Radio-Electronics

MARCH

IND

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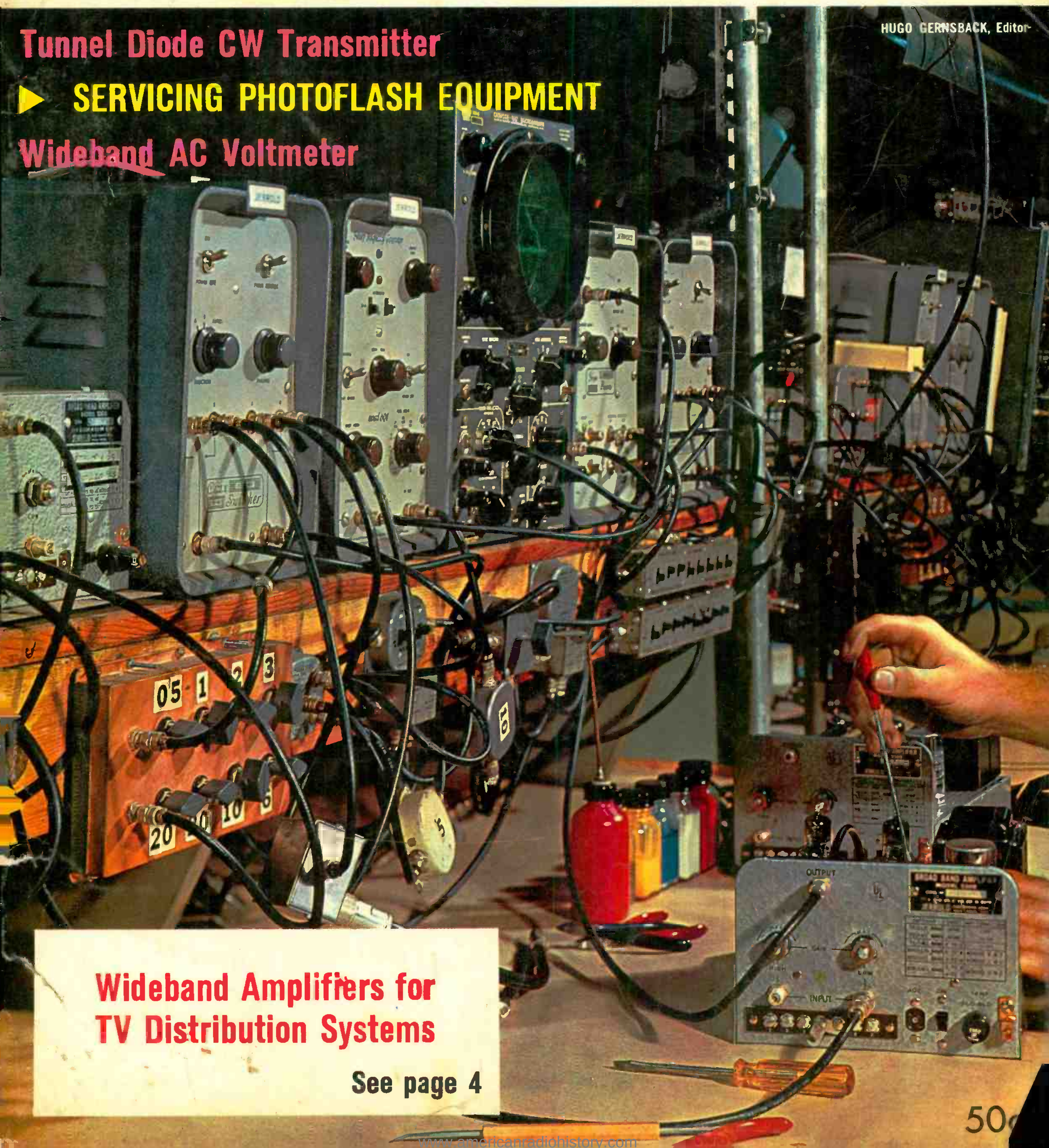
HUGO GERNSBACK, Editor

Tunnel Diode CW Transmitter

▶ SERVICING PHOTOFLASH EQUIPMENT

Wideband AC Voltmeter



Wideband Amplifiers for TV Distribution Systems

See page 4

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Radio-Electronics

MARCH, 1961

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ON THE COVER

(Story on page 50)

Aligning amplifiers with a 50-mc passband is not simple. All the equipment on this section of a Jerrold test bench is really useful.

Color original by Jerrold Electronics

Radio-Electronics is indexed in *Applied Science & Technology Index* (Formerly *Industrial Arts Index*)

the departments

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News Briefs

New Color TV System May Help Small Stations

A new system of photographing and transmitting color TV signals worked out by Prof. William T. Hughes of Iowa State University offers many advantages of simplicity and low cost, according to its developer. A two-camera pickup, with one camera picking up the luminance signal and the other an alternately blue and red signal, as controlled by a color wheel, replaces the conventional three-camera setup. A delay line in parallel with the red-blue line supplies an extra delayed-chroma signal, and both chroma and luminance are fed to an NTSC encoder which puts out an NTSC signal.

The signal, it is claimed, can be sent over wire or microwave circuits of lower quality than would be necessary for conventional color transmission, can be monitored en route with simple equipment, and can be recorded on a black-and-white video recorder. Present TV stations can modify their equipment to use the Iowa State system at a much lower cost than would be necessary to install conventional color TV equipment.

Ultraviolet Now Used For Communications

An experimental system designed for long-distance communication in free space has been demonstrated by Westinghouse. Signals picked up by a standard TV camera are used to modulate the beam of a 5ZP16 cathode-ray tube, which radiates 1 watt of ultraviolet from a .011-inch spot. This is focused into a .033° conical beam by an optical reflector. This beam is intense enough, says Dr. Paul Pan of Westinghouse, to permit communication over a 10-kc band at distances up to about 15,000,000 miles. For shorter ranges, such as the distance to the moon, video bandwidths could be transmitted.

The receiver is a phototube—an ultraviolet-sensitive photomultiplier. The output image is displayed on the screen of a regular TV receiver, as shown in the photo.

Electricity Replaces Ether

An abdominal operation performed on a woman patient at the Medical Center of the University of Michigan depended on electricity as the anesthetic. A 700-cycle signal from a signal generator was fed through an amplifier to 1-inch diameter electrodes connected to the patient's temples. In less than a minute after the unit was turned on, the patient was unconscious. The patient remained asleep as long as current was fed to the electrodes. After the operation, the current was turned off and the patient regained consciousness in less than 60 seconds. The patient said she felt no discomfort or nausea upon awakening. The entire system costs about $150.

This anesthetic system is highly desirable, since it works directly on the nervous system and does not seem to affect blood circulation or any body organs.

The use of the electrical anesthesia was developed after 4 years of research by the university's Medical Center under an Army grant. The Army was interested because quick recovery from anesthesia is advantageous when operating under combat conditions.

New Computers Speak English

Announcements by three companies in the computer field indicate that computers may be programmed with plain English instead of coded commands in the language of binary numbers. IBM first described a new computer called *Suitcase*, which recognizes the digits from 1 to 9, spoken by a person who has been given an hour's training in enunciation.

More recently RCA and Remington Rand reported on an experiment in exchanging computer programs using plain English between data processing systems of different manufacturers. Using conventionalized English, called *Common Business Oriented Language* (COBOL) two problems were programmed and first fed to the equipment of the manufacturer who prepared the program. Then, with minor changes, they were fed into the other manufacturer's equipment. The machines worked equally well and gave the same answers in both cases.

When using COBOL, the machine is programmed to understand nouns used in the business in which it works, such as "payroll file" or "employee number." It also knows some 20 verbs, including the arithmetic commands "add, divide," etc., and such words as "read, display," or "stop." A computer order in COBOL, for instance, might be written "SUBTRACT DEDUCTIONS FROM GROSS GIVING NET." The same command in the older numerical code would be, for the RCA 501, 72-010237--00-600000. The UNIVAC II translation would be B00549 S00623 C00942.

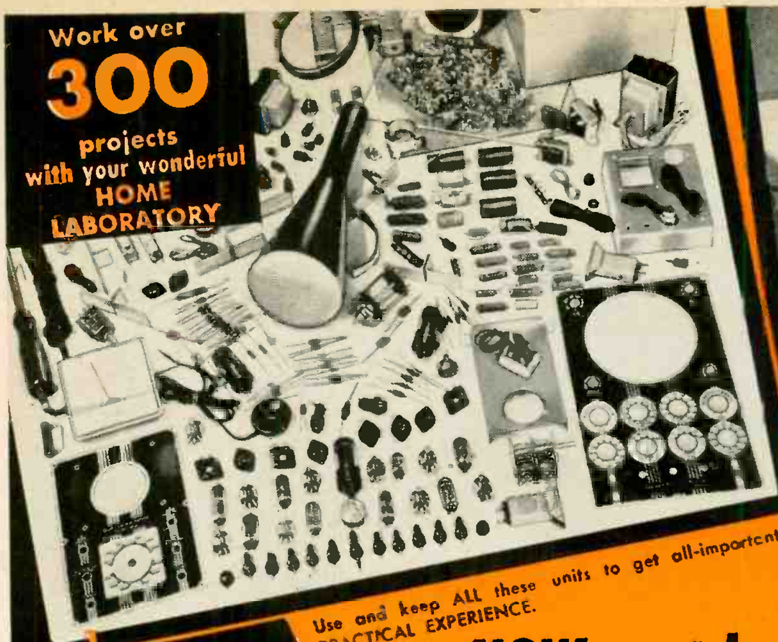
Low-Power Optical Maser Announced by IBM

A new optical maser (RADIO-ELECTRONICS, December, 1960, page 8) that is expected to permit continuous generation of coherent light waves is reported by Drs. Peter P. Sorokin and Mirek J. Stevenson of International Business Machines. Earlier masers, as developed by Hughes and Bell Laboratories, require so much power that they can be operated only in short pulses.

Secret of the new maser is the crystal in which the light is generated. It is calcium fluoride, a common optical material, and the ions that are stimulated into coherent light emission are of trivalent uranium or divalent samarium. The rods with trivalent (three electrons missing from the outer shell) uranium impurities emit infrared light at a wavelength of 2.5 microns; the divalent samarium (two electrons missing from the outer shell) produces light at 0.708 micron, in the deep red portion of the spectrum. The power required to stimulate the crystal is less than 1/500 that necessary for a ruby crystal with chromium atoms as the impurity.

NAA Transmits Again

The new super-power low-frequency Navy radio station at Cutler, Me., has been allotted the traditional call letters NAA. The call was made famous by the Navy's original high-power station at Arlington, Va., Work over **300** projects with your wonderful HOME LABORATORY



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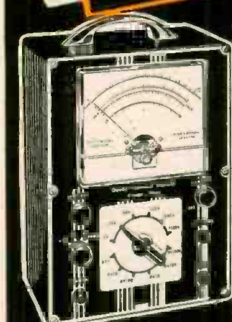

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which was the foremost of the US coast stations and whose time signals were received not only by mariners but by watchmakers, who used special "Arlington" receivers fixed-tuned to that station.

The new NAA is now being tested at frequencies as low as 14 kc and will operate on some frequency in that region. It will not send time signals since NBA, at Balboa, has a complete schedule of time signals on 18 kc.

Electronic Refrigerator Announced by Hitachi

The Consumer Goods Div. of Hitachi Ltd., Tokyo, has released specifications on an electronic refrigerator, including a freezer compartment. The capacity of the refrigerator is approximately 3⅓ cubic

feet and the outside dimensions 20 x 46 x 23 inches. It uses 36 thermo-elements. The power consumption is given as 30 volts, 10 amps for the cooling space and 20 volts, 10 amps for the freezer. Box temperature is 40°F, freezer temperature 9°F at an ambient temperature of 86°F.

Radio Pioneer Passes

John V. L. Hogan, early pioneer in radio and high fidelity, died Dec. 29, 1960, in New York City. He was 71.

His career started while a schoolboy, when, as he said, he was the chief (and only) laboratory assistant to Dr. Lee de Forest in the winter of 1906–07. In that capacity, he was one of the three or four people who were present at the birth of the Audion. Shortly afterward, as a student in the Sheffield Scientific School at Yale (where de Forest had received his training), he invented the gang capacitor, the patent on which fortunately had a few years to run when ganged tuning devices came into general use. Later he was associated with Fessenden in some of his work at Brant Rock.

Mr. Hogan became a consulting engineer in 1921 and worked with TV, facsimile and communications radio among other projects. He founded the country's first high-fidelity broadcast station in 1928. Using the experimental call W2XR, it broadcast high-quality musical programs and signals intended to

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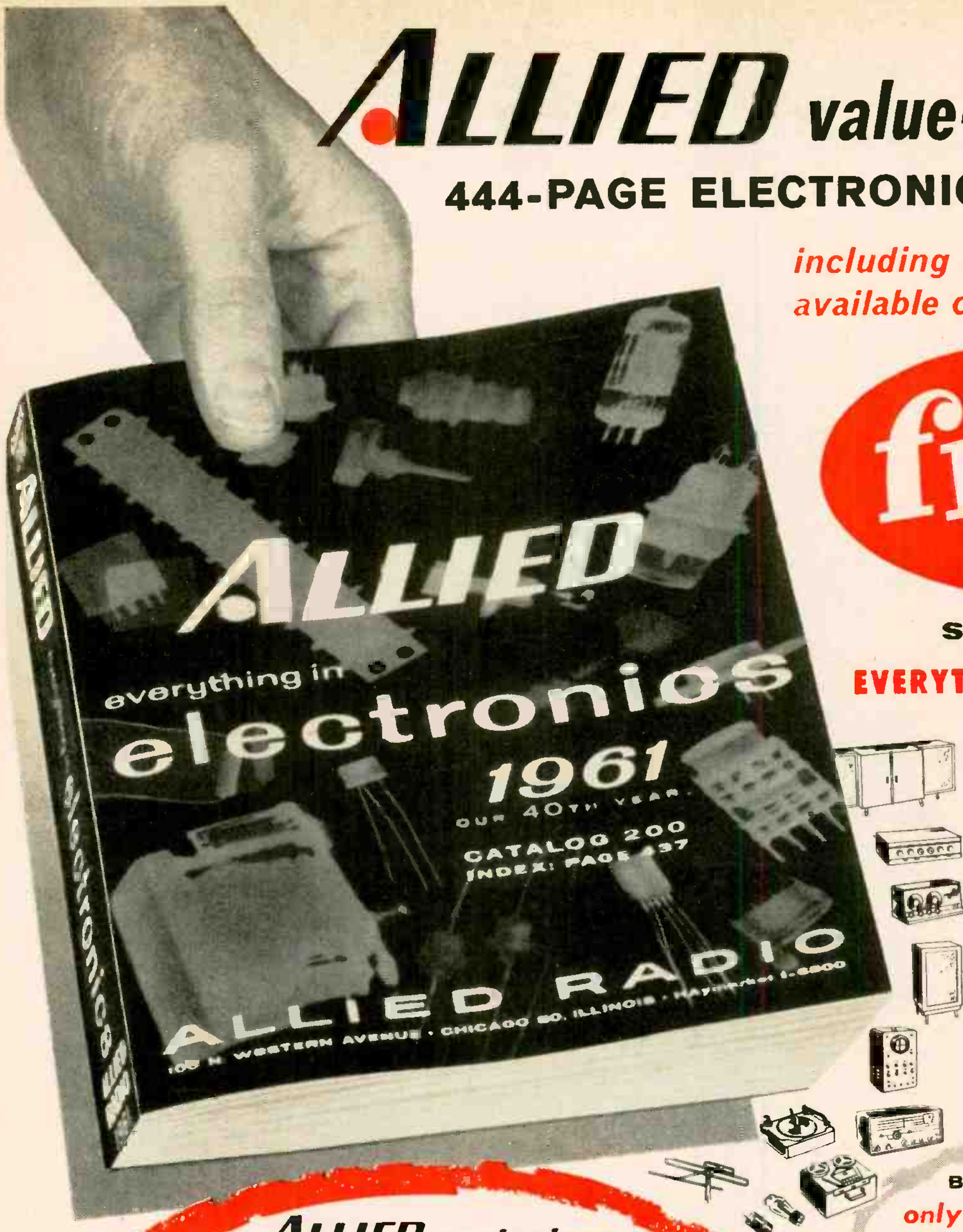

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test the response of home broadcast receivers. In 1936 it became a commercial station, WQXR, under which call it is still being operated as a broadcast station by *The New York Times*.

He developed a facsimile system (described in this magazine July, 1946) that reproduced text at the rate of 500 words per minute. Transmission at this speed, he pointed out, made a home radiofacsimile newspaper possible.

As secretary of the Society of Wireless Telegraph Engineers when it merged with the Wireless Institute to form the present organization, he was one of the founders and an active member of the Institute of Radio Engineers.

FCC Will Construct Experimental UHF TV

New York's Empire State Building Corp. recently announced the signing of a contract for housing a uhf TV transmitter for the FCC and for an antenna on the Empire State Building tower. The new station will be used by the FCC to study uhf coverage and other problems as a guide to allocations policy. The new station will become the eighth to transmit from the Empire State Building.

Erwin Schrodinger Dies

Prof. Erwin Schrodinger died in his native Vienna, Jan. 4, at the age of 74. His work, in combination with that of de Broglie and Dirac, formed the foundation for the modern concept of wave mechanics. He shared with P. A. M. Dirac the Nobel prize for physics in 1933.

Professor Schrodinger conducted a seminar at the Institute for Advanced Studies in Princeton, N. J., in 1934. He left Austria at the coming of the Hitler regime in 1938 and taught at the Dublin Institute for Advanced Studies in Ireland till 1956, when he returned to Austria.

Earth, Too, Has Hum

That the earth itself gives off a subsonic radio hum at 7.8 cycles per second has been discovered by scientists of the Lincoln Laboratory,

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RE-51-A

Massachusetts Institute of Technology. The low-frequency waves, they say, are excited by lightning discharges in the area between the earth's surface and the ionosphere. This space forms a resonant cavity, with waves reflected from the ionosphere at one boundary and from the earth at the other.

Calendar of Events

Pacific Electronics Trade Show (PETS), Feb. 26–Mar. 1, Great Western Exhibit Center, Los Angeles, Calif.

EIA Spring Conference, Mar. 15–17, Statler Hilton Hotel, Washington, D.C.

Magnetic Recording Industry Assoc., San Francisco High Fidelity Show, Mar. 15-19, Cow Palace, San Francisco, Calif.

1961 IRE International Convention, Mar. 20–23, Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y.

IHFM High Fidelity Music Show, April 4–9, Ambassador Hotel, Los Angeles, Calif.

American Society for Testing Materials Symposium on Materials and Electron Device Processing, April 5–7, Benjamin Franklin Hotel, Philadelphia, Pa.

Southwestern IRE Conference & Electronics Show, April 19–21, Baker Hotel and Dallas Memorial Coliseum, Dallas, Tex.

IRE 7th Region Technical Conference and Trade Show, April 26–28, Westward Ho Hotel, Phoenix, Ariz.

Television Classroom Takes to the Air

A flying TV school 23,000 feet above Indiana was ready to start telecasting instruction over Indiana and portions of Michigan, Illinois, Ohio, Wisconsin and Kentucky early in the year, Westinghouse Electric reports.

The Stratovision system was tested by Westinghouse some years ago. Two planes are allotted to the work, one being on the air at a time. Transmission is on uhf channels 72 and 76. Each plane is equipped with two 1-kw transmitters. The signal is a special narrow-band type—3 mc wide, and will be transmitted from video tapes.

WWV Sets Its Clock Back

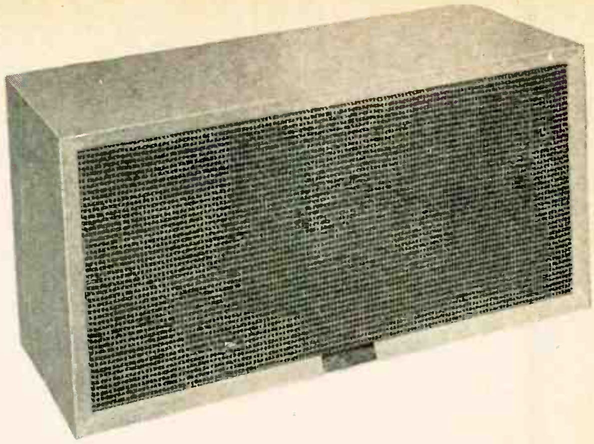
The time signals from WWV, Washington, D. C., and from WWVH in Hawaii were retarded by 5 milliseconds early in January. The adjustment brought the signals of the US stations into closer agreement with the standard-frequency broadcast stations of other countries throughout the world. At the same time, the two stations resumed broadcasting a special timing code that gives the day, hour, minute and second for 1-minute intervals ten times per hour.

World-Wide Color Television At 1964 Fair, Says Sarnoff

The 1964 World's Fair at New York may well be ushered in by a world-wide color television broadcast, reported David Sarnoff, RCA chairman and chief executive officer.

"From a technical standpoint," he stated, "I am certain that it will be possible to televise the fair opening in natural color, over remote parts of the world, by a satellite communications system." END

THE A.E.S. *Gigolo*



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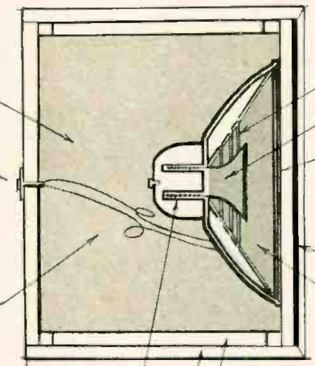

SIZE: 24" wide, 12" high, 9½" deep.

Response: 19-21,000 CPS

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PRODUCT RESEARCH & DEVELOPMENT COMPANY

CONSUMER PRODUCT REPORT*

A new product recently introduced is the subject of much controversy. It has been this controversy that prompted the Product Research & Development Company to make the following tests and report.

REPORT SUBJECT: A. E. S. GIGOLO

Description: Bookshelf type speaker system. Size, 24" wide, 12" high, and 9½" deep. Which places the Gigolo among the few true bookshelf speakers. Cabinet construction is unusually heavy and well reinforced. Its weight is 25 lbs. Viusal inspection showed care in assembly, with tightly sealed front and back. Cabinet was expertly sanded and ready for finishing. The grill material is of the plastic, acoustically transparent type, neutral in color and acceptable in style. Our first impression was that the manufacturer's efforts were directed to sound reproduction only, with little regard for furniture finish or style. But, some of the do-it-yourself finishing kits on the market will help rectify this situation. The wood product used throughout the cabinet is of a new type and differs from the usual plywood construction. The completely sealed enclosure is filled with spun orlon, which in our opinion will not only do a better job of dampening than fiberglass but also will eliminate the possibility of glass particles finding their way to the speaker voice coil. A real first—Good thinking A.E.S. The reproducing unit is an eight inch high compliance silicone treated woofer, with an exceptionally long-throw double wound voice coil. This speaker is also equipped with a hardened high frequency reproducing cone . . .

Listening Test. This was the most enlightening part of our test. To exploit the manufacturer's claim of efficiency and power handling capacity, we went to the extreme of using a six transistor radio as a sound source. We found it had sufficient power to drive the A.E.S. Gigolo to a good listening level. What makes this simple experiment so remarkable is that the balance of this test was completed by using a Scott model 272-88 watt stereo amplifier . . .

The manufacturer's claim of frequency response from 19 cps to 21 KC cannot be disputed from the standpoint of response only. But the test indicated that this was not a flat reproduction. However, we would like to point out that in group listening tests the Gigolo was repeatedly picked out from other bookshelf speakers ranging from $49.00 to over $200.00, to have the liveliest and a most realistic performance. These unusual reactions (considering price) may be somewhat explained by the fact that the Gigolo seemed to be the more efficient and to have the most midrange presence of the units tested.

Summary: Without a doubt there are available speaker systems with specifications better than the A.E.S. Gigolo. But, at a selling price of fifteen dollars ($15.00) this unit offered by A.E.S. Inc., 3338 Payne Avenue, Cleveland 14, Ohio, is, in our opinion, the best value ever offered to the audio market.

In conclusion it is the opinion of our marketing analyst that the manufacturer's cost of the Gigolo exceeds the present selling price of fifteen dollars ($15.00). Look for a price increase in the very near future. PRD.

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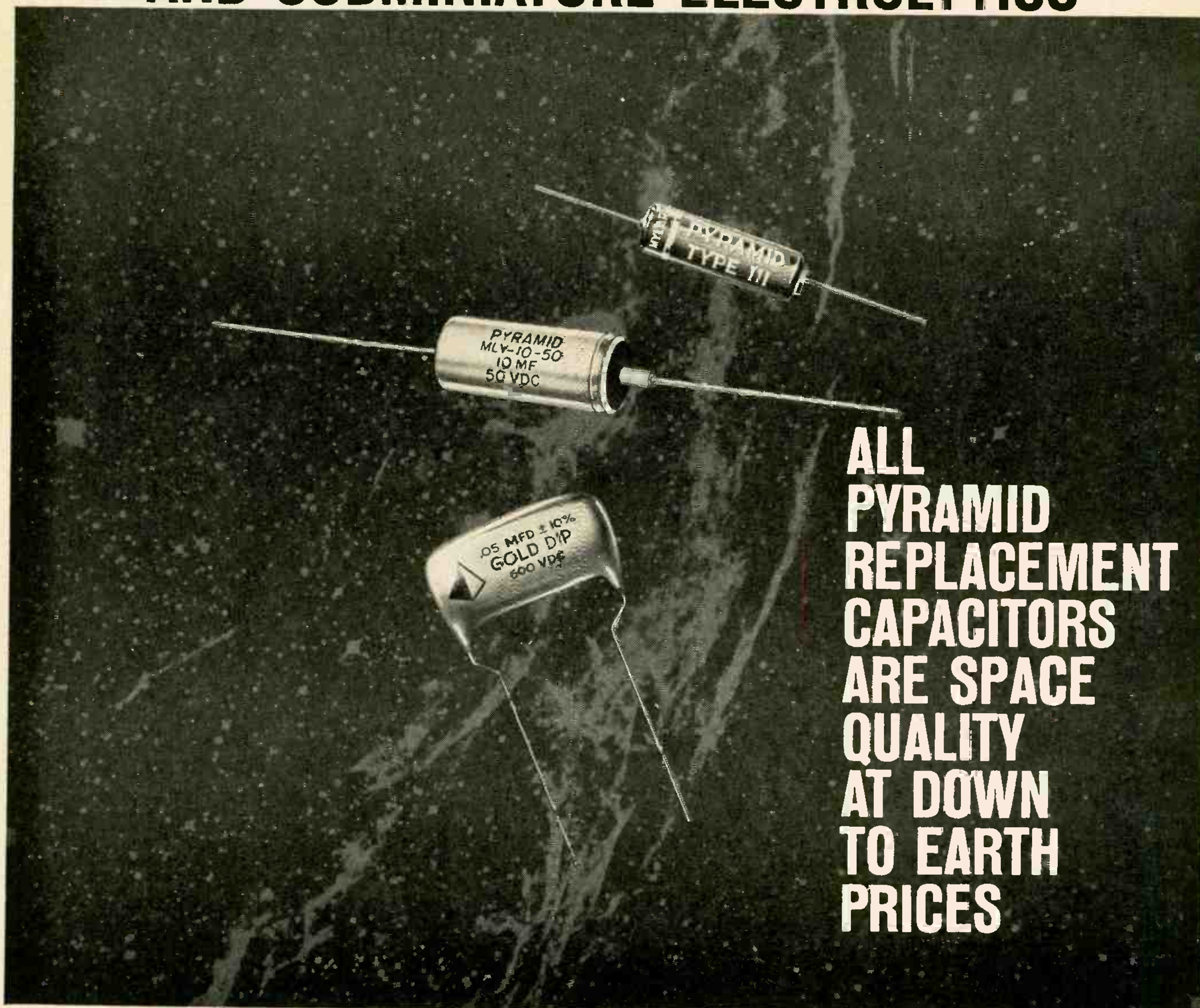

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Type 151 Gold-Dip Mylar capacitors are designed to be used for printed board circuitry as well as conventional applications. They are engineered for the highest reliability, are moisture resistant and have high insulation resistance.

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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
Hugh J. Stock, Box 446, Lander, Wyo.	1st	11
Orlie W. McCool, 414 W. South St., Neosho, Mo.	1st	12
Eugene R. Kraus, Moore Drive, Peru, N. Y.	1st	12
Robert E. Sullivan, 2475 E. Douglas, Des Moines, Iowa	1st	12
Jack Hughes, 101 4th Street, Sebring, Fla.	1st	22
Dennis K. Bingaman, R.D. #1, Dalmatia, Penna.	1st	14
Earl Howard Tolley, RR #3, Eaton, Ohio	1st	11
Victor B. Arroyo, 3633 Gangel Ave., Pico Rivera, Calif.	1st	20
Henry N. Wright, 160 Cedar Street, Springfield, Mass.	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.

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Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

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Address________________________

City________________________State__________

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☐ Hollywood classes, ☐ Kansas City classes, ☐ Washington classes 14C

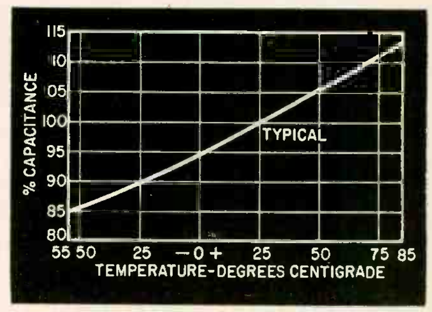
Correspondence

LOW-VOLTAGE CAPACITORS

Dear Editor:

I note the article on Centralab's Ultra-Kap ceramic capacitors which appears on pages 60 and 61 of your January issue. These are reduced barium titanate ceramics. They are made and sold by Sprague under the trademark Hypercon.

Although your article states that such capacitors are not made at voltages above 10 volts, we regularly produce 12-volt capacitors for the original equipment manufacturer market. Further, we are furnishing 20-volt capacitors



consisting of two 10-volt discs stacked in series to some set manufacturers.

Our *Engineering Bulletin No. 6141A* lists our current catalog designs for the single-disc 3- and 12-volt units. The curve of capacitance with temperature might be of particular interest to your readers. The one for the 3-volt units is shown.

The new Sprague Transfarad Capacitor Analyzer, which is intended specifically for transistorized electronic equipment, *does* make it possible to measure quickly leakage currents in reduced barium titanate capacitors such as our Hypercon series or the Centralab Ultra-Kap series.

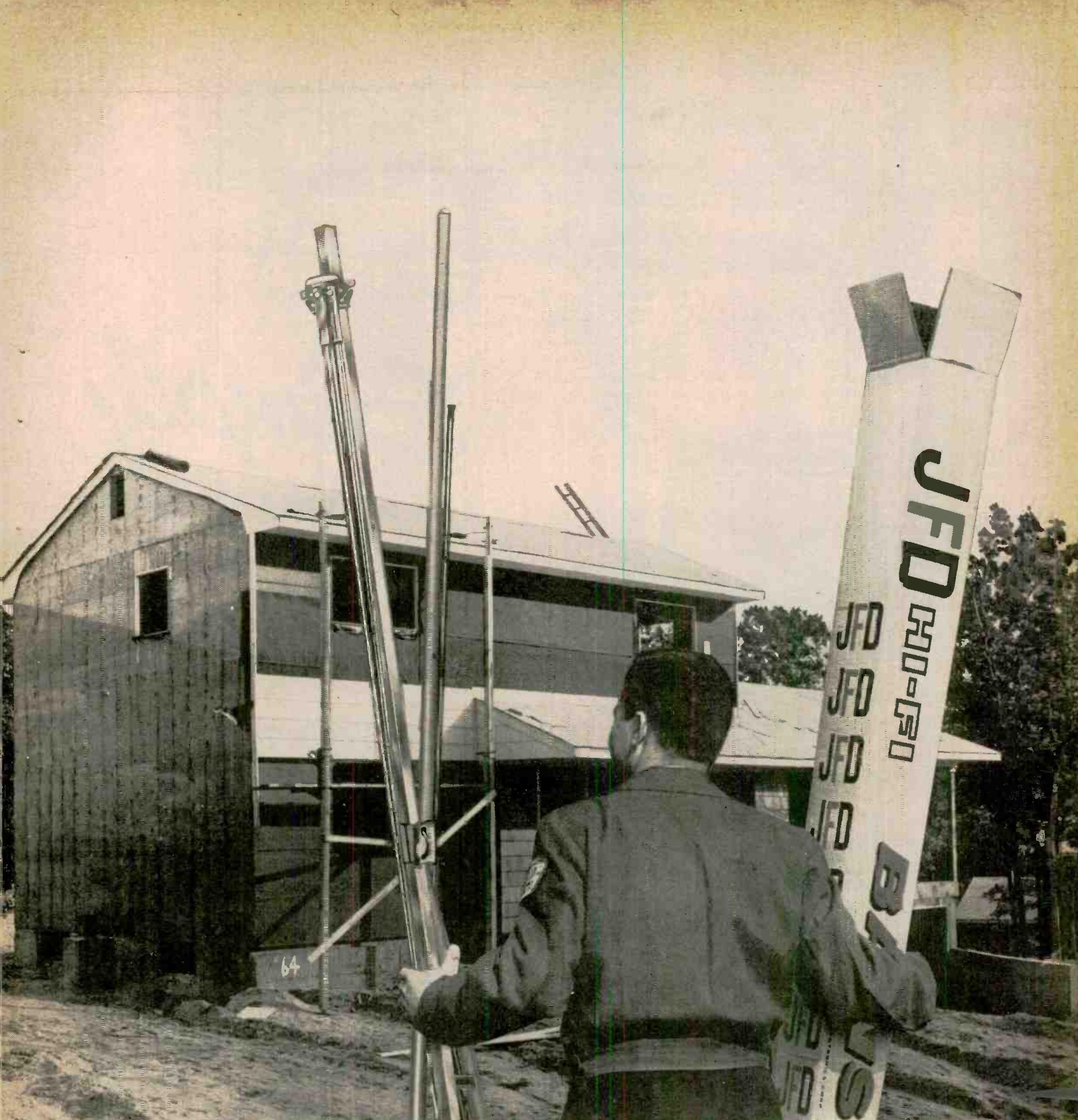
SIDNEY L. CHERTOK
Sprague Electric Co.
North Adams, Mass.

IT ISN'T SO!

Dear Editor:

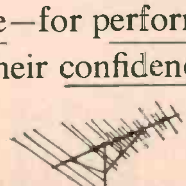
I would like to take issue with Jack Darr's statement that the eight types of balun coils shown in the December, 1960, article on tuner input coils would replace 95% of the coils in modern tuners. Although the illustrated coils are fairly popular ones, I doubt that they would even replace one-third of the coils in currently used tuners. As

(*Continued on page* 22)

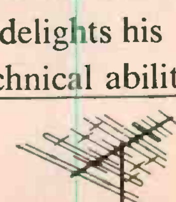


The Businessman in the Serviceman suit knows 1,400,000 new houses* mean unlimited opportunities in new antenna installations. He intends to get his share of this profitable business. His antenna brand? . . . JFD, of course—for performance that delights his customers and confirms their confidence in his technical ability.

HI-FI HELIX



HI-FI BANSHEE



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there be any trouble within 24 hours after delivery, there is no charge for labor or parts, *if it was the part we replaced.* For the next 10 days, if the customer calls us for service, we make the minimum service charge plus parts (no parts charge if any of the parts installed by us break down). Up to 90 days, should any part we install go bad, we make a minimum service charge. After 90 days, full rates go into effect.

All this is explained to the customer. Furthermore, we tell the customer, whenever we pull the chassis, that we have a flat rate shop charge. We *do not* give an estimate, only our labor charges.

After all of this, we ask the party to sign an Authorization Sheet so we may proceed with the repair of his set. This Authorization Sheet contains two pertinent facts according to law in this state. (1) The party shall pay *cash* for all work done upon delivery. (2) The party allows the technician to retain the right to all parts entered in the set, according to the invoice, and that, the repairman may enter his premises at any time during the day to retain possession of said parts if the bill is not paid.

When the customer calls, he is told that all services are for cash only.

We have had many instances of invoices reading: Parts $00.35, Labor $16.00, Total $16.35 plus State Tax.

Our customers do not complain about this for they appreciate our honesty.

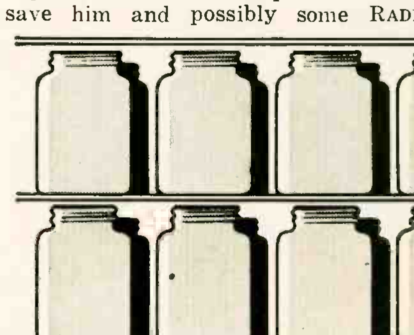
HENRY NAKAZATO
Kailua, Oahu, Hawaii

[Sounds like an interesting approach. Offers the customer a little more than just a warranty on the work done. Assures him of some protection (costwise) if his set should fail again within a short period of time. Any other customer relation ideas?—*Editor*]

TOPLESS JARS

Dear Editor:

I would like to offer a delayed comment on an article by Henry J. Miller in the May, 1960, issue, page 88. Mr. Miller uses a large number of screw-cap jars to store small parts. It would save him and possibly some RADIO-ELECTRONICS readers a considerable amount of time and patience if the shelves were spaced a little closer to the jar tops (see diagram). Such a close fit would let the user keep the jar open and still dust-free, and make it a lot easier to get parts in and out when desired.



L. H. BROWN
Abingdon, Berks, England

END

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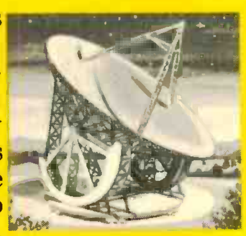

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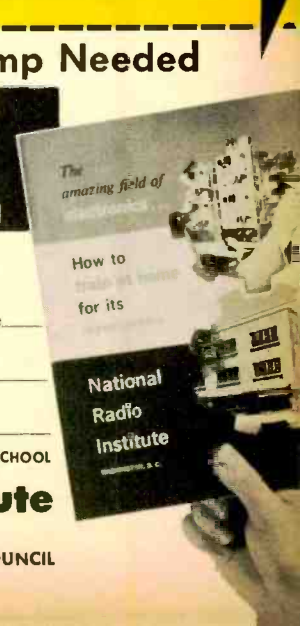

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Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention 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.

SPEAKER SYSTEM CATALOG describes systems in detail and includes specifications, enclosures and photos for each. Full page of components.—R. T. Bozak Sales Co., Box 1166, Darien, Conn.

SPEAKERS, KITS AND ACCESSORIES in 8-page catalog graphically illustrating manufacturer's line with accompanying detailed specifications for each unit.—**Oxford Components**, 556 W. Monroe St., Chicago 6, Ill.

COMPONENTS *Catalog S600* supplements previously issued *W600*. Lists manufacturer's new product additions in complete detail.—**Cambridge Thermionic Corp.**, 445 Concord Ave., Cambridge 38, Mass.

STANDOFF FASTENERS for supporting tubing, wire bundles, conduit, equipment and instruments are covered in new illustrated 20-page booklet, *What You Should Know About Standoff Fasteners*.—Western Sky Industries, 21301 Cloud Way, Hayward, Calif.

RADIO ELECTRONIC MASTER, 25th edition, silver anniversary number. More than 175,000 items, their specifications and prices featured in its 1,600 pages. Over 12,000 illustrations. Pinpoint index.—United Catalog Publishers, Inc., 60 Madison Ave., Hempstead, N. Y. See your distributor for price.

POTENTIOMETER FOLDER, Buyers and Engineers Guide to *Squaretrim Potentiometers*. Outlines complete details of the functions, specifications and ratings of these subminiature units in quick-reference, tabular form. 4 illustrated pages. —**Schweber Electronics**, 60 Herricks Rd., Mineola, N. Y.

SEMICONDUCTOR CHART lists more than 4,000 types and their 38 manufacturers. 12 new companies included. 68 pages. Write for descriptive literature. —**United File-O-Matic**, 60 Madison Ave., Hempstead, N. Y.

STEREO CARTRIDGE BROCHURE, on *model ADC-1*, gives background information, description and specifications of manufacturer's newest magnetic cartridge, and chart that traces its typical response curve.—**Audio Dynamics Corp.**, 1677 Cody Ave., Ridgewood, N. Y.

TAPE RECORDING HEAD REFERENCE GUIDE, revised, contains information for technician and tape recordist on repair, upgrading or conversion to stereo. Features cross-reference data, specification and illustrations on record/playback and erase heads, 2- and 4-track stereo, 2-track monophonic and ¼-track record/playback units. 16 pages.—**Robins Industries Corp.**, 36-27 Prince St., Flushing 54, N. Y. 50¢.

DEPOSITED-CARBON RESISTORS, their performance and reliability, are the subject of a study that includes data based on testing of more than 37,000 separate units. Over 20 charts and diagrams. Special section deals with resistor selection in equipment design.—**International Resistance Co.**, PO Box 502, Burlington, Iowa.

PHOTOSENSITIVE DEVICES *and Cathode-Ray Tubes, CRPD-105B.* Sets related technical information up for quick reference. Contents include data for 151 special-purpose industrial tubes.—**RCA**, Commercial Engineering, Electron Tube Div., Harrison, N. J.

OPTICAL MASER describes theory, design and applications of the recently announced solid-state optical maser. 8-page booklet is reprint of article by Dr. A. L. Schawlow, an inventor of the maser, that appeared in his company's publication.—**H. W. Mattson, Bell Telephone Laboratories**, Murray Hill, N. J.

REPLACEMENT PARTS for radio, television and electronics indexed by product, type and page for easy reference. 48 pages of descriptions, specifications and illustrations.—**International Resistance Co.**, Distributor Div., 414 N. 13th St., Philadelphia 8, Pa.

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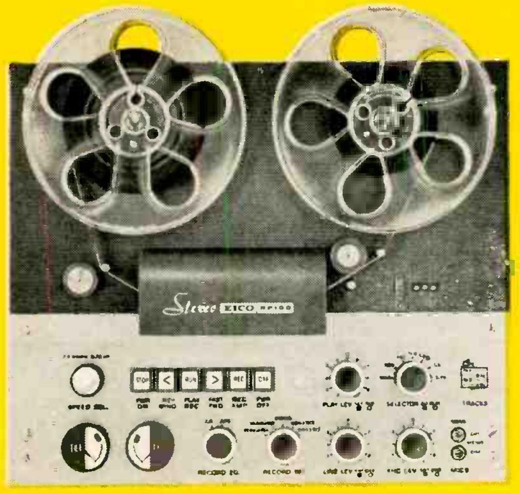
TRANSISTOR *Application Guides. RCA Silicon Power Transistors, ICE-215,* deals with the special features and uses of 16 medium-power, intermediate-power and high-power silicon transistors. *RCA Silicon Vhf Transistors, ICE-228,* describes capabilities of 3 silicon vhf transistors intended for industrial and military applications at frequencies up to 300 megacycles.—**RCA Semiconductor & Material Div.**, Commercial Engineering, Somerville, N. J. **50¢ each.**

VIDEO AMPLIFIER Application Note, *Video Amplifiers Using the 2N741 Mesa Transistor,* makes use of circuit schematics, performance curves and photographs of a completed 10-mc amplifier to describe high-quality video amplifier circuits using low-cost 2N741 mesa transistors. — **Motorola Semiconductor Products Inc.**, 5005 E. McDowell Rd., Phoenix, Ariz.

WIRELESS MICROPHONE SYSTEM described in brochure that also carries specifications of complete line of accessories and illustrates a number of suggested applications.—**Vega Electronics Corp.**, Cupertino, Calif. END *dedicated to perfection*



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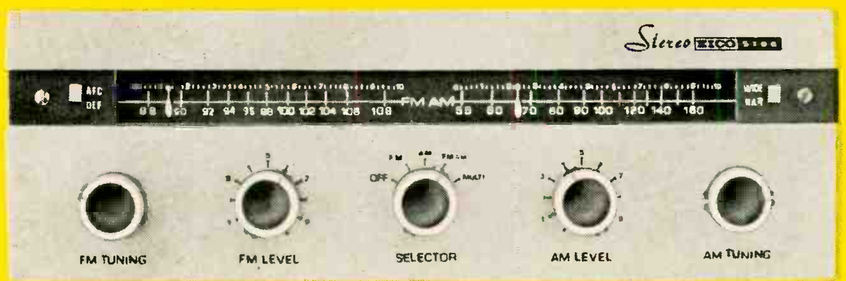

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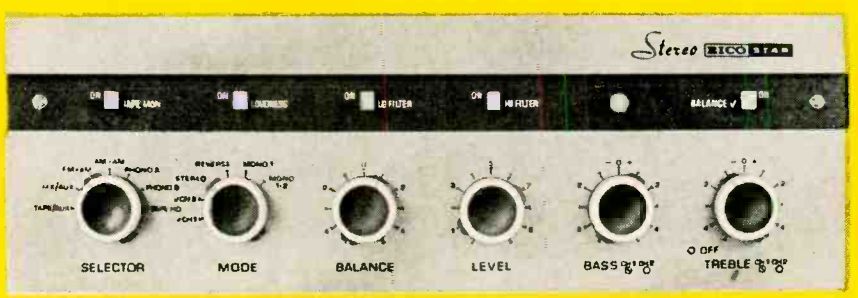
OF EICO STEREO . . . .



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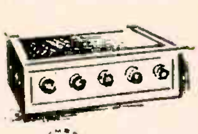

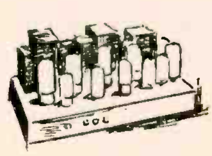

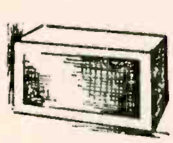

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Radio-Electronics
Hugo Gernsback, Editor

ANTI-PLANE-COLLISION RADAR

. . . Up-to-Date Aircraft Safety Measures Are Needed Urgently . . .

THE tragic airplane disaster of Dec. 16, last, in which 134 persons were killed as a result of the collision of two airliners over New York, points up anew that present-day safety measures are fundamentally inadequate, particularly near our large metropolitan air centers.

More than 175 planes are often in the air together within a radius of 50 miles over New York City. By 1975, there will be over 350, according to a Federal study recently made.

Modern jets today fly at the rate of 550 miles an hour when cruising at full speed. Two jets on a collision course can thus approach each other at rates up to 1,100 miles per hour, *or over 3 miles in 10 seconds*. Even if the pilots see an oncoming plane, it is doubtful that they can prevent a full head-on or partial collision.

In a few years, jets now on the drawing boards will fly at 1,300 miles cruising speed. How will *they* be handled?

Today, jets approaching our airports must fly at a reduced speed of about 230 miles an hour, and are guided to the proper runway by the technicians of Federal Aviation Agency. The guiding is customarily by radiophone from ground to plane. The tower operator literally talks the plane down. In an overcast and thick weather, the incoming plane also uses its electronic Instrument Landing System (ILS).

But last Dec. 16, when the two doomed planes were on a collision course and were fully alerted to their danger by ground personnel, one of the planes was some 11 miles off course and completely "blind" in the thick cloud overcast. Hence, even if the pilot did take evasive measures, he could not possibly have known whether he was heading out—or into—the danger course in the thick murk.

The obvious answer to this and similar situations is radar. We have commented on this over the years since 1951.*

After the 1956 two-plane collision over the Grand Canyon that took 128 lives, we said editorially, in our May 1956 issue *"Airplane Collision Control"*:

> But a plane flies in a three-dimensional medium. Pilots have only a comparatively small angle within which to make visual observations. They cannot look behind them, far sideways or above, or below them at a steep angle in a heavy overcast. Hence the "visual control" is wholly academic and—under certain adverse weather conditions—absurd.

We also quote from our 1951 editorial (before the practical advent of the transistor):

> It should be possible in the meanwhile, however, to use a six-way modified—or sweep—radar installation, which need not weigh too much if miniature tubes and other miniature components are used. In this case, too, there would be several miniature screens which pilot or copilot could watch and see if another plane was approaching from any direction. When finally engineered, such a device will prevent many collisions. Such radar installations will be particularly advantageous during night flying and while flying in overcast weather when the visibility is extremely poor or nil.

*"Needed Electronic Inventions," RADIO-ELECTRONICS, May 1951.

What was meant here was two specialized steep angle sweep radars, one on top of the plane, one in the belly. Using two such radars, the pilots are enabled to see in six directions at once: east, west, north, south, below and above.

Weight and space requirements, once a serious handicap for commercial airplane radar, are no longer an insurmountable problem today, thanks to transistors and microminiaturization.

It is quite inexcusable to postpone the adoption of collision radars any longer—neither the cost nor technical difficulty can be given as valid reasons for delay. While radar installation on aircraft may not be a 100% solution and insurance against all collisions, it will certainly do away with a large proportion of midair crashes.

When we speak of radar, we should also mention the fact that not all radars function on radio waves. There is, for instance, the infrared or heat radar developed during the past several years by Aerojet-General Corp. It uses a rapidly rotating mirror which scans the sky for other planes. The mirror is sensitive to infrared heat rays from a distant airplane engine. It has an automatic warning instrument in the cockpit to alert the pilot that he is on a collision course. It also gives the range and bearing of the oncoming plane. Total weight of the new infrared radar is but 30 lb.

How serious the density of our aircraft in the sky is becoming was pointed out recently in a study made by scientists at the University of Michigan's Institute of Science and Technology. One of the scientists, Dr. Gustave Rabson said: "Today more than 109,000 planes use the same air space and many are flying more than 100 miles per hour. By 1975 we can expect aircraft to more than double their present air mileage. . . . We must develop a control system to handle incredibly complicated situations rapidly and safely."

Just what does this mean for the future? It means to us that, by 1975, there probably will be over 200,000 aircraft, a goodly percentage flying at more than 1,000 miles per hour. Midair collisions are bound to get worse unless we take heroic electronic measures on the ground and in the air.

As we see it, radar warnings originating in the plane and from the ground can only be a temporary makeshift —they cannot prevail for long. Man's perception and his reactions are hopelessly slow and far too sluggish for the air and space age.

