Poor Man's Direction Finder

MAY 1960

Radio-Electronics

PAGE 100 Radio
IF aligned & scope

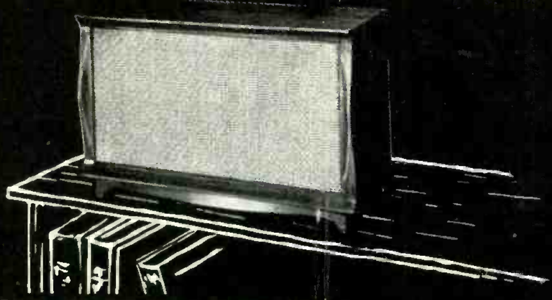
HUGO GERNSBACK, Editor

Electronics Teaches Naval Strategy

Microminiature Transistor Amplifier

Electronics Can Save Your Heart

TV Technician Repairs a Weld Timer



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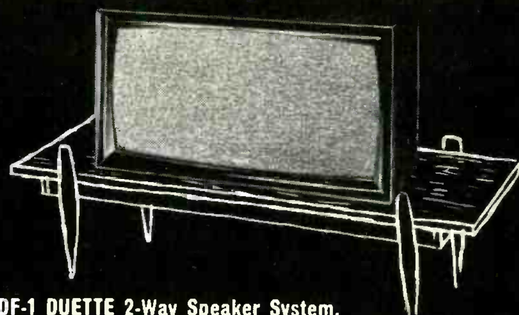

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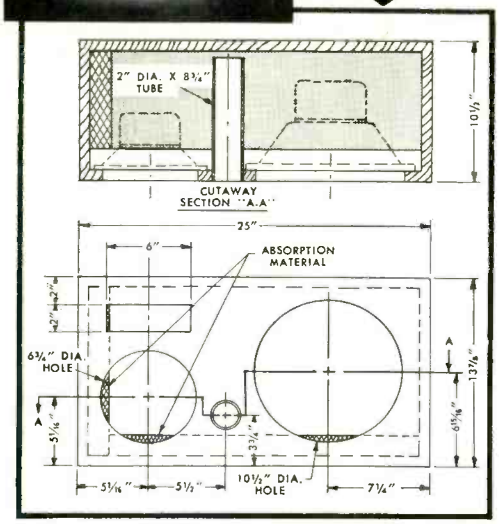

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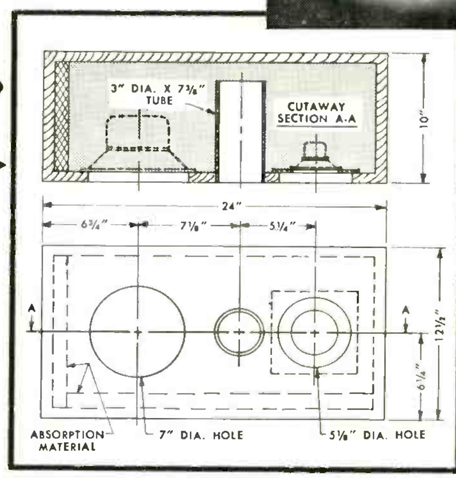

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ELECTRONICS

AUDIO-HIGH FIDELITY

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RADIO

ON THE COVER

(story on page 48)
Chief Trainingdeviceman John J. Miller, War Gaming Department, Naval War College, and one of the navigational computer units as it looks pulled forward in position to service.
Color original by Hans Knopf

Average Paid Circulation Over 174,000

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News Briefs

Electronic Engineers Meet

More than 68,000 persons representing all sections of the wide field of electronics met at the international convention of the Institute of Radio Engineers, in New York City March 21 to 24. A total of 270 papers (including at least one proposing the abolition of written papers at conventions) were read. They ranged from discussions of aerospace systems to signals produced by the human organism; from navigation of space vehicles by star radiations to molecular techniques wherein a tiny speck of material may be an amplifier, multivibrator, or switch; from the use of the sun to relay signals to highway radio.

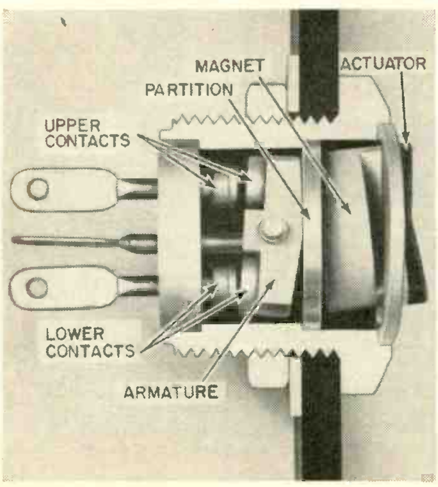
The Radio Engineering Show which forms part of the meet featured exhibits of 856 firms, covering the whole four floors of New York's Coliseum. Some of the more interesting devices exhibited—and some of the more interesting papers delivered—are reported in this department and on page 58 of this issue.

New Switch Concept

The FluxLink switch, developed by Space Components, Inc., has only one moving part (no springs either) and is operated by a magnet located outside the hermetically sealed compartment that houses the moving part and contacts. This allows the units to operate under temperature, pressure (and vacuum) and vibration extremes—as well as in explosive or corrosive atmospheres.

The cutaway photograph shows the switch with the lower contacts closed and the upper contacts open. When the lower section of the actuator is depressed, lines of force from the magnet "piped" through nonmagnetic partition by magnetic insets opposite the magnet poles attract the corresponding section of the armature. This snaps the armature over to its other position, closing the upper contacts and opening the lower set. Depressing the upper part of the actuator reverses the procedure.

The units exhibited are ⅝ inch long and ¾ inch in outside diameter. The contacts can carry up to 15 amperes at 125 volts ac.



Universe Radio Record Set

The longest-distance radio communication record for the universe was set—at least up to that date—on March 21, when Pioneer V was interrogated for a signal to open the 1960 IRE international convention in New York City.

Since the sun satellite was close to a million and a half miles away at the time and the only radio equipment out so far in space, communication with it constituted a record automatically. (Any later communication would necessarily set up a new record, of course.)

The communication was by way of the great antenna at Jodrell Bank, England. A message sent by telephone from the New York Coliseum was relayed to the satellite by the Jodrell Bank station, triggering the space-travelling transmitter and sending a message back to Jodrell Bank, to be retransmitted to New York.

Only one flaw marred the experiment. Power to the closed-circuit TV which was to bring an oscilloscope view of the signal to the large crowd in the Coliseum, was interrupted twice, once just before the signal was received. The screens of the several TV receivers remained dark through the experiment. The sound signal, a 1,000-cycle note modulating the carrier and being in turn modulated by telemetering information, was clearly audible to all present, however.

Communication via Satellite

Two 17-year old ham operators have used a satellite (either Explorer VII or Sputnik III) or its ionized path as a reflector to complete a two-way communication system. Perry I. Klein, K3JTE, and Raphael Soifer, K2QBW, took turns transmitting the letter Z in Morse code on 21.011 mc. After 35 attempts, Mr. Klein received the Z (at about 1:00 am Feb. 6) and sent back the letter M, meaning "I copy you and your signal is fairly strong," as previously arranged.


Perry I. Klein, K3JTE, transmitting.

Dr. Jerome B. Weisner, director of the MIT Research Laboratory of Electronics, verified the student's claim, but added that more data are desirable.

New FCC Chairman

FCC Commissioner Frederick W. Ford was appointed chairman of the FCC by President Eisenhower to replace John C. Doerfer, who resigned because of criticism of his conduct in office. The President then nominated Edward K. Mills, Jr. to be an FCC Commissioner to fill the unexpired term of Doerfer. The new appointments signaled a tougher stand by the Commission in regulating the broadcasting industry.

Stereo for the Unborn

Many babies commit suicide before birth, by entangling themselves with the umbilical cord in such a way that they are strangled during delivery. A stereo system of picking up sounds from the unborn child as a way of detecting this was described to the recent IRE convention by Dr. F. D. Napolitani and L. E. Garner. Two microphones placed on the mother's abdomen succeeded in picking up the baby's and mother's heartbeat. The directional effect made it possible in some cases to establish the position of the baby and the placenta, thus giving an idea of whether the cord was probably free or not. Though not yet generally accepted by the medical profession, the authors believe such a stereophonic instrument, may well become as standard as the common stethoscope.

men 17-55

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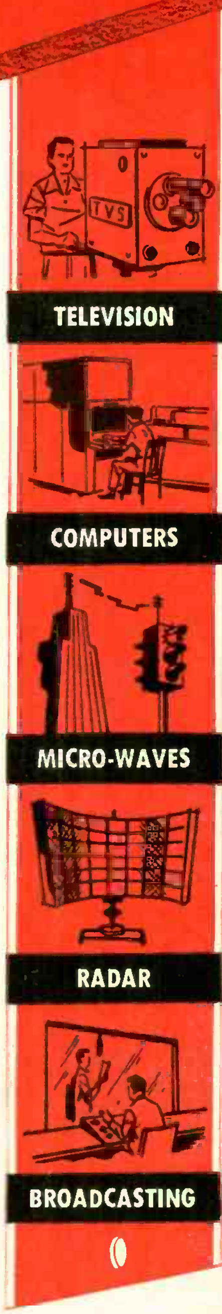

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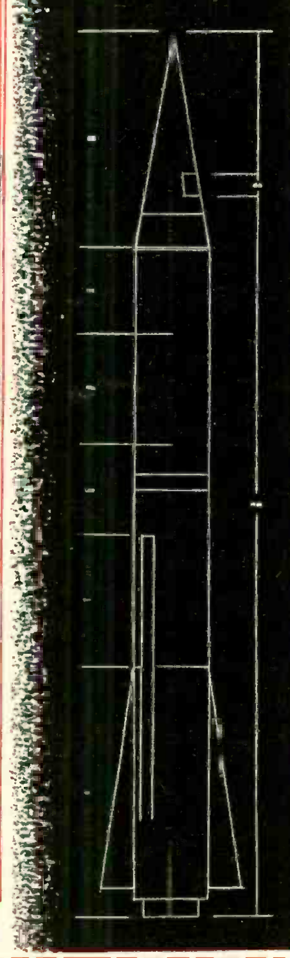

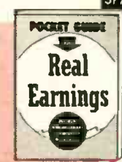

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Antenna Fraud

Attorney General Louis J. Lefkowitz (New York State) has charged Moto-Matic Co. with persistent frauds arising out of false and misleading advertising. The claim that a TV socket antenna sold by Moto-Matic (see article on similar device, RADIO-ELECTRONICS, December, 1959, page 100) would turn "ordinary house wiring into a super-power 500-foot television antenna" has sold to the extent of more than $100,000.

The Attorney General's office said tests show that the $3.98 and $4.98 "Radarex-Tenna" (depending on model) devices are no better than an ordinary pair of rabbit ears and in some cases are worse.

Mr. Lefkowitz obtained a Supreme Court order directing Charles Torelli to show cause why he should not be enjoined from false advertising practices and why a receiver should not be appointed to safeguard refunds due purchasers of the device. The Attorney General said that, in asking for the appointment of a temporary receiver, his office had discovered that while Moto-Matic had collected more than $117,000, its bank balance had been depleted by withdrawals to the point where the bank account is now less than $10,000. This amount, according to the Attorney General's office, has been placed in escrow to assure refunds to customers who may want their money back.

Japanese TV Arriving

Designed to sell at $69.95, some 15,000 7½-inch screen Japanese receivers are said to have been ordered. They are 14-tube 117-volt ac-powered units with built-in rabbit-ear antennas. The sets are 11 inches deep (front to back), weigh 18 pounds and have metal cabinets finished in a variety of colors. The importer is Star Lite Merchandise Corp. New York, N. Y.

IRE Makes Awards

The Institute of Radio Engineers has named the recipients of six awards for 1960. The Founders Award, given only on special occasions, goes to Haraden Pratt, secretary of the IRE, "for outstanding contributions to the radio engineering profession and the IRE."

The institute's highest technical award, the Medal of Honor, was presented to Harry Nyquist, consulting engineer, "for fundamental contributions to a quantitative understanding of thermal noise, data transmission and negative feedback."

"For contributions to the development of magnetic devices for information processing," the Morris Liebmann Memorial Prize Award goes to J. A. Rajchman, RCA Labs, Princeton, N. J.

(Continued on page 16)

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Have dependable, economical 2-way radio communication with this top-rated, do-it-yourself transceiver. Has two crystal-controlled transmitting positions; operates at maximum FCC legal power input of 5 watts fully modulated. Superhet receiver is continuously tunable over the full 22 channel band; also has two optional crystal-controlled fixed frequency positions. Works just like press-to-talk intercom—speaker also serves as mike.

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

Model Y-712L. *$5 Down.* ONLY $79.95

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Y-769L. Optional Receiving Crystal (specify frequency) .. 1.99
Y-719L. Optional Hand-Held Mike. 1 lb. NET 9.50

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

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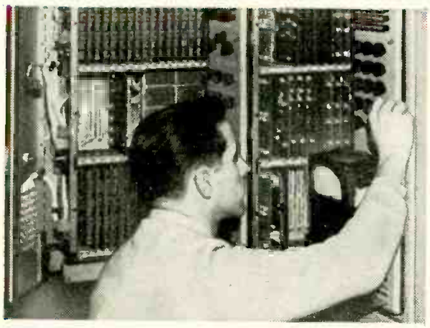

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Recently, in New York, Boston, and Los Angeles nearly 300 sound room personnel of top high fidelity dealers were given the opportunity to spend an afternoon listening to and rating the "sound" produced by three of Electro-Voice's new ultra-compact speaker systems (Regal, Esquire, Leyton) and six other currently popular competitive ultra-compact systems. All nine systems were placed behind an opaque curtain and each listener's selector switch was coded but unmarked so he had no way of knowing which system he was hearing. The result of the listening test was that more than 80% ranked Electro-Voice Esquire and Regal units either first or second. And Electro-Voice's economical Leyton was ranked third by over 50% of the participants —thus outscoring systems at double its price.

Now, we don't think this proves a single thing except that there is a heavy percentage of knowledgeable people in New York, Boston, and Los Angeles who could recognize the clarity and purity of sound that we build into any Electro-Voice speaker system. We long ago discovered that it is impossible to build a speaker that sounds exactly the same to every listener, so we have always strived to create instruments that let our customers listen to the music rather than the speaker.

New Convertible Drivers Bring Public Address Performance to Hi-Fi Levels

The basic characteristics needed to satisfy any critical sound job—wide range, low distortion, and high efficiency—are all combined in E-V's new group of drivers. But there has been one great plus added to the unmatched performance of these units. *The same driver can be used on reentrant horns and in compound horns.* This means that a single driver will fit the famous E-V Compound Diffraction Horn as well as conventional reflector horns. This unusual versatility is accomplished without compromising the performance quality of either horn type.

Engineered with careful attention to detail, these drivers feature such exclusives as: ceramic magnets; edge-wise wound voice coils; and dual concentric centering. They are easier to install with their push-type polarized connectors and permit easy diaphragm replacement in the field.

If you are planning a P.A. system don't fail to consider these rugged, weatherproof drivers that have eliminated "peaked" response to provide the tonal balance needed for good musical reproduction and the rising frequency response necessary for clear, crisp voice projection. Available as listed below as well as with 45-ohm voice coils for high-powered inter-com:

• DC30A — 30 Watts, 150-10,000 cps, $27.50 List

• DC30T — 30 Watts, With 70.7 V. Transformer, 150-10,000 cps, $37.00 List

• DC40 — 40 Watts, 140-11,000 cps, $36.00 List

• DC40T — 40 Watts, With 70.7 V. Transformer, 140-11,000 cps, $46.50 List

• DC50 — 50 Watts, 140-11,000 cps, $47.00 List

• DC50T — 50 Watts, With 70.7 V. Transformer, 140-11,000 cps, $57.50 List

What Does E-V's Magneramic 31 Do That Your Magnetic Cartridge Can't Do?

The stereo cartridge has rightly been termed the "gateway" to your sound system. If the response characteristics of the cartridge lacks fidelity of reproduction, the system performance will not possess the essential brilliance of the recorded sound. Similarly, if the cartridge fails to provide adequate electrical input to the amplifier, much of the recorded definition and authority may be attenuated. The factor of cartridge output influences not only the system gain—but the quality and definition of the sound as well.

In distinct contrast to magnetic type cartridges, the revolutionary, new E-V Magneramic 31 produces an output of 8 millivolts—over 60% higher than most magnetics. Thus, it is possible to play your system at noticeably lower amplifier gain and speaker pad settings. This bonus output is often the difference between marginal and outstanding performance, particularly when employing low-efficiency speaker systems. Lower amplifier gain settings also reduce the likelihood of introduction of tube thermals and transformer hum into the system. You hear only what is recorded —clean and true-to-life—without the introduction of stray parasites from the amplifier.

First Users of New Model 644 Mike Rave About Performance

The all-new Model 644 Sound Spot Microphone introduced by Electro-Voice early this year has already started to prove itself in its initial installations. Here are just a few of the comments received from sound installers and audio specialists throughout the country:

"Move anywhere on the stage and be heard easily throughout the auditorium"...

"Better pick-up of a band across a football stadium than any parabolic microphone ever tried"...

"By using the 644's we turn up the system to more than needed sound without feedback—but with old microphones we could just barely crack the control open"...

"The anticipated feedback in this installation from any normal application would be tremendous. The 644 was installed and all preliminary tests were amazing"...

The microphone that all these men are talking about utilizes a slotted tube on the front that can actually discriminate between sounds arriving from random directions and reduce pick-up from sides and rear by 20 db or more. This new design concept enables the 644 to offer as much as four times greater working distance than the best cardioids; greatly reduced feedback; retention of "on-mike" presence despite extended working distance; excellent performance out-doors because of elimination of wind noise. Despite the outstanding performance characteristics built into the 644, it is still priced low enough ($110.00 list) to fit most budgets.

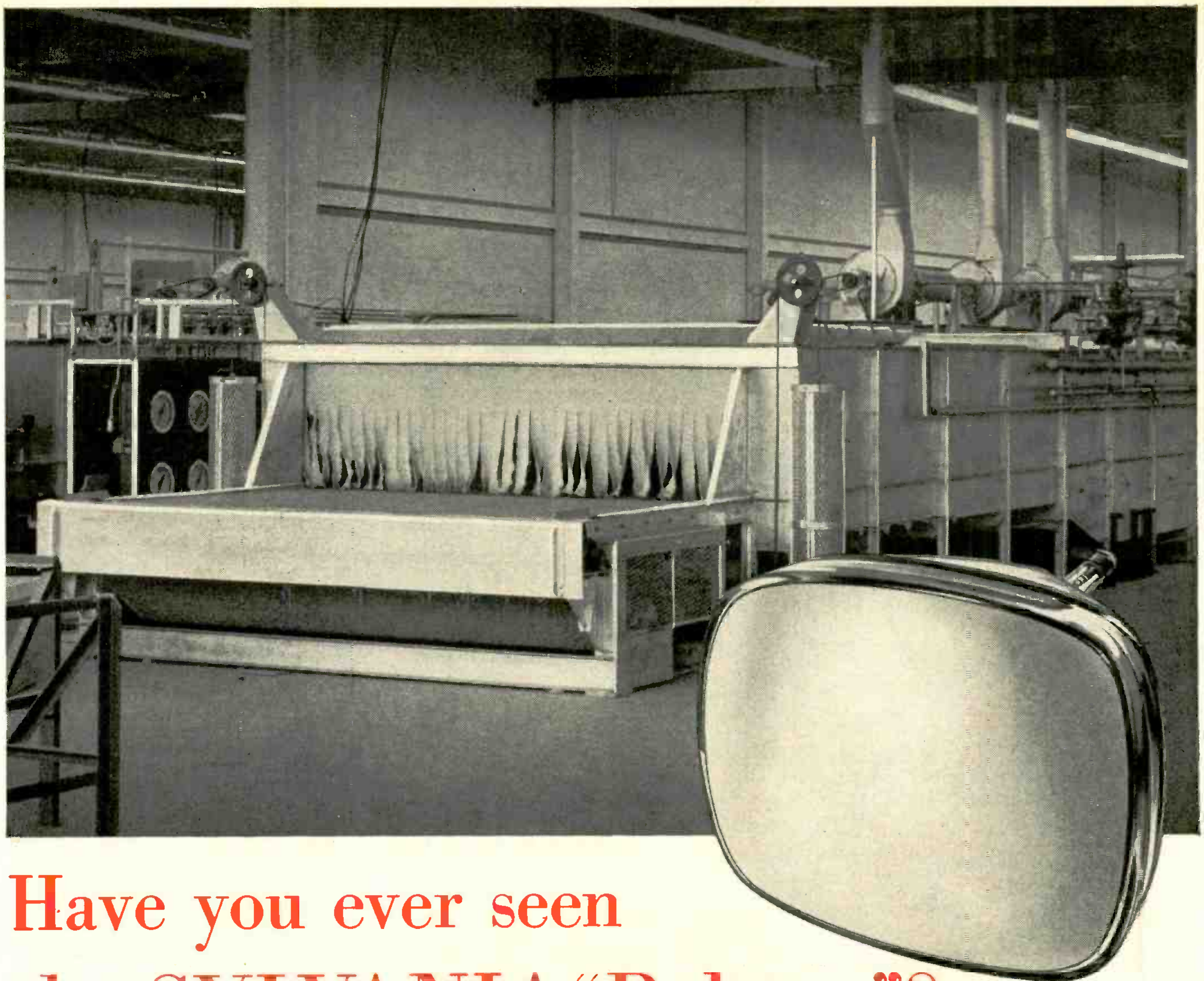
Did You Know?

Depending on the weight of the tone arm, a needle exerts as much as 30,000 to 50,000 pounds per square inch pressure on the record groove. So, it's easy to see why even a slight imperfection in the tip could ruin records in a hurry. Don't take chances with your valuable collection. Always select Electro-Voice Power-Point Needles. The only replacement needle line sold by a manufacturer of high-fidelity equipment.

Want more information on any of the items mentioned in the Sounding Board? Simply check the appropriate boxes below and mail the coupon to Dept. 50E, Electro-Voice, Inc. Buchanon, Michigan.

☐ .... ☐ ....
☐ .... ☐ ....
☐ .... ☐ ....

Electro-Voice®
BUCHANAN, MICHIGAN



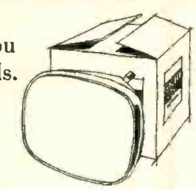
Have you ever seen the SYLVANIA "Bakery"?

"Bakery"? An "Oven"? Yes, but not for bread. For Silver Screen 85 Picture Tubes! Giant ovens (Lehrs)—each about one-third the length of a football field—"bake in" the big differences that make Sylvania Silver Screen 85 the finest replacement TV picture tube . . . *second to none!*

The giant ovens heat-treat the glass and bake the phosphor screen and other internal coatings. Important, too—this process removes residual volatile materials such as lacquer and water used in applying the phosphor screen.

This treatment must be done slowly, under careful controls and is very essential to the proper processing of the bulb. This process also assures "stronger" glass, free of undesired strains. It extends picture tube life by ridding the bulb of contaminants that could later cause inter-element leakage, gassing and loss of emission. The manufacturer who employs expensive equipment such as this can assure you of a consistently top-quality product.

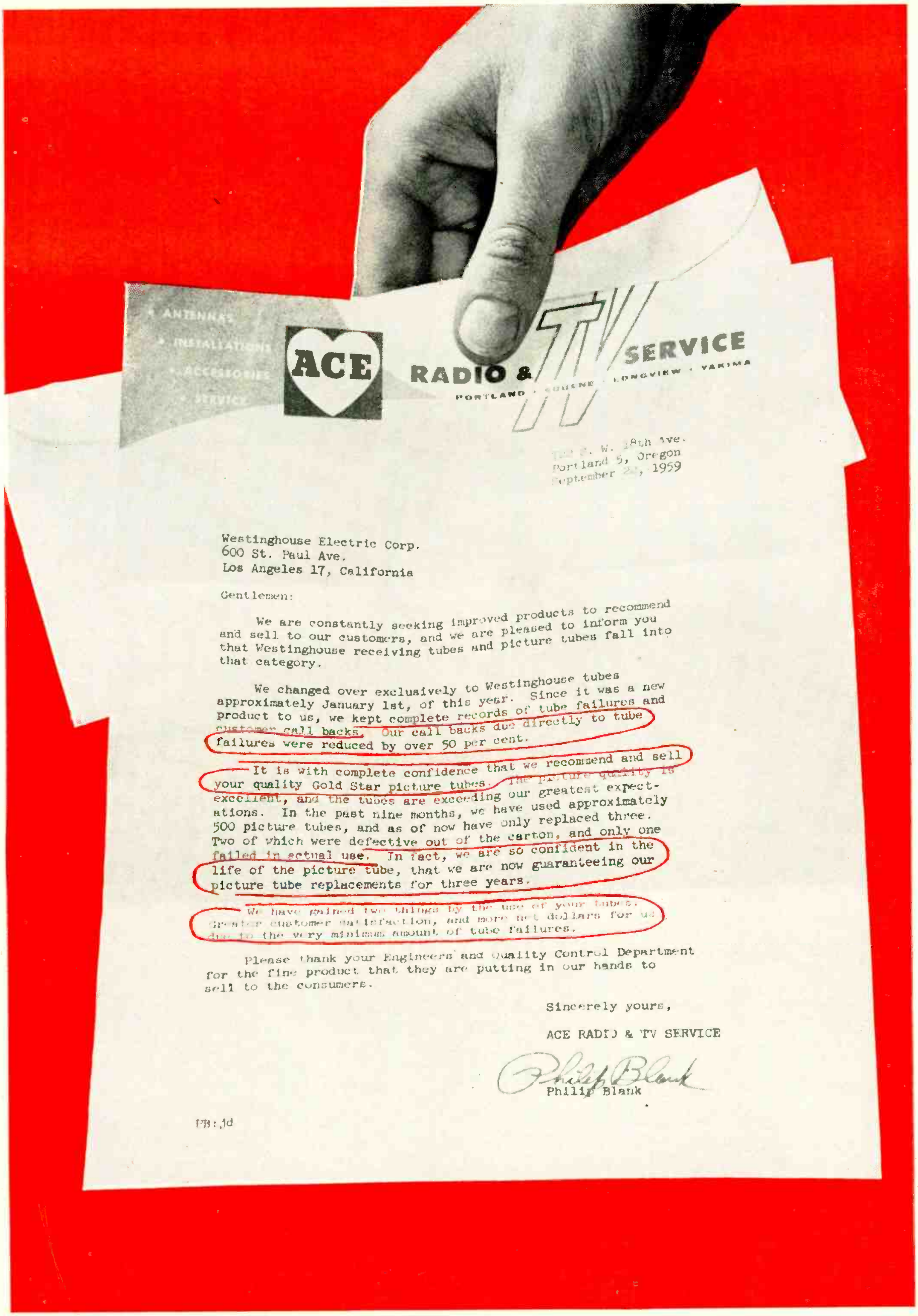
So, when you recommend a replacement picture tube, recommend the finest . . . a Sylvania Silver Screen 85. It gives your customers what they want: better pictures for a longer time. Gives you what you need: profitable TV service calls.



Electronic Tubes Division,
Sylvania Electric Products Inc.,
1740 Broadway, New York 19, N. Y.

SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS GENERAL SYSTEM



S. W. 18th Ave.
Portland 5, Oregon
September [illegible], 1959

Westinghouse Electric Corp.
600 St. Paul Ave.
Los Angeles 17, California

Gentlemen:

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

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

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

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

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

Sincerely yours,

ACE RADIO & TV SERVICE

Philip Blank

Philip Blank

PB:jd

NEWS BRIEFS *(Continued from page 8)*

Kenneth A. Norton, National Bureau of Standards, Boulder, Colo., received the Harry Diamond Memorial Award. The W. R. G. Baker Award was presented to E. J. Nalos, G-E Co., Palo Alto, Calif., and J. W. Gewartowsky, Bell Telephone Labs, Murray Hill, N. J., earned the Browder J. Thompson Memorial Prize Award.

Calendar of Events

PACE Annual Meeting, April 29–May 1, Nevele Hotel & Country Club, Ellenville, N. Y.

Semiannual Convention of Society of Motion Picture and TV Engineers, May 1–7, Ambassador Hotel, Los Angeles, Calif.

National Aeronautical Electronics Conference, May 2–4, Biltmore & Miami Hotels, Dayton, Ohio.

URSI-IRE Spring Meeting, May 2–5, Sheraton Hotel, Washington, D. C.

Western Joint Computer Conference, May 3–5, Jack Tar Hotel, San Francisco, Calif.

National Symposium on Microwave Theory and Techniques, May 9–11, Hotel Del Coronado, San Diego, Calif.

Summer Instrument Automation Conference & Exhibit, May 9–12, Civic Auditorium, San Francisco, Calif.

Electronic Components Symposium, May 10–12, Hotel Washington, Washington, D. C.

Electronic Parts Distributors Show, May 16–18, Conrad Hilton Hotel, Chicago, Ill. Closed show for manufacturers, representatives, distributors. RADIO-ELECTRONICS and GERNSBACK LIBRARY will exhibit in Room 504 and Booth 588.

EIA Annual Convention, May 18–20, Pick Congress Hotel, Chicago, Ill.

National Telemetering Conference, May 23–25, Miramar Hotel, Santa Monica, Calif.

IRE Regional Technical Conference & Trade Show, May 23–25, Olympic Hotel, Seattle, Washington.

Armed Forces Communications & Electronics Association Convention, May 25–27, Sheraton Park Hotel, Washington, D. C.

Annual Radar Symposium, June 1–3, University of Michigan, Ann Arbor, Mich.

Radio Frequency Interference Symposium, June 13–14, Washington, D.C.

Spring Conference on Broadcast & TV Receivers, June 20–21, Graemere Hotel, Chicago, Ill.

Electronic Standards & Measurements Conference, June 22–24, NBS Boulder Labs., Boulder, Colo.

Workshop on Solid State Electronics, June 23–24, Purdue University, West Lafayette, Ind.

Congress of the International Federation of Automatic Control, June 25–July 9, Moscow State University, Moscow, USSR.

National Convention on Military Electronics, June 27–29, Sheraton Park Hotel, Washington, D. C.

New England Electronic Conference, June 27–29, Balsams, Dixville Notch, N. H.

TV Station Changes

The opening of two new TV stations ended the lull we reported last month:

KRET-TV, Richardson, Tex..........23
WSLA, Selma, Ala..........8

KRET-TV's activity is educational.

KLOR-TV, Provo, Utah, channel 11, left the air temporarily because

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

What is the F. C. C.?

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

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

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

What are the Different Types of Operator Licenses?

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

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

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

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

What are the Different Classes of RadiotelePHONE licenses?

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

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

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

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

Which License Qualifies for Which Jobs?

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

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

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

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

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

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

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

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

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

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

Why Choose Grantham Training?

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

Is the Grantham Course a "Memory Course"?

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

Is the Grantham Course Merely a "Coaching Service"?

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

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

	License	Weeks
Ron Taylor, 29 S. Franklin St., Chambersburg, Pa.	1st	12
Beri Moore, P.O. Box 169, Opp, Alabama	1st	15
Donald R. Titus, 270 Park Terrace, Hartford 6, Conn.	1st	12
Robin O. Okinishi, P.O. Box 375, Hanapepe, Kauai, Hawaii	1st	12
Billy R. Kirby, Route #3, Smithfield, N. C.	1st	9
J. H. Reeves, 10621 Ruthelen, Los Angeles 47, Calif.	1st	12
Donald H. Ford, Hyannis Rd. (Cape Cod), Barnstable, Mass.	1st	12
James D. Hough, 400 S. Church St., East Troy, Wisc.	1st	12

FOUR COMPLETE SCHOOLS

To better serve our many students throughout the entire country, Grantham Schools of Electronics maintains four separate Divisions – Hollywood, Calif.; Seattle, Wash.; Kansas City, Mo.; and Washington, D.C.—all offering the same courses in F.C.C. license preparation, either home study or resident classes.

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

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

GSE

GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western Ave.	408 Marion Street	3123 Gillham Road	821 - 19th Street, N.W.
Hollywood 27, Calif.	Seattle 4, Wash.	Kansas City 9, Mo.	Washington 6, D.C.
(Phone: HO 7-7727)	(Phone: MA 2-7227)	(Phone: JE 1-6320)	(Phone: ST 3-3614)

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MAIL TO SCHOOL NEAREST YOU

To: GRANTHAM SCHOOL OF ELECTRONICS

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Gentlemen:

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.

Name ______________ Age ______

Address ______________

City ______________ State ______

Interested in: ☐ Home Study, ☐ Resident Classes 04-E of technical difficulties. We will report its return to programming.

The US count consequently becomes 568, including 474 vhf and 94 uhf. The noncommercial figure is upped to 44.

Canada's tally grows to 61 with two new stations:

CFCY-TV-1, New Glasgow, N.S.....7
CJCN-TV, Grand Falls, Nfld..........4

CFCY-TV-1 repeats its parent CFCY-TV, Charlottetown, P.E.I., channel 13. CJCN-TV is a CBC supplementary outlet.

MARS Net Schedule

The Military Affiliate Radio System (MARS) SSB Technical Net will present: May 4—"Antenna Panel," Warren Offutt, engineer, Airborne Instrument Labs, Inc.; May 11—"Frequency Control," Dr. Gernot Winkler, scientist, USARDL (United States Army Research and Development Laboratory); May 18—"Communication Electronic Needs of the Future," Drs. John V. Harrington and Benjamin Lax, MIT Lincoln Laboratory; May 25—"Fundamentals of Oscillator Operation," Robert W. Gunderson, editor, Braille Technical Press.

