVANIA CHASSIS 1-544-1



The complaint was vertical compression, but of a rather unusual type. The compression was only in white areas. Directly below this area, the scanning lines were spread. A check of Sylvania service data in our files revealed that

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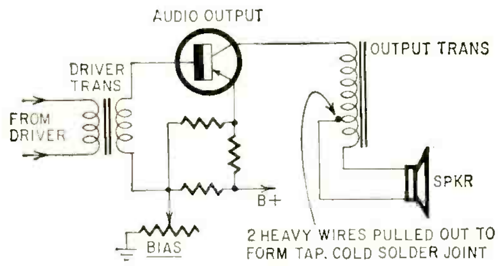
this trouble is often caused by grid current in the picture tube (the video signal drives the picture tube's cathode negative with respect to the grid). This grid current disrupts the waveshaping accomplished in the vertical retrace plate and causes a notch in the waveshape at the grid of the vertical oscillator. A quick field repair called for inserting a 22,000-ohm resistor between the picture tube grid and the lead now connected to the picture tube. The resistor isolates the picture tube grid.—*Warren Roy*

NO SOUND

If a transistor auto radio is dead (no sound) and the power transistor is cold, check the transistor very carefully. Beware of hasty diagnosis. Before ordering another transistor, make a careful ohmmeter test of the output trans-



former, especially if it is an autotransformer type. The transformer tap may be open because of an imperfect solder joint, causing the same symptoms as a defective transistor! This defect can usually be repaired. Carefully slit the paper covering the transformer to expose the leads. Then clean and resolder, coat with insulating compound and retape. —*Jack Darr*

MAGNAVOX 105 SERIES

The complaint was that, about once a week, the picture would fall into some peculiar behavior sounding to us like a piecrust or multiple-triggering condition. We replaced the horizontal sweep tubes and after a short air test told the customer to let us know if there was any further trouble.

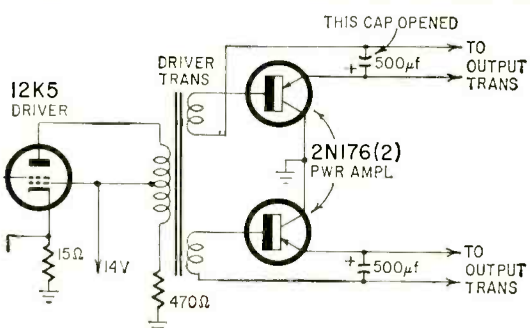
We were back again 4 days later and this time were lucky enough to have the set act up while we were there. Sure enough, it looked like multiple triggering since each scanning line was displaced from its sidekicks. We also discovered that, each time the trouble cleared up, we could make it recur by turning the brightness control way down.

From this we deduced that the offending component must be directly associated with the high voltage since varying the brightness does affect the current flow through the second-anode supply source. A new 1B3 did not help and neither did a high-voltage capacitor and limiting resistor.

We pulled the set and installed a new flyback transformer. Although we had never seen a flyback behave in this manner before, it seemed like a logical hunch—and it paid off. The old transformer was evidently setting up its own parasitic oscillations, giving all the symptoms of a defective afc circuit.—*Frank A. Salerno*

MOTOROLA CAR RADIO 78MF

The trouble was a loud squeal no matter how the volume control was set. A check of this receiver revealed an open



500-µf electrolytic in the transistor power output stage. The solution was to replace the open electrolytic with a new one.—*M. L. Leonard* END

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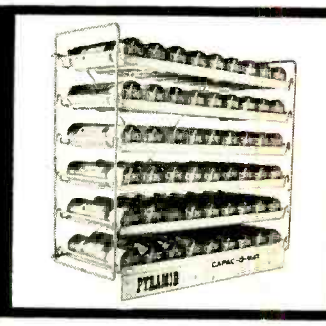

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TECHNICIANS' NEWS

NATESA ANNUAL CONVENTION

The National Alliance of Television & Electronic Service Associations met in Chicago, Aug. 19–21. Those attending represented 98 affiliated cities and total attendance showed a 30% increase over last year.

Following a closed council meeting the day before, the convention officially opened the morning of Aug. 19. Morris Finneburgh, vice president in charge of public relations at the Finney Antenna Co., was keynote speaker during the convention and delivered, according to *TESA News*, "a most inspirational talk . . . the kind where you can hear a pin drop in the room."

An important part of the convention was the election of officers. Alphonse A. Benoit from New Orleans became the new NATESA president. He succeeds Mac Metoyer.

Other officers elected were: Wally Hirschberg, St. Louis, secretary general; Nelson Burns, Memphis, re-elected treasurer; Irving Toner, Eastern vice president; T. R. Nabors, East Central vice president; John Graham, East Central secretary; Harry Eales, West Central vice president; Ralph Woertendyke, West Central secretary; Winston Haines, Western vice president, and Jim Humphrey, Western secretary.

QUERY SERVICE RATES

In an attempt to aid its members in charging proper, reasonable rates for service work, the Tri-State Council of Television Service Associations will circulate questionnaires among its members in New Jersey, Delaware and Pennsylvania asking for information on business problems. The association stresses that there will be no price fixing.

The results of the survey will be used only to assist members who are not charging enough or who are charging too much.

SERVICE CALL

TSA *Service News* states that many technicians have been asking for a definition of a service call. They use the following definition adopted by NATESA:

"*Service Call:* Consisting of travel time to the home, the inspection and/or testing of circuit tubes, and minor adjustments, with a 30-minute time limit and no chassis pull. Beyond the 30-minute time limit, regular hourly rates apply."

TUBE WARRANTIES

R. M. Andrews, assistant district sales manager for Tung-Sol, recommended discontinuing receiving tube

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warranties and reducing the retail price of the tubes some 30% at the NATESA convention in Chicago. He backed his recommendation by stating that with the quality now put into tubes, the industry could actually dispense with all warranties and make a policy of adjustment when and where necessary. In this way, the industry could save hundreds of thousands of dollars in handling, and also do away with one of its big by-products, namely the "dishonest tube jockey who is often the plague of the service technician."

ESFETA ON LICENSING

At a recent meeting in Buffalo, N. Y., Daniel Hurley, chairman of the Empire State Federation of Electronic Technicians Associations license committee, presented a final draft of the ESFETA-sponsored state license bill. A delegate from Long Island introduced a motion that the license bill include a provision for licensing the shop owner as well as technicians. After debate, the motion was defeated. Then the bill was presented to the delegates for final ratification.

The vote to accept the final draft of the bill was unanimous.

NEWS FROM G-E ST. LOUIS

Independent service dealers in St. Louis were notified by General Electric that the company was discontinuing "out of warranty" service. The news marks the culmination of TEAM efforts to get G-E to change its policy according to *TEAM News*.

Under the new policy, there will be franchised G-E service dealers with approved telephone book listings, store identification, technical assistance, parts and service information.

THIS IS JUSTICE?

From CSEA member Lee Hoy comes this true tale.

In early March of this year, a man brought in a 14-inch portable for an estimate. After checking it completely, Lee found two bad tubes and a shorted picture tube and called the man, who told him not to repair it, and that he would pick it up in a few days. When he came in, Lee asked for $3.50 for the estimate fee and the gentleman (?) hit the ceiling and said that he would refer the matter to his attorney.

Subsequently, Lee received a letter from the attorney demanding the return of the set or legal action would be taken. Turning this letter over to his own attorney, Lee heard nothing more until March 24, when he received an order to appear in Small Claims Court on a claim of $115.00, *plus* cost of the rental of a television set while the set was being held.

On April 24 Hoy appeared in court, before Judge Sims and was ordered to release the set at no charge and pay the man $30 for the rental of a TV while his was held. The reason—"Lee had not told the man that there would be a charge, even though he did have a sign posted, stating that a charge would be made for estimating repairs."