The collision radar in the future must be wholly automatic—it must steer the plane out of its collision course without benefit of pilot. A warning bell or signal will sound, notifying the pilot that the plane is now under radar control. Likewise, large airliners will no longer be "talked down" by the tower during overcasts or at night. The tower operator—not the pilot—will have total electronic control over the plane during its airport approach and its touchdown. The operation will be watched by a bank of special TV cameras near the runway, via closed-circuit automated television receivers in the tower. The rest of the routine landing operation will be by the pilot. ***—H.G.***

home-made TUNNEL-DIODE CW transmitter

By
LESTER A. EARNSHAW, ZL1AAX

Crystal-controlled transmitter operates on 3.5 mc, has verified 160-mile range

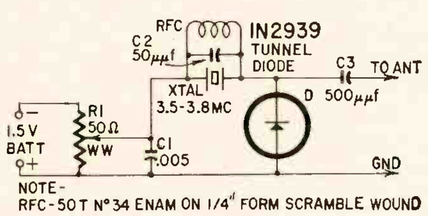
PREVIOUS articles in RADIO-ELECTRONICS have shown that the tunnel diode makes an excellent oscillator (September 1960, page 40; October 1960, page 58, and November 1960, page 42). The device will "take off whenever the correct operating voltage and a suitable tuned circuit are connected to its leads. The only important consideration is the power supply. Although this is usually an unlikely source of trouble, the tunnel diode supply must have a very low output impedance. If the power source impedance is *not* low, the diode is likely to slide from one end of its negative resistance slope to the other, and behave much the same as a flip-flop transistor circuit.

It is a very simple matter indeed to make the tunnel diode oscillate. It is not so easy to make the device oscillate at the correct frequency, however. Each piece of wire connecting the components together will form a tuned circuit and each of these may oscillate simultaneously. Even the rf choke may form part of the oscillatory circuit! It is essential that the undesired oscillations be suppressed.

In Fig. 1, the diode, crystal and capacitor are all in series. This configuration constitutes an oscillator circuit. However, to bias the diode with dc voltage, we need a dc path across the crystal. An rf choke will provide the necessary path but will also form an oscillatory circuit of its own. A coil and capacitor tuned to the frequency of the crystal will lock in with the crystal. The oscillator will not take off on a spurious frequency unless the coil is badly detuned.

Part of the wirewound potentiometer (R1) is shunted across the .005-μf ceramic capacitor. This effectively damps any tendency toward oscillation in the capacitor. The components must be connected with the shortest possible leads to keep unwanted inductance in the circuit to a minimum. The result is an oscillator circuit which will operate over a wide portion of the potentiometer range without any tendency toward parasitic operation. Parasitics are possible only when the potentiometer or coil is grossly misadjusted.

A 1.5-volt flashlight battery will power the transmitter and provide approximately 50 ma. Most of this is consumed by the 50-ohm potentiometer. This apparent waste of power is necessary to hold the voltage to the tunnel diode constant, and provides the low impedance mentioned earlier.



BATT—1.5 volts, flashlight cell
C1—.005 μf, ceramic
C2—50 $\mu\mu$f, ceramic
C3—500 $\mu\mu$f, mica
D—1N2939 (General Electric) tunnel diode
R—pot, 50 ohms, wirewound
RFC—50 turns No. 34 enameled wire scramble-wound on a Miller No. 4300 ¼-inch diameter coil form
XTAL—3.5-3.8 mc
Chassis, to suit
Miscellaneous hardware

Fig. 1—Tunnel-diode transmitter's circuit.

An excellent source of power is a silicon solar cell. In many ways, the solar cell is ideal for this application for it is in itself a low-impedance supply. Connect the cell directly across the 50-ohm potentiometer, in place of the battery (Fig. 2). Naturally, sunlight or a bright lamp is essential.

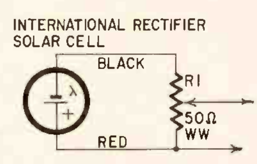


Fig. 2—International Rectifier solar cell will make an excellent substitute for the battery.

Another "stiff" supply suitable for consistent transmitter operation is the voltage developed across a silicon-rectifier junction. The rectifier is connected in series with a resistor and this combination is connected across a dc source. The dc may be a 12-volt transistor power supply, a battery charger or even an automobile battery. The resistor size is computed by Ohm's law. First determine the current to flow through the silicon rectifier and then divide the supply voltage by the current figure. The voltage drop across an average silicon

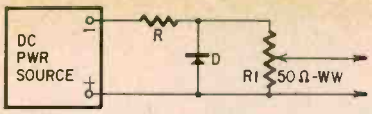


Fig. 3—Voltage drop across a silicon diode rectifier makes a good regulated power supply for the transmitter. Adjust R for 100-ma through the diode.

diode (such as the Sarkes Tarzian M500 or International Rectifier SD-94) is approximately 0.6 volt. If a battery charger is used, a filter capacitor may be required across the diode or charger output to reduce the ripple. A suitable circuit for the silicon-diode regulated power supply is shown in Fig. 3.

Adjustment and operation

Connect a few feet of wire to the antenna terminal and place this lead near the receiver. Tune the receiver to the crystal frequency and advance the potentiometer until you hear the signal beat with the receiver bfo. Just as oscillation starts, or (as the potentiometer is advanced) ceases, the note will be ragged and rough. Between these two points it will be clean and pleasant-sounding and remarkably free from chirp. If the solar cell is used to power the oscillator, a slight change in frequency will be noted as the strength of the sunlight varies, but this effect is not objectionable. Of course, if the sun goes behind a cloud (or is otherwise obscured), oscillation may cease. At these times the potentiometer may have to be readjusted.

Excessive current through the tunnel diode may ruin it and readers are warned against connecting the transmitter to a higher voltage source than that recommended unless a silicon rectifier is used to hold the voltage constant. Always turn the potentiometer to the voltage-off position before applying power to the diode. Then, depress the key and advance the potentiometer slowly until the oscillator starts. (The key is inserted in the line between C1 and the arm of R1.)

It is an excellent idea to check diode current with a 0-to-10 ma meter connected between the arm of the potentiometer and the .005-μf capacitor (C1). As the potentiometer is turned up you will see the meter pop up to a reading of less than 1 ma. If the potentiometer is increased further, the meter will jump another step. If the voltage is increased beyond this point, the diode may be damaged! If the potentiometer is reduced, the meter will suddenly drop to the intermediate point and then to the starting current. The **middle step is the correct operating point for the diode.** By observing the meter and listening to the receiver, you should have no trouble getting the transmitter to work.

It was interesting to note that, with only a 3-foot length of wire connected to the antenna terminal, the oscillator was heard on a communications receiver more than 300 yards away. The strength of the signal indicated that much greater distances were possible.

To see if the tunnel diode was actually a useful communication device, rather than a laboratory curiosity, I arranged to have a fellow New Zealand ham (ZL1AOF, some 160 airline miles distant) listen for the signals. Initial tests were very discouraging—not a peep could be heard. Next the transmitter was used to drive a 6BQ5 amplifier. Amateur radio ZL1AOF discovered he had been listening on the wrong frequency as soon as he picked up the "high-power" CW transmitter excited by the tunnel diode oscillator. Once again the tunnel diode transmitter was connected directly to the antenna. This time the signals were received with amazing clarity. A tape recording of Jack's reception, along with a card confirming the contact, attest to the performance of the transmitter.

If actual contacts are desired, rather than experiments, an 80-meter antenna must be connected to the tunnel diode, as shown in Fig. 1. A good earth ground is also absolutely essential to duplicate the author's successful contact. [Apparently ZL1AAX has never tried a good counterpoise?—*Editor*] Some antennas may pull the diode out of oscillation and, if this happens, the value of C3 (nominally 500 $\mu\mu$f) should be reduced until oscillation starts. For best results adjust the potentiometer with the antenna connected to the transmitter. **END**

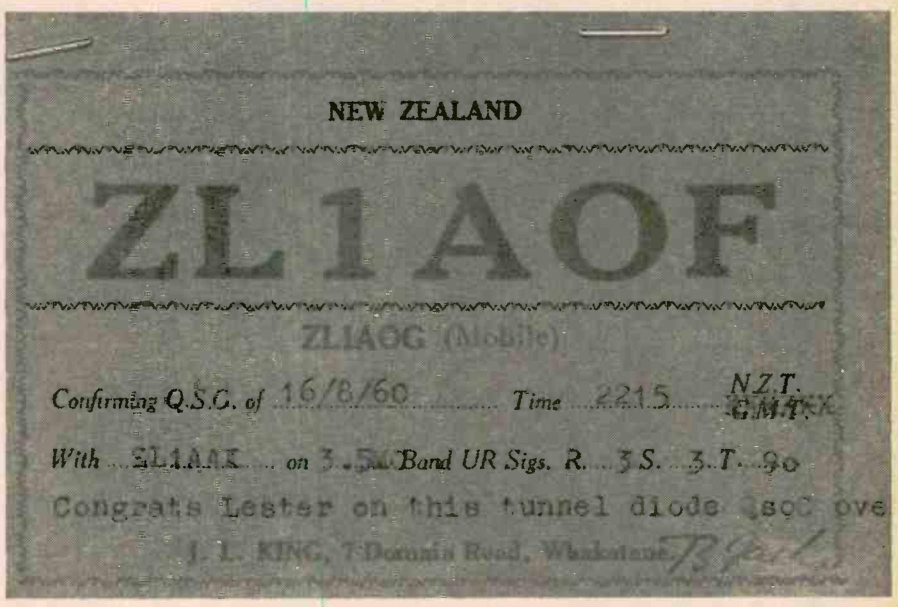
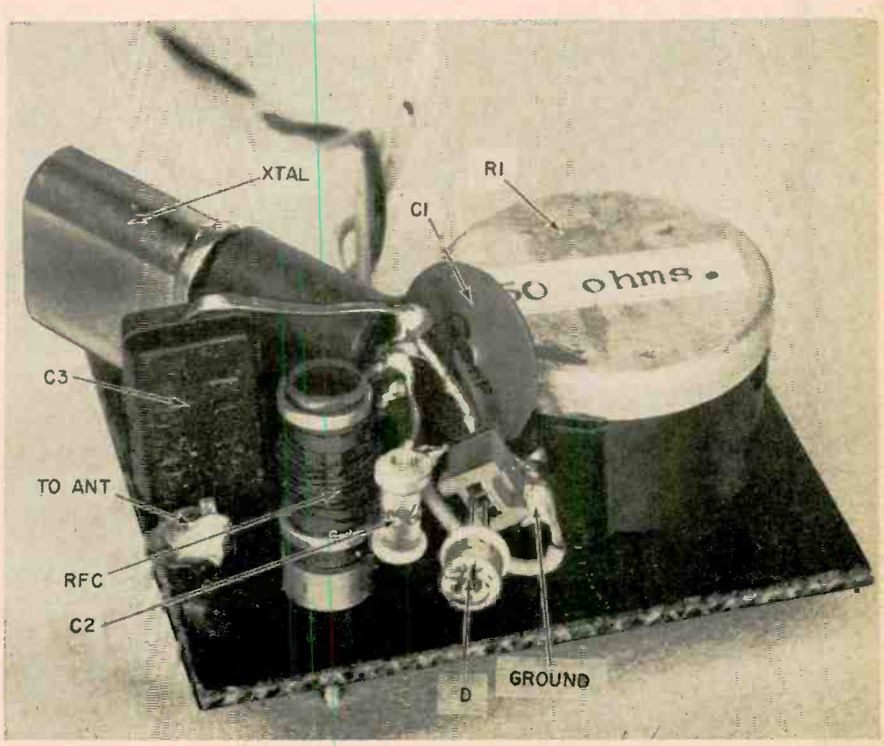
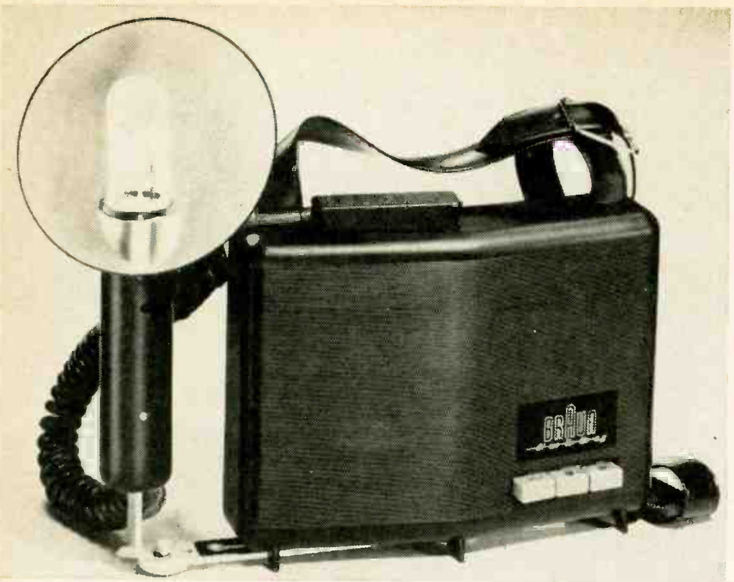

NEW ZEALAND
ZL1AOF
ZL1AOG (Mobile)
Confirming Q.S.C. of 16/8/60 Time 2215 N.Z.T.
With ZL1AAX on 3.5Mc Band UR Sigs. R 3 S 3 T 9
Congrats Lester on this tunnel diode QSO ove
J. L. KING, 7 Domain Road, Whakatane.

Fig. 4—Original QSL confirming 160-mile contact using tunnel-diode transmitter.



Completed transmitter requires only antenna, ground and power source.



E. Leitz, Inc.

The Braun Hobby Automatic EF-3.

American Speedlight Co.

The Ascorlight A423.

INSIDE THE ELECTRONIC PHOTOFLASH

Photoflash repairs can be business builders. Don't pass up work on these simple electronic circuits.

By C. L. HENRY

THE electronic service technician who limits his servicing to TV and radio sets is passing up a substantial amount of business. Electronics is invading new fields rapidly, and more equipment requires servicing than ever before. A good example of this is in the field of amateur and professional photography.

More than one-fifth of the amateurs and almost all professional photographers have electronic photoflash equipment. The latest photography directory lists 31 manufacturers of such equipment, each having from 2 to 16 models. All photoflash units contain at least one large electrolytic energy-storage capacitor, batteries, several resistors, a flash tube, switches, several cords and connectors. Many units are more elaborate, using dc-to-dc converters consisting of transistor oscillators, silicon rectifiers, power monitoring circuits, battery recharging and thyratron triggering circuits. As you can see, this is a fertile field for electronic servicing. Though modern photoflash units are complex, the circuitry is usually easy to understand. Fig. 1 shows the basic circuit used in all photoflash units. C1 is charged to its rated voltage through R1. The time it takes to charge C1 to 63% of capacity is T=RC, the old familiar time constant formula. This is what photographers refer to when they speak of recycle time, although a slightly longer interval is usually allowed to permit the capacitor to charge to more than 80% of its rated voltage. Most photoflash units recycle in 5 to 20 seconds, depending on their power supplies.

One formula that may be unfamiliar to you is E (energy) equals ½C (microfarads) times V (kilovolts) squared ($E = \frac{1}{2}CV^2$). This tells us that the energy in the capacitor depends on the capacitance and the square of the voltage. For instance, in Fig. 1, with 450 volts applied to a 1,000-μf capacitor

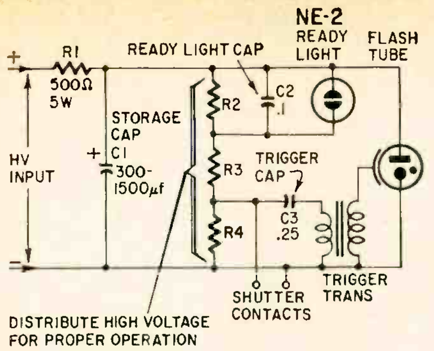


Fig. 1—Basic electronic flash circuit.

(C1), a total of 100 watt-seconds will be available when the capacitor is discharged. If this discharge takes place in .001 second through the gas tube, the circuit, in that instant, is carrying 100,000 watts. Incidentally, 100,000 watts developed in your screwdriver blade will probably melt it and will surely ruin the electrolytic capacitor. Always discharge these large capacitors through a resistor of 500 to 1,000 ohms.

Capacitor C1 is a special electrolytic, not only because of its high capacitance, but also because of its very low leakage current. Typical leakage resistance on a good capacitor will average 10 megohms. This type capacitor must be carefully re-formed after any idle period of 2 months or more. The voltage applied should be raised slowly over a period of minutes until the rated voltage is reached. It must never be exceeded. These capacitors are also expensive ($13.50 is typical) so be careful.

The balance of the circuit is composed of three parts: the flash tube, the ready light and the triggering circuit.

Flash tube

This is a xenon-filled tube made of either fused quartz or high-grade Pyrex. It presents a dynamic resistance, when triggered, of from 0.1 to 5 ohms depending on the type tube, and may draw an instantaneous current of 1,000 amperes. The circuit of the flash tube should be of very low resistance to prevent limiting this current. This means that all connectors must be clean and tight, and the wiring must be adequate. The spectra of these flash tubes approaches daylight, with much infrared and ultraviolet included.

The triggering circuit is composed of a trigger transformer which fires the tube by developing about 10,000 volts on its secondary, which is applied to the flash-tube trigger electrode. It should be as close to the flash tube as possible, preferably inside the envelope. C3 supplies the power for this triggering circuit by being charged to 200 volts and discharging through the primary of the trigger transformer when the shutter contacts on the camera close. An oscilloscope with a triggered sweep is very useful in checking the various instantaneous currents and voltages developed in these circuits.

Ready light

The last part of the typical flash unit is the ready light. This is an indicator that tells the photographer when the capacitor is charged to at least 80% and ready to fire. After the flash tube is fired, the neon lamp will glow steadily until the capacitor is recharged. Then it will start blinking at a rate determined by R3 and C2.

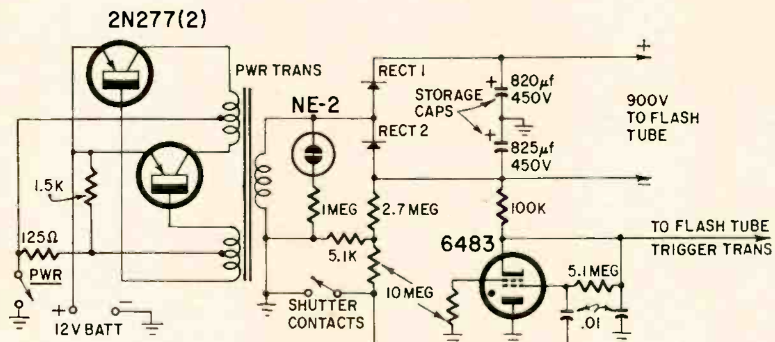


Fig. 2—Two-transistor one-tube circuit of the Ascorlight.

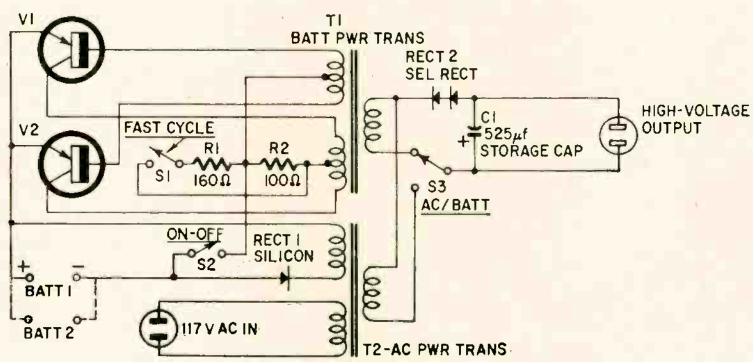


Fig. 3—Circuit of the Synctron Sixty.

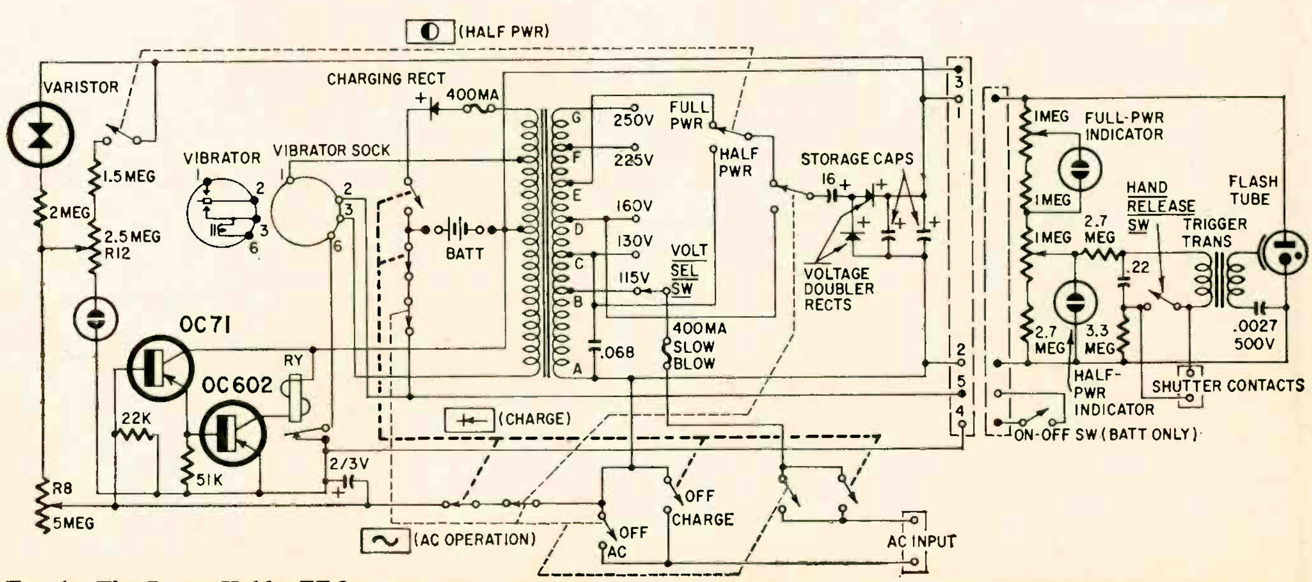


Fig. 4—The Braun Hobby EF-3.

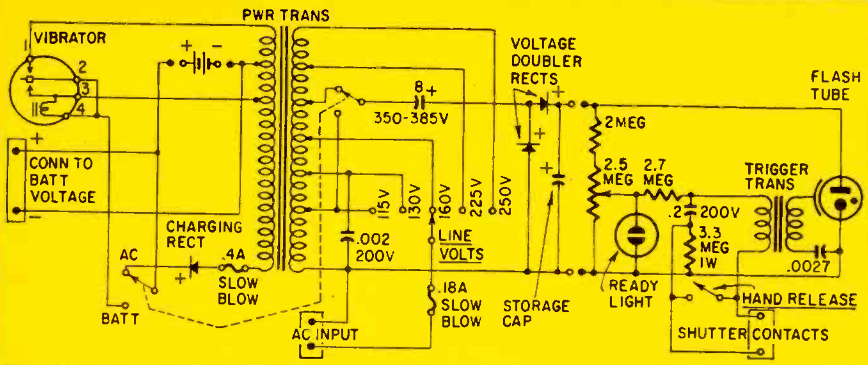


Fig. 5—Braun Hobby EF-1 electronic flash circuit.

Multiblitz, Inc.

The Multiblitz Color CL.

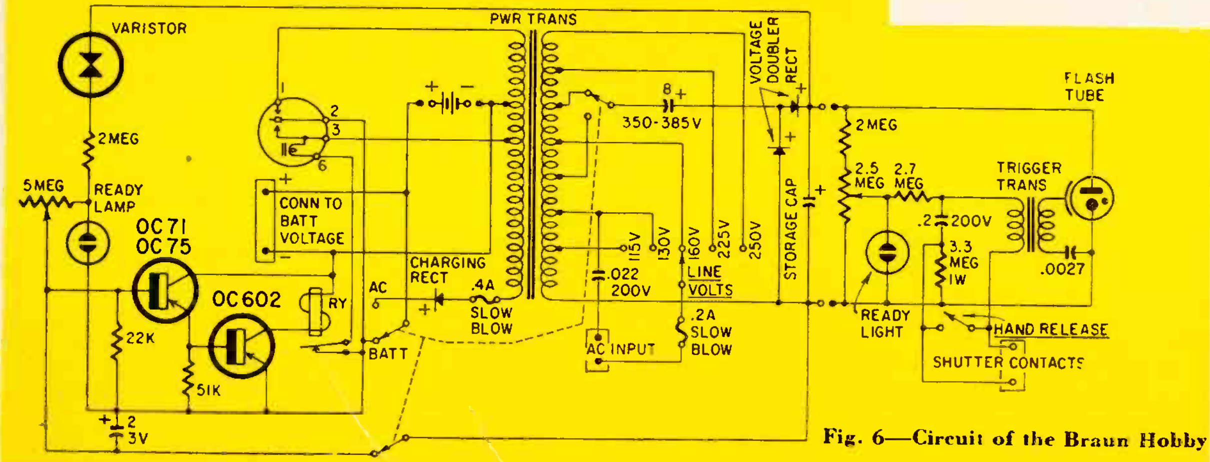


Fig. 6—Circuit of the Braun Hobby EF-2.

There are many variations of this basic circuit. Fig. 2 is the circuit of a professional photoflash unit, the Ascor-light A423, made by American Speedlight Co. A 200-watt-second unit, it will recycle in 7 seconds and has a power-conserving circuit for its nickel–cadmium battery. Drain on the battery during charging is 5 amperes, and drops to 350 ma when idling. The transistor oscillator, using two type 2N277 transistors, operates at 1,500 cycles. Waveforms from collector to collector and base to base are square, with little or no overshoot.

The transformer output is doubled by the rectifiers and supplied to the flash-tube balanced to ground, to prevent insulation troubles. The flash tube is triggered by the thyratron, a 6483. Firing the flash tube in this manner prevents excessive shutter-contact current.

Photoflash circuits

Fig. 3 is another transistor photoflash unit—the Synctron Sixty, made by Dormitzer Electric Co. Notice that ac operation is provided by T2 and RECT 2. This circuit also recharges the built-in battery through RECT 1. S1 provides a fast recycle in cases where this is desirable. As you can see, this switch raises the biasing voltage on the bases of V1 and V2, increasing the output of the circuit and also increasing the battery drain. Recycling takes 12 seconds normally and 6 seconds with S1 closed.

Figs. 4, 5 and 6 illustrate three flash units made by E. Leitz, Inc. Fig. 4 is the Braun Hobby Automatic EF-3; Fig. 5, the EF-1, and Fig. 6, the EF-2. These flash units are transistorized (transistor power-monitor circuit) and have vibrator power supplies powered by built-in nickel–cadmium batteries. A self-charger is included in each unit. The EF-3 flash head has an adjustable reflector, to vary the beam width.

The EF-3 (see photo) has three pushbutton type multi-circuit spst and spdt switches as function selectors. When all are up, the unit operates from batteries and is controlled by a switch on the gun. The button on the left (marked with a sine wave) is the ac on–off switch; the center button (marked with a half-shaded circle as on the diagram) is pressed for half-power operation on batteries or ac. The button marked with the rectifier symbol is pressed to charge the battery from the power line.

The transistorized power monitor cuts off the vibrator when the storage capacitors are charged to 510 volts ±10 volts on full power or 350 volts ±10 on half power. R8 and R12 set the

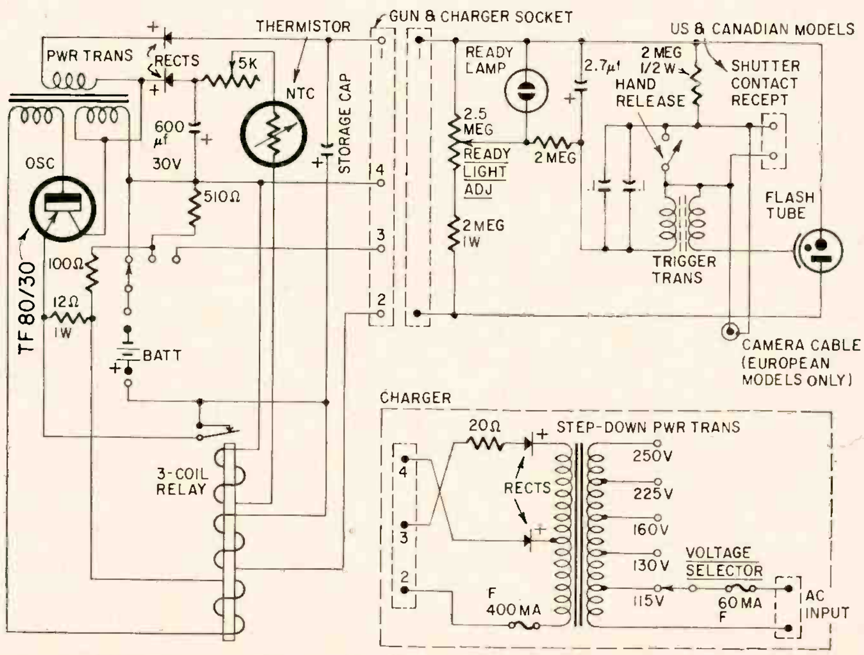


Fig. 7—F-60 power supply for the Braun flash units.

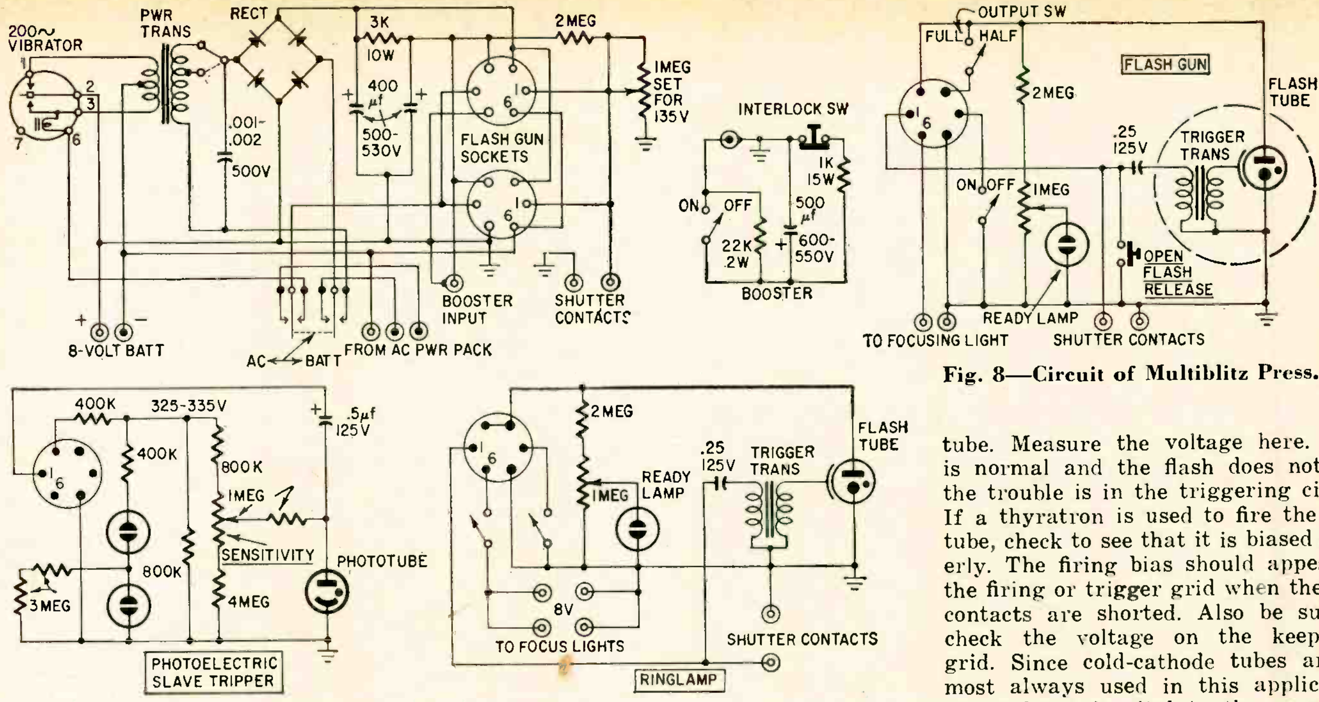


Fig. 8—Circuit of Multiblitz Press.

turnoff points for full power and half power, respectively. The vibrator comes on when the output voltage drops 10 to 30 on full power or 10 to 40 on half power.

E. Leitz advises me that they supply parts only to authorized Braun Hobby repair stations. Fig. 7 is the power supply made by E. Leitz for various flash heads, and is similar to the three just described.

The Ultrablitz Press in Fig. 8 is a versatile professional type electronic flash. It operates from an internal 8-volt storage battery, a combination ac power pack and charger or flashlight batteries. Accessories include a photoelectric slave tripper, focusing lamps, an extension flash head that can be used simultaneously with the standard head on the camera, a booster (plug-in 600-µf capacitor) to double light output and a circular or ringlight for shadowless lighting when making closeups of small objects.

Fig. 9 is another Multiblitz flash, the Color SL. A vibrator converter is also used in this unit, together with a unique transistor power-monitor circuit that allows the battery to idle between flashes. This lengthens the usable battery life before recharging is necessary.

Many electronic photoflash manufacturers discourage local service of their flash units, even though photographers may be caused considerable inconvenience (and loss to professionals) in sending the equipment to an authorized service station in the next state, or even back to the manufacturer, for service. However, a reputable service shop should be able to obtain parts if necessary from the manufacturer, or even obtain the local service franchise! A pleasant letter here will help! In many cases substitution may be possible, even if exact replacement parts are not available. Kemlite Laboratories supply many different types of flash tubes, Sprague supplies several types of photoflash capacitors, and alternate transistors, transformers, rectifiers and vibrators are also available. All current manufacturers of photoflash units are listed in the *Popular Photography Directory*, 1960 issue.

After repairing a flash unit, test it by shooting a roll of film, following the manufacturer's guide number.

Troubleshooting

An electronic flash is easier to service than an ac–dc radio. A vom is the only piece of test equipment you must have. A scope is an additional aid.

The best place to begin is at the flash tube. Measure the voltage here. If it is normal and the flash does not fire, the trouble is in the triggering circuit. If a thyratron is used to fire the flash tube, check to see that it is biased properly. The firing bias should appear on the firing or trigger grid when the sync contacts are shorted. Also be sure to check the voltage on the keep-alive grid. Since cold-cathode tubes are almost always used in this application, this voltage is vital to the operation. Low voltage here or a bad tube can cause the flash tube to fire too late, although this defect will be noticed only on the faster shutter speeds of the camera.

After the tube part of the trigger circuit is eliminated, check the trigger coil for proper operation. If an oscilloscope with triggered sweep is not available, replace the trigger transformer if you suspect it. A triggered scope will tell you whether the trigger transformer is functioning properly. A milliammeter in series with the trigger coil will kick slightly when the trigger capacitor is discharged through it, but experience is necessary here to judge whether the components are good.

In the event of low or no high voltage, trace the circuit further toward the battery. Also, don't forget the necessary low leakage factor of the electrolytic flash capacitor. If the capacitor's leakage current increases, a long recycle time will result. If this current is too high, the power supply may not be able to charge the capacitor to its rated voltage. The capacitor can be disconnected temporarily **(Be careful!)** and the output of the rectifier measured unloaded. In the event of high-voltage battery operation, this is, of course, unnecessary. If with the capacitor disconnected, the voltage is still low, check the rectifiers, transistors or vibrator. Remember that normal voltage with the capacitor disconnected will be only 0.7 times the voltage with it in circuit.

Some units use a power monitoring circuit. It is supposed to cut down the activity of the vibrator or transistor oscillator when the flash capacitor reaches full charge. A wrong bias here will cause the input circuits to idle all the time and will cut down the output voltage. It is best to disconnect this circuit if there is any doubt of its operation. Then if the output voltage assumes its normal value, you know where to find the trouble. END

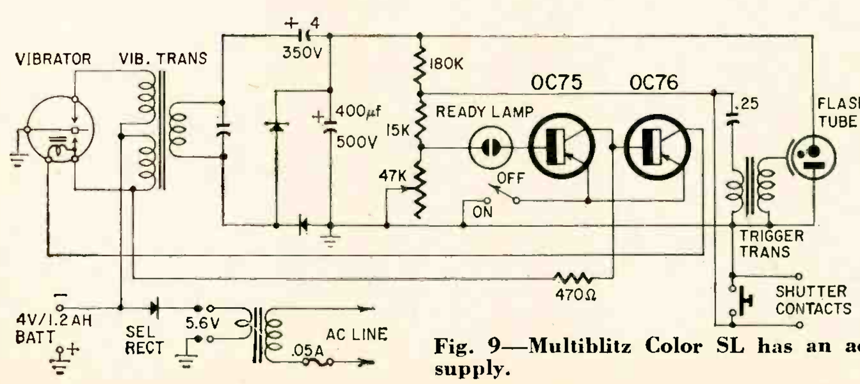
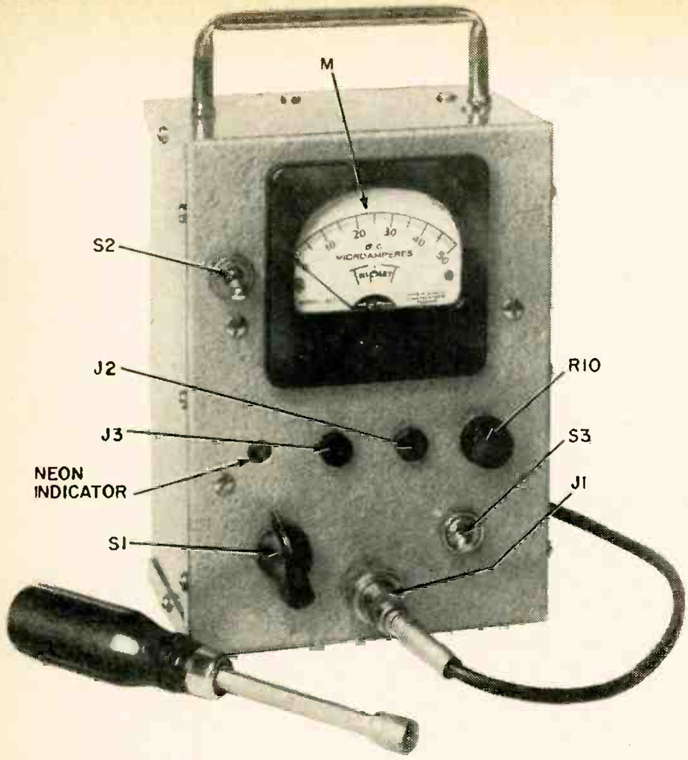


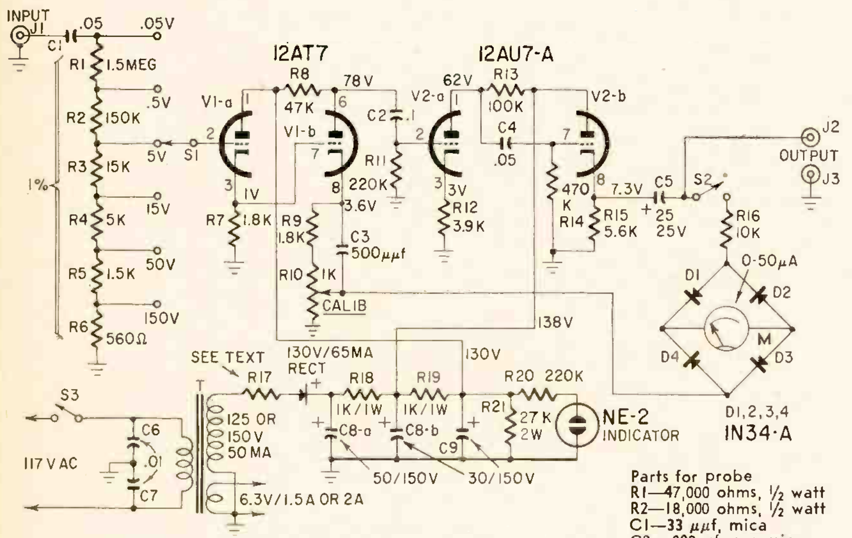
Fig. 9—Multiblitz Color SL has an ac supply.



The completed unit in a neat crinkle-finish case.

EASY-TO-BUILD WIDE-BAND VTVM DOUBLES AS AUDIO ANALYZER

Three-way instrument is audio vtvm, signal tracer and 1,000-cycle oscillator



R1—1.5 megohms, 1%
R2—150,000 ohms, 1%
R3—15,000 ohms, 1%
R4—5,000 ohms, 1%
R5—1,500 ohms, 1%
R6—560 ohms, 1%
R7, 9—1,800 ohms
R8—47,000 ohms
R10—pot, 1,000 ohms
R11, 20—220,000 ohms
R12—3,900 ohms
R13—100,000 ohms
R14—470,000 ohms
R15—5,600 ohms
R16—10,000 ohms
R17—see text
R18, 19—1,000 ohms, 1 watt
R21—27,000 ohms, 2 watts
All resistors ½-watt 10% unless noted
C1, 4—.05 μf, 400 volts, paper
C2—0.1 μf, 400 volts, paper
C3—500 μμf, mica
C5—25 μf, 25 volts, electrolytic
C6, 7—.01 μf, 600 volts, ceramic disc
C8—50-30 μf, 150 volts, electrolytic
C9—30 μf, 150 volts, electrolytic
D1 2, 3, 4—1N34-A
J1—coaxial connector
J2, 3—tip jacks
M—0-50 μa
RECT—selenium, 65 ma, 130 volts
S1—6-position rotary, nonshorting
S2, 3—spst toggle
T—power transformer: primary 117 volts; secondary; 150 volts, 50 ma; 6.3 volts, 1.5 amp; or 125 volts, 50 ma; 6.3 volts, 2 amps (Thordarson 22R12 or Stancor PA-8421 or equivalent)
V1—12AT7
V2—12AU7-A
Neon indicator lamp, NE-2
Sockets, 9-pin (2)
Case, 3 x 5 x 7 inches
Chassis, 4¾ x 2⅞ x 1½ inches
Miscellaneous hardware

Parts for probe
R1—47,000 ohms, ½ watt
R2—18,000 ohms, ½ watt
C1—33 μμf, mica
C2—.002 μf, ceramic
P1—coax connector to match J1
P2—tip plug to match J2 on meter
S—dpdt slide or miniature toggle
Probe case and tip (see text)
Alligator clip, wiring, etc.

Fig. 1—Circuit of the handy analyzer.

By KENNETH E. WALTERS

WOULD you appreciate a wide-band voltmeter which could also be used as a preamplifier, signal tracer and, with a special probe, as a 1,000-cycle test oscillator? If so, this article was written expressly for you.

The circuit (Fig. 1) uses two dual triodes, a 12AT7 and a 12AU7, in a highly stable amplifier circuit. Response is essentially flat from 20 cycles to about 250 kc. The instrument is usable to about 1.6 mc for comparative purposes. A low-capacitance switch for S1 would improve high-frequency response.

V1-a is a cathode-follower input stage, direct-coupled to the grid of V1-b. This second section of the 12AT7 is an ordinary voltage amplifier that has high-frequency compensation due to the low-reactance path offered by C3. The 1,000-ohm potentiometer in the

Ac vtvm covers 0 to 150 volts in 6 ranges—lowest range, 0-.05. Audio oscillator produces square-wave output with peak-to-peak amplitude of about 12 volts. Signal-tracer function useful in all audio stages. Can be used with demodulator probe in radio if stages.

Tested by a member of RADIO-ELECTRONICS' staff, the instrument operated quite satisfactorily. Readings on low-voltage outputs from Heath, Eico, and Knight audio generators were compared to scope readings. Author's frequency range of 20-250 kc is correct within total variation of 5-10%—error increases with frequency. Unit will make measurements at higher frequencies but accuracy is impaired. However, a correction chart could be drawn up.

BENCH TESTED

cathode circuit of this stage is the calibration control. Its setting determines the amount of degenerative feedback voltage from V2-b through the metering circuit. This feedback path is broken when S2 is open and the amplifier gain increases. This is highly desirable when using the instrument as a signal tracer.

V2-a is a voltage amplifier with R-C coupling to the cathode-follower output stage. We have degenerative feedback in V2-a because of the unbypassed cathode resistor R12.

A close look at the schematic reveals that there are two phase inversions, one at the plate of V1-b and the other at the plate of V2-a. Thus the output voltage will be in phase with the input. This is one of the requirements of an oscillator, and the feedback path through C1 and the switch in the probe (Fig. 2) is the other. The circuit oscillates at about 1,000 cycles. The output is a square wave with an amplitude of about 12 volts peak-to-peak at the probe tip.

The circuit is built into a 3 x 5 x 7-inch case. The small chassis is only 4¾ x 2⅞ x 1½ inches. The 1½-inch right-angle portion is cut to fit snugly around the meter case.

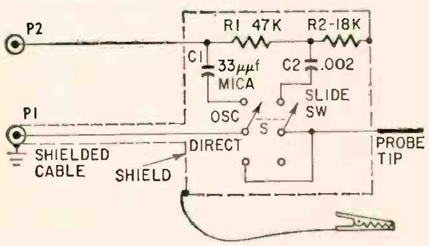


Fig. 2—Probe circuit enables operation as 1,000-cycle oscillator.

A common bus made of No. 18 copper wire is used for all B-minus connections. All leads are kept short and direct.

The combination direct and oscillator probe was built in the aluminum housing of an old can type electrolytic capacitor. The probe housing measures 1⅜ inches in diameter and 3⅜ inches in length. The probe tip consists of a small nail soldered into a phono plug.

Power requirements are slight. The power transformer I used had a 150-volt secondary so I added R17, a 750-ohm 1-watt resistor, to protect the 130-volt selenium rectifier. If a 125-volt transformer is used (as described in the parts list), R17 can be omitted.

Coupling capacitor C5 should be checked for leakage before closing S2. If this capacitor is leaky, excessive current may damage the meter movement. After completing the instrument, open S2 and apply power to the circuit. Check for voltage between J2 and J3 with a dc voltmeter. If voltage is found after initial warmup, it indicates leakage. An unformed, new capacitor may show leakage by the above test. Do not discard the unit—try forming it by leaving the instrument on for about an hour with a jumper across J2 and J3. This applies about 7.3 volts dc to the unit. Then make another voltage check.

To calibrate, set the range switch to the 5-volt position and touch the test leads to a 5-volt source, preferably at 1,000 cycles, and adjust R10 for a full-scale reading.

To use the instrument as an oscillator, open the meter-circuit switch and set the range switch for .05 volt. Plug P2 (Fig. 2) into J2 and then throw the probe switch to the oscillator position. The 1,000-cycle square-wave test voltage is now available at the probe tip. After using the instrument as an oscillator meter, switch S2 should not be thrown to the meter position for about 8 seconds. This lets capacitor C5 charge through the 47,000- and 18,000-ohm resistors in the probe assembly. This prevents damage to the meter movement as the charging current of C5 is much greater than that required for full-scale deflection of the meter.

When signal-tracing, place the probe switch in the direct position and open the meter switch to increase the amplifier gain. Phones are used to monitor the output.

With a detector probe the instrument can be used to signal-trace in rf and if circuits. My vtvm detector probe works nicely with the instrument, so I did not need a special detector probe.

The 1,000-cycle square wave can be used for amplifier response testing. An amplifier with good response to 10,000 cycles or more should pass the signal without changing the shape of the waveform.

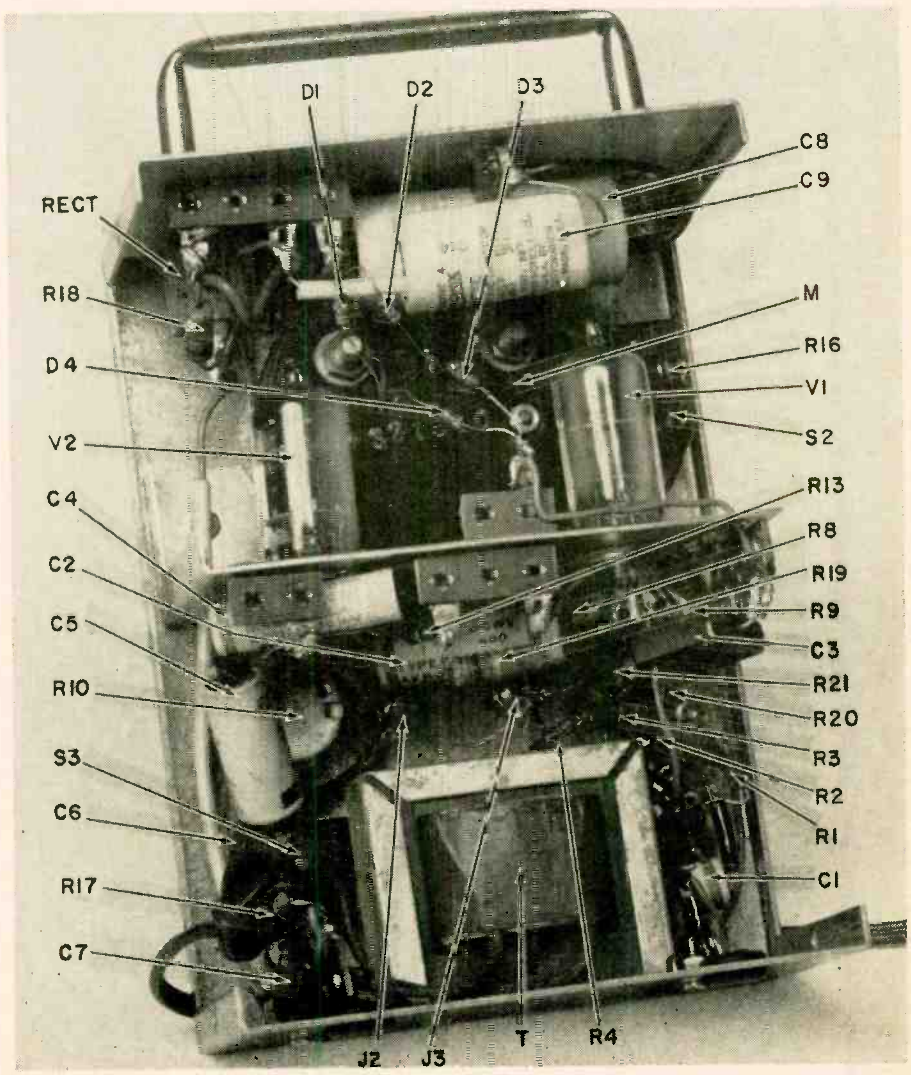
Use the voltmeter with an audio oscillator and you have a good capacitance meter. It measures capacitance from 1 to 2,000 μμf.