The Net meets on 4030 kc each Wednesday at 9:00 pm EDT. After the May lectures, the Net will recess until September.

Spray Can Changes Chanel

Double-duty spray cans can kill odors and change the station on a TV receiver. At least, according to the *New York Daily News*, one Edward McBride knows it works. Seems he was in a Bay Shore, N. Y., hospital relaxing after a bath, when some typical hospital odors started to bother him. He requested some deodorant, got it, and used it. But each time he sprayed, the program on the screen of his rented TV receiver changed too. An emergency call for a TV service technician brought the answer. The set's remote control reacted to the hissing sound of the spray can—the spray operated on the remote's ultrasonic frequency. Tests showed this happened with other sets in the hospital too.

Messages From Outer Space

Trying to intercept meaningful messages from other worlds is the job of a sensitive radiotelescope at Green Bank, W. Va. Set up by the National Radio Astronomy Observatory (NRAO) and named Project Ozma, the project is centered around the hope of picking up intelligence-bearing radio transmissions. Dr. Frank Drake of NRAO sums up the project's purpose by stating, "We hope to find a narrow-band radio source, varying in intensity in an apparently logical manner, from the vicinity of single stars not very unlike our own sun." END

IMPORTANT: For the man who wants to make big money in Radio-Television!

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. . . through these practical proven plans and ideas we help you make plenty of extra money in spare time while training.

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. . . the famous Sprayberry Training kits have been newly engineered by our staff to offer you the latest in Radio-TV Service Techniques!

NEW TRANSISTOR COURSE

. . . literally millions of new transistor radios are being used. We show you how to make money fixing them!

NEW HIGH FIDELITY

. . . there's big money to be made installing and servicing Hi-Fi units. Your Sprayberry training now offers you this valuable and profitable preparation!

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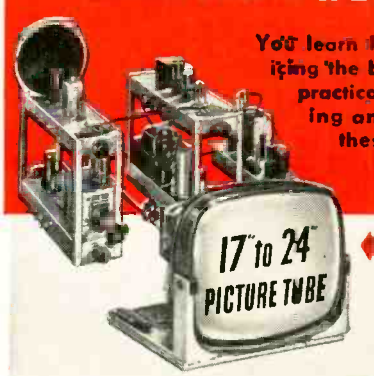
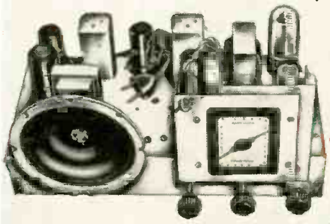
WITH THESE 25 BIG COMPLETE KITS of PARTS & EQUIPMENT

You learn Radio-TV Servicing the best way . . . the practical way . . . testing and assembling these modern kits of equipment.



The new Sprayberry Training Television Receiver, built and tested in 5 sections.

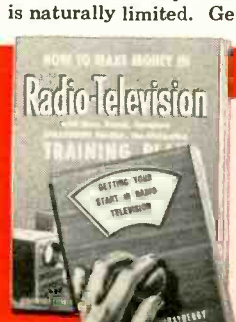
Now offered . . . this fine modern oscilloscope.



You build this powerful two-band superheterodyne radio receiver.

You build the new Sprayberry tester — a complete 18-range Volt-Ohm-Milliammeter test meter.

FREE These two big new books are yours free! Find out what Radio-Television offers you . . . and let us show you how easily you can learn, even without previous experience of any kind. Rush COUPON today!



SPRAYBERRY ACADEMY OF RADIO-TELEVISION
Dept. 20-L, 1512 West Jarvis Ave., Chicago 26, Ill.

The field of Radio-Television Servicing is such a fast moving industry that the best jobs and biggest incomes always go first to the man with the most modern, complete and up-to-date training. Thanks to constant revision and improvement . . . Sprayberry Training helps you earn more from the start . . . and keeps you earning more in the months and years ahead!

Make no mistake! All radio-television training is *not* alike. The basic purpose behind Sprayberry Training is to prepare you as rapidly and as surely as possible . . . to make top money servicing Radio and Television sets and equipment. This is where the big money has been for years . . . and will continue to be in the years ahead.

It's important for you to know that for over 30 years . . . Sprayberry Training has been preparing ambitious men for success in this interesting and profitable kind of work. Our school has helped hundreds to qualify for the best jobs . . . or to get started in profitable businesses of their own. Today our student rolls are the largest in our school's history . . . because the need and demand for Radio-Television Service Technicians has never been more urgent.

Just $6.00 Starts You

To encourage more men to enter Radio-Television at once . . . to help fill the great need for trained men . . . we're making it easier than ever before to start training. Just $6.00 enrolls you. This liberal offer is naturally limited. Get the facts now and consider enrollment while these favorable terms are available to you.

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Under the Sprayberry Plan you train entirely at home in spare time. You combine the most modern lesson training with fascinating and invaluable practical work with 25 big kits of parts and equipment that we supply. You get the equivalent of years of shop practice . . . and you can train as fast or as slowly as you wish. We help you make excellent spare time money while learning . . . and everything you receive—lessons, books, manuals, equipment—all yours to keep!

This is the Radio-Television industry's most modern and up-to-the-minute training. Sprayberry is the *one* school that gives you personalized attention and takes a real interest in your progress. Remember . . . just $6 starts you! Mail the coupon today. Let the facts speak for themselves. Let us send you our new catalog and sample lesson . . . and *prove* the kind of opportunity that Sprayberry training can open up for you.

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easiest to build...satisfying to own...money-saving

ONLY $2 DOWN on orders up to $50; $5 down on orders up to $200...

only $2 down

Y-713 Top value, best-selling Citizens Band Transceiver. Tunable 22-channel super-regenerative receiver, 5-watt transmitter.................... **$39.95**

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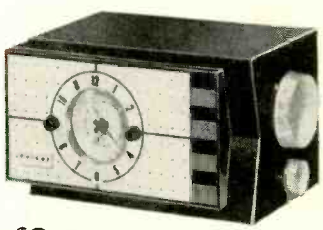
Y-258 4-Band "Span Master" Receiver; exciting world-wide reception; with cabinet.................... **$25.95**



only $2 down

Y-737 "Ranger" Clock-Radio with Telechron clock, sleep switch and appliance outlet.................... **$24.95**

Y-608 Lab quality AC VTVM with amazing Automatic Range Selection; reads as low as 100 μv. **$99.50**

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Y-125 General-purpose VTVM (11 meg input resistance) **$25.75**

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only $2 down

Y-143 Model "600" Tube Checker (checks over 700 types)..... **$32.95**

full selection of

INSTRUMENT KITS

5" Oscilloscopes
Tube Checkers
RF Signal Generator
Signal Tracer
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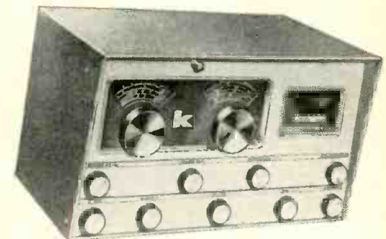
Transistor Checker
R/C Tester, plus
many others



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R-100 Amateur Communications Receiver (Hi-gain, with built-in Q-Multiplier).................... **$104.50**

G-30 Amateur Grid Dip Meter (continuous coverage, 1.5-300 mc)..... **$22.95**

only $2 down

other fine

AMATEUR KITS

50-Watt Transmitter
Self-Powered VFO
100 kc Crystal Calibrator
RF "Z" Bridge
Code Practice Oscillator

plus many other

HOBBYIST KITS

"Space-Spanner" Receiver
"Ranger" Radios
"Ocean Hopper" Radio
Radio-Intercom
5-Transistor Portable
2-Transistor Pocket Set
2-Way Intercom
Electronic Lab Kits
Photoelectronic System
and many others

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Write for catalog featuring the complete KNIGHT-KIT line. Order the kit of your choice—judge quality and value for yourself under our FREE examination privilege!

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100 N. Western Ave., Chicago 80, Ill.

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RADIO

Pioneer in quality electronic kit development...

Correspondence

WHAT YOU CAN DO

Dear Editor:

I have worked in radio, electronics and television for the past 35 years. During this time, I have heard complaints from all sides: Dealers, service shops, customers, engineers, electricians and manufacturers. To me, there is only one answer!

Get behind your local Better Business Bureau. Do something about the handcuffs forced on them by lack of capital and understaffing. It is *your* fault if they are inadequate to clear up any odorous situation that may exist or arise. I mean you Mr. Dealer, Service technician, Customer or any other honest citizen who wants fair dealing and honest value.

When you get in touch with your BBB, remember they are doing the best they can with the meager tools they have to work with. Ask them, "What can I do to help the situation?" Don't start by demanding this or that. When you have learned what they can or cannot do, *then* you or your association can act.

I do not see any reason for licensing technicians. Classify them, yes, but do it through a democratic union or association. I say this because this field is basically the same as any other. The man who double-talks the customer into something will disappear; the one who wants to cut a fat hog will have to go into the butchering business.

Yours for fairness and honesty in the best business on earth.

RALPH K. EATON

Richmond, Calif.

INFRARED GUIDANCE NOT NEW

Dear Editor:

Your "Infrared Guides Missiles" story (January, 1960) is not so new as some may thing. In 1911–12 I built (for J. H. Hammond, Jr.) while working in Fritz Lowenstein's laboratory, 115 Nassau St., New York City, an infrared automatic guidance device that was known as the "Electric Dog." This was a three-wheeled box. Two wheels were 6-volt motor-powered via a differential gear box; the third was at the other end, turnable on a vertical shaft by opposing electromagnets for steering, like a velocipede.

Up front, two headlight-like "eyes" consisting of 5-inch-diameter lenses with Korn (selenium) photocells, sensed infrared and visible light. A horizontal plate was located between and forward of the two lenses. Sensitive Weston microammeter relays, which I fitted with anti-vibration, mercury-globule fixed contacts, were operated by the selenium cells. These relays in turn operated heavy-current relays for turning the motor on and off, and for operating the steering-wheel solenoids.

A dpdt motor switch permitted either forward or rearward drive for the front-end power wheels. A 6-volt storage cell provided the power.

The Electric Dog would start moving if a light or heat source were turned on 10 to 20 feet away and in angular range of its "eyes." If forward motion were selected by the external, manually operable dpdt switch, the dog would move toward the radiant energy source. For reverse motion it would back away, always facing the "light" in either case.

(*Continued on page* 26)

LET RCA TRAIN YOU IN ELECTRONICS

RCA Institutes, one of the world's leading electronic technical schools, offers a Home Study Course in . . .

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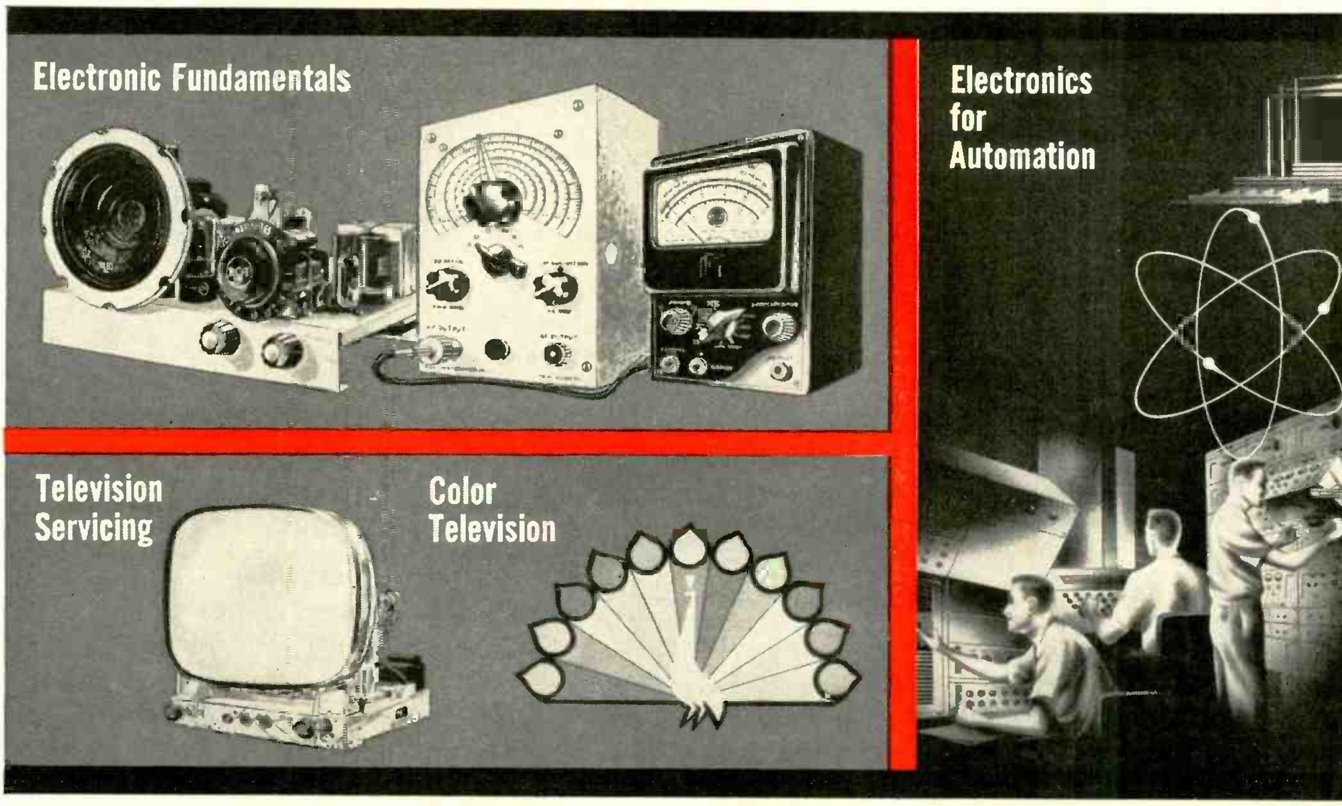

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CORRESPONDENCE *(Cont'd from page 22)*

If the light were moved, the dog would follow or back away, crablike. For forward motion, it would follow the light or heat source in circles, figure-eights or any other course, within its turning radius of a few feet.

This automatic orientation machine (as we called it) was made to demonstrate the principles of an automatic homing type of radiant-energy-sensing guidance system for torpedoes, using high-power searchlights or the hot smokestacks of enemy battleships as the attracting energy, just as the Sidewinder missiles use the hot exhausts of aircraft jets or engines.

I worked out a double orientation mechanism with a 90° cross-axis for use on aerial missiles, as described in my book *Radio Dynamics* (D. Van Nostrand Co., 1916) on pages 198–9.

For a remote-command guidance system, this orientation mechanism can be used with an infrared (only) searchlight, to keep the "eyes" always facing the searchlight. If the light is modulated by an ac supply, the missile's receiver is made insensitive to other steady light or heat sources by tuned circuits.

Energy from the target plane or missile is not seen by the "eyes" of the controlled missile. Interruptions of the searchlight beam for short periods can provide guidance signals.

Does it not seem incongruous that 50 years should elapse before the principle is put to work for national defense?

BENJAMIN F. MIESSNER
Miami Shores, Fla.

HELPFUL HINTS

Dear Editor:

May I express my opinion of your magazine? I think it is excellent. I first came into contact with it in England, my home before I came to Canada in 1958.

Its pages display such a variety of electronic aplications that one can never fail to find interest in them. Industrial Electronics is a feature of prime interest, although my work is as a full-time radio–TV technician.

Many jobs that have seemed to be tough-dogs at first have ceased to be such after I have looked through back issues and found a similar problem described. One that comes to mind is a Crosley Super V with lack of vertical hold at high contrast, due to first if grid-coil pickup from the deflection yoke. Screening was the answer to that one.

I quote this example as an idea of the tremendous help one can get by taking time off to read up on other people's problems. No other magazine does this as efficiently as yours does.

F. H. FRENCH
Manitoba, Canada

RECORD OF THE FUTURE?

Dear Editor:

A recent juke-box advertisement suggests that the 7-inch 33⅓-rpm record

Extra because: 1. A rotator is a natural add-on for every TV set and outdoor antenna. 2. A rotator improves reception for 99 out of 100 sets. 3. The need grows daily with the swing to Color TV.

Easy because: 1. Alliance Tenna-Rotor leadership makes it the name *most* customers know and respect. 2. Alliance advertising makes selling easier. 3. Alliance control units *look* modern. 4. Alliance has the *complete* line.

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ALLIANCE, OHIO (Division of Consolidated Electronics Industries Corp.)

may become "the singles record of the future."

Why did it flop when brought out some years ago? Was the small spindle hole, vintage 1896, one factor?

Small spindles did little damage until the invention of stack-and-drop automatic changers, although seating the record was—and still is—at best, a fumble. Spindle scratches on record labels show the energy wasted in fumbling for the hole.

Why not start the small 33 on its second try for fame with a modern and practical center? and why not, at long last, give the 12-inch 33 similar advantages:

1. Eliminate the "stabilizing-lever" nuisance.
2. Eliminate center-hole elongation and consequent wow.
3. Simplify changer mechanism. Put it all in the center.
4. Protect delicate stereo grooves with label areas thick enough to separate playing surfaces *all the way across.*
5. Make it very much easier to stack records.
6. Rejuvenate and revitalize the record and player business with another revolution.

CHARLES W. FARRINGTON
Arlington, Mass.

CRYSTAL OSCILLATOR

Dear Editor:

I recently built the crystal-controlled transistor oscillator described on page 82 of the January (1960) issue and would like to say that I am very pleased with it. I used it with a 10.7-mc crystal.

I have two Heathkit FM-3A tuners and had no success in aligning them with an Army signal generator, an old rf generator and a Heath TV alignment generator. (I have since found out that the crystal used with the TV generator was defective).

I could not find a plastic box of the size called for, so I built it in one about twice as large. This worked out well, as I mounted clips in the box for four penlight cells.

A friend of mine checked the output of the oscillator on his scope. The output was good, but not quite a true sine wave. For some reason the variable capacitor had no effect on the output.

I tried to align my tuners as prescribed by Heath with no results. I thought that the output of the oscillator might be too high and might be biasing the rf and if tubes to cutoff. I wrapped the "hot" lead around the tube instead of connecting it to the grid. It worked fine. I went over the slug adjustments four times (instead of the recommended once) until the readings on the voltmeter did not change.

My tuners now work well and I recommend this oscillator to anyone with a similar problem.

R. E. BORDEN
Encino, Calif.

END

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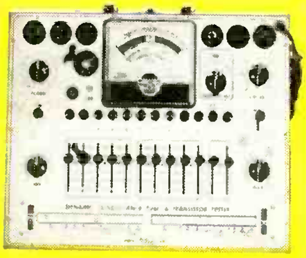

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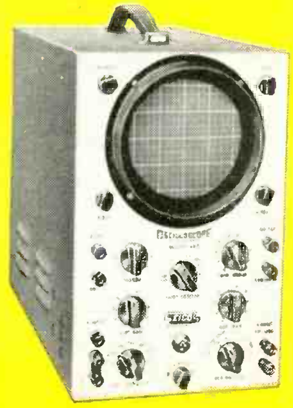

E
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KIT $79.95 WIRED $139.50
5" PUSH-PULL Oscilloscope #425:
Kit $44.95 Wired $79.95

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

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

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

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

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

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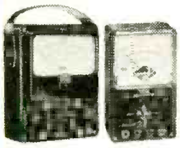

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INVENTIONS WANTED

. . . Our Armed Forces Call for New Electronics Ideas . . .

IN our February, 1959, issue, we printed a list of electronics ideas wanted by our Armed Forces. Here is the latest list, which contains mostly new requests.

Anyone may submit proposals to the National Inventors Council for basic inventions needed for national defense. Such proposals should be submitted separately, typewritten, if possible. It is advisable that descriptions be complete, including references to the basic principles underlying the invention and a discussion of any experimental work or tests that have been conducted. Advantages of the invention as compared to existing devices or techniques should also be listed. It is not necessary that sketches or drawings be professional.

Keep copies of all items presented and retain one copy that has been notarized with the exact date so you will always have proof of conception for patentability. This is important because your original copy will not be returned by the Government.

It is suggested that you write for the booklet *"Inventions Wanted by the Armed Forces,"* November, 1959, issue. Write to: National Inventors Council, US Department of Commerce, Washington 25, D. C. —*H.G.*

* * *

819. **(Revised) ELECTRONIC TIMER.**—Device to measure time intervals, 0.1 μsec to 0.9999999 seconds, to an accuracy of $\pm$.01 μsec or better. The device should be similar to units now capable of resolving to $\pm$0.1 μsec over the same time interval.

859. **(Revised) MICROWAVE FILTERS.**—Extremely sharp-cutoff selective filters for the microwave region (L-band or X-band). A significant increase in signal-to-noise ratio would be realized by the use of filters having a bandpass of a few kilocycles.

864. **(Revised) MISS-DISTANCE SYSTEM.**—A system which will determine the vector miss distance between a missile and an aerial target. The system should be of a passive or semi-active type and should possess the capability of measuring miss distance to the nearest foot at extremely high sampling rates at any altitude below the ionosphere.

973. **LOW-LOSS HIGH-POWER FERRITES FOR USE AS MICROWAVE PHASE SHIFTER.**

974. **A BROAD-BAND MASER AMPLIFIER FOR USE IN THE MICROWAVE REGION.**

975. **A NEW METHOD OF ELECTRONICALLY (NOT WITH FREQUENCY CHANGE) SCANNING AN ANTENNA.**

976. **RELIABLE LONG-LIFE CATHODE.** An efficient indirectly heated unipotential thermionic cathode having 100,000 hours life in negative grid tube with current density of 500 ma dc per cm^2.

983. **PREFORMED SEMICONDUCTOR CRYSTALS FOR DEVICE FABRICATION.**—Germanium and silicon single crystals grown in ribbons or rods with uniform physical and electrical characteristics to the sizes suitable for direct fabrication into diodes, transistors, solar cells, etc. is desired. The semiconductor material should have properties equal or superior to material presently used in germanium and silicon transistors. The new growing method should permit the direct utilization of the semiconductor for device fabrication, thus eliminating the conventional wasteful and expensive slicing, lapping and polishing operations.

998. **TECHNIQUES FOR SUPPRESSING SIDE LOBES OF HIGH-GAIN ANTENNAS BELOW ANY SPECIFIED MINIMUM.**—It has been shown theoretically that the optimum antenna for microwave communications is that having high gain and very good side-lobe suppression. Invention of techniques for achieving high gain and negligible side lobes would result in a great saving in equipment and installation costs.

1000. **METHOD OF TRANSMITTING SPEECH ON TELETYPE CIRCUITS.**—The use of narrow bandwidths for the transmission of speech requires eliminating the redundancy of speech waveforms and transmitting only the desired information. A single method of extracting this information, transmitting it in a code and re-creating speech at the terminal end is needed.

1001. **ANTENNA MEASUREMENTS.**—For use in interference prediction, as well as to determine antenna behavior outside of the design band, rapid and reliable technique is required for measuring three-dimensional antenna response outside the design band. The technique should include consideration of aperture feeds at frequencies other than the design band.

1002. **MICROWAVE DELAY LINE.**—A microwave delay line of reasonable size, with stable electrical characteristics and capable of producing delays in the order of several hundred microseconds. It is desired that attenuation should not exceed 50–60 db, but higher values are acceptable. Bandwidth of at least 0.2 mc is desired.

1008. **TRANSDUCERS THAT ARE RELATIVELY UNAFFECTED BY HIGH-TEMPERATURE ENVIRONMENT.**—Accuracy of generally 1% or better.

1018. **VIBRATION-ISOLATED PRESSURE TRANSDUCER.**—A pressure transducer and/or mounting assembly capable of operating under an environment of: (1) 3,500°F at the transducer diaphragm; (2) 500 g's varying from 0 to 5,000 cycles per second with less than a 1% detriment on the data produced is required.

This transducer must have a frequency response flat to 3 db up to 10,000 cycles or more. This device is desired for the study of unstable rocket engines.

1024. **HIGH-POWER BROAD-BAND SOLID-STATE RF AMPLIFIERS.**

1025. **BROAD-BAND. RF MEMORY CAPABLE OF REMEMBERING FREQUENCIES RECEIVED SIMULTANEOUSLY. PHASE AND VIDEO INFORMATION WITH QUICK READOUT (.05 μSEC).**

1043. **APPLICATION USEFUL TO THE MILITARY FORCE FIELDS, GRAVITATION FIELDS, ANTI-GRAVITY FORCES, ETC.**

1056. **TRANSISTORS.**—Transistors with power gain and linear characteristics at extremely small emitter currents and collector voltages permitting efficient operation at very low signal levels.

1057. **SOLID-STATE MICROWAVE OSCILLATORS.**—A solid-state device is wanted capable of producing more than 50 mw of microwave power in the frequency range above 2000 mc/sec to serve as a solid-state pump for parametric amplifiers.

1059. **IONICALLY CONDUCTIVE MATERIAL (CATION).**—Ionically conductive material with the following characteristics: (1) strength sufficient to permit the casting of thin films practically impermeable to gases such as hydrogen, oxygen, etc., (2) very high capacity (in the thin film form) for the acceptance of hydrogen ions at the film or membrane surfaces, (3) high mobility of hydrogen ions within the material so that films or membranes made of the material will have low electrolytical resistance, (4) high concentration of cation acceptor groups throughout the material, (5) hydrophyllic, (6) high stability in acid solutions, (7) very low electronic conductivity.

1060. **NONMECHANICAL MICROWAVE CAVITY TIMING METHOD FOR GAS MASERS.**—Microwave cavities in X- and K-band should be tunable smoothly and without hysteresis over a range of at least $\pm$2 mc with a sensitivity 1 kc per reproducible control step. No electric or magnetic field is allowed to be present in the cavity besides the microwave field to avoid Stark or Zeeman influences. The total mechanism (without the cavity proper) should not weigh more than ½ pound and should be easily adaptable to drive by a servo control circuit to hold the cavity to the exact molecular frequency. The time needed for the tuning device to effect a frequency change of 5 kc should be less than 1 second.

1061. **PRESSURE TRANSDUCER.**—Pressure transducer(s) for the range 0.1 to 1,000 mb with an electrical output (preferably resistance) which employs no moving parts such as diaphragms, linkages or liquids (hypsometers).

1063. **PHASE-COHERENT EXCITATION OF MOLECULAR BEAMS IN THE MM-WAVE RANGE.**—Ramsey excitation of a molecular beam results in a narrow spectral line whose center position depends to a small extent on the phase difference between the two exciting electromagnetic fields. For zero phase difference the center frequency is unshifted. For 180° phase difference the center is shifted by the amount of the bandwidth. A simple excitation method is needed to allow a Ramsey type excitation of molecular beams in the region between 100 and 300 kmc with a maximum phase difference of 2° between the two separated oscillating fields. For information on the Ramsey method see book by N. F. Ramsey, *Molecular Beams*, 1956, Oxford University Press.

1064. **HIGH-POWER INSTANTANEOUSLY TUNABLE RESONANT CIRCUIT FOR THE VHF AND LOWER UHF RANGE.**—A resonant circuit capable of handling 200 watts at a minimum efficiency of 50%. 400-watt maximum input. Q of approximately 50 to 100. Rate of tuning to be in the order of milliseconds within the band. This could be an improvement of the existing power increductors.

1065. **MINIATURE ANTENNA IN THE 6–60-MC RANGE.**—An antenna not over 6 feet in any dimension, weighing less than 100 lbs. and capable of handling 200 watts average power over the 6–60-mc range with an impedance of 50–75 ohms. Omnidirectional to 90° beam width in the horizontal plane and a minimum beam width in the vertical plane of 20°. Linear polarization is desired.

1066. **PCM REPEATER.**—A PCM repeater for land or submarine cables, to handle capacities from 6 to 96 channels, having extreme reliability, of size small enough to become an integral part of the cable or connector, capable of being self-powered, self-fault-locating, and of such design that failure of several repeaters in a system will not affect operation of the system.

1068. **CRYSTAL OSCILLATOR.**—A crystal oscillator which will automatically adjust its frequency so that the crystal unit operates at zero phase angle (resonance). It must be capable of this self-adjustment to within 1 part in 10^6 whenever there is a change in the crystal parameters, or when one crystal unit is replaced by another. The frequency range of current interest is 1–200 mc.

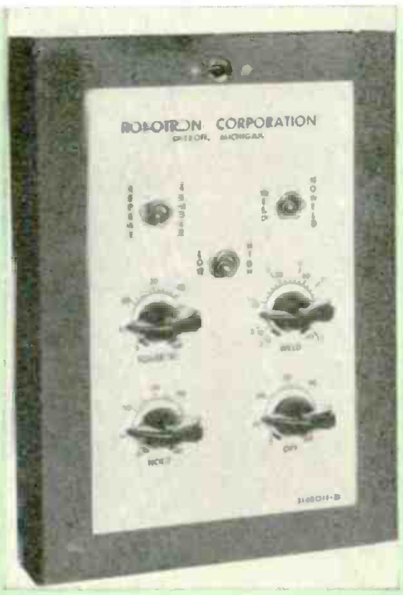
(*Continued on Page* 120)

TV Tech repairs

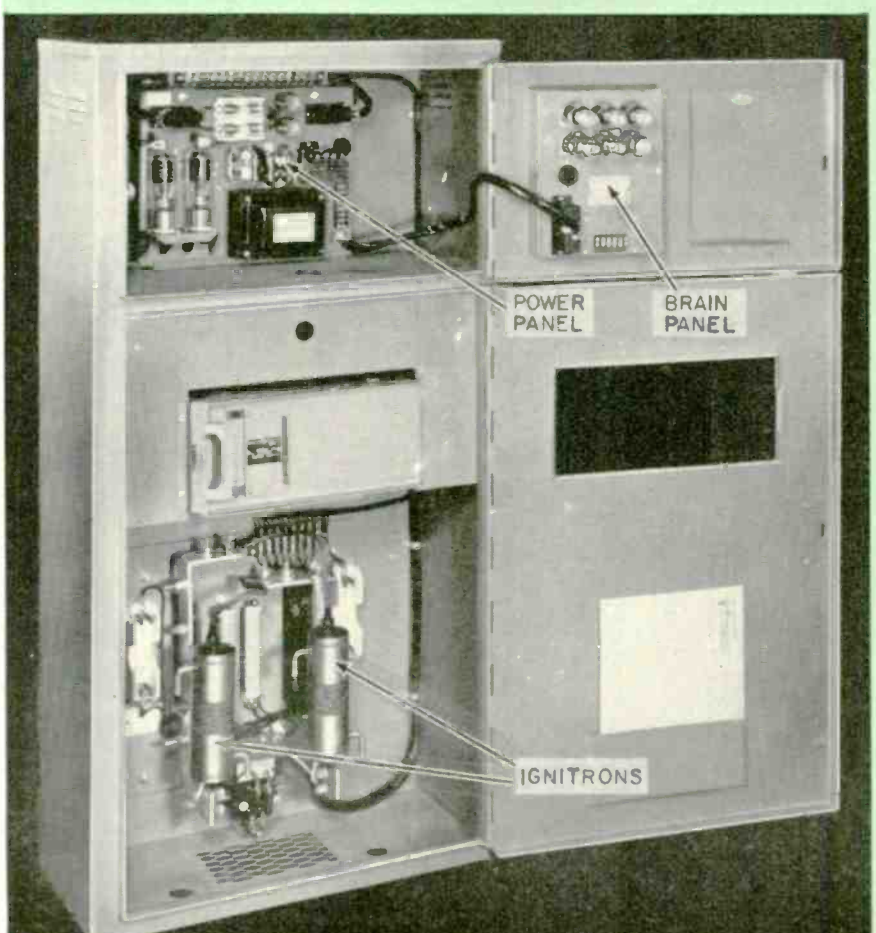
A WELD TIMER

It doesn't take a new technique, just a reapplication of basic electronic servicing principles

By DELLROYE D. DARLING



Close up of brain panel.



Inside the weld timer. Note three major electronic assemblies.

FOR years you have been fixing TV sets. But today a customer comes into your shop and says he has a **weld timer** that doesn't work right. (Don't think this can't happen to you. With the amount of industrial electronic equipment now in use, and a shortage of trained technicians, more and more plant operators are turning to television technicians to maintain their equipment.)

It's a challenge, so you decide to have a crack at it. What's the first step? Well, let's use the TV man's approach right down the line:

1. *Make and model.* It's a Robotron model 3B weld timer, operating a spot welder.

2. *Symptoms:* When the initiation switch is pushed to make a weld, nothing happens. Power? Yes, the customer looked inside the cabinet, and the tubes were lit.