The moral: Have a *large* sign posted and point it out to each customer in a case such as this. Better yet, deliver to the customer a claim check on which you have stated that there will be a fee and how much.—*(CSEA)*

CALIFORNIA WAGES INCREASED

RTA–SCVSC directors at a recent regular meeting made the following changes in their pay scales:

Apprentice pay begins at 50% of journeyman's pay for the first 6 months, increasing 5% each month, with boosts of 10% each 6 months during the final year. Thus, the beginning apprentice pay is raised from $1.32½ an hour to $1.50. The current journeyman wage is $3 an hour.

The increase is part of a program designed to make TV and radio servicing more competitive with surrounding industry which has lured many technicians into manufacturing and research and development because of fringe benefits.

WINS "MAC" AWARD

The motion picture industry has the "Oscar," television has the "Emmy" and TSE (Television Service Engineers, Inc.) has the "MAC." Just as the Oscar and the Emmy are the highest awards in their respective fields, the MAC award is the highest honor which TSE can bestow upon a member or an individual.

This year the award went to Bob Hester. It is inscribed, as always, "In recognition of outstanding effort on behalf of the industry and the Television Service Engineers of Greater Kansas City."

SERVICE CHARGES

This story comes from the New York State *TSA News*.

We are finding it hard to raise our service charge to $5.95. If you find it hard also, just tell people this incident that happened in our shop.

A useless, idle loafer (bum) walked into our shop asking for a handout. He became furiously affronted upon receiving a dime from a sympathetic bystander. This "bum" said he had never been so insulted in all his life. He vowed he would never, as much as he needed it, take a little old dime from any fellow being.

So, as you can see, even their prices are going up.

ARTSNY STUDIES CITIZENS BAND

The Associated Radio Television Servicemen of New York together with RCA distributor Bruno-New York ran a technical demonstration and lecture on Citizens-band radio that was open to the public. Held at the Central Plaza Annex in New York City, it was conducted by Chet Gaven, Bruno's district sales manager. Each person who came to the lecture received an application for a Citizens-band station license.

BBB TO SET STANDARDS, ARBITRATE DISPUTES

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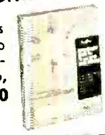
HOWARD W. SAMS REPLACEMENT GUIDE FOR TV & AUTO RADIO CONTROLS



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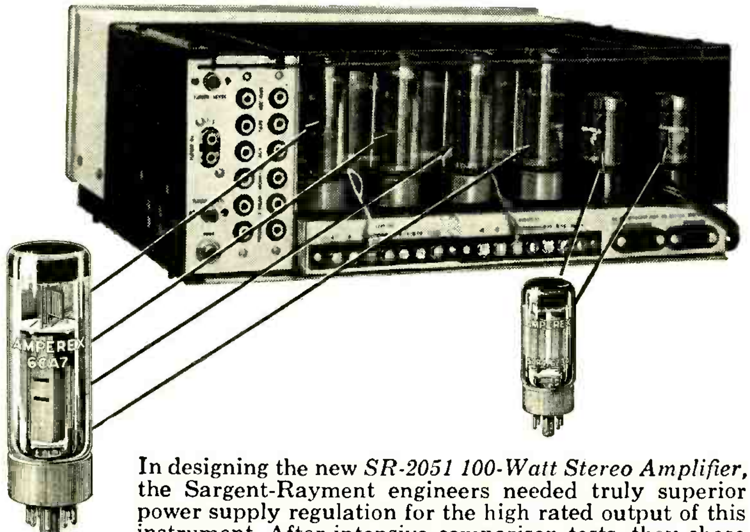

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RF AMPLIFIERS
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- **6ER5:** Frame grid shielded triode
- **6EH7/EF183:** Frame grid pentode for IF, remote cut-off
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- **6AQ8/ECC85:** Dual triode for FM tuners
- **6DC8/EBF89:** Duo-diode pentode

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- **6V4/EZ80:** Indirectly heated, 90 mA
- **6CA4/EZ81:** Indirectly heated, 150 mA
- **5AR4/GZ34:** Indirectly heated, 250 mA

INDICATORS
- **6FG6/EM84:** Bar pattern
- **IM3/DM70:** Subminiature "exclamation" pattern

SEMICONDUCTORS
- **2N1517:** RF transistor, 70 mc
- **2N1516:** RF transistor, 70 mc
- **2N1515:** RF transistor, 70 mc
- **IN542:** Matched pair discriminator diodes
- **IN87A:** AM detector diode, subminiature

What articles would you like to see published in RADIO-ELECTRONICS? Maybe you're the man to write them. Ask for an author's guide.
RADIO-ELECTRONICS 154 West 14th St. New York 11, N. Y.

Memphis (Tennessee).

"We have been handling about 1,000 public inquiries and complaints about TV service each year," George V. Morse Jr., BBB manager, said. "It is quite apparent that the industry is suffering from a lack of public confidence and understanding. We all know that most of Memphis' 200 licensed shops are honest and fair, but there is a fringe group who give the industry a bad name."

The most frequent complaints were: replacing parts unnecessarily, charging new prices for used parts, low estimates and high prices, inadequately trained men and bait advertising.

The BBB's new division will set up a code of ethics to which members would subscribe, undertake an advertising and public-relations program to regain public confidence (cost of program to be borne by qualified service dealers), set up a grievance committee to investigate complaints, set up an arbitration panel and a committee to work with city officials to get ordinances passed that will eliminate undesirable operators.

The BBB set up a similar group to handle complaints and disputes in the laundry and dry-cleaning industry. Their arbitration panel consists of two laundry-cleaner industry men, two housewives, a BBB official and two retailers. The panel does not know the names of the principals in any dispute. They are referred to as "Customer A" and "Dealer B."

Members of the program will be identified by decals in their shop windows.

At the first organizational meeting, 26 firms signed applications to join the program.

NEW APPRENTICE PLAN

A program has been planned to reduce the number of steps between starting apprentice and journeyman technician by the International Brotherhood of Electrical Workers Local 46, Seattle, Wash.

According to Don Macpherson, the business representative of the union, the apprentice would work in the shop 2 days a week in his first year with the other 3 days in school. The second year would have him in the shop 3 days a week with 2 days spent in school. The third year would be spent in the shop full time.

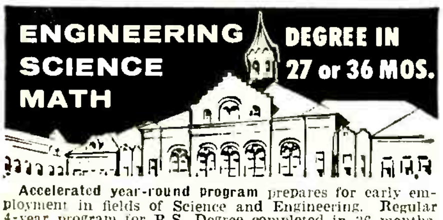
The apprentice would start at half the journeyman's pay as he does in the present program, but he would advance to full pay in two steps instead of the previous three.

Mr. Macpherson said this would aid the small shop that cannot afford to hire a full-time man or that cannot afford to have a full-time journeyman instructing the apprentice at all times.

TESA-SHEBOYGAN ELECTS

The Television and Electronic Service Association—Sheboygan County (Wis.) elected Fred Leonard, president; Elroy Van Shuy, vice president; Paul Miller, secretary; John Bruder, treasurer; and Roger Curtiss, NATESA director. END

ENGINEERING SCIENCE MATH — **DEGREE IN 27 or 36 MOS.**



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NEW TUBES and SEMI-CONDUCTORS

A NEW semi-conductor device stands out this month. It is a tetrode device called a Binistor. All other releases, with the exception of a TV damper tube, are also in the semiconductor category.

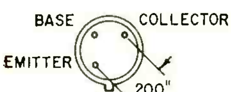
2N1302,-'1303: 2N1304,-'1305: 2N-1306–'1307

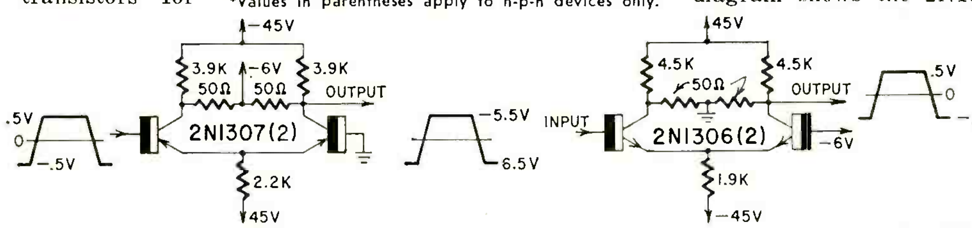
Three sets of complementary alloy-junction germanium transistors for computer and switching applications. The diagram shows a circuit for using these transistors as a non-saturating switch cascade that operates at a 3-mc rate.