Set the oscillator to 1,000 cycles and adjust its output until the voltmeter reads full scale on the 0.5-volt range. Leave the ground leads of the signal generator and voltmeter connected and place the capacitor to be tested between the oscillator hot lead and the voltmeter input. The 1,000-cycle voltage divides between the reactance of the capacitor and the input impedance of the voltmeter according to the ratio of reactance to resistance.

On the 0.5-volt range, the meter reads capacitance from 20 to 2,000 μμf. For capacitance below 20 μμf, switch to the .05-volt range. This range reads from 1 to 11.6 μμf.

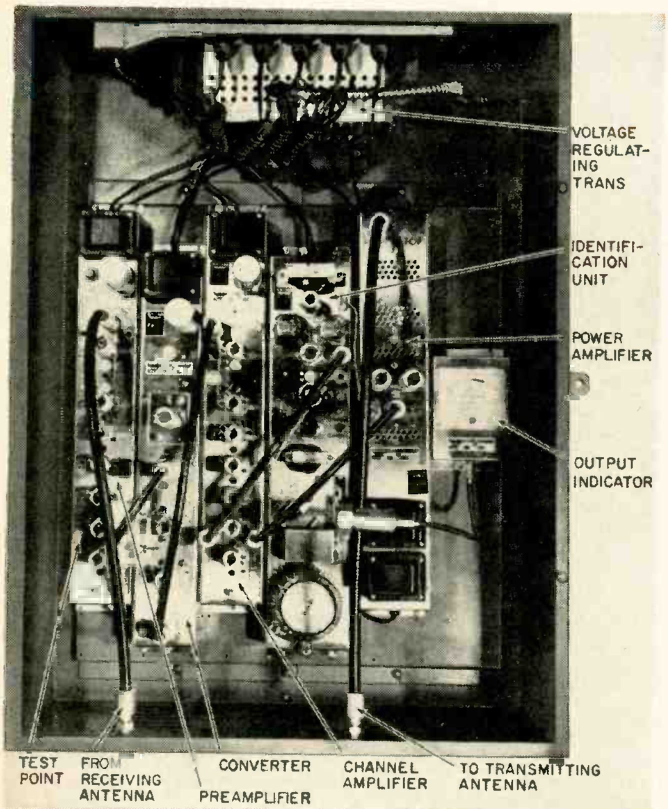
I would like to point out one more possible use for the instrument. That is as a code-practice oscillator. Insert a key between P1 and J2. Then set up the circuit for oscillator operation as previously described. The code signals appearing at the output (the probe tip) may be fed to phones or to a small amplifier and speaker system.

An instrument as versatile as this should find many uses. END



Parts arrangement inside the case.

VHF translator TV for YOUR town



Complete vhf translator less antennas and matching transformers.

Are you ready to install a translator?

By PHILIP FREEN*

TELEVISION coverage in North America has been steadily extended in populated areas, but there are many places where a full-fledged TV station is an economic impossibility. However, with translators, the same television programming can be brought to villages of as few as 100 families.

Until recently the Federal Communications Commission allowed the use of translators on uhf only. This often required uhf converters for each home TV set. FCC docket No. 12116, September 16, 1960, legalized vhf translators. Operators of vhf translator equipment must now file applications for temporary use until October, 1961, at which time all equipment in use must be approved by the FCC.

A translator is basically an automatic television transmitter, which picks up the signal from an originating station and rebroadcasts it to an isolated community that cannot normally receive the signal from the originating station.

Vhf translators can usually be completely installed for less than $3,000, if a suitable site with a source of 117-volt ac is available. A typical translator can be maintained for about $500–$1,000 per year. The local radio technician can usually maintain the equipment, providing himself with an additional source of income while performing a service for his community.

*President, Benco Television Associates Ltd., Rexdale, Ont., Canada.

How translators work

The photo shows the front view of the Benco T-1 translator. The callouts identify the various units contained in the transmitter housing.

The signal is received and fed through an antenna matching transformer to a preamplifier. This low-noise unit is tuned to the frequency of the distant television station. It has a gain of 65 db. The noise figure is 4 db on low-band channels and 6 db on high-band vhf channels. The circuit includes agc to maintain satisfactory picture quality with input signals as low as 50 mv.

The preamplifier raises the level of the input signal so that any man-made noise in the vicinity of the translator will have little effect. In addition, any traps or filters that may be necessary to clean up the received signal can be inserted at the preamp output, where the signal is at a relatively high level.

Next comes a crystal-controlled converter which changes the frequency of the incoming wanted TV channel to that of the chosen output channel.

The converted signal is further amplified by a low-distortion channel amplifier. This unit uses agc to assure that maximum permissible drive is supplied to the output power amplifier tube even when the input signal fades severely. This low-distortion channel amplifier also prevents any possibility of spurious signals (harmonics of the crystal oscillator, etc.) from reaching the power amplifier.

Finally, the signal from the channel amplifier is fed to the power amplifier. This unit feeds 8.7 volts with good linearity to the 75-ohm transmitting antenna, providing 1 watt of rf power plus, of course, the antenna gain.

By using a Yagi type transmitting antenna—it can be a heavy-duty version of a standard receiving antenna—it is possible to get 10 watts of effective radiated power.

Automatic operation

The second output of the channel amplifier is fed to the identification unit. This is a programmer designed to operate the translator. It switches the transmitter off when a very weak signal, or no signal at all, is being received. It provides facilities for remote-control operation, and superimposes station identification every ½ hour. The unit also provides a delayed switch-off action to avoid cutoff due to momentary signal fading.

The identification unit discriminates between the TV signal and an equal amount of noise, assuring a positive action when operating with weak signals.

A power indicator is connected to the final rf output. It is factory-set to indicate maximum permissible power level with a translator output of 1 watt.

The last unit shown is the voltage-regulating transformer. It is important for constant power output since most translators are operated at the end of poor-quality power lines, and the ac input often varies between 95 to 130 volts. Tube life can be doubled by using a voltage-regulating transformer.

Site location

Site location is a task that should be undertaken very carefully. These factors must be considered:

▶ A signal of at least 100 μv should be available from the remote master TV station more than 98% of the time. To find a suitable receiving site, erect a temporary antenna, usually a Yagi type, and monitor the received signal for about 100 hours. Bear in mind that during the summer months extremely erratic conditions prevail, and it is possible to get signal-strength readings 10 times higher than those which are normal for a particular TV station.

In mountainous country, the best receiving site is often on the slope of a mountain facing the distant TV station rather than on the top of the mountain as might be expected. Try to find a fairly gentle slope rather than a precipitous one. By searching with the test antenna, both vertically (5–20 feet) and horizontally, it is usually possible to find a signal if the desired TV station is less than 150 miles away and there is no abnormally high mountain between.

In flat country, the dominating factor is usually the height of the receiving antenna which, obviously, must be as great as possible.

A good translator receiving antenna becomes especially important in low-signal areas—stacked Yagis are generally recommended. Rhombic antennas are more difficult to construct, but, judging by our experience, have superior signal-capture characteristics.

▶ Having located one or more possible receiving sites, pick out a suitable transmitting site. It should be as close to the receiving site as possible. The most desirable would place the translator transmitting antenna overlooking the town or village to be serviced and not more than 5 miles away.

The translator transmitting antenna should not have high horizontal directivity. As a general rule, when maximum radiated power is required, vertical stacking is advisable. Here again good-quality heavy-duty antennas should be used.

The polar diagram of the selected antenna should, as far as possible, cover only the populated area of the village and have a minimum of back radiation and spurious side lobes. This puts all the available power where it will do the most good and decreases the possibility of interference with other translators in the vicinity.

If the best transmitting site happens to be some distance away from the best receiving site, a coaxial cable system will have to be used to bring the received signal to the translator.

▶ Whatever site is finally chosen for the transmitting antenna, there must be 117-volt power available. The source of power should be capable of delivering at least 1.5 kw with reasonably good regulation. The 1 kw over and above the electronic equipment's appetite is for soldering irons, lights and, most important of all, a 1-kw heater or hot plate. (Hot coffee and some warmth can be a life-saver after trekking up a mountain on a cold winter's day to replace a tube.)

If the receiving site is not at the same location as the transmitting site and amplification through a coaxial cable is required, it is possible to use remotely powered transistor amplifiers to eliminate the need for ac power at the receiving site.

The availability of ac power at a particular site in many cases overrides other considerations, since the cost of running ac power lines of even moderate length is rather high.

▶ After all the three factors outlined above have been considered and a site chosen, the next problem is the choice of a suitable enclosure for the equipment. While the Benco T-1 translator is completely weatherproofed and may be mounted outdoors on the antenna support, it is highly desirable, if possible, to have a small building available for tools, spares and human comfort. The translator will work quite happily in a temperature of 20 below, but *you* will not be at peak efficiency if you have to change a tube in this temperature.

▶ The nomogram shows the signal strength available across the input terminals of the home television receiver in a village served by a translator when the TV channel and distance from translator transmitting antenna to home receiver are known. The nomogram assumes a home receiving antenna gain of 9 db and a translator transmitting antenna gain of 6 db (with reference to an isotropic antenna) and a 2-db feeder loss on both the receiving and transmitting antennas.

For example, the dotted line indicates that a signal from a channel-2 translator will arrive with 500 μv across the home TV set's 300-ohm terminals via a line-of-sight path of 30 miles provided that the first *Fresnel* zone is cleared.

In simplified terms, the Fresnel zone is a criterion to determine whether the earth is sufficiently far removed from the line-of-sight ray to allow free-space propagation conditions.

For those interested, the first Fresnel-zone clearance is given by

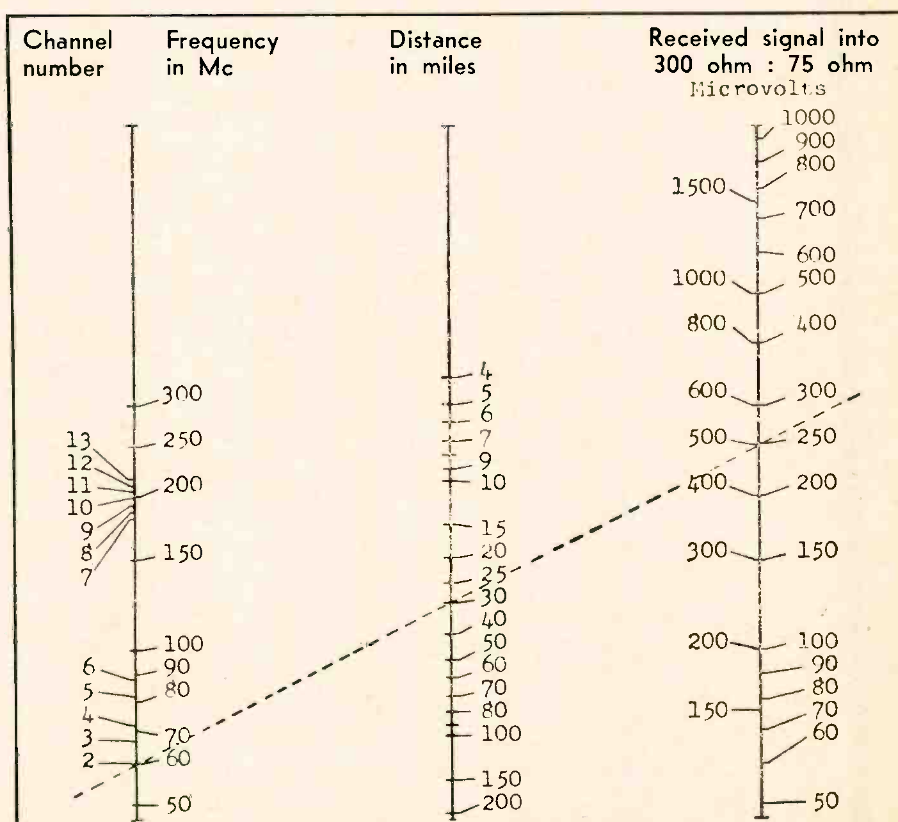
$$1{,}140\sqrt{\frac{d}{F}}$$

where d is the distance in miles between the transmitting and receiving antennas and F is the operating frequency in megacycles.

To take the example shown, the first Fresnel-zone clearance for Channel 2 for 30 miles is approximately 800 feet:

$$\left(1{,}140\sqrt{\frac{30}{60}} = 1{,}140 \times 0.7 \text{ approx.}\right)$$

This means that the line-of-sight ray



Translator signal vs distance and frequency.

from the translator transmitting antenna to the home viewing antenna should clear any obstacles in the middle of the span (15 miles) by 800 feet for the nomogram to be correct.

Installation

Installation is relatively simple since the translator package is a complete self-contained unit which, basically, needs only a receiving antenna, transmitting antenna and a connection to a 117-volt 60-cycle power source.

The unit is factory-aligned and the only control which may be set in the field without using test equipment is the power output control. The Benco unit has a power output meter. It should never read more than *maximum permissible power*. No other adjustments on the translator should be made without having a complete set of alignment data available with the necessary test equipment.

Be especially careful with coaxial cable connectors. Remember that each connection will be subjected to severe temperature variations, which tend to loosen threads and cause intermittents. Follow the manufacturer's instructions exactly.

Make power connections to the unit according to the local electrical code and make sure they are properly switched and fused.

The remote-control line, if required, should be installed from the translator to the operator's house or place of business. The line may consist of ordinary twisted-pair telephone line, but total loop resistance must not exceed the manufacturer's specifications (for the Benco T-1, 2,500 ohms).

After the translator is completely installed, use a television set to monitor the input signal at the monitor point provided. The picture obtained from the output of the translator can never be any better than the input, but, strangely enough, quite a few people expect it to be. Use a field-strength meter to check the ratio of sound to picture carrier. According to Hoyle, the sound carrier should be about half the strength of the picture (¼ of the power). Adjustments on the T-1 translator alter this ratio if necessary.

The sound carrier should never be allowed to become greater than the picture carrier. To be safe, we have found it advisable to keep the sound carrier at only ¼ the signal strength of the picture carrier (1/16 of the power).

This still allows excellent sound reception, but assures that, if for any reason (summer conditions), the sound carrier rises in respect to the picture carrier at the input to the translator, it will never exceed it. Moreover, it allows 15/16 of the output power of the translator to be put into the picture carrier.

The information in these few pages should, we trust, assist the local technician in siting and installing translators and, while this article has been slanted toward vhf translation, the same reasoning and procedure apply equally to uhf units. END

BBB Raps Set Manufacturers

NOT all those complaints against the electronic industry that we hear about from the Better Business Bureaus are customer complaints against the local service technician. More than a few are complaints from service technicians and dealers against distributors and manufacturers. This was revealed by Kenneth B. Wilson, president of the National Better Business Bureau, in a recent address to a meeting of the Service Committee of the Electronic Industries Association (EIA).

The technician did come in for his share of complaints, Wilson pointed out. But even then, the greatest volume of complaints directed at the technician was due to *misunderstanding of warranties*. It is no surprise to the service technician that the set owner is unpleasantly surprised to learn that, under the warranty setup, set owner and manufacturer are co-guarantors of the receiver and that his share—cost of the labor in replacing a defective part—may run several dollars more than that of the manufacturer—the cost of the actual component. The manufacturers may not be as aware of the situation. If such is the case, they heard of it at this meeting.

Dilatory service was another major cause of complaint, according to the BBB. Technicians may keep a set many days or even weeks. Customers are especially annoyed because "few explanations, if any, are given as to the cause of the delay in the meantime.

Overcharging, ineffective and incompetent service, and failure to live up to promises were the other main complaints against service technicians by customers.

Unavailability of replacement parts is the greatest cause of both public and service industry complaint against manufacturers (and distributors). The industry, says the BBB, may feel that it has some good alibis for this problem, but they are not good enough to satisfy either irate customers or frustrated technicians who have to wait weeks or even months for a needed part:

"The plain and inescapable fact of the matter is that they find it difficult, if not impossible, to believe that the brains and intelligence which have been able to create the fabulous new electronics miracles about which they read every day, cannot develop a system which will deliver replacement parts promptly."

Inadequate field testing and inadequate inspection formed the second complaint of the service technicians, and, they report, a frequent cause of customer complaints. Said Wilson, "Dealers report there are very few brands of TV sets they would dare take to a customer's home in an unopened carton, because so many sets require servicing *before* installation."

A group of related complaints centers around the quality of the product. Poor quality of components, unavailability of parts for discontinued or small-run items and units badly designed from a servicing standpoint all came in for their share of criticism.

Delay in correcting manufacturing faults irked technicians especially. In many cases, they tell the BBB, the manufacturer discovers a production weakness soon after a new model starts running, but continues to distribute sets already completed.

Poor communications of this type are often the fault of the distributor, as is the dissemination of other service information. He and the manufacturer are both held responsible by the service organization for failure to supply product and service data promptly. Another form of poor communications is the distributor's failure to report whether an order is being filled immediately or will have to be ordered from the factory. This puts the service technician at a disadvantage with his customer, because he cannot report definitely and accurately as to possible delays.

Availability of replacement parts is a responsibility of the distributor whose business is supposed to distribute just such parts, as well as of the manufacturer. Some distributors are the subject of complaints on this score.

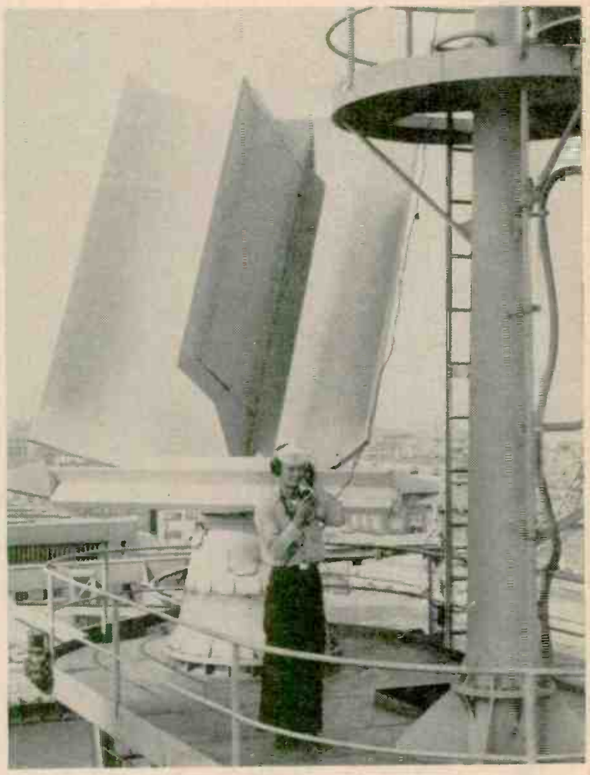
As might be expected, many complaints arise from distributor sales of parts to consumers at the same prices as to service customers, as well as the "nurturing" of spare-time service operators. Many of these, complainants point out, are presumably operating illegitimately, without filing tax reports on business done.

In concluding the report, the National Better Business Bureau presented 12 recommendations to manufacturers from among those received from the servicing industry:

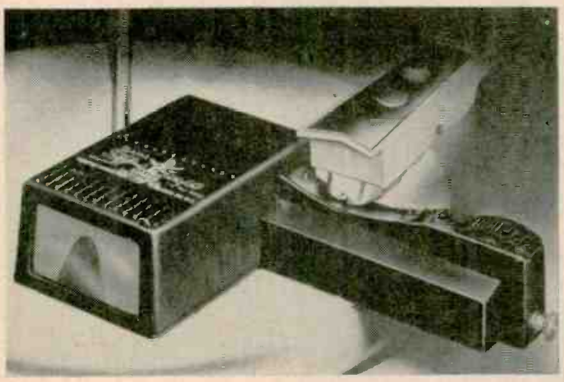
- Ship only tested products.
- Do more thorough field testing to minimize "built-in" breakdowns.
- Stick to high-quality components with long-life potential.
- Create better public understanding of the true nature of your warranties.
- Keep warranties within time periods which will be profitable to service.
- Get service information to the industry.
- Limit advertising claims to demonstrable performance in the field.
- Provide more and better training facilities and clinics for the servicing of the industry's products.
- Make replacement parts promptly available to the service industry.
- Design circuits with better accessibility to parts.
- Recognize and correct manufacturing faults promptly.
- Secure distributor cooperation in expediting parts orders. END

WHAT'S NEW

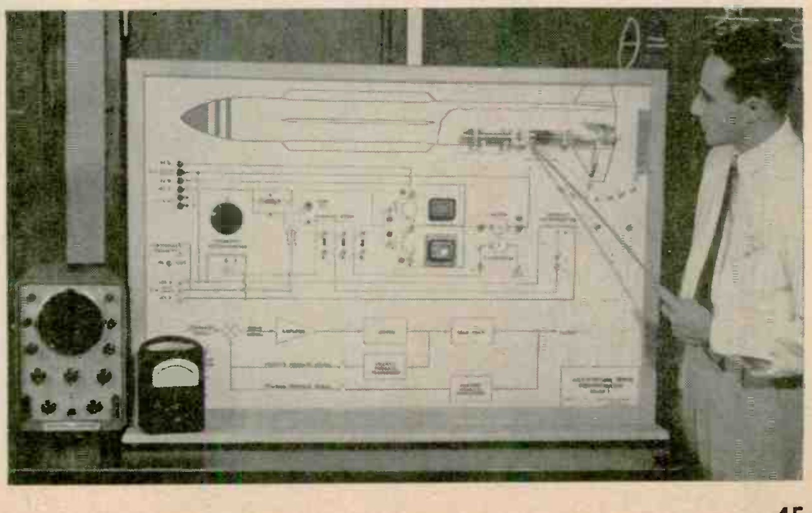
SCIENCE-FICTION MONSTER substitutes for man in dangerous places. Two TV camera eyes transmit pictures of its handiwork to human operator at a remote-control console. They can be remotely adjusted to view any action of the robot. Arms of the Hughes Aircraft *Mobot* are double-jointed at shoulders, elbows and wrists for extreme flexibility.



3-D RADAR ANTENNA on the masthead of missile cruiser USS Galveston simultaneously detects range, bearing and attitude of aircraft. Single antenna replaces two or more previously required to do the same job. Unit is part of Hughes Aircraft Frescan radar system.



WORN STYLII are easy to spot with the Syl-A-Scope. This simple optical instrument, a shadowgraph, displays a detailed magnified picture of any phonograph stylus and reveals any wear or flaws. The device is made by Robins Industries, New York, N.Y.



DYNAMIC EDUCATOR helps teach servo theory, design and application. Developed by Advanced Research Associates, Kensington, Md., the device includes an operable velocity and position feedback servo system mounted on a 33 x 49-inch demonstration panel. It is designed for use in vocational schools.

By **MANNIE HOROWITZ***

Custom HI-FI PreAmp

Engineering considerations in amplifier design

CHOOSING an amplifier to buy or to build from a kit or magazine article can be difficult. Overcomplicated units loaded with controls confuse rather than provide any worth-while benefit. On the other hand, a simplified unit which does not serve the complete purpose of the audiophile should also be avoided.

To simplify circuitry comparison, the amplifier is divided into two sections—the preamplifier and the power amplifier. Here, the preamp is discussed as an individual unit. This discussion also applies to the preamp section of a composite unit that has the preamp and power amplifier on a single chassis.

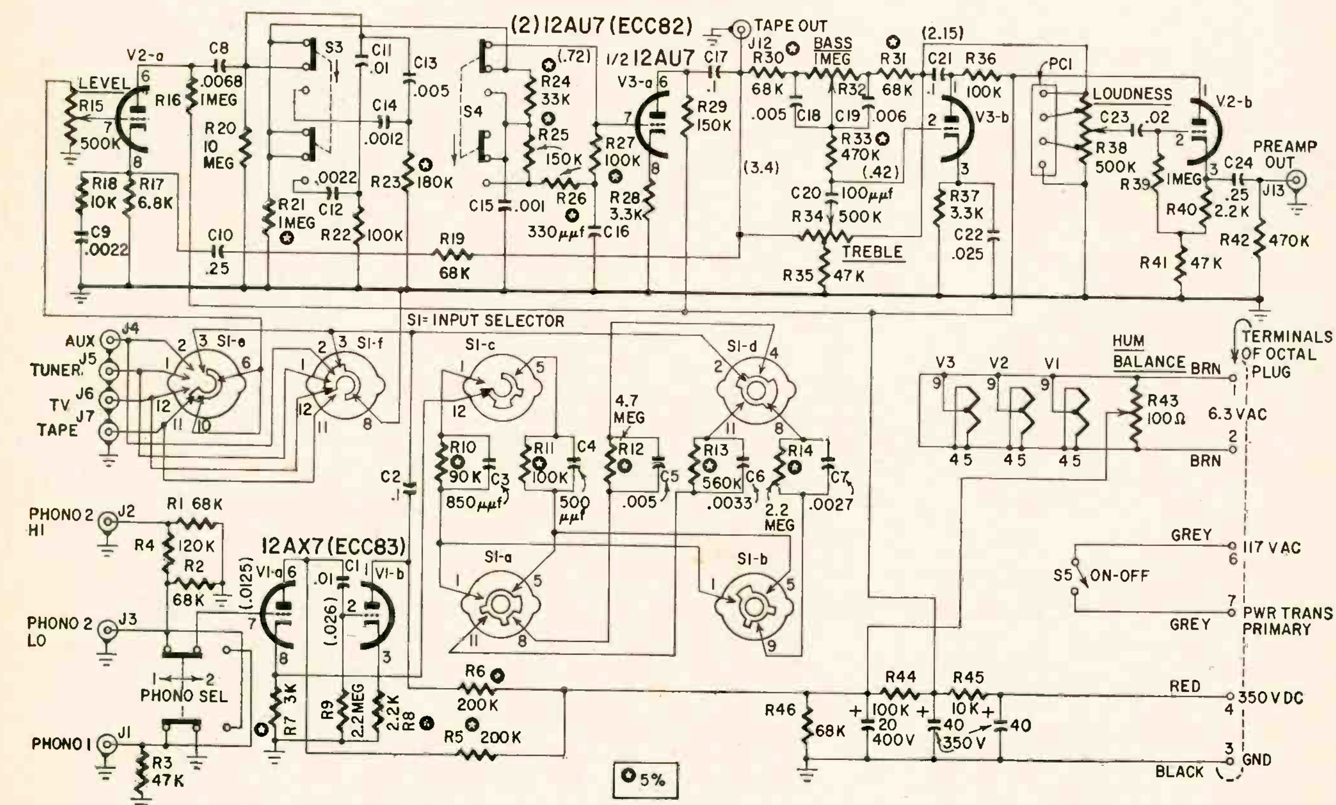
The preamplifier may consist of an amplifier stage for a magnetic cartridge, a group of rumble and scratch filters, a tone-control section and a low-impedance output stage.

Fig. 1 is the schematic of the Eico HF-61A preamp. A simple yet complete unit, it lends itself easily to analysis and circuitry comparisons.

That the unit is built for versatility is especially noticeable at the phono input, where there is a special slide switch for selecting one of two record players. This is useful for individuals who use a record changer for old 78- and 45-rpm discs and a turntable for 33's. Phono 2 has two input jacks, J2 and J3. J2 is compensated for high-output magnetic cartridges. Fig. 2-a shows how this section can be simplified when only one input is necessary.

The output from the phono pickup is fed to a high-gain amplifier stage for a magnetic cartridge. Not only must this stage provide a gain of about 50 at mid-frequency, but it must also incorporate the circuitry for the various record equalizations. The most common

*Electronic Instrument Co. (EICO), Long Island City, N. Y.



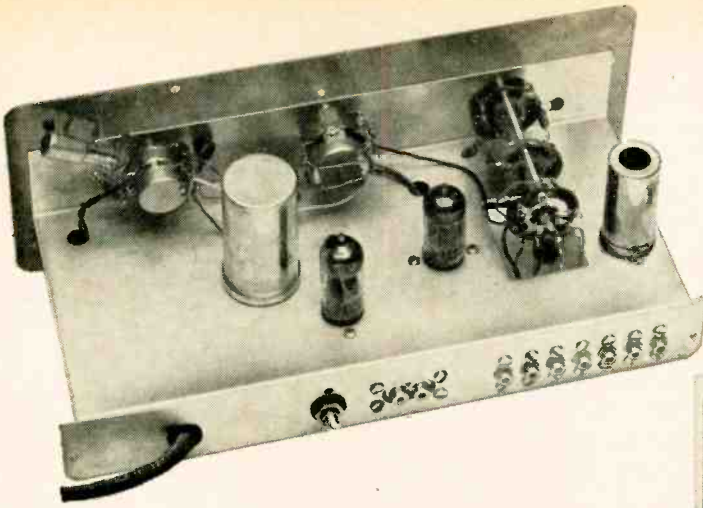
NOTES

Selector switch S1 shown in TAPE position. Moves clockwise to TV, TUNER, AUX, COL, LON, RIAA, AM-78, EUR-78.

Rumble filter S3 shown in flat position. Moves down to 50Ω and 100Ω.

Scratch filter S4 shown in FLAT position. Moves down to 10 KC and 5 KC.

Fig. 1—The Eico HF-61A preamp.



Chassis layout of the HF-61A. Input jacks and hum-balance control are on back panel.

The Eico HF-61A, a control preamp.

equalization in use today is RIAA-Ortho. Some equipment manufacturers feel that equalization for Columbia, London, American 78 and European 78 records should also be included. This is done here by switching networks with sections S1-a through S1-d on the INPUT SELECTOR. Actually, the curves for all these equalizations vary slightly from each other, and any slight compensation, although approximate, can be made by adjusting the tone controls.

Hum, noise and distortion

Fig. 2 shows the schematics of two magnetic-cartridge amplifier stages featuring RIAA equalization. Fig. 2-a is the same circuit used in Fig. 1—this time shown with only a fixed RIAA compensation. The stage must be designed for a minimum of hum and distortion. Frequently, one of these factors is sacrificed for the other. Circuits using feedback usually do both and have minimum distortion without excessive hum.

Low hum levels in a feedback circuit are possible; 50 db of hum below full output is not too difficult to get. You can get somewhat lower hum, but higher distortion, if you use a losser, rather than a feedback circuit (Fig. 2-b).

Several manufacturers have attempted to eliminate hum entirely by using transistors in this stage. While they got rid of the hum, the transistors sometimes introduced a more annoying factor—a high noise or hiss level. At the present state of the art, a good 12AX7 or its European low-noise equivalent, the ECC83, is probably superior to the transistor in this application.

Careful design and layout can overcome the many hum, noise and distortion problems inherent in the magnetic-cartridge preamplifier stage. However, it would be preferable to eliminate this stage entirely.

Several ceramic cartridges on the market are as good as many magnetic types and require no more gain from the preamp than does a tuner—making the extra amplifier stage unnecessary. The better ones are accurately equalized to the RIAA curve. Using these cartridges, we can get comparable results without the drawback of the hum, noise and distortion inherent in some of the amplifier stages designed for magnetic cartridges.

The phono amplifier output as well as the high-level inputs (J4, J5, J6 and J7) are all fed to a selector switch, S1-e, where the particular channel to be used is chosen. Barring the use of the selector switch for any other function, input selection can be handled by a single-pole five-position rotary switch (Fig. 3). However, switch S1 on the HF-61A accomplishes one more important function not possible with a jobber stock item. Section S1-f shorts to ground all inputs not in use to avoid crosstalk.

S1-e leads to a level control. Although theoretically a simple attenuator, a pot has a small inherent capacitance from the sliding arm to ground. So, if its value is made too large, some settings of the control result in rolloff at the high frequencies. Values between 500,000 ohms and 1 megohm will give satisfactory results. Lower values can be too much of a load on the inputs.

The networks and switching for scratch and rumble filters are between

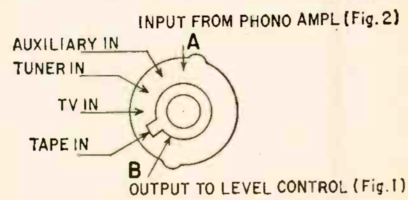


Fig. 3—Input selection can be handled by 1-pole 5-position rotary switch.

V2-a and V3-a. Rumble switch S3 moves down for 50- and 100-cycle cutoffs. Scratch filter switch S4 moves down for rolloffs at 10 kc and 5 kc. In the position shown, there is no filtering action. Sliding the switches down provides for rumble and scratch filter action. Since each switch has three positions two degrees of filtering can be provided, with the remaining position for flat output.

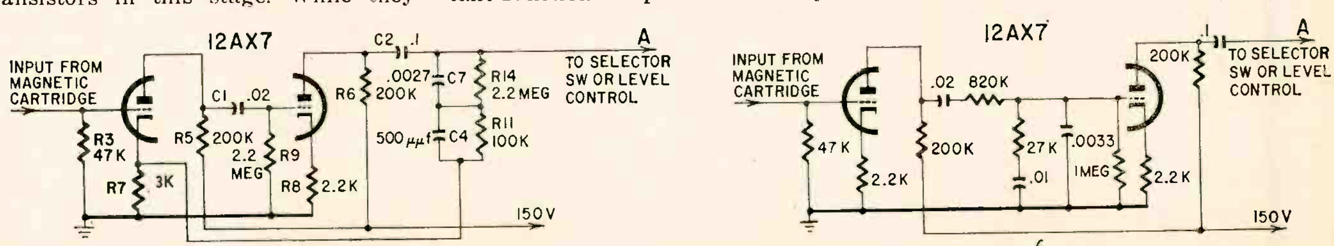


Fig. 2—Equalization circuits: a—feedback type; b—losser type.

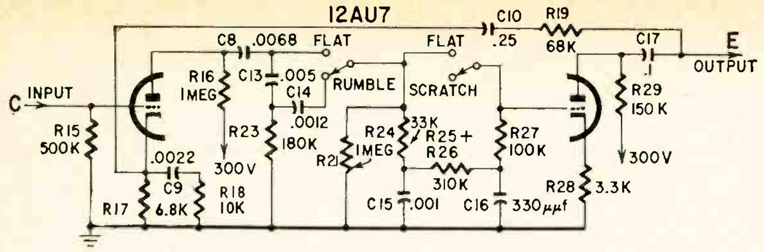


Fig. 4—Simplified feedback type scratch and rumble filters.

When good mechanical equipment is used in conjunction with a preamp, the scratch and rumble filters are not an absolute necessity. A good tone control, such as the Baxendall type, can be used for some of this filtering action. However, if these controls are desired (scratch and rumble), they should be

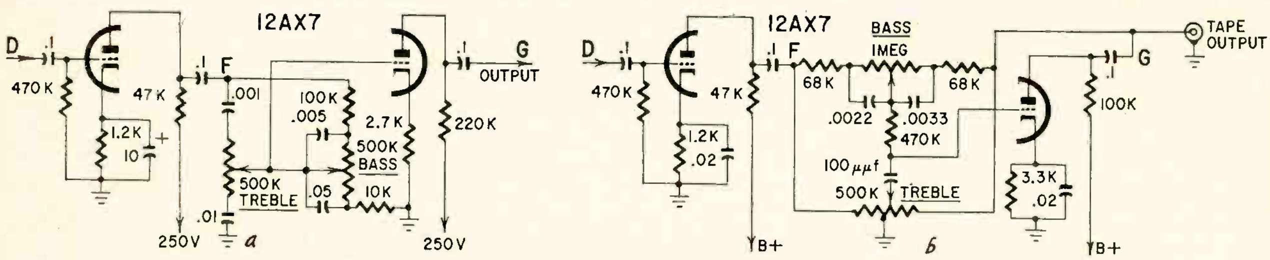


Fig. 5—Tone control circuits: a—losser type; b—Baxendall feedback type. When used with Fig. 4 circuit, eliminate everything ahead of point F.

inside a feedback network (Fig. 4). In the Eico HF-61A, this feedback network is from the plate of V3-a to the cathode of V2-a through R19 and C10 (Fig. 1).

Tone controls

For many years, the most popular type of tone control was the losser. No feedback is included in the circuit. As a result, response was seldom perfectly flat and distortion was high. An excellent system, the Baxendall gives perfectly flat response with cancellation of distortion in the tone control stage. This is done with the help of the feedback loop (from plate to grid which also provides the tone control action (Fig. 5-b).

An output to a tape recorder should come from some low-impedance point in the unit. It should not include loudness compensation, but should include rumble and scratch filters, if any. This output should come before the tone controls because of the lack of linearity in these circuits. However, when using the Baxendall type, this objection is minimized.

To do all this, a cathode-follower output should be placed before the tone controls for the tape takeoff. However, a low-impedance output can be taken directly from the feedback type Baxendall tone control, if used (Fig. 5-b). The HF-61A uses the low impedance at the plate of V3-a (the result of feedback) for this output. In this instance, there is no undesirable tone-control coloration when recording.

The LOUDNESS control, compensating for ear inefficiencies at the high and low frequencies at low output levels, follows this circuit. When located at this point in the circuit, the LOUDNESS control can serve as a volume control for monitoring the signal being recorded, without affecting the actual recording. The LEVEL control, R15, limits the signal strength to the tape recorder to undistorted amplitudes. The preamp has a very-low-impedance output because of the cathode-follower action of V2-b.

One note about the power supply is highly important for good results from any preamp.

A good, well filtered power supply is necessary. However, many separate filter capacitors are frequently provided in one metal can. This can lead to coupling within the can betwen the individual capacitors, resulting in excessive 120-cycle ripple being introduced into the high-gain phono amplifier section. It is thus necessary to have a physically separate decoupling capacitor for the earlier preamplifier stages.

Build your own

A simple preamp can be made by combining some of the drawings. For example, you can start with a phono equalizer stage, either Fig. 2-a or 2-b. Feed the output from this, A, and the other inputs to a selector switch in (Fig. 3). The output from this switch, B, can go to a level control and then to the scratch and rumble filters (C in Fig. 4) when desired; or else it can go directly to the tone controls (D of Fig. 5-a or 5-b). If scratch and rumble filters are used, the output from these, E, can be connected to point F on either tone-control system, omitting the first tube and associated circuitry. The tone control output, G, can serve as the preamplifier's output. A conventional, well-filtered power supply can be added, using the rectifier circuit shown in Fig. 6 and the filtering circuit connected between the red and black leads of Fig. 1.

Many combinations are possible and

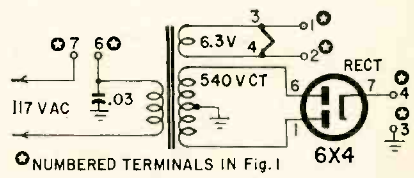
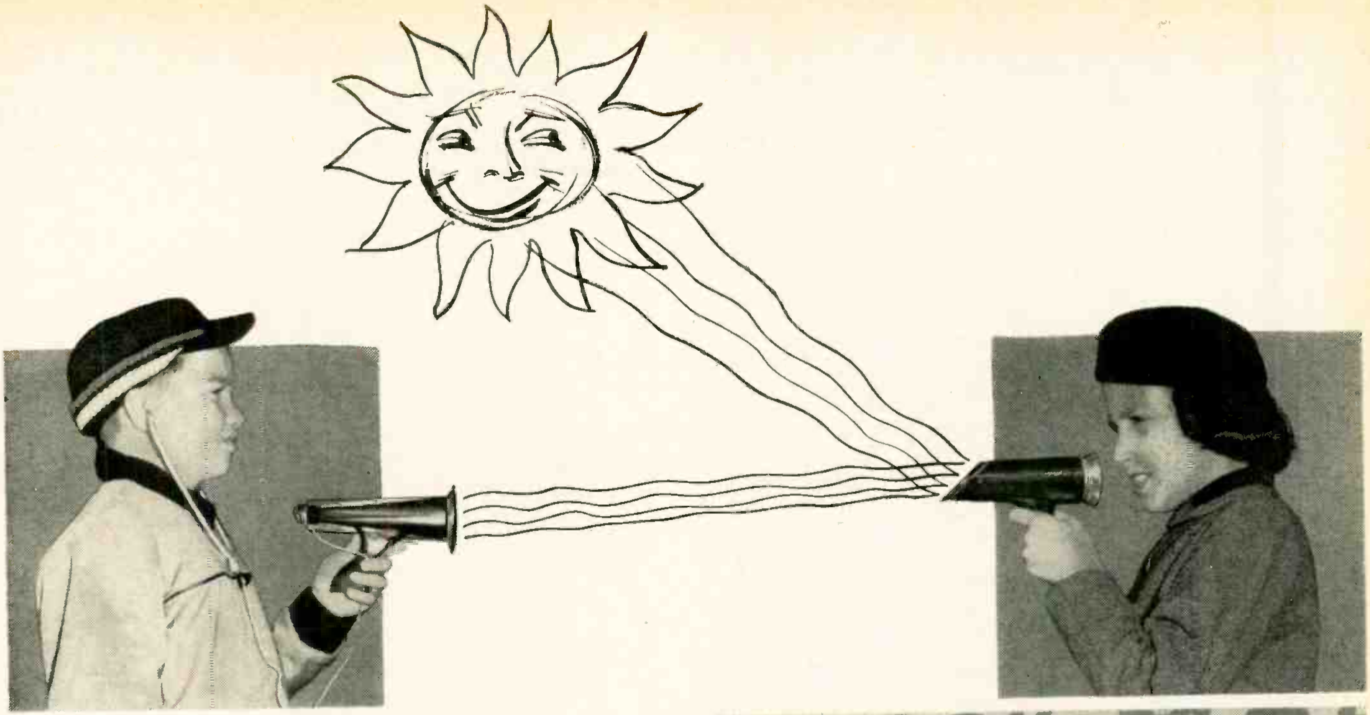


Fig. 6—Power supply used to convert Eico HF-61 into a self-power unit.

interesting results can be achieved.

A general note on wiring is important to the successful completion of any preamp. Beware of noise-causing rosin joints or rosin flux flowing into sockets. If necessary, clean the sockets with contact cleaner when the pre-amplifier construction is completed. Pay careful attention to necessary shielding and rules concerning ground loops to avoid hum and oscillation caused by electrostatic and electromagnetic fields. END

Suggested by G. Auman



LIGHT-WAVE Communication

The Infraphone. Large upper circle is receiver detector, smaller lower one, the infrared source.

ORDINARY daylight and infrared light are the signal carriers of two new line-of-sight communications systems. One, the daylight version, is sold as a toy, yet works well enough to be considered much more. The infrared unit is sold as a communications device, a job which it fills effectively. Communications systems of this type would work well in space and might some day be used by a future space corps.

The toy is called a Sun-Fone. It consists of two units—a receiver and a transmitter. The transmitter is a plastic gun-shaped device with a mouthpiece on one end and a flexible mirror on the other. The mirror is adjusted so sunlight is reflected from it toward the receiver. Once aimed, the user speaks into the mouthpiece. The voice causes the mirror to vibrate at an audio rate, modulating the light-beam reflected by the mirror.

The receiver is another plastic gun-shaped device. The modulated light strikes a solar cell mounted at the rear of a trumpet-shaped light shield. It changes the modulated light into an ac voltage that is fed to a pair of headphones. They convert the ac signal back into sound and the listener can hear what his partner with the transmitter said. There is no amplifier and no batteries in the unit.

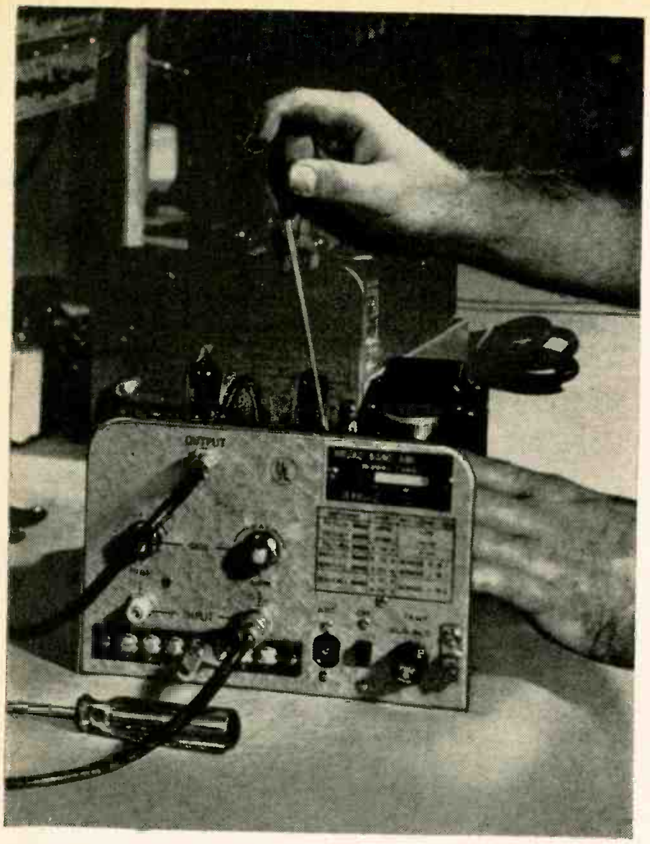
The infrared device is called an Infraphone. It is made by Infrared Industries Inc., Waltham, Mass. It is designed for commercial applications where it can fill the need for low-cost two-way communications in places where radio cannot be used or is not practical.

The unit is battery powered and can be used day or night. With mirrors, it can even be used to communicate around corners.

All infraphone units are combination receivers and transmitters. Each looks a little like a reflex camera in which one lens is the infrared source and the other the detector. Both receiver and detector use a printed-circuit transistor amplifier; the transmitter to modulate the infrared output, the receiver to amplify the detected signal.

Both units point the way to efficient two-way communications devices that may one day be as common as the telephone. END

COVER STORY



ALIGNING WIDE-BAND VHF AMPLIFIERS

By JACK BEEVER*

Right equipment and techniques make it simple

ONE of the frustrating experiences in a bench technician's life is to be faced with the job of realigning a TV receiver after the customer has helpfully screwed down all the tuning slugs because he "found them all loose when the set quit, and knew they ought to be tight." When there are no alignment notes available on the receiver, even more puzzling things can occur. What technician hasn't watched the beautiful if response curve he had developed on the scope screen change to a horribly twisted affair just because he moved the alignment generator lead or turned the chassis over?

Well, TV receivers are simple! The technician is working "only" with amplifiers having 6-mc bandwidths at the most. Manufacturers of TV distribution amplifiers have had to face aligning amplifiers with vhf bandwidths of over 50 mc and to do it on a production-line basis with people who need not be artists in the alignment field.

The problems they face, and the answers they have worked out, may help the TV bench man in his struggles with misaligned TV sets because the problems only differ in degree, not in kind.

Let's look at the things that are done when a vhf broad-band amplifier comes off the assembly line. It is roughly in the condition of the TV set of the first paragraph of this article—all the alignment slugs are set at random, just as the assembler left them. Before anything else can be done, the input and output circuits must be "matched"; that is, they must be made to show the proper impedances to the vhf signals they will receive or those they put out. In the equipment on the cover, this is 75 ohms, unbalanced, to match the standard cables (RG-59/U and RG-11/U types) used in wiring television distribution systems. If this is not done—and the next statement is important because it tells you why alignment curves can shift when leads are moved—the sweep generator used to develop the frequency response curves will see an improper load, and reflections will be set up in the lead.

This produces standing waves on the lead and may "suck out" part of the generator's output at some frequency and enhance it at others. The technician will then try to align his curve flat when the generator's output is not flat and his curve has no relation to the actual response of the amplifier. Fig. 1

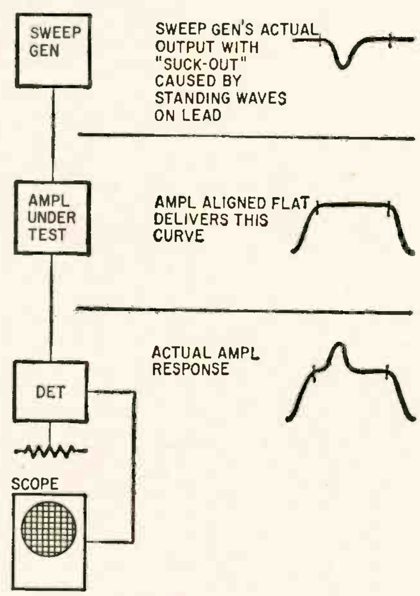


Fig. 1—Aligning an amplifier when generator output is not flat can produce strange effects.

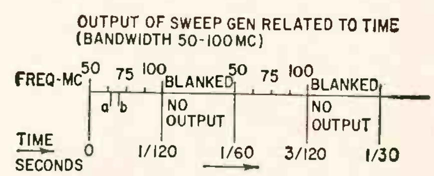


Fig. 2—Repetitive action of sweep generator.

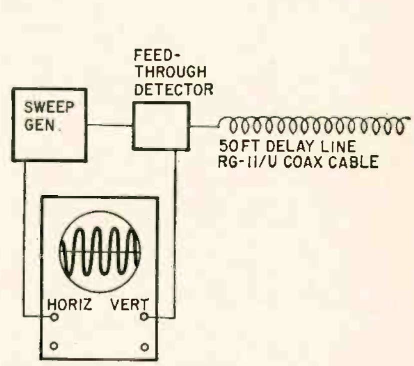


Fig. 3—Sweep generator feeding 50-foot delay line with feedthrough detector for developing scope pattern.

*Jerrold Electronics Corp.

graphically illustrates this effect.

Logically enough, the presence of standing waves on a line is used to determine the impedance match. If none exist, then the load is matched. The method of measurement is interesting and depends on the nature of sweep frequency generators.