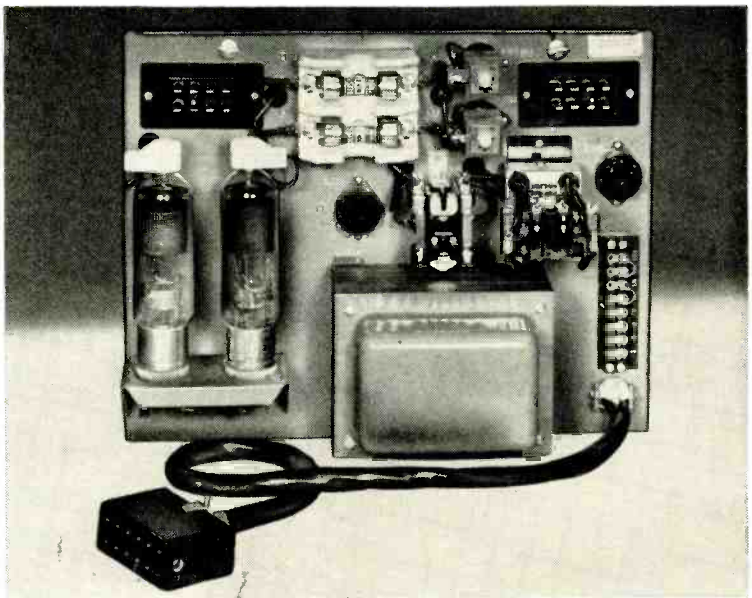
3. *Examine the equipment.* You'll have to go to the job, because most industrial equipment is permanently installed and wired directly to the power lines.

The unit is in a steel case, the timer section is about 12 x 14 x 18 inches, and has a double front door. Open the small one. Inside we find a control panel with four knobs and three toggle switches.

The knobs are labeled SQUEEZE, WELD, HOLD and OFF. The SQUEEZE knob is calibrated to 120, the HOLD and OFF to 60, and the WELD has two scales, one in red to 15 and one in black to 60. Question the customer (diplomatically, of course), and he tells you the calibration is in cycles of time. The line supply is 120 cycles, so you reason that 1 cycle on the dial equals 1/60 second.

Basic operation

A few more questions, and you learn that SQUEEZE is the time the welder electrodes take to squeeze the work pieces together before a weld can be made. WELD time is the length of time current flows through the metal to develop the correct heat. The length of time the electrodes stay closed while the weld cools and congeals is called HOLD time, and OFF time is the time the electrodes stay open between welds



The power panel mounts a couple of thyratrons, rectifiers, fuses and relays.

to allow the next piece of work to be inserted.

The WELD knob has two ranges, LOW (to 15) and HIGH (to 60) as selected by a toggle switch next to the WELD knob. Of the two remaining switches, one is labeled SINGLE and REPEAT, to allow the machine to work automatically, one weld after another (this is where OFF time comes in) or to limit it to one weld each time the pilot switch is pressed. The last switch is marked WELD and NO WELD, and allows the service technician to test-operate the welder without actually passing weld current.

Now that we have seen the controls, open the main door and we'll have a look at the innards. Inside we find two separate units or panels. One small one, on the back of the control panel, is called the BRAIN panel and carries six small thyratrons, some terminals and a large plug and cable connecting to the POWER panel in the main case. Turn a "quick-fastener" on the right edge one-quarter turn and the BRAIN panel swings open, revealing the components which make up the timer circuits.

Here is a service technician's dream! The wiring is open, and the parts are easy to get at. Each part is labeled (1R, 3C, 2T, etc.), to correspond to the circuit diagram. This is certainly an improvement after working on portable TV sets!

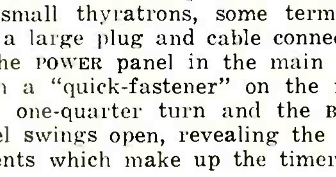


Fig. 1—Relay symbols (industrial symbol on left): a—normally open; b—normally closed; c—relay coil.

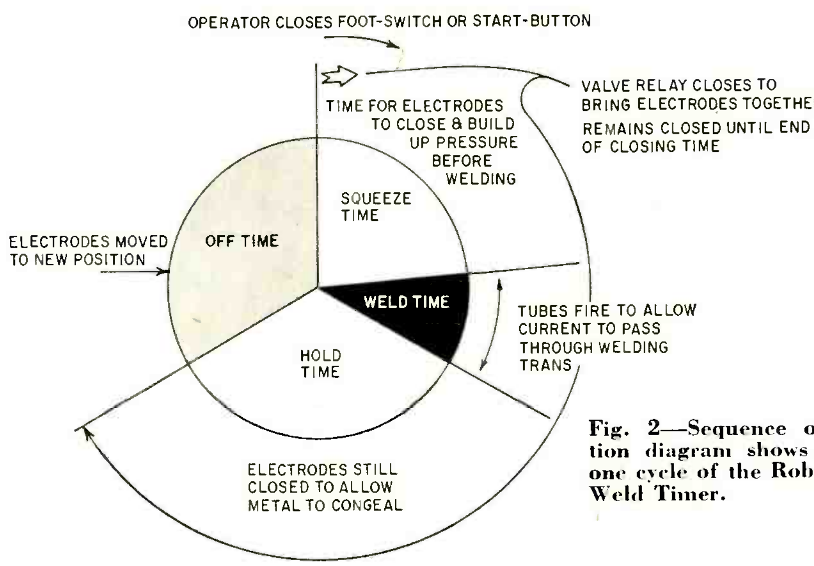


Fig. 2—Sequence of operation diagram shows steps in one cycle of the Robotron 3B Weld Timer.

In the rear of the main case we find the POWER panel, carrying two larger thyratrons, power transformer, relays, fuses, etc. Now here is a feature that appeals both to the user and the technician. If this control requires more extensive repairs than you can make conveniently with the unit in its cabinet, either the BRAIN or the POWER panel can be removed and replaced without cutting wires, disconnecting leads, etc. Just pull the plugs, turn the quick-fasteners, and remove the panel. This feature cuts down-time and saves thousands of dollars in lost production.

4. *Get a schematic.* This problem is a little different from fixing TV sets, too. With the variety of industrial equipment in use, it is almost impossible for an independent technician to stock all the service information necessary. However, the owner will usually have the information received from the maker when the control was purchased.

We'll ask the customer for the envelope he received when this timer was installed. Inside are schematics, specifications and a good description of how the circuit works.

A quick visual inspection, substitution of tubes and fuses, and a voltage check tell us that the power panel seems OK, so we'll look for our trouble in the brain or timer circuits. Dig out the timer schematic and spend a few minutes studying the description of how the circuit works. (By the way, an electrician or industrial technician would call this a print, as many diagrams are in blueprint form.)

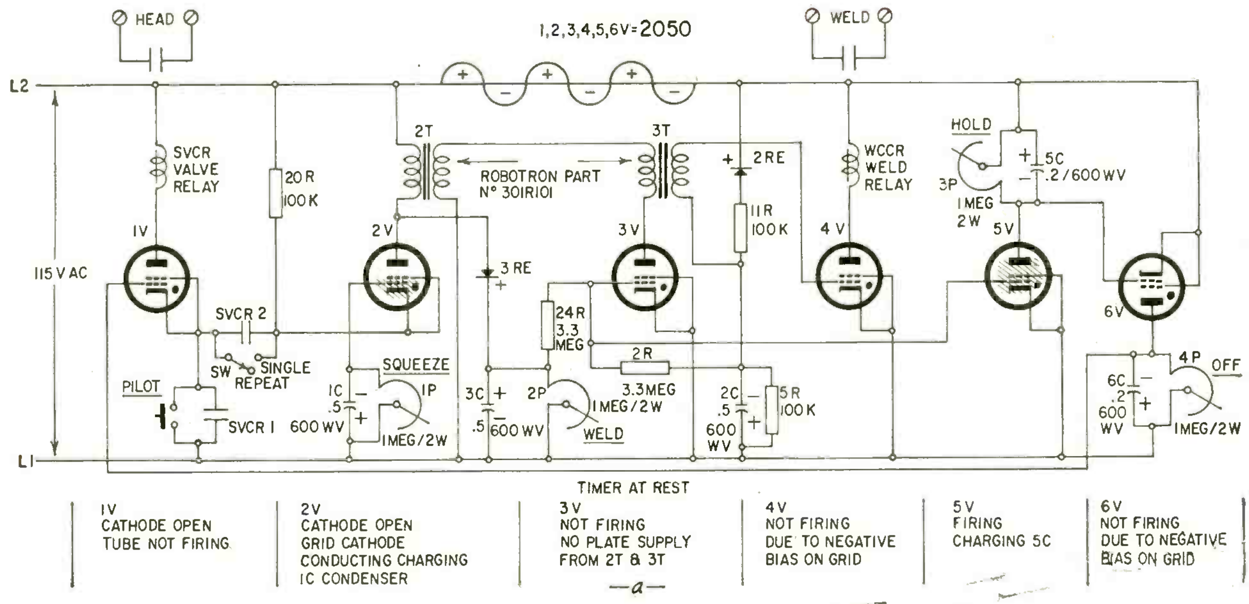
Some of the symbols look a little strange, but common sense tells us that a rectangle with 2R alongside it must be a resistor, 3T is a transformer, and so on. Watch out for relay contacts, though, they're drawn much like a capacitor (Fig. 1).

Another point that you have to watch in an industrial print is the coding. Unlike electronics style (for example, V1 for a tube), the number comes first (1V). In such instances 5V above a tube is an identifying code and not the plate voltage. With thyratrons, univibrators, frequency dividers and similar circuits where one or more tubes are cut off and others are conducting, the normally conducting tubes (when the equipment is at rest) are shown by crosshatching or shading the tube envelope. (In Fig. 3, 2V is conducting only between grid and cathode while 5V is conducting cathode to plate.)

Into the circuit

Now let's take the symptoms, go through the circuit and figure out what part could cause *nothing* to happen when the initiation switch is pressed.

The circular sequence diagram (Fig. 2) shows that things must happen in this order: SQUEEZE, WELD, HOLD, OFF. Air pressure must be admitted to the welder during SQUEEZE, WELD and HOLD. The solenoid valve control relay turns on the air whenever 1V conducts to energize its coil, marked SVCR (Fig. 3). Weld current flows through the elec-



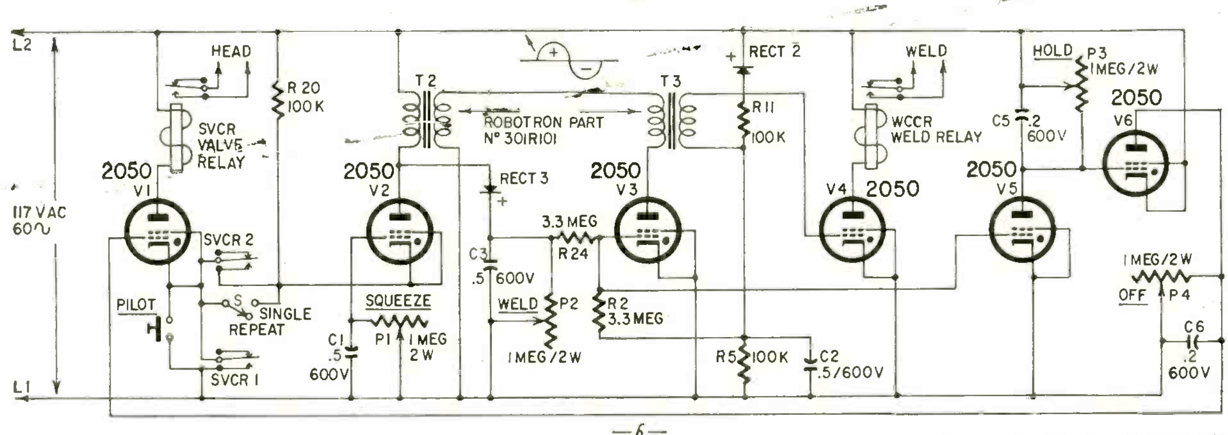
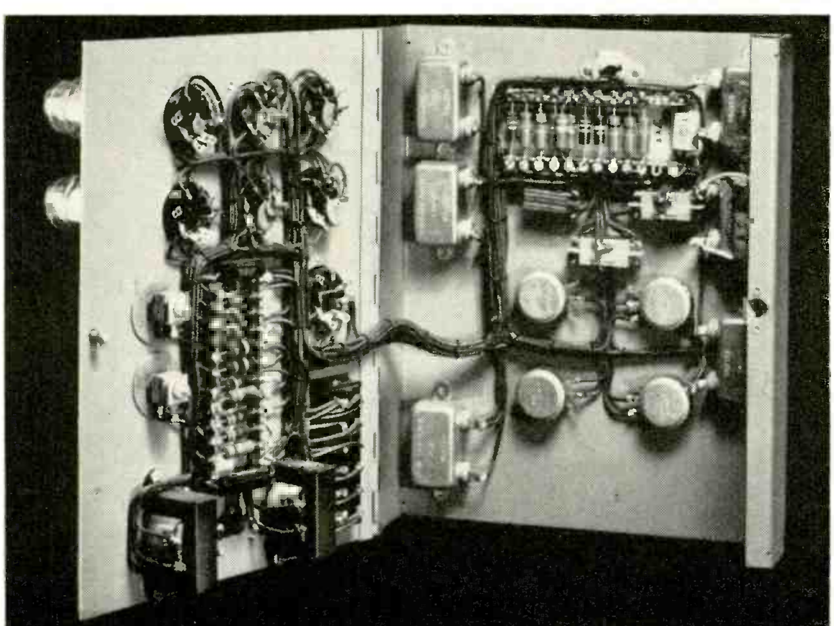


Fig. 3—Simplified schematic shows brain panel of Robotron timer in two languages: a—industrial diagram; b—electronic diagram.

The brain panel with its back door open.



trodes only during WELD time. In the equipment, weld current is controlled by ignitron tubes fired by the two thyratrons on the POWER panel, which get their grid voltage from a transformer in 4V's plate circuit. Since we are interested right now in the BRAIN circuits, we can simplify things by assuming the weld current is turned on and off by WCCR, the weld current control relay.

The sequence begins with air being turned on, which happens when 1V fires. Our sick timer won't start at all, so we'll look first at this 1V circuit. What would you suspect first? The tube, naturally. Although industrial controls use high-quality premium tubes, tube failure is still the most common cause of trouble, just as it is in radio and TV. Try a new 2050 thyratron in place of 1V. No change? Well, while we have the tube handy, let's try it in place of the other five tubes. There's another nice thing about industrial service; even though there may be a lot of tubes in a control, you often find that most of them are the same type.

Now that we've tried all the tubes and the control still doesn't work, we'll have to analyze the circuit to see which underchassis component could keep 1V from closing the air-valve circuit. But wait: how about the relay itself? Use your TV multimeter to check the

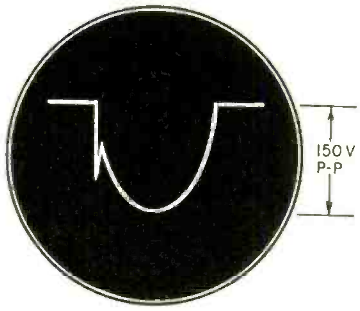


Fig. 4—Waveform across 6V's grid and cathode when capacitor 5C is open.

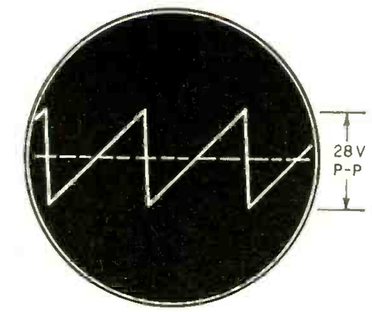


Fig. 5—Waveform across 6V's grid and cathode when capacitor 5C is good.

resistance of its coil. A reading of 1,000 ohms or more indicates a burned-out coil. (In this Robotron timer the relay plugs in and can be removed easily for checking or replacement.) While you have the relay out, you might as well check contact resistance too.

If the initiation switch also checks out with the ohmmeter, 1V's cathode and plate circuits are OK. Now there can be only one reason left for 1V not firing—negative grid bias. With a plate voltage of 115 rms, a 2050 will not fire if the grid is negative about 2 volts or more.

The first grid of 1V is tied to 6V's plate, and when 6V conducts a voltage is developed across 4P and 6C with the correct polarity to block 1V. Check the grid voltage on 1V and we find almost 150 volts negative bias.

According to the description on the print, when the timer is at rest, 5V should fire to charge 5C negative to the grid of 6V, keeping 6V blocked. We've already substituted 5V, so there must be some other reason for 5V not firing. But wait—did you notice that faint blue glow inside the tube? 5V is firing. (Thyratrons are nice to troubleshoot. When conducting, they glow.)

Think it out

Sit back and think a minute. If 5V is firing, it must be developing a voltage across potentiometer 3P, negative to 6V's grid. Metering 6V's grid–cathode circuit shows 100 volts negative at the grid, yet 6V keeps firing. As a TV technician, used to dc plate supply and vacuum tubes, it's easy to overlook an important point here. Because the only way to make a thyratron stop conducting is to cut off its plate supply, thyratrons are generally used on ac.

Because 5V and 6V are connected with their plates on opposite supply lines, they cannot conduct at the same time. 5V conducts only when L2 is positive, and 6V conducts only when L1 goes positive. If capacitor 5C were open, there would be a voltage across 3P only when L2 is positive, and 6V can't conduct then anyway. When L1 goes positive, the bias is gone, and 6V fires to charge 6C and blocks 1V.

A TV service scope connected to V6's grid–cathode circuit will show half-wave pulses at line frequency if 5C is open (Fig. 4), dc with a slight sawtooth ripple if 5C is OK (Fig. 5). (Remove 6V for this check or its firing will cause other, stray signals to appear on its grid.)

This time 5C was bad. Since it is a timing capacitor, it is important to replace it only with a unit that has the same value, tolerance, etc. to maintain the calibration of the HOLD pot.

Now, clean up, check the operation of the control, present the bill and you're finished with your first job as an industrial electronic technician.

On the way back to the shop you get to thinking. That plant had a lot of electronic equipment and no one to repair it. How many other small shops are there in your town with the same problem? You may have just made the most important service call in your whole career. END

Using Surplus 24–28-Volt Relays

By GEORGE P. OBERTO, K4GRY

SINCE the end of the Second World War there have been plenty of 24–28 volt dc relays on the surplus market. These could be useful in various control devices, but their odd voltage has often seemed an obstacle to their use. Many people have built expensive 24-volt supplies so they can use these relays.

Most people think of these relays in terms of voltage and not current. Surprising as it may seem, quite a few of them operate on relatively low current. This type has a dc resistance of 200 to 400 ohms, and the higher the coil resistance the less current it will draw.

The applications in Figs. 1 and 2 will work well in most circuits having between 250 and 400 volts dc and drawing 50 ma or more.

The output of the power supply is connected to one terminal of the relay coil. The other terminal of the coil is connected to the load, which can be a receiver, amplifier, transmitter or any circuit which draws enough current to meet the 50-ma or more current requirement of the relay.

When the equipment is turned on, the relay energizes as soon as the tube filaments warm up. In much equipment the power transformer center tap or B-plus is broken, which would de-energize the relay. One switch in the power supply of a piece of equipment can control additional equipment with these relays. A switch can be wired across the relay coil to de-energize it, if you do not want to shut-off power.

The 350-ohm 10-watt adjustable resistor (R) connected across the relay coil in Fig. 1 is used when the equipment would draw too much current through the coil. The resistor is adjusted to give a voltage drop of 24–28 volts across the relay. Measure with a dc voltmeter. Connect the positive test prod of the meter to the B-plus side and the negative prod to the load side of the coil.

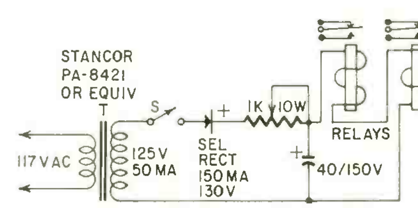


Fig. 3—Independent relay power supply.

If the relay chatters, connect a 10- to 40-μf capacitor across the coil, as shown in Fig. 2. Since the voltage drop is small, the rating of this capacitor need be no more than 50 volts.

The Fig. 3 circuit is most useful for applications where an independent relay power supply is desired. Several relays may be connected in series to give complete control of all circuits. The relays are energized by pressing the spst switch.

If more relays are needed in the circuit of Fig. 3, the power supply can be increased to handle the load.

With a little thinking, additional ways can be found to use these relays, saving yourself the cost of new ones. I have used this method for several years in a AM and SSB amateur station with excellent results. END

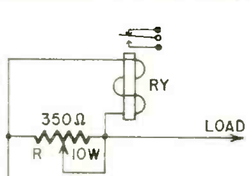


Fig. 1—Adjustable resistor gives correct voltage across coil.

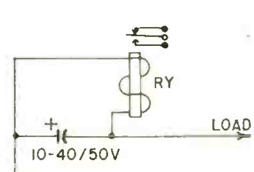


Fig. 2 — Capacitor eliminates relay chattering.

more STATIC CONTROL in INDUSTRY

New control systems are built around logic units made up of magnetic amplifiers. The reason: logic units are complex programmed switches and the magnetic amplifier makes an excellent switch

By TOM JASKI

LAST month we discussed magnetic amplifiers and the Ramey units based on that principle. Next we explained how these units are made up into a control system, marketed by Westinghouse under the name CYPAK. The Ramey units are self-saturating. They control because of conduction due to saturation in the on state and nonconduction when saturation is blocked in the off state. In other words, the impedance of an ac winding is varied by partially or completely saturating the core with a small amount of dc "bias" current put through another winding on the same core. Thus, a large amount of power in the ac winding can be controlled with small direct-current changes.

Of course we can use conventional magnetic amplifiers to build logic units. To do so we take advantage of the magnetic amplifier's switching characteristics. General Electric makes two industrial control systems based on magnetic amplifiers. One uses conventional and the other special pulsed units. Both systems are important to industry, and are discussed here.

G-E ICD system

Fig. 1 is the circuit of a conventional amplifier used to build logic units. We have two cores, each with a load winding of N turns, and a set of bias, and combined feedback and signal windings common to both cores. The supply is center-tapped, giving us full-wave output. Obviously, the on winding turns the unit on and the off winding turns it off. But the bias winding is also center-tapped, allowing us to apply zero, one unit or two units of bias as we choose or need. (For simplification, we will assume that one unit of bias is 1 ma.) The bias opposes the effects of the signal windings. The feedback will tend to aid the on winding.

It is fairly obvious how logic units can be built from these amplifiers. If we have 2 ma of bias and require an on signal at both terminals 1 and 2 (1 ma and 1 ma), we obviously have a two-input AND unit. (There must be a signal at both inputs to cancel the bias.) If we tie the two input terminals together (either the two on or the two off terminals), and supply only 1 ma of bias, we simply have a switching unit. If we set the bias at 1 amp and supply separate signals for either 1 or 2 (1 ma or 1 ma), we have an OR unit (either input cancels the bias). With zero bias the feedback winding keeps the unit saturated even when the input signal is removed. This becomes a memory unit, which remains on or off, according to the latest pulse signal. We can similarly manipulate the bias and the off windings to produce a NOT and an OR–NOT circuit. The OR–NOT unit is turned off by either of two NOT pulses. The name OR–NOT is most often contracted to NOR, and this is what we shall use.

Last month we also discussed how these logic units are used to make a control system. With this type of conventional magnetic amplifier, we can also use a relay as the final element.

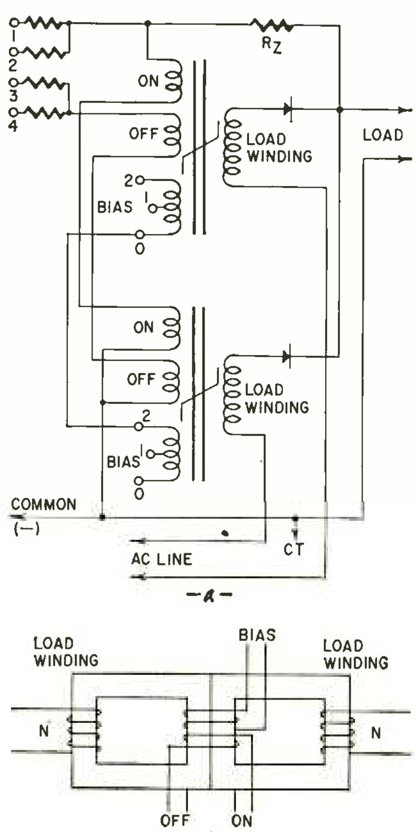


Fig. 1-a—Circuit of switching unit made from conventional magnetic amplifier; b—core and winding arrangement.

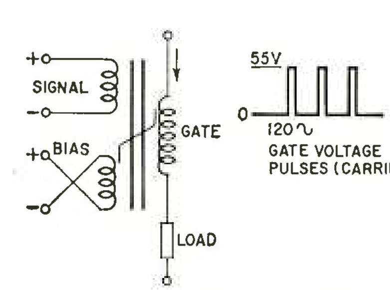


Fig. 2—Basic unit for pulsed magnetic amplifier system.

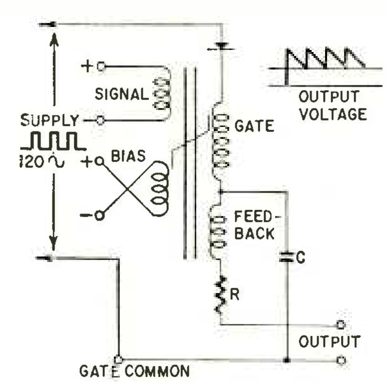


Fig. 3—Unit with series feedback winding is basis of pulsed logic units.

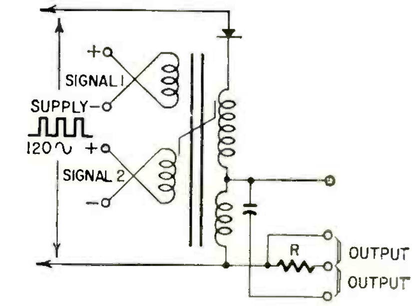


Fig. 4—*NOT* unit uses no bias. Extra terminals (on all units) allows use without feedback winding.

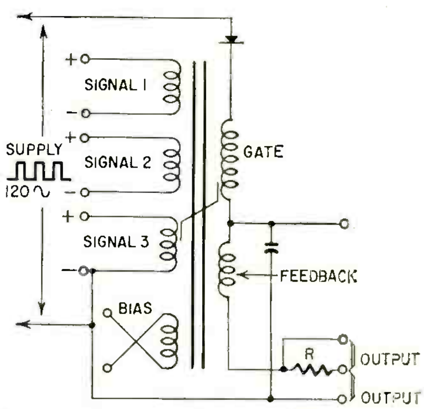


Fig. 5—Circuit of 3-input *OR* unit from pulsed magnetic amplifier.

But we can make magnetic amplifiers in such a variety that it may well be possible to handle the controlling function with a magnetic amplifier without any relay.

G-E GPCP controls

The other G-E system uses magnetic amplifiers in a different way. The basic circuit is in Fig. 2. The unit has three windings, a gate winding (which we have been calling the load winding), a bias winding and a signal winding. The bias winding is shown in reverse, indicating that it opposes the action of the signal winding.

If we apply a pulse (carrier pulse) to the gate winding with the core not saturated and a constant bias on the bias winding and no signal applied, the gate pulse starts to drive the core into positive saturation. But it does not succeed very well and the effect at the output is negligible, because of the bias. However, with a signal (input pulse) applied, the pulse goes toward positive saturation, and load current flows. The signal nullifies the bias current. Remember that we are dealing with a rectangular magnetization curve, which means that, after a certain level of current is reached, the core magnetizes very rapidly. If we add a feedback winding to this unit (Fig. 3), a rectifier and a capacitor, we have a true switching unit. As the pulses arrive, the capacitor charges. Between pulses the rectifier keeps the capacitor from discharging through anything but the feedback winding, which keeps the core saturated between pulses. We can

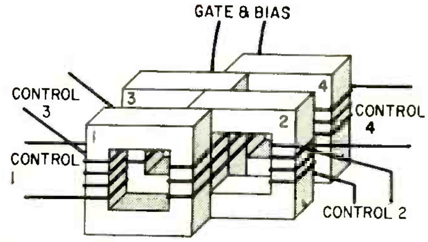


Fig. 6—Physical arrangement of *AND* units. Stacking the cores is required.

make the feedback great enough to keep the core magnetized with no signal at the input.

To turn the unit off we need a strong negative signal. We are interested only in the effect of a negative signal, not necessarily in the polarity. Essentially, then, this idea gives us the basis of a NOT unit (Fig. 4). If we have the gating and feedback windings and two signal windings (one large enough to block the effects of the other), we can prevent an output by applying a signal to the larger winding. Notice that this is the same as the original switching unit with the reversed winding, but now we apply a NOT signal instead of a constant bias.

If we have several signal windings, any one of which can turn on the unit, we have an OR unit (Fig. 5). The core is not saturated until at least one input is present. Then the bias is cancelled and the gate winding delivers an output.

The idea of providing enough feedback to keep the unit saturated without input signal is the basis of the MEMORY unit, which must have a bias winding, an overgrown feedback winding, an on winding and a reversed off winding.

To build an AND unit, a stack of several cores is used, with a common gate winding and bias winding and separate signal windings. The general arrangement is shown in Figs. 6 and 7. Any one core can block the gating current, and an input to all the core signal windings is required for an output.

The system is powered by pulses derived from a 60-cycle power supply by saturable reactors and rectifiers. We'll not go into detail on how this is done since it takes a lot of space. But there is one noteworthy feature about this G-E system: The bias windings in any one system or section of a system are all connected in series, and we get fail-safe operation by including a relay to turn off all supply power. The reasoning is that, if bias fails, a unit would turn on. This might have disastrous results if it does so out of sequence. Rather than have such failure, they would turn off the entire system.

The G-E systems are also packaged in plug-in units, like their competitor, the CYPAK. Ready-made buses allow simple plug-in construction for control systems. Such units feature an obvious economy in service and troubleshooting.

Before leaving magnetic amplifiers to go on to other static switching systems, let's take a brief look at other func-

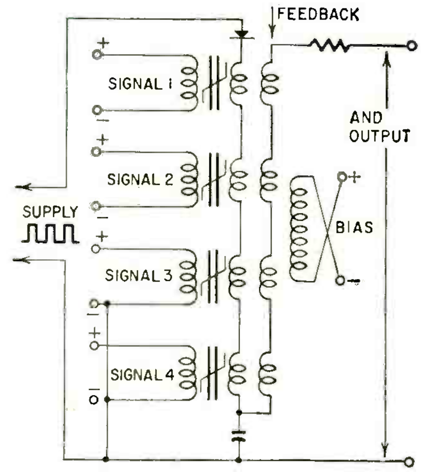


Fig. 7—Circuit of pulsed magnetic amplifier *AND* unit.

tions that by magnetic amplifiers can handle.

Other switching units

Knowing the switching characteristics of the magnetic amplifier, we might ask ourselves if they can be used to build flip-flops, one of the more common types of switching circuits. They can. Fig. 8 shows a magnetic amplifier flip-flop. We have two cores with appropriate gate (or load), signal and feedback windings. The latter also serve as bias windings. The rectifiers provide the dc voltages used to saturate cores, and the power winding also generates some dc voltage in the rectifiers.

When we consider conventional flip-flops, we are accustomed to thinking of the tubes in terms of *conducting* and *cutoff*. In magnetic amplifiers, the saturated state corresponds to the conducting state and the nonsaturated to the cutoff state. However, a saturated magnetic amplifier (unlike the cathode circuit in a tube flip-flop) does not generate a bias, since no voltage is induced in the winding, while in the cutoff state a very large voltage is induced in the bias winding.

Now look at Fig. 8. The bias windings are in series with each other. Assume that core 1 is saturated and this circuit conducting. Since no voltage is generated in bias winding 1, but a large voltage in the bias winding on core 2, which aids the voltage generated by the power winding, core 1 has a relatively large dc in its bias (feedback) winding, keeping the core saturated. If we apply a signal to the signal winding, this core momentarily desaturates a bit. This causes a voltage to be induced in the bias winding on 1, which, after rectification, produces a dc in the bias winding on core 2, giving it a bit of magnetization toward saturation. This in turn reduces the dc feedback fed to the bias winding on core 1, and so on. So we get the typical runaway or regeneration process as we know it from other kinds of flip-flops. Thus, with a strong enough signal in the signal winding, the units will change

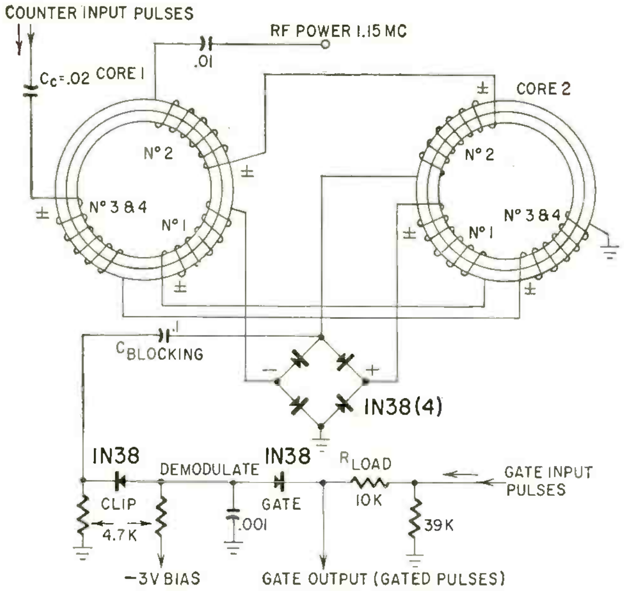


Fig. 8—Magnetic amplifier flip-flop. Demodulation and filtering are required to get clean square wave output.

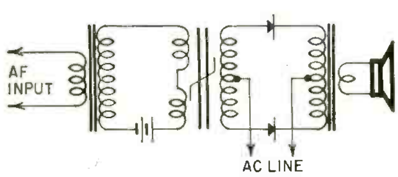


Fig. 9—Magnetic audio amplifier is theoretically possible, but not very practical.

state. The next pulse gives core 1 a bit of magnetization, reducing the dc bias it is feeding to core 2's bias winding and also reducing the current keeping core 2 saturated. The units again change state in typical flip-flop fashion.