Maximum ratings of these Texas Instruments complementary pairs are:

	2-N1302, 3	-1304, 5	-1306, 7
V_{CB}*	(25) 30	(25) 30	(25) 30
V_{EB}	25	25	25
I_C (ma)	300	300	300
P_{total} (mw)	150	150	150
h_{FE} (I_C=200 ma, V_{CE}=0.35) (minimum)	(10) 10	15) 15	(20) 20

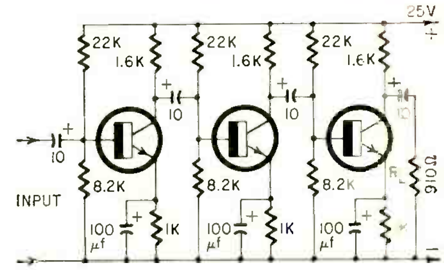
*Values in parentheses apply to n-p-n devices only.

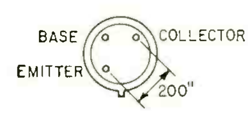




2N1564, 1565, 1566

A group of general-purpose n-p-n





2N1564
2N1565
2N1566

double-diffused silicon mesa transistors that cover an ac beta range from 20 to 200. In free air, all three types have a maximum dissipation of 600 mw. The diagram shows the 2N1566 in a cas-

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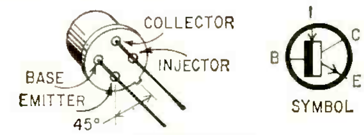
caded audio amplifier. This circuit gives a typical current gain of 92 at 25°C.

Characteristics of these Texas Instruments devices are:

BV_{CEO} (breakdown voltage) (I_C=10 ma, I_E=0) (max)			60
I_{CBO} (reverse current) (V_{CB}=40, I_E=0) (max)	(μa)		1
	2N1564	-1565	-1566
h_{fe} (V_{CE}=5, I_E=5 ma, f=1 kc)	20	40	80

3N56, 3N57

Called Binistors, these silicon n-p-n tetrodes are designed for switching and storage circuits. Typical applications include ring counters, binary counters, shift registers and general-purpose switching circuits.



3N56,3N57

INJECTOR IDENTIFIED BY YELLOW DOT ON CAP

Maximum ratings of these Transitron units are:

V_{CE}	15
V_{CJ} (collector to injector)	20
V_{CB}	18
V_{EB}	3
I_C (25°C) (ma)	30
I_J (injector current) (25°C) (ma)	30
Forward base current (I_b on) (25°C) (ma)	30
(I_b off) (25°C) (ma)	5
P_{total} (mw)	150

The 3N56 has a wider temperature range than the 3N57 (−65°C to 150°C vs −55°C to 100°C). This characteristic makes the 3N56 suitable for military applications.

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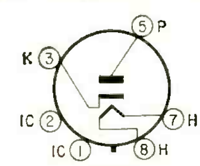

6CQ4

virtually to eliminate plate–cathode mica arcing and permits a peak inverse plate voltage which is conservative for 110° autotransformer deflection systems.

Maximum ratings of the Westinghouse 6CQ4 when used in damper service are:

PIV	5,500
I_P (peak) (ma)	1,200
I_P (ma)	190
P_P (watts)	6.5
Heater–cathode voltages	
Heater neg with respect to:	
cathode	900
total dc and peak	5,500
Heater pos with respect to:	
cathode	100
total dc and peak	300

2N1671, -A, -B

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___	8AW8	.93
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___	12BZ7	.75
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___	12CA5	.59
___	12CN5	.56
___	12CR6	.54
___	12CU5	.58
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___	25L6	.57
___	25W4	.68
___	25Z6	.66
___	35C5	.51
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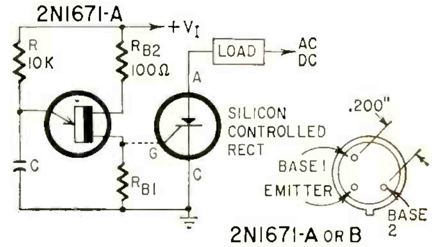
sistors useful in oscillators, timing circuits and pulse generators where they can serve the purpose of two conventional silicon or germanium transistors.

The 2N1671 is intended for general-purpose industrial applications. The 2N1671-A is intended for industrial use in firing circuits for silicon controlled rectifiers (see diagram) and other ap-



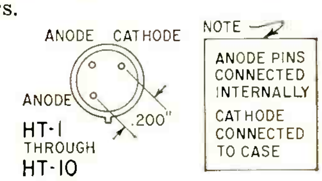
plications where a guaranteed minimum pulse amplitude is required. The 2N-1671-B is intended for applications where a low emitter leakage current and a low peak point emitter current (trigger current) are required.

Maximum ratings of the General Electric 2N1671 series are:

P_{total} (mw)	450
I_E (ma)	50
I_E (peak) (amps)	2
V_E (reverse)	30

HT-1 through HT-10

A series of silicon tunnel diodes designed for use in digital pulse circuits, gating, memory matrices, negative resistance amplifiers and microwave oscillators.



All will handle a maximum of 200-ma forward current and 200-ma reverse current.

Electrical characteristics of these Hoffman tunnel diodes are:

Type	Peak Current (ma)	Voltage at I_P (mv)	Voltage at I_V (mv)	Typical Neg Resistance (ohms)
HT-1	1.0	65	420	220
HT-2	1.2	65	420	180
HT-3	1.5	65	420	150
HT-4	1.8	65	420	120
HT-5	2.2	65	420	100
HT-6	2.7	65	420	83
HT-7	3.3	65	420	68
HT-8	3.9	65	420	56
HT-9	4.7	65	420	47
HT-10	5.6	65	420	39

Note: I_P is current at peak of characteristic curve. I_V is valley current (current at lowest point on negative-resistance slope). END

CORRECTION

There is an error in the value of the capacitor bank used to develop the 5,000,000-ampere arc described on page 45 of the September issue. The value (390,000) is in μf, not μμf. This is apparent from the words immediately following the wrong value, which state that the bank is made up of 2,000 capacitors of almost 200 μf each.

Our thanks to Mr. H. Q. Duguid, of Darien, Conn., for bringing this to our attention.

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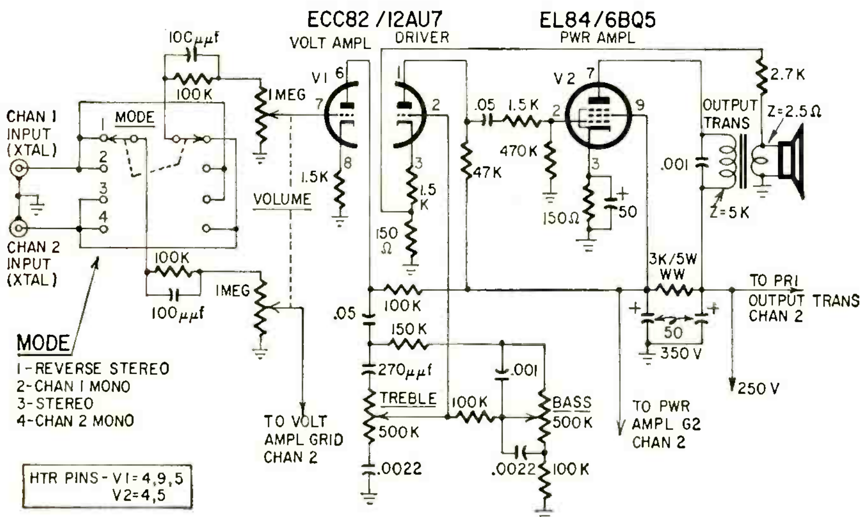
NOTEWORTHY CIRCUITS

SIMPLE STEREO AMPLIFIER

This circuit was described in the March, 1959, issue of the French magazine *Le Haut-Parleur*. It is a simple stereo amplifier used in portable stereo record players. Only one channel is shown. The actual unit uses two ECC82's, two EL84's and a common power supply. Despite its being uncomplicated and requiring a crystal cartridge connected to its input, the amplifier is quite versatile. It has a rather elaborate group of controls: a MODE control for selecting the type of operation, a dual VOLUME control and separate BASS and TREBLE controls. Feedback over two stages is used—from the secondary of the output transformer to the driver tube's cathode.