A sweep frequency generator, at any one instant, is delivering a signal of a single frequency. A moment later, the frequency it delivers has changed, and this change goes on in one direction, say of increasing frequency until the upper band limit is reached. Then the direction of sweeping changes and the delivered signals are lowering in frequency until the lower band limit is reached. At this point the cycle starts again.

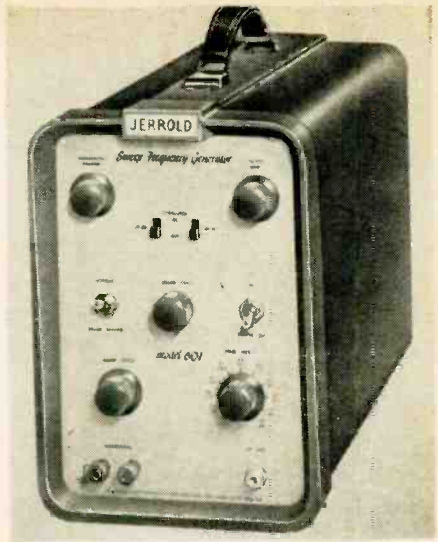
Fig. 2 illustrates this action with a generator using a 60-cycle sweep rate, and blanking. One full cycle of operation takes 1/60 second, the first half of this, 1/120 second, being occupied by the generator sweeping through all frequencies between the start (50 mc) and the finish (100 mc). The next half of the cycle is blanked—the generator output is cut off. The next cycle starts again at 50 mc and repeats the procedure.

Now examine Fig. 3. It shows a sweep generator feeding a long length of transmission line (50 feet or more at vhf), but has inserted into the input end of the line a vhf detector which does not interfere with the characteristics of the line (Jerrold D-86). The detector's output is connected to the vertical input of an oscilloscope, and the horizontal sweep is driven by a voltage from the generator which syncs it with the sweep's changing frequencies. Assume that the transmission line ends without termination—any vhf energy arriving at the end will reflect in its entirety and return down the line to the sweep generator. Let's see what happens!

Take an instant of time identified by point "a" in Fig. 2. At this instant, a signal of a given frequency starts down the transmission line. It takes a certain amount of time for it to get to the end of the line and an equal amount for it to return (as a reflection) to the beginning. By the time this signal returns, the sweep frequency generator has changed its frequency to that indicated by point "b" in Fig. 2. Then, at the detector we now have two frequencies, that of "a" and that of "b". When they are mixed in a detector (often called a "mixer"), we get heterodyne beats, which are the sum and difference of the two frequencies. The sum will be from more than 100 mc to more than 200 mc, which cannot be reproduced by ordinary oscilloscopes. But the difference frequency will be only a few hundred cycles per second, depending on the delay caused by the line. This will appear on the scope.

We are, therefore, seeing a beat note which is the difference frequency between the outgoing generator signal and the returning reflection. We, therefore, know that a reflection exists and that the line is not terminated (or infinitely long, which is the same thing). We do not know how much is reflected. But, the amplitude of a beat note is a function only of the lower powered of the two signals which produce it. Therefore the amplitude of our scope response relates directly to the strength of the reflected wave, since it is the weaker of the two due to losses suffered in the 100 or more feet of line it traversed before returning to the detector.

If we were to terminate the end of the transmission line in its characteristic impedance, there would be no reflected wave and, therefore, no beat to make a signal on the scope. However, let's put numbers to this, as the engineers say. We need this because getting a perfect match is well nigh impossible with practical vacuum-tube circuits and we must set a specification somewhere that says how good (or poor) our match needs to be. This is usually stated in VSWR—voltage standing-wave ratio —the ratio between the maximum voltage peak found on a line and the minimum, ignoring line losses. If standing waves exist, such peaks will alternate along the line, and the ratio between the lowest voltage found and the highest is the VSWR. If there are no reflections, the voltage along the line will be constant, and the ratio between any two points will be 1 to 1, so a VSWR of 1 (to 1 is understood) represents a perfect match.



Model 601 sweep generator.

A measurement could be made by carefully calibrating the scope, generator, detector and line losses to determine the actual reflection, but a much better technique is one which removes all these hard-to-control variables. This is by direct comparison. If a mismatch of known and variable characteristics can be used to compare to an unknown, we can make them equal and then know the value of the unknown.

A variable attenuator can be placed in series with a delay line such as that of Fig. 3 and, by attenuating the direct wave (outgoing signal) and the reflected wave, be made to appear as though it were anything from a 100% reflection to a perfect match. Such an attenuator is shown in Fig. 4.

To make such a measurement, the equipment is set up as in Fig. 5. The attenuator is set to 0 attenuation, and the beat-note pattern on the screen of the scope to a known height. The delay

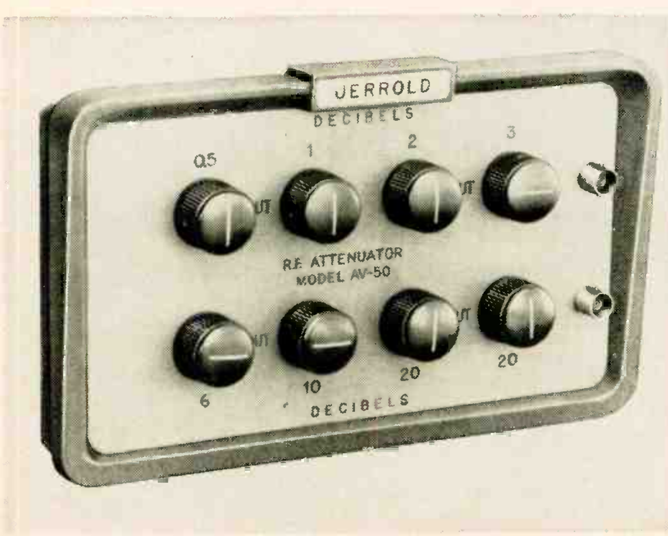
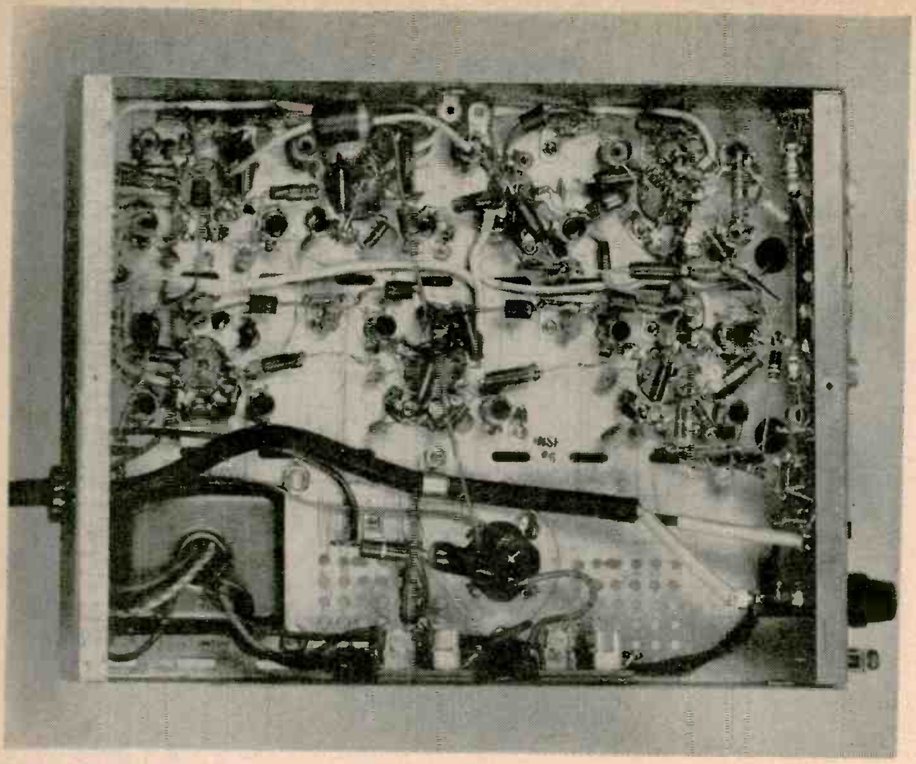


Fig. 4—Rf attenuator, model AV-50.

Model 2300 broad-band amplifier.



Underchassis view of the model 2300 amplifier.

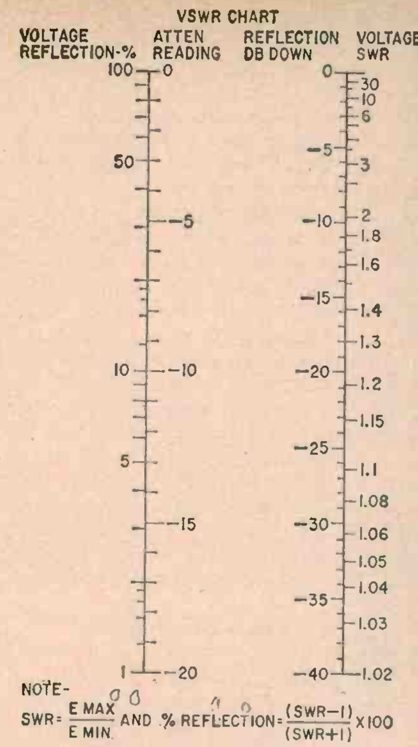
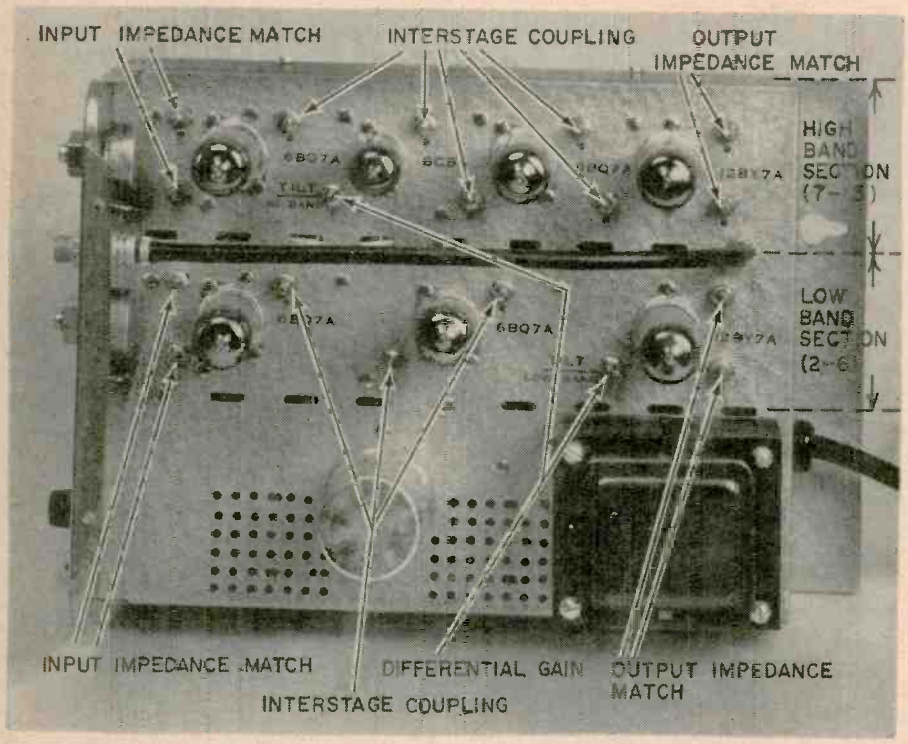


Fig. 6—VSWR nomograph.



Model 2300 top-chassis view reveals number of alignment adjustments.

line is then disconnected from the unknown impedance, at which time (if any degree of match is present) the beat-note pattern will increase in amplitude. The attenuator is then adjusted by adding attenuation until the beat-note amplitude returns to the same height as before. The attenuator reading can then be compared to the nomograph of Fig. 6 to determine the VSWR. Since the attenuator acts upon the signal twice (once going and once coming back), its attenuation is actually twice that indicated. Thus, a reading of 20 db is actually 40 db of attenuation and indicates a voltage reflection of 1% or VSWR of 1.02 (a very, very good match!!).

Introducing the "flicker-dicker"

It is cumbersome to adjust two or three controls to get such a match in an amplifier input or output, so a continuous display technique was worked out in which the operator merely matches two traces on the scope screen. This is done by using a high-speed coaxial switcher which can switch these vhf currents from point to point without introducing significant mismatches in the lines involved. Such a switcher is seen on the cover. Fig. 7 is a simplified diagram of the setup.

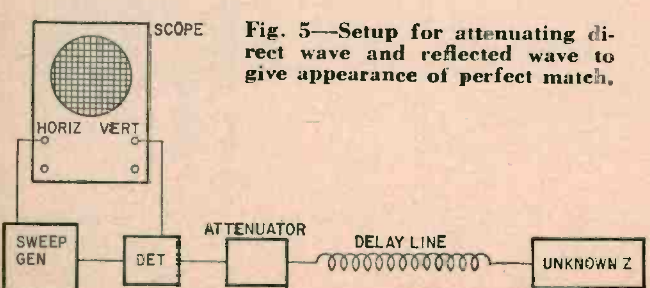


Fig. 5—Setup for attenuating direct wave and reflected wave to give appearance of perfect match.

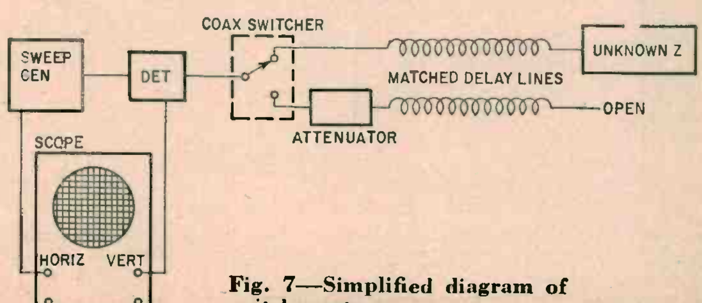
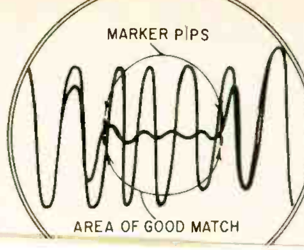


Fig. 7—Simplified diagram of switcher setup.



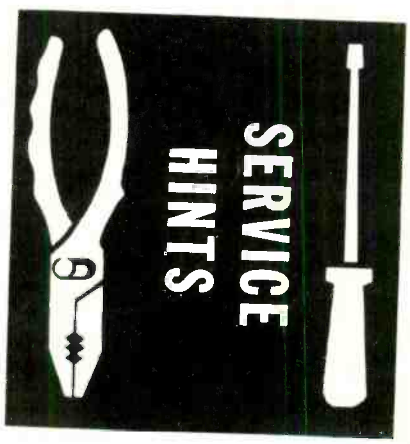
generator, it will trace line A in Fig. 10. During the second half-cycle, the blanking period (Fig. 2), there is no output and the scope presents line C in Fig. 10. This gives us a representation of the generator's output, one which will remain relatively true to other signals no matter where the scope's vertical amplitude is set.

At this point, the switcher flips to the up position and the generator out- ... amplifier whose out-

resistance depending upon lighting conditions. Rarely will the failure mechanism of a photoconductor show up as a short; however, a photoconductor may develop an open circuit due to damage to the cadmium-sulfide wafer which could be the result of dropping the device and cracking the wafer. The glass envelope is quite rugged and capable of withstanding more abuse than the fragile wafer.

It is important that no moisture enter the glass envelope, as radical changes in resistance will result. This can best be determined by measuring the resistance of the photoconductor in total darkness. Simply wrap the suspected device in a dark cloth with only the leads exposed and measure the dark resistance. It should be greater than 100K ohms. While all photoconductors presently manufactured by Sylvania are sealed in glass, it is possible that some TV receiver manufacturers are using those sealed with epoxy resin. This material may allow moisture to enter. For your convenience, all Sylvania photoconductors contain the "Blue-Dot" feature long found in Sylvania flash bulbs. This is a blue colored dot which turns pink with as little as an 8% increase in humidity. A photoconductor displaying the slightest change in dot color should be discarded even though it appears to have normal characteristics; it will soon become very unstable.

Undoubtedly, some TV receiver owners will require education in what should be expected of automatic brightness and contrast controls. There should be no apparent change in picture quality when room lighting is changed. This is the purpose of the automatic feature which may be demonstrated by placing the hand over the photoconductor and observing the change in brightness and contrast. Many observers will be surprised that the change is not greater than it is; but, as mentioned earlier, only a 50% change is required from total darkness to very bright room lighting.



NO VERTICAL DEFLECTION

In servicing the RCA chassis KCS 94, 95 and 97, I found zero voltage on the grid of vertical output tube VIII (6AQ5) and about 200 volts on the plate. I then noticed the white horizontal line did not seem bright enough and checked voltage on the CRT which was too low. In tracing from pin 10 of the CRT, I found R182 resistor (270K ohms) open. Replacing the resistor restored picture to normal. This same condition and defect was identical in all three chassis.

Mack Kunzman
San Francisco, California

NO-KINK TEST LEADS

sweeping at the rate which ...
full deflection to the half-cycle of sweep

setup of Fig. 9.

TRANSLATOR AUTHORIZATION FACT SHEET

...ve to set up a TV vhf trans- ...or your area and obtain proper ...ation for the station. Or you ...e to legalize an existing booster. ...select a vhf channel that will ...rfere with signals from other ...ons or translators. Then pick ... the translator. Instructions of ...nd installation can be found in ...le by Philip Freen on page 42. ...oration or association docu- ...f the organization putting up ...slator must be in order, and a ...sheet showing the outfit's abil- ...purchase the necessary equip- ...mandatory.

...note-control point for shutting ...he translator should it start ...g improperly must be allowed ...he translator cannot be reached ...han 15 minutes.

...you will need permission from ...ginating station to rebroadcast ...ansmissions.

...is point you file an application ...e Federal Communications Com- ... Use Form 346, obtainable from ...arest FCC field office or direct ...e FCC, Washington 25, D.C. The ...brought up so far are needed to ...e this form.

...you are ready to start work on ...ion. A small building is prefer- ... a housing for the equipment, ...desired, a locked weatherproof ...ounted right on the antenna mast ... Notify the FCC a little ahead ... of your intention to conduct on- ... tests so you can conduct them ...n as installation is complete.

...en the station is in satisfactory ...ing condition, file an application ... Television Translator Station on ...Form 347. Two days after notify- ...e FCC and the engineer in charge ... field district you can start pro- ...ning.

...eral organizations manufacture ...ranslator equipment that complies ...ll FCC requirements. They can be ...l sources of information and as- ...ce:

...lectronics
...re Ave.
...chelle, N. Y.

...-Tongue Laboratories Inc.
... St.
..., N. J.

...Television Associates
...an Div. of Blonder Tongue
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...lectronics
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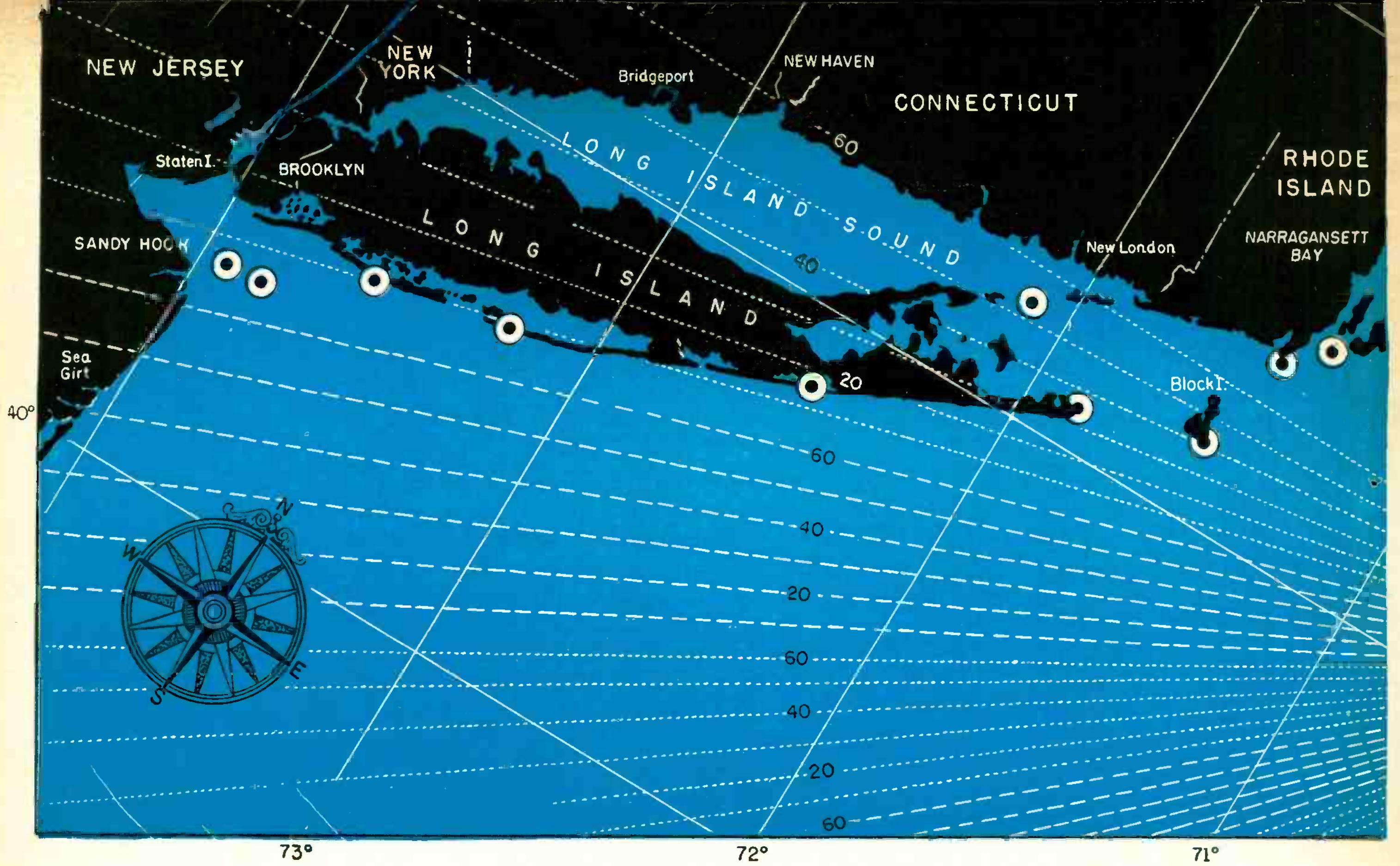


CONSOLAN—

New navigation aid for small boats needs only a surplus long-

By **ELBERT ROBBERSON**

I AM accustomed to odd questions. Like, someone will telephone and say, "I am sailing single-handed to England next month. What kind of communications equipment can I get that doesn't cost much, and doesn't need any batteries to speak of, and that will bring help if I am dismasted in mid-Atlantic."

The answer: homing pigeons. I can handle most questions of this type with similar answers.

But last spring I began to get calls: "Tell me something about Consol. Is it good? What kind of equipment do I need to pick it up? How does it work? How accurate is it?"

It seems that hundreds of yachting laddies were planning to enter the 1960 sailing race from Newport, R. I., to Bermuda. Word had passed down the grapevine about a new radio aid to navigation that would tell a skipper his position without having to shoot the sun with a sextant, or make pips behave on an oscilloscope, or twist a DF loop. This would make small-boat navigation as easy as falling off a bar stool. The idea had the boys drooling for the dope.

All I knew was that there were Consol beacons broadcasting in Europe and that airplanes using them got around in the fog just fine. But the fact there are Consolan stations in the US that can be used by boats was apparently one of the best kept secrets in electronics.

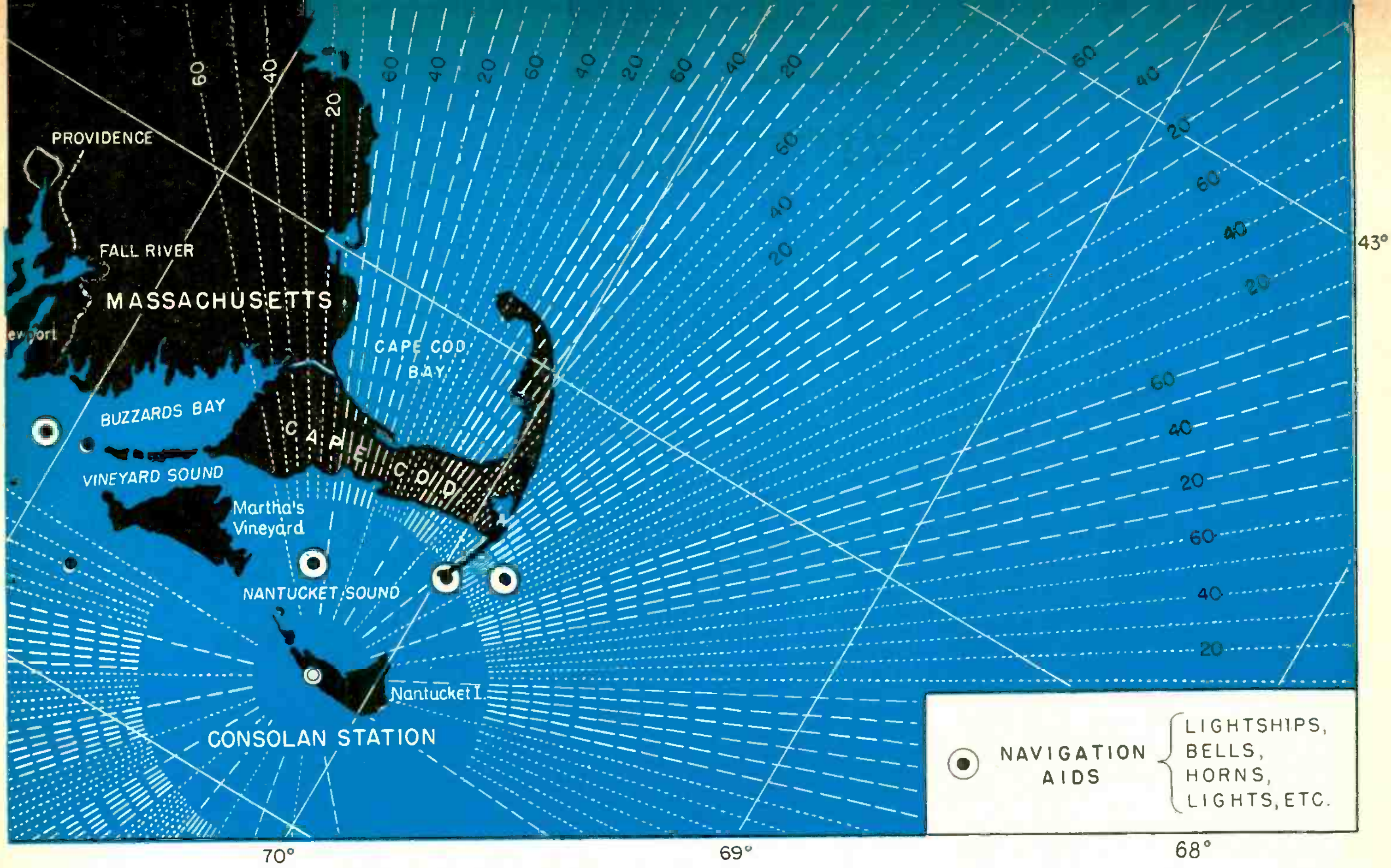
It is likely that electronic service agencies around coastal waters will begin to hear questions about Consol and Consolan with increasing frequency. You can be the first in your neighborhood to know the answers. And there might be something in it for the shop able to set up radio receivers to pick up Consolan signals. Here is the information I have been able to dig up.

During World War II, English pilots picked up curious radio signals from Germany. It was not long before they deduced that the directional pattern was just as useful for navigating Spitfires as Messerschmidts. This was Sonne, presumably so-named by the Germans because of the resemblance of the pattern to sunrays.

When the British built their own stations, they named the system Consol. In the United States, a slightly different system is called Consolan. All of them produce the same end result: a long-range pattern of radial sectors of dots and dashes. Simply by tuning in the signal and counting the dots and dashes heard, a vessel's line of position may be obtained from a set of tables or a Consolan chart. The only special requirements for the receiver are that it tune to frequencies between 190 and 200 kc, and that it have a bfo. No tricky circuits or adjustments are needed. All you need are ears and the ability to count dots and dashes. Consolan stations are operating at Nantucket and San Francisco, and a Consol type station in Miami is scheduled for completion in late 1960 or early 1961. There are five Consol stations in Europe, and Japan has a similar system.

How Consol works

Three vertical radiators in a line spaced three wavelengths apart and excited in phase with a power ratio of 1 to 6.75 to 1 produce the radiation pattern shown in Fig. 1. If the phase of the north tower is advanced 90° and the south tower retarded 90°, the pattern will be squeezed as shown in Fig. 2. And if this is reversed, so the north tower lags by 90° and the south tower



WHAT IS IT?

wave receiver, and some simple modifications you can make.

leads the same amount, the pattern is squeezed in the other direction, making a mirror image.

If we attach a keyer to the phase-shifting networks so the end towers are alternately leading and lagging, the pattern flip-flops between the solid and dotted lines of Fig. 3. With the keyer making interlocking dots and dashes for the two end towers, a receiver moved around the station would pick up dots in one sector and dashes in the next "around the clock." Between sectors the dots and dashes would merge into an "equisignal." There would be 24 equisignals, and each could be used like a radio range to "home" on the station.

To make the system useful on more than just 24 course lines, one more element is added: a rotating goniometer. The principle of the goniometer is illustrated in Fig. 4. This goniometer couples the transmitter to the towers so that, as it rotates, the excitation to the end towers undergoes a gradual change of phase from plus 90° to minus 90° (or the opposite). The effect is that the dot-and-dash lobes and the equisignal bearing lines rotate around the station.

The goniometer is driven at a constant speed of 48 revolutions per hour, taking 75 seconds to complete a revolution. Attached slip rings control the dot–dash keyers and the station-identification keyers. At the beginning of a sequence, the end towers are disconnected and the identification keyer sends out the station's identification letters for 7.5 seconds on the center (nondirectional) tower. Then for 30 seconds, as the phasing changes through 180°, the end towers are fed interlocking dots and dashes. A 7.5-second silent period or an identification follows; then another 30-second phasing sweep.

Each sweep 60 dots and dashes are sent out. The number and order of the dots and dashes you hear depends upon your geographical location with respect to the antenna lobes. Since equisignals are repeated approximately every 20° around the station, it is necessary for you first to know approximately where you are, but this ambiguity is of small importance in a boat because your position by reckoning (or guessing) will indicate in which of the sectors of the Consol pattern you are.

In effect, your count of dots or dashes tells you how far around the circle from the starting point the goniometer has turned to bring the equisignal to you. Hence, it gives your angular relation to the transmitting station.

Thus, if you happen to be on one of the lines marked "60" on the chart, you are along the leading edge of a segment and will hear 60 dashes (or dots) before the segment passes you (minus a few as you get into the equisignal). If you are in the middle of a segment, however, it will sweep around to the equisignal halfway through the listening period, and you will hear about as many dashes as dots.

Consolan is the same as Consol except that only two towers spaced three wavelengths apart are used. Due to the fact that three wavelengths very nearly amount to 3 miles at 190 kc, this saves a lot of ground area for the farmers. The lobe nulls become zero with Consolan, whereas they are filled in by the center tower of a Consol station. As far as the use of the facilities are concerned, however, operation is the same.

Theoretically, to obtain a Consol (or Consolan) line of position, you tune the receiver to the frequency with the bfo on and the avc off. Immediately after

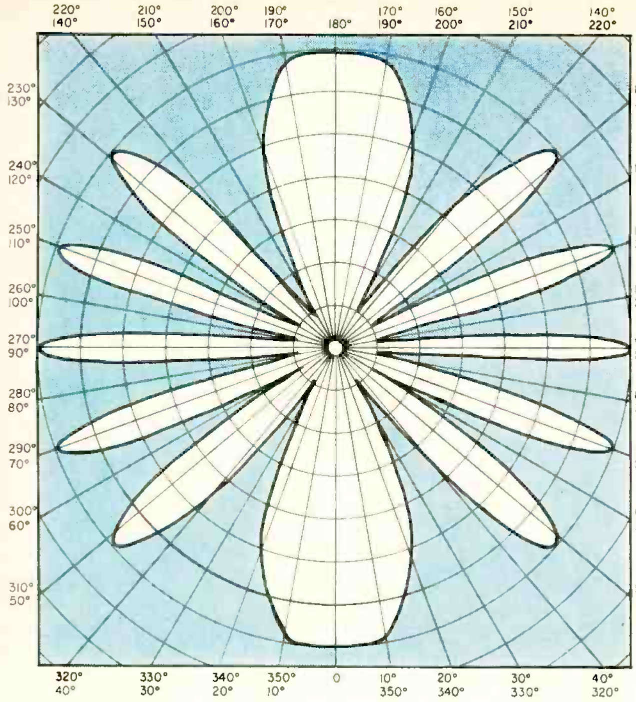


Fig. 1—Fundamental pattern from which Consolan pattern is derived.

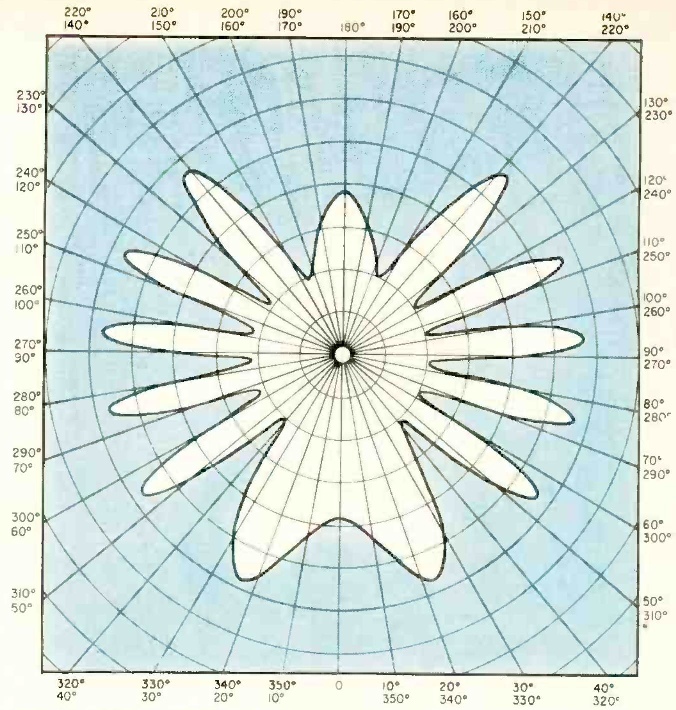


Fig. 2—Effect of 90° lead on north and 90° lag on south tower.

the identification signal is sent in code, start counting the first thing heard, dots or dashes, until they blend into the equisignal. Then, just look on the Consol chart and find the line that corresponds to your count. For example, a Consolan line from Nantucket (TUK) for 40 dots brings you to the Kitchen Shoals buoy off the eastern tip of Bermuda. Consol chart lines are inscribed every 10 or 20 characters; to find intermediate lines, just interpolate.

There are also Consol and Consolan tables for the various stations. These give bearing lines in degrees which can be marked on a conventional navigating chart.

In practice, the equisignal may be several characters wide or obscured by noise, so that one or more characters will be lost in the mud. To get an accurate number in spite of this, we add one refinement to our counting. It is based on the assumption that, during the equisignal period, the same number of dots and dashes is lost. Because 60 dots and dashes are transmitted, we can tell the exact number of characters that were not recognized, by subtracting the total number of dots and dashes heard from 60. Divide this difference by 2, and you have the number of dots and dashes lost.

For example, on Long Island Sound in my own boat, the *Short Wave*, I tune in TUK at Nantucket and start counting after the station identification is sent. I get 39 dots, then equisignal, then the dashes become audible and I count 17 dashes. Because 39 and 17 add up to 56, I see that I have lost four characters to make up the 60. This means that I lost two dots and two dashes. Adding the lost two dots to my count of 39 gives 41. Therefore, according to my chart, I am on the 41-dot line which extends from Mamaroneck, N. Y., eastward down Long Island Sound.

At the present time, due to the lack of additional stations from which to obtain cross bearings, it is necessary to use a course line or to take a radio direction-finder bearing on one of the numerous radio stations along coastal waters to determine a "fix." However, in the many cases for which Consolan is appropriate, this is no great disadvantage.

A simple regenerative receiver,

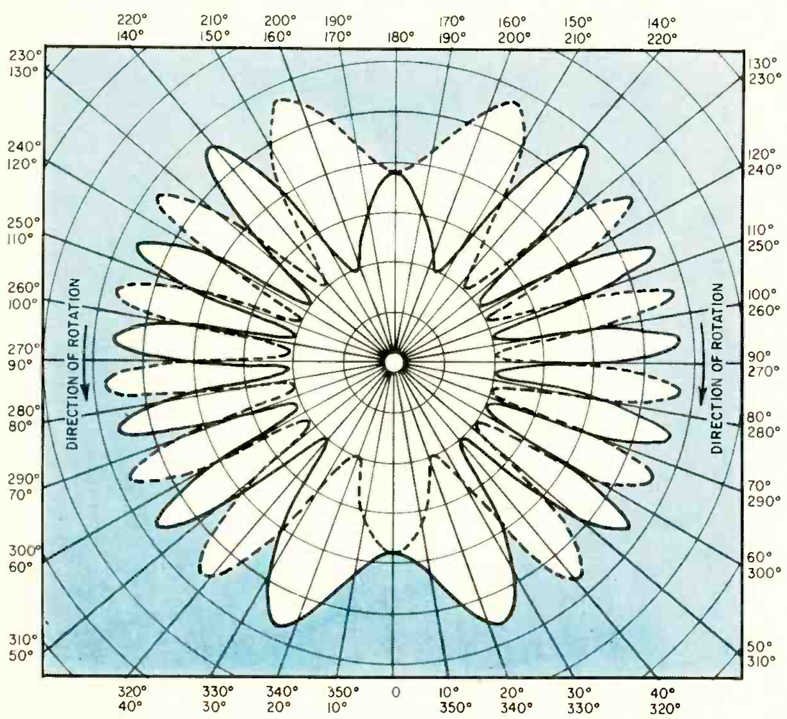


Fig. 3—Consolan patterns produced by dephasing antenna elements alternately.

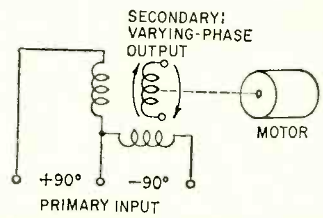


Fig. 4—Goniometer makes pattern rotate.

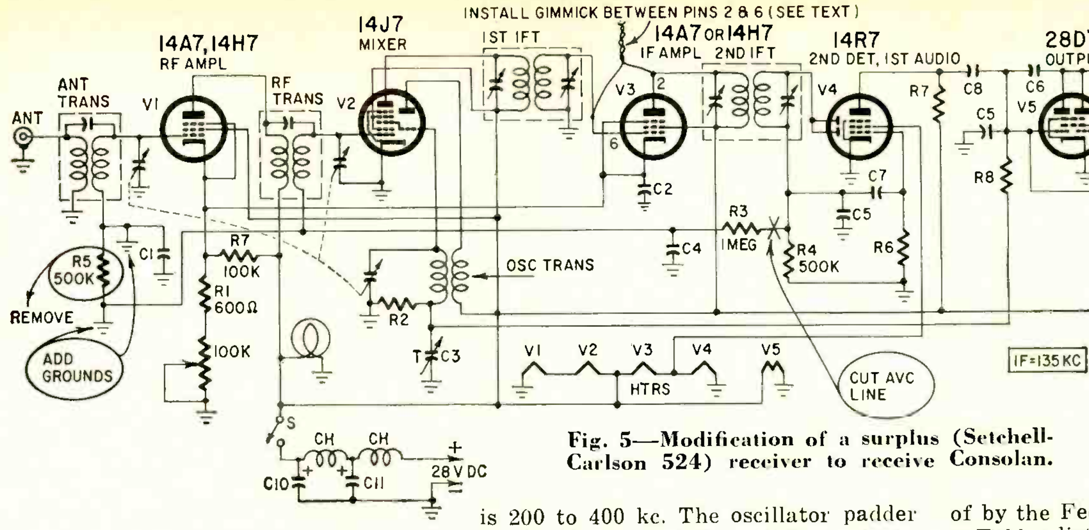


Fig. 5—Modification of a surplus (Setchell-Carlson 524) receiver to receive Consolan.

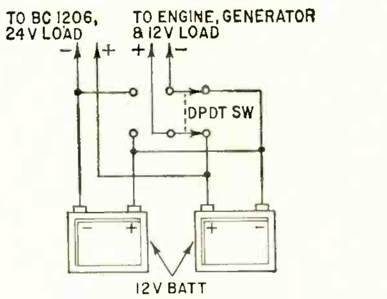


Fig. 6—Battery hookup on author's boat.

vacuum tube or transistor, is entirely suitable for Consolan reception. Too many of these have been described in the literature for me to make any further suggestions on their construction.

Another very good receiver for the purpose can be obtained from military surplus for under $10—the Setchell-Carlson BC-1206 Radio Range receiver. This set is originally wired with avc and has no bfo. I altered one of these for the *Short Wave* by grounding the avc bus and by soldering a 1¼-inch length of insulated wire to the grid terminal of the if amplifier tube. Dressing this wire across the socket and around the plate terminal for the same tube introduces enough positive feedback, or regeneration, to cause the stage to oscillate when the sensitivity control is advanced. This self-oscillation serves the same purpose as a bfo, permitting reception of the CW Consolan signals. Fig. 5 indicates the changes made.

The BC-1206 operates on from 24 to 28 volts. On the *Short Wave*, this voltage is obtained by connecting my two 12-volt engine batteries (the one in use and the reserve battery) in series, as shown in Fig. 6. This hookup, with a double-pole double-throw 80-ampere battery switch, permits using either of the 12-volt batteries on the engine and to operate auxiliary devices while making 24 volts available at all times for the Consolan receiver.

One caution—using this hookup, it is imperative that the 24-volt receiver *not* be grounded. Otherwise, you will have serious trouble from an opposite engine ground when the switch is closed.

The frequency range of the BC-1206 is 200 to 400 kc. The oscillator padder on the main tuning capacitor can be readjusted to extend the tuning range to 190 kc at the expense of losing a few unimportant kc on the high-frequency end of the band. The same effect could be obtained by realigning the if transformer tuning to bring in 190 kc when the tuning capacitor is fully meshed.

The same kind of alterations can be made to conventional small-boat radio direction finders or low-frequency receivers not already equipped with a bfo. Another possibility is to construct a small self-contained heterodyne oscillator covering the range of from 190 to 200 kc. This should be built in a nonconductive container to give the circuit the maximum coupling to the input circuit of the receiver. To make a 194-kc CW signal audible, the external heterodyne oscillator is placed alongside the receiver and tuned to from 500 to 1,000 cycles above or below 194 kc. A compact transistorized oscillator designed for this purpose is available from R. B. Stoops, 52 Hoyt St., Stamford, Conn.

The Consolan system is an interim aeronautical aid to navigation which will be used until some future date (my guess is that this is a long way off) when an "ultimate" aeronautical aid is decided upon. The construction and operation of US stations is taken care of by the Federal Aviation Agency.

Tables listing the location and bearing angles of US Consolan stations are printed in the US Navy Hydrographic Office and Coast Guard *Notices to Mariners* available to mariners at no cost. The US Navy Hydrographic Office, Washington, D. C., also issues a chart on which Consolan lines for TUK (Nantucket, Mass.) are inscribed: Plotting Chart (Newport to Bermuda), H.O. 16,510-A ($1).

The following aircraft charts containing Consol and Consolan angles may be purchased from the Coast and Geodetic Survey, Washington, D. C.:

Aircraft Position Chart, North Atlantic, 3071 (10¢)

Continental Entry Chart, East Coast, CEC-1 (50¢)

Caribbean Sea, GLC-9 (50¢)

Aircraft Positioning Chart, US–Honolulu, 3096 (for San Francisco, SFI)

Aircraft Positioning Chart, Caribbean Sea 3073 (for Miami, MIA)

Nothing is perfect, and Consolan is right up in there on this score, but here is a navigational aid for coastal waters that can be used to the fullest extent, requiring nothing more complicated than an ordinary "blooper" receiver. It is sure to find increasing use among boatmen as well as aviators. To be up to date, master its workings. END

NANTUCKET CONSOLAN STATION

DOT SECTORS

Count of Dots	True Bearing from Station								
0	20.2	39.5	60.7	91.4	138.6	169.3	190.5	209.8	229.6
1	20.1	39.3	60.5	91.1	138.9	169.5	190.7	209.9	229.8
2	19.9	39.1	60.3	90.7	139.3	169.7	190.9	210.1	230.0
3	19.7	39.0	60.1	90.3	139.7	169.9	191.0	210.3	230.2
4	19.6	38.8	59.9	89.9	140.1	170.1	191.2	210.4	230.3
5	19.4	38.7	59.7	89.5	140.5	170.3	191.3	210.6	230.5
6	19.3	38.5	59.5	89.2	140.8	170.5	191.5	210.7	230.7
7	19.1	38.3	59.3	88.8	141.2	170.7	191.7	210.9	230.9
8	18.9	38.2	59.1	88.5	141.5	170.9	191.8	211.1	231.0
9	18.8	38.0	58.9	88.1	141.9	171.1	192.0	211.2	231.2
10	18.6	37.9	58.7	87.7	142.3	171.3	192.1	211.4	231.4
11	18.5	37.7	58.6	87.4	142.6	171.4	192.3	211.5	231.6
12	18.3	37.5	58.4	87.1	142.9	171.6	192.5	211.7	231.7
13	18.1	37.3	58.2	86.7	143.3	171.8	192.7	211.9	231.9
14	18.0	37.2	58.0	86.4	143.6	172.0	192.8	212.0	232.1

Fig. 7—Portion of table showing bearings from TUK against given dot counts.

HEAT to electricity

The Klein converter, a new device for direct conversion of heat into electricity

By E. AISBERG*

ON July 1, 1960, the Academy of Sciences held a meeting in Paris, France, that may become historic. That day Francis Perrin, High Commissioner of Atomic Energy, read a note from Siegfried Klein entitled modestly, "Obtaining a Direct Current of Electricity from an Ionized Gas or Vapor."

Siegfried Klein is far from being unknown among electronics people. He has been known for several years as the inventor of the first loudspeaker, without a membrane, in which the sound waves are generated by vibrations of molecules of an ionized gas—the Ionophone.

One of the classic problems in the domain of energy is that of converting heat directly into electricity. The method used at present in atomic reactors appears thoroughly barbarous in the eyes of scientists. Between the calories that enter and the output watts from an atomic converter one finds several intermediary conversions. The heat boils water or heats a liquid metal. The vapor produced operates turbines that drive electrical generators. We can see how little logic there is in this and how urgent it is to find a direct method of converting heat into electricity.

In one type of heat-to-electricity converter—the MHD generator—heat ionized a gas, producing a *plasma*. At high temperatures, the extremely rapid movement of molecules produces numerous collisions between them. Some atoms are broken into two parts—a positive ion and a negative electron. By passing a jet of plasma through a magnetic field, we can separate the negative and positive charges, for the field impels them in opposite directions. They are then directed toward two electrodes which become the terminals for the electromotive force.

Siegfried Klein works with the same ionized gas. But he separates the opposite charges without using any deflecting field, magnetic or electric. And it is in this that his invention is remarkable.

Siegfried Klein's paper

We have been able to establish an important separation of positive and negative electric charges in a jet of ionized vapor, metallic or otherwise. This separation of charges is obtained without applying a magnetic or electric field in the vicinity of the collecting electrodes.

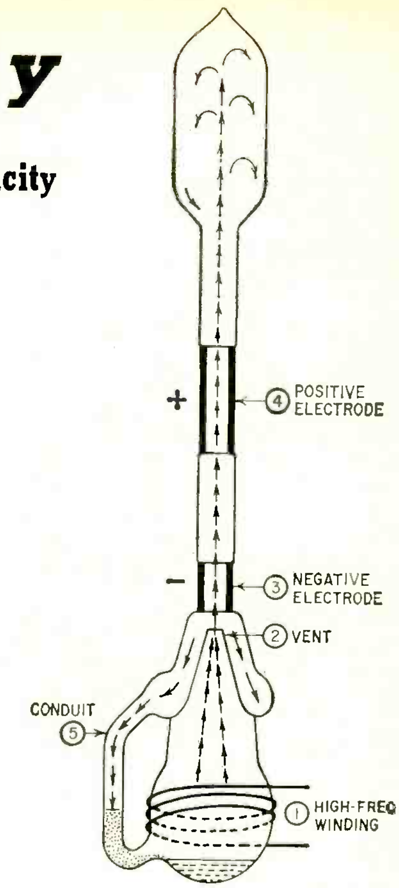
The experimental equipment shown uses mercury vapor. The setup consists of a glass vessel whose base forms a reservoir containing a certain amount of mercury. This reservoir has a vent (2) at its top and a tube (5) connecting the upper portion to the base. This section extends upward as a glass cylinder with metallic electrodes (3) and (4). The lower portion of the reservoir is encircled by a coil through which a 40-mc rf current flows to ionize the mercury vapor. Before being put into operation, the apparatus is evacuated to a pressure of about 10^{-3} millimeter of mercury.

Once ready, the device is placed over a Bunsen burner and the mercury brought to a temperature of several hundred degrees centigrade. Because of this heating, the mercury-vapor pressure in the reservoir rises to several centimeters of mercury and a powerful jet of vapor, ionized by the 40-mc field and carrying about 1 gram of mercury per second, traverses the vent and the electrodes. These vapors condense in the upper portion of the apparatus, where there is a vacuum in the order of 10^{-2} millimeter of mercury. The condensed mercury descends through the tube (5) into the base of the reservoir.