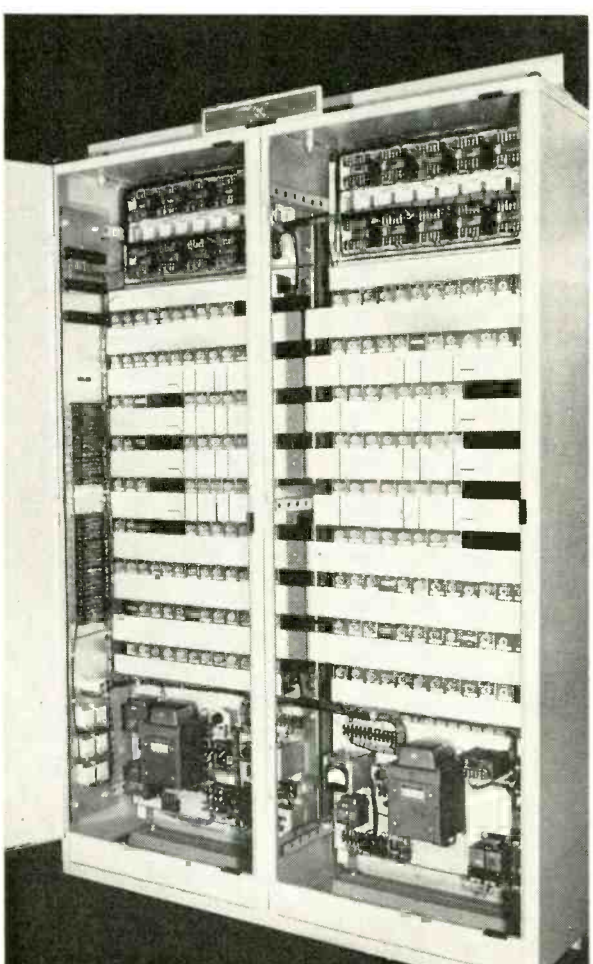
To build this kind of a flip-flop, we use a special core material, since the flip-flop must be much faster than we can make it with ordinary core steel, or even with the special high-permeability steels used in the magnetic amplifiers described. So we use a ferrite, something which looks like the material in the loopstick, but has radical magnetic characteristics which have an even squarer magnetization curve than those we have been showing. Ferrites also have three states, saturated in either direction and not saturated.

For the flip-flop in Fig. 8, we need not consider the negatively saturated state. If we operate the units with positive-going pulses only, there is no way in which the cores could reach negative saturation.

Magnetic-amplifier applications

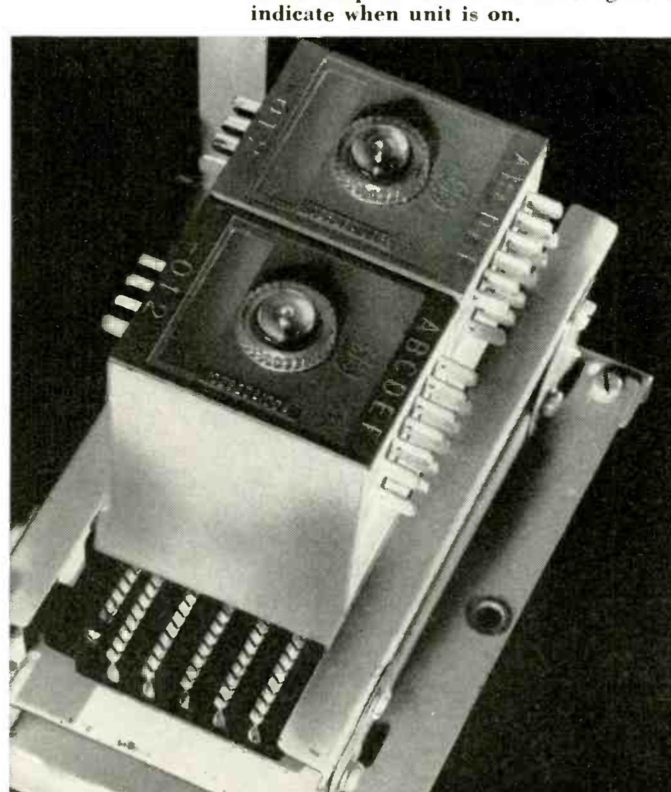
We have been talking mostly in terms of digital types of control systems, and thus have been busy with switching characteristics of magnetic amplifiers and similar devices. But these are not the only functions that can be labeled static control. We can make many kinds of analog or continuously variable controls with magnetic amplifiers. And if this is possible, we should even be able to build radios and audio amplifiers with them. This has in fact been done, and in several ways.

We can balance magnetic amplifiers so well that we can actually balance out the carrier and end up with only the modulation. This kind of amplifier is shown in Fig. 9. The rectifiers as well as the magnetic amplifier windings must balance perfectly. This is very difficult to achieve, particularly to a point where the average hi-fi fan is satisfied with the hum elimination. Another solution



Control system built from G-E Megamp logic units. Power supply is on the bottom.

Encapsulated units are G-E multi-purpose conventional Megamp logic units. Pilot lamp in center of unit lights to indicate when unit is on.



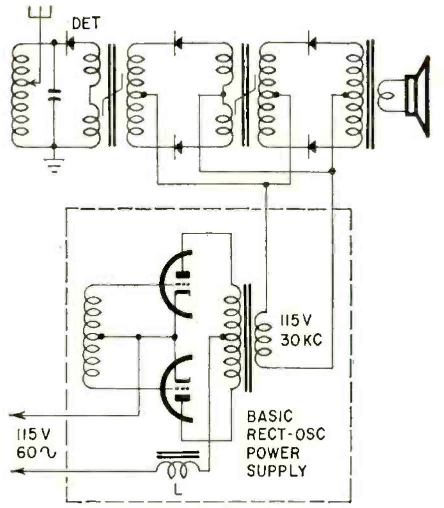


Fig. 10—Basic magnetic amplifier radio.

is to make the carrier such a high frequency that we cannot hear it. But remember, even if the speaker cone does not respond to the signal, it still dissipates energy in the speaker, reducing its efficiency to audio signals. The amplifier of Fig. 9 is theoretically possible, but practically not a very good instrument. However they have been made and they have terrific gains, but we can still do the same thing more economically in other ways. The radio receiver shown in Fig. 10 is also possible, but not particularly practical.

Much more practical and applied daily in industry are motor control systems using magnetic amplifiers. A typical arrangement is shown in Fig. 11. The diagram is self-explanatory. Fig. 12 shows a comparison between a thyratron-controlled directional motor drive and its magnetic equivalent. The polarity of the input signal determines

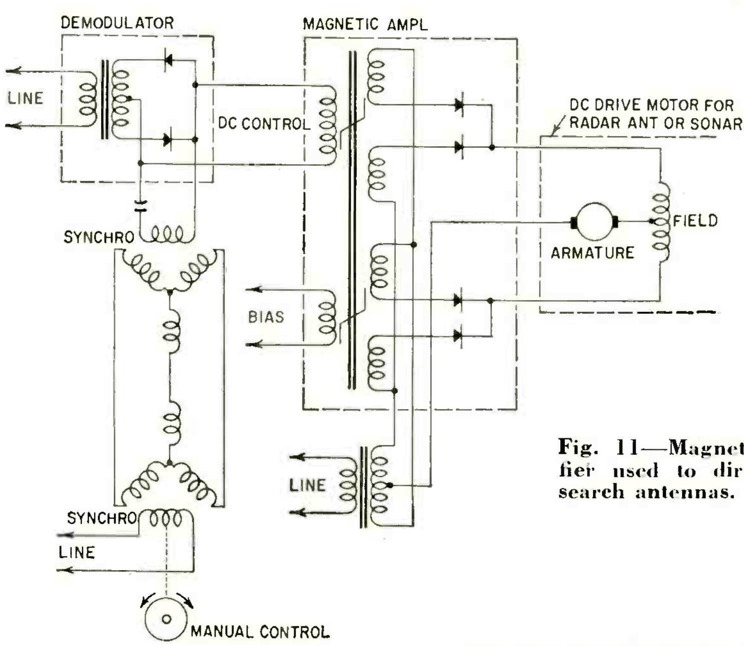


Fig. 11—Magnetic amplifier used to direct radar search antennas.

the direction the motor turns. In both cases, the control polarity determines which INPUT magnetic amplifier (or saturable reactor) reaches saturation first. This lets the thyratrons fire or the output magnetic amplifier "half" to feed current to the motor. The phase relationship between the windings determines the direction the motor rotates.

We have covered some of the more common applications of magnetic amplifiers and a small portion of their possible or even their actual uses. We could not even begin to describe them all. But there are other industrial static controls which also merit consideration. They include vacuum tubes, transistors, Unijunction transistors, controlled rectifiers, and special devices which handle either analog control or digital control.

These devices can be and have been combined into control systems fully as sophisticated, and perhaps as reliable as the magnetic devices, and in our next discussion we will view such static control devices and their many applications. END

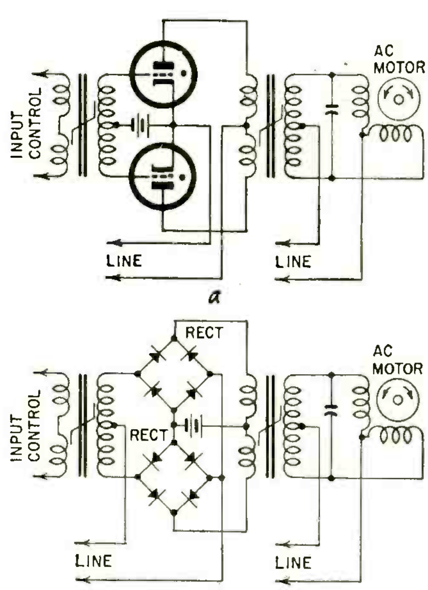


Fig. 12-a—Thyratron control of split-phase ac motor; b—magnetic amplifier equivalent.

INDUSTRIAL SAFETY INTERLOCK

By RONALD L. IVES

A COMMON trouble with pushbutton-controlled devices is that every so often someone will push both buttons at the same time. This can lead to anything from an overheated motor to a system burnout and, since human behavior is hard to change, protective circuits are desirable. This is easily done in many instances by using single-pole double-throw pushbuttons and a few minor circuit changes.

Fig. 1 shows such a modification as applied to a capacitor type motor. In this circuit, when S1 is depressed to produce counterclockwise rotation, current flows from the line through S2's normally closed (NC) contact through the switch-arm interconnection and finally through S1 to the motor. Pressing S2 for clockwise rotation does the same thing, but through the opposite switch and motor winding. If both buttons are pressed simultaneously, the line is disconnected and nothing happens.

A similar safety circuit can be used with a permanent-magnet dc motor as in Fig. 2. Here, when neither button is pressed, both sides of the motor are connected to the same side of the line and nothing happens. When S1 is pressed to give counterclockwise rotation, the one brush is connected to the negative side of the line while the other remains connected to the positive side. If S2 is pressed for clockwise rotation, the upper brush remains connected to the positive side of the line while the lower brush is connected to the negative line.

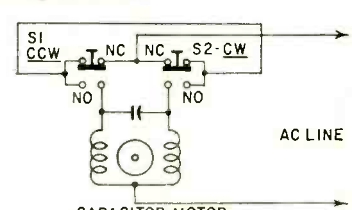


Fig. 1—Protective circuit for capacitor motors.

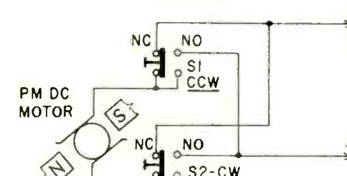
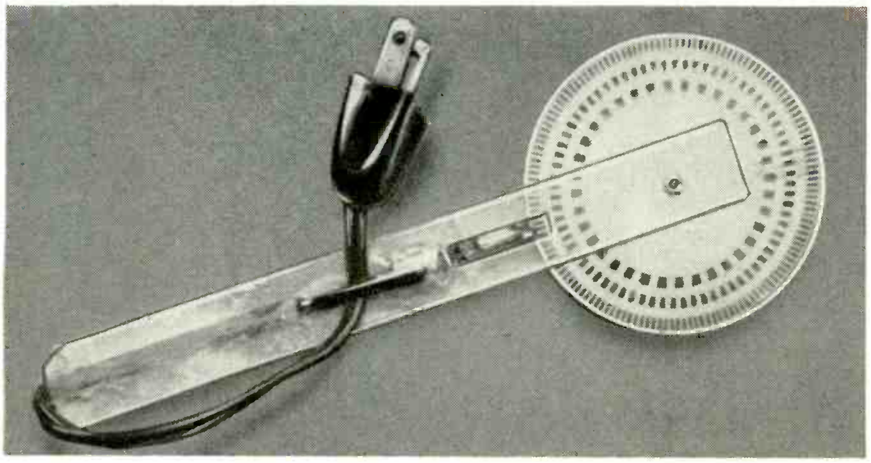


Fig. 2—Permanent magnet dc motors can be protected by using this control circuit.

By some rather obvious modifications following the same lines, this general principle can be applied to a variety of dual-control situations to prevent conflicts of circuits or functions. END



a STROBE for TAPE

Home-made unit checks your tape recorder's speed—a must when playing prerecorded tapes

By W. E. McCORMICK

HERE is a pocket-size strobe that measures accurately tape speeds of 3¾, 7½ and 15 inches per second.

Since it contains a built-in diode rectifier that flashes a ¼-watt high-brilliancy neon lamp 60 times a second, it requires no external light source. This feature permits on-the-spot checks wherever 117-volt 60-cycle current is available. Though small enough to be carried in a shirt pocket, the strobe will reach to the hub of a 7-inch reel.

To make the strobe, first cut the polystyrene handle pieces to the dimensions given in Fig. 1.

Cement the two spacers to the bottom with polystyrene cement, leaving a ¼-inch channel between them, as shown in Fig. 2.

Next, attach a male line plug to a 10-inch length of No. 18 lamp cord, and wire up resistor, diode and lamp, as shown in Fig. 3. Cover soldered connections with pieces of spaghetti split lengthwise.

Position the base of the neon lamp even with the ends of the spacers, and press the cord, resistor and diode into

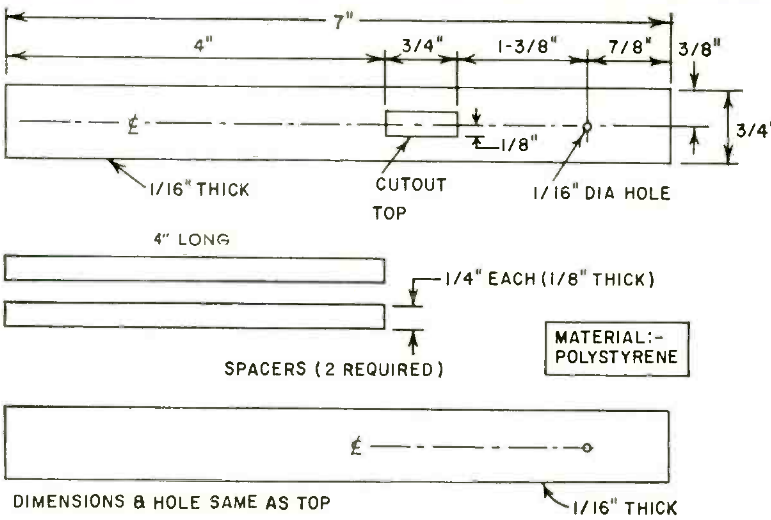


Fig.1 BOTTOM

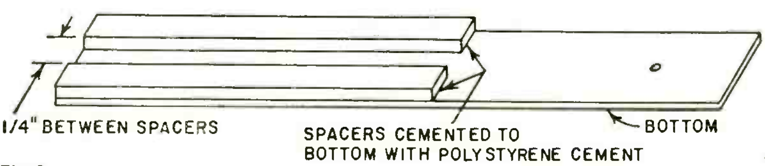


Fig.2 SPACERS & BOTTOM ASSEMBLY

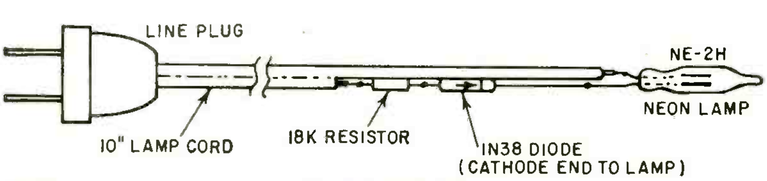


Fig.3 WIRING ASSEMBLY

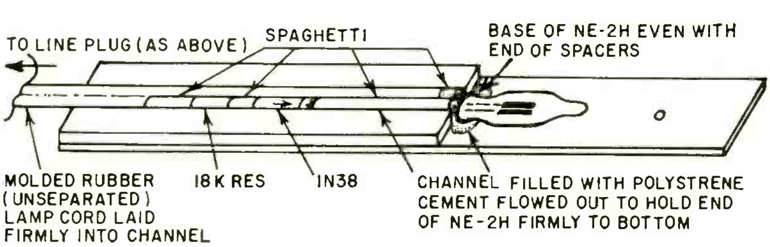


Fig.4 BOTTOM, SPACERS & WIRING ASSEMBLED

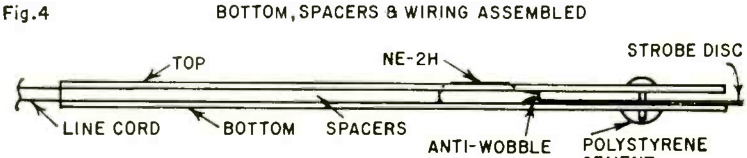
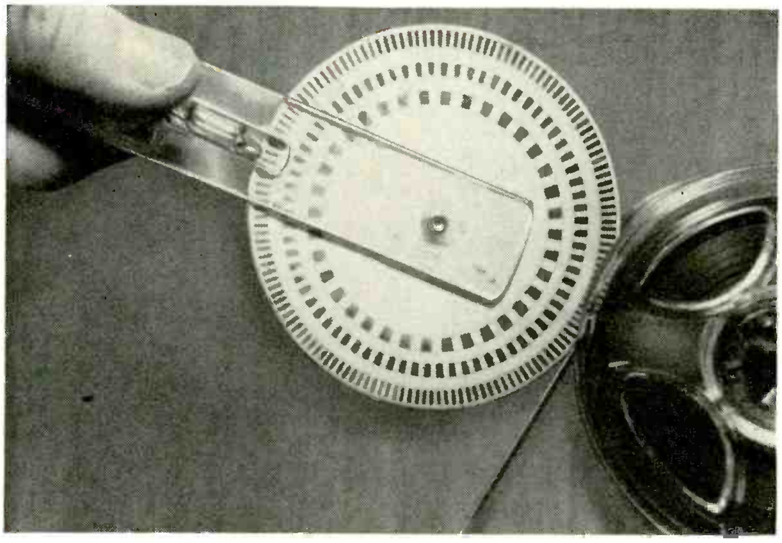


Fig.5 COMPLETED ASSEMBLY (SIDE VIEW)

Bottle polystyrene cement (3 oz.)
4 x 8 x 1/16-inch sheet polystyrene (1)
4 x 8 x 1/8-inch sheet polystyrene (1)
Length No. 18 lamp cord (10 inches)
Male line plug (1)
1/8-inch diameter spaghetti (4 inches)
1N38 diode (1)
NE-2H 1/4-watt neon lamp (1)
18,000-ohm 1/2-watt resistor (1)
Pencil clip (1)
Rivet, 1/8-inch diameter, 1/8 inch long (1)
Rivet, 3/16-inch diameter, 1/4 inch long (1)
4 x 4-inch pasteboard (1)
Rubberband (1)
Wood glue

Fig. 1—Dimensional drawing of the polystyrene parts of the tape strobe. Fig. 2—How the polystyrene parts are put together. Fig. 3—Wiring the strobe unit. Fig. 4—Close-up of the handle assembly. Fig. 5—This is how the strobe disc is mounted.



The tape strobe in action.

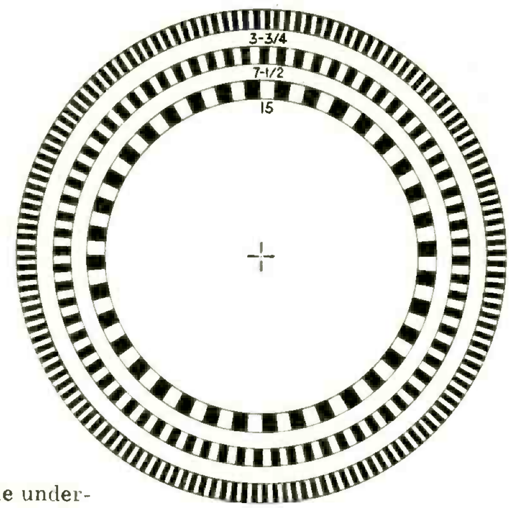


Fig. 6—Cut out and use this strobe dial in your unit.

the channel between the spacers. Then fill the channel with polystyrene cement.

Hold the neon lamp and the bottom handle piece together with a rubber band, and apply a generous drop of cement between them at the base of the lamp (Fig. 4). Put this assembly aside to dry.

Cut out the strobe dial and glue it to a 3-inch diameter pasteboard disc. Press flat until dry.

Put a ⅛-inch diameter by ⅛ inch long tubular rivet through the center of the strobe disc. The cross on the strobe dial locates its center accurately. Split the rivet and peen it over, distorting its hole as little as possible. The assembled disc should spin freely on a 1/16-inch drill shank.

Sand the edge of the disc assembly evenly all around until it is exactly 9 inches in circumference. This dimension is important. It can be checked by pencilling a starting mark on the underside of the disc and rolling it over the face of a ruler.

Cement the top handle piece in place, aligning the upper and lower rivet holes with a 1/16-inch drill shank.

Slip the strobe disc into the handle. Its inside edge will be under the bead of the neon lamp, which acts as an anti-wobble (Fig. 5).

Fasten the strobe disc in the handle with a 1/16-inch diameter by ¼ inch long rivet. At this point, a word of caution is in order. Polystyrene is a temperamental material. It is better to cement the end of the rivet to the bottom handle piece than risk cracking it trying to spread it with a hammer.

Next, a pencil clip, with its wrap-around flattened out and trimmed, is cemented to the handle.

Round off the handle corners to suit, and the strobe is finished.

To check tape speed, plug the strobe into any handy extension, and turn the recorder on. Press the strobe disc gently against the tape on the recorder's supply reel. Either near the neon lamp or beyond the end of the handle where the polystyrene "pipes" the light, observe the circle of radial lines on the strobe disc corresponding to the speed at which the recorder is set.

If the tape is traveling too slowly, the lines will appear to slip backward. If it is traveling too fast, they will creep forward. Let's hope the lines remain stationary, for when they do, the tape is moving along at exactly the right speed. END

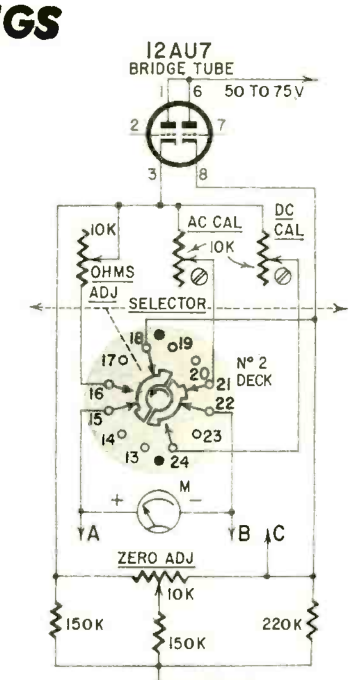
EQUALIZE VTVM READINGS

VTVM users have often noted that the DC+ meter indication is normally slightly higher than (or conceivably, slightly lower than) the DC− indication. This difference is explained as the result of the bridge tube operating on different sections of its characteristic curve, and some have said that nothing can be done about it except to try to find a bridge tube with a more linear characteristic curve.

However, a far easier and more certain method is to connect a high-ohmage resistor across the meter on the high side, to reduce the meter sensitivity on this side. The sensitivity reduction is slight and is of no moment anyway, since the difficulty here is that the meter is relatively too sensitive on the high side. The procedure below is outlined for the Heathkit 7-A, but can easily be adapted to other vtvm's having a similar switching arrangement.

If the meter indication is higher on the DC+ side, calibrate on the DC− side. Then temporarily connect a 100,000- or 250,000-ohm carbon potentiometer across positions 15 and 18 of selector-switch deck 2. (Position 15 is most readily reached at the meter "+" connection (A), while position 18 is most easily reached at the ZERO-ADJUST control (C)). Now rotate the temporarily connected pot until the meter indication is the same on the DC+ as on the DC− side. Disconnect the pot, without changing its setting, and with the ohmmeter note the resistance used. (My V7-A required approximately 80,000 ohms.) Then select a ½-watt 10% carbon resistor which gives the same, or nearly the same, ohmmeter indication. A series or parallel pair of resistors may give a closer match. Finally, insert this resistor or pair permanently across positions 15(A) and 18(C) as above.

Alternatively, if the meter indication is higher on the DC− side, calibrate on the DC+ side. Then proceed as above, except that switch positions 18(C) and 22(B) will now be used.—*Joseph H. Sutton*



HAND-SIZED GRID DIP METER

By I. QUEEN
EDITORIAL ASSOCIATE

Portable unit covers a wide range of frequencies and includes a crystal oscillator for self calibration

A GRID-DIP meter is indispensable for measuring tank resonance. It is helpful when winding coils and for tuning up circuits. The device may be transistorized (see RADIO-ELECTRONICS, May, 1956, page 34) but the tube version is better. A tube does not load its tank coil, so it permits higher sensitivity and wider tuning range with a given tuning capacitor. A tube is more stable with respect to ambient temperature and operating voltages. Finally, a tube is less expensive than an rf transistor.

Unfortunately, portability is often impractical because of the physical size of a tube and its need for heater power. This grid-dip instrument overcomes these disadvantages. Its range is 3.4 to 31 mc at full efficiency, and 30–55 mc at reduced efficiency. Coils for lower frequencies may be wound if desired.

The tube is a 1AH4 flat subminiature made by Raytheon. (Other manufacturers make it as a round subminiature.)

The B-battery is a Burgess Y20 which measures 1¼ x 1⅛ x 9/16 inches and should last more than 100 hours. The A-supply is much smaller. It is a nickel–cadmium cell (Eveready N32T) that should last about 5 hours in this circuit, and may be recharged again and again. In the life of a dip meter, 5 hours usually means many weeks, perhaps months. I keep a spare N32T fully charged for immediate replacement when the cell becomes exhausted.

Circuit details

One of the unit's features is high–low switch S1 (Fig. 1) which shorts out part of the coil winding. Therefore, two bands are available with a single coil. Without changing coils, frequency coverage is 3.4 to 15 mc! This is a wider stretch than was covered by the transistor dip meter (previously mentioned) with its two coils. Yet bandspread is excellent, each dial range being a frequency ratio of only 2 to 1.

Like other dip meters, this one acts as a variable-frequency signal generator when needed. But there is an extra feature. When a crystal is plugged in, and the tank tuned appropriately, the signal is crystal-controlled! This can be done on a crystal fundamental and its odd overtones! Simply tune the tank for approximately an odd harmonic and watch the meter dip.

Low-frequency crystals work best on overtones. My 3.7-mc rock generates third, fifth and even seventh overtones, the latter becoming tricky to tune.

Obviously, the crystal feature comes in handy when you calibrate the instrument. You can locate easily and exactly any frequency (and its overtones) for any handy crystal.

An earpiece jack lets you monitor external signals. For example, you can tune your ham rig by zero-beating it against the dip meter.

My 1AH4 is so small that it fits between the variable capacitor and the B-battery (see photo). The tube is wedged in upside down and its socket is plugged onto the tube. My tube has an external metal shield coating which I scraped off to keep it from shorting against the capacitor plates. You can use a sheet of plastic or some other insulator instead.

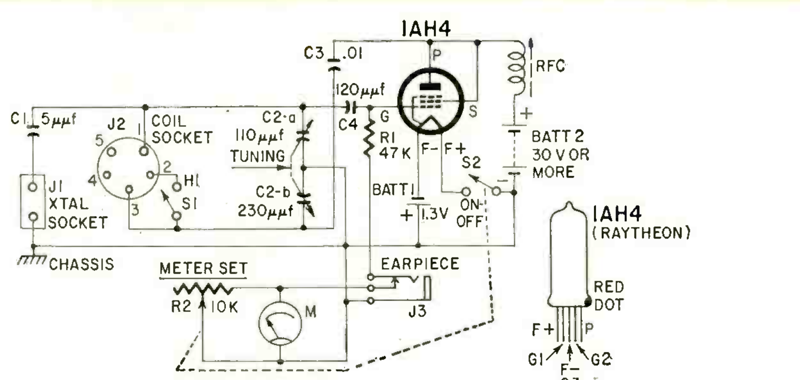
For want of a more complicated arrangement, a rubber band holds the A-cell grounded against the variable capacitor. Its positive terminal is grounded. A lead is soldered to the tab of the negative terminal to make circuit connection. Use a minimum of soldering heat.

The tuning capacitor is a two-gang superhet type with an 11-plate oscillator section and a 19-plate antenna section. It measures about 1½ inches on each of its three dimensions. Maximum capacitances are approximately 230 μμf (antenna) and 110 μμf (oscillator). There is no reason why other capacitors with nearly the same capacitance should not work. I tried a very tiny unit (Lafayette MS-261) and found it worked well, but with slightly reduced bandwidth.

For the rf choke I use the larger winding of a broadcast type oscillator coil (Lafayette MS-265, terminals 2 and 5.)

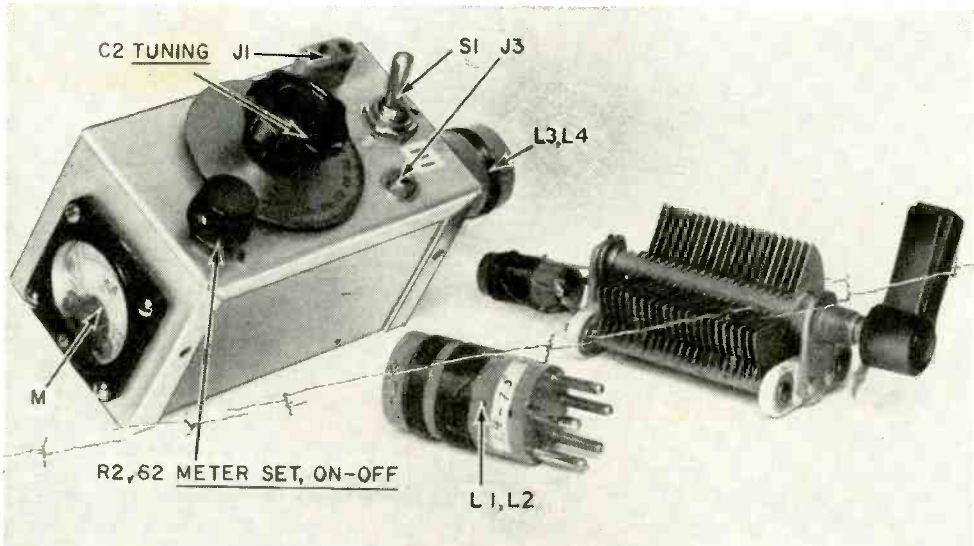
Coil data

Winding the tank coils is the hard part, but the following specifications will save you time and work: Coils are wound on Millen No. 45005 or other 1-inch forms with five prongs. Only

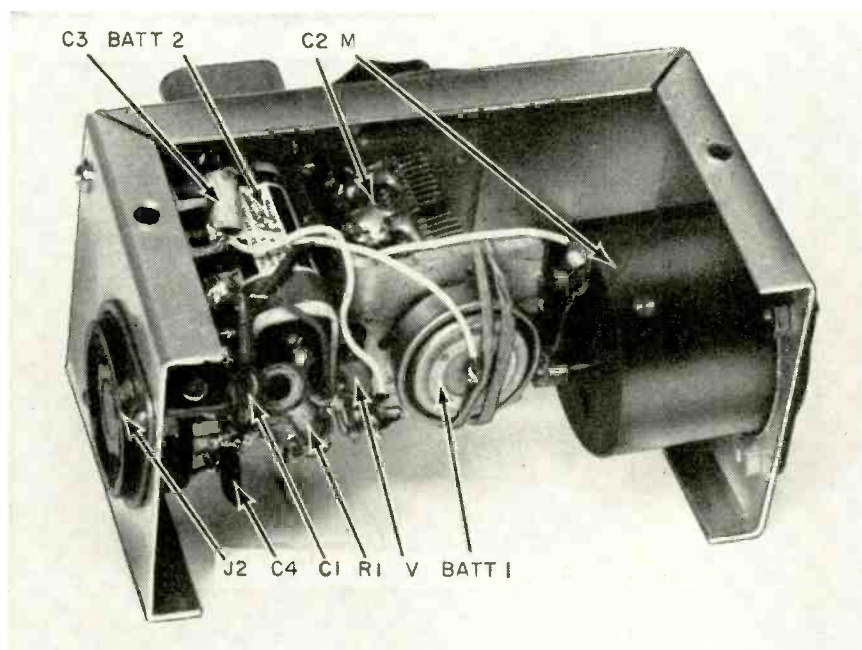


R1—47,000 ohms, ½ watt
R2—pot, 10,000 ohms, linear taper, with spst switch S2
C1—5-μμf disc ceramic
C2—tuning capacitor: antenna section, 230 μμf; oscillator section, 110 μμf
C3—.01 μf, disc ceramic
C4—120-μμf disc ceramic
All capacitors 50-volts or higher
BATT1—1.3 volts, nickel-cadmium cell (Eveready N32T or equivalent)
BATT2—30 volts (Burgess Y20 or equivalent)
J1—crystal socket
J2—coil socket
J3—phone jack, closed-circuit
L1, 2, 3, 4—see Fig. 2 and text
M—50 μa (Lafayette TM-200 or equivalent)
RFC—see text
S1—spst toggle
S2—spst on R2
V—1AH4
Case, 4 x 2¼ x 2¼ inches
Socket for tube
Miscellaneous hardware

Fig. 1—Circuit of the 1-tube unit.