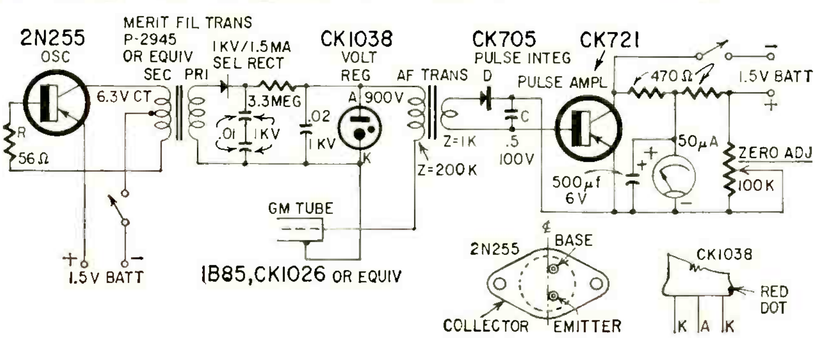
TRANSISTOR PULSE INTEGRATOR

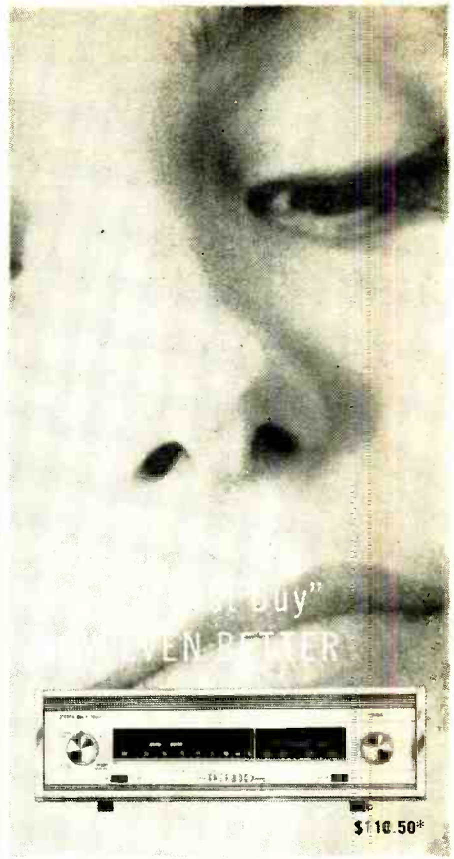
Integrating the pulses from a high-impedance low-current source is difficult. In this specific problem, I wanted to integrate the pulses from a standard Geiger tube to provide a meter indication with a minimum of circuitry. The same circuit and method will prove useful in many similar applications.

The diagram includes a high-voltage power supply. Complete information on this part of the circuit may be found in RADIO-ELECTRONICS, February 1957, page 58. Resistor R should have the largest value that will let 10 μa be drawn through the voltage-regulator tube. This minimizes current drain from the high-voltage battery.

In the pulse integrator part of the circuit, the high-voltage low-current pulses are stepped down through a transformer to low-voltage high-current pulses. Almost any interstage transformer can be used here. I used a Chicago UM-112 to keep size down. Connect transformer secondary leads for maximum current. One way provides four times as much as the other.

The pulses are rectified and integrated by germanium diode D and capacitor C. The average dc is then





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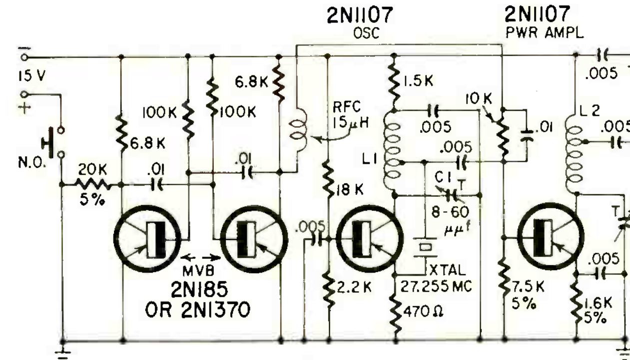
amplified by a 1-stage transistor amplifier. No serious attempt to use a 2-stage amplifier was made as all the simple two-stage circuits have too much drift.

With this circuit, the 50-μa meter gives a full-scale indication when the Geiger tube is held in a 5.0-mr/hour radiation field. To increase sensitivity, Geiger tubes may be paralleled. A dc amplifier with higher gain also increases sensitivity.

The entire unit can be packaged in a very small box if miniature components are used, but even with full-size less-expensive parts the unit will still stay in the miniature class.—*Edwin N. Kaufman*

REMOTE-CONTROL TRANSMITTER

This four-transistor Citizens-band (27.255-mc) remote-control transmitter circuit appeared in a Texas Instruments application note. A crystal oscillator with feedback through the crystal taken from a tap on the collector coil. C1 tunes the circuit to the crystal frequency. A common-emitter power ampli-



L1-16T N° 22 ON 5/8" DIA AIR CORE, 1" LNG, TAPPED 3-1/2 T FROM GND END
L2-15T " " " " " " " ,15/16" LNG, TAPPED 1-1/2 T FROM GND END
(BOTH AIRDUX 516 OR EQUIV)

and a keyed power amplifier make up the rf portion of the circuit. The modulator is a free-running af multivibrator which keys the power amplifier at an audio-frequency rate.

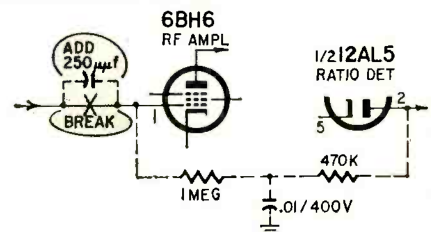
The oscillator is a common-base stage fier is used, and it is triggered on and off by the two-transistor multivibrator.

Naturally, output power is well under the 30-watt limit, so before using the unit make careful tests to determine its effective range.

AVC FOR HALLICRAFTERS S-94

The Hallicrafters S-94 is an eight-tube ac–dc set that covers 30–50 mc. This band includes civil defense, fire, police and other important communications. The receiver has built-in relay squelch which grounds the control grid of the audio output tube when there is no incoming signal. However, annoying blasting may occur, for example, while tuned to a police department whose patrol cars and central station transmit on the same frequency and a patrol car is transmitting while close to your receiver. This blasting is not only annoying, but speech may become unintelligible.

The modification shown here will give automatic gain control to minimize such blasting. Simply disconnect all wiring from pin 1 of the 6BH6 rf amplifier.



Connect a 250-μμf ceramic capacitor between this wiring and pin 1. Also connect a 1-megohm and a 500,000-ohm resistor in series—the 1-megohm unit to pin 1 of the 6BH6 and the 500,000-ohm unit to pin 2 of the 12AL5 ratio detector. From the junction of the resistors connect a .01-μf 400-volt capacitor to ground.—*Carl C. Seidler* END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

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

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In November, 1910, *Modern Electrics*

Prevention of Interference by Selective Apparatus, by G. F. Worts.

Does Wireless Affect Homer Pigeons?

Why Do Wireless Waves Travel Farther By Night Than By Day, by Professor W. Weiler (University of Esslingen, Ger.)

A Simple Current Gauge, by Austin C. Lescarboura.