Experiments show that a continuous emf of approximately 10 volts appears between electrodes (3) and (4). The characteristic of output voltage vs load is that of a battery having in the most favorable case an internal resistance of about 50 ohms. The value of the emf is within large limits independent of the high-frequency power absorbed in the process of ionizing the mercury vapor. Varying the degree of ionization, on the other hand, modifies the amount of current collected between the electrodes. The current also depends on the amount of ionized fluid that traverses the equipment. For no load it starts from zero and increases rapidly. It reaches a maximum and then starts to decrease again, the flow of mercury continuing to rise. This fact is important, since it demonstrates that for a low degree of ionization of the vapor it is possible to obtain relatively strong currents. The amount of rf power absorbed increases directly with vapor flow.

It is worth noting that electrode (3) is near the vent and is always negative with respect to electrode (4). If more than two electrodes are placed in the path of the vapors, there is always 10 volts between two successive electrodes. Everything takes place as if two comparable electric generators were hooked up in series.

A slight cooling of electrode (4) facilitates the condensation of ionized vapor and influences current strength favorably. Other things being equal, if electrode (3) is at 350°C and electrode (4) at 80°, the emf is 10 volts and the internal resistance 15 ohms. If, on the other hand, electrode (3) is at 350° and (4) is 150° C, emf remains the same and resistance rises to 30 ohms.



Klein's converter.

Why it works?

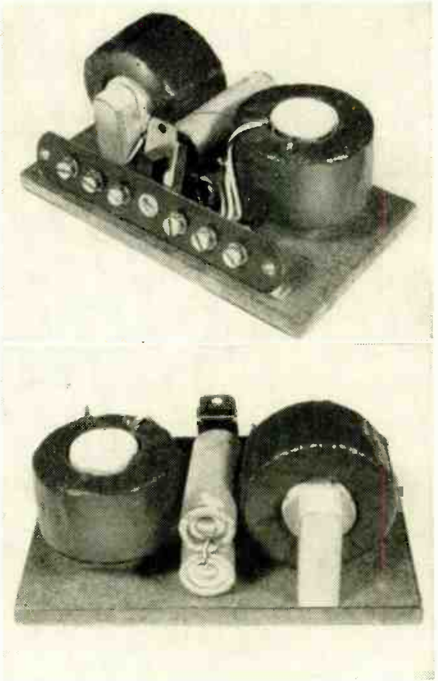
No exact explanation of the phenomenon that causes this separation of electric charges under the conditions described can be given at present. We believe that the separation occurs because the fluid formed of molecules, ions and electrons, in traversing the equipment at a high speed and penetrating afterward into a zone of low pressure, diffuses in an unequal fashion. The more mobile electrons reach the first electrode more rapidly and the ions and droplets, because of their greater mass, travel farther and condense on the farther electrode (4).

We have repeated the same experiment using water in the place of mercury. We got 90 volts instead of 10, but the internal resistance of the source of voltage is considerably greater. It seems that there is a relation between the emf's of voltage sources of this type and their internal resistances.

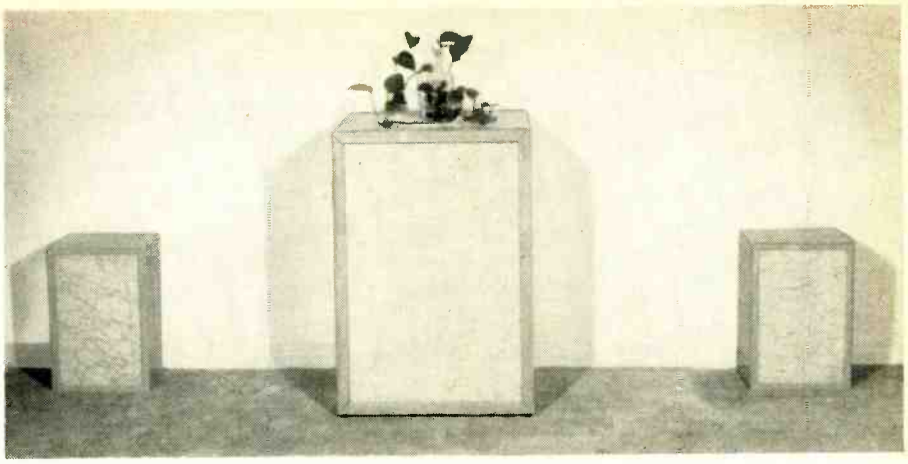
We believe that such a device could convert heat to electricity, assuming that the cesium vapor or other substances could be ionized by heat, for example by contact with a surface at high temperature.

To determine the yield of this kind of apparatus, we used a high-frequency source of energy that heated the mercury with eddy currents and ionized the gas and have found, up to the present, a yield up to 12%. END

*Director, *Toute la Radio*, Paris, France.



Two views of the completed crossover. Note the electrolytics nestled between the coils.



Convert Your Speaker System to STEREO for $20

Wing speakers and a simple crossover network combine with your present unit to make a satellite-type system

By GORDON R. LICHTENWALTER

HAVING built up what I considered a good-quality hi-fi system over the last few years, and upsetting the family budget at intervals, I was all set for fine recorded sound. Then came stereo on records! I listened here and there. No doubt about it. Stereo was very impressive, and the bug bit me bad.

My wife had been very tolerant of the "woofs" and the "tweets", the explosion of cannons and the tinkle of bells, which came after the children were in bed, the dishes done and the garbage disposal had stopped its infernal racket.

Then, once again I looked into the budget. My wife, reading my thoughts, give me one of those "Oh no you don't" looks. So the following is my inexpensive solution to stereo.

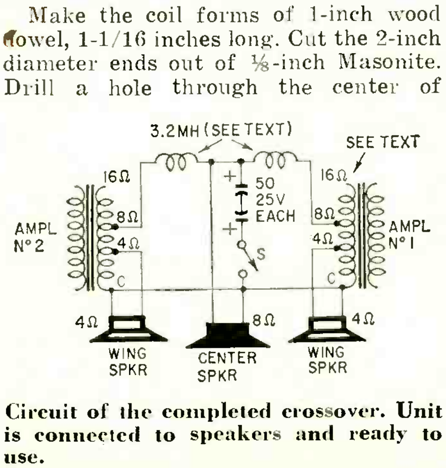
Browsing around one day I chanced to hear a stereo system using a good existing speaker system and two small wing speakers. The center speaker handled the bass end from both channels up to about 400 cycles, which, some say, is not too directional anyway, and the wing speakers took all frequencies available from the amplifiers. Just what I needed to go with the 15-inch speaker and Karlson enclosure, until I saw the price—the better part of $200! Not for me, but why not make something similar for myself?

A glance through the catalog and a trip to the Electronic House, and I had two 8-inch speakers that could handle 10 watts each. The dealer also furnished the plans for a small ducted-port enclosure (18 x 12 x 8½ inches) designed for the speakers.

The enclosures were sawed out and assembled in a few evenings, then checked out with a Hewlett-Packard audio oscillator, which my employer owns. The enclosure and speakers performed well, and played very nicely on the monaural system.

Next, work was started on the crossover, which consists of two inductors about 3.2 mh each, and two 50-μf 25-volt electrolytics hooked back to back to make a 25-μf ac capacitor. These electrolytics should be checked for equal capacitance and be of the same make and age, so that their power factor will be the same.

Make the coil forms of 1-inch wood dowel, 1-1/16 inches long. Cut the 2-inch diameter ends out of ⅛-inch Masonite. Drill a hole through the center of the dowel, and the Masonite ends. Assemble into a spool, using a 3/16-inch bolt and nut with large washers on each end. The bolt is removed later so, if you have no previous experience in coil winding, glue the Masonite ends to the dowel. Otherwise, when the bolt is removed, your coil may come apart. Of course, other forms may be used as long as they are not metal and have the same dimensions.

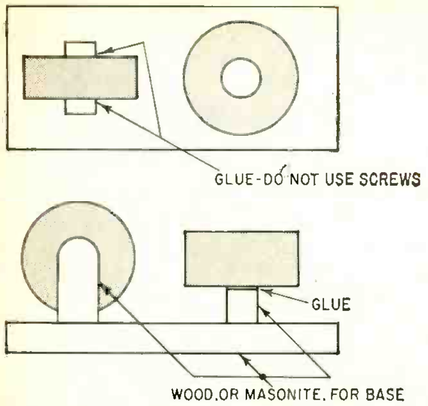


Circuit of the completed crossover. Unit is connected to speakers and ready to use.

Wind 355 turns of No. 20 enameled wire on the forms. Do not scatter-wind them or your coils will come out larger than the 2-inch forms and may have more inductance than needed.

If the layers become uneven, wrap a strip of heavy paper around the previous layer and start a new even one. I inserted paper about every third layer. When your coils are finished, wrap them with plastic tape or apply motor varnish to keep them from coming apart. Tie the end down or bring it through a hole in the Masonite. Remove the bolt and mount your coils as shown in the diagram and photos, using only nonmetallic mounts. The coils are mounted at right angles to keep one from inducing current in the other, as in a transformer.

The use of nonmetallic mounts keeps down eddy currents in nonmagnetic metals, and reduces the inductance and hysteresis distortion which would occur if magnetic materials were used. Hook up the coils and capacitors as shown. If you install a switch in series



Coils are mounted at right angles to each other.

with the electrolytics, you can change the crossover frequency and db-per-octave slope. This will result in filling in the center channel more with the switch open, or less with the switch closed. Either way, the center speaker will handle the bass for either channel or the sum of both.

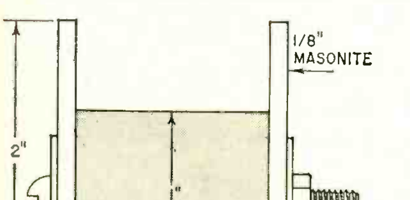
Phasing is a must in this system. Check all three speakers with a 1½-volt flashlight battery. Touch the speaker leads to the battery. If the speaker moves forward, mark the positive lead. If the speaker moves backward, reverse the leads and then mark the positive lead. These are your polarities. This movement can be seen through most grill-cloths with the aid of a flashlight.

Hook up the crossover as shown, and don't worry if the amplifiers are not matched. The unit has been tried with several combinations (thanks to interested friends and their stereo systems) and functions well with all types.

I use one 20-watt and one 10-watt amplifier. If you use amplifiers that are not alike, use a four-wire input system and reverse the wires on one half of the cartridge for correct phase. This is evidenced by full bass or lack of bass.

Properly hooked up and phased, the three speakers give wonderful non-directional sound on monaural, and all the stereo effect you can ask for without a hole in the middle when playing stereo.

This crossover was designed for an 8-ohm center speaker, but, if you now have a 16-ohm unit, you can get good results with the crossover as is, or add 80–100 turns to each coil. END



Details of coil construction.

TV Service Clinic

conducted by

JACK DARR, SERVICE EDITOR

Signal Generators in TV Alignment

We use several kinds of signal generators in TV work—rf, FM sweep, marker and so on—but in one aspect they are all alike. *For best results, we must match the impedance of the generator output to that of the load to which it is connected.*

Any kind of signal generator is a source of power. Its output is usually taken off through a coaxial cable whose characteristic impedance should match the output impedance of the generator. The cable impedance is determined by its physical characteristics: the dimensions and spacing of its conductors. The generator's output impedance is determined by the characteristics of the transformer or coupling device used.

Now, what about the *other* end of the cable? What happens there? If we simply connect a short piece of coax to a generator, we will inevitably find that it's a stub at some frequency! The generator is pumping rf power into the cable. Under certain conditions, some of this power will bounce back toward the generator, causing standing waves on the coax. If the coax were infinitely long, all of the power would be absorbed in it. If it has a finite length, there are always some conditions where we have incomplete absorption, reflection and the formation of standing waves.

In the infinite-line case, all of the power is dissipated in the line. It is shunted by the inherent capacitance and attenuated by the line inductance and resistance. With shorter lines, we can get the same desirable result by providing what we might call an artificial termination to do the same thing —absorb all the power that reaches the end of the line. To do this, we can connect a noninductive resistor across the end of the line. If it has the same resistance value as the characteristic impedance of the coaxial cable, it will absorb the power, thus preventing any of it from being reflected up the line to cause standing waves.

"But," says somebody in the back row, "if you absorb all the power, there won't be any left to put into the TV set! What do you do then?" A very good question. I was afraid you were going to ask that! Actually, I've been saying that all the power was absorbed in the terminating resistance. This, of course, isn't quite true. If you remember your textbooks, the power relationship between a generator and a matched load looks something like Fig. 1-a. Exactly half of the power developed by the generator is delivered to the load. Why? Because this power is the product of the current flowing in the circuit and the impedance (I^2R). If the impedances

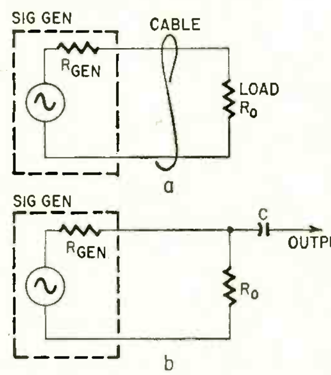


Fig. 1-a—Power developed by generator is divided equally between internal impedance of generator and impedance of load R_o. b—Power still equally divided between impedance of generator and resistance of load. Voltage drop across load resistor is taken off through capacitor C and used for alignment work, etc.

are matched, to prevent reflections and phase shifts, the two impedances must be exactly equal. Right? Therefore, if the same current is flowing through two equal resistors, half the power is developed across each one.

Same voice from the back: "Well, you've still used up all the power. What am I going to use for alignment on my TV?" Patience, friend, we'll get there. Now, let's see, I've used up all the power that was developed, but what you're forgetting is what happens when we pass current through an impedance (or resistance).

We get a voltage drop! If our impedances are matched, we get maximum current flow; therefore we also get maximum voltage drop. This is what we use to align our TV sets, the signal voltage (Fig. 1-b)! Power in these circuits is just a handy thing to do arithmetic with. The actual power output of the average generator is about seventh-tenths of a fleapower or thereabouts!

To terminate any signal generator output cable properly, simply look up the output impedance in the instruction book, if you can still find it. The average seems to be about 50 ohms, although some go as high as 90 and others have ready-made 300-ohm balanced terminations for use in tuner alignment. To make a termination, simply connect a plain molded carbon resistor of the right value across the end of the cable, as shown in Fig. 2, connect a small capacitor to the hot lead (the center conductor), and you're ready to go to work.

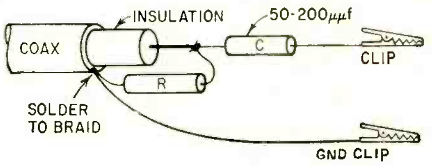


Fig. 2—Physical construction of terminating resistor and coupling capacitor.

Fig. 3 shows one of the ill effects you can run into when the cable is improperly terminated—false indications of regeneration in the video if strip or tuner. Even though the signal generator is very loosely coupled to the input (by clipping the output lead to a floating tube shield on the mixer tube), you can

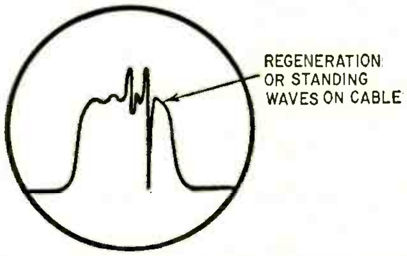


Fig. 3—How regeneration shows up in response curve during alignment.

still have trouble if the generator has standing waves on that cable!

Incidentally, if you want to check your generator's output cable to see if there is already a terminating resistor in it, disconnect it from the generator and simply take a reading across the cable conductors with an ohmmeter. If you get a 50-ohm reading, for instance, there must be a terminating resistor already in place. A completely open reading shows that there is no termination.

Herringbone on color set

In servicing an RCA 21CT660U color receiver, I found a herringbone pattern, discernible when color is tuned in. It seems to be tunable. It is particularly noticeable when a picture of little detail or a full screen of one color is present. Also, there are two vertical lines on the left side of the screen when color is being received.—J. I. H., Reseda, Calif.

This herringbone pattern on color can be caused by several things. The easiest to repair would be a misadjustment of the fine tuning itself. This would push the oscillator slightly off center on your color channel, making the color burst ride too far down the slope. Center the fine-tuning adjustment, then reset the tuner oscillator on that channel while color is being received.

Another possibility is that the 13th harmonic of the 3.58-mc oscillator is beating with the 45.75-mc picture carrier. This harmonic, which is about 46.5 mc, is coupled into the picture if circuits by the shielded cable which runs from C175, at the plate of the vertical output tube, to R29, on the terminal board nearest the CRT. The shield of this cable is grounded to the chassis near the 3.58-mc oscillator socket. Cut this ground loose and ground it at the other end, near the terminal strip. The new ground is apparently not critical. The trouble is caused by ground-return currents between the shielding and the chassis.

This type of interference, as I know, can be caused by a strong channel 8 signal. The 4th harmonic of the picture carrier will be picked up by the 300-ohm ribbon going to the vhf/uhf switch. Try installing a 22-μμf capacitor between terminals B and C on the 4th video if transformer. This usually reduces this interference to the point where it isn't noticeable.

Vertical shrinkage

A short time after this G-E 21C1550 is turned on, it loses height from the bottom. It comes up to about 2 inches after about 15 minutes. How do I tackle this one?—A. D., Quezon City, R. I .

This set uses a 6BL7 for both oscillator and output. The most likely possibility is a weak tube. However, this stage is fed from the boost so check the boost voltage for dropping after 15 minutes.

Another possibility: there is a thyrite resistor in the B-plus supply, 1 megohm cold and 600,000 ohms hot. Check it for excessive change in value.

Drive line?

A G-E 21C40 developed horizontal sweep trouble and I replaced the flyback transformer Since then, there has been a slight wrinkle in the horizontal sweep which appears as a bright line near the middle of the screen. Changing the horizontal linearity control no longer affects picture linearity to any appreciable extent.

I've replaced tubes, linearity coil and the screen resistor of the output tube with no effect. The bias voltage on the horizontal output grid is −45.—W. N. T., New York, N. Y.

It is definitely possible that the wrong flyback was used. This series is pretty critical about its flybacks and I do not know of any one outside of G-E who makes an exact duplicate. The correct part number for this chassis is an RTO-166-5. Check the flyback to see that the correct one was used.

Aside from this, the major clue would be in the action of that linearity control. All linearity controls introduce a "cancelling" or opposing voltage which lowers the power dissipated in the horizontal sweep circuit and increases the efficiency; in other words, the linearity control *must* "tune" to the flyback frequency to have the proper effect. If this isn't done, you will get a wrinkle in the raster.

From your reading of −45 volts on the grid of the horizontal output tube, it might seem that the trouble is caused by an overdrive condition; the value given in the service data for this chassis is −33. Overdriving the horizontal output tube will give you a drive line.

This chassis does not include any kind of horizontal drive control. So, if you have checked all the possible causes of overdrive (plate resistors in the horizontal oscillator, excessive B-plus to the horizontal oscillator, etc.), I suggest you try adding a drive-control trimmer capacitor to the circuit (Fig. 4). This is comparatively simple, as it can be a screwdriver-adjustable unit of about 3 to 15 μμf. It can be mounted

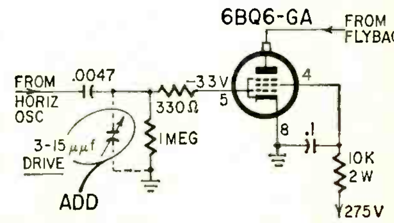


Fig. 4—Adding a horizontal-drive control to a G-E 21C40.

on the back apron of the chassis. With this, pull your drive down and see what effect this has on the line. I would recommend checking the horizontal output tube plate current both before and during these adjustments. Also, see what effect the horizontal linearity control has on plate current; it should show a dip, even though it may be a slight one. You might, as a last resort, try using a different linearity control; the correct replacement has an inductance range from 4 to 28 millihenries.

Jitter

I have an intermittent vertical jitter in a Crosley 426. It occurs about every 30 seconds, after the set has warmed up for 5 minutes. This seems to be due to only one field of the scan jittering! When I put a scope on the yoke, I can see one pulse stationary while the other jitters!

I've changed everything in the circuit including both electrolytics and the transformer and yoke. Now I've run out of possibilities!—C. F. W., Mason City, Iowa.

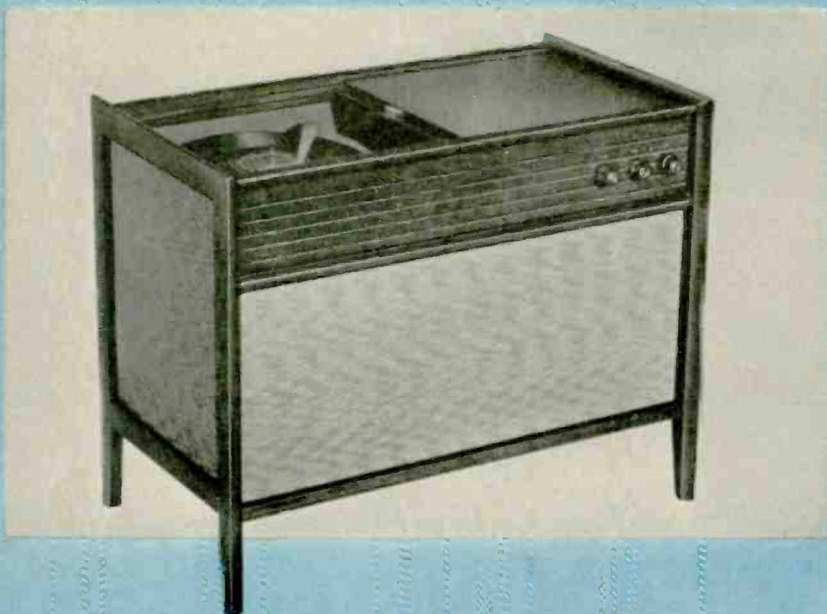
I notice a factory modification on this series calling for a larger electrolytic in the cathode circuit: from 30 μf to 100 μf. You can try this quickly by simply bridging 70 μf across the present capacitor. However, I don't think that this is a cure.

(*Continued on page* 66)

50-WATT STEREO AMPLIFIER AND CONTROL CENTER

Get the most from your stereo system with this superb unit; power-packed 50 watts (25 w. per channel); complete tone, balance and stereo /mono function controls; five dual-stereo inputs plus separate monophonic mag. phono; mixed-channel center speaker output; luggage-tan vinyl clad steel cover. 31 lbs.

Kit Model AA-100 .... **$84.95**
Assembled Model AAW-100 .... **144.95**



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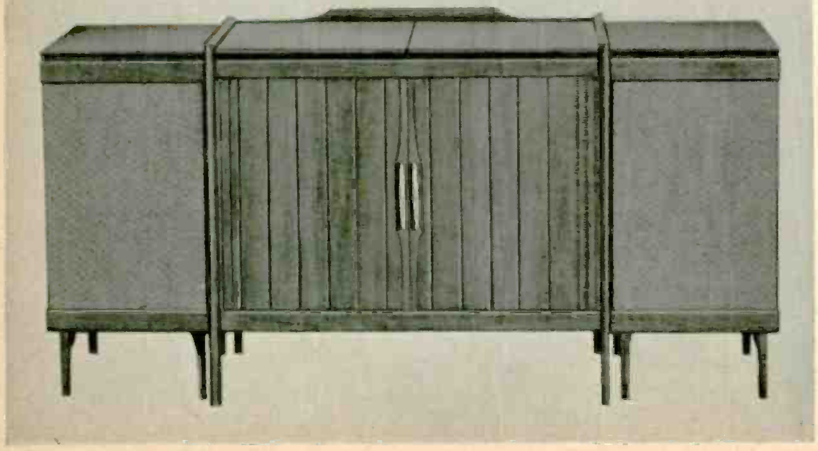
Kit Model GD-31 .... **$129.95**
Assembled Model GDW-31 .... **149.95**



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Enjoy incomparable Heathkit stereo with factory wired components in beautiful preassembled, prefinished cabinets . . . ready to use! The consoles are available in both 28 and 50 watt models, with money-saving optional kit plans. The 28-watt model (HFS-26) contains the Heathkit AJ-10 stereo AM /FM tuner, SA-2 stereo amplifier, AD-50A stereo record changer and two US-3 12" coaxial hi-fi speakers. The 50-watt model (HFS-28) contains the Heathkit AJ-30 deluxe stereo AM /FM tuner; AA-100 deluxe stereo amplifier; AD-60B deluxe stereo record changer; and two Jensen H-223F coaxial 2-way 12" hi-fi speakers. Specify walnut or mahogany.

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(Cabinets available separately, write for information)

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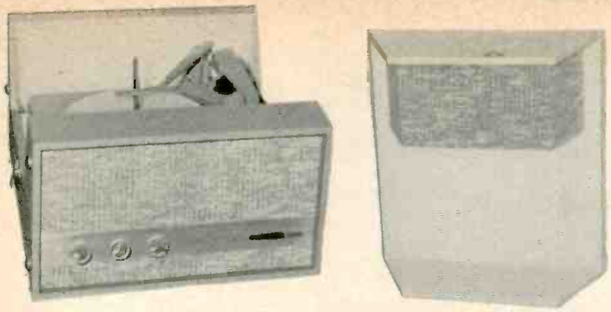

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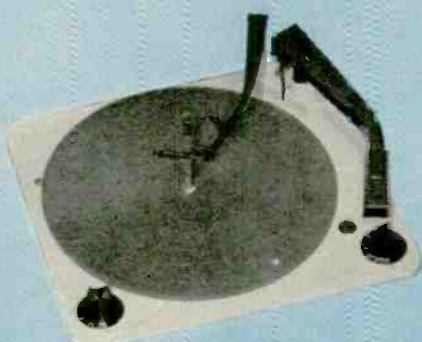
Kit Model AD-40 .... **$179.95**



NEW LOW COST STEREO RECORD CHANGER KIT
Here's fine changer features at a budget price . . . oversize 11″ turntable, "anti-skate" device, jam-proof mechanism and plug-in cartridge head. 4 speeds with automatic shutoff. Assembles easily, quickly with no special tools. Complete with your choice of three different, famous-name, diamond-styli stereo cartridges. 15 lbs.

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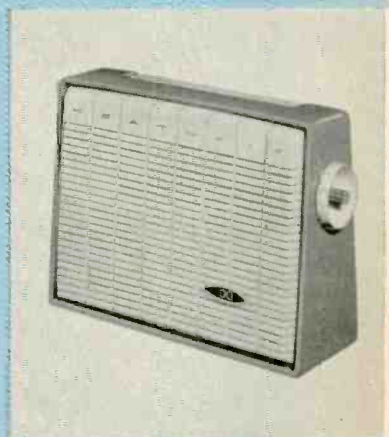

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Assembled Model GWW-30 each **50.95**

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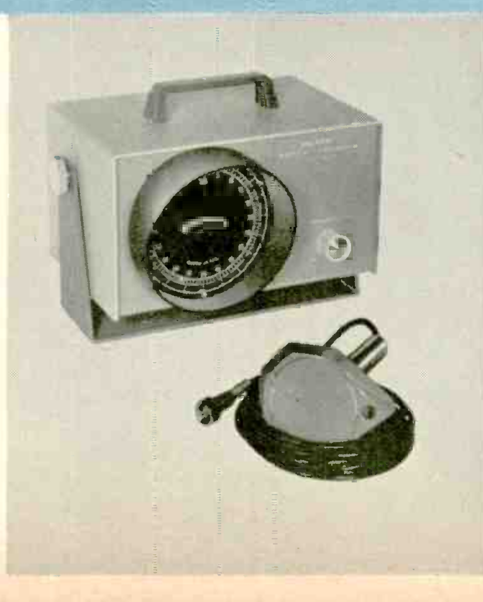
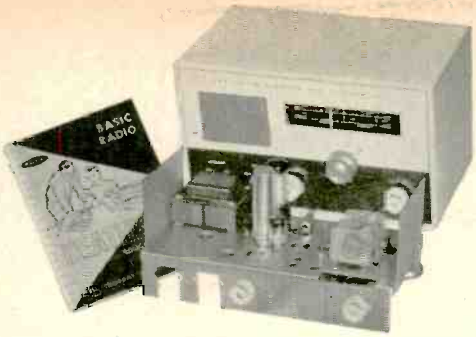
Kit Model MI-10 . . . . **$ 69.95**

Assembled Model MIW-10 . . . . **107.95**





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(*Continued from page* 61)

Check the coupling capacitors and plate resistors in the sync circuits, especially around the 6AN8 and 6U8. As a good test, disconnect the vertical sync by lifting one end of the vertical integrator, free-wheeling the picture and watching for any sign of the jitter. It might also be wise to check the vertical circuit's B-plus line with a scope for traces of ripple.

There is one more possibility in some of these sets. Add a 33,000-ohm resistor in series with a 0.005 μf ceramic capacitor (1,000 volts or so) from the back picture-tube support to the nearest chassis ground. This network bypasses any pulses which could disturb the interlace and conceivably be causing this trouble.

Markers meet in the middle!

I'm aligning an RCA TV. I get two markers on the response curve, instead of only one. They start from the center of the first hump and second hump, and move together until they meet in the middle. Then they disappear! If you keep on turning the dial of the sweep, they reappear in the middle and go back out to their original positions at the side!

Why do I get two markers when I am only feeding in one signal? After aligning at what I think is the right place, the result is no better than when I started. I get sound without picture or picture without sound, and a lot of swishing noises when I turn the fine tuning—J. B., Philadelphia.

Your trouble with the dual markers is caused by an incorrect setting of the sweep generator. Instead of getting the whole response curve, you get only half of it (Fig. 5). In other words, instead of displaying the entire response curve of the tuner, you're actually seeing only half of it. The extra marker is the mirror image of the first.

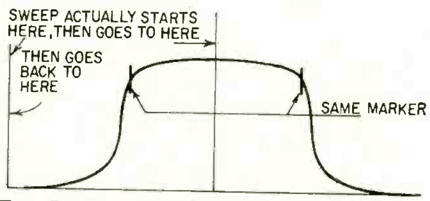

Fig. 5—Improperly adjusted sweep generator can give this pattern.

To set up a sweep generator properly, tune it to *approximately* the center of the band being swept. In your case this would be channel 13 (210–216 mc), so set it to about 213 mc. Now run a marker into the curve. If you get the dual-marker effect you mention, your sweep is improperly set. Try feeding the horizontal sweep from the sweep generator into the scope. Now, set your phasing control until you get a curve with only a single marker. You may wind up with something that looks like Fig. 6, but that's the right curve! You can also get rid of mirror images by adjusting the horizontal blanking (return-trace blanking) on your generator. This will (or should) take out half of the curve, and one of the markers.

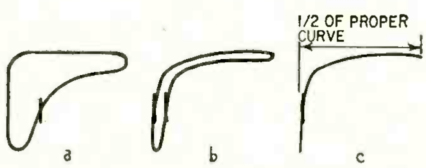

Fig. 6-a—possible proper scope pattern; b—this pattern can be changed to c by turning on scope's retrace blanking.

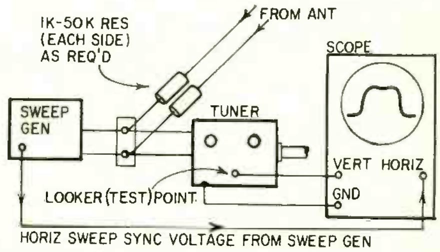

Fig. 7—How to use TV station signals as sweep generator markers.

The simplest way to adjust a curve like this is the use of strong TV station signals as markers (Fig. 7).

Picture-tube change

We want to convert an RCA KCS-47-A chassis to use a 21-inch picture tube. How about a 21AMP4 or a 21ALP4 for this? If the normal 12,000 volts is not sufficient, what changes in the existing components are needed to boost the high voltage? Are there any other changes that you would recommend—yoke, flyback, etc.?—J. O. D., Williamsburg, Va.

I doubt the advisability of trying to convert this chassis to use the picture tubes you mention. This is mainly due to their high-voltage requirements—16,000 volts for each type. Several other types would be much more applicable. Look in your picture-tube book and you'll find ones which require less high voltage. My first choice would be Bob Middleton's favorite, the 21EP4. It requires only 12,000 volts and is a 70° tube.

Fada flyback replacement

We are servicing a Fada S-1060 which has an open winding on the primary of the flyback transformer. Our distributor tells us that Fada has gone out of business.

Can you give us the name of a source which might supply the required replacement part, or the necessary information to alter the high-voltage circuit to use a standard replacement part?—G. E. S., Whippany, N. J.

A Triad flyback No. D-112 will be suitable. This is listed as a direct replacement for Fada part Nos. 37.255 and 37.255B. It should be available from any parts supply house.

Antenna coupling

Can you tell me if there is a company making transformers to couple bays of TV antennas together? These are supposed to be superior to stacking bars *in terms of impedance matching.*

I'm now using an Amperex ECC88/6DJ8 tube in the lower section of my Jerrold De-Snower. Is there any better tube, for low-noise, at 100 volts plate?—F. E., Port Orford, Ore.

I'm a little confused here as to your meaning. Actually, the so-called stacking bars used to couple two bays of a TV antenna together *are* transformers. Their principal function is to match the two impedances and to couple the antennas together. They are generally used as quarter-wave transformers to match the 600-ohm impedance of the stacked antennas to the 300-ohm impedance of the transmission line. I have never heard of anyone manufacturing *transformers* specifically for this purpose.

The ECC88 is probably the latest of a long series of low-noise tubes, to the best of my knowledge at the moment. It is a twin-triode of the new frame-grid construction and is being widely used in community-antenna system amplifiers, where its tremendous mutual conductance is a big help: 12,500 micromhos! It is interchangeable base-wise with the popular twin-triode types (6BQ7, etc.).

Incidentally, this tube is also made with the numbers 6922 and E88CC. This last numerical arrangement denotes a special type of construction for hard service such as in computers. But as long as the same numbers are there, it is the same tube. This is the European numbering system: the E stands for 6.3 volts filament, the C means triode (CC means twin-triode) and the 88 is the series number.

Add a dc restorer

I would like to install a dc restorer on my Hotpoint 21S505 TV, preferably a silicon or germanium diode. Will I need a retrace eliminator?—A. G. K., Oak Park, Ill.

You can use the dc restorer shown in Fig. 8. It is for a cathode-driven picture

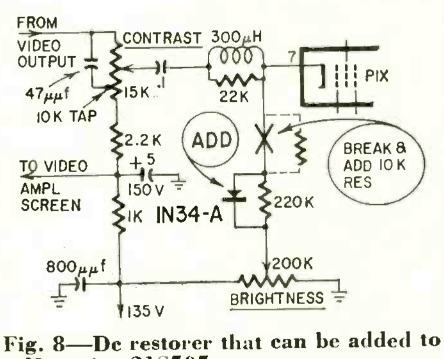

Fig. 8—Dc restorer that can be added to a Hotpoint 21S505.

tube like the one your Hotpoint uses. Several diodes would be suitable, either silicon or germanium. Be sure to check the one you have to see that it has a very high back resistance—at least 100,000 ohms. Otherwise your results won't be too good. You won't need a retrace eliminator. If you get retrace lines after the dc restorer is installed, the diode is reversed! END

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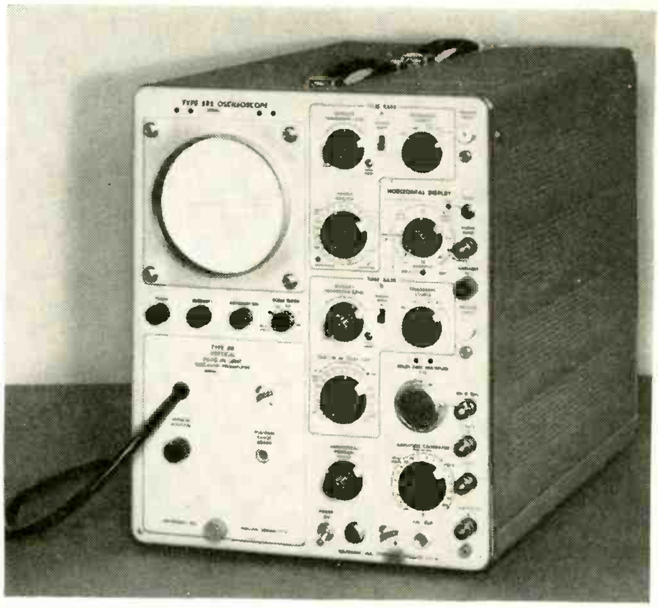


Tektronix 585 oscilloscope uses distributed amplifiers for 100-mc bandwidth.

By TOM JASKI

IN this age of moon rockets, message repeating satellites and supertelemetry from space platforms, and particularly in the industrial fields where electronics is rapidly becoming the workhorse for the control of machines too fast and complex for human control, electronic development has demanded higher performance standards from the instruments used. Particularly in oscilloscopes, where the problem of bandwidth vs sensitivity has always dominated the design scene, the new demands have forced radical approaches to deflection-amplifier design. The technology of these new amplifiers is not based on new discoveries. Primarily it is the application, for commercially produced oscilloscopes, of circuitry already familiar but used only rarely in special laboratory situations.

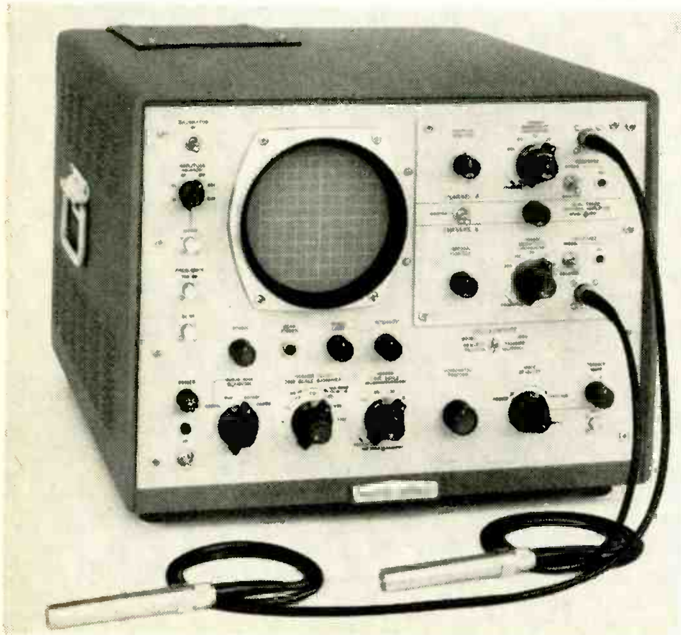
Two main approaches have been taken. The first is an improvement of the amplifiers themselves to the limits of tube capabilities, and the improvement of cathode-ray tubes to match the strides in amplifier progress. The second approach is to divide the incoming signal into a number of equal portions which are easily amplified and to reconstitute it from the amplified "samples". Both methods have their problems and limitations. Let us briefly examine what they are and how we can solve them.

In cathode-ray tubes, the electron beam that writes the image on the screen is deflected in its brief passage between the deflection plates in proportion to the signal applied to these plates. For greater writing speed, we must—to obtain sufficient image brilliance—speed up the electrons so they will collide with the fluorescent particles on the back of the screen with greater intensity, thus giving a normal trace despite the faster scanning time. This is relatively easy to do. We can simply apply a higher potential to the accelerating anode.

Another method is to develop new fluorescent materials for the face. This too has been done successfully. But by "intensifying" the beam we have created a new problem. The beam is now "harder", more difficult to deflect, putting greater demands on the deflection amplifiers.

Another way to improve the deflection system is to mount in the tube a series of deflection plates so shaped and spaced that an electron traveling between them will receive from each additional plate another bit of deflecting force in the proper time sequence. This is illustrated in Fig. 1, which is, in effect, a type of traveling-wave deflection structure. Electron speed must be very closely controlled to avoid distortion in the trace.

After we have pulled all these tricks with the CRT, we must look elsewhere



Hewlett Packard 185A oscilloscope uses sampling system to display fast pulses.

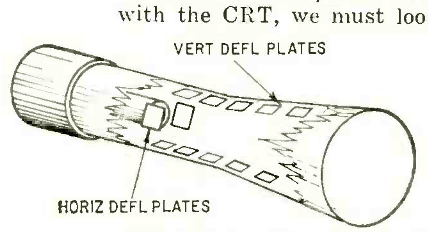
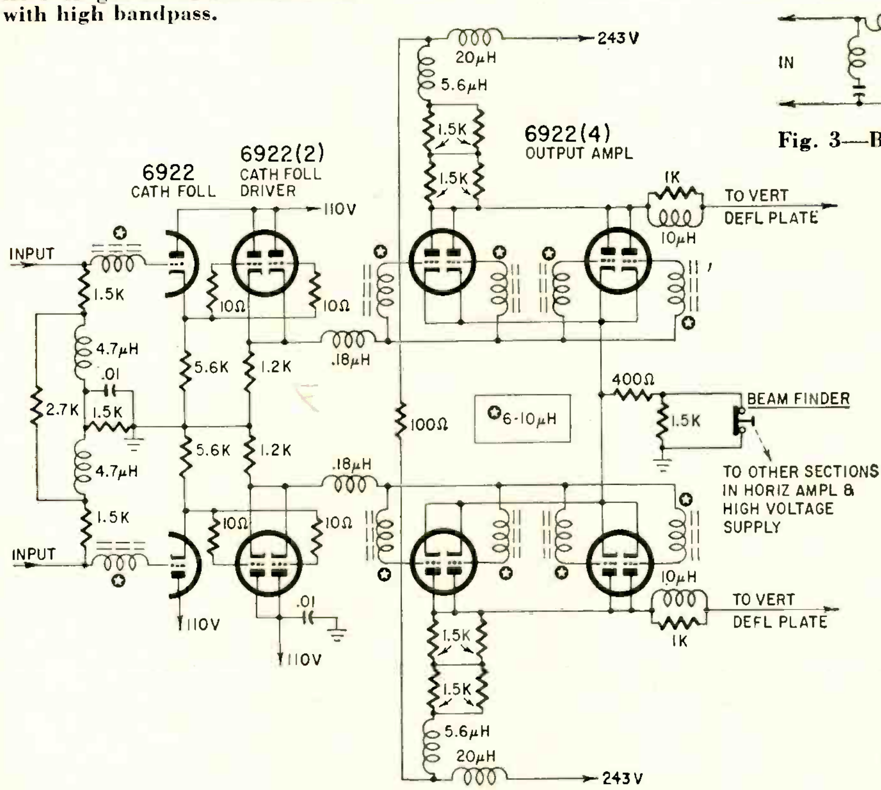


Fig. 1—Special cathode-ray tube with a series of deflection plates. (Deflection plate supports and connections are not shown.)

Fig. 2—Partial circuit of main vertical amplifier in Hewlett Packard model 160 scope illustrates the use of parallel amplifiers to get sufficient deflection with high bandpass.



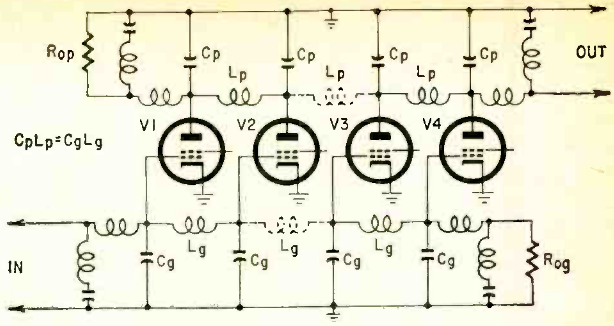


Fig. 3—Basic distributed amplifier circuit.

for further improvements, keeping in mind that in spite of our special structure, we still need greater deflection voltages.

Now what about the deflection amplifiers? In a conventional amplifier, the gain of a deflection stage is proportional to the transconductance of the tube. Thus, with high-transconductance tubes, we can reach a certain level of sensitivity for the final stage. But there is a limit to this simply because of the tube's structural requirements—high transconductance requires close element spacing. By increasing the plate load resistance we can get more deflection voltage for the same voltage applied to the grid, but this increases the time constant of our deflection amplifier circuits, since it is proportional to a product of circuit capacitance and resistance. And if we increase the time constant, we limit the amplifier's upper frequency response severely.

So we must keep the plate load resistor as small as practicable. To do this we can increase the size of the tube and thus the total current through the plate load. A modern approach to this is the parallel output tubes used in some high-performance scopes such as the Hewlett Packard 160 (Fig. 2). Here several tubes have a common plate load and provide adequate deflection up to about 15 mc.

Beyond this, or at least beyond about 30 mc, we have to turn to a special kind of an amplifier to reduce the time constant further. More parallel tubes or larger tubes would now begin to increase the total capacitance, the other factor involved. Because of this capacitance, amplifiers have had to be developed in which the advantages can be tapped, without the burdens. These turned out to be *distributed amplifiers*, in which the transconductance of the tubes work together and their outputs can be added, without being particularly affected by the input and output capacitances. Successful distributed amplifiers have been built for several thousands of megacycles, but in oscilloscopes the best deflection amplifiers, within practical commercial limits, have an upper frequency limit of about 600 mc.

Fig. 3 shows a basic distributed amplifier. Here we see what look like two conventional delay lines of lumped capacitances and inductances, and that is what they are. The input signal travels down the grid delay line, and the output of each tube down the plate delay line. The lines are so designed that when a signal, amplified by the first tube, leaves its plate, it will arrive at the plate of the second tube precisely at the same time that the input signal, now also amplified by the second tube, is being reproduced on the plate of that tube. Thus the two amplified signals add. This process continues all the way down the line until a signal is obtained strong enough to deflect the beam in the cathode-ray tube.

The signal on the plates will, of course, tend to travel in both directions along the delay line but we are interested only in the forward-traveling one. So we absorb the backward-traveling signal (which must not reflect into the line) in terminating resistance R_{og}. Since now the principle of amplification is entirely different and we no longer depend on certain values of plate load resistances, the tube capacitances can now be used as part of the delay line capacitances and no longer contribute in the same way to the time constant of the circuit. You can see that we have neatly licked the time-constant problem.

This does not mean that we can build these amplifiers for *any* frequency, for we now have other problems, such as the upper cutoff frequency of the delay line. This is primarily determined by losses in connecting leads, capacitors, and through grid loading. Insulation also behaves differently at very high frequencies, and insulation losses increase. But the picture is more favorable with a conventional unit.

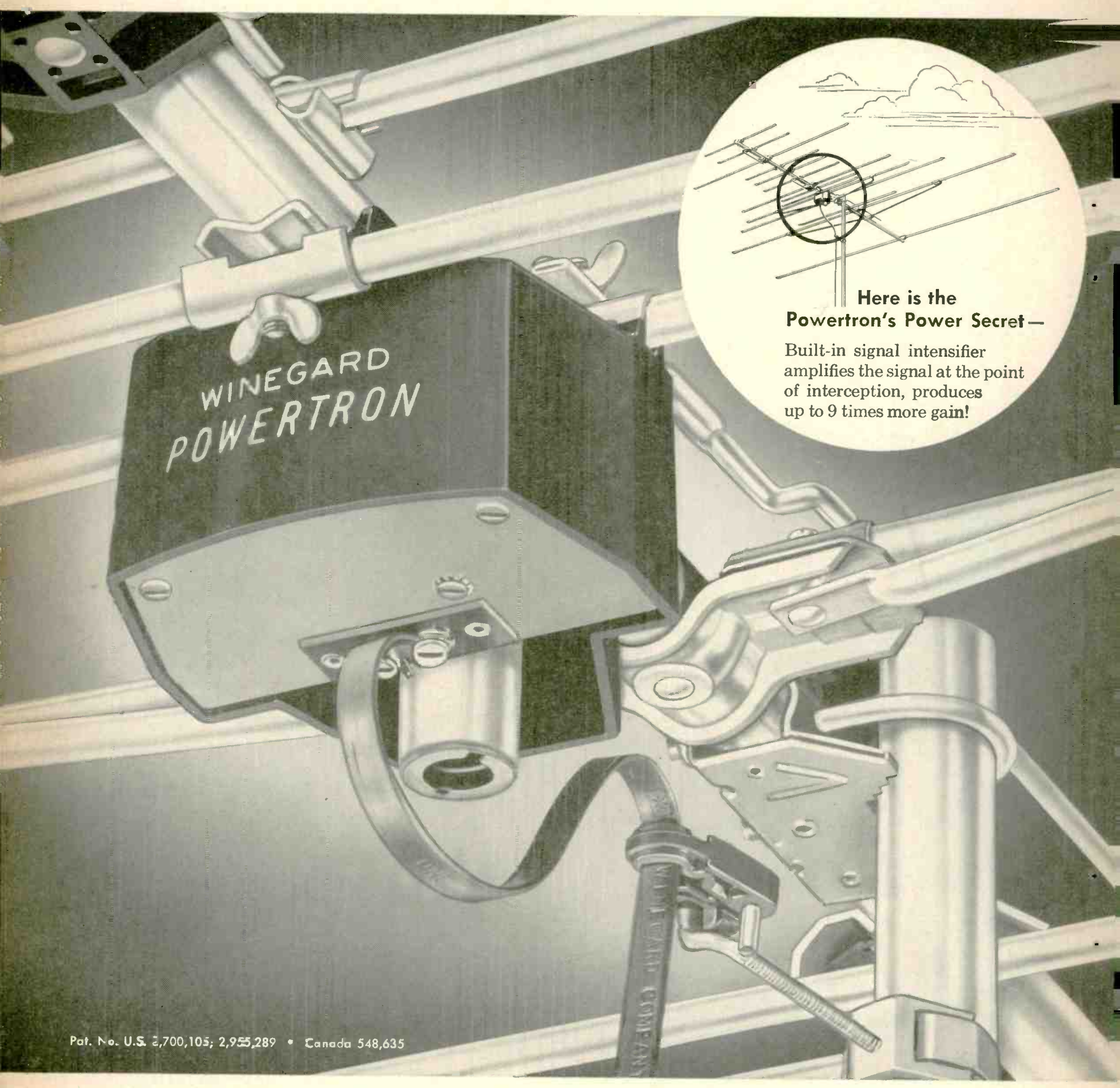
At low frequencies, when a signal would virtually not be delayed by the line (the delay is the same, but the relative significance of the delay compared to the signal frequency is insignificant), how does the distributed amplifier work? Well, here we have the situation that all these tubes are virtually in parallel, and we need only a very small load resistor to get ample deflection, as discussed previously. Thus the distributed amplifier has a very great bandwidth. We do encounter some problems at low frequencies, but none as serious as time delay or losses.