The completed grid-dip meter. Coil-capacitor assembly is used to test the unit.



Inside the meter's case. The subminiature tube is sandwiched between the tuning capacitor and B-BATT.

three prongs are actually used; the others serve as tie terminals.

All coils are close-wound following the specifications in Fig. 2, and all are wound in the same direction. The actual direction does not matter, of course. A ⅛-inch space is left between coils L1 and L2. Note the smaller diameter of L3. It is wound to be self-supporting and is placed inside the coil form.

You may have to vary the number of turns in your particular instrument, but Fig. 2 will serve as guide. Note how S1 shorts out one winding when it is closed, to tune to the upper half of the frequency range. When S1 is open, both windings are effective.

Following are the frequency bands covered by the dip meter:

LF COIL

S1 open	3.4– 7.5 mc
S1 closed	6.9–15.5 mc

HF COIL

S1 open	13.7–31.0 mc
S1 closed	28.0–55.0 mc

Note that the coils are designed to overlap. Furthermore, I have favored the ham bands by resonating them at the high-capacitance end of each range. Bandspread is much better at this end. Here are typical dial calibrations:

LF coil, S1 open

DIAL	FREQ. (mc)
16	3.5
42	4.0
68	5.0
91	7.0

HF coil, S1 open

DIAL	FREQ. (mc)
9	14.0
15	14.4
97	31.0

LF coil, S1 closed

DIAL	FREQ. (mc)
3	7.0
13	7.3
53	9.0
80	12.0
95	15.0

HF coil, S1 closed

DIAL	FREQ. (mc)
57	27.0
67	30.0
92	50.0
97	54.0

To measure an unknown tank, couple its coil to that of the dip meter. Start with a spacing of 1 inch or less and start tuning from the low-frequency side. When you find the dip, separate the coils because a smaller dip is more accurate. To use the instrument as a crystal-controlled signal source, plug in the desired crystal and tune for a dip (again from the low side). Stop as soon as you note the *beginning* of a dip. Tuning for maximum dip may result in instability.

Calibrate the dial by listening to the dip signal on an all-wave receiver or with the help of several crystals (as mentioned above).

R2 controls the meter setting for any given range. The meter does not have to be set for full scale, of course, but it should be in the upper half for a more distinct dip. Meter readings tend to decrease with increasing frequency range. The lowest band easily gives full-scale readings. On the highest band, the maximum readings will be near mid-scale. END

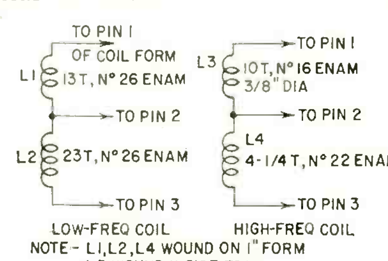


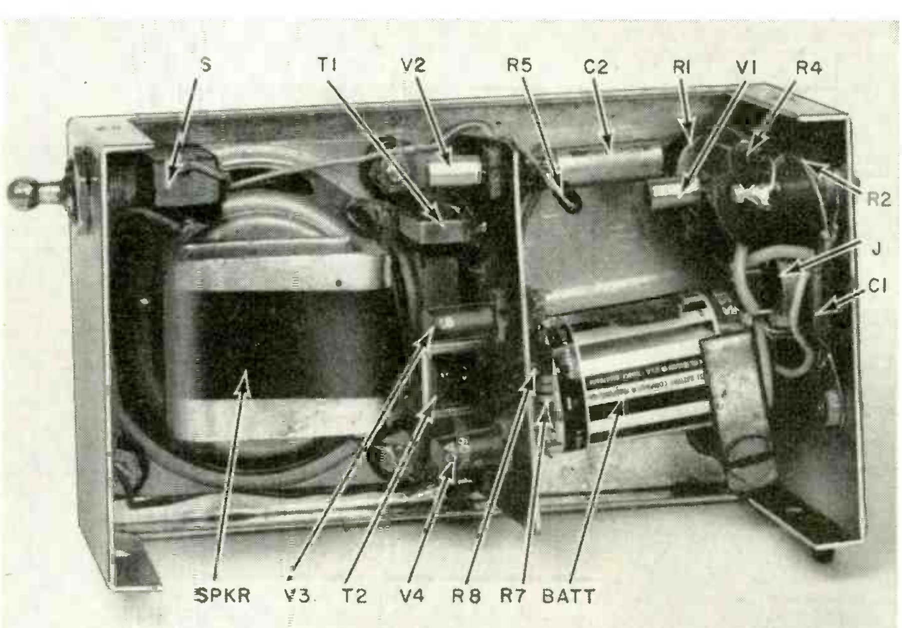
Fig. 2—Coil data for grid-dip coils covering 3.4 to 55 mc in four bands.

The completed unit with the rf probe attached.

mini-tracer speeds radio repairs

By DAVE STONE

Pocket-size unit does everything its shop counterpart can. The difference is the miniature unit travels to the job with the technician



A look inside the tracer's case. The possibilities for miniaturization are obvious.

THE signal tracer is a time-honored instrument universally used for troubleshooting and isolating defective stages in many types of electronic equipment. It is used as a detector–amplifier to check the operation of rf and if amplifiers. It can be used as a straight audio amplifier to check phono cartridges, microphones and preamps and the operation of audio circuits and to detect noise and hum in amplifiers.

This test instrument is so versatile and useful that I built a compact transistor unit to fit into a rear pocket or small toolbox so it could be on hand at all times. Battery requirements are modest and the transistors are almost indestructible. This combination of long life, ruggedness and dependability is hard to beat.

An rf signal is applied to the unit through the probe's dc-blocking capacitor C5 to the diode, for detection. For audio use, C6 serves as a dc-blocking capacitor, and the signal is applied directly to potentiometer R1, which doubles as the diode load and its GAIN control. The detected audio signal is coupled to V1's base.

The push-pull output stage (V3, V4) is driven by a 2N215 voltage-amplifier driver (V2), and produces more than adequate sound output from the miniature speaker. A 100-μv input at V1's base gives an audible response, at a total battery drain of 6 to 8 ma.

Construction kinks

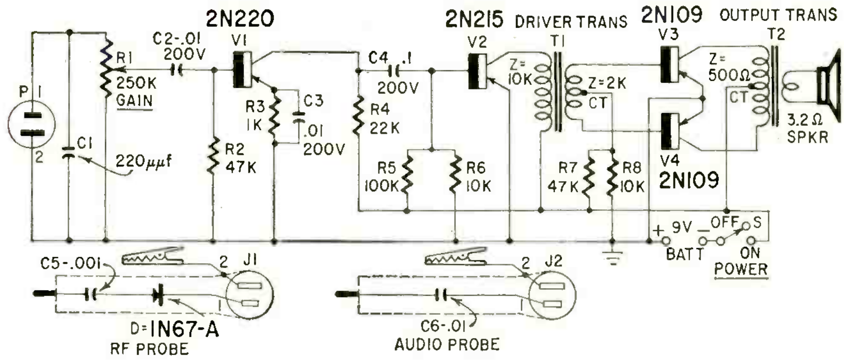
The only critical consideration is the location of the 2N220 input stage and GAIN potentiometer R1. They must be mounted close to plug P1, and as far as possible from the output stage to minimize coupling between input and output.

The rest of the circuit is straightforward. I used two pieces of copper-clad laminate board for a chassis—one to mount the input circuit, the other for the driver and push-pull output. Driver transformer T1 and output transformer T2 are mounted at right angles to each other to minimize coupling.

The input probe connector can be any good quality type that is strong enough to support the probe's weight and stand the pressures of use. I used Cinch series 300 plugs and sockets because they are rugged enough to take rough handling and are easily adapted for probe construction.

The rf probe is fabricated from a standard test probe and connector. If necessary, enlarge the inner diameter of the probe body by drilling carefully. Then slip the capacitor and diode into the probe housing. Solder the probe tip to the capacitor and the diode lead and ground wire to the connector terminals. File a little notch in the connector shell to allow the ground lead to pass through freely, then assemble the shell over the connector and probe body and fasten in place.

The audio probe is made from a banana plug and plug connector. It may



R1—pot, 250,000 ohms
R2, 7—47,000 ohms
R3—1,000 ohms
R4—22,000 ohms
R5—100,000 ohms
R6, 8—10,000 ohms
All resistors ½ watt, 10%
C1—220 μμf, mica
C2, 3—.01 μf, 200 volts, paper
C4—.1 μf, 200 volts, paper
C5—.001 μf, miniature paper (Aerocox P83Z or equivalent)
C6—.01 μf, miniature paper (Aerovox P83Z or equivalent)
BATT—9 volts
D—1N67-A
J1, 2—jacks (Cinch-Jones Series 300, No. S302-CCT)
P—plug (Cinch-Jones Series 300, No. P302-AB)
S—spst toggle
T1—driver transformer: primary, 10,000 ohms; secondary 2,000 ohms ct (Lafayette TR-98 or equivalent)
T2—output transformer: primary, 500 ohms ct; secondary 3.2 ohms (Lafayette TR-99 or equivalent)
V1—2N220
V2—2N215
V3, 4—2N109
Speaker, miniature, 3.2 ohms
Case, 5¼ x 3 x 2⅛ inches (Bud Minibox CU-3006 or equivalent)
Test probes
Miscellaneous hardware

Circuit of the 4-transistor signal tracer.

also be necessary to enlarge the inner diameter of the banana-plug body to admit capacitor C6, which is soldered to the plug tip. The other capacitor lead and the ground lead are attached to the connector terminals and assembled the same as the rf probe.

A 24-inch cord with mating connectors on each end extends the probe's reach into tight corners or deep chassis. The battery is a small 9-volt unit and can be mounted with a mounting clamp in any position where space is available.

Final check

When the unit is completed, carefully check transistor connections and battery polarity. Incorrect polarity may ruin the transistors! Throw POWER switch S to ON and listen for the characteristic rushing noise produced by the first transistor stage. The 2N220's internal noise is amplified by the succeeding stages and indicates that the amplifier is working. If nothing is heard, remove the battery power immediately and recheck the circuit or transistors.

If all seems well, apply an audio signal from a generator or phono cartridge for a check of the amplifier's performance. Then connect the rf probe and test it with an operating broadcast receiver tuned to a strong local station. Connect the probe ground to the receiver ground and place the probe tip at the detector tube's diode pin or the plate of the last if amplifier. The station program should be heard loud and clear if the probe is wired correctly.

Using the tracer

Very little audio input is needed to operate the signal tracer as a straight audio amplifier. Always start with the GAIN control turned down, for it is easy to overload and distort the small speaker's response with too much input. Don't use the tracer for a check of fidelity for it is designed for maximum sensitivity without regard to frequency response.

For rf testing, the probe's ground lead must be connected to the power supply ground of the receiver under test. This may be the chassis or, in ac–dc types, the common ground at the power switch or the filter capacitor negative lead.

Start at the detector diode side of the last if transformer and work your way toward the front of the set. The sequence should be detector diode, last if amplifier plate, then grid, next if amplifier plate, and so on. If there is no output at any of these test points, the stage is defective and the defective components can be isolated.

The probe may load the mixer plate or input if grid in some receivers. If this happens, inject a tone-modulated rf or if signal into the receiver's front end to get an output from the tracer.

This instrument will return the modest investment of parts and construction time a hundredfold by its usefulness and versatility. The old-timer knows the value of a good signal tracer, and the younger technician will be delighted with the help this servicing aid can give. END

BENCH TESTED

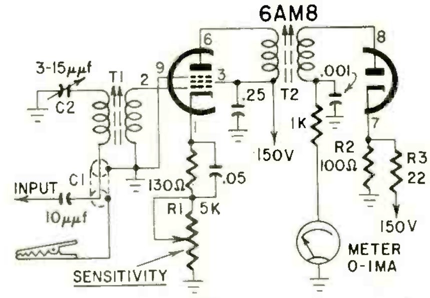
The unit was checked and found to operate satisfactorily. It gets a good signal between antenna and ground although it did not pick up a satisfactory signal at the output of a converter stage in a ferrite-loop type receiver except on a strong local station.

CHROMA TRACER

WHEN a color TV receiver gives a good black-and-white picture but does not produce a color picture, something is obviously wrong with the set's color circuitry. A fast but accurate way of checking these circuits is to follow the chroma signal to determine if it is coming through. A tuned dc voltmeter *(chroma tracer)* will do this job.

One such unit can be built around a 6AM8. The tube's pentode section serves as a tuned 3.58-mc amplifier while the diode forms a vtvm (see diagram). Resistor R1 adjusts the unit's sensitivity. If the value shown does not give a wide enough range for very high signal levels, increase its resistance or connect a 1.5-μμf capacitor in series with C1. R2 and R3 form a network that develops a voltage in the meter circuit which cancels the 6AM8 diode's contact potential. This arrangement zeroes the meter when no signal is present. R3's value may have to be changed slightly to get zero deflection.

After building the unit, it must be aligned. To do so, connect the chroma

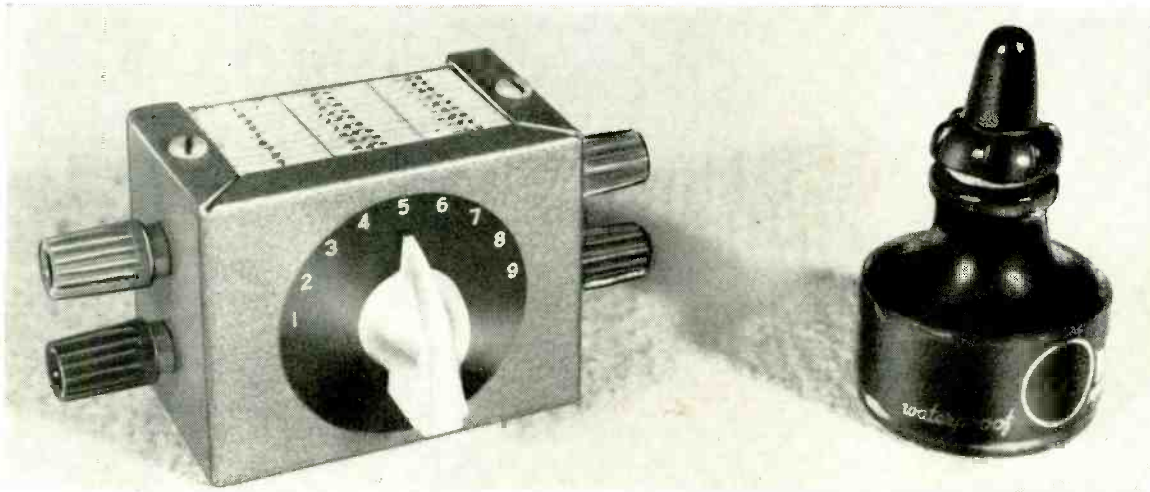


T1-CHROMA TAKEOFF TRANS (SYLVANIA N° 120-0014)
T2-CHROMA BAND TRANS (N° 120-0013-SYLVANIA)

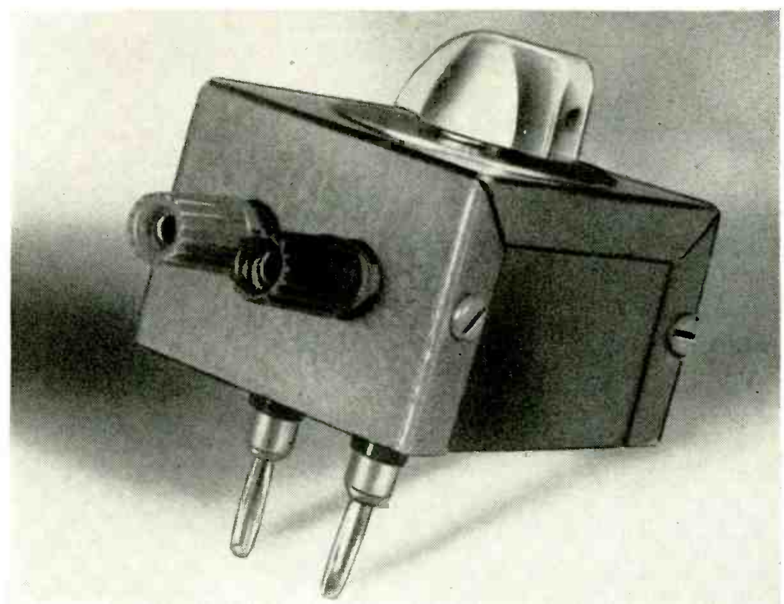
Simple chroma tracer circuit uses only one tube.

tracer's probe to the subcarrier generator of an operating color receiver. Then adjust transformers T1 and T2 and trimmer capacitor C2 for maximum meter deflection.

The chroma tracer lets us measure the chroma signal and only the chroma signal, thanks to the 3.58-mc tuned amplifier. By following the chroma signal through the color circuits (in the same manner you would circuit trace a radio receiver), the technician can find out where it disappears and start looking for trouble in that stage. While the chroma tracer is a useful instrument, it is not intended to replace the oscilloscope. It only supplements the scope.—*Sylvania News*



The completed Signal Padder.



Banana plugs on the instrument's rear plug into an audio oscillator.

AUDIO ATTENUATOR-PADDER for LOW LEVEL TESTING

Tiny passive unit for making practical amplifier noise tests with inputs of 1 mv or smaller

By HAROLD REED

WHEN testing audio amplifiers we would often like to check the microphone input vs amplifier output, and noise levels with a microphone input. Unfortunately, the voltage delivered across its characteristic load impedance by a low-impedance mike or other low-impedance device is so low that it cannot be measured with an ordinary audio vtvm.

The standard way of getting around this problem is to set an audio generator to some output level that can be easily measured and use pads to reduce the signal to the fraction of a millivolt we apply to the amplifier's input, rather than try to use a microphone to supply the input signal. But making the necessary pads on short notice or trying to find the ones you used the last time is time-consuming.

I solved this problem by putting all the pads (L-pads) into a single box; a *Signal Padder* as I call it. By turning a single rotary switch, I can now select the proper impedance source for the amplifier and the desired input voltage.

How it's made

All parts are built into a 2¾ x 2⅛ x 1⅝-inch aluminum box. I installed two banana plugs on the back of the box so it would plug right into my oscillator. Binding posts on the left side of the case are connected to the banana plugs and are used to take voltage readings. Leads from the banana plugs to the pads are kept short and are twisted together. The circuit is shown in Fig. 1. Just remember to keep all leads as short as possible and you won't have any trouble. A chart cemented to the top of the case lists levels and impedances.

Using the padder

After the unit is plugged into or otherwise connected to your oscillator, connect an audio vtvm to its input binding posts. The amplifier is connected to

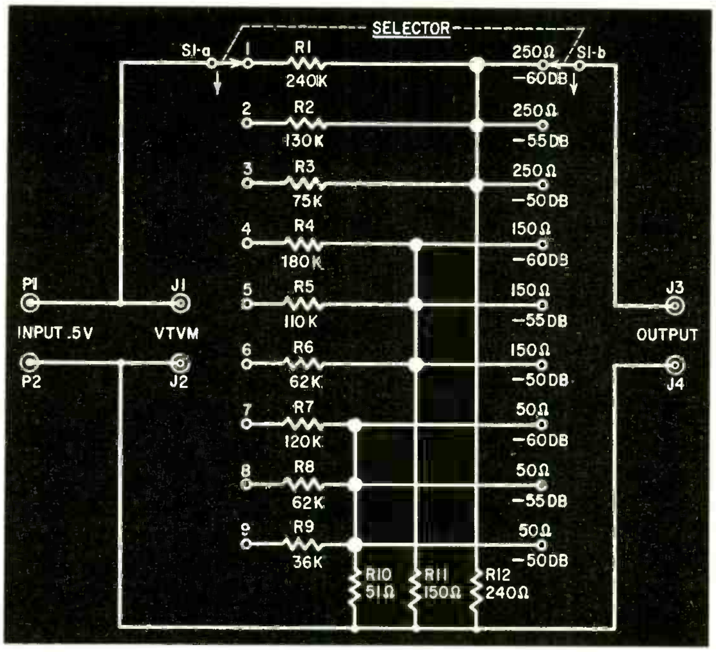


Fig. 1 — Circuit of the Signal Padder.

R1—240,000 ohms
R2—130,000 ohms
R3—75,000 ohms
R4—180,000 ohms
R5—110,000 ohms
R6—62,000 ohms
R7—120,000 ohms
R8—62,000 ohms
R9—36,000 ohms
R10—51 ohms
R11—150 ohms
R12—240 ohms

All resistors are ½-watt units. Actual value should be as close as possible to the indicated value, so select the units you use by checking them with a resistance bridge.

J1, 2, 3, 4—binding posts
P1, 2—banana plugs
S1—2 poles, 9 positions (Mallory 3229J or equivalent)
Dial plate (Mallory 459 or equivalent)
Case, 2¾ x 2⅛ x 1⅝ inches
Miscellaneous hardware

the output binding posts on the right side of the case. No input impedance load is needed since it is included in the device. Set the switch for the desired impedance and dbm level.

Next set the oscillator output for 0.5 volt on the vtvm. This is the input voltage to the Signal Padder. When this is done, the selected output is fed to the unit under test.

Any practical output level can be arranged for. Or by changing the input level you can change the output. I used three of the most common low-impedances and power levels in my unit. Others can be added.

Accuracy depends on the tolerance of the resistors you use. For a really precision unit use selected 1% units. If you decide to use 10% resistors, check their resistance and use the ones that come closest to the desired value.

Additional pads

To add another pad we have to know what voltage level we want to duplicate. If the device is rated in Ndbm (a given number of decibles below 1 mw), we find this power level first by using:

$W = (1 \times 10^{-3}) / (\text{antilog} -55 \text{ dbm } 10^{-1})$ where W is watts and 1×10^{-3} is equal to 1 mw. For example, let's try and duplicate the output of a 50-ohm mike rated at −55 dbm. Our formula would read:

$W = (1 \times 10^{-3}) / (\text{antilog} - 55 \text{ dbm} \times 10^{-1})$ and the power level comes out to 3.16×10^{-9} watts.

The next step is to find the voltage across the characteristic load impedance. $E^2 = \sqrt{WZ}$. Using the preceding example, $E^2 = \sqrt{3.16 \times 10^{-9} \times 50}$ and E, which comes to 0.398 or rounded off, to 0.4 mv. Some handbooks[1] give tables of power and voltage levels referred to 1 mw. Remember, *a power level holds for any impedance, but the voltage holds only for a given impedance.*

The circuit of the L-pads is in Fig. 2. When not referring to a 1-mw power level, use the following simple equations: R1 = Z/C and R2 = Z/B where Z is the output impedance and B and C are from a table of values from a handbook[2]. R1 is also equal to the impedance multiplied by the voltage ratio. So R1 = E1/E2(Z). R2 can also be determined for attenuations from 20 to 100 db simply by dividing the impedance the pad is to work into by 0.95. Thus R2 = Z/0.95. END

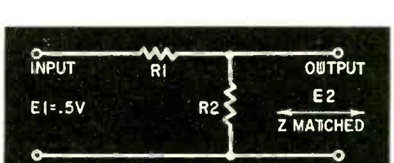
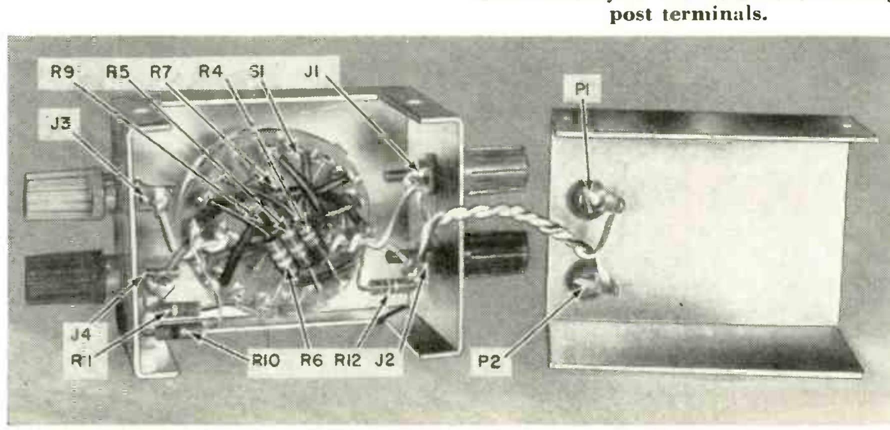


Fig. 2—Basic L-pad arrangement.

Test setup for feeding very small test voltages to an amplifier.

Inside the Signal Padder. Resistors are wired directly to the switch and binding-post terminals.

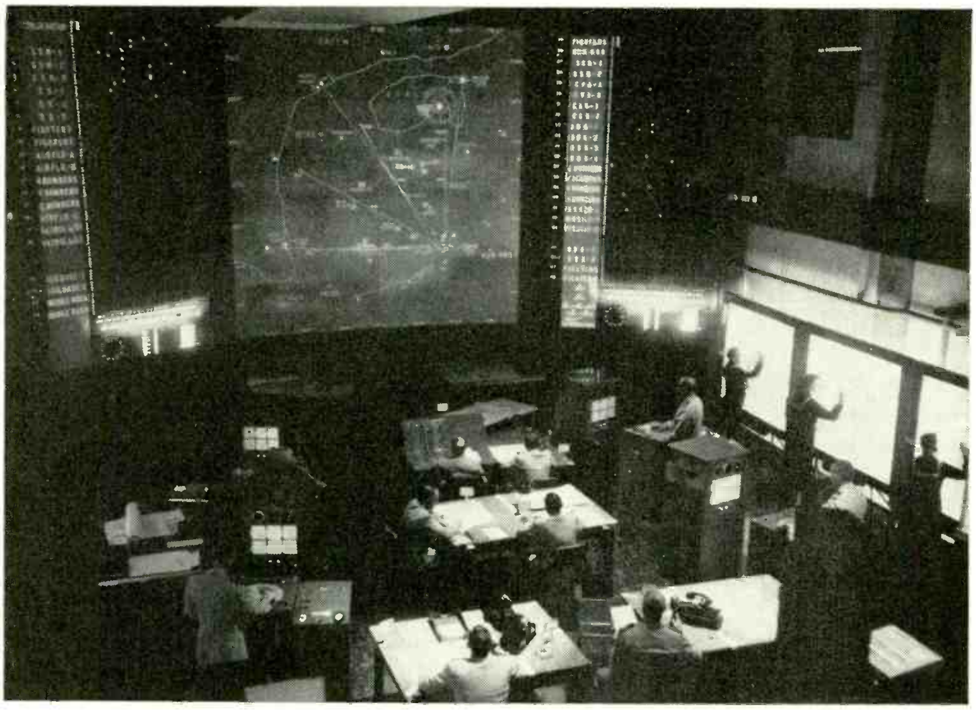


References

[1] Langford-Smith, *Radiotron Designer's Handbook*, Fourth Edition, 1952, page 814.
[2] *Allied's Electronics Data Handbook*, Second Edition.

COVER FEATURE

THE NEWS



Naval Electronic Warfare Simulator brings atomic-age techniques to traditional war games

By D. C. REDGRAVE*

The master plot screen on which the game is played. Umpires—in foreground—monitor the play and evaluate results.

A WAR game, as defined at the Naval War College, is a "generic term describing the means for simulating the play of systematic strategic or tactical operations of opposing forces." In the past, war games were played with small models of ships, aircraft and submarines manipulated on the floor of a large auditorium. The opposing sides consumed hours of time to play out only a few minutes of actual action. Experienced senior officers did the umpiring. They used the roll of dice to predict the probabilities of damage.

The speed and complexity of modern warfare have outstripped these methods. Fortunately, the very technological concepts that have given rise to the new concepts of naval operations have also provided the means for updating war games. The *Navy Electronic Warfare Simulator* (NEWS) is the vehicle developed to answer the nuclear-age need in war gaming technique. Costing over $7.25 million, containing 250,000 terminations interconnected with 2,500 miles of wiring, using 10,000 tubes and drawing an equipment electrical load of about 250,000 volt-amperes, the NEWS is an electronic engineer's dream—one of the most elaborate electronic equipment systems ever assembled under one roof.

General description

The NEWS is primarily a two-sided electromechanical warfare simulator making available the elements of mobility, firepower and intelligence to opposing commanders for use in controlling assigned forces as programmed in an operational war game. Command decisions are based on simulated information the commanders receive (similar to what they would receive in actual combat at sea), and result in interactions which are then assessed and evaluated by the NEWS in percentage of damage to engaged forces.

Outputs of the assessment and evaluation processes modify the mobility, firepower and intelligence available to the two forces. Human umpires can interpret or override any portion or all of the computed damage results. These modifications are fed back to the commanders, who are now confronted with a new situation requiring a new estimate and new decisions. This continuous dynamic "closed-loop" play in real time provides the technique for the conduct of educational war games.

Functional areas

The NEWS occupies a building a block long and three stories high, and extending to over 35,000 square feet of floor space. Within that area are 20 *command centers*, a large *umpire area*, a *communication control room*, *main control room* and *equipment room*. Fig. 1 is a simplified schematic that shows the NEWS major components and the flow of electronic and mechanical data. The 20 command centers (10 to each side) are manned by the commanders and staffs of the active forces in a war game. Each command center has facilities for maneuvering forces (one to four forces per command center), obtaining radar detection and evaluated CIC (combat information center) information, weapon control (four weapons per force) and communications (eight voice and one teletype channel per command center). Plotting boards maintain navigation information, and meters indicate the percentage of own-force effectiveness remaining at all times. One of the command centers on each side is that of the admiral, who has only one force (his flagship) and directs the action through communications to other command centers, as would be the case in a real engagement.

The *umpire area* is dominated by the great square *master plot screen*, 15 feet to a side. The movements of all 48 forces (24 to a side) are projected on this screen as shaped, colored images (green, white or amber) by 48 optical

* Lieutenant Commander, US Navy, Naval War College, Newport, R. I.

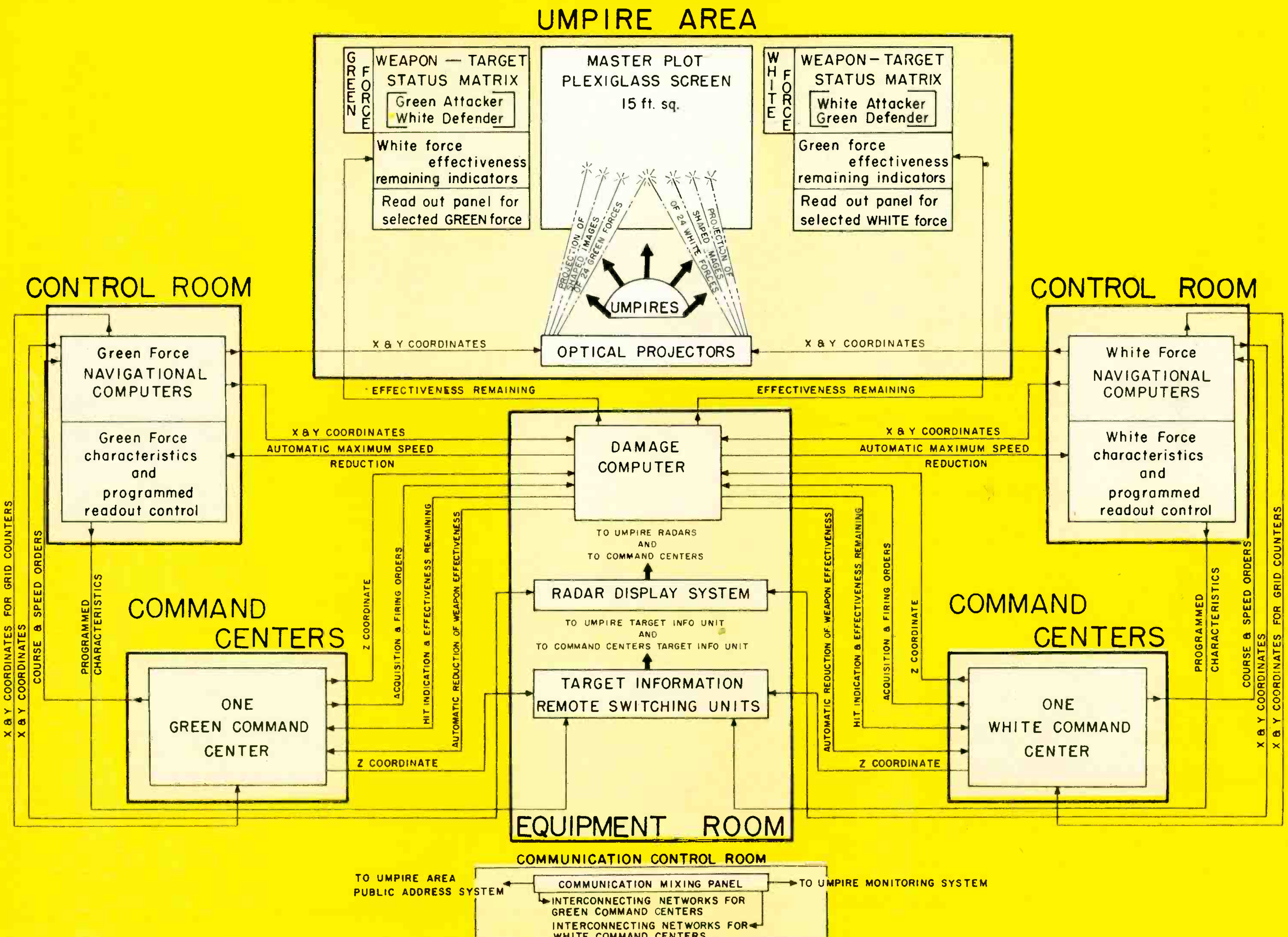


Fig. 1—Simplified composite schematic of the NEWS shows all major components and indicates flow of electrical and mechanical data.