Construction of an Exhausted Coherer, by Kreigh B. Ayers, E.E.

Unique Signaling Device.

New Liquid Microphone.

Design for an Oscillation Auto-Transformer, by M. A. Deviny.

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BUSINESS and PEOPLE

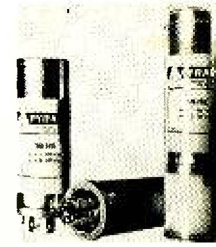
Sencore, Addison, Ill., is building a new addition to its present plant which will nearly double capacity. Herb Bowden, Sencore president, is surrounded by plant personnel and well wishers as he breaks ground for the

new addition. Sencore recently released the third in its series of slide films on how to use Sencore testers in servicing. The latest in the series, "Old Tubes Seldom Die, They Just Fade Away," features the Mighty Mite tube checker.

Sylvania Electronic Tubes Div.'s re-

ceiving tube operations won the president's Safety Citation for 15 months of operating without a single disabling injury. Matthew D. Burns (left), president of the division, presents the award to Walter A. Weiss (right), vice president in charge of receiving tube operations.

Pyramid Electric Co., Darlington, S. C., is merchandising its electrolytic



twist-mount capacitors in new clear plastic tubular Vu-Paks which are reusable for storing small parts and tools.

George C. Connor (left) was elected a senior vice president of Sylvania Electric Products, New York, with responsibility for the company's marketing activities. He had been regional sales vice president–East. William O. Spink was

appointed vice president–sales of Sylvania Electronic Tubes Div., New York. He had been equipment sales manager for the division. He succeeds Donald W. Gunn, who is now regional vice president of Sylvania, covering marketing activities in the 12 Western states and Hawaii.

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- ☐ 2 – TOP NAME #6SQ7 TUBES............... $1
- ☐ 2 – GENERAL ELECTRIC TUBES #35W4.... $1
- TOP NAME TUBES OZ4, 1B3, 1X2B, 5U4, 6AC7, 6AX4, 6CB6, 6J6, 6K6, 6U8, 6V6, 6SN7, 6X8, 12AU7, 12AX7, 50L6 .... Each $1
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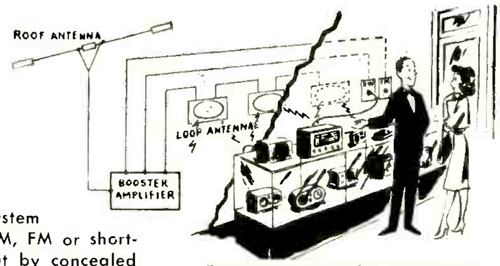

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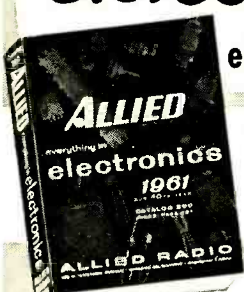

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CBS Electronics, Danvers, Mass., is offering distributors a colorful new Tools and Service aids floor-easel merchandiser.

W. Walter Watts (left), recently elected chairman of the board and president of RCA Sales Corp., in addition to his post as RCA group vice president, was elected a director of Radio Corp. of America. He succeeds **Dr. Charles B. Jolliffe**, vice president and technical director of RCA. Dr. Jolliffe retired last


year but continues to serve the corporation on special assignments. RCA also announced the consolidation of institutional and staff advertising and sales promotion activities under **R. H. Coffin** (right) as staff vice president, advertising and sales Promotion. He had been director, advertising and sales promotion, and a vice president.

Raymond T. Leary has been named vice president–marketing of Cornell - Dubilier Electronics Div., Federal Pacific Electric Co., South Plainfield, N. J. He had been general sales manager.

Robert E. Svoboda, manager of the Amphenol Distributor Div. of Amphenol - Borg, Broadview, Ill., was made president of the division.

James W. Noland is now general manager of the Gonset Div., Young Spring & Wire Corp., Burbank, Calif. He was formerly manager of manufacturing.

Harold E. Luber, director of student services at National Radio Institute, Washington, D. C., was appointed executive vice president. **Everett A. Corey**, formerly with Capitol Radio Engineering Institute, joined NRI as special assistant to president **J. Morrison Smith. Edward L. Degener**, general manager, and an NRI employee for 42 years, retired.

Sam Poncher of Newark Electronics, Chicago, was elected president of the Electronic Industry Show Corp. for 1 year. Other new officers are: **Robert D.**

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Ferree, International Resistance Co., vice president; **Norman Triplett**, Triplett Electrical Instrument Co., secretary, and **Robert E. Svoboda**, Amphenol-Borg Electronics, treasurer.

Obituaries

Bond P. Geddes, radio industry pioneer and for many years executive vice president and secretary of the Radio Manufacturers Association (now the EIA), in Washington, D. C., at the age of 78.

William A. Nicely, vice president and general manager of CTS Corp. (formerly Chicago Telephone Supply Corp.), in Elkhart, Ind., after a sudden illness.

William H. Miller, sales manager Jerrold Electronics Corp., Philadelphia, of a heart attack at the age of 48.

David H. Ormont, president of Hudson Radio & Television Corp., New York, in an automobile accident in Las Vegas.

Wesley M. Angle, president of Stromberg-Carlson Co. from 1934 to 1945, suddenly at his summer home in Kennebunk, Me., at the age of 77. END

TECHNICIANS' CALENDAR

We hear, with increasing frequency, that the inequities of our calendar are the source of much business woe. Many plans have been submitted and a special UN committee of international experts is discussing a 13-month calendar.

Not to be outdone, and as another special service, the following calendar is being submitted for the benefit of hard-pressed service business:

Sun.	Sat.	Sat.	Fri.	Thurs.	Wed.	Tue.
8	7	6	5	4	3	2
17	16	14	13	12	11	9
24	23	22	21	20	19	18
31	30	29	28	27	26	25

Here are the reasons why you will like it:

1. Each month starts with a Sunday, a day of rest. After all, who can rest properly if he's too tired from working all week.

2. With this calendar you can speed up your work. For example, you can start a job on the 7th and get it back on the 6th to the customer who knew his set was broken down a month ago but wants the job done yesterday, once he makes up his mind to call you.

3. Saturday is usually a busy day so this calendar has two of them and they are early in the week so you can do a lot of work before getting tired.

4. You'll note the calendar has no 1st, 10th or 15th so you won't have to pay those pesky bills, taxes, etc., that are due on those days.

5. You will note, too, that the 13th is always on a Friday and, since Friday the 13th is unlucky, you just stay in bed all that day and stay out of trouble.

We are sure that anyone with a good imagination will discover many other great advantages to this calendar and that it will soon be adopted.

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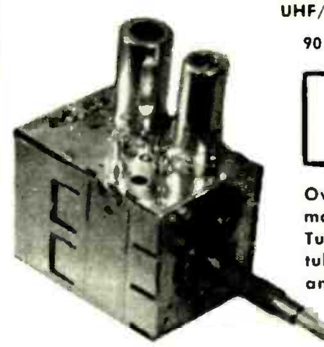

SAME DAY SERVICE

ON POPULAR TYPES—48 HOURS MOST OTHERS

Overhaul charge includes labor and minor parts; tubes and major parts are extra at net prices.
Tuner to be overhauled should be shipped complete; include tubes, shield cover and any damaged parts. Quote model and state complaint. Pack well and insure.

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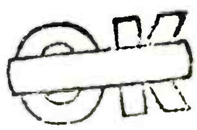

STAMP OF APPROVAL

A mail-order tube advertisement in RADIO-ELECTRONICS is its own stamp of approval—your assurance that you will get what you pay for when you order. Since January, 1956, RADIO-ELECTRONICS has insisted that mail-order tube advertisers tell you that their tubes are new and unused, or if they're not—that they are seconds, rejects or otherwise imperfect. Over the years this has cost us thousands of dollars in advertising—but it has protected you.