Distributed amplifiers, of course, also have disadvantages, the most serious of which is noise. With so many tubes, thermal noise becomes a real problem. Another obvious disadvantage is cost. We need more tubes and larger heater and power supplies which must be carefully regulated for stability.

Fig. 4 is a practical version of a distributed amplifier for deflection. It is used in the Tektronix type 585 100-mc scope. The series of deflection plates is also shown. Notice that this main deflection amplifier uses 10 triode sections and a dual pentode. The delay line driver is built along the same principles, and uses another 14 triodes. Sensitivity is 0.25 volt per inch, bandpass dc to 100 mc and rise time .0035 μsec. Additional amplification can be obtained wherever bandwidth can be sacrificed for greater sensitivity. Notice

(*Continued on page* 72)

World's first Electronic TV Antenna . .



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WINEGARD POWERTRON

POWERTRON AMPLIFIES TV SIGNALS AT THE POINT OF INTERCEPTION

Now Winegard engineers have designed a new high gain, all-channel yagi antenna incorporating a low noise, high gain RF amplifier in one integral unit! Because the input circuit of this amplifier *exactly matches* the characteristics of the *new "Tapered T" driven elements* to which it is *directly coupled*, every last particle of signal is amplified. The results are amazing.

We call this new electronic antenna the POWERTRON. The Powertron amplifier uses the frame grid 6DJ8 dual triode (12,500 MHOS) transconductance, in a radical new RF circuit, that allows this one tube to amplify all signals in the VHF TV band, 54 to 216 MC, with a gain of 5 times (14 DB). This gain is added to the gain of the antenna which is a high gain yagi design, quite superior to other all channel antennas.

The Powertron power supply lowers 117 VAC to a safe 24 volts which is fed up the lead-in to the Powertron antenna. Completely fused, the power supply is made shock-proof by an AC isolation transformer.

Imagine what this super-powerful electronic antenna can do! Weak signals become strong and clear—dim pictures bright and contrasty. Old-style tuners pull in snow-free pictures better than 1961 models on ordinary antennas.

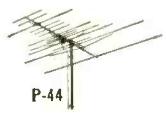
You can do many things with this new antenna that are impossible with any other. You can drive up to 6 TV sets in deep fringe, 10 TV sets in normal areas without an additional amplifier. You can put TV outlets in every room of the house and all sets will have better pictures than any single set with a regular antenna.

Because of its extreme sensitivity, Powertron can be installed lower than other antennas. For instance, where 40-ft. masts are normally used, a Powertron can usually be installed at 25 ft., yet give better results!

Where desirable, the Powertron can be remoted up to 1/4 of a mile and still deliver a perfect signal.

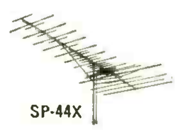
In large distribution systems (motels, apartments, etc.), Powertron makes the perfect antenna to use in conjunction with Winegard's 4-tube A-400 or 7-tube A-700 distribution amplifiers.

For critical color, Powertron's extremely linear frequency response makes it the ideal antenna for your "color" installations.



P-44

P-44X



SP-44X

To sum it up, Powertron makes weak TV pictures good, and good TV pictures even better. It *works equally well* for *color or black and white* reception. It is the world's first all channel (VHF) *electronic* TV antenna, and is a tremendous step forward in the search for improved TV reception.

3 Gold Anodized Powertron Models —

Powertron Model P-44, 14 elements **$74.95 list.**

Powertron with Power Pack Model P-44X, 21 elements, **$91.90 list.**

Super Powertron Model SP-44X, 30 elements, **$104.95 list.**

NEW TELETRONS, TOO! NON-ELECTRONIC, BUT 26% TO 484% MORE POWER INCREASE THAN COLOR'CEPTOR

Similar to the Powertron, but without the RF amplifier, Teletron embodies the same new WINEGARD "TAPERED T" DRIVEN ELEMENTS for proven performance superior to any other non-electronic TV antenna. Teletron is gold anodized, has the same fine quality construction and mechanical features as the Powertron.

3 Gold Anodized Teletron Models —

Teletron Model T4, 14 elements, **$34.95 list.**

Teletron Model T-4X, 21 elements, **$51.90 list.**

Super Teletron Model ST-4X, 30 elements, **$64.95 list.**

COMPARISON OF POWERTRON AND TELETRON MODELS TO WINEGARD COLOR'CEPTOR

Chart shows Gain and Power Increase over Color'Ceptor (CL-4) Antenna

Model		DB Gain Over CL-4	Power Increase Over CL-4	Voltage Gain Over CL-4
P-44	Powertron	14 DB	25.1 Times (2500%)	5.01 Times
P-44X	Powertron with Pack	15.8 DB	38.4 Times (3800%)	6.20 Times
SP-44X	Super Powertron	19.1 DB	81 Times (8100%)	9.0 Times
T-4	Teletron	1.0 DB	1.26 Times (26%)	1.12 Times
T-4X	Teletron with Pack	2.8 DB	1.9 Times (90%)	1.38 Times
ST-4X	Super Teletron	6.1 DB	4.84 Times (484%)	2.2 Times

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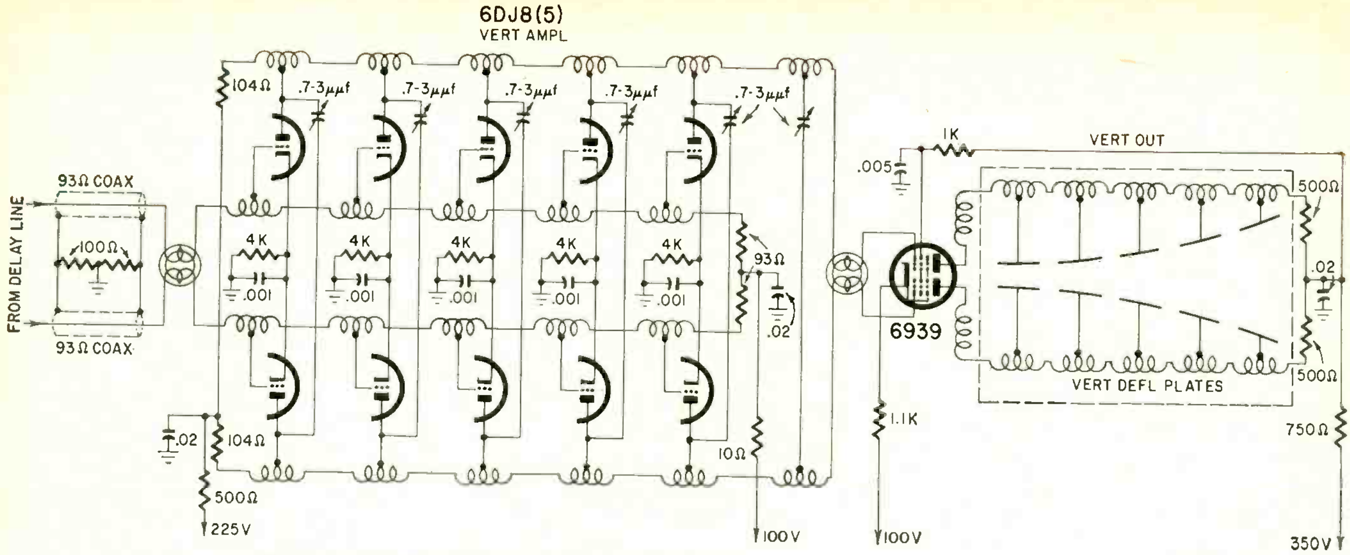


Fig. 4—Distributed amplifier used in the Tektronix type 585 scope.

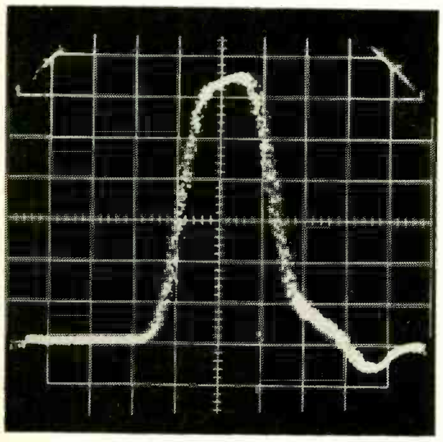


Fig. 5—Scope pattern of 2-mμsec pulse displayed by using sampling technique.

(*Continued from page* 69)

that the bandwidth-vs-gain problem is still with us.

Several instruments on the order of the 585 are being marketed and the principles used in their vertical deflection systems are more or less alike.

Horizontal amplifiers and sweep circuits, although of a high caliber and with very high top sweep speeds, are conventional and need no detailed discussion.

The other approach to improving scope performance has taken a trick from telemetering practices. The signal is scanned by a sampler at a definite rate of sampling. The sampling "carrier," which is modulated in accordance with the signal, is then amplified. Our sample carrier frequency can be as low as one-fiftieth of the input signal frequency. If the bandwidth required for the input signal were 500 mc, then the bandwidth demanded of the amplifier would be only 10 mc, a much more reasonable figure.

After amplification, the signal samples are put together again to display a true image of the input pulse signal. Fig. 5 shows such a trace of a 2-mμsec pulse which is displayed with a sweep speed of 1 mμsec per cm, and with a vertical sensitivity of 5 mv per cm.

Fig. 6 shows how this is done. The signal, which must be of a repetitive type, is applied to a sampling gate which samples the signal periodically, the rate being determined by the setting of the time scale. Since the sampling must be synchronized with the signal to obtain a stationary image, the signal is delayed in the amplifier, allowing the triggering of the sweep system by the signal. Since the signal is so much shorter than the total time it takes to sample a number of times, each sample taken successively in time will be of a different portion of the input signal. If we were to sweep continuously, the signal displayed would be a series of small dots (if they were visible) for, in between samples, the input would be zero (closed gate). Thus the scope employs a special sweep circuit which advances the spot horizontally only a small distance on the screen per sample. When a trigger is received, the avalanche blocking oscillator (so called because it uses avalanche transistors) starts a ramp (rising) voltage which increases precisely in time, depending on the time-scale setting.

The ramp voltage is fed to the voltage comparator where it is compared with one from the staircase generator. If this voltage equals the one fed back from the staircase generator the sampling gate is opened and the staircase generator is advanced one step. By sweeping the spot horizontally across the tube face this way, all the "dead" spots are eliminated from the trace, and it appears to the viewer as a continuous line. The resolution of the picture is determined by the size of the steps of the staircase generator. The larger these steps, the greater the distance between the spots that make up the trace. The trace can be magnified by reducing the feedback voltage to the comparator. This lets the comparator fire sooner, reducing the time between spots and the distance per spot.

Obviously, only repetitive signals can be viewed this way. The signal must last long enough in approximately the same form for the number of scanning operations required to reconstitute the signal.

These then, are the two principal methods used for very-high-frequency oscilloscopes. Other methods have been used, such as the Japanese oscilloscope capable of displaying sine waves of 30,000 mc. But in this case the special cathode-ray tube had to be viewed with a microscope, since no practical deflection amplification was possible at the time. Before long, someone will join the two methods and put the advantages of both in one instrument.

● Since this article was written, Textronix has come out with a distributed type oscilloscope, similar to the 100-mc unit described here, which has a bandwidth from dc to 1,000 mc. Principles of operation are the same as those for the 100-mc scope. END

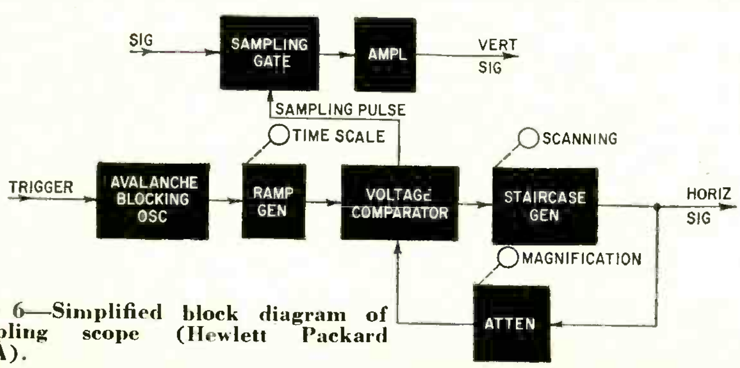


Fig. 6—Simplified block diagram of sampling scope (Hewlett Packard 185A).

2-Terminal Oscillator

By I. QUEEN

THIS negative-resistance oscillator covers a wide frequency band and can generate a pure sine wave. It functions without a transformer, center-tapped coil or even a capacitor. It uses a pair of transistors, which may be low-gain types. The circuit is a modification of patent No. 2,943,282, issued recently to Harold J. Pfiffner of Venice, Calif.

The diagram shows a practical version of the oscillator. Its tank coil is simply a high-impedance (about 1,500 ohms resistance) earpiece shunted by .002 μf. Output is a pure sine wave.

Actually a wide variety of two-terminal inductors can serve as tank (instead of the earpiece). I have tried choke coils, transformer windings, large rf chokes and ferrite antennas. The smaller the inductor the higher the output frequency and, in general, the smaller the capacitor required across it. An antenna loopstick shunted by a 365 μμf capacitor at C will generate frequencies up to about 1 mc. By removing turns you can go higher.

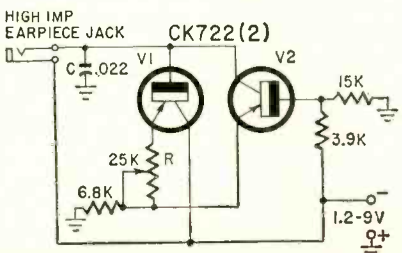
To adjust the circuit, begin with R at minimum. Increase it until oscillations occur (observe a scope or voltmeter, or listen in on a nearby receiver). The waveform is purer (lowest distortion) when R is as large as possible before oscillations die out. With the earpiece, the output is about 0.3 volt at about 1,500 cycles.

Among other tanks tried was a small surplus transformer currently found in many radio stores. It has three center-tapped windings specified as 22,000, 5,200 and 600 ohms. The following results were noted:

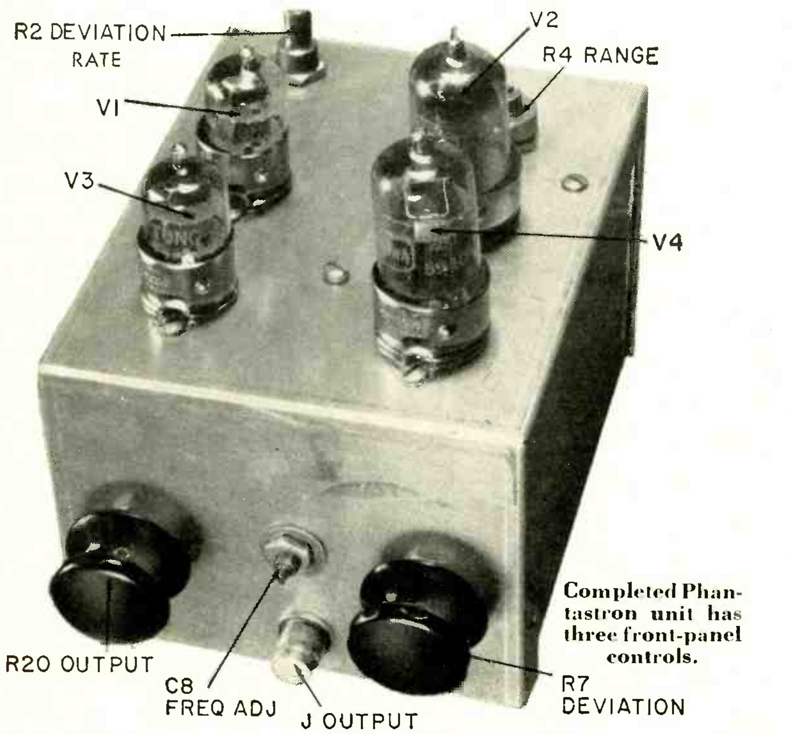
Winding	*Voltage*	*Frequency*
high	0.6	350
medium	0.3	2,000
low	0.05	3,500

In each case, the full winding was used and the other two were left open. The capacitor value for C was .022 μf.

In the audio range, low-cost low-gain transistors are suitable. In fact, some that tested poorly in other equipment gave good results here. For if and higher-frequency bands, use high-frequency types like 2N484. END



WOBBULATING SWEEP GENERATOR



Completed Phantastron unit has three front-panel controls.

By **GERALD WILNER**

Accurate narrow-band sweep generator for checking crystal filters, aligning if strips, aligning AM receivers, etc.

WHEN designing and building crystal filters for single-sideband activities, I found it almost impossible to take response curves with the standard variety of signal generators. A good part of the difficulty was caused by the small bandwidths of the crystal filters, coupled with the fact that they provide extremely sharp skirts on either side of the passband. Unless an ultra-stable signal generator with a vernier dial is available, it becomes almost impossible to set the generator so the resulting output can be measured. If it can be done, many readings are needed to evaluate the filter's response properly. Moreover, each time the filter is adjusted, the procedure must be repeated. Since bandwidths are small, I decided to build a simple narrow-band sweep generator, commonly known as a wobbulator.

It uses an all-electronic transducer, such as a common reactance tube, to sweep the desired frequencies. Changing the tube's gain (Fig. 1) changes its input capacitance. The tube used has its suppressor grid brought out to a base pin and not internally connected to the cathode. The gain is changed by applying a changing voltage (Δe) as shown. A sinusoidal voltage could be used, but it would give a scope trace bunched up in some places and spread out in others. A more sophisticated method is to use a sawtooth, so it can be used as both the deviation voltage and sweep or sync for the scope.

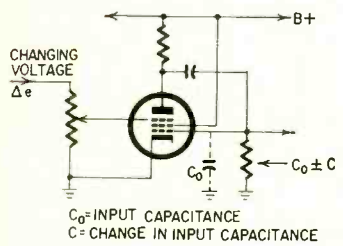
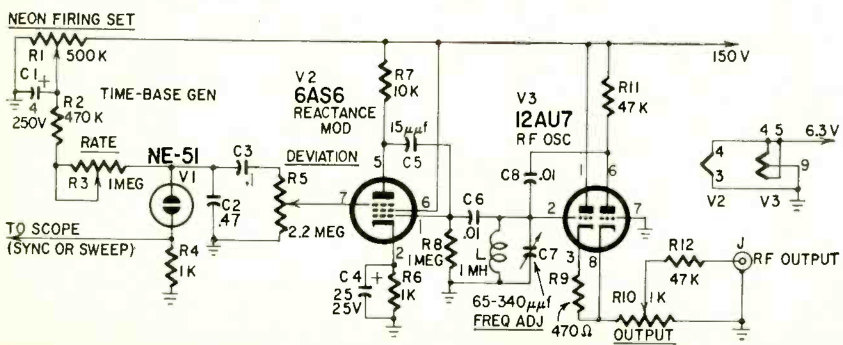


Fig. 1—Basic wobbulator is built around a reactance tube.

R1—pot, 500,000 ohms
R2—470,000 ohms
R3—pot, 1 megohm
R4, 6—1,000 ohms
R5—pot, 2.2 megohms
R7—10,000 ohms
R8—1 megohm
R9—470 ohms
R10—pot, 1,000 ohms
R11, 12—47,000 ohms
All resistors ½-watt 10%
C1—4 μf, 250 volts, electrolytic
C2—0.47 μf, paper
C3—0.1 μf, paper
C4—25 μf, 25 volts, electrolytic
C5—15 μμf, mica
C6, 8—.01 μf, ceramic
C7—65-340 μμf, trimmer (El-Menco 303 or equivalent)
J—coaxial connector
L—1 mh (Miller 952 or equivalent)
V1—NE-51
V2—6AS6
V3—12AU7
Chassis, to suit
Miscellaneous hardware

Fig. 2—Circuit of neon wobbulator.



Two wobbulators—a simple two-tube neon lamp type and a four-tube reactance-wobbled instrument—are described. The more practical four-tube wobbulator is designed for a center frequency of 455 kc, but may be adapted to other ranges. Maximum deviation is about 80 kc—sweep rate 2-15 cycles per second.

Instrument performs exactly as specified by the author. It would also be ideal as a sweep generator for AM radios and especially useful for hi-fi AM tuners where flat, broadband response is important. The electronic sweep is both interesting and practical. Do not confuse this instrument with trick gadgets and gimmicks.

BENCH TESTED

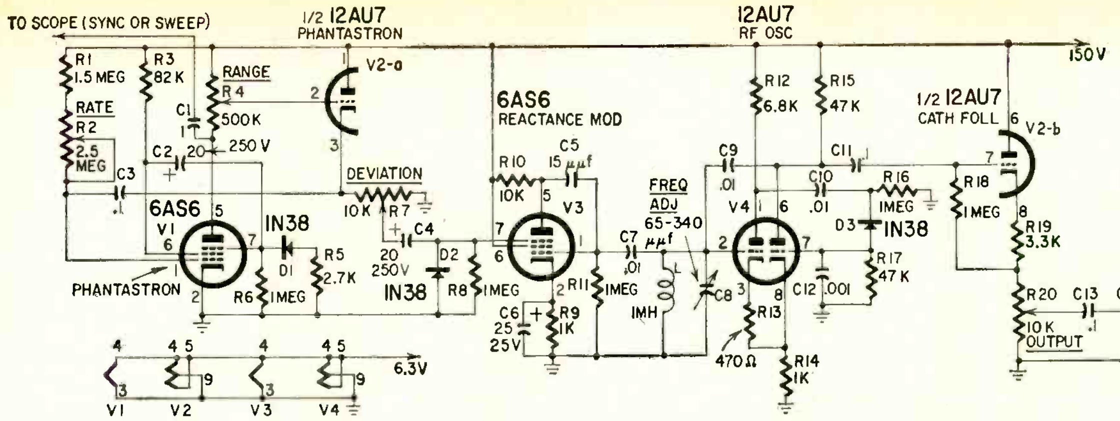


Fig. 3—Four-tube phantastron wobbulator is an extremely accurate instrument.

R1—1.5 megohms
R2—pot, 2.5 megohms
R3—82,000 ohms
R4—pot, 500,000 ohms
R5—2,700 ohms
R6, 8, 11, 16, 18—1 megohm
R7, 20—pot, 10,000 ohms
R9, 14—1,000 ohms
R10—10,000 ohms
R12—6,800 ohms
R13—470 ohms
R15, 17—47,000 ohms
R19—3,300 ohms
All resistors ½-watt 10%
C1—1 μf, paper
C2—20 μf, 250 volts, electrolytic
C3—0.1 μf, ceramic
C4—20 μf, 250 volts, electrolytic
C5—15 μμf, mica
C6—25 μf, 25 volts, electrolytic
C7, 9, 10—.01 μf, ceramic
C8—65-340 μμf, trimmer (El-Menco 303 or equivalent)
C11, 13—0.1 μf, paper
C12—.001 μf, ceramic
D1, 2, 3—1N38
J—coaxial connector
L—1 mh (Miller 952 or equivalent)
V1, 3—6AS6
V2, 4—12AU7
Chassis, to suit
Miscellaneous hardware

Two 455-kc wobbulator designs are detailed. The first, a neon wobbulator, is a simple two-tube affair with a neon-lamp relaxation oscillator that is easy to build, but lacks certain refinements. Nevertheless, it will give a good account of itself. The second, called a phantastron wobbulator, is a four-tube affair giving complete versatility.

Neon wobbulator

The neon wobbulator is composed of a neon-lamp time-base generator (Fig. 2) which supplies a sawtooth voltage, set by R3, between 1 and 10 cycles. Resistor R4 is inserted to extract a spike to sync the scope. The sawtooth amplitude is controlled by R5, the DEVIATION control. This sawtooth is then fed to V2's suppressor and varies V2's gain, hence controlling part of the capacitance in shunt with coil L. The oscillator itself is a two-terminal Crosby. Its output is developed across R10, the cathode resistor in the cathode-follower output stage.

Resistor R12 isolates the output from the oscillator to minimize oscillator pull, and at the same time presents a high impedance to the external load. Maximum deviation is approximately 80 kc.

This circuit has several drawbacks but functions satisfactorily. The sawtooth is not linear, but exponential, leading to distortion. Also, the sawtooth is a rising function that puts the low-frequency end of the pattern on the right side of the scope screen and the high-frequency end on the left. This is not serious, but could cause misinterpretation of results. The final difficulty is that anything connected to the output circuit could pull the oscillator since the load is in the cathode circuit.

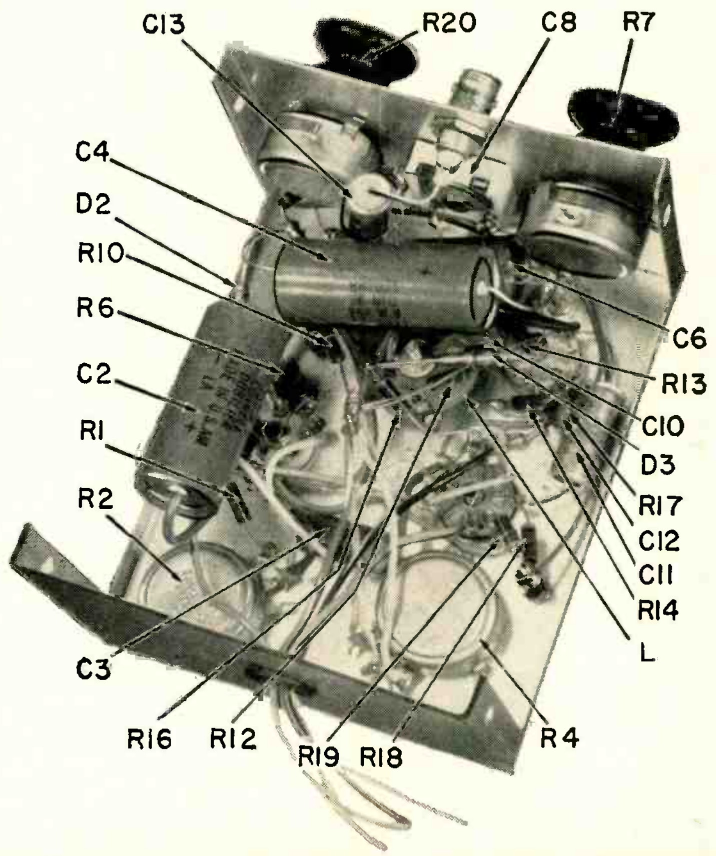
Phantastron wobbulator

The circuit shown in Fig. 3 has none of the neon-wobbulator drawbacks. It develops a linear sweep that has a negative slope—decreases with time. Thus, the presentation on the face of the scope has the low-frequency end at the left and the high-frequency end on the right. V1 and V2-a comprise a linear phantastron. Potentiometer R2 controls the rate, which has a range of about 2 to 15 cycles. The output is taken off V2-a's cathode and fed into V3. From here on, the operation of the circuit is identical to the neon wobbulator. The only exception is that the output is taken from V4's plate instead of the cathode. It is then delivered to V2-b, a cathode follower. Thus, a load hung on the cathode follower's output cannot disturb the oscillator.

To set up this circuit:

- Turn the DEVIATION control full on.
- Connect a scope to the output and adjust for a screen pattern similar to Fig. 4.
- Distance A represents one excursion through the frequency range desired. Now connect a signal generator with approximately 10,000 to 20,000 ohms in series across the wobbulator output. A "glitch" or beat marker will be seen.
- Alternately adjust RANGE control (R4) and the signal generator until the maximum deviation is around 50 kc or any range desired. Once R4 is

(*Continued on page* 80)



Bird's eye view of the insides of a phantastron wobbulator.

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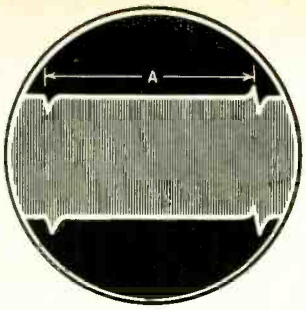


Fig. 4—Scope trace produced by the wobbulator.

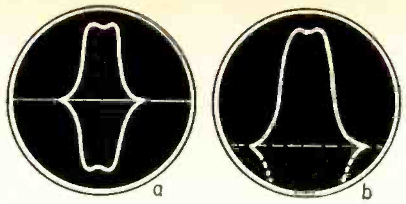


Fig. 6—Filter check waveforms; a—starting waveform; b—only top half is kept on scope screen.

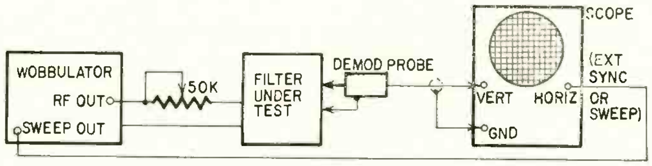


Fig. 5—Setup for checking filter response with the wobbulator.

(*Continued from page* 75)

set, do not disturb. Use the DEVIATION control for all adjustments.

Power supplies are not shown. Any voltage around 150 will suffice. It is advisable to use a regulated supply.

Construction procedure

No part of the layout or construction should be difficult; there is nothing critical about the wiring.

The phantastron wobbulator is built into a 5 x 4 x 3-inch case. The photos show the position of the parts. If a self-contained power supply is desired, a larger chassis is needed.

One final word in passing. This particular wobbulator was designed for 455 kc for crystal filter investigations. However, it may be used for other applications such as aligning if strips, fm receivers, etc. For these jobs the center frequency may have to be raised by using a smaller coil and tuning capacitor. It was not the scope of this article to include such designs, but those who are enterprising enough will find the following hints helpful:

- It might be desirable to increase the repetition rate by decreasing C3 to say .01 μf.
- Decrease R15 and include about 200 μh in shunt with it.
- Knowing that V3 supplies a capacitance change of approximately 50 μμf, one can determine the value for L necessary for the required frequency.

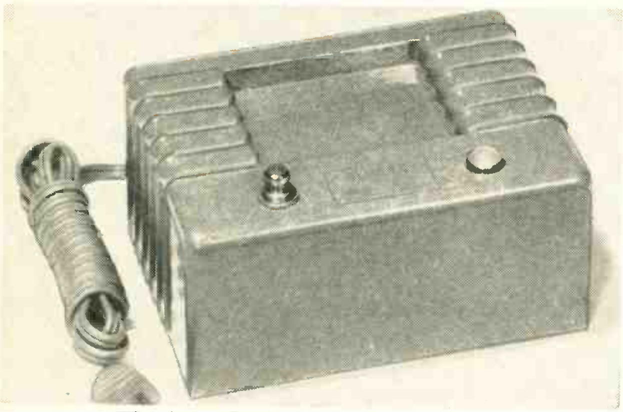
Using the wobbulator

Let's assume we have built a filter and want to know what its response looks like. First, we set up the pattern as in Fig. 4, and connect a signal generator. Set the signal generator at the desired frequency and adjust the wobbulator frequency control so a glitch appears approximately in the center of the trace. The wobbulator is now ready for use.

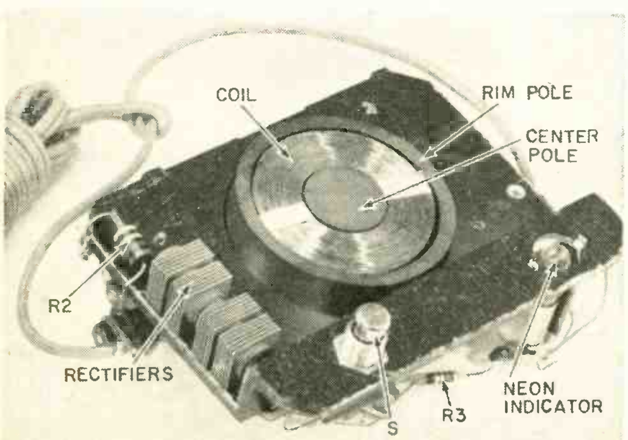
Since the wobbulator presents a low-impedance output, we run it through a high resistance into the filter as in Fig. 5. If the filter is fed through a buffer tube, connect the wobbulator directly into the grid. Connect a scope as shown. Adjust the wobbulator's output for as little drive as possible so as not to overload, if going through a buffer tube. Adjust the scope's gain and the wobbulator's deviation control until you get a pattern like the one in Fig. 6-a. The pattern should be symmetrical about the axis. If it is not, decrease the wobbulator's output. Now, since we are interested only in the top half of the figure, adjust the vertical position and gain of the scope to display only the top half. The pattern in Fig. 6-b should result.

With this pattern on the scope, effects of adjustments, additions and touch ups are readily apparent. END

WATCH DEMAGNETIZER



Watch is placed in recessed section.

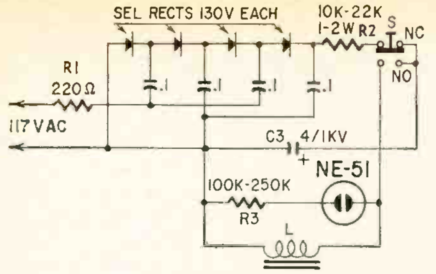


Inside view of watch demagnetizer.

THIS simple compact unit demagnetizes watches quickly and safely. The entire process takes only 1/20 second and the unit operates at a frequency that cannot damage any part of the watch.

The demagnetizer is shown in the photos. To use it, the watch is placed in the recess on its top. The recess is aligned with a coil of enameled wire wound on a powdered-iron core. This, of course, is the demagnetizing coil. Then, with the unit connected to the ac line, the pushbutton is depressed. A few moments' wait and the watch is demagnetized. A neon lamp flashes to show the device is working.

The unit's operation is simple (see schematic). The demagnetizing coil (L) is connected to the normally open



switch contact. When not in use, the pushbutton's normally closed terminals complete a charging circuit to charge capacitor C3. A voltage quadrupler supplies 440 to 600 volts charging voltage. When the pushbutton is depressed, the charging circuit is opened and the discharge circuit, through L, is closed. When the capacitor's discharge current flows through L, a *ringing circuit* composed of L and C3 produces the damped ac wave (one that dies down quickly from its maximum value to zero) that does the demagnetizing. The frequency of the damped wave is determined by circuit values—about 500 cycles in the arrangement shown.

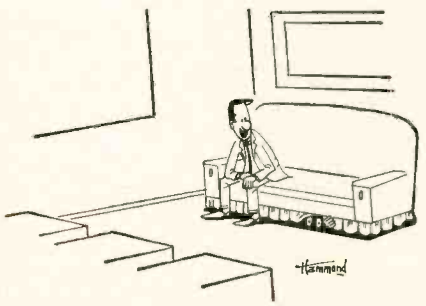
The damped oscillations give the same effect as using a standard demagnetizing device and moving its coil away from the watch—the amplitude of the ac field decays to zero.

The core and rim of the demagnetizing coil form opposite poles of an electromagnet with the polarity of each reversing at the ringing frequency. When a watch is placed in the demagnetizer, magnetic lines of force pass through the watch movement from the center post to the rim in rapidly reversing directions and decaying intensity to demagnetize the watch. The demagnetizer is the invention of Frank Dostal, chief engineer of American Time Products, Inc., which manufactures it.

CORRECTION

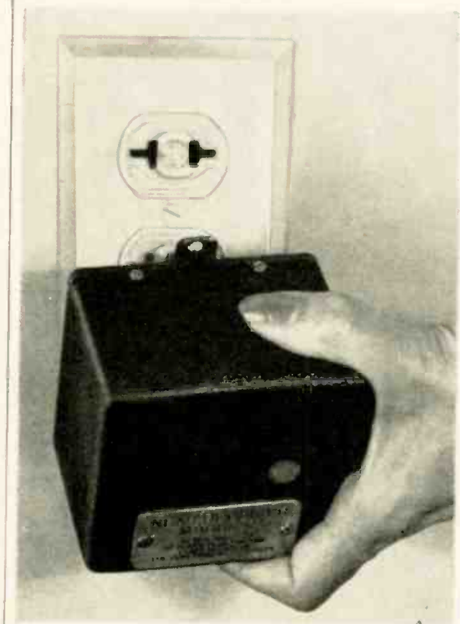
The symbol for pi (π) was inadvertently left out of the two reactance formulas in the second line of the second paragraph of the article "L-C Reactance Nomo Saves Calculation" on page 52 of the February issue. The nomo itself is correct. The formulas for capacitive and inductive reactance are $X_c = \frac{1}{2\pi fC}$ and $X_L = 2\pi fL$, respectively.

We thank Mr. Lewis F. Garber, of Pasadena, Calif., for bringing this to our attention.



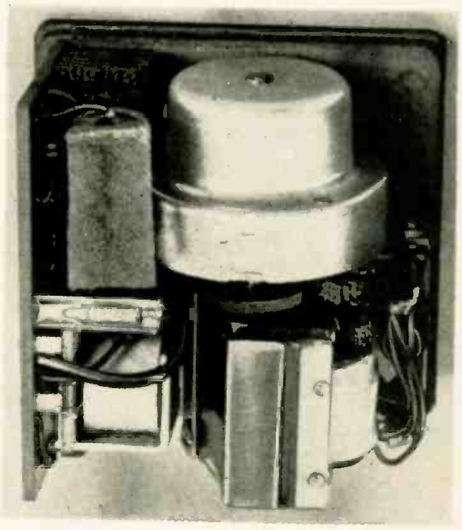
"See the difference in 3-channel stereo?"

emergency alarm in your home



Alarm receiver simply plugs into convenient wall receptacle.

Proposed new system for Civil Defense emergency warnings would use simple warning device that can be plugged into the nearest ac electric outlet and forgotten



With cover removed, internal construction is revealed.

As intercontinental ballistic missiles approach perfection, our Office of Civil and Defense Mobilization is intensifying its efforts to produce an emergency warning system that will be immediate, universal and economically practical.

Sirens have been depended on in the past. Though effective for outdoor use in urban areas, they cannot always be heard indoors and, as population thins out, their effectiveness drops, reaching practically zero in rural areas.

Three routes for reaching the indoor population were considered: the telephone, the radio and the power line. The cost of modifying the telephone system to give an instant warning was found prohibitive. Besides, not all people have telephones. Radios are almost universal, but only a small percentage of them may be turned on at any given moment (a very small percentage at such hours as 3 AM, for example).

But 96% of the population has electricity, and the power line is "on" 24 hours a day. An alarm device that would operate from the power lines would approach the ideal.

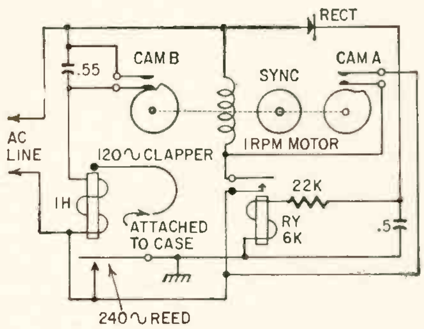
Such a system has been developed and, after passing intensive field tests at Charlotte, Mich., last fall, appears to be the coming warning method. Called the National Emergency Alarm Repeater (NEAR), it is simply a small box (see photo) that plugs into any convenient outlet. It sends a raucous buzz—or series of irregular buzzes—for 50 seconds when a warning signal is put on the line.

Details of NEAR device

The basic units of the device are a series coil–capacitor circuit tuned to 240 cycles, across the line; a vibrating reed that closes a circuit intermittently when a 240-cycle is received; a time-delay device and a 120-cycle clapper to sound the alarm.

The time delay is a very important feature. A useful receiver must operate every time a warning signal is received, but must not be triggered by a 240-cycle transients or the coded signals often used on power lines. If the homeowner is awakened a few times by false alarms, he will unplug the device and its usefulness will have ended.

The resonant circuit across the line is a 0.55-μf capacitor in series with a 1-henry coil (see diagram). Both the 240-cycle reed and 120-cycle clapper are actuated by the core of this coil. With only 60-cycle current in the line, not enough current can pass through the coil to attract either reed or clapper.



Circuit of the NEAR receiver.

When a 240-cycle signal is received, more current flows in the resonant circuit and the reed buzzes at a 240-cycle rate. This passes current through the rectifier every time the reed makes contact when the line current is in the right direction. The dc passing through the 6,000-ohm relay pulls down its armature and starts the 1-rpm motor.

The motor, which is the time-delay device, starts to rotate. If the signal lasts less than 10 seconds, the relay opens and the motor returns to its starting point. But if the signal continues for 10 seconds, two cams attached to the motor shaft close contacts. One set shorts out the 0.55-μf capacitor across the line, putting the full 117 volts on the coil. The current is now great enough to operate the 120-cycle tuned-reed clapper, and it sounds the alarm, using the case of the receiver as its "bell." The cam may be so shaped as to close the contacts for 50 seconds, or to open and close them irregularly during that period, heightening the alarm effect.

The other cam shorts the relay contacts, permitting the alarm to continue after the signal is shut off. After 1 minute, the first cam reaches the end of its cycle and shuts the motor off, awaiting another signal.

The 240-cycle warning signal is obtained from the 60-cycle power frequency with saturable reactors which act as frequency multipliers. These are installed at power stations or substations and supply a signal of approximately 1 volt to the receivers. The NEAR plan would link them up into a series of repeaters, so that a signal from the key station would actuate the adjacent ring of signal generators, which would in turn actuate another ring. Between 400 and 600 generators, properly placed, could cover the whole United States. END

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship at our risk one or more of the testers described on these pages.

SUPERIOR'S NEW MODEL 770-A

VOLT-OHM MILLIAMMETER

FEATURES:

- Compact—measures 3⅛" x 5⅞" x 2¼".
- Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.

6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.

2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm.

3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps.

3 DECIBEL RANGES: —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with test leads and operating instructions. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL VIEW METER

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
DECIBELS: —6 to + 18, + 14 to + 38, + 34 to + 58.

The following components are all tested for **QUALITY** at appropriate test potentials. Two separate **BAD-GOOD** scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. All Germanium Diodes.
All Silicon Rectifiers. All Silicon Diodes.

Model 79 comes complete with operating instructions, test leads and carrying case. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!

SPECIFICATIONS:

- **DC VOLTS**—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1500 volts.
- **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2000 volts.
- **ELECTRONIC OHMMETER**—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- **DECIBELS**—10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads and carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

SPECIFICATIONS:

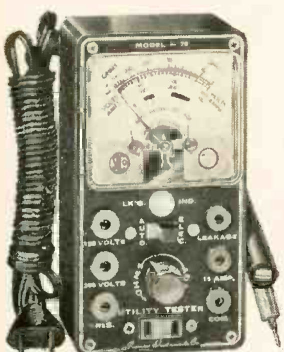
7 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES: —6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS ★ AUTOMOBILES



INCLUDED FREE

64 page condensed course in electricity. Profusely illustrated. Written in simple, easy-to-understand style.

As an electrical trouble shooter the Model 70:
• Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc. • Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:
• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

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- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write...wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
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CO-MAKERS

EMPLOYER NOTIFICATION

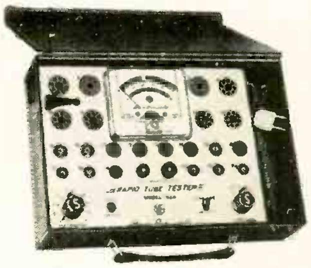
The simple order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A

MULTI-SOCKET TYPE TUBE TESTER



SPECIFICATIONS:

- Tests over 1000 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82A comes housed in handsome, portable, saddle-stitched Texon case. **Price is $36.50. Terms: $6.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large-easy-to-read type.
- **NOISE TEST:** Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- **SEPARATE SCALE FOR LOW-CURRENT TUBES**—Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 comes housed in a handsome, portable, saddle-stitched Texon case. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 83A

C.R.T. TESTER

Tests and Rejuvenates ALL PICTURE TUBES

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

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

Model 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

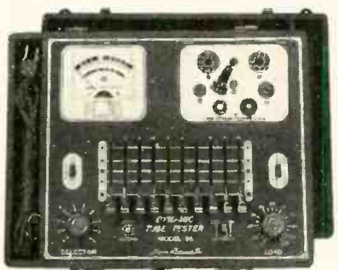
Model 83A will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus.

Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 85

TRANS-CONDUCTANCE TYPE TUBE TESTER



- Employs latest improved **TRANS-CONDUCTANCE** circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- **SYMBOL REFERENCES:** 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 necessary and advantageous.
- **"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.
- **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. **Price is $52.50. Terms: $12.50 after 10 day trial then $8.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER
7 Signal Generators in One!

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

A versatile all-inclusive **GENERATOR** which provides **ALL** the outputs for servicing:

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

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 88

TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS

AS A TRANSISTOR RADIO TESTER
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 is located and pinpointed.

AS A TRANSISTOR TESTER
The Model 88 will test all transistors including 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!*

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. & I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC., Dept. D-865, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

- ☐ **Model 770-A Total Price $15.85** $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ **Model 79 Total Price $38.50** $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 77.. Total Price $42.50** $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 80.... Total Price $42.50** $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TW-11 Total Price $47.50** $11.50 within 10 days. Balance $6.00 monthly for 6 months.
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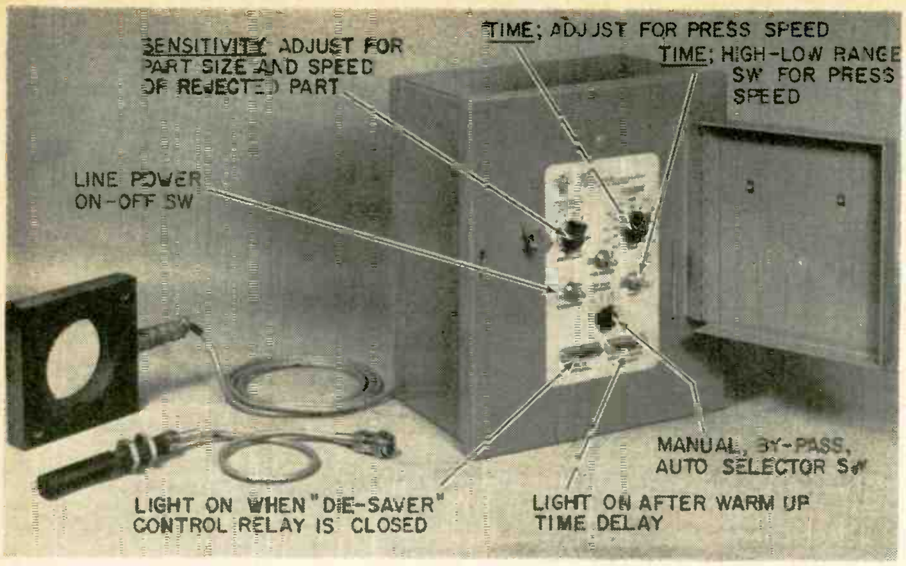
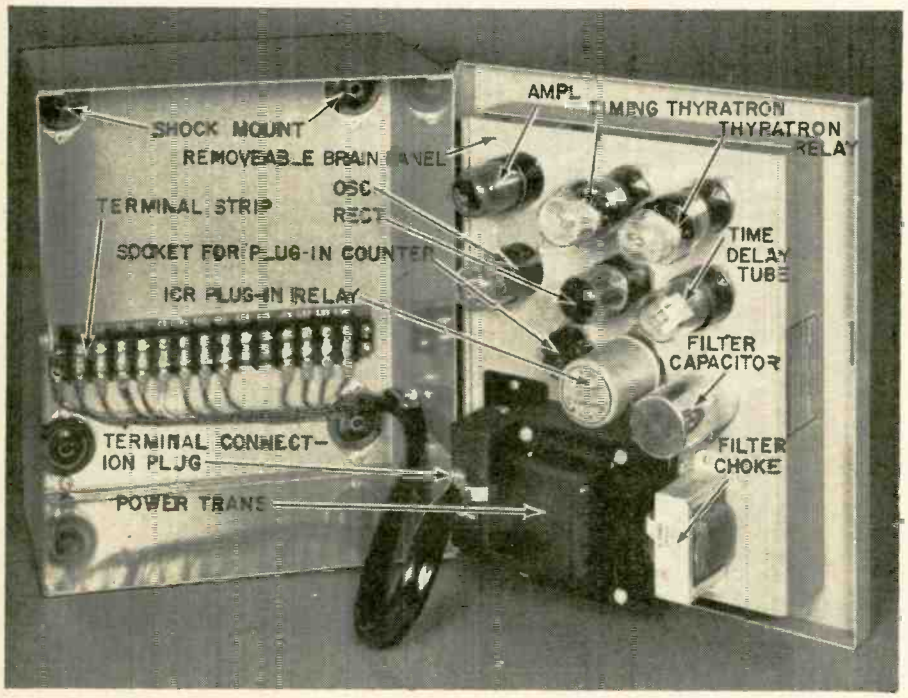


Robotron die saver with two of the many types of sensing coils.

RADIO-CONTROLLED DIE PROTECTION

Electronics increases production and lowers costs



A look at the components inside the control box.

By DELLROYE D. DARLING*

MOST high-production metal assemblies are made up mainly of die-stamped parts. The dies used to make these parts are very expensive; a set to produce some small item like a hubcap often costs several thousand dollars. Protecting these dies from damage is an important item in the cost of production, and anything that will increase the production rate will help also to reduce the price of the finished product.

A common cause of die damage is the insertion of two or more blanks into the die at the same time. This is called "multiple heading." Clearances between the male and female sections of a die are carefully calculated, and there is no room for more than one blank at a time. When a press is operated at a slow speed by a human operator, he can make sure the stamped part is removed before inserting a fresh blank. At high production rates, though, and especially on automatic presses, there is always a chance of multiple heading.

The rf proximity control offers one good means for checking to make sure the stamped part has been ejected before reloading. The Proximity Die Saver manufactured by the Robotron Corp. is especially designed for the job. When a human operator is running the press, it allows him to work faster without the chance of die damage. With suitable transfer equipment, this control can produce completely automatic production stamping.

One of the chief differences between this die saver and a standard rf proximity device is its ability to sense the movement of a piece of metal, yet be able to ignore large stationary masses of metal at a comparatively close range.

Circuit operation

The heart of this die saver is an electron-coupled rf oscillator, operating at about 300 kc. It is basic theory that a tuned circuit will oscillate when excited by an electrical pulse, but the resistance of the circuit gradually damps the oscillation. The tube in an oscillator circuit makes up for these losses and keeps the tuned circuit oscillating.