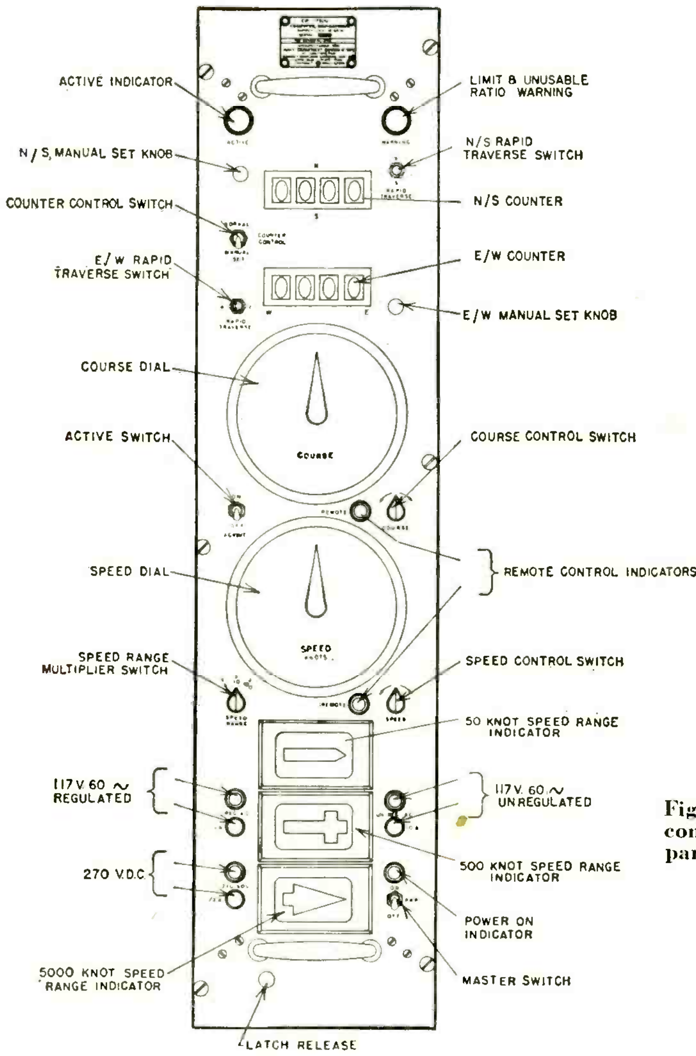


Fig. 2—Navigational computer, front panel.

projectors. Large panels on each side of the screen contain 5,136 lights showing the complete weapon-target status of all 48 forces. Below these, meters show remaining effectiveness of each force.

Positioning forces

A grid coordinate system positions all forces in the NEWS. The simulated ocean area is gridded into 4,000 x-coordinates measured from the western ocean boundary to the east, and into 4,000 y-coordinates measured from south to north. The z-coordinate, for aircraft altitude and submarine depth, is introduced into the display system via the *force characteristics* panels.

The umpires have facilities to control the "ocean size," making the screen represent an area 40, 400, 1,000 or 4,000 miles on a side; the problem speed, 1, 2 or 4 times clock time; damage assessment, and other factors such as force and weapon characteristics, communication networks and intelligence-type information to command centers.

The *communication control room* sets up and patches networks as required by the commanders. It also contains facilities for leaking communications from one of the opposing sides to the other when the umpires detect violations of radio security. The *main control room* houses the 48 *navigational computers,* one of which appears on the cover picture, also the controls for area size, problem clock time and problem speed. The *equipment room* includes the damage computer and various electronic and electromechanical components of the maneuver and display, and the communications subsystems.

Navigational computer

When a commander in a command center maneuvers his force by adjusting the course and speed dials, he is remotely transmitting a signal to one of the navigational computers (see cover picture). The computer simulates the course and speed of his force by generating rectangular coordinate data from the course and speed inputs (polar voltages) so that the movement of a force—on any of the four ocean sizes and at any of the three clock speeds—can be presented on the master plot screen.

Speed is set in—either locally on the front of the computer (Fig. 2) or remotely from the parent command center—by a speed switch. (Fig. 3 is a side view of the computer opened for inspection or service.) The speed control motor rotates in the direction specified by the switch to increase or decrease the speed setting. The motor shaft rotation transmits speed output information to local and remote indicators and to the *speed voltage resolver.* A top-speed-limiting facility located on the force characteristics panel is connected electrically to this speed system to limit the top speed of the force.

Course information is set in—either locally or remotely—by a course switch. The course control system is generally similar to the one for speed. Speed input is represented by a 60-cycle voltage and course input by the mechanical angle of a shaft.

The output of the speed Variac is exactly proportional to the speed dial setting controlled by the speed switch. *This* output is applied to the stator terminals of the *sine-cosine resolver,*

One of the 20 command centers. Officer in left background adjusts course dial and altitude level; officer in foreground is probing radar pip and reporting results to superior by radiophone.

a transformer in which the angle between primary and secondary windings is continuously adjustable. It resembles a small wound-rotor induction motor with two stator windings at right angles to each other. The speed voltage E is fed into the stator winding and the motor shaft, geared to the course dial, rotates through an angle θ in accordance with course information.

The output of the resolver is, then, two rectangular (x and y) voltages proportional to the speed and course. (The x-coordinate E_x is equal to E sine θ and the y-coordinate voltage E_y is equal to E cosine θ. These coordinate voltages, after suitable amplification, are applied to one of the optical projectors, which displays a shaped image representing that particular force on the screen. The projector unit (containing the lamp and reflector) of the optical projector is supported by a gimbal mounted in a pivot support and positioned by the x and y synchro voltage input. The heading of the shaped image—as distinct from the position—is controlled by a separate synchro voltage from the computer course information.

In addition to positioning the image of its force on the screen, each computer supplies a number of other outputs, including digital counter readings to the parent command center (also displayed on its own front panel) as well as information used in the command center to plot own-force position for navigational purposes. The course and speed information is furnished to the *radar display system* and the *damage computer*.

The navigational computers have three auxiliary control functions that provide greater convenience and more flexibility in programming and operation. *Rapid traverse* enables the force controlled by the computer to be slewed rapidly across any ocean size before the start of a game. *Transmission sync* provides rapid rotation of the electromechanical transmission input shafts to permit meshing the change gears in a few seconds. *Position matching* is a remotely controlled operation for matching the position of one force with that of another (such as an aircraft on the deck of a carrier or a Polaris missile in a submarine). With this feature it is possible to slave three forces to one master force, or to three different ones.

Damage computer subsystem

The *damage computer* is the most novel equipment from an electronic standpoint. Unfortunately, its very complexity prevents its being described in detail here. This partial treatment is due only to the difficulty of describing it—the subsystem is possibly the most important feature of the NEWS, and would be well worth an article in itself. The reader can get a rough idea of its complexity from the flow diagram, Fig. 4. Not all the components shown in that diagram will be mentioned, and those that are must in most cases be discussed in terms of what they do, without attempting to explain how they perform their functions.

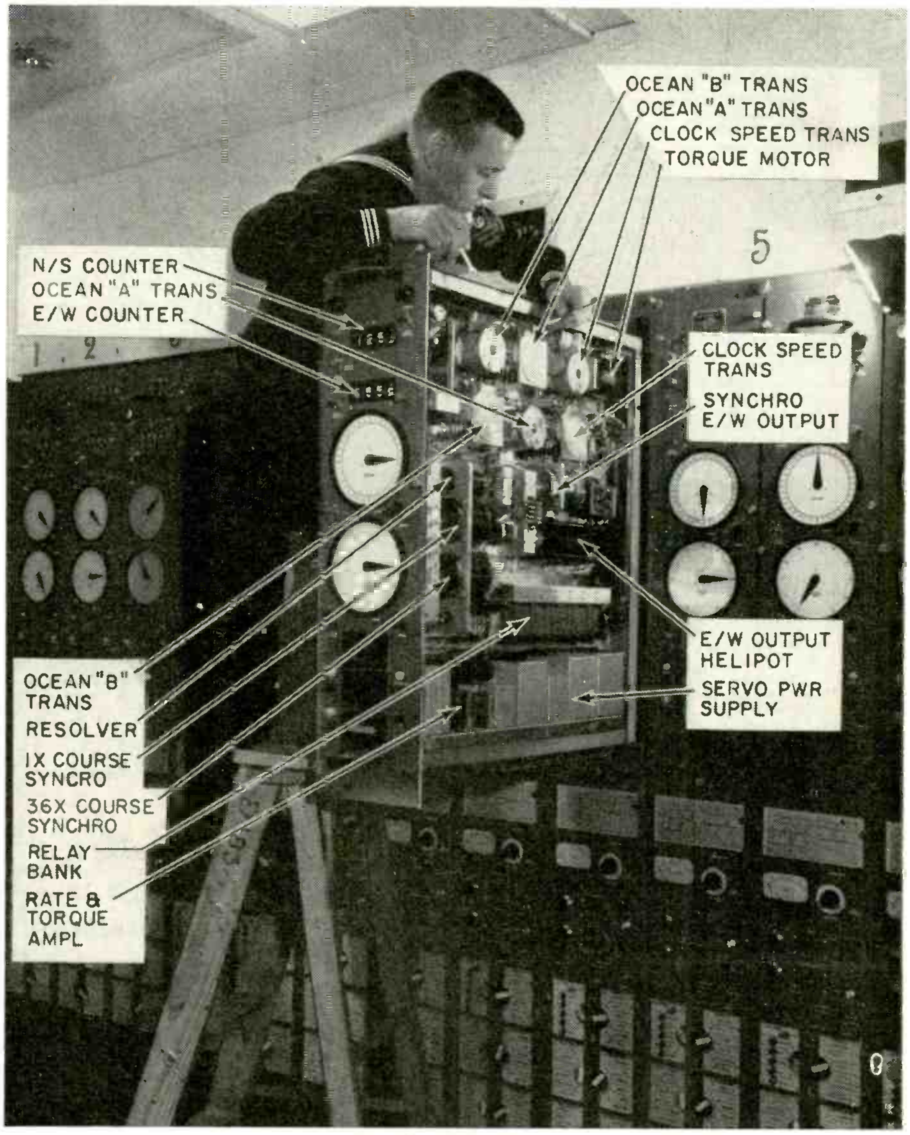


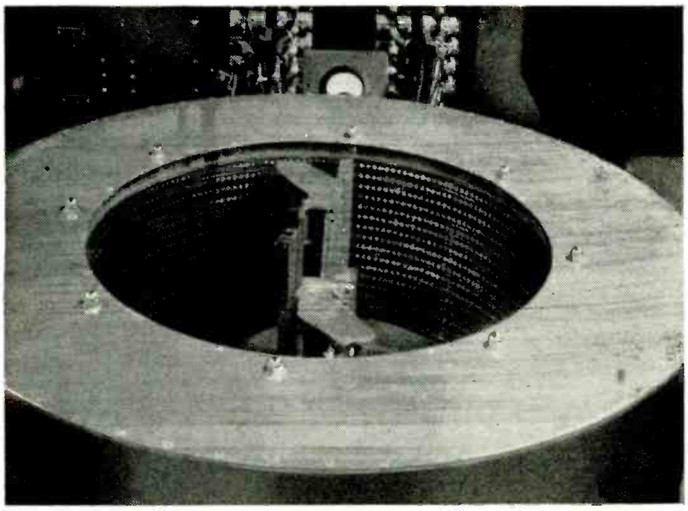
Fig. 3—Side view of computer. Some components mentioned in text are on the opposite side.

One of the features of the damage computer is a *sequential switch* that somewhat resembles a magnified telephone-exchange stepping switch. It consists of 193 vertical rows (192 weapons and one test circuit) of 14 active contacts each, all arranged on the periphery of a circular tub. Fourteen brushes sweep across the active contacts of each vertical row once a second.

Another portion of the computer consists of a bank of 2,000 Helipots, grouped in 20 horizontal rows of 100 pots each.

To simplify the required machine parameters, the 192 weapons (4 each for each of the 48 forces) are divided into a possible 20 weapon types (such as 5-inch guns, missiles, torpedoes or depth charges) and the 48 forces are grouped into a possible 20 target types (such as cruiser, destroyer, aircraft or submarine).

To follow the operation of the damage computer subsystem, let us assume that the commander of White Force 25 sees a pip on his radar. He interrogates (or probes the pip with an electronic eye) this target, and obtains such information on it as has been preprogrammed. (This information may change during an action—for example, a pip at maximum radar range may give only the bearing of an opposing force; as range decreases, the type of target, its range and other information may become available, as would be the case in a real engagement.) The commander decides to acquire (place himself in readiness to fire on) this target with his weapon C. (The four weapons per force are identified as A, B, C and D.) The acquisition button of weapon C is pressed, starting a chain of events. The computer picks up, from the navigational computer, the coordinates of the weapon and the target (Green Force 1) and calculates the range. It also computes, from a number of factors, a probability of a hit, and, if there is a hit, the amount of damage that might be inflicted. A steady light is



The sequential switch that samples all weapons once each second.

lighted on the *weapon target status boards* (matrix) in the umpire area to let the umpires know what target the weapon has engaged. Five of the potentiometers, those programmed for weapon 25C against target Force 1, in the 2,000-pot bank are connected to the sequential switch and their output is sampled once per second for calculation of the hit probability and damage per hit. All this flow of information takes place even though the weapon does not fire at the target. But unless the weapon fires, there is no output from the *hit resolver* and *damage resolver.*

When the commander of White Force 25 presses his firing button, two pulses are sent out. One rings an "under-attack" gong and lights an indicator for Green Force 1 for 25 seconds. It also causes the steady light for weapon 25C in the umpire area to blink for 25 seconds, informing the umpires that firing has commenced.

The other pulse is routed through the sequential switch to the hit resolver, where it triggers a gate. A random noise generated in the hit resolver is trying to feed pulses continuously through this gate. The length of time the gate is open is determined by the height of the *hit probability* pulse (50 to 80 volts) as determined by the computer. If the gate is open long enough for three noise pulses to get through), a *hit pulse* is generated. Employment of the noise generator results in a randomization of hit probability not under human control.

If a hit resolver gate pulse is received, the damage resolver generates damage pulses through a gate as in the hit resolver. Each damage pulse represents 1% damage to the target.

The number of damage pulses generated is proportional to the voltage of the damage weighting pulse from the control function computer. The damage weighting pulse varies between 50 and 80 volts, with 50 volts representing zero and 80 volts representing 100% damage. If the damage resolver is operated in the "fixed" mode, the damage pulses have a frequency of about 45 kc and their number is proportional to the amplitude of the damage weighting pulse. If the damage resolver is operated in the "random" mode, a chance factor is introduced. The pulses occur at random intervals and the number of pulses will vary above and below that which would be expected from the amplitude of the damage weighting pulse.

Since there is only one damage resolver in the system, the pulses must

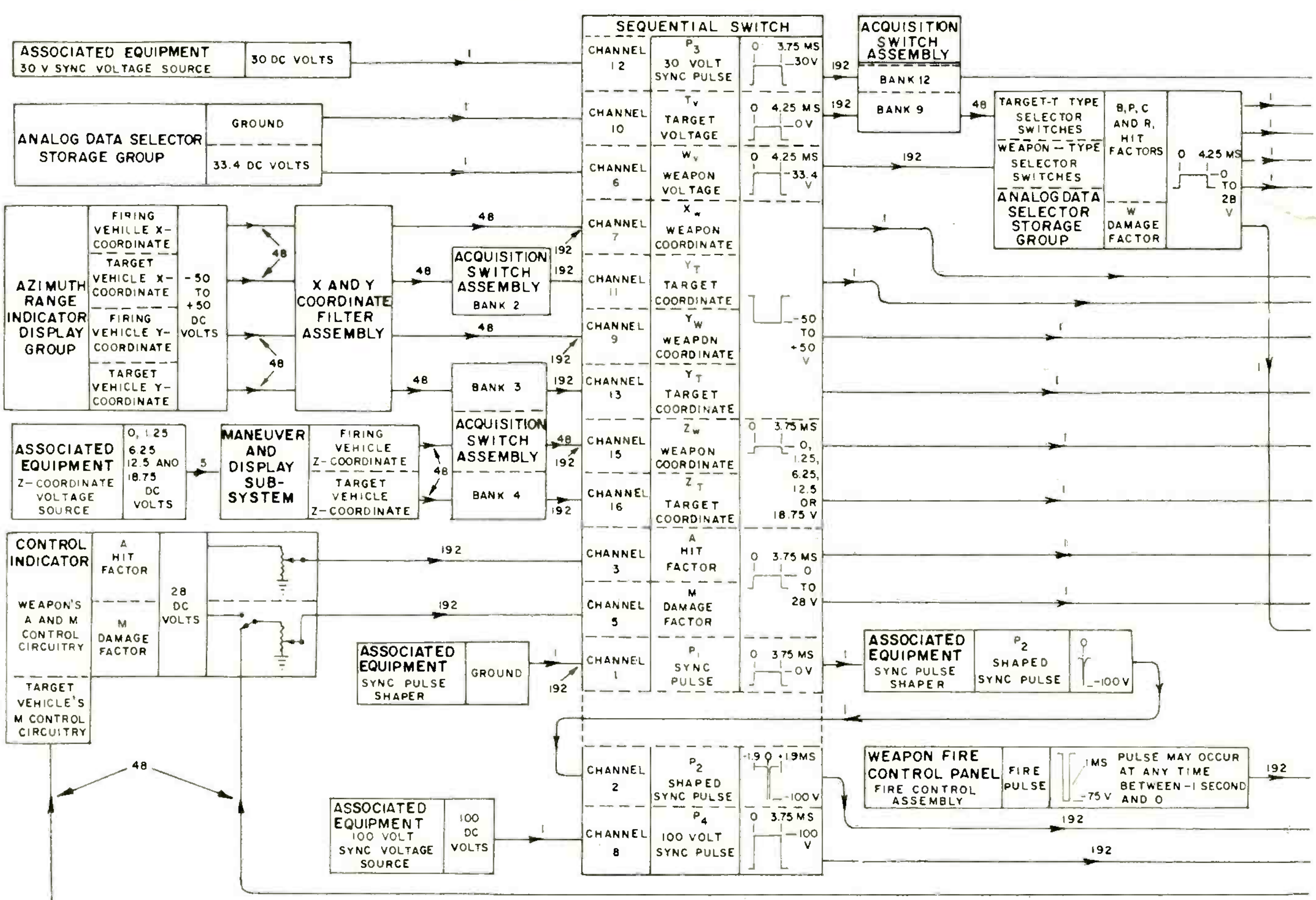


Fig. 4—The damage computer. Simplified schematic and

be routed to the correct target. The coincidence gate is again used. The damage pulses are routed to all tubes in the damage distributor but there is no output from them until another pulse is received. This is a 30-volt pulse P3 fed from the vertical row of the sequential switch for (in our example, 25C) the weapon to the acquisition switch assembly. The acquisition switch for weapon 25C is pointed at Force 1, so the tube in the damage distributor for Force 1 is gated. The damage pulses then feed through this tube to the *v*ehicle *e*ffectiveness *r*emaining *c*onverter (VERC). In the VERC, the damage pulses are recorded by electronic counters and the percent damage is converted into percent effectiveness voltage. The counters of an undamaged vehicle will read 00, and its effectiveness voltage will be 28, giving an effectiveness reading of 100% on the effectiveness meters. After a hit which causes, for example, 25% damage, the damage resolver will generate 25 pulses which will give a reading of 25 on the vehicle effectiveness register converter damage counters. This produces an effectiveness voltage of 21, which gives an effectiveness of 75% on the effectiveness remaining indicators.

The percent effectiveness voltage is transmitted from the vehicle effectiveness register converter to the control indicator, effectiveness remaining indicators in the target command center, umpire area and the force characteristics panel in the control room.

If the target damage equals or exceeds 100% (effectiveness remaining is zero), additional outputs from the VERC indicate to the umpires that the force has been killed and also prevent the force killed from doing further firing.

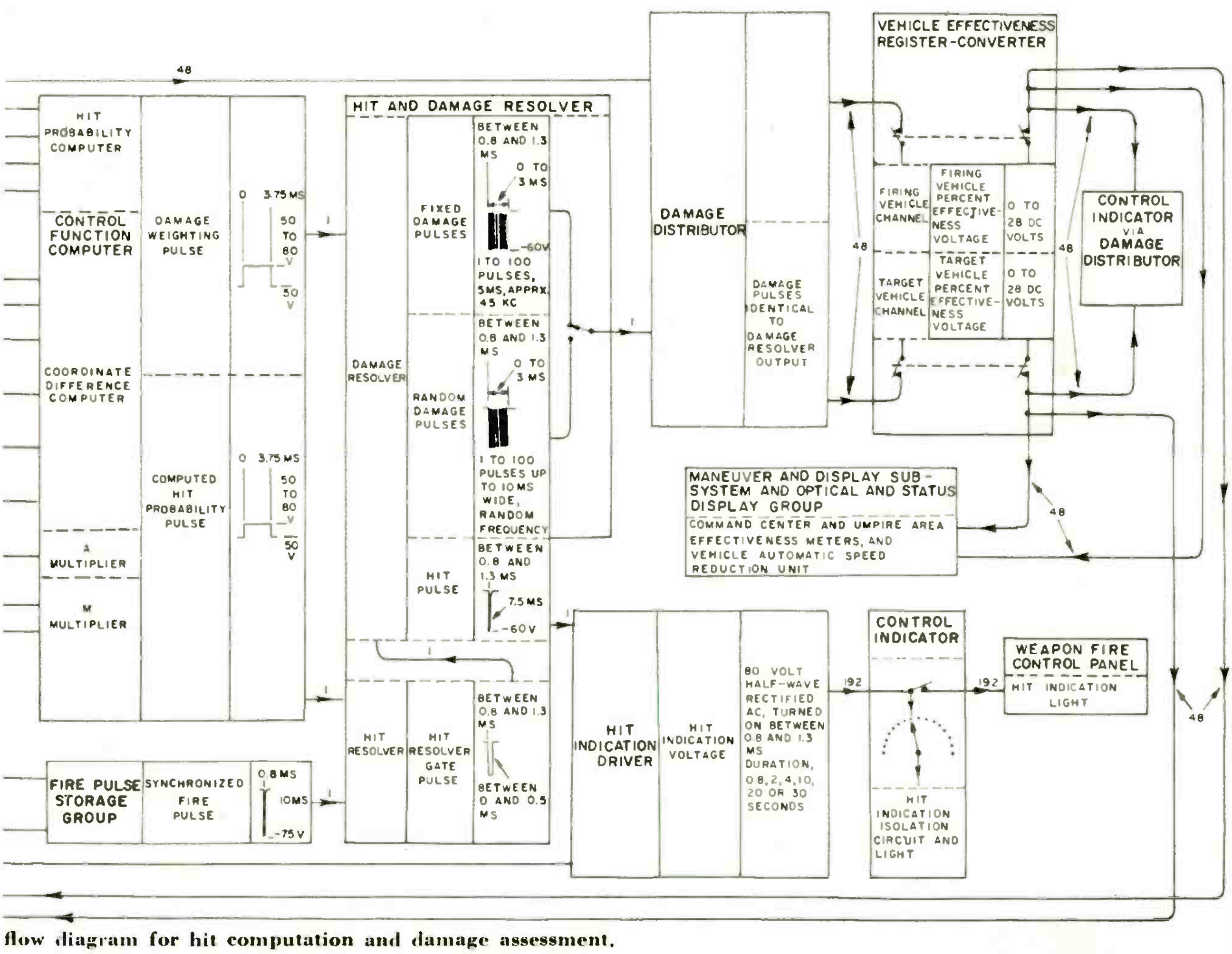
Another feature of the damage computer, one not always used, is permitting the firing force to know he has registered a hit. To do this, the coincidence gate is again employed. The hit pulse generated in the hit resolver is on one line and fed to all tubes in the hit indication driver group. A 100-volt synchronizing pulse (P4) from channel 8 of the sequential switch goes out on the vertical row to the weapon channel in the hit indication driver group. In our example, weapon 25C vertical row is connected to the tube for 25C and, if a hit is made, a pulse is fed through a switch (manually preset) on the control indicator to the command center. If permitted, the commander of Force 25 knows when he has obtained a hit.

While the discussion on the damage computer subsystem takes a lot of words, the actual hit computation, damage assessment and hit indication for any one weapon take place within 4.5 milliseconds. The damage computer subsystem can sample all the possible 192 engagements once each second.

Summary

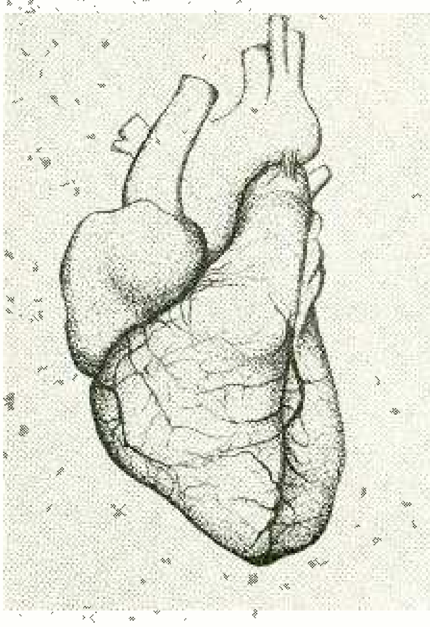
The NEWS represents a novel concept in the employment of a computer as a military problem aid. Computers have been used to help analyze various aspects of warfare, but in these cases mathematical models describing a rigid situation have been fed into them, and an outcome, or series of outcomes, has been the generated result. In the NEWS the situation is not rigid, and the computer serves to assist in the rapid assessment of weapon employment as dictated by the opposing commanders. The NEWS does not provide for automatic operation but rather for manual variation in the parameters of the various elements of warfare. The skill in the exercise of professional military judgment is *the* most important element in the NEWS.

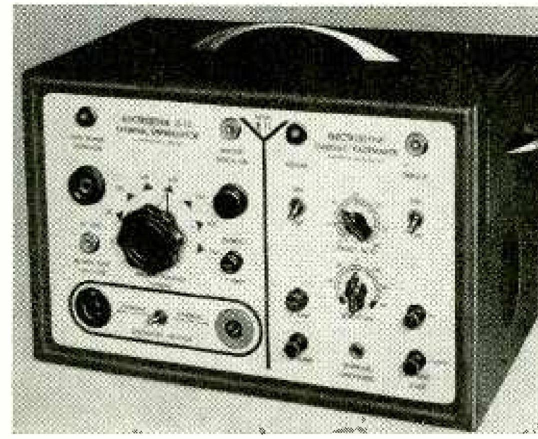
The full potential of the Navy Electronic War Simulator is rapidly gaining recognition, though years of operational experience may be required to realize all its potentialities. It has already provided the US Navy with an immeasurably valuable vehicle on which to further the education of its officers and to provide them the opportunity to gain significant command experience in various aspects of modern naval warfare. END



Flow diagram for hit computation and damage assessment.

ELECTRONICS CAN SAVE YOUR HEART



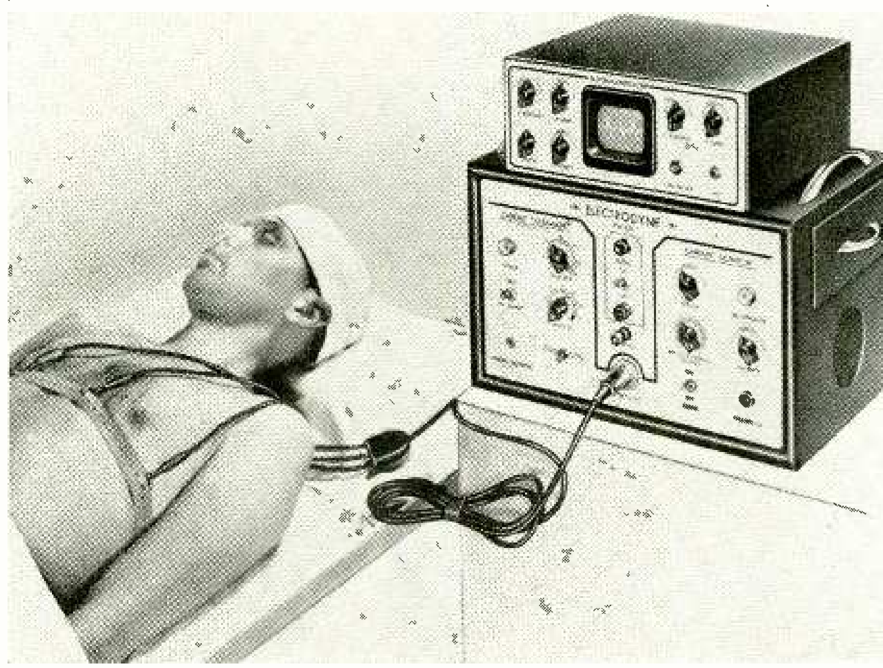


Combined Pacemaker and external Defibrillator.

Two electronic instruments promise to help you live longer by keeping your heart pumping

By DR. BERNARD S. POST *

MEDICAL electronics is the special field which deals with all electronic devices and techniques used in the diagnosis and treatment of disease in the human body. It also includes special pieces of apparatus used in basic medical research. Among such equipment are two items which are more spectacular than others in their application. These are the *cardiac Pacemaker* and *cardiac defibrillator*.



Cardiac Pacemaker, Monitor and Electrocardioscope in use.

The Pacemaker is used if the heart has stopped completely or is not beating rapidly enough to maintain life, as in certain forms of heart block where the pulse beat may fall to a rate of 30 or less. The heart is essentially a four-chambered pump (Fig. 1) which operates on a mechanical force basis. It pumps blood through the organs, supplying them with nutrition and oxygen and a way to eliminate waste products. The chambers of the heart contract in a definite sequence called the cardiac cycle. The contractions are controlled and timed by nerve impulses. These impulses are electrical in nature, as has been demonstrated with oscilloscopes and electrocardiographs.

In some situations the nerve mechanism in the heart is either poisoned by the toxic products of disease or scar tissue constricts the conducting tissues in the heart. When this happens, some of the impulses which initiate the normal contraction cycle are blocked and insufficient contractions take place per minute. This causes a deficit in the supply of food and oxygen, which can result in death. In these cases there is time to supply the patient with an artificial Pacemaker which takes over the nerve tissue's job and sets up a cycle of impulses that keep the heart beating properly. This equipment, if available, can also be used on a patient who may have died suddenly from shock or during surgical procedure. If used promptly, normal heart action may be re-established.

There are other diseases which affect the human heart by setting up a period of wild, asynchronous contractions of all the chambers. This condition is called fibrillation and may involve either auricles or ventricles or both. When the heart fibrillates, it twitches in all directions at the same time and there is no concerted, unified pumping action. The condition rapidly leads to death because, even though the ventricles are beating, the body is not getting enough blood to carry on its vital function. The defibrillator is a piece of equipment used to re-establish a suitable rhythm. It delivers a pulse to the ventricles each time a switch is depressed. This pulse, known as a countershock, has a fixed 0.15-second duration with a 1.5- to 3-amp current. The shock will sometimes stop the heartbeat completely, after which the Pacemaker is applied. Or the heart may be shocked out of fibrillation and made to beat

* BS, MD, PGME of IRE. In charge, Electromyography Laboratory, St. John's Episcopal Hospital, Brooklyn, N. Y.