Ask By Name For GENUINE "NO NOISE" PRODUCTS

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NO-NOISE VOLUME CONTROL and CONTACT RESTORER

• Cleans • Lubricates • Protects

Not a Carbon Tet Solution

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6 oz. Spray Can $2.25 Net to Servicemen

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- Cleans, lubricates, restores all tuners, including wafer type.
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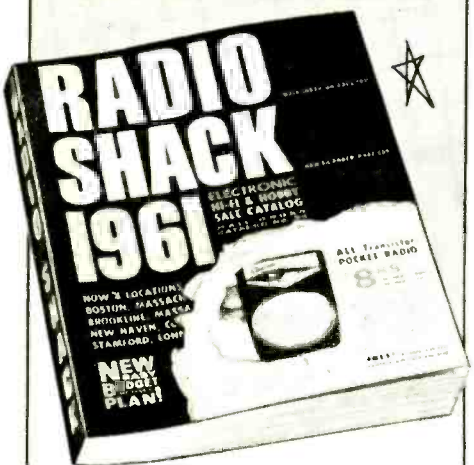

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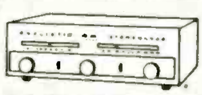
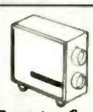


T-5 FM-AM Stereo Tuner $59.50

3.98 & 4.98 Stereo Records .... Each $1.00



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BATTERY REMINDER

Because of the small current required, the average multimeter will continue to work even after the internal battery may have started to leak and corrode nearby components.

After losing one expensive meter this way, I formed the habit of taping a note on the face of the instrument every time I replace the batteries. Mine say: "Replace Battery Dec. 25," or whatever date is a safe 6 months from installation.—*William E. Bentley*

CORKSCREW FOR TIGHT CAP

Many plastic insulating tool-dip containers have plastic plug type caps that are very difficult to remove. If you use a screwdriver or similar tool to pry the cap off, you are likely to damage the cap. A guy-wire ring screwed into the cap as shown makes a dandy corkscrew to help you pull the cap off easily even though it might be stuck.—*John A. Comstock*

HANDY HOLDER

A small corrugated cardboard box with a double rim at the top will be found to be extremely useful in making TV repairs or adjustments. The tubes

can be removed from the radio or TV and their prongs easily speared into the "sockets" of the double thickness of the corrugated cardboard. They may be placed in the same relative position as they are in the TV and, of course, need not be marked. The interior of the

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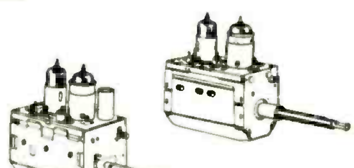
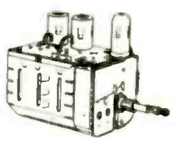
Tarzian Offers 24-hour Direct Factory Service on TUNER REPAIRS ... $8.50





TARZIAN tuners received one day will be repaired and shipped out the next. No increase in price: $8.50 per unit and $15 for UV combinations. That includes *all* replacement parts, and a 6-month warranty against defective workmanship and parts failure due to normal usage. Tuners repaired on approved, open accounts. Replacements available at low cost on tuners beyond practical repair.

Tarzian-made tuners easily identified by this stamping. When inquiring about service on other than Tarzian-made tuners, always give tube complement . . . shaft length . . . filament voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. And, allow a little more time for service on these tuners. Use this address for fast, factory repair service:

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box is useful for small parts, extra tubes, etc. By cutting down the height of the box you can make the necessary double thickness rim for it from the material you trim off.—*Glen F. Stillwell*

TOOL HOLDERS

Empty metal wire spools can be used as tool holders. The spool shown is a 4-inch type with 6½-inch diameter flanges.

By removing the top flange, an ordi-

nary two-cell flashlight will fit into the spool. The remaining flange can be attached to the shop wall with the flash lamp extending outward.—*H.*

CUSTOM TIPS

Low-wattage pencil type soldering irons are handy, but every so often their relatively short tips may not penetrate far enough into crowded chassis corners. Since most of these irons have screw-in tips, it is easy to make your own special tips at low cost.

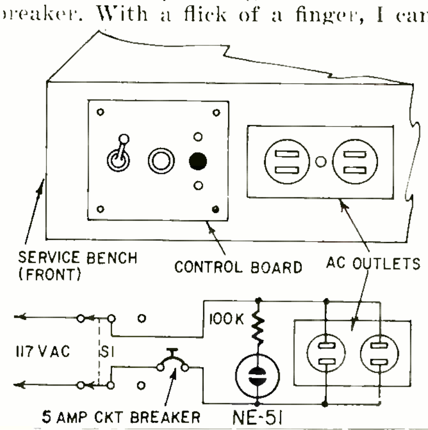
Buy several lengths of small-diameter copper rod and an inexpensive die to cut the thread used in the tip end of the heating element of your iron. Clip off a length of rod to suit the job, run a thread ¼ inch long on one end and file the other to the tip shape best suited to the joint being soldered.

An added bonus arises from the fact that the longer tip also radiates more heat to the air, and thus provides a slightly gentler tip for delicate printed-circuit boards.—*Benjamin Yeltin*

SERVICE BENCH AID

In the course of servicing electronic equipment, line power is often connected and disconnected many times. Most service technicians do this by withdrawing and inserting the line-cord plug. This soon becomes a nuisance as the plug usually falls to the floor when it is withdrawn. Using the power switch on the unit being serviced sometimes opens only one side of the line which doesn't completely isolate the unit from the power line.

I solved this problem by making an ac outlet control board and mounting it next to the ac outlet on my service bench. This control board includes a dpdt switch, pilot light and circuit breaker. With a flick of a finger, I can



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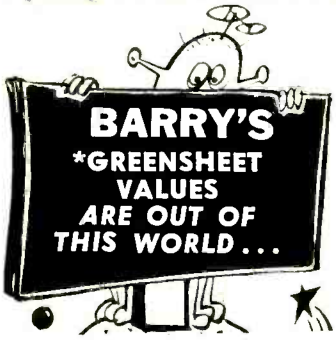

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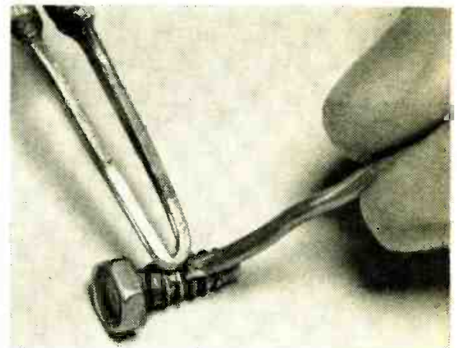
completely disconnect the unit being serviced from the power line. The pilot light indicates when the power is on, and the circuit breaker will prevent blowing the main fuses should there be a short in the unit being serviced.

The circuit and details of the control board are shown in the diagram. I found it practical to construct the control board on a 4-inch square of aluminum. Needless to say, this unit has made servicing much faster and safer.—*Albert J. Krukowski*

TIGHTEN SELF-TAPPING SCREWS

When a self-tapping metal screw continues to turn as you attempt to tighten it, flow some solder into the



screw's threads. When you put the screw back in, the heavier solder-tinned threads will make the screw anchor firmly again.—*Alan C. Johnson*

ATTRACTIVE PANELS

Professional-looking panels for home-built equipment are easy to make from white Formica, often used on table and counter tops. Available in small pieces at hardware and lumber stores, this material is dirtproof, scratch-resistant and easily worked with ordinary hand tools. The smooth white surface gives the equipment a modern look and takes black decal lettering for easy control identification.