Usually, a well-designed oscillator is arranged so the tube is able to make up the losses even when some energy is being taken out of the tuned circuit. For use as a proximity control, the opposite

*Director, Industrial Electronics Radio Electronic Television Schools.

is true. The oscillator is designed to be very weak, and even a small amount of additional loss will stop it altogether. A piece of metal coming close to the coil acts like a shorted secondary, and the oscillator will reduce its output or stop completely. (This is something like the action of some military mine detectors.)

Fig. 1 shows how the pickup coil (detector ring) is mounted on the press so the stamped parts will pass through it as they are ejected from the die.

This control's secret of success lies in the fact that it senses *movement* of a piece of metal near the coil, but ignores the large, stationary mass of the press itself. This is done by using coupling capacitors in the control amplifier so that only a change in oscillator output will trip the control.

The circuit diagram (Fig. 2) shows how the rf output of the oscillator, taken from the cathode, is rectified and used to charge capacitor 9C. Any change in this charge is coupled to the grid of amplifier 1V-a through capacitor 6C. The amplifiers then feed a large positive pulse to the control grid of thyratron 2V, forcing it to fire.

Although 2V has a dc anode supply, it fires only long enough to charge timing capacitors 1C and 13C. When these capacitors are fully charged, the impedance of the anode circuit becomes so high that 2V can't pass enough current to keep firing, so it goes out automatically.

Relay tube 3V has a negative bias on its shield (grid 2), which keeps it blocked. When a positive bias is put on its control grid from 2V's anode circuit, it is forced to fire and keeps firing until the charge on 1C and 13C drops to a certain level. This provides a timing action to keep relay 1CR pulled in as long as there is enough charge on the timing capacitors. The contacts of 1CR are in series with the press initiation circuit in such a way that the press can start only when 1CR is energized.

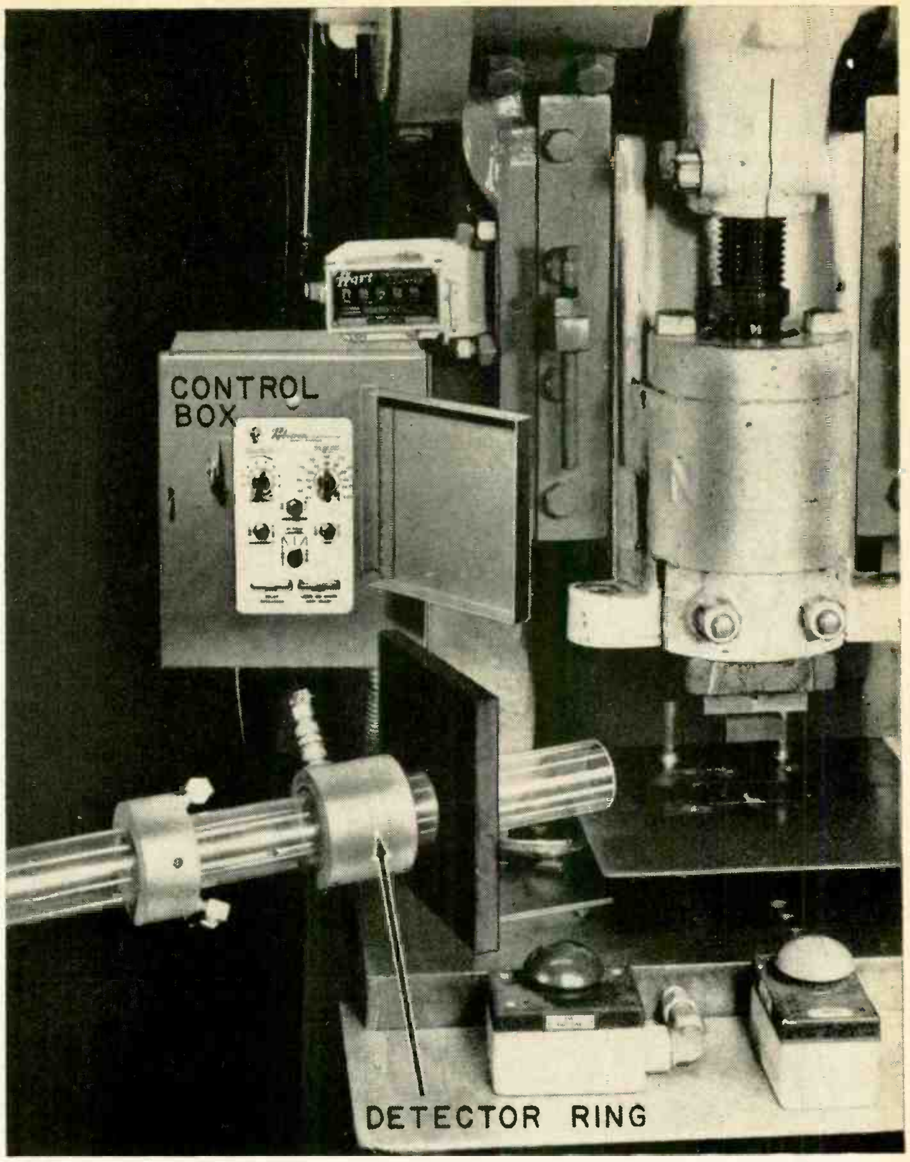


Fig. 1—The die protector set up for use.

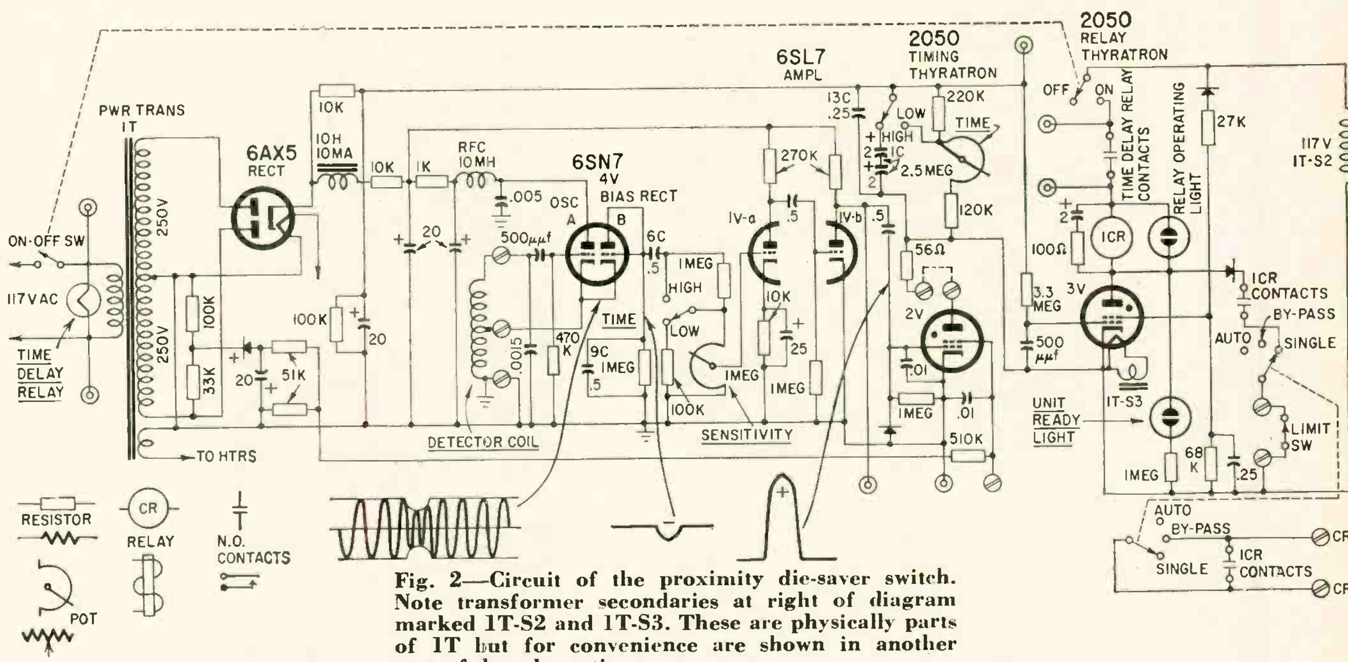
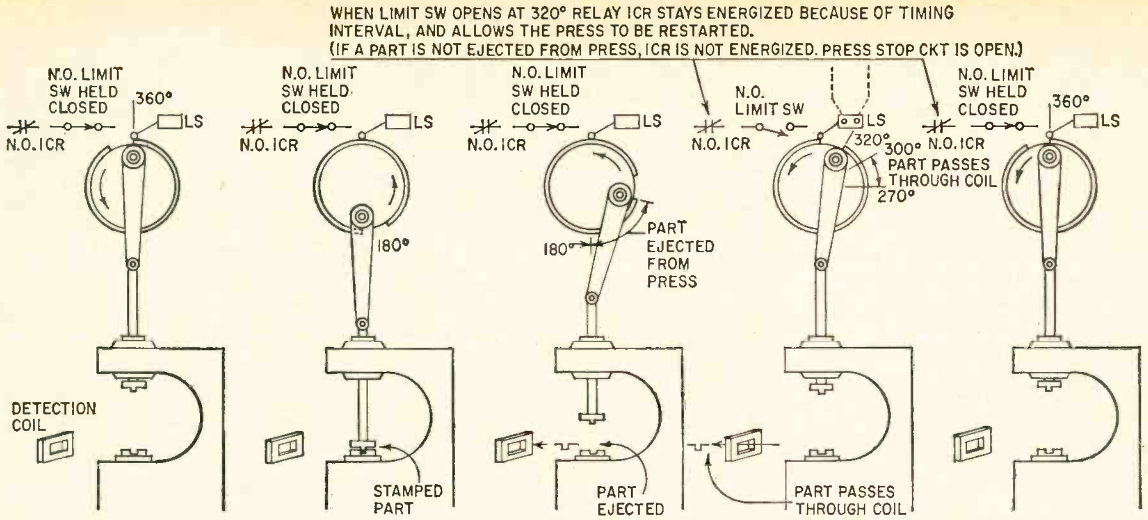


Fig. 2—Circuit of the proximity die-saver switch. Note transformer secondaries at right of diagram marked 1T-S2 and 1T-S3. These are physically parts of 1T but for convenience are shown in another part of the schematic.



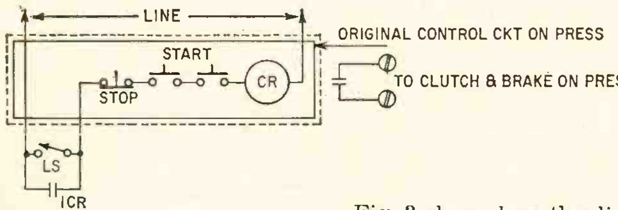
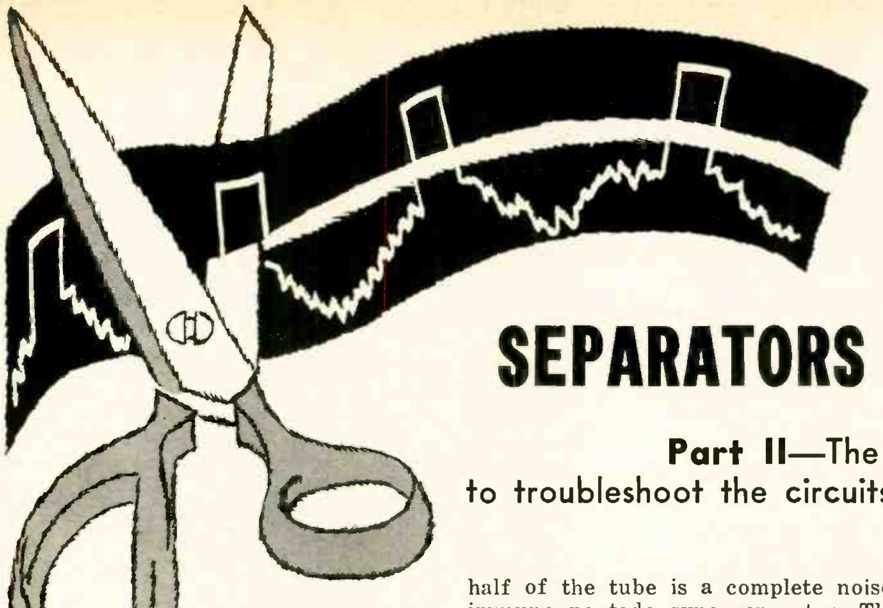


Fig. 3—Typical installation and operating cycle of die saver on a hand-fed press.

Fig. 3 shows how the die saver works in conjunction with the press. The setup shown here as an example is for a hand-fed press with a pin-and-dog clutch and brake.

A limit switch and cam is used to complete the press initiation circuit during all but 20° of press rotation. If a part has been ejected through the sensing coil, relay 1CR completes the circuit during this 20° and the press turns far enough to reclose the limit switch, allowing the press to be initiated again. If a part is not ejected, both the limit switch and 1CR are open, and the press will stop before the revolution is completed. The part must then be removed from the die and the press restarted with a bypass switch on the control unit.

Troubleshooting this control is relatively simple, but like anything else, the secret of fixing it is in knowing how it works. END



SYNC

SEPARATORS AND CLIPPERS

Part II—The 'BU8—how it works and how to troubleshoot the circuits it's used in

By JACK DARR
SERVICE EDITOR

LAST time we covered a combination tube with three functions (sync separator, sync clipper and noise gate). Here is another tube that handles these three functions plus a fourth — it provides agc action too! This is the 'BU8 series (3BU8, 6BU8, etc.). For simplicity, we'll refer to it as the 6BU8.

The internal construction of this tube is what makes it unique. Fig. 1 shows the base connections. While it seems to be an ordinary twin-pentode at first glance, a closer look shows that the cathode, screen grid and control grid are *common to both sections.* There are separate suppressor grids and plates for each section.

Now let's see how it works. Each section of the tube is the equivalent of the dual-control pentodes we discussed last month, and the sync-separator action is exactly the same. So in Fig. 1 half of the tube is a complete noise-immune pentode sync separator. The other half is a duplicate of the first section with the separate plate and suppressor (G3). Circuitry for the first half is exactly the same as the 6BE6: signals from the video amplifier plate are applied to G3. Since G1 is common to both sections, the signal from the video amplifier grid is fed to both sections. Conduction periods of both sections are the same and the sync is clipped and amplified and noise is removed (Fig. 2).

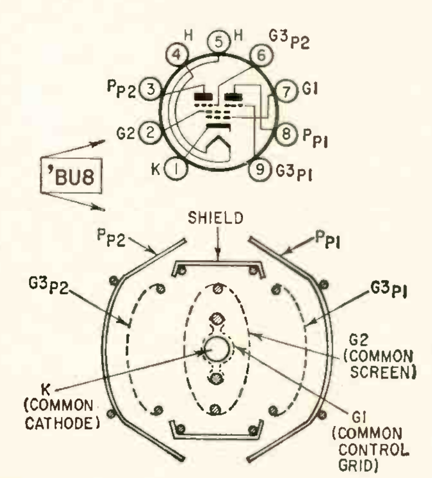


Fig. 1—Basing diagram and physical layout of the 'BU8.

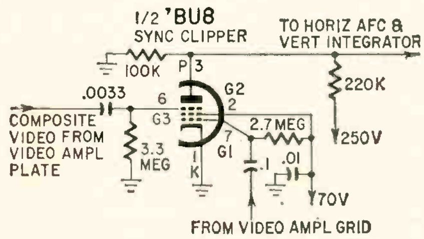


Fig. 2—Sync circuit using the 'BU8.

The agc

For the extra application—agc—we have a slightly different process. Video amplifier plate signals are applied to G3 (second section) at about 15 volts peak to peak. The tube is so biased that G3 is never driven to zero bias. This level may be set with the agc control.

The set's agc should hold receiver gain at as nearly a constant level as possible. For this reason, we must use some part of the signal with a constant amplitude. Obviously, we cannot use the video signal as this is constantly changing with brightness and contrast levels in the televised scene. So, we fall back on our old friends, the sync tips. They always correspond to 100% of the rf input level. By setting the bias of the agc section of the tube and applying a video signal to G3 of the agc section, we can develop a dc voltage which is always proportional to the amplitude of the incoming signal.

As the plate must be about 35 volts positive to conduct at all, it obviously can't be used directly as an agc voltage source. So we set up a voltage divider (Fig. 3). One end is connected to a source of positive voltage, the other to a source of negative voltage. (In many sets, the negative voltage is obtained from the grid of the horizontal oscillator or horizontal output stages!)

Now, we've about 40 volts positive at one end (the voltage at the plate of the agc tube with zero signal input) and 75 volts negative at the other. High-value resistors are used here to limit current flow.

The tube's plate is connected near the center of the circuit. Here it acts as a sort of variable resistor or a source of variable voltage, whichever way you want to consider it. (If the grid voltage of a vacuum tube is changed, the plate voltage changes correspondingly if the plate load resistance is fixed.) We connect the tuner and video-if agc lines to points along this voltage divider, so we can apply to them any value of "fixed bias."

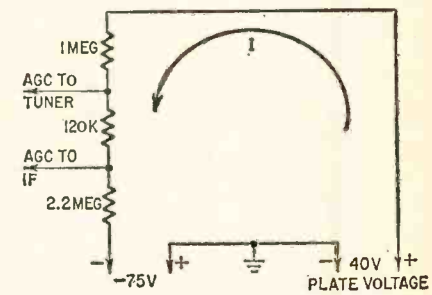


Fig. 3—Agc voltage divider.

If we vary the plate voltage of the tube, we vary the agc bias. If the plate voltage of the tube varies in accordance with average signal strength, we have practical agc action. Assume the tuner and if agc are about 3 and 4 volts negative, respectively. If the signal strength rises, the tube's grid bias goes more positive and the tube conducts more heavily. This *lowers* the plate voltage, *increasing the negative bias* on the tuner and if agc (reducing the gain

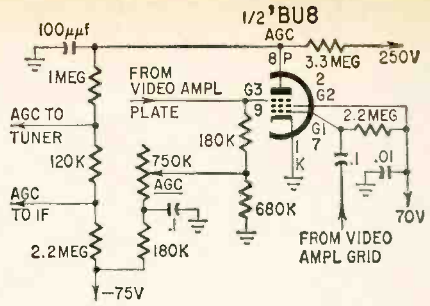


Fig. 4—The 'BU8 agc circuit.

of those stages). The gain is held constant and there's your agc action.

Fig. 4 shows a complete circuit of this agc section used in many sets. In addition to its agc action, the tube has the same immunity to noise that the sync separator has because it is connected in basically the same way. Since the video amplifier grid signal is applied to the common control grid, noise pulses are not only clipped out of the sync, but kept from affecting the agc. Filter component time constants in the agc network are low enough so that the agc bias will not drop during the very small chopped-out portion of the noise pulse.

Servicing sync circuits

Servicing a sync circuit isn't difficult, if you understand what they're supposed to be doing! There is always one good positive symptom of sync trouble: the picture will be *very* unstable, in one or both directions!

It's usually easy to find out which section is causing the trouble. For example, if both horizontal and vertical sync are weak, the trouble would be most likely found in some stage which handles both sync signals: clippers, separators, etc. Of course, the very first step in sync-circuit testing should be tube replacement with *known good* tubes. It is a good idea to check even new tubes before installing them in any sync circuit. Many tubes have been pulled from sync separators and installed in tuners where they performed perfectly, although they would not work at all in the sync section.

Video in the sync will cause the most trouble in horizontal oscillators. Horizontal sync depends more upon the phase than the amplitude of the sync pulse. If the horizontal sync is contaminated by video signals, it will cause pulling of the picture, usually near dark objects. (Dark places are the points where the video signals are strongest.) The trouble is due to erroneous correction voltages developed by the horizontal afc.

Vertical sync performance depends mainly upon pulse amplitude: the sync signals are passed through an integrator circuit and fed to the vertical oscillator in the form of sharp spikes. Weak vertical sync action with good horizontal sync, therefore, points toward trouble somewhere in the sync separator: a weak tube, incorrect operating voltages, etc.

Loss of both horizontal and vertical

sync can also be caused by sync clipping in an overloaded video if stage. This can be checked quickly by adjusting the agc control or, better still, by applying an override bias to the if agc line. If the picture straightens up, the trouble is *not* in the sync stages. Gassy if tubes or heater–cathode leakage in agc controlled stages can cause this. (For some reason, second video if tubes seem to be the major cause of this trouble.)

'BU8 circuit troubles

A few peculiar troubles turn up in circuits using 'BU8 tubes. They are the result of the slightly unusual circuitry involved. For example, loss of both horizontal and vertical sync would indicate that either the G3 signal was missing in the sync section or that the tube was defective. Unstable sync in the presence of noise would indicate loss of the G1 signal or too low a setting of the noise control.

A white-out (snowless white raster, no picture, usually no sound either) often indicates agc trouble. The if amplifiers are blocked if trouble hits the voltage divider. An opened (or increased) 3.3-megohm 'BU8 plate resistor (Fig. 4) would apply −70 volts to the tuner and if agc. This would block both stages completely!

If the 2.2-megohm resistor to the −75-volt source should increase or open, the controlled grids would go positive causing a severe overload condition: negative picture or complete picture loss (blank screen). To check this circuit, measure all voltages, especially the two source voltages with a vtvm to see that they are within the tolerance. They will vary from set to set, as do all other voltages, but should agree closely with those shown on the schematic.

Check the high-value resistors in the divider as they must be quite close to their nominal value to prevent troubles. (One unusual trouble was found in this circuit recently: the agc voltages were off and the trouble turned out to be lack of drive voltage on the horizontal output tube! This reduced the −75 volts and upset the whole circuit even though there was apparently plenty of brightness. Always check those source voltages!)

One last horrible example before we quit. After much checking of parts in a vertical sync circuit, a pair of the little diodes used in the horizontal phase comparator was unsoldered to check another part. The diodes were found to be badly unbalanced when checked with an ohmmeter "while they were out." These were replaced as a matter of course. Lo and behold, when the set was turned on, the *vertical* sync trouble was gone! Apparently the leaky diode was shunting the vertical sync signals enough to affect the operation of the vertical sync circuits which depend upon amplitude, remember? Apparently there was sufficient horizontal signal left to operate the phase comparator which depends on phase and not amplitude! END

the CASE of the missing spot

Introducing a chart that will indicate what stages to check when your scope is out of order

By PAUL W. KARROL

WHEN Phil (my young ham friend) brought his scope over to my shop for repair, little did I think that I would spend the rest of the morning on it; but that is what happened.

"This scope never gave me any trouble before," Phil began, "but finding the gremlin in it is harder than I thought it would be."

"What are the symptoms?" I asked, while leafing the instruction book to the page with the diagram.

"Well, I've been using it to monitor my final linear amplifier. Right in the middle of a QSO it just stopped operating—no spot—no nothing."

"Did you check the fuse and tubes?"

"Oh, sure," he answered quickly. "I checked most of the voltages too."

"How about point-to-point resistance tests according to the chart in the book?"

"I did some of them, but my ohmmeter only goes up to 100,000 ohms. That's one of the reasons I brought it over here—I know you have proper test instruments."

"How about the tubes? How did you check them?"

"I checked them on my emission checker. Why?"

"Well, I think we had better test them on my dynamic checker. We'll also check out the cathode-ray tube. Let's take the set out of its case now."

Phil carefully removed the scope.

"Before we do anything else, I'll short out all the capacitors in the high-voltage circuits with this long screwdriver," I told him. "You can't tell if one is charged or not—bleeders do open up you know. Whenever you work on a scope or any electronic equipment for that matter, always short out the high-voltage capacitors. When you begin the live test, be doubly careful—4,000 volts or more is nothing to fool with."

"Yeah, I know." Phil smiled. "Even a small charge can bite."

We tested and put back all tubes but one.

"This one is a little weak, Phil," I said, handing it to him. "I have a replacement, but I'm sure that is not the trouble."

After we had plugged in the new tube, I began to remove the fuse-holder screw.

"I checked the fuse," Phil said, "and it looked OK. In fact, the pilot lit and all the tubes warmed up fine on my last test."

I placed the ohmmeter test prods across the fuse—the needle didn't move. "A fuse may look OK but sometimes it isn't. What were you saying about a 'good' fuse?" I laughed.

"Well, as I said, it was fine about an hour ago. Maybe that's our trouble, huh?"

"I hardly think so," I answered. "Reach into that top bench drawer on your right and give me a 3AG 2-ampere fuse."

Before plugging in the power cord, I turned to Phil.

"Now we'll examine the set very carefully and look for burned resistors or anything else that looks abnormal."

Phil watched closely as I probed various connections and examined all visible parts.

"Everything looks OK," I said, "but that doesn't mean we don't have a bad part or two. So far, we have *looked for the simplest causes of trouble first*. Now we begin detailed testing."

I examined the power-cord plug connections. "The plug looks in order," I said, plugging it into the nearest receptacle. I turned on the scope.

In a few seconds, all tubes (including the CRT) were glowing.

I turned up the intensity control to get a spot on the CRT screen—but it remained blank.

"Before we go any further, let's take a look at the scope troubleshooting chart I prepared for one of my radio classes," I said. "It's on the wall above my desk." [See page 94—*Editor.*]

"As you can see, Phil, it is so laid out that all you have to do is to go to the left side, pick out the symptom, then go to the center for the scope section or stage action involved. The right-hand column gives possible causes. For example, let's take your scope's symptoms—no spot on the screen. We find this information on the second and third lines of the chart.

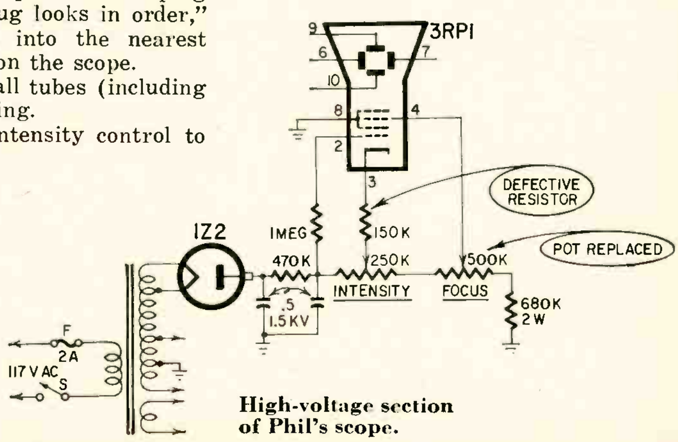
"A number of possible causes are listed in the end column. Let's check the high-voltage supply first. Before we do, let me draw a sketch of the sections we are interested in."

I copied the circuit from the instruction book (see diagram). "There's nothing complicated about this. First, let's check the voltage on both sides of the 470,000-ohm filter resistor."

With my voltmeter set to the proper high scale (and using a voltage-multiplier probe), I measured the voltage on the resistor.

"Looks OK. Now let's check at pin 3

(*text continued on page* 95, *chart on page* 94)



High-voltage section of Phil's scope.

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SCOPE TROUBLE CHART

SYMPTOM	SECTION OR ACTION	TROUBLE SOURCE
No tubes lit	Heater and pilot power supply	Fuse, transformer, line cord or plug
No spot Irregular spot due to CRT hum modulation	Cathode-ray-tube spot	High-voltage supply, open feed resistors, shorted bypass capacitors, horizontal or vertical plate-load resistor open, defective positioning circuits causing beam to go off screen, bad cathode-ray tube Check CRT shield position
No spot or no focus or control	Intensity and focus	Focus or intensity controls, cathode-ray tube, bleeder open, cathode-ray-tube pin contacts, broken leads to cathode-ray tube
No vertical positioning or no amplifier action	Vertical positioning Vertical amplifier	Vertical amplifier tubes, low-voltage supply (including tubes), resistors, coupling and bypass capacitors, position control, attenuator switch
No horizontal positioning or no amplifier action	Horizontal positioning Horizontal amplifier	Horizontal amplifier tubes, low-voltage supply, resistors, coupling and bypass capacitors, position control
No sweep (some or all ranges), no frequency control	Sweep (horizontal amplifier)	Sweep or horizontal amplifier tubes, sweep-circuit switch, capacitors, resistors, low-voltage supply
No sync (drifting patterns)	Sync amplifier and switch	Sync amplifier tubes, switch, resistors, capacitors, low-voltage supply
No intensity modulation	Z-axis amplifier	Z-axis amplifier tubes, resistors, capacitors, low-voltage supply

on the CRT," I suggested.

No reading!

"Hmmm—looks like a bad intensity control," Phil said, his eyes still on the meter.

"Don't be too hasty." I switched the probe to the 250,000-ohm intensity potentiometer.

The meter needle went up the scale.

"I think we've found it," I said, placing the probe first on the pot arm and then at the other end of the resistor connected to it.

No reading again.

I turned the scope off and shorted out the high-voltage capacitors again.

After cutting out the offending part, we checked it on the high-range ohmmeter.

"She's open," Phil said. "But it doesn't look cooked."

I took another 150,000-ohm resistor from the box. "It doesn't have to look cooked to be bad. Remember the worm with an apple wrapped around it?"

"I can see what you mean," he replied with a grin.

After the new resistor had been soldered in place, we again turned on the scope.

As the faint green glow began showing on the CRT, Phil exclaimed, "Boy, it sure is good to see that missing spot again!"

I turned down the intensity control and tried to focus the spot—but there was no action.

"We may have a bad focus pot," I said, reaching for a bottle of contact cleaner.

"Oh, that control has always been a little erratic," Phil declared, reaching for the focus knob and pulling it a little. "See, you have to pull on it to make it work."

I put down the bottle of cleaner. "Seems to me we ought to replace that control. No use having a control that doesn't work properly."

Phil agreed.

As soon as the pot was installed, the scope was again tested and worked beautifully.

I told Phil to put the scope back in the case and then come over to my desk.

"I don't know how to thank you, Paul," he began, "not only for the work on the scope but also for the troubleshooting hints. I'd certainly appreciate a copy of the chart for future reference."

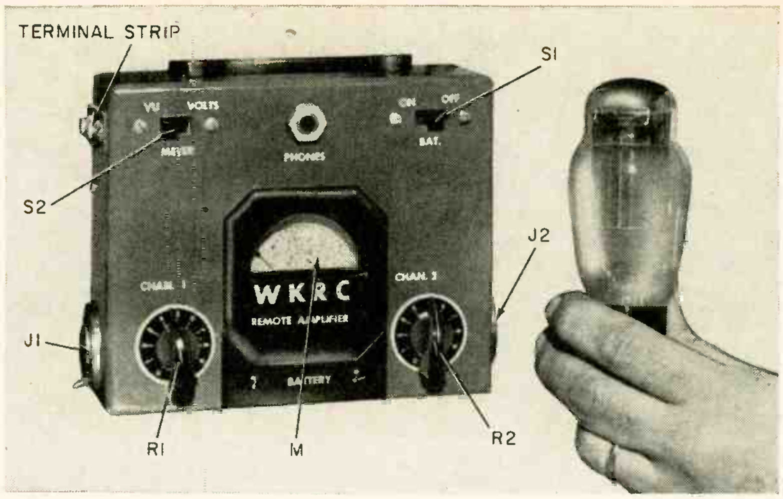
I pulled a mimeographed copy of the chart out of a desk drawer and handed it to him.

"This will help you think, if it does nothing else," I told him. "But, remember, locating the fault is only part of the job. You still have to look for the simplest causes of trouble first and then make resistance and voltage checks according to the book."

Glancing down at the scope by his side, Phil said with a wide grin, "I hope I don't have to bring it back soon—thanks again."

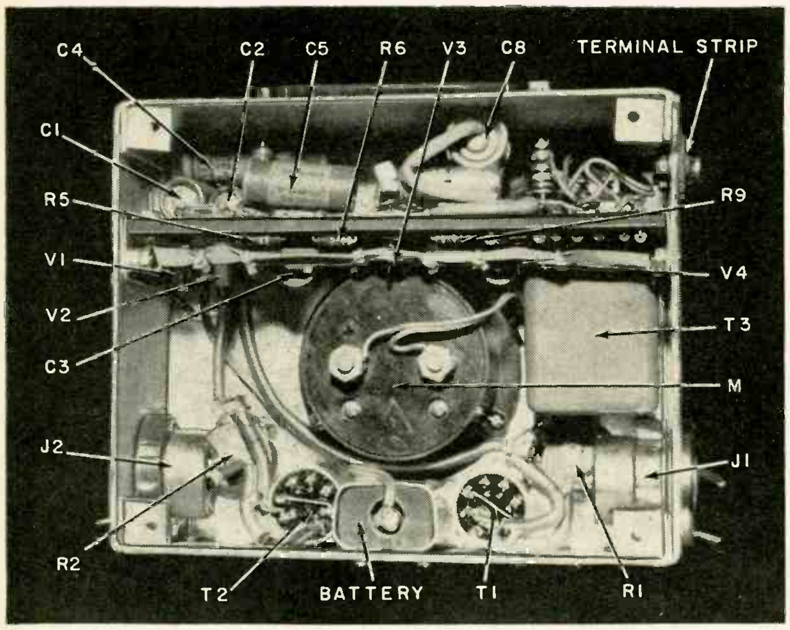
"No, I don't think you will have to," I replied, looking over my shoulder at the chart on the wall and then toward the departing ham." END

Remote Amplifier has Transistor Circuit...



Careful construction gives the remote amplifier a professional appearance.

2-microphone 4-transistor unit is completely portable and low in cost



Rubberband holds transistors in place. V1 and V2 were originally CK727's. As this transistor is no longer available, 2N207-B's are now used.

By GEORGE WASLO, WKRC-TV

REMOTE broadcast amplifiers are important to any radio station, no matter how small or large the station may be.

The usual problems with all these units is their high cost, high battery drain (or dependence on ac line voltage) and bulky size and weight. To get around these problems, I came up with the two-microphone four-transistor unit described in this article.

This transistorized unit does the same job as larger, more expensive commercial units and thanks to the transistors, battery life is much better. The

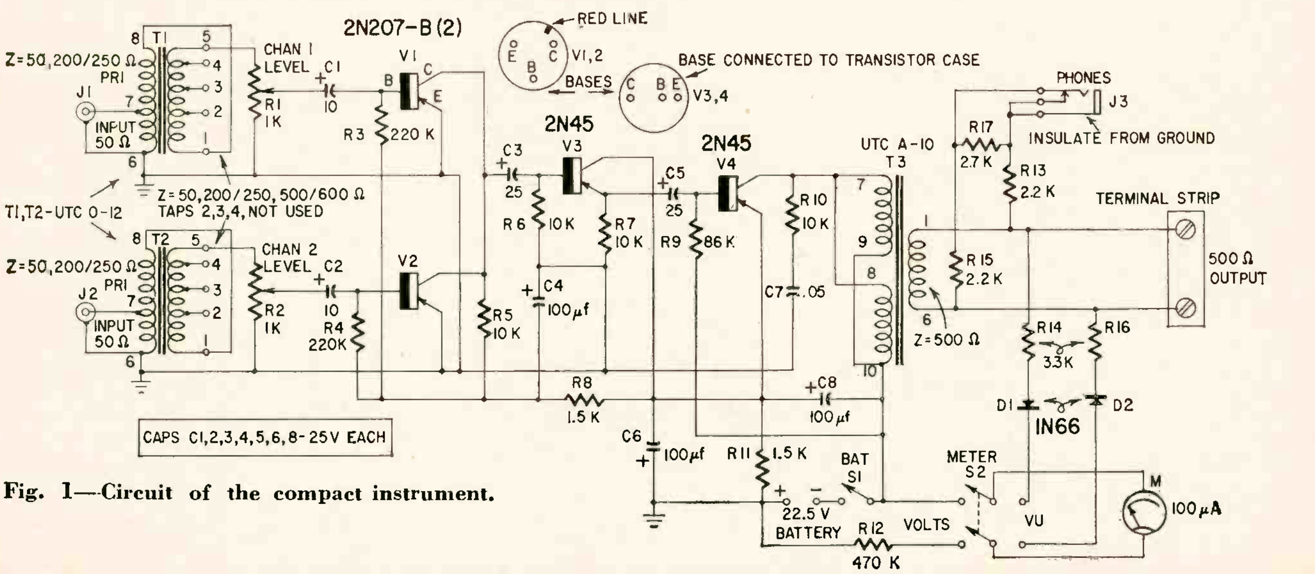


Fig. 1—Circuit of the compact instrument.

unit is still used at WKRC (AM radio), primarily as a standby amplifier at Cincinnati Redlegs home baseball games.

Fig. 1 shows the circuit of the remote pickup. The two input channels are identical. Designed for use with 50-ohm microphones, each one feeds through a matching transformer to the base of a 2N207-B low-level, low-noise, common-emitter amplifier stage. The outputs of these transistors are tied together and R-C-coupled to two medium-power transistor stages. The first, V3, is a common-emitter circuit using a 2N45. V3's output is fed to V4, a common-collector stage. The voltage developed for this stage is used to supply operating potential for the preceding low-level stages. Audio is bypassed and the effective supply impedance for V1 and V2 is lowered by a large shunt capacitor across R11.

The output of V4 is now fed to the primary of an output transformer selected to match the transistor output to a 500-ohm line. Isolation resistors for phones and diode rectifiers are connected to the secondary of this transformer. The meter (0–100 μa) can be used as an audio-level indicator or to check battery voltage. The function is

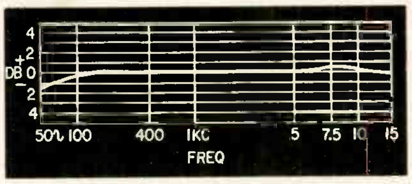


Fig. 2—Curve shows excellent frequency response of the portable, low-cost amplifier.

selected with switch S2. The device's frequency response is shown in Fig. 2.

The unit is built into a 5 x 6 x 2½-inch case. Rubber feet are mounted on the bottom and back so it can be used in either position. The battery lasts 25 hours or more (total current drain is only 5 ma). Of course, with a larger battery, life would be longer. The unit was built three years ago and is still in use, a sure indication of its practicality and dependability. END

R1, 2—pot, 1,000 ohms, audio taper
R3, 4—220,000 ohms
R5, 6, 7, 10—10,000 ohms
R8, 11—1,500 ohms
R9—86,000 ohms
R12—470,000 ohms
R13, 15—2,200 ohms
R14, 16—3,300 ohms
R17—2,700 ohms
All resistors ½-watt 10%
C1, 2—10 μf, 25 volts, electrolytic
C3, 5—25 μf, 25 volts, electrolytic
C4, 6, 8—100 μf, 25 volts, electrolytic
C7—.05 μf
D1, 2—1N66
J1, 2—microphone jacks
J3—phone jack (Switchcraft 12-A, ICA 1871, or equivalent)
M—0-100-μa meter
S1—spst slide
S2—dpdt slide
T1, 2—miniature input transformers: primary, 50, 200/250 ohms; secondary, 50, 200/250, 500/600 ohms (UTC 0-12 or equivalent)
T3—hi-fi audio transformer: primary, 50, 125/150, 200/250, 333, 500/600 ohms; secondary, 50,000 ohms (UTC A-10 or equivalent)
V1, 2—2N207-B
V3, 4—2N45
Battery 22.5 volts (RCA VS084 or equivalent)
Case, 5 x 6 x 2½ inches
Sockets, transistor (4)
Lug terminal strip, screw type (2)
Miscellaneous hardware

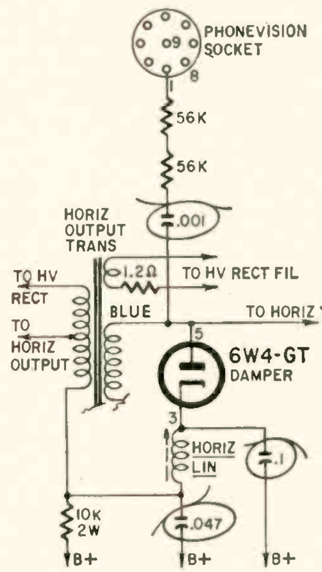
Technotes

HIGH-VOLTAGE HINT

An interesting troubleshooting procedure is possible when you have high-voltage troubles in sets using the 3A3. Quite often, when trouble develops in the horizontal sweep system, there will still be some sweep energy, but not enough to light the filament of the 3A3. By substituting a 1B3 you can frequently get light on the screen. This will help you identify the circuit fault. For instance, when a yoke shorts, there may be no light on the screen but, by substituting the 1B3 for the 3A3, the familiar keystone raster can be seen and the trouble diagnosed.—*Wayne Lemons*

ZENITH 23H22

Complaints of horizontal wiggle and loss of horizontal sync have been caused by a leaky .001-μf capacitor connected between the blue lead of the horizontal output transformer and two 56,000-ohm resistors that go to pin 1 of the Phonevision socket. Also check the 0.1-μf and .047-μf capacitors off the damper cathode for leakage or arcing. Replace with 600-volt units if bad.



Piecrust oscillations giving a watery picture after the set has warmed up can be cured by lowering the setting of the horizontal grid drive and adjusting the horizontal linearity coil. For stubborn cases, insert a 47-ohm 1-watt resistor in the plate and cathode leads of the 6W4.

Poor width and low voltage or no raster at all can be caused by a decrease in value or an open in the 10,000-ohm 2-watt carbon resistor connected from B-plus to the horizontal output transformer primary and horizontal linearity coil. Replace this resistor with a 4-watt unit.—*George P. Oberto*

CRT CHECKER

Obtain a 90–550-volt neon test lamp. Solder two 12-inch lengths of No. 2, rubber-covered wire to the neon-lamp wires. Tape the soldered connections carefully. Bare the free ends of No. 2 wire and solder heavy-duty alligator clips to one of them. On the other one, build up solder on it and file into a test-probe point. Now wrap many layers of electrician's rubber tape above the clip and fashioned point. This protects you against shock and it also acts as a convenient hand grip.

To use this neon lamp to test for brightness and contrast on a picture tube, proceed as follows: Clip one end lead to the TV chassis. Turn the set on and touch the other probe to the control grid of the picture tube (generally pin 2 of the 12-pin socket). Now, turn the brightness control. If everything is normal, the neon-light brightness should vary with the setting of the brightness control. To test the contrast control, do the same, only this time touch the probe to pin 11 of the picture tube, the cathode. For another test connect the lamp between pins 2 and 11. Turn the set on, rotate both contrast and brightness controls. Either control should vary the neon-lamp brightness. If this is so, everything is OK in the contrast and brightness circuits.—*A. von Zook*

MOTOROLA TS53

The complaint was too frequent replacement of the 1B3. The tube would have an open filament each time it went bad. I found that the filament winding of the flyback transformer had two turns around the core. I had believed that once around the core was standard practice. Since the 1B3 filament seemed to burn rather brightly, I removed one turn and eliminated the existing 3.3-ohm resistor. Now the filament glowed normally. The lighter load on the flyback increased horizontal sweep and high-voltage too.—*Charles Andrews*

LAB SCOPE ACTS UP

We were called to troubleshoot a $3,000 lab scope—its horizontal sweep refused to work. The operator had already replaced tubes to no avail. This scope was a trigger-sweep instrument with a calibrated sweep circuit. The spot rested contentedly at the left-hand edge of the screen and refused to move horizontally, although there was plenty of vertical deflection when signal was applied to the scope.

The first question that came to mind was whether the electronic trigger was working or a defect in the preamp was keeping the trigger circuit from working. So we took a conventional service scope with low-capacitance probe and checked the output of the trigger circuit. Each time the operator applied an input signal, the trigger circuit kicked. Evidently, the trouble was between the trigger and the CRT. So we proceeded to trace the trigger signal down to the sweep circuit (sawtooth maker).

Following the signal down a harness and into a printed-wiring board, we lost the signal upon entering the board. The sawtooth maker was dead. When we checked the connection of the harness conductor to the printed board, the trouble was apparent. The insulation had been carelessly removed from the conductor and the lead had been cut almost in two. It took only normal vibration and jarring of the instrument to open the connection.

We cleaned the terminal, skinned the end of the conductor properly and soldered it in place. Now we were back in business and the beam swept horizontally as it was supposed to.

This was an interesting job, because this is the last kind of trouble that you expect to find in very expensive test equipment.—*Robert G. Middleton* END

TECHNICIANS' NEWS

TV SERVICE LICENSE IN D.C.?

The District of Columbia Business Licensing Committee is pushing a move to introduce legislation in the next session of Congress to require licensing of local TV shops. This would affect only shops in the District of Columbia and is not intended as a nation-wide licensing law.

Tests run by the committee from time to time have indicated that some TV shops have made unreasonable charges for repairs.

FRAUD IN CALIFORNIA

Los Angeles, Calif.—Two local TV technicians, Herman and Oscar Singer, were arrested on charges of petty theft. They were called to repair sets placed in the homes of policemen. Each set had either one bad tube or one bad capacitor with an anticipated repair cost of about $2 plus labor.

Three sets were repaired. The bills ran $41.46, $41.76 and $42. Police also reported that five new tubes in one of the sets had been replaced with used ones. Another unfortunate black eye for the honest service technician.

The California State Electronics Association supports the fight against fraud. The association's president, Robert Whitmore has stated, according to *Home Furnishings Daily*, "Public exposure of the sundowners provides strong support for our campaign for state licensing of TV technicians.

"Actually, the sundowners represent only a small fraction of our industry, but account for more than $60,000,000 of the $168,000,000 total volume of TV service in this state. However, this small group has continually blackened the public image of TV technicians, causing serious problems for conventional operators."

WARNA-GRAM

Alameda County, Calif.—This technique is used by the Alameda County TV & Radio Association to give its members immediate notice of crooked operators preying on their business:

This setup informs members at once of bad or fraudulent checks, stopped checks for service payment, fake or questionable "charity" solicitations, thefts and burglaries, questionable or worthless advertising promotions, just plain gyps of any kind.

The plan is simple. A member, say, has a check for service "stopped." He immediately phones ACTRA executive secretary Phil Fisher, detailing the situation. Five key members are immediately called. Each of these phones the two members on his list; each of the latter passes the word to two more, and so on.

It has been checked out, and the entire membership can be covered in half an hour.

If any dealer doesn't answer the call, the dealer responsible is urged to call again later in the afternoon or earlier the next morning, or at noon when most one-man shop owners are in. If a break in the chain shows up, Phil is phoned at once. He bypasses the break, calling lower in the chain to keep the warning moving.

ESFETA-PROPOSED LICENSE BILL

At a recent meeting of the Empire State Federation of Electronic Technician Associations, the proposed New York State license bill was reviewed with legal counsel.

Important extracts from the proposed bill are:

Any TV technician now engaged in television repair work will be eligible for a license under the "Grandfather Clause" (necessary on all new license legislation).

Tube changers, those who know nothing about circuit repairs, will not be eligible for a license.

No part-timer will be denied a license, provided he is qualified. (This will help good part-timers to become good full-timers.)

The license board will be composed of seven members: four licensed technicians (from different geographical areas of the state); one service manager for a manufacturer of TV receivers; one electronics teacher appointed by the State Board of Education; and one individual who shall have had no previous and no present interest in the television service industry, to be representative of the consumer.

The license board will protect the public from unscrupulous service shops and will protect the TV technician from unscrupulous customers.

In addition, once the license bill is in effect, courses of instruction will be set up which will allow licensed technicians to take voluntary courses to keep them up to date with technical advances in the field. It will also allow apprentices to get first-class schooling instead of the present "90-day wonder" courses.

ASSOCIATION PROTECTS SET OWNER

Fort Worth, Tex.—The local branch of the Texas Service Association gives its members a solid backing and protects its members' customers at the same time.

If a customer has a complaint, he sends it to association headquarters. It is then referred to a committee to investigate immediately. If the complaint is justified, it is settled to the customer's satisfaction and the service shop that did the original work is billed for the cost. If the bill is refused, the firm is dropped from the association, and the Texas Electronics Association of Fort Worth assumes the cost.

During the 3 years the plan has been in operation, only one member has been dropped.

PHILCO LABOR WARRANTY

The new line of Philco TV receivers will carry a 90-day warranty that covers labor as well as parts. The customer must bring the set to the shop.

Servicing will be handled by some 30,000 independent Philco service technicians, dealers with qualified service shops and technicians who repair sets for non-servicing retailers, according to Henry T. Paiste, Philco consumer relations and service director.

There is a certain cost to the customer, although it is included in the price of the TV set. The new sets cost between $1.75 and $4 more than before.

ARTS OFFICERS FOR '61

St. Joseph Valley, Ind.—The Association of Radio & Television Service of St. Joseph Valley elected the following officers for 1961:

President: Cas Molenda, Avenue Radio Shop. First vice president: Ed Barant, Marquette TV-Radio. Second vice president: Harold Rhodes, The Electric Co. Secretary: Jack Cook, Electronic Service Co. Treasurer: Dick Tepe, Tepe Television Service. Sergeant at Arms: Dan Walker, Walker's TV & Radio Service. Chairman of the board: Buss Bills of Bills' TV Service.

CABLE SYSTEM DEFEATED

Lompoc, Calif.—A vote of the people of Lompoc defeated an attempt by Cablevision to get a franchise for their cable TV system in that area, reports the *CSEA Countdown.* The decision was 3 to 2 against the franchise. *Countdown* says that "as a service group we are not against cables, if an area cannot be served by free TV; but where a promotion to capture an audience with only promises is offered then we must, for the preservation of independent service, fight with all the facilities we have at our disposal."

TESA SPRINGFIELD MEETS

Springfield, Ohio—At a recent meeting held at the local Credit Bureau, Mr. James Merrill spoke on effective credit management. Methods of gathering and filing credit information were described. A question-and-answer period followed. END

HAM "AUCTION-FEST"

Broward Amateur Radio Club is holding its fifth annual Auction-fest March 11, 1961 in Fort Lauderdale, Fla., at the Armory, SW 4th Ave. and 24th St. Doors open 8 am; auctioning from 10 am to 5 pm, with a lunch break at noon. Attendance has placed this event as tops in Florida ham radio auctions.