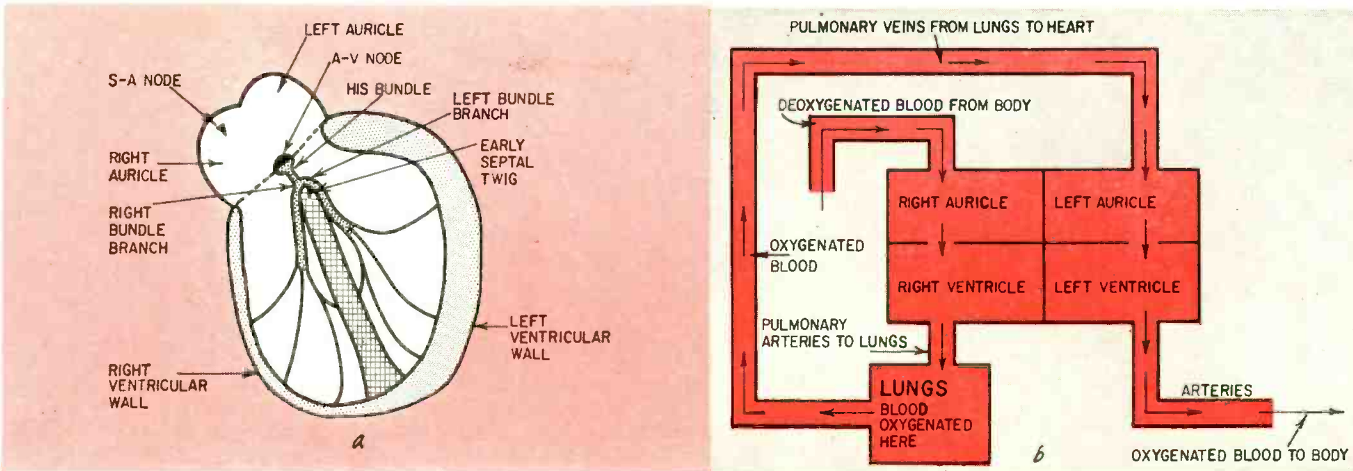


Fig. 1 — The human heart: a—schematic drawing; b—block diagram—hydraulic analogy to demonstrate force-pump action.

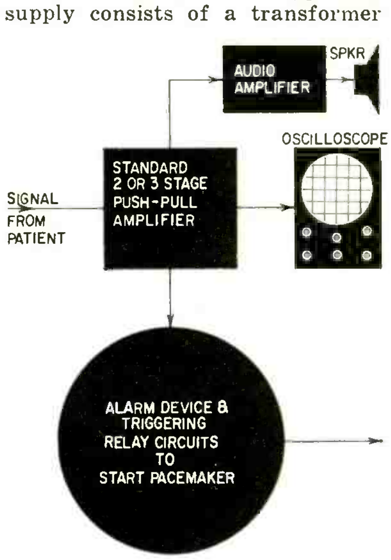
regularly on its own. Countershock voltage may be applied in steps up to 750 and up to 15 amps can be applied through the closed chest wall. The power relay contacts and isolation transformers will safely transmit 12,000 watts. The automatic timing circuit which fixes the impulse duration at 0.15 second will not allow successive countershocks more often than one per second, to protect the patient from undue heating.

Pacemaker circuit

Fig. 2 is a typical example of Pacemaker circuitry. Power to the instrument is controlled by an ON–OFF–STANDBY switch (S) located on the front panel. All power is disconnected in the OFF position. In STANDBY, all circuits are activated with the exception of the pulse output jacks to the patient's electrodes. These are energized in the ON position. With the switch in ON or STANDBY, the POWER INDICATOR glows. The PULSE INDICATOR is excited only in the ON position and only when a pulse occurs. This makes the lamp flicker once for each pulse. A typical power supply consists of a transformer and selenium rectifier. They are used in a conventional half-wave rectifier supply that delivers approximately 325 volts dc. Ripple is filtered by R6 and C1.

The pulse is produced by the blocking oscillator pulse generator composed of V1 and associated circuits. This is how it works: Assume that C2 and C3 are charged in such a manner that V1's grid is negative with respect to ground. If this potential is large enough, V1 is cut off and no plate current flows. V1's grid potential will then rise slowly toward the voltage dictated by the setting of the HEART RATE control (R2) as C2 and C3 charge through R2, R3 and R4. At some point in this charging cycle, V1 will start drawing plate current which will flow through winding L2 of T2. This current flow induces a voltage in L1 the upper part of T2 in the diagram. This in turn causes the grid to go even more positive, which causes even more current to flow in L2. This regenerative action takes place very rapidly and the current drawn by V1 increases to the saturation point of T2. Now there can be no further change in current flow through the lower portion of T2's winding. In 2 to 3 milliseconds, the voltage on T2's grid winding begins to drop, causing current through V1 to decrease. A similar but opposite action to the buildup portion of the pulse cycle, takes place, returning the circuit to cutoff. In so doing, C2 and C3 are discharged to a negative voltage with respect to ground and the slow charging of the capacitors starts another pulse cycle. RECT2 is used as a diode and prevents negative overshoot of the pulse at V1's filament. R5 and C4 form a shaping network to round off the top of the output pulse. The pulses flowing in the filament return circuit of V1 are coupled to the electrodes through T3. R9 is the PULSE AMPLITUDE control.

The HEART RATE control (R2) sets the interval between pulses, and therefore the pulse rate, by controlling the capacitor voltage toward which C2 and and C3 rise during the charging part of the cycle. The pulse at V1's filament is coupled to the output through coupling transformer T3. Pulse amplitude is controlled by R9. The schematics presented are not meant to be used as a guide for the construction of a pacemaker. (Circuitry in such equipment



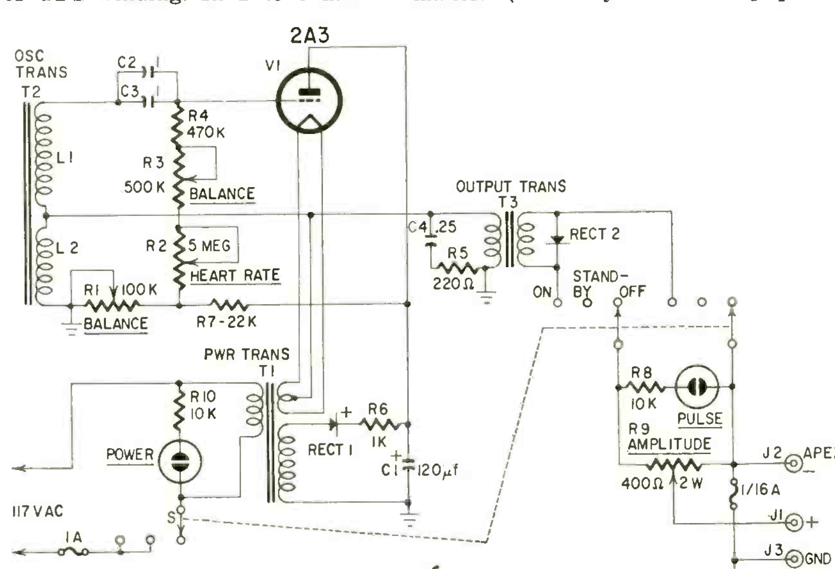


Fig. 2 — Typical Pacemaker unit: a—block diagram of monitor system to start the Pacemaker automatically when it is needed; b—schematic diagram.

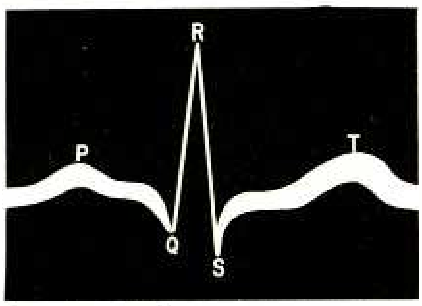


Fig. 3 — Typical electrocardiograph waveform—one cycle.

is critical and requires careful laboratory trial and checking before they can be used, since improper use could result in a death.)

The cardiac Pacemaker is often combined with a device which monitors the rate of the patient's heartbeat and automatically cuts in the Pacemaker if the rate falls below a safe level. The patient is wired to the circuit and remains connected to the equipment at all times, whether he is in his bed or on the operating-room table. In cardiac surgery, the hookup is made to the limbs so that the chest is free for the surgical procedure. The equipment consists of three parts which are unified in construction. On the left in the head photo is the Pacemaker section; on the right, the automatic monitor, and above, a specialized oscilloscope called an electrocardioscope. The apparatus is compact and simple to operate. The oscilloscope controls are standard. The Pacemaker controls consist of two potentiometers. One of them controls the rate of stimulation (between 30 to 180 impulses per minute). The other varies the voltage amplitude continuously from 0 to 150. A neon signal light is activated by each impulse for visual reassurance that the current is flowing to the heart muscle. Note also the switching device which activates a jack plug to transmit impulses directly to the exposed heart during surgery if necessary. These internal electrodes may be placed directly by the surgeon if desired.

The three monitor controls include a potentiometer to regulate the audio component of the electrocardiographic tracing on the scope; a second one to increase the sensitivity of the alarm system which goes off simultaneously with the Pacemaker is the patient's heart rate falls below a safe level, and a third to vary the interval between heartbeats (periods of asystole). A neon signal light flickers for each heartbeat. A panel light indicates power to the preamplifier through the on–off–alarm switch.

Reading heart action

The electrical activity of the heart is picked up through the patient's electrodes, amplified by a self-contained electrocardiograph amplifier and displayed on a long-persistance oscilloscope tube for continuous visual monitoring of the patient's electrocardiogram. The scope has a writing rate of 1 inch per second and a total sweep time of 3 seconds. Electrosurgical instruments do not disturb the operation of this instrument. The typical waveform picked up from cardiac output is shown in Fig. 3.

The heart's contractions are timed and controlled by nerve impulses which arise within the heart itself. As these impulses stream through the heart, they leave the tissue through which they pass momentarily electronegative with respect to the rest of the heart and body. The resultant shifting of this electronegative area with the passage of the nerve impulse constitutes a minute electrical current change which produces the waveform shown in Fig. 3. This wave is referred to physiologically as depolarization. When the impulse has passed, the muscle tissue returns to its normal state by a process called repolarization.

The letters P, Q, R, S, T are arbitrary names given to each part of the total heart-contraction waveform. The P-wave is the deflection produced by auricular depolarization. The Q-wave is the initial negative deflection caused by ventricular depolarization. It precedes the R-wave, which is the first positive deflection during ventricular depolarization. S is the first large negative deflection of ventricular depolarization. This does not contradict the statement concerning the Q-wave, since that is not always present and when it is, it usually is of very small amplitude. For this reason, I referred to it as the initial negative deflection. The T-wave is considered to be the repolarization of the ventricular muscle. Sometimes a repolarization wave for the auricular muscle is also seen and, when present, is referred to as the T_a-wave. However, it is rarely seen in the usual electrocardiographic examination of the heart.

The QRS complex which represents the ventricular contraction is further amplified by the monitor while all other electrical activity is filtered out. The QRS is converted to a neon flash and a sharp audible note of about 800 cycles. The audible signal of each heartbeat immediately indicates any abnormality, making it unnecessary to view the scope constantly. This has its greatest advantage in the operating room. If the heart should stop or slow down, an alarm will immediately go off. A loud continuous 800-cycle tone (high A) will sound when the time interval between any two heartbeats exceeds the time set by the systole (interval) control on the instrument. This time may be varied from 1 to 10 seconds (6 to 60 beats) per minute. When the alarm sounds, the pacemaker section is energized through a relay timing circuit, and begins to produce monophasic round-topped 3-millisecond impulses. These are optimum for cardiac stimulation but can cause no physical damage. The low internal impedance (less than 50 ohms) permits better than adequate power output even across very low body resistances.

Thanks to close cooperation between medical men, electronic engineers and workers in medical electronics, progress has been accelerated in this field in the last 15 years. Equipment for diagnostic and therapeutic purposes has been produced to fill each need as it arose, so today our instruments border on what would have been unbelievable 20 years ago. Recent reports mention transistor cardiac Pacemakers small enough to be implanted in the body tissues (2 inches in diameter by ½ inch in thickness and permanently encased in epoxy resin) and with a battery life of nearly 5 years. These are in operation in a number of human patients as well as laboratory animals. This has taken the patient out of his bed and made a useful human being out of him, rather than a medical oddity.

A number of other electronic applications to medical problems will be discussed in later articles. The series is being written so all technicians may have some insight into the electronic requirements of modern medicine and also in the hope that some of you may be stimulated to go still further in this field. END

FOUR NEW SOURCES OF POWER

SOME—or maybe a great deal—of our future electric power may be generated by one of the unconventional means shown on this page. This was the theme of a recent demonstration at the Westinghouse Research Laboratories.

Basically, it was pointed out, the ideas are not new—their application to power production is. The fuel cell dates back to Sir Humphrey Davy in 1802, thermoelectricity to Seebeck in 1821, and thermionic effects to Edison in 1878 and magnetohydrodynamics to Faraday in 1831.

The devices that were demonstrated produced direct current at potentials ranging from a fraction of a volt to about 30 volts, and powers from 0.2 watt to 5 kilowatts.

At present all are highly experimental, and electricity produced by them is far more costly than by conventional methods. But even now one or another of these generators may be economic for certain applications, such as those in which noise or vibration cannot be tolerated, or for use in remote areas (the Russians sell a kerosene-powered thermoelectric generator to operate a radio in remote areas).

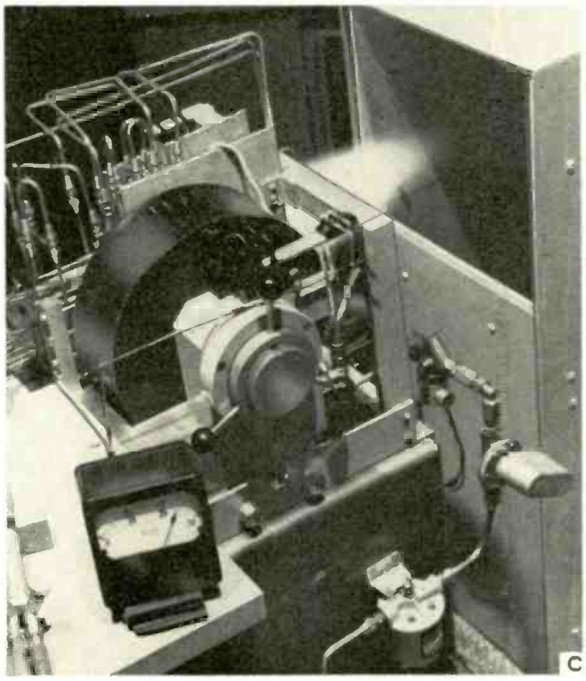
Within a few years, it is expected that the power available from devices using these techniques will be vastly increased, with possibly a corresponding drop in initial cost and fuel expense. END

A

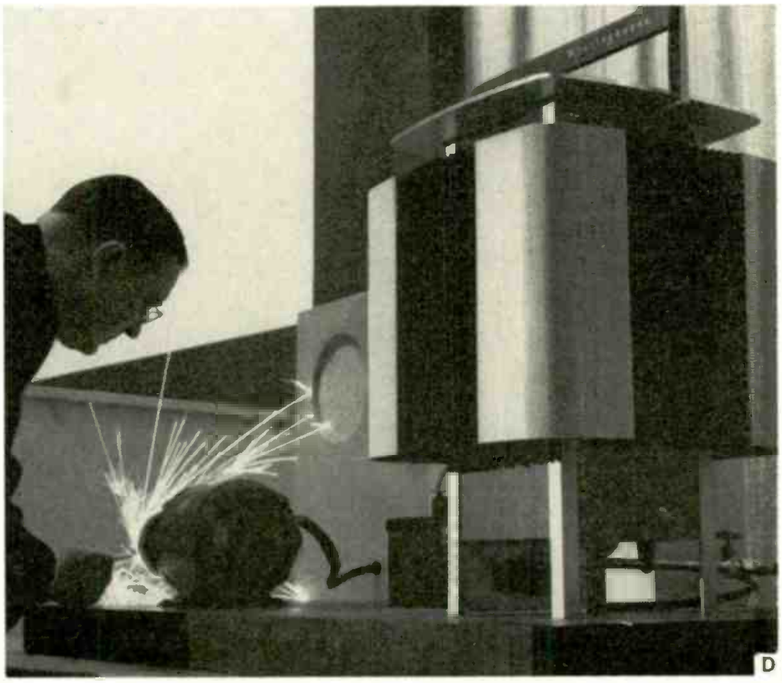
B

In the fuel cell at A, carbon and oxygen or air are consumed in a high-temperature furnace (about 800°C) to produce electricity. Such cells may be capable of producing 2 kw per cubic foot of cell (excluding surrounding furnace). In the thermionic converter (B), a vacuum-tube cathode (filament) at high temperature emits electrons which are collected at the anode and do useful work passing through a load to the cathode. This unit produced small amounts of power at 3-volts—lit a pilot lamp brightly and turned a tiny fan. The tube is a "soft" type, containing cesium gas.

This magnetohydrodynamic generator (see RADIO-ELECTRONICS, January, 1960, page 8) blasts ionized gas through a magnetic field at velocities from 1,000 to 2,000 miles per hour to generate current. The generator shown (C) produces about 1 watt—a larger unit demonstrated at the same time was capable of 5-kw output. The thermoelectric generator at D consists of a large number of thermocouples, uses propane gas for heating. It produces 100 watts. A 1,000-watt unit—powered by nuclear fuel—is under construction.



C



D

NEW at the 1960 IRE CONVENTION

Engineers' meeting and show held in New York March 1960, brings out some original ideas and novel gadgets

(See News Briefs for other convention news)

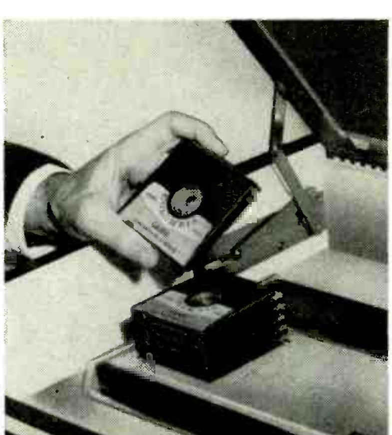
The Ear Is Not Fooled (Much)

A series of experiments in which listeners were given the opportunity to rate various types of stereo systems was described by Harwood B. Moore of the General Electric Co., Utica, N.Y.

Various types of stereo and partial stereo, including regular stereo systems with two distinct channels, satellite systems with mixed bass, and single-cabinet stereo systems, were used in the experiments. Though nothing startling came from the experiments, many high-fidelity aficionados had their previous opinions confirmed. The listeners almost unanimously preferred the true stereo over all other systems. And the closely placed speakers of the single-cabinet systems gave the listeners less feeling of stereo than any of the others.

Stereo at $1\frac{7}{8}$ ips

Dr. Peter Goldmark of the CBS Laboratories unveiled a new tape playing and recording system at the IRE convention. It consists of a revolutionary new tape that produces good sound at $1\frac{7}{8}$ ips and a stereo tape-changer mechanism that plays for five hours without attention. The tape is 150 mils wide and carries three tracks. Two are the ordinary stereophonic pair. The third track—situated in the center of the tape—is intended to carry the reverberated and delayed sound which is an important part of what the listener hears in a concert hall.



Experiments show this sound adds greatly to the illusion of realism. Each track is 40 mils wide.

The tape is wound in sealed cartridges approximately $3\frac{1}{2}$ inches square and 5/16 inch thick. Each tape plays 64 minutes and can be rewound in 20 seconds. Dr. Goldmark stated that Zenith in this country and Grundig in Germany intend to market the equipment in 1961.

The CBS instrument may not be the only tape changer to appear in the near future. Another changer was described to the convention by Marvin Camras, whose work was largely responsible for our present-day magnetic recording equipment. Camras' changer is to be compatible with existing tape recorders and players, only a takeup reel with a ball detent in the hub (costing about 50c) would be necessary, said Camras. Inexpensive adapters could modify the same players for semiautomatic operation. The system is applicable to all type speeds and modes of operation.

Human Body a Broadcaster?

Muscles of the human body originate radio-frequency signals, members of the IRE were told at the recent convention. Frequencies as high as 150 kc have been detected, but higher-frequency radiations may exist.

According to Dr. Volkers of Cohu Electronics, one of the authors of the paper presented to the IRE convention, signals are emitted by muscles in action, such as those of the chest while inhaling. No signals were sent out during exhalation, though they continued if the subject inhaled and held his breath. Another interesting feature is that some of the smaller muscles of the body transmit stronger signals than larger ones. Thus, exceptionally strong signals are sent out from the muscles of the little finger. The only part of the body that does not transmit signals, Dr. Volkers found, is the head! The signals are in the form of sharp spikes.

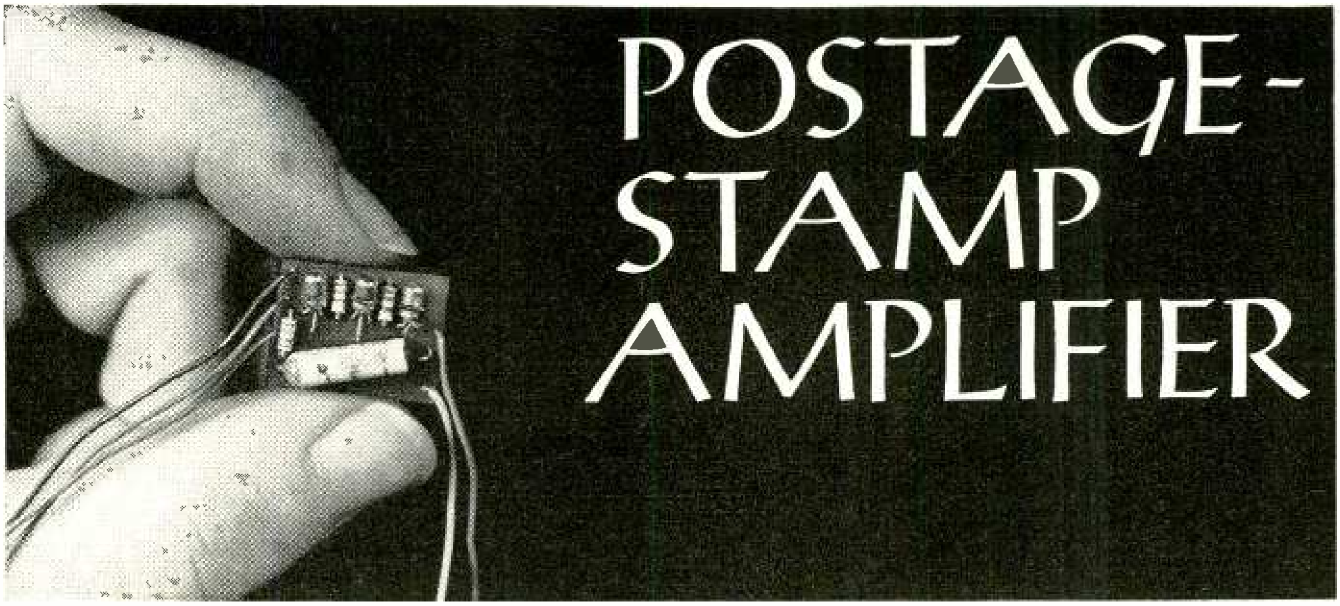
Varicaps Tune Auto Radio

One of the few new departures that appeared at the Radio Engineering Show was a remote radio tuner in a car steering wheel. Exhibited as an experimental model by Hughes Aircraft Co., the tuner uses voltage-variable capacitors to tune

the receiver. Pushbuttons in a head mounted in the center of the steering wheel select stations. The receiver itself may be mounted in the usual place (where it may be tuned manually when expedient) or in any other desired location in the car.

Ultrasonics Measures Liquid Flow

Two papers presented at the convention described how ultrasonics can be used to measure flow of liquids. Both pointed out that the speed of sound is low enough that, in a moving stream, a transverse acoustic wave is carried along by the stream as it passes through the water. If acoustic signals—sonic or ultrasonic — are introduced into a flowing stream—either a river or in a pipe—and reflected from the opposite side of the stream, they will have traveled a longer distance in a flowing liquid than in a still one, and the length of the path would increase with the speed of liquid flow. Thus, measuring the time required for the signals to return measures the rated flow. One of the papers, presented by Miller, Richardson and Serotta of Raytheon, discussed measuring river flow; the other, by Dahlke and Welkowitz of Gulton Industries, measurement of flow in pipes. END



POSTAGE-STAMP AMPLIFIER

By EDWIN BOHR

Microminiature unit is a complete 3-transistor amplifier

HERE is a microminiature transistor amplifier you can build and hide behind a postage stamp. The circuit-board area is less than 0.5 square inch.

The circuit is ultra simple, too. The only components are three transistors, three resistors and one capacitor. Cost is low, and assembly is unusually easy.

Circuit simplicity and reductions in commercially available component sizes make a home-built amplifier of such exceedingly small size possible. Resistors are 1/10-watt type and the electrolytic capacitor is the minimum-size variety sealed in a ceramic or aluminum sleeve.

The transistors are the smallest available, 2N207's. However, other slightly larger transistors, the 2N105 for example, can be used without increasing the circuit board size.

Circuit details

The direct-coupled circuit is a Philco development and appears on the data sheet for the 2N207. The collectors of V1 and V2 operate at about 0.3 volt. This mode of operation yields somewhat less than normal gain, but is tremendously simple and gives a considerable reduction in transistor-produced input-stage noise.

Resistor R3 supplies bias current for the input transistor (V1) and, because of the direct coupling, subsequently controls the bias current for the second stage and output transistor V3.

Because transistors, even of the same type, vary enormously in the amount of no-bias current flow (I_{co}), R3's value must be selected experimentally to provide optimum bias for V3.

Bias variations caused by changes in temperature are reduced by dc negative feedback, since R3 connects to V3's collector. For example, as V1's I_{co} increases with temperature, V3's collector voltage decreases. This reduced voltage causes *less* current to flow through R3, partially compensating for the increased I_{co}.

Generally, the circuit compensates against temperature changes of bias and operating point to about 107°F. Above this temperature, the transistors may be driven into nonlinear operation. This, of course, results in distortion and greatly reduced power output.

Fig. 1 gives the circuit details. Input and output impedances are both about 1,000 ohms. Maximum output voltage into the earphone is approximately 0.5.

Earphone resistance is important. Earphone voltage drop affects the bias and operating conditions of all three stages. Use an earphone with a dc resistance of approximately 1,000 ohms. Most 2,000-ohm impedance earphones actually have resistances of about 1,000 ohms.

If in doubt, measure the earphone resistance with an ohmmeter. Also, its dc resistance may be marked on the box.

A volume control is needed to prevent overloading and distortion on loud signals from the microphone or other pickup device. Fig. 1 shows how a 5,000-ohm volume control and microphone connect to the amplifier input.

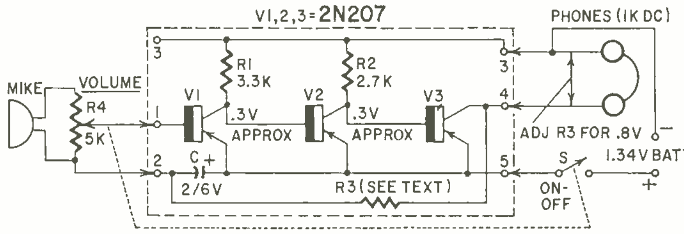
Fig. 1-b gives an alternate connection for coupling from a crystal detector or similar source.

Build one yourself

Fig. 2 shows the printed-circuit wiring for this unit. However, ordinary prepunched or solid insulating board and standard wiring also work. Drill holes, pull the leads through and tie them together with short pieces of small wire.

If equipment is available for drilling small holes, use No. 76 wire drills for the lead holes. This size is excellent for capacitor, resistor and transistor leads.

Wire the circuit, but omit resistor



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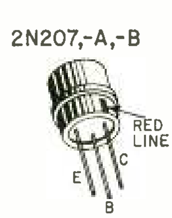
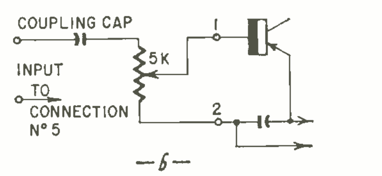
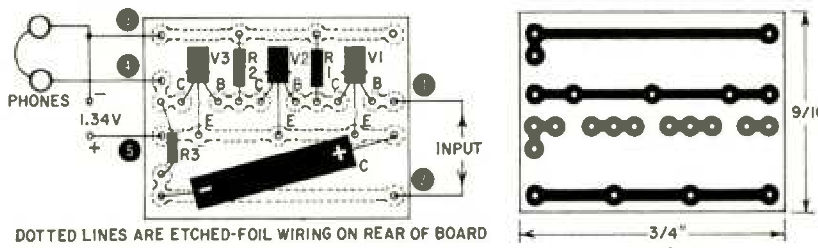




—b—

R1—3,300 ohms, 1/10 watt (Allen-Bradley, Ohmite)
R2—2,700 ohms, 1/10 watt (Allen-Bradley, Ohmite)
R3—see text, 1/10 watt (Allen-Bradley, Ohmite)
R4—pot 5,000 ohms, with spst switch
C—2 µf, 6 volts, miniature electrolytic
BATT—1.34 volts (Mallory RM-400R, RM-401R or equivalent)
MIKE—Shure MC-1 or equivalent

Fig. 1-a—Circuit of the 3-stage amplifier; b—alternate input arrangement for coupling from a crystal detector or similar source.



—a— —b—

Fig. 2-a—Parts layout on the printed circuit board; b—wiring side of board shown approximately twice actual size.

R3. However, be sure to leave a space to connect R3 later conveniently.

Next, connect the volume control, microphone, earphone and mercury cell. Be sure battery polarity is correct.

Connect a voltmeter from terminal 4 to terminal 5 and select a value for R3 that produces a reading of about 0.8 volt. The resistance may range anywhere between 27,000 and 180,000 ohms.

For convenience, temporarily connect a 250,000-ohm variable resistance —a volume control will do—in place of R3 and adjust it until 0.8 volt is measured. Then measure the resistance of the control with an ohmmeter and substitute the nearest value of fixed resistance.

If the measured resistance of the variable control is 110,000 ohms, use either a 100,000- or 120,000-ohm fixed resistor. After the fixed resistor is installed, it is a good idea to remeasure V3's collector voltage to see if it is still approximately 0.8 volt.

When transistors are changed or swapped, even though they are the same type, R3's value will have to be readjusted.

If ultra-low noise levels are needed, the selected low-noise 2N207-B's and 2N207-A's should be used in the first two stages. However, the 2N207 is a very-low-noise unit and we feel it is satisfactory for most applications.

Operating notes

The amplifier's supply voltage should be constant and present low internal resistance. For this reason, a single mercury cell is recommended. Current drain is roughly 2 ma.

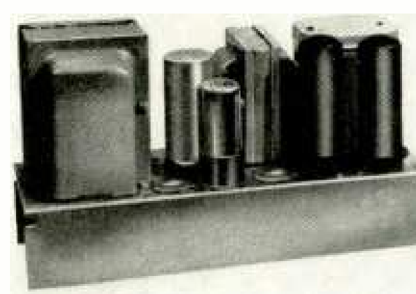
A tiny RM-400R operates the amplifier for about 40 hours, and the RM-401 gives approximately 400 hours of operation.

To prevent ultrasonic parasitic oscillations, keep microphone leads as short as possible, or use shielded wire for necessarily long leads. If the amplifier is placed in a metal case, connect the case to either terminal 3 or 5.

Any additional tendency toward oscillation can be cured by connecting a .05-μf microminiature ceramic capacitor from V2's collector to terminal 5. Do not connect capacitance across the microphone or earphone because this will produce resonances and an undesirable amount of sea-shell ringing and noise enhancement.

You can get considerably more gain and better low-frequency response results if C1 is increased to 10 μf or more. It may, however, increase the amplifier's size slightly. END

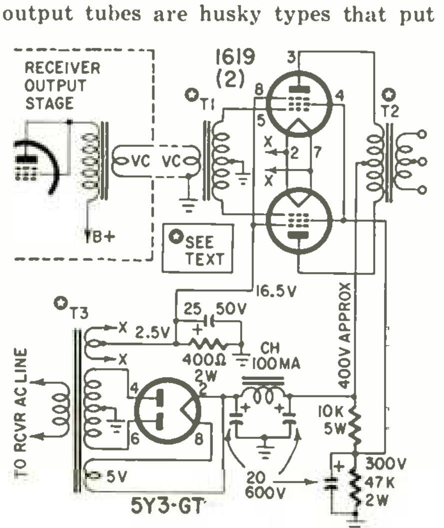
Power Amplifier for AC-DC Sets



By JOHN A. DEWAR

IF you have ever tried to connect a power amplifier to an ac–dc receiver, you know the difficulties involved with hum and hot line connections. The power output amplifier described here solves the ac–dc coupling problem and also kills another bird with the same stone.

Being a little Scottish by nature, I have long worried about what to do with power transformers from c' olete radios. Many of these with a 2.5-volt heater winding for 45, 46, 47 or 2A5 output tubes are husky types that put out 350–400 volts at more than 100 ma. Brittle insulation and potted transformers make rewinding the 2.5-volt secondary to 6.3 volts impossible. However, by using a 1619 tube, we can still use the 2.5-volt secondary and extend the useful life of those old transformers. (New, this tube runs about $4; surplus less than 50c.)



The 1619 is a metal tube, similar to the 6L6 but with a 2.5-volt 2-amp directly heated filament that can handle up to 36 watts of audio in class-AB_2 operation.

Characteristics of the 1619 are:

Class	Plate (volts)	Screen (volts)	Plate (ma)	Bias (volts)	Pwr. Out (watts)	Load Resis. (ohms)
AB_1	400	300	50	−20	17.5	14,000
AB_2	400	300	75	−16.5	36	6,000

The amplifier (see photo and diagram) is built into a 4 x 11-inch chassis and incorporates a unique system for coupling to the ac–dc receiver. The push-pull output transformer from the obsolete radio is used as the push-pull to input transformer for the amplifier. The receiver's voice-coil winding is connected to the voice-coil winding of the input transformer. This couples the audio but isolates the amplifier from the ac–dc set as long as the input transformer is left floating. Also, since the dc resistance of the input transformer's grid winding is low, the amplifier can be driven into the region of class-AB_2 operation without running into serious distortion caused by grid current.