If shielding is a problem, mount the Formica panel directly over a regular metal panel or simply back the plastic panel with aluminum foil.—*William E. Bentley*

PLASTIC RUBBER CLEANS FILE

The electronic hobbyist will find that Duro plastic rubber does a good job of removing filings of solder, brass and aluminum from a fine-cut file. The

plastic rubber (available at hardware stores) is applied to the file and allowed to dry. Then it is peeled off. The filings adhere to the sticky rubber and are removed from the file teeth.—*Charles A. Cunningham*

END

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new LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

ELECTRONICS CATALOG. 414 pages list over 40,000 items. 240 pages of rotogravure.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

SEMICONDUCTOR PRODUCT GUIDE contains transistor classification charts for audio- and radio-frequency and computor and switching service for germanium alloy-junction types, power-switching and amplifier applications for silicon diffused-junction types, and silicon rectifiers.—**RCA Semiconductor Products-Distributor Sales**, Harrison, N. J.

"JENSENEEDLOG" lists in its 12 pages 800 types of special-shank phonograph needles and their matching cartridges by a cartridge-number to needle-number reference section. Supplements Jensen's large needle wall chart.—**Jensen Industries, Inc.**, 7333 Harrison St., Forest Park, Ill.

MOLDED-CABLE ASSEMBLIES for the industrial electronics industry appear in the 4 pages of *Catalog M-701*. A guide for engineers, it lists engineering considerations for standard assemblies and illustrates those most commonly used. —**Switchcraft**, 5555 N. Elston Ave., Chicago 30, Ill.

FUSES of the small-dimension nonindicating and indicating type for aircraft, electronics, instruments, appliances, industrial and automotive use are outlined in a new 12-page catalog.—**Sightmaster Corp.**, 50 Aleppo St., Providence, R.I.

TV AND FM TUNER *Catalog T60* presents their uses, features, specifications, mounting dimensions, terminal connections and installation instructions for the company's line of tuners.—**Sarkes-Tarzian Inc., Tuner Div.**, Bloomington, Ind.

STEREO is defined and explored in *Stereo and High Fidelity* with emphasis on live broadcasting, discs and tapes, stereo systems using various combinations of component setups, design principles of such components and conver-

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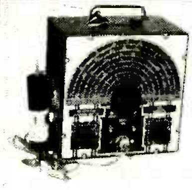

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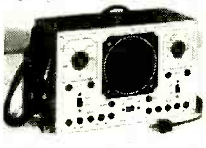

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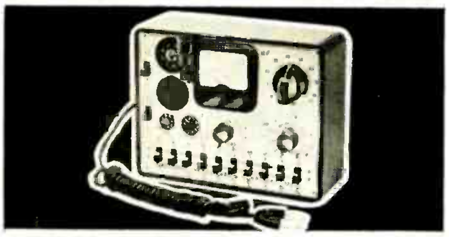

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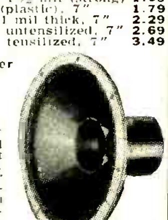

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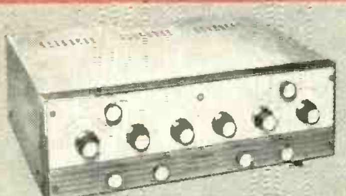

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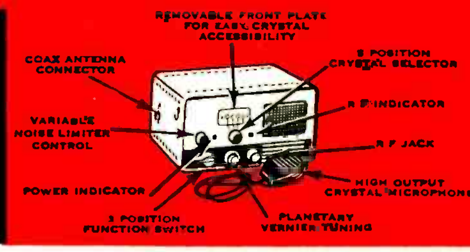

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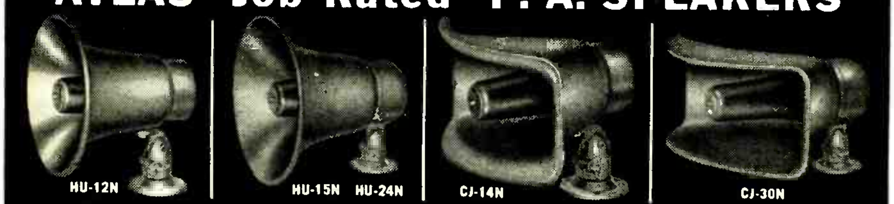

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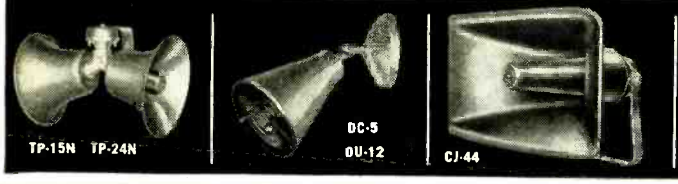

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(*Continued from page 130*)

Among other topics are antennas, noise, power supplies and test equipment. This new edition also covers emergency and portable operation.

USING AND UNDERSTANDING PROBES, by Rudolf F. Graf. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in. 192 pp. $3.95.

Where and how to use probes to test all types of electronic equipment accurately is the subject of this text. Written for the service technician and engineer, the book describes the many probes used in radio and TV servicing plus special-purpose probes used in industry, agriculture and medicine. —*LS*

ELECTROMAGNETIC FIELDS, ENERGY, and FORCES, by Robert M. Fano, Lan Jen Chu, Richard B. Adler. John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 6 x 9 in. 520 pp. $12.00.

Most of this book is suitable for junior and senior college students, the last 2 chapters being at graduate level. Readers should know physics, math and circuit theory. Vectors are introduced in the second chapter. Beginning with Maxwell's equations in integral form, the authors discuss circuit and field theory. All chapters close with problems and references.

TV SERVICING SHORT CUTS, by Milton S. Kiver. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in. 104 pp. $1.50.

History repeats itself. In TV repair work, certain defects are more likely to recur than others. A group of 69 case histories are described here in detail. The symptoms, trouble location and repair are given, together with some theory so the reader will be in position to know what happened. Thus he is able to cope with similar troubles in the future. Schematics illustrate the procedures.—*IQ*

TOPICS IN ELECTROMAGNETIC THEORY, by Dean A. Watkins. John Wiley & Sons, Inc., 440 Park Ave. S., New York 16. N. Y. 6 x 9¼ in. 118 pp. $6.50.

This is based on a lecture course organized for graduate students. The topics are related to microwave engineering. They include periodic transmission systems, the helix, coupled-mode theory and anisotropic media. Much of this material has never before appeared in book form. END

Answers to "Sawtooth Sticklers," page 90

ANSWERS: 1—F, 2—F, 3—A, 4—J, 5—H, 6—D, 7—D, 8—E, 9—I, 10—C, 11—G, 12—H, 13—J, 14—A.

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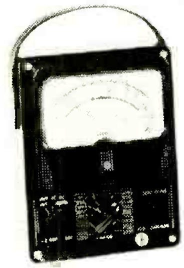

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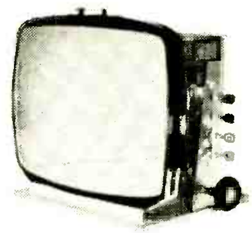

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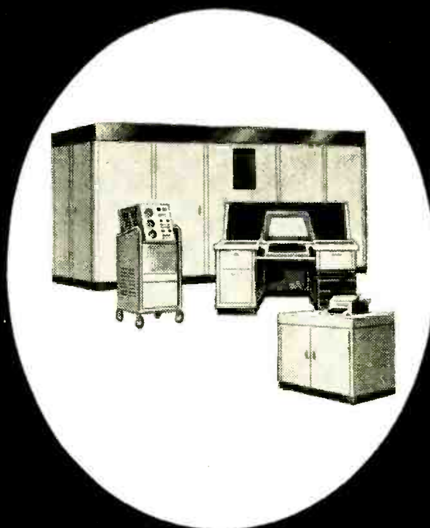

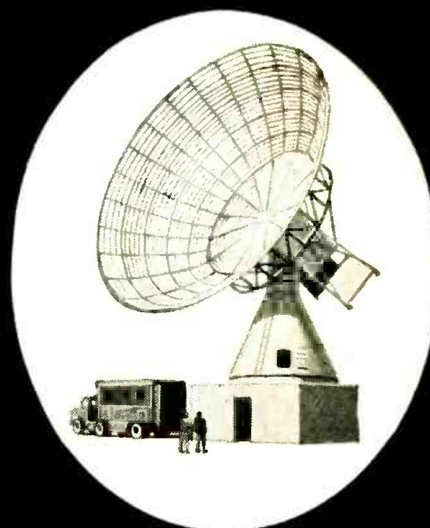

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DETAILS OF THE PROGRAM

"Classics that Made the Hit Parade" includes these popular symphonic themes:

Borodin	Polovtsian Dances from Prince Igor (Stranger in Paradise)
Tchaikovsky . . .	Symphony No. 5 in E (Moon Love)
Waldteufel . . .	Espana Waltz (Hot Diggity)
Chopin	Polonaise No. 6, in Ab Major (Till the End of Time)
Tchaikovsky . . .	Symphony No. 6 in B (The Story of a Starry Night)
Rachmaninoff . .	Piano Concerto No. 2 in C Minor (Full Moon and Empty Arms)
Chopin	Fantasie Impromptu in C♯ Minor (I'm Always Chasing Rainbows)
Tchaikovsky . . .	Romeo and Juliet Overture (Our Love)

DETAILS OF THE OFFER

This exciting recording is available in a special bonus package at all Audiotape dealers. The package contains one 7-inch reel of Audiotape (on 1½-mil acetate base) and the valuable "Classics that Made the Hit Parade" program (professionally recorded on Audiotape). For both items, you pay only the price of two reels of Audiotape plus $1. And you have your choice of the half-hour two-track stereo program or the 55-minute monaural or four-track stereo versions.

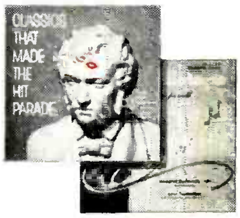
See your Audiotape dealer now.

— a new bonus reel from Audiotape

Some of our greatest popular songs — hits like "Full Moon and Empty Arms," "Till the End of Time," "Stranger in Paradise" — took their melodies from the classics. Eight of these lovely themes — in their original classical setting — are the basis for "Classics that Made the Hit Parade," a program with strength, variety, and, of course, rich melodic beauty.

This unusual program, professionally recorded in sparkling full fidelity on Audiotape, is available RIGHT NOW from Audiotape dealers everywhere. (And only from Audiotape dealers.) Ask to hear a portion of the program, if you like. Then, take your choice of a half-hour of two-track stereo, or 55 minutes of four-track stereo or dual-track monaural sound — all at 7½ ips. Don't pass up this unique opportunity.

"Classics that Made the Hit Parade" makes an ideal addition to Audio's first two bonus reels, "Blood-and-Thunder Classics" and "High Spirits," still available at Audiotape dealers.



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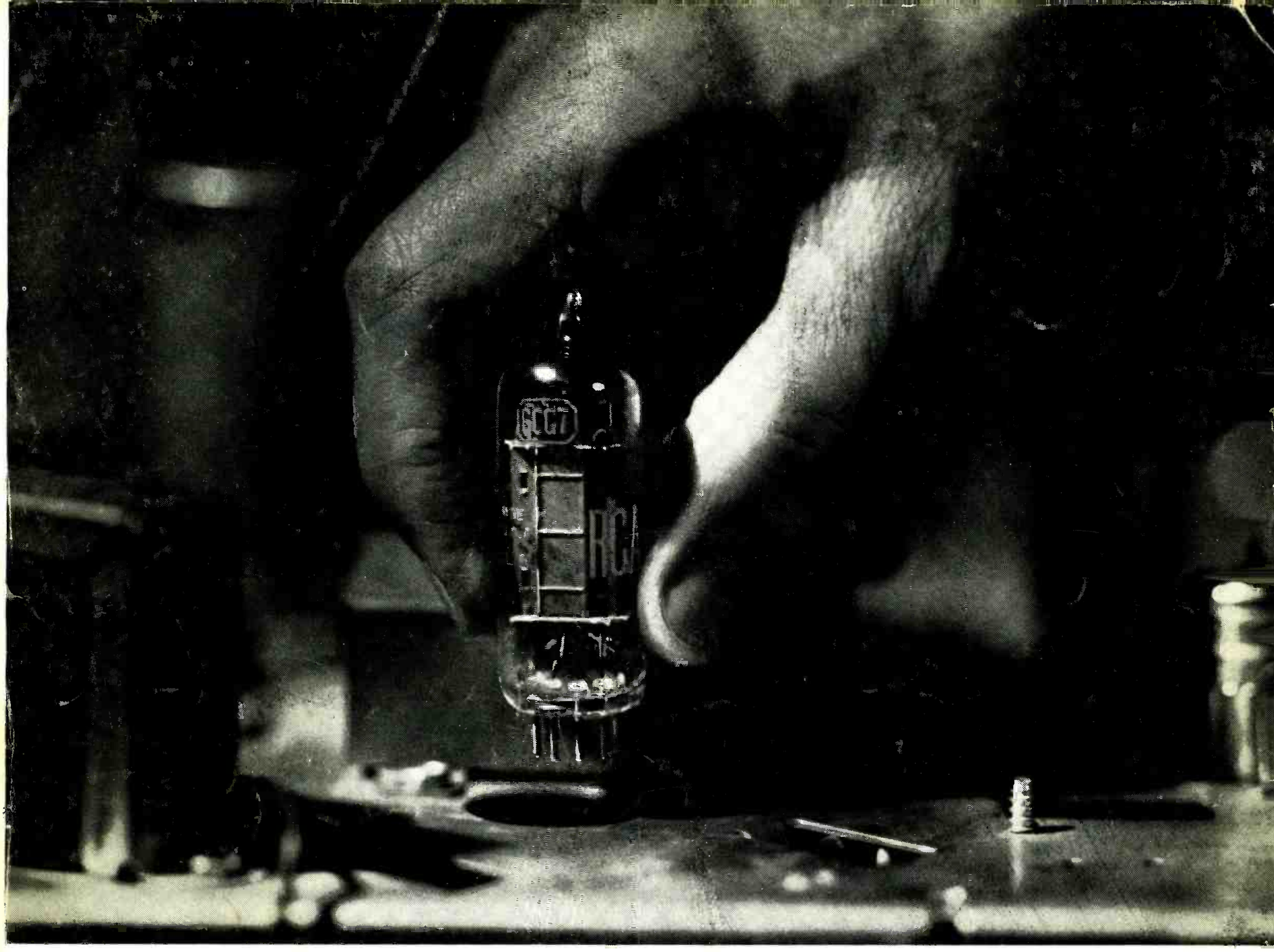

WHEN YOU REPLACE A TUBE . . .

You have a lot at stake each time you replace a receiving tube in a customer's set. Your professional reputation, your customer's confidence, your day's profits—even future business—all depend on the quality of that replacement tube.

It is RCA's constant aim to provide receiving tubes you can install with confidence. To this end, RCA carefully controls every step of the tube making process from initial design to final test.

QUALITY BY DESIGN—Some of the foremost tube experts in the industry collaborate on each new RCA tube design. Engineers, chemists, physicists, metallurgists, production specialists, field representatives, all contribute their own skills and knowledge before a new RCA tube design ever leaves the drafting board.

IMPROVED QUALITY FROM NEW AND IMPROVED MATERIALS—All parts and materials in RCA tubes are either *produced* or *processed* by RCA under strictest quality control. Moreover, RCA scientists search constantly for new and better materials which will still further improve performance of RCA tubes. Many tube types you install today benefit from new cathode and plate materials developed in RCA labs.

QUALITY IN MANUFACTURING—Because tube construction is just as important as design and materials, RCA maintains a system of supervisory microscopic inspection at key points on every production line to detect any flaw in assembly. And to minimize the chance of human error, RCA has automated certain critical steps in tube production.

QUALITY BY TESTING AND CONTROL—Before shipment, *every single RCA receiving tube* is factory-tested for every significant characteristic. *A tube that fails one single test is rejected and destroyed. So there is no such thing as a "second" when you buy RCA.* In addition, thorough aging of tubes and rating-lab tests assure strict adherence to performance specifications.

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