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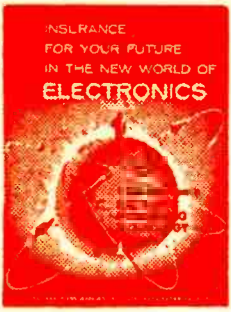

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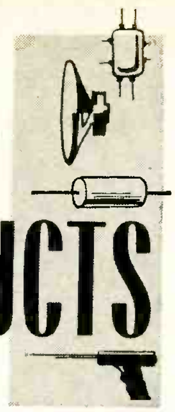
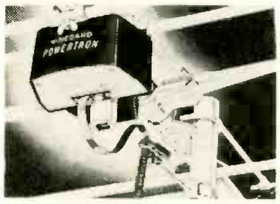
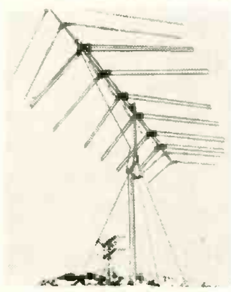


ELECTRONIC TV RECEIVING ANTENNA, *Powertron.* Booster at antenna amplifies TV signals up to 9 times normal signal voltage. All-channel



Yagi. 14-, 21- and 30-element models suitable for color and black-and-white. Power transformer plugged into house outlet supplies 24 volts to booster via lead-in.—**Winegard Co.**, 3000 Scotten Blvd., Burlington, Iowa.

TRAVELING-WAVE ANTENNAS, *Super 10 T-W* 10-element antenna combines 6 hairpin-driven



dipoles with 4 parasitic low-band and co-linear high-band elements. *Super 8 T-W*, 4 driven and 4 parasitic elements.—**Channel Master Corp.**, Ellenville, N. Y.

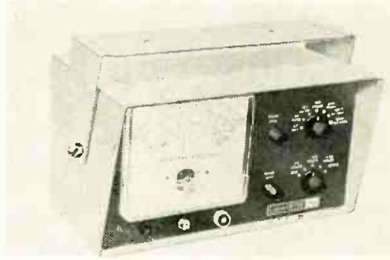
TV/FM SYSTEM KIT, *model HK-1,* feeds up to 4 TV or FM sets from single indoor antenna.

4-set coupler, 300-ohm ribbon line and installation hardware.—**Blonder-Tongue Labs**, 9-25 Alling St., Newark 2, N. J.

OSCILLOSCOPE KIT, *Dual Trace.* Simultaneous observation of 2 signals. Flat 10 cycles to 5 mc, useful to 9 mc. Push-pull vertical and horizontal

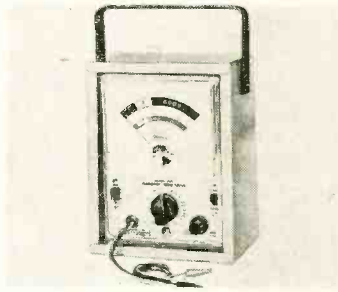
amplifiers. Cathode-follower inputs. 5-inch screen. 13¼ x 8¾ x 18½.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

VACUUM-TUBE VOLTMETER KIT, *KT-174.* 200-ma meter movement with balanced-bridge push-pull circuitry. 2-color scale incorporates direct decibel scale plus zero-center scale. Rear scope terminals for simultaneous waveform observation and ac measurement. Dc and ac volts 1.5 to



1,500 full scale in 7 ranges each; resistance 1,000 ohms to 1,000 megohms full scale. Special low ac ranges (0–50, –150, –500 mv rms, 0–140, –420, –1,400 mv peak to peak) for audio and hi-fi applications. Printed circuit. 8½ x 6 x 5 in.—**Lafayette Radio Corp.**, 165-08 Liberty Ave., Jamaica 33, N. Y.

TRANSISTOR TESTER, *Model 700.* Checks existing, (and future) transistors without need for data chart reference. Also diodes for forward–



reverse ratio. Hammertone-finish steel case. Handle folds back to rest instrument in tilted position. Instruction manual—**Mercury Electronics Corp.**, 77 Searing Ave., Mineola, N. Y.

TEST INSTRUMENT for color TV installing and servicing in home and on bench, *WR-64A.*

Color bar/dot/crosshatch generator combines functions of both. Rf output cable, cable-carrying bracket attachment. Instruction booklet. Heavy-duty metal case. 13 lb. 13½ x 10 x 8 inches—**RCA Electron Tube Div.**, Harrison, N. J.

CB POWER OUTPUT AND MODULATION METER. *Model LS* for insertion in transmission

line between antenna and set. *Model TS* test set, with a 50-ohm dummy antenna for testing transmitter with antenna disconnected. Black crackle case. 2 x 4 x 4 in.—**Crown Electric Products Co.**, P.O. Box 171, Orange, N. J.

TRANSMITTER-RECEIVER COMBINATION, *Pawnee*. Complete AM and CW facilities on 2-meter amateur band. Built-in 3-way power supply. 117-vac fixed station or 6- or 12-vdc mobile operation. Built-in speaker, ac and dc

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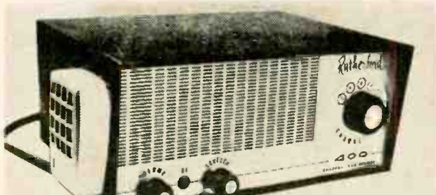
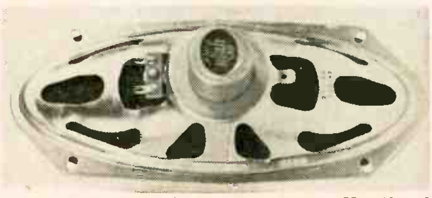
CITIZENS-BAND RADIOPHONE, *400*. Meets FCC requirements. Universal power supply operating from 6 or 12 volts dc or 117 vac. Automatic



noise limiter. Adjustable squelch. 6 crystal-controlled receive and transmit channels. Black splashproof case.—**Rutherford Electronics**, 8930 Lindblade St., Culver City, Calif.

AUTO RADIO SPEAKER, *model SP410E*, for '61 Buick, Cadillac, Chevrolet (except Corvair), Studebaker (except Lark), Pontiac and Olds-

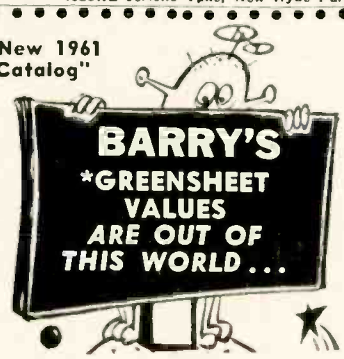


mobile 2.15-ounce Alnico V magnet. Handles 8 watts power. 4 x 10 in.—**Utah Radio Products Co., Inc.**, 1124 E. Franklin St., Huntington, Ind.

BATTERY ELIMINATOR, *Professional model 2*. For transistorized equipment. Supplies clean,

filtered dc fully variable from 0 to 15 volts.—National Radio Institute, 3939 Wisconsin Ave., Washington 16, D. C.

SUBSTITUTION UNIT, *Big 20, model PR111*. For all power resistors encountered in radio and



TV work. Each power resistor can be substituted in circuits that dissipate up to 20 watts—**Service Instruments Co.**, Addison, Ill.

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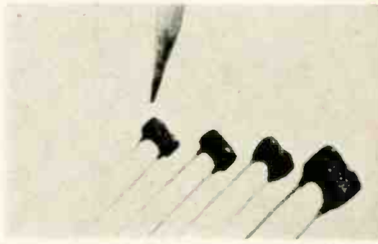

and ½%.—**Cornell-Dubilier Electronics Div., Federal Pacific Electric Co.**, 55 Cromwell St., Providence, R. I.

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PACKAGED ELECTRONIC CIRCUITS. Compentrol network, *PC-405*; audio, *PC-406*; integrators,

PC-407 and *PC-408*; phase detector, *PC-409*.—**Centralab, Div. of Globe-Union**, 900 E. Keefe Ave., Milwaukee 1, Wis.

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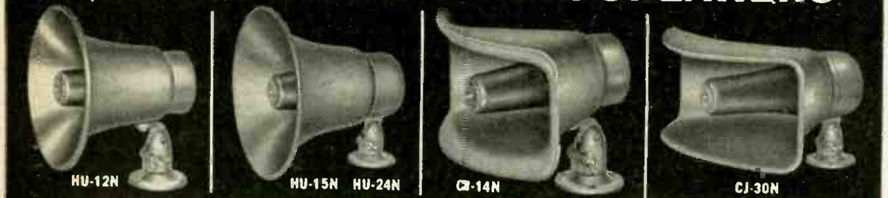

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POWER*	7.5 w	25 w	25 w	7.5 w	25 w	60 w	25 w	25 w	7.5 w	6 w
IMPEDANCE**	8 ohm	8 ohm	8 ohm	8 ohm	8 ohm	16 ohms	8 ohm	8 ohm	8 ohm	8 ohm
FREQUENCY C.P.S.	350-10,000	250-10,000	200-10,000	400-10,000	250-10,000	150-9000	250-10,000	200-10,000	400-10,000	120-7000
LENGTH OVERALL	7¼ in.	8¾ in.	12 in.	8 in.	11¼ in.	23" x 13"	16½ in.	23 in.	14 in.	14 in.
BELL DIAMETER	7½ in.	9¾ in.	11¼ in.	9½" x 5½"	14" x 6"	19 in.	9¾ in.	11¼ in.	7 in.	7 in.
NET PRICE	$16.20	$20.10	$22.35	$18.00	$24.60	$43.50	$31.20	$34.50	$19.80	$13.20

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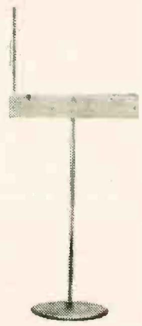

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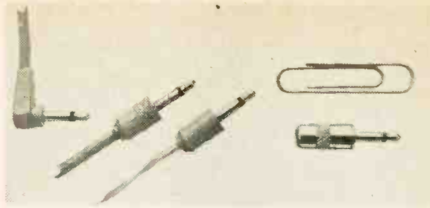
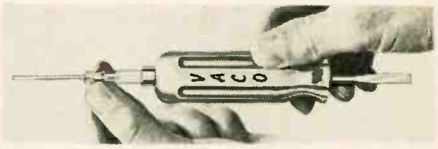


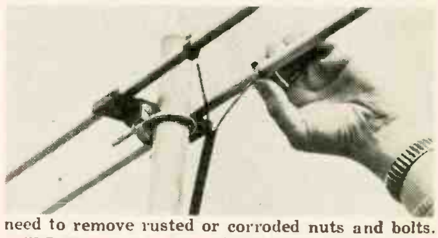
vices, tape recorders—**Switchcraft Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

TOOL, *Piggy-Back*. Plastic handle with ¼-inch hexagon socket. Reversible blade with one end



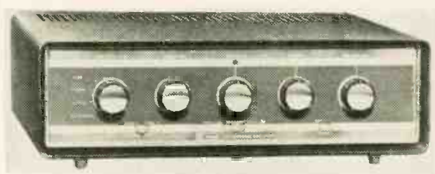
3/16-inch regular blade and other end No. 1 Phillips bit. Midget instrument type screwdriver fits into ¼-inch hexagon socket.—**Vaco Products Co.**, 317 E. Ontario St., Chicago 11, Ill.

CONNECTOR, *Kwik-Klip*. For antenna lead replacement. One-hand, clip-on operation eliminates



need to remove rusted or corroded nuts and bolts.—**CBS Electronics**. Div. of Columbia Broadcasting System Inc., Danvers, Mass.

STEREO HI-FI AMPLIFIER KIT. 2 fully integrated preamps. Rated power output of 16 watts

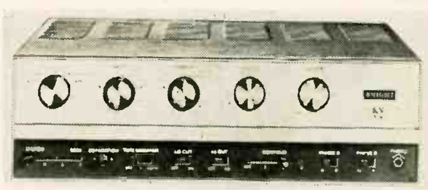


per channel. Total IHFM music power rating 39 watts. For bookshelf placement, measures 4¼ x 14⅜ x 11¾ inches. Cordovan gray finish—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

STEREO RECEIVER, *Fisher 500-S*. 0.9 µv sensitivity for 72-ohm antenna. Microray tuning indicators on FM and AM. 45-watt stereo power

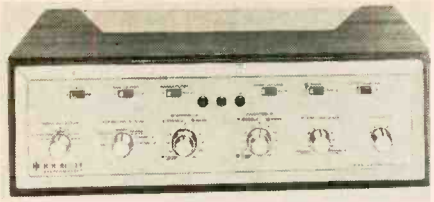
amplifier. Master audio control with 20 controls and switches for every application.—**Fisher Radio Corp.**, 21-21 44th Drive, Long Island City 1, N. Y.

STEREO AMPLIFIER, *KN-775*. 37.5 watts per channel. Minimum IHFM music power rating of 96 watts. 4 EL34 audio output tubes. Frequency response ±0.5 db, 25 to 20,000 cycles; IHFM



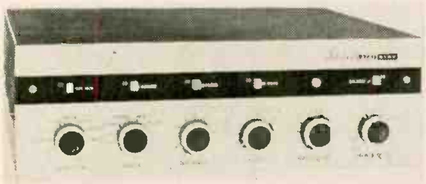
power bandwidth 15 to 85,000 cycles. Has 16-ohm center-channel output, front-panel phone jack. Solid aluminum front panel. Gold and charcoal brown finish. 4⅞ x 15¾ x 15⅛ inches. Beige case.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

STEREO AMPLIFIER, *New 299B.* Tape monitoring provisions for recording. Extra high level



input for connection of electronic organ. Increased power to 50 watts.—**H. H. Scott Inc.,** Dept. P, 111 Powdermill Rd., Maynard, Mass.

STEREO INTEGRATED AMPLIFIERS, 70-watt *ST70* and 40-watt *ST40*. Kit and factory-wired. For any stereo program source. Williamson type



circuits employing voltage amplifiers and split-load phase inverters driving output stage. ±½ db 12–25,000-cycle frequency response. Harmonic distortion less than 1% 40–20,000 cycles.—**EICO (Electronic Instrument Co. Inc.)** 33-00 Northern Blvd., Long Island City 1, N. Y.

STEREO PHONOGRAPH CARTRIDGES, *M7-N21D* and *M-3-N21D*. M7 and M3 cartridges

equipped with high-compliance N-21D stylus originally designed for M212 Studio Dynetic pickup. For independent tone arms at tracking force of 2 grams. Stylus compliance 9.0 x 10^{-6} cms/dyne, frequency response 20 to 20,000 cycles, ±2½ db.—**Shure Brothers Inc.,** 222 Hartrey Ave., Evanston, Ill.

READY-BUILT HI-FI CABINETS. *Model AE-20 Series.* Center cabinet holds all components but

speakers for which speaker-wing cabinets *models AE-30* and *AE-40* series, available.—**Heath Co.,** Benton Harbor, Mich.

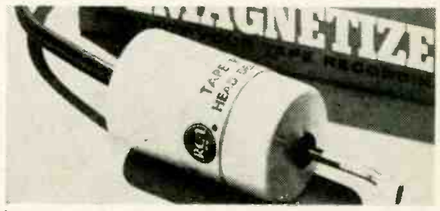
RECORD CABINET, *model 106.* Matches manufacturer's hi-fi equipment cabinets and speaker

enclosures. Walnut, hand-rubbed mahogany, blond or ebony. Removable base or legs. 20 x 32½ x 18 in.—**Rockford Special Furniture Co.,** 1803 W. Belle Plaine, Chicago 13, Ill.

TAPE RECORDER. *Magnematic. Bookshelf,* 3¼ x 10 x 11½ in., for home (illustrated); *Broadcaster,* fitting standard 3½-inch rack panel, for professionals. Tape handling eliminated by plastic cartridge that inserts into player. Cartridges

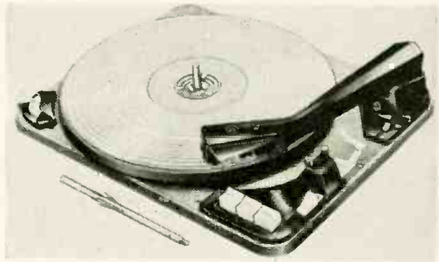
handle up to 1200 feet. 20 models available for 1⅞, 3¾, 7½ and 15 ips, mono play only, mono play and record, stereo play only, stereo play and mono record, and stereo play and record.—**Magnematic Div.**, Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.

TAPE RECORDER HEAD DEMAGNETIZER, *type 516C1.* Reduces noise and distortion. Unit is plugged into 117-volt ac outlet, tip brought



into contact with record–playback head and withdrawn.—**Dist. Prod. Dept., RCA Tube Div.**, 415 South Fifth Street, Harrison, N. J.

TURNTABLE CHANGER, *Dual-1006 Custom.* Fully automatic and manual turntable and automatic record changer. Roller-feeler indexing action measures record for lead-in groove. Ele-



vator-action spindle operates without pusher arms or offset spindles. One-piece free-floating tone arm tracks and trips down to 1½ grams.—**United Audio Products**, 202-4 E. 19th St., New York 3, N. Y.

4-SPEED TURNTABLE AND TONE ARM. *PK-449.* 3-lb., rim-weighted 12-inch aluminum table with permanently lubricated oilite bronze bearing. Precision spindle turns on single ball bear-

ing. Speed control allowing for ±7% variation of each speed. Supplied with stroboscopic disc, 45-rpm adapter, shielded hookup cables and ac line cord.—**Lafayette Radio Corp.**, 165-08 Liberty Ave., Jamaica 33, N. Y.

PREAMPLIFIER, *model 122 Dynaural Stereo Control Center.* Dynaural rumble and scratch suppressors. Center-channel level control on front

panel. 5 separate stereo inputs, each with own level control.—**H. H. Scott Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

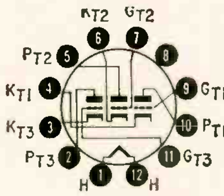
All data are from manufacturers' specifications.

NEW TUBES and SEMI-CONDUCTORS

A TRIPLE-TRIODE 12-pin Compactron leads off this month. It is followed up by a series of switching transistors, a conduction-cooled uhf beam power tube, a 9-pin triode-pentode for TV and other recent releases.

6D10

Compactron containing three high-mu triodes with separate pin connections for all three cathodes, grids and plates. It is designed for use as an oscillator, mixer, grounded-grid amplifier, and automatic frequency control service.



6D10

Maximum ratings of this Tung-Sol tube are:

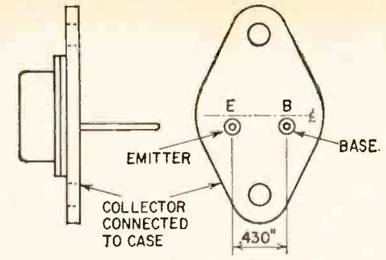
	(each section)
V_P	330
V_G (max pos)	0
(max neg)	50
P_P (watts)	2

Characteristics with 125 volts on the plate and −1 volt on the grid are:

	(each section)
μ	57
R_P (ohms)	13,600
g_m (μmhos)	4,200
I_P (ma)	4.2

2N1136, -A, -B

A series of very high gain p-n-p transistors designed as high-current switching devices for dc-dc converter and dc–ac inverter circuits. The series has three voltage breakdown ratings for use in both 12- and 28-volt supplies without danger of burnout. Current gain is controlled to eliminate need for matching. The transistors can switch up to 400 watts.



2N1136,-A,-B

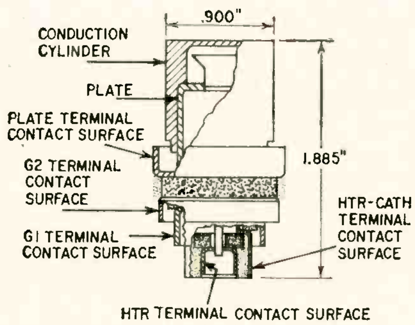
Maximum ratings of these Bendix transistors are:

	2N1136	-36-A	-36-B
V_{CES}	40	70	80
V_{CEO}	30	55	65
V_{CB}	60	90	100
I_C (amps)	6	6	6
P_C (watts)	60	60	60

(P_C is the maximum average power dissipation. It can be exceeded during switching time.)

7842

A very small conduction-cooled uhf beam power tube for missiles, satellites or mobile equipment where air cooling may not be practical. It is intended for use as an rf power amplifier, oscillator, frequency multiplier, af power amplifier or modulator.



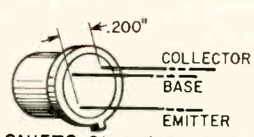
7842

Typical ratings of the RCA 7842 as an rf power amplifier in class-C FM telephony service are:

	at 400 mc		at 1215 mc
V_P	400	900	900
V_{G2}	200	300	300
V_{G1}	−35	−30	−22
I_P (ma)	150	170	170
I_{G2} (ma)	5	1	1
I_{G1} (ma)	3	10	4
Useful power output (watts)	23	80	40

2N1572, -73, -74

A group of general-purpose n-p-n double-diffused silicon mesa transistors that cover a beta range of 20 to 200. They are well suited to use in cascaded audio amplifiers where they produce current gains between 80 and 92 db for 1-kc signals.



2N1572, 2N1573, 2N1574

Maximum ratings of these Texas Instruments transistors are:

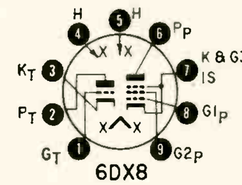
V_{CE}	80
V_{EB}	5
P_{total} (at 25°C ambient) (watts)	0.6

Electrical characteristics at 25°C ambient are:

	2N1572	-73	-74	
h_{fe}	15	30	80	($V_{CE}=5$, $I_E=-1$ ma, f=1 kc)
h_{oe}	25	65	95	($V_{CE}=5$, $I_E=-5$ ma, f=1 kc)

6DX8

A triode-pentode in a 9-pin miniature envelope. The triode is for use in keyed agc, sync separator, sync amplifier and noise suppressor circuits; the pentode for use as a video amplifier.



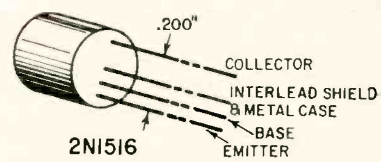
6DX8

Typical operating conditions and characteristics for the Tung-Sol 6DX8 are:

	Triode	Pentode		
V_P	200	170	200	220
V_{G2}	—	170	200	220
V_{G1} (bias)	−1.7	−2.1	−2.9	−3.4
I_P (ma)	3	18	18	18
I_{G2} (ma)	—	3	3	3
g_m (µmhos)	4,000	11,000	10,400	10,000
R_P (kohms)	—	100	130	150
µ	65	—	—	—
µ (G2 with respect to G1)	—	36	36	36

2N1516/OC170

A p-n-p germanium PADT (post alloy diffused transistor) designed for use as an if or rf amplifier and for oscillator–converter applications in the medium- and high-frequency ranges. Power gain at 10.7 mc is 20 db min-



2N1516

imum and conversion gain at 26 mc averages 18 db.

Maximum ratings of this Amperex transistor are:

V_{CB}	20
I_C (ma)	10
I_E (ma)	10
I_E (reverse) (ma)	1
P_C (mw)	83

END

TENTH ANNUAL SSB DINNER

The SSB Amateur Radio Association will sponsor the Tenth Annual SSB Dinner and Hamfest on Tuesday, March 21 at the Hotel Statler-Hilton, 33rd St. and 7th Avenue, New York, N.Y. All amateurs and their friends are invited. There will be no formal speeches.

Equipment displays open at 10 a.m. and the dinner starts at 7:30 p.m. Tickets purchased in advance are $10 each and $11 at the door.

NEW PATENTS

RECTIFIER

Patent No. 2,953,738

Richard L. Bright, Adamsburg, Pa. (assigned to Westinghouse Electric Corp.)

A transistor makes an efficient rectifier. Here it is alternately biased to full conduction and to complete cutoff. In the first case, the voltage

across the transistor is nearly zero, and in the second its current is nearly zero. Therefore the power dissipation is negligible.

For highest efficiency, the bias source should supply a square-wave signal.

SENSITIVE DC AMPLIFIER

Patent No. 2,952,815

Stuart C. Rockafellow, Plymouth, Mich. (assigned to Robotron Corp., Detroit, Mich.)

Hams and others are familiar with the dip in plate current when as oscillator is tuned to resonance (Fig. 1). This principle is used here.

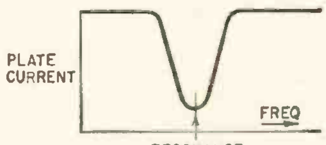


Fig.1

In Fig. 2, the dc signal to be amplified is fed into the primary of saturable reactor T. Its secondary is the plate tank of a crystal oscillator. The secondary inductance is higher than needed

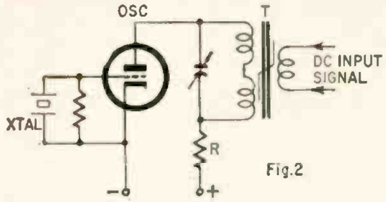


Fig.2

for resonance. The dc tends to saturate T's core and lower the coil inductance. This causes a dip in plate current as resonance is approached.

The inventor finds that a signal of a few mv can produce a large change in the voltage drop across R. The voltage gain may be as high as 200.

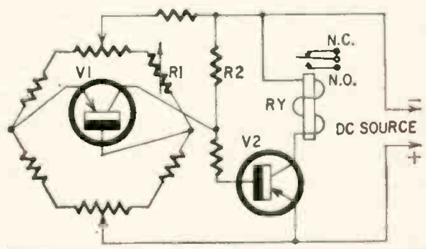
BRIDGE THERMOSTAT

Patent No. 2,945,133

Balthasar Hubert Pinckaers, Hopkins, Minn. (Assigned to Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.)

This device is a sensitive thermostat, requiring only a single power supply. When the bridge is balanced, there is no bias between emitter and base of V1. Little current flows through R2, so V2's base is at the potential of the negative power terminal. The transistor conducts fully and energizes RY.

R1 is a temperature-sensitive resistor whose resistance balances the bridge at some critical temperature. Below this value, R1's resistance



drops, biasing V1 to conduction. Due to the drop across R2, V2 conducts less and RY releases its armature and the contacts close.

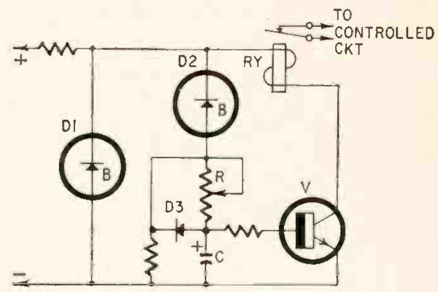
If desired, the relay contacts may close a circuit (not shown) to supply heat to R1. Its resistance will rise until bridge balance is restored, at which time the relay contacts will open again.

TIMING DEVICE

Patent No. 2,942,123

Niles F. Schuh, Jr., Lima, Ohio. (Assigned to Westinghouse Electric Corp., E. Pittsburgh, Pa.)

This is an adjustable voltage-sensitive time-delay device. For example, it operates the relay rapidly on high overvoltages and less rapidly on



lower voltages. Thus it is insensitive to line transients.

D1, D2 are Zener diodes. D1 holds the input constant and is rated at higher voltage than D2.

Below its breakdown value, D2 is blocked. Little current flows through R into C, and any charge is wiped off by D3. After breakdown, D3 is blocked by flow through R, and C begins to charge. This biases V to conduction. Eventually, the bias will be sufficient to energize RY and end the time interval.

END

50 Years Ago

In Gernsback Publications

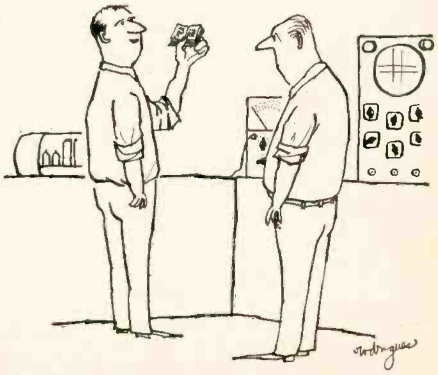
HUGO GERNSBACK, *Founder*

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 March, 1911, *Modern Electrics*

An English Thermo-Electric Generator, by Frank C. Perkins.
Bela Gati (Radio) Experiments, by A. C. Marlowe.
Cathode Ray Tele-Photography, by Dr. Alfred Gradenwitz (Berlin).
A New Photophone.
Mercury Interrupter.
A Liquid Transmitter.
A Handy Detector, by E. S. Stull, Jr.
Wireless Key, by Clarence J. Carney.
A Unique Receiving Outfit, by Stanley C. Battles.



"It's a hearing-aid service manual."

NOTEWORTHY CIRCUITS

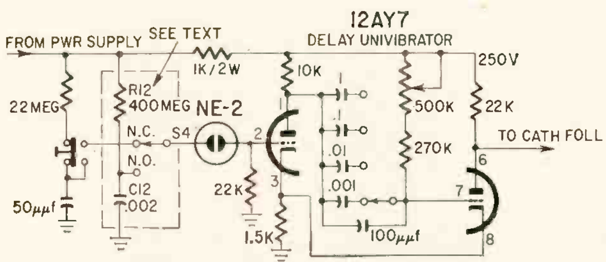
MULTIVIBRATOR FROM SINGLE PULSER

The "Single Pulse Generator" by J. H. Thomas on page 79 of the April, 1960, issue of RADIO-ELECTRONICS was just the thing we needed in the test lab. The pulses provided by our standard pulse generators and chopper equipment were either too narrow or too wide, consequently the pulser met our requirements. However, we realized that the unit could be made more versatile by developing it into a free-running multivibrator, without resorting to additional equipment, should the necessity arise. Jacks J1–J2 are specifically shown for this purpose in the original issue.

We required a repetitive pulse spaced every 100 milliseconds over the entire pulse-width scale. By trial and error we developed the circuit shown. The only additions were a two-way switch (S4), 400-megohm resistor (R12, several 22-meg units in series) and a .002-μf capacitor, C12.

With switch S4 in the NC position, the circuit behaves as designed. In the NO position, the neon lamp oscillates at a low-frequency rate sufficient to drive the 12AY7 tube.

Before making this modification, we had difficulty trying to trigger the unit pulses to determine the pulse widths. All that is now required is to synchronize the scope to the input with the

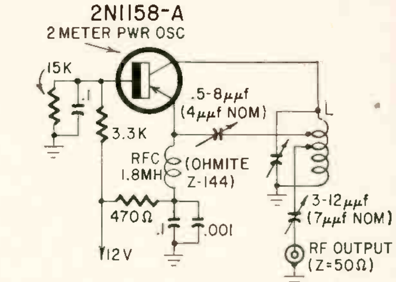


switch in the NO position, examine the pulse, then flip the switch back to NC position.—*M. A. Suntop*

100-MC TRANSISTOR OSCILLATOR

It wasn't too many years ago that special techniques were required to get an ordinary receiving tube to oscillate above 100 mc. Now, we have a number of transistors that operate readily at frequencies exceeding 200 mc. The Philco data sheet on the 2N1158-A MADT type transistor shows several power oscillator circuits for 70, 100 and 200 mc. The circuits feature high efficiency and good temperature stability.

The circuit of the 100-mc oscillator

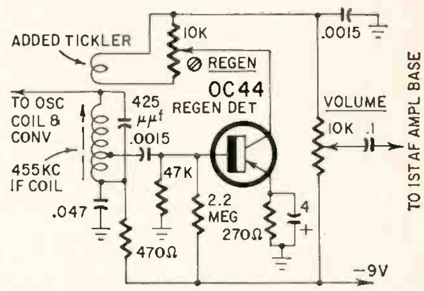


shown can be used on the 2-meter amateur band. With collector current of 9 ma, power output is 16, 24 and 32 milliwatts when V_{CE} equals 6, 8 and 10 volts, respectively. Coil L consists of 5 turns of No. 608T Air Dux with the emitter feedback tap at 4 turns and the output tap at 3½ turns from ground. The feedback capacitor should be adjusted for maximum power output at the supply voltage used.

At 100 mc, the frequency drift (negative) does not exceed 250 kc over a temperature range of 20 to 60° C. With supply voltage variations between 4 and 17 volts, the oscillator does not drift more than 1 mc.

REGENERATIVE SUPERHET

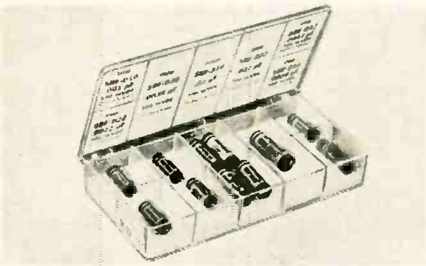
In the 1930's regenerative second detectors were sometimes used in simple superhets for increased sensitivity and selectivity. When adjusted close to the point of oscillation, the regenerative detector may provide as much gain and selectivity as two or three stages of if amplification.

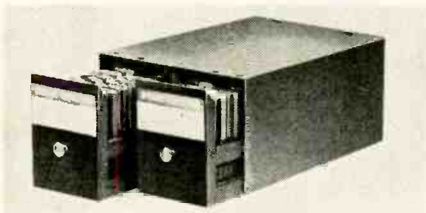


A similar trick was used in a four-transistor superhet described in *Radio, Television & Hobbies* (Australia). The circuit is shown. Regenerative feedback for the 0C44 detector was provided by adding a tickler winding to the if coil. Performance is optimum with the regeneration control set just short of the point of oscillation. END

BUSINESS and PEOPLE

Sprague Products Co., North Adams, Mass., is now packaging two specially selected assortments of its Isofarad capacitors for electronic service tech-



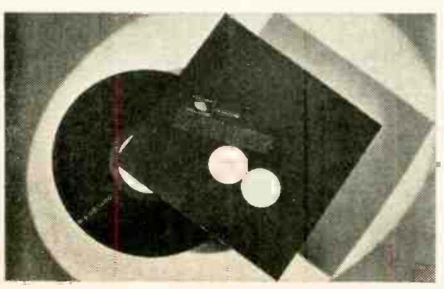


nicians in hinged, compartmented clear plastic cases. Specially selected assortments of its Difilm Orange Drop radial-lead dipped tubular capacitors are being packaged in metal file-drawer cabinets.

Harman-Kardon, Plainview, N. Y., has been cited by the editors of the Seventh Annual Design Review of *Industrial*

Design Magazine for its Citation II 120-watt stereo high-fidelity power amplifier kit which was designed by Stewart Hegeman.

Shure Bros., Evanston, Ill., produced a privately commissioned stereo record, "The Orchestra . . . The Instruments," which shows the spatial relationships of



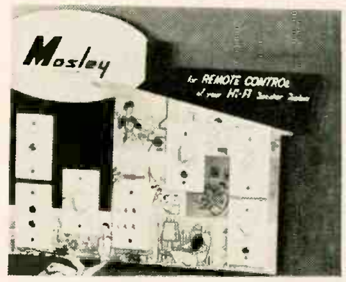
What articles would you like to see published in RADIO-ELECTRONICS? Maybe you're the man to write them. Ask for an author's guide.

RADIO-ELECTRONICS
154 West 14th St. **New York 11, N. Y.**

the instruments in the orchestra. The recording, by Westminster Recording Co., is available only to purchasers of Shure's M3D and M7D cartridge, Stereo Studio Dynetic integrated tone arm and cartridge or Professional tone arm.

Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Newark, N. J., designed a Pik-A-Pak display rack for distributors who purchase a selection of its most popular capacitors. It holds 5,000 capacitors in less than 3 square feet of floor space.

Mosley Electronics, Bridgeton (St. Louis), Mo., developed a colorful new point-of-purchase display showing its



complete line of audio control plates, including speaker switches, attenuator plates and speaker wall outlets.

William E. Wilson (below left) has been named vice president and general manager of the Chicago Standard

Transformer Div. of the Essex Wire Corp., Chicago. **Jack D. Hall** (above right) becomes vice president, sales and marketing, and **Karl F. Crease** (right), vice president in charge of manufacturing. All three have extensive experience in the transformer industry.

Frank M. Hickey was promoted to manager, industrial products sales, for CBS Electronics, Danvers, Mass. In his previous assignment he was merchandising manager, industrial products.

Donald Jonson has been named distributor sales manager of the Columbia Wire & Supply Co., Chicago. He has had wide experience in sales to radio and

TV parts distributors and was previously with General Cement and with Erie Resistor.

George C. Isham, manager of marketing services for Sylvania's Electronic Tube Div., was presented with a gold watch marking his 25th anniversary

with the company. **Robert E. Lewis** (right), president of Sylvania, is shown making the presentation at the company's distributor sales meeting in Bal Harbour, Florida.

Seymour S. Sadowsky was appointed to a newly created position in the General Electric Cathode-Ray Tube Dept., Syracuse, N. Y. He will provide technical liaison between field requirements for replacement picture tubes and development engineering, concentrating on distribution and installation of replacement tubes.

EIA Production and Sales Statistics

(First 11 months— in units)	*1960*	*1959*
TV Retail Sales	5,176,905	5,046,971
Radio Retail Sales*	8,326,275	7,142,424
TV Production	5,302,877	5,756,210
Radio Production	15,604,784	14,069,049
Picture-Tube Factory Sales	8,481,924	8,705,759
Receiving-Tube Factory Sales	365,989,000	395,688,000

*Excluding auto.

Irwin K. Paul was promoted to assistant sales manager of Arco Electronics Inc., New York. He joined the company last June and was formerly with Sprague Products Co. and Aerovox Corp.

END

new BOOKS

FUN WITH ELECTRICITY, by Tom Kennedy, Jr. Gernsback Library, Inc., 154 W. 14th St., New York 11, N. Y. 5½ x 8½ in. 128 pp. $2.65.

All the old experiments and equipment adult readers remember in the electricity books for boys which may have started them on their electronic careers are found here—the galvanometer, motor, generator, solenoid, Tesla coil and D'Arsonval meter are all present. Drawings are carefully worked out, the author having built each piece of equipment before describing it. The language of the book is aimed at the adolescent.

His first two chapters deal with principles and throughout the book there are interesting sidelights and references—for example, few people know that the Roget dancing spiral was invented by the author of Roget's *Thesaurus*.

The author—who was for 25 years radio reporter for the *New York Times* and a well known experimenter in the fields of electronics and hi-fi—writes with the style of a person who feels that his material is important, making the book far different from the usual work intended for a juvenile audience.

NOISE IN ELECTRON DEVICES. Edited by Louis D. Smulin and Hermann A. Haus. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 6 x 9 in. 413 pp. $12.

This text, based on a MIT course, is prepared by seven authorities on the subject. Using higher math, it analyzes tube and semiconductor noise, noise propagation and other topics. Masers and parametric amplifiers are studied. It is a comprehensive book for students and specialists.—*IQ*

INFRARED RADIATION, by Henry L. Hackforth. McGraw-Hill Book Co., 330 W. 42 St., New York 36, N.Y. 6 x 9 in. 303 pp. $10.

A complete guide that starts right at the beginning, this book covers the basic physical laws which govern IR, using a minimum of math. IR sources, optical systems and detectors are described in Part I. The second part describes, illustrates and discusses applications to science and industry. A final chapter shows how IR is helping space technology. The book is clearly written, well illustrated.—*IQ*

FROM TIN FOIL TO STEREO, by Oliver Read and Walter L. Welch. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 6 x 9 in. 524 pp. $9.95.

This will presumably become the authoritative work in its field. Chapter 1 starts *Before the Phonograph* and Chapter 29 is entitled *Tape Versus Discs, a Look Into the Future*. Between is the whole history of phonography.

Due to the interests of the authors, the book covers in depth both technical and commercial angles, so we have chapters on the early local phonograph companies and the modern automatic phonograph industry as well as discussions of discs vs cylinders and a complete chapter on the theory of matched impedance.

An appendix covering subjects that range from Edison's early sketches to a piece of sheet music, the "Song of Mr. Phonograph," and an extensive bibliography and index conclude the book.

The photographic illustration is extensive, covering models from the earliest tinfoil devices to juke boxes of the 1958 period. A large number of the photographs are from the collection of Oliver Read, probably the leading American collector of old phonographs.

MARINE RADIO AND ELECTRONICS, by Allan Lytel. Cornell Maritime Press, Cambridge, Md. 6 x 9 in., 242 pp. $7.

This book explains FCC rules, lists marine frequencies and tells how to make and receive calls. Radar, depth sounders, electron beacons, fishfinders, foghorns and compasses are among the devices discussed. It is clearly written and well illustrated.

Vhf, medium and high frequencies and the Citizens band are covered. Equipment maintenance, antennas, maps and schedules are among the useful information for the boatman. The book will add to safety and convenience at sea.—*IQ*

LET'S EXPLORE WITH THE ELECTRON, by Alfred Bender. Sentinel Books Publishers Inc., 112 E. 19th St., New York 3, N. Y. 5½ x 8 in. 128 pp. $1.

Beginning with a chapter on electricity in the making, experiments with simple batteries, electroplating, magnetism and electromagnetism, resistors and thermistors, thermoelectricity and photoelectricity are described. The book is well illustrated.

INDUSTRIAL ELECTRONICS LABORATORY MANUAL FOR ELECTRONICS TECHNICIANS, by Paul B. Zbar. McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N. Y. 8½ x 11 in. 201 pp. $5.

The latest in the series sponsored by the Electronic Industries Association and the New York Trade School, this manual is devoted to industrial electronics. It is divided into 39 jobs, beginning with the characteristics of a gaseous rectifier and running through thyratrons, phototubes, timing circuits and time-delay relays, three-phase rectifiers, motor control and other types of controls to computers. Six jobs deal with computers and counters. The last three cover synchros and servomechanisms.

The book fills a gap in the literature. Far too little has been written on industrial electronics. END

SOLAR-CELL PRECAUTION

Be careful when handling small, unmounted, "single-shingle" silicon photocells (such as International Rectifier type 1020). These little cells break and chip like thin glass. They will stand no bending, very little pressure and little dropping.—*Rufus P. Turner*

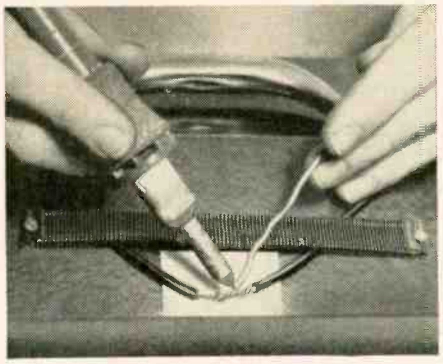
HEAT-SINK INSULATOR

When commonly recommended materials are not readily available for insulating a transistor from a heat sink, an excellent substitute is varnished cambric.

It can be found around most service shops, particularly in the high-voltage cages of discarded TV sets. It has excellent insulation qualities, can be cut to any shape with a pair of scissors and has fine heat-conducting ability. Be sure to coat the cambric with silicone grease before using it.—*Domenic Ripani*

TOP-OF-TOOLBOX VISE

Instead of tossing an old wristwatch expansion band away after it becomes



worn, fasten it down to the lid of your toolbox. This little gadget comes in mighty handy for holding small parts that are being soldered or tested.—*John A. Comstock*

INEXPENSIVE PANEL BEARINGS

Quite often, while building a piece of electronic gear, the home constructor needs a panel bearing to support the

(*Continued on page* 126)

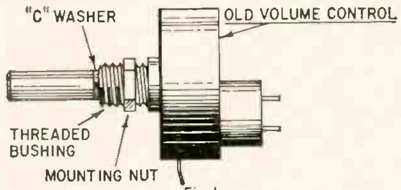


Fig. 1

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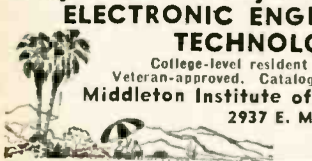

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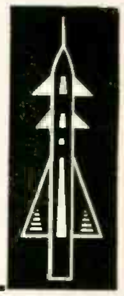

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(*Continued from page* 123)
long shaft of a switch or potentiometer located deep within the chassis. A suitable bearing can be made from the threaded mounting bushing of a discarded volume control (Fig. 1).

Take the back off the old control and remove the C-washer that holds the shaft in place. Slide the shaft and wiper

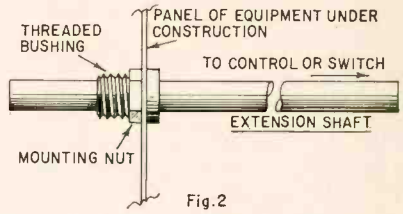


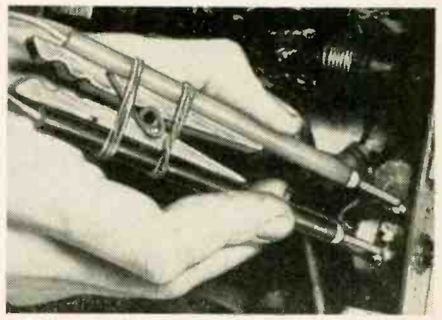
Fig.2

arm out of the control. If the case is plastic, break it away from the threaded bushing with a pair of pliers. Tin snips or a hacksaw may be required to extricate the bushing if the case is made of metal.

Use the old volume-control nut to mount the bushing on the panel of the unit being constructed (Fig. 2). Carefully position the bushing so that the shaft which passes through it will work freely without binding.—*Hartland B. Smith*

CLOTHESPIN EASES PROD HANDLING

By attaching your test prods to the legs of a wooden spring type clothespin with rubber bands as shown, you will be able to handle them much more



easily. Since both prods are attached to each other, you can handle them single-handed. Just a squeeze puts the tips closer together to touch test points only a short distance apart. You will find this clothespin-and-prod arrangement a real convenience once you get used to working with it.—*John A. Comstock*

BONDING STRAPS

One day while I was preparing to align a TV set I discovered that I needed some bonding straps right away but none could be found in the shop. I noticed some coaxial cable lying in a corner and an idea struck me. Why not use the shield of the coax?

First I measured off the desired length of coax cable. Next, with a razor blade, I slit the coax lengthwise and removed the outer covering. Then I pulled the inner conductor out of the shield and stored it for future use. Next I attached alligator clips to both ends and pulled the copper shield through my fingers to flatten it out and my inexpensive bonding strap was complete.—*Paul Mitnaul* END

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	3CY5	.71		6CF6	.64		12CU5	.58
	3DK6	.60		6CG7	.60		12CU6	1.06
	3DT6	.50		6CG8	.77		12CX6	.54
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TF-3

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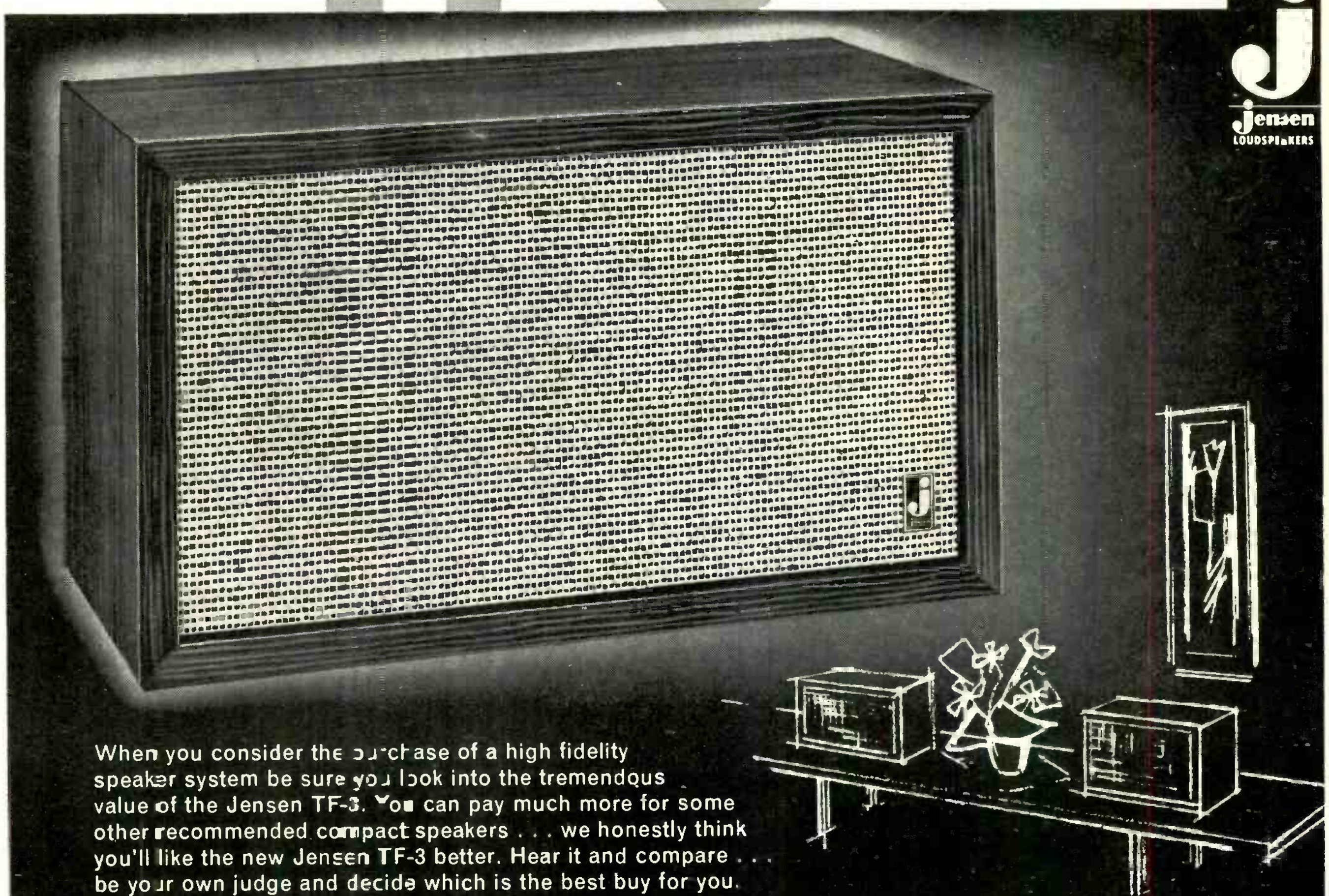

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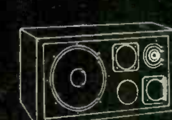

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