Removing the screen connection from the receiver's output tube and connecting its screen to its plate for triode operation gives less audio gain but better quality and the output tube acts as the 1619's driver. For better treble response, remove the bypass capacitor usually connected to the output tube plate, since some of the highs will be lost in the distributed capacitance of the succeeding transformers.

The impedance of the output transformer is not critical—about 10,000 ohms is suitable. I even used a vibrator transformer in my unit. Strange as it may seem, this gives good audio response and has a large power-handling ability. Either half or all of the center-tapped low-voltage winding can be used for best impedance match.

No claim is made that this is a high-fidelity amplifier, but it does have good quality. The highs are brilliant, bass is strong, and the amplifier will load a heavy-duty 12-inch speaker to the point where the windows rattle. END

DESIGN YOUR OWN PREAMP

Part V—Putting the pieces together

By NORMAN H. CROWHURST*

HAVING discussed the salient points of the various important sections of a preamp, we can now design a complete unit.

The exact shape will depend upon your choice of styling, but there are some construction features that should be mentioned from the viewpoint of performance. A preamp has to handle extremely small signals and bring them up to a level suitable for the input of the basic amplifier. This means that hum and other spurious sounds must be minimized.

To do so, the low-level circuits should be adequately shielded and kept away from possible radiating fields from which they may pick up hum. This is an advantage of the long low type of construction that has become popular in preamp styling. It permits the input end to be kept well away from the power transformer and other power supply components.

You can save yourself considerable trouble in hum elimination by using an aluminum chassis rather than a steel one. All power transformers radiate a certain amount of hum field, and the steel chassis tends to convey it throughout its length while the aluminum chassis does not.

The entire amplifier should be enclosed in a metallic casing, preferably aluminum. This provides integrated shielding for all the low-level stages and avoids the necessity for shielding individual leads. The latter practice causes difficulty with high-frequency response because shielded leads introduce extra capacitance to ground, which means that the high-frequency rolloff will be quite severe. Use a completely enclosed construction, so the tubes and their associated circuits are all surrounded by a metallic shield, and arrange the layout so the signal path progresses steadily across the chassis from left to right with the minimum lead length between any two points, to get the best all-around performance.

*Author: *Understanding Hi-Fi Circuits*, Gernsback Library.

General circuit plan

Assume we want the low-level input to take 1 mv from a pickup and give 2 volts from the preamp output, to provide a margin for the usual amplifier input—in the region of 0.5 to 1 volt. One half of a 12AX7 operating with a 270,000-ohm plate coupling resistor and a following-stage grid resistor of 470,000 ohms will give a gain of 66, according to the tube manual. Three such stages will give a gain of 66^3 or 287,000, or 109 db.

We need equalizing circuits that will introduce 20-db attenuation and our tone control circuit should provide a similar loss. This will leave a net gain of about 69 db, which allows 3-db margin over the 66 db we set for ourselves (1 mv in to 2 volts out). This looks as if we could use two 12AX7's, using the spare half for a cathode-follower output (Fig. 1).

From this we can sketch out the approximate level at different points, as in Fig. 1 to see how we can arrange the sequence. With a 1-mv input, the first stage will give a gain (in round figures) of 60, producing 60 mv at the plate. If we put the equalization in at this point, it will reduce the level to 6 mv at the grid of the second stage, which is 16 db higher in level than the grid of the first stage and hence keeps a safe margin above noise.

The second stage will give a further gain of 60, bringing the level up to 360 mv at its plate. We also need a high-level input for radio, TV, crystal pickup or tape sources, each of which may be in the region of 0.5 to 1 volt, and none of which require this phono equalization. So the output of the second stage is a convenient point to place a high-level input.

Next we can add the volume control, followed by the tone control. The tone control brings the maximum level down into the region of 36 mv. The last of the three amplifying stages brings the level up to a maximum of 2 volts—our specified output level.

Here we can insert the loudness control and finish off with the cathode follower. It provides a low source impedance for the connecting link to the power amplifier and insures that loading by the power amplifier input impedance does not affect loudness-control performance or any other part of the preamplifier in any way.

We have based this calculation on the 12AX7, but this tube is notoriously microphonic and hum-generating in low-level application. But the 7025 has electrical characteristics identical to those of the 12AX7, and is specially constructed to be non-microphonic and have low hum for preamplifier use.

Power supplies

With the amount of bass emphasis given by the equalizer (and possibly

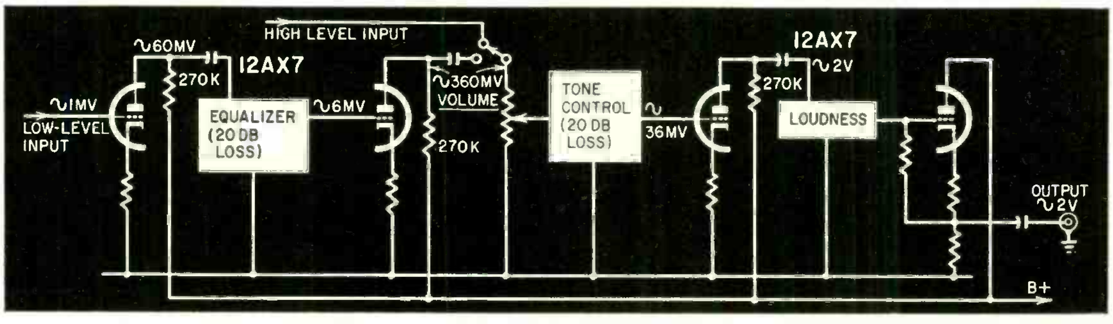


Fig. 1—Preliminary figuring; first the general tube plan is laid out and prospective signal levels at various points filled in.

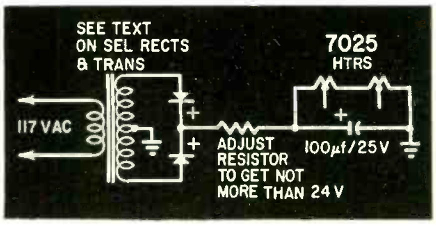


Fig. 2—Ac heaters may cause hum problems; this dc heater supply solves them.

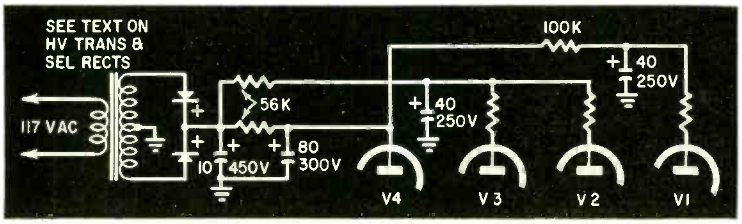


Fig. 3—Basic outline of B-plus supply arrangement with values.

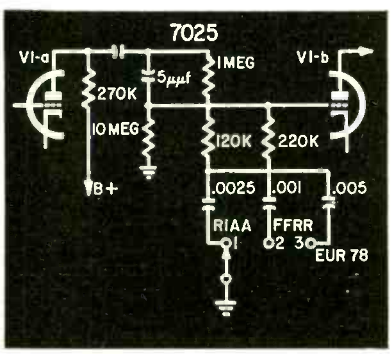


Fig. 4—Basic low-frequency section of the equalizer circuit.

some additional from the tone control), hum level is not low enough using ac heaters. The tube data give the maximum rms hum level referenced to the grid as 7 µv. With the circuit discussed, the audio level at the input is only 1 mv, so this gives us a hum level only 43 db below maximum audio level, although this will, it is true, be all 60 cycles.

The best sure-fire remedy is to use dc for the heaters of all tubes (using 7025's both places). If the heaters are connected in series, the supply needed for them is 24 volts at 0.150 amp. This is conveniently supplied by a selenium rectifier and a suitable transformer. A minimum of filtering gets heater hum down to a satisfactory level. A 100-µf 25-volt electrolytic across the heater line will do, as shown in Fig. 2. This circuit may need a little trimming to get the right heater supply voltage. Don't have it over 24 volts. If anything, err on the low side—say 20–22 volts.

A dc heater supply can be built around one of the newer transformers for feeding selenium rectifiers and a rectifier that can handle 24 volts at 150 ma. Two connected in full-wave with a suitable transformer will give 24 volts at 150 ma quite well filtered with the aid of a 100-µf electrolytic capacitor and a resistor to provide the necessary voltage drop to protect the tube heaters.

The dropping resistor must be carefully adjusted to avoid burning out the heaters. Start with a value that is obviously too large—say 50 ohms—and work your way down until you get 24 volts or a little less. If you start the wrong side of 24 volts, you may well blow the tubes.

A 3,300-ohm cathode resistor gives correct bias for each stage. To get maximum gain it is bypassed by an electrolytic capacitor. A 100-µf 6-volt unit is satisfactory.

For the B-supply, a transformer with a 500-volt center-tapped secondary rated at 20 ma is ample. A pair of selenium rectifiers feeding a resistance–capacitance filter give adequately smooth B-plus at each point.

To minimize feedback problems caused by the common B-supply, the cathode-follower feed is decoupled on the first stage, while the middle two stages have a common B-plus feed point as shown in Fig. 3. This insures that any common coupling through the supply will always be *negative* feedback. This can occur only under maximum-gain conditions, with bass boost, volume control and loudness control all set at maximum.

The resistors are calculated to provide the right plate voltages at each supply point. Each tube takes 0.45 ma (according to the tube manual). The rectifier will give about 300 volts on the 10-µf electrolytic. Allowing 50 volts' drop in the feed to the cathode follower requires 56,000 ohms. A further 100,000 ohms to the first stage will give it about 200 volts. The feed to the middle stages also uses 56,000 ohms to give 250 volts B-plus.

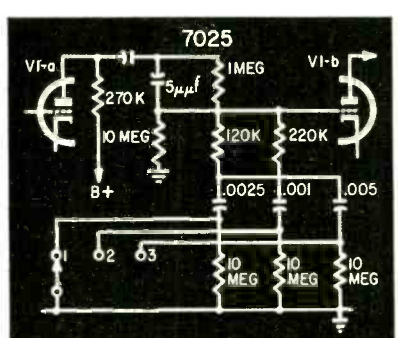


Fig. 5 — Low-frequency equalizer with click suppressing resistors added.

Equalization

Now for the audio circuits. We decide we want three equalizations: one for the RIAA curve which gives a 20-db low-frequency boost between 50 and 500 cycles and a high-frequency rolloff commencing at 2,120 cycles. The ffrr, for older London records, requires a 14-db low-frequency boost, with the critical points at 150 and 750 cycles, and a 20-db downward step for the high end, with the critical points at 1,000 cycles and 10 kc. Finally, a curve to suit the European 78 is desirable. It gives a 20-db low-frequency boost, with the critical points at 25 and 250 cycles, with no high rolloff at all. If a special equalization is needed, it can be added in a similar manner.

The maximum low-frequency boost required for any of these is 20 db, although the ffrr requires only 14 db. So we can use a 1-megohm series resistor from the plate-coupling resistor of the first stage to provide the top end of the boost network as a starting point.

For the European 78 characteristic, which has no high rolloff, connecting this circuit to the grid of the second stage causes a loss of high frequencies due to about 50-µµf stray capacitance to ground. This will be across a resultant resistance of approximately 100,000 ohms. To compensate for this, connect a 5-µµf capacitor across the 1-megohm resistor.

For each of the 20-db boosts, the bottom-end resistor should be about 120,000 ohms. The capacitor has to be modified to give the right turnover point in each case. For a 14-db boost, the bottom-end resistor must be about 220,000 ohms.

To get the boost in the right place, the turnover point should be at 500 cycles for the RIAA. For a 120,000-ohm reactance at 500 cycles, we need .0025 µf. For the European 78, we need a capacitor with a 120,000-ohm reactance at 250 cycles. This requires .005 µf. For

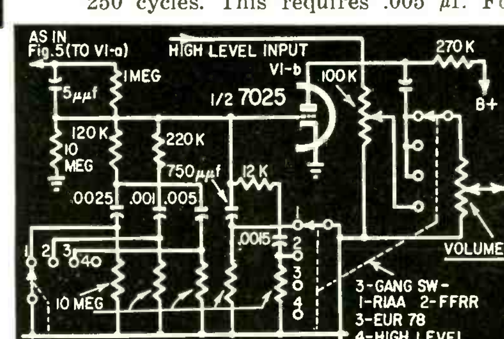


Fig. 6 — The complete equalizer and input switching arrangement.

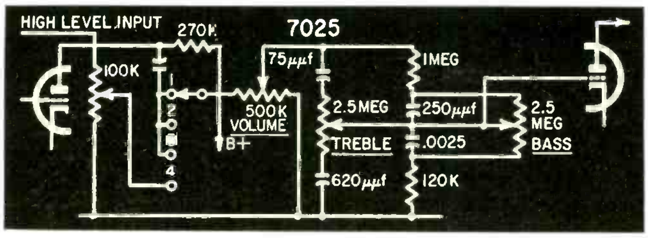


Fig. 7—Figuring out the tone control circuit values.

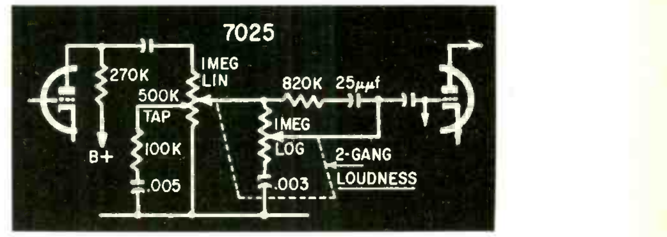


Fig. 8—Details of loudness control circuit.

the ffrr we need a capacitor with a 220,000-ohm reactance at 750 cycles. This requires .001 μf. The circuit so far is shown in Fig. 4.

As a precaution against switching clicks when the switch is turned with the program turned on, connect a 10-megohm resistor between the switch contact and ground, to keep each of these capacitors discharged when not in the circuit, as shown in Fig. 5.

To take care of the high-frequency rolloff, the RIAA requires a capacitance with a 100,000-ohm reactance at 2,120 cycles. Here 750 μμf will serve. For the ffrr characteristic, we need a 12,000-ohm resistance in series with a capacitance giving a 110,000-ohm reactance at 1,000 cycles. This requires .0015 μf. This takes care of the three equalization characteristics, which can be wired as shown in Fig. 6. A three-pole four-position switch is used to select phono equalization characteristics in three positions. The fourth position is for high-level input.

Volume and tone controls

To satisfy the loading requirements of the second stage, a 500,000-ohm LEVEL control should be used. This is the minimum value to secure maximum gain from the second stage. At same time, the resistance of the second stage, looking back from the top end of the volume control, is somewhat less than 100,000 ohms while the maximum source resistance, looking in at the slider of the volume control, occurs when this is approximately 300,000 ohms from the bottom and will be a resistance of 150,000 ohms. So the source resistance, looking back into the volume control from the tone control circuit (Fig. 7), will be a maximum of 150,000 ohms and a minimum, near its bottom position, in the region of zero.

It should have a logarithmic taper to give the correct range discussed in the article on this subject. An inexpensive little luxury is the 100,000-ohm preset potentiometer connected in the high-level input, which adjusts the input so program switching does not drastically alter level.

If we make the top-end resistor of the tone-control divider network 1 megohm, and the bottom-end resistor 120,000 ohms, we should get tone compensation which is practically unaffected by the volume control setting. The bass-boost capacitor should have a reactance of 120,000 ohms at about 500 cycles, which requires .0025 μf. The rolloff capacitor should be about 250 μμf. The BASS control should be 2.5 megohms as an optimum value. If more control is required, 5 megohms may give better results but this runs the risk of putting too much resistance in the grid circuit of the third stage.

High-frequency rolloff needs a capacitor with a 120,000-ohm reactance at 2,000 cycles. A 620-μμf unit is about right. For high-frequency boost, the capacitance should have a 1-megohm reactance at 2,000 cycles—about 75 μμf. Another 2.5-megohm control serves as the TREBLE control. The completed volume and tone control circuit is shown in Fig. 7.

Next is the loudness control. Its circuit is shown in Fig. 8.

Cathode-follower output

The cathode follower for this circuit is quite simple. The same circuit values can be used, putting the 270,000-ohm resistor in the cathode circuit instead of the plate. However, it is advantageous to use a somewhat lower value as we do not need maximum gain and we do not want to strangle the tube. About 150,000 ohms would probably be better, with a bias resistor in the region of 2,700 ohms. The grid-to-bias point resistor can be lower than usual—in the region of 100,000 ohms. This will not appreciably load the loudness control circuit, because of the feedback in the cathode follower which is in the region of 34 db, which will multiply its effective value by 50, to 5 megohms.

The output coupling capacitor choice depends on the input resistance of the basic amplifier. If it is 100,000 ohms, a 0.25-μf capacitor will give less than 1 db loss at 20 cycles. If the basic amplifier input resistance is 250,000 ohms, a 0.1-μf capacitor will give the same results. But if the input resist-

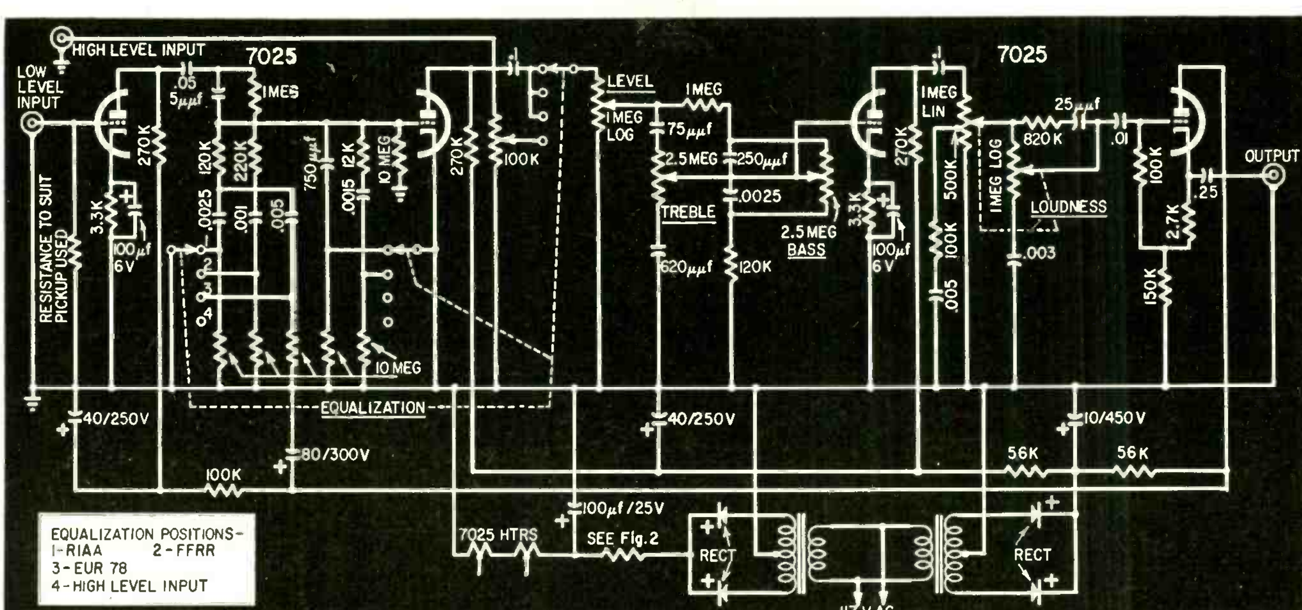


Fig. 9—The complete preamp circuit

ance (or impedance) is 600 ohms, 0.25 μf will give bass loss beginning 3 db down at 500 cycles, while 0.1 μf will start the bass rolloff at 1,250 cycles! Apart from which, operating a cathode follower this way will cause much distortion.

We have now gone through all the essential features of this preamplifier circuit and the whole circuit is shown in Fig. 9. We have still a few more points that need attention.

Coupling capacitor values have not been given. There are four. To find the 3-db point in the whole amplifier, it will correspond with 0.75 db each, if they are all the same. If this frequency is made 10 cycles, we shall have a 1-db loss at 20 cycles in overall response, which should be acceptable. So the 3-db point of each coupling should be at about 3.5 or 4 cycles. For the first stage, the associated resistance is just over 1 megohm, so .05 μf will be adequate. For the second stage, the associated resistance can be as low as about 600,000 ohms (100,000 ohms in the plate and 500,000 ohms in the following grid), so we should use 0.1 μf. For the coupling from the third stage to the loudness control, 0.1 μf again is needed, while the input to the cathode follower looks like 5 megohms, so .01 will be adequate here.

This completes the story as far as values are concerned. The input resistor is suited to the type of pickup used. The high-level input is 100,000 ohms. If a larger value is needed for satisfactory operation of whatever you connect (a crystal pickup, for example), it can be changed without causing serious difficulties.

A final point is ground wiring. If the following points are observed, you should have no trouble with hum or instability.

- Wire all ground returns to the associated stage, and make the ground a single continuous bus running from input to output.
- Connect the ground bus to the chassis only at one point, preferably near the input end. Avoid using electrolytic capacitors that provide a ground to chassis. If they have a metallic case connected to their negative lead, isolate the case from the chassis, and connect it to the ground bus at the appropriate point, which should be near the output end or where the transformer center tap is.
- Keep all heater current out of the ground bus. Wire the heaters separately, including the supply and filtering, and ground the negative side at one point only.

You may like to add an on–off switch, attached to either the VOLUME or LOUDNESS control. If so, be sure the ac wiring to the switch is kept well away from audio circuits, especially low-level ones. Follow the same precaution if you add a pilot light. As stated earlier, it pays to keep audio leads short, and it's also a good idea to run them close to the chassis. END

Night Switch for Hi-Fi

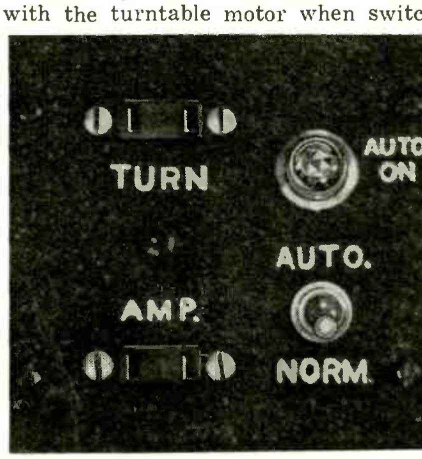
By RICHARD G. BEMIS

FOR hi-fi system owners who like to be lulled to sleep by the soothing strings of Mantovani or some other favorite musical selection, here is a device that automatically shuts off all components after the last disc has ended.

It is an adaptation of a feature now available on many record changers. The changer's built-in automatic shutoff is extended to include the power amplifier and its associated components.

An inexpensive hookup of six components on a small chassis completes this project in an evening at home. The basic component is the 6-volt single-pole double-throw relay. It is mounted near the center of one cover of a 4 x 4 x 2-inch cabinet. Mounted next to the relay are two ac outlets for the turntable and amplifier. On the other side of the relay, a dpdt toggle switch and a 117-volt neon pilot light assembly are mounted (see photos).

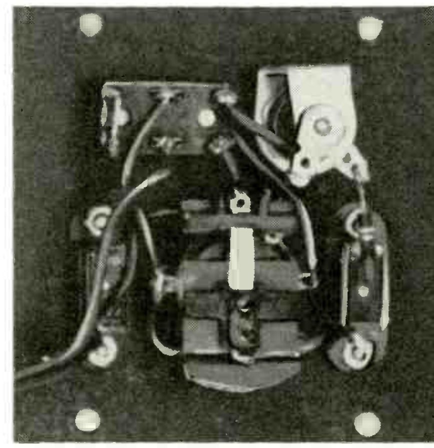
The relay's coil is connected in series with the turntable motor when switch S is in the AUTO position. Using only 6 volts, this relay has no undesirable effects on the 105–130-volt turntable motor circuit. (The model used by the author is Garrard model RC-88.) This relay passes ac line power for the amplifier through its contacts when in the energized position. After the last record has played, the automatic shutoff of the turntable motor stops current through the relay, which opens, turning off line current to the amplifier.



The completed unit makes a neat little package.

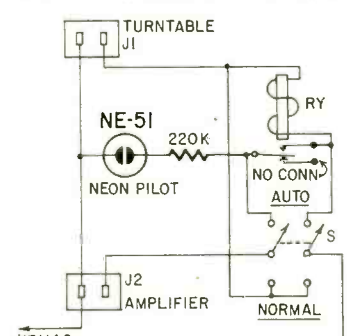
The neon pilot light is connected across the alternate amplifier power circuit and is on when the relay is energized in the AUTO position. In the NORMAL position the pilot lamp is out. A 220,000-ohm resistor (R) is a current limiter for the lamp circuit.

There must be a common ground between the night switch and the main power amplifier to keep the neon bulb from glowing dimly in the NORMAL position when the equipment is not in use. If, upon original hookup, this does not put out the glow, reverse the plug from the power amplifier. The lamp will still glow dimly in the NORMAL position when the power amplifier is on. I have not found a solution to this problem. Any suggestion will be appreciated.



All parts are mounted to the unit's front panel.

If the record player is in operation when the switch is thrown from NORMAL to AUTO, there is a noticeable pop in the sound system. This is an unavoidable reaction caused by the mechanical operational delay of the relay over that of the dpdt switch. So be sure the system is turned off before switching in the night switch. Also, remember to place the switch in the NORMAL position before restarting the record player the next morning. Pleasant dreams. END



R—220,000 ohms, 1/2 watt
J1, 2—ac sockets, female
RY—6 volts, spdt
S—spdt toggle
Pilot-light assembly with NE51 neon lamp
Case, 4x4x2 inches

Circuit of the simple night switch.

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HEATHKIT AA-20 $34.95

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Here it is! A new manual stereo record player kit

Made by famous Garrard of England, the AD-10 is a compact 4-speed player designed to provide trouble-free performance with low rumble, flutter and wow figures. Rubber matted heavy turntable is shock-mounted, and idler wheels retract, when turned off, to prevent flat spots. Powered by line-filtered, four-pole induction motor at 16, 33⅓, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. 10 lbs.

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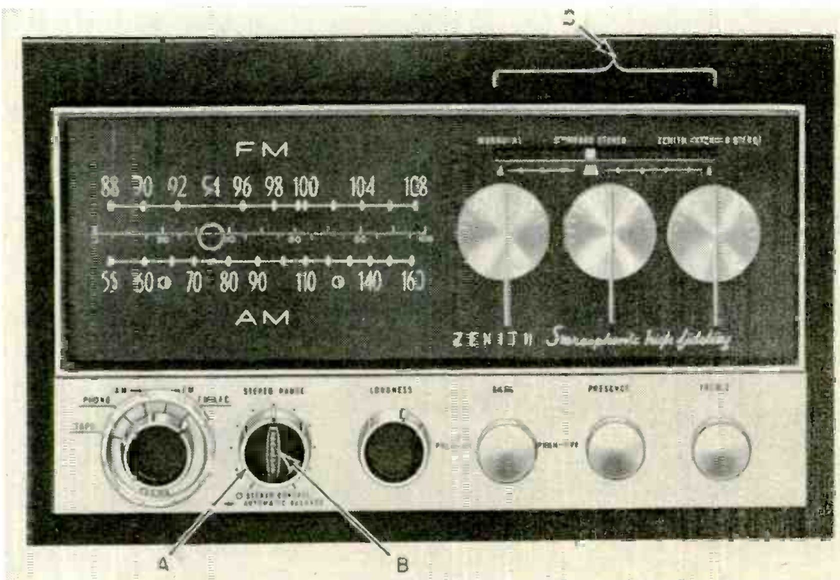
HEATH COMPANY Benton Harbor, Michigan

New Features in Stereo Packages

Three interesting audio circuits in single-cabinet instruments

By ROBERT F. SCOTT
TECHNICAL EDITOR



Zenith has extended stereo control (A) on panel of their hi-fi instruments. Clockwise rotation moves indicator from monaural to standard stereo to extended stereo (C). Balance control (B) is mounted coaxially with stereo range control.

IN the article "Stereo in a Package," page 57 in the November, 1957 issue, Larry Steckler described some of the circuit features in new packaged stereo equipment. As a followup, we will cover in detail unusual circuitry in late Zenith, Magnavox and Motorola stereo phonographs and combinations.

Zenith's extended stereo

Many new Zenith stereo units feature amplifier circuits with a control that permits the listener to vary the spread of the stereo effect—filling the hole in the middle so there is no sensation of separate sound sources, or exaggerating the separation as desired. The information from the left and right channels of the pickup is mixed so one amplifier carries the *sum* (L + R) of the signals derived from the right and left channel and the other carries the *difference* (L − R) signal. The sum

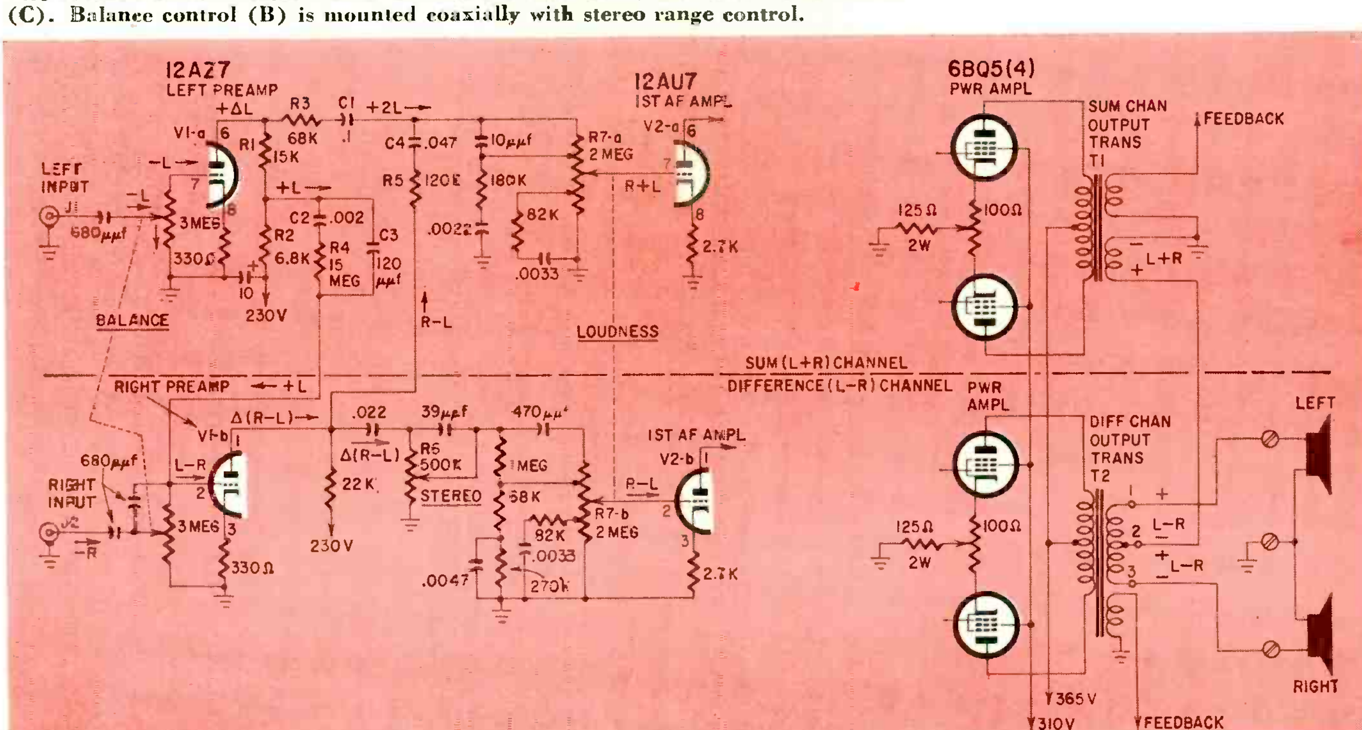


Fig. 1—Simplified circuit of Zenith extended stereo system.

channel carries the combined information of both channels and provides good monophonic hi-fi reproduction when the difference channel is eliminated. The difference channel is responsible for the separation or spread in stereo reproduction.

The output transformers of the L + R and L − R power amplifiers are connected as a matrix network so the information originating in the left channel of the source comes out of one speaker while that from the right channel comes out of the other. The stereo effect is controlled by varying the magnitude of the R − L signal fed to the difference amplifier. When no signal is fed to the difference amplifier, the system operates monophonically with the sum signal appearing in both speakers. Standard stereo is obtained with the control set for equal signals fed to the sum and difference amplifiers, and extended stereo is obtained when the greater signal is fed to the difference channel.

Fig. 1 is a simplified circuit of the Zenith extended-stereo system. Right and left signals from the stereo cartridge are fed through J1 and J2 to the arms of the dual BALANCE control. The sections of this control are connected so the signal to the grid of one of the preamplifiers increases as the signal to the other decreases in proportion.

Circuit analysis

Assume that at a given moment the stereo source delivers minus L (−L) and minus R (−R) signals to inputs J1 and J2, respectively. The left preamp inverts the phase of the signal and amplifies by a factor Δ, equal to stage gain. If, in this case, stage gain is 2, a +2L signal will appear at the plate and at the junction of C1 and C4.

The plate load for the left preamp (V1-a) consists of R1 and R2 in series. This network forms a voltage divider developing a +L voltage at the junction. This +L signal is tapped off and fed through a network consisting of C2, R4 and C3 to the grid of V1-b, the right preamplifier.

The incoming −R and the +L signals appear as an L − R signal on V1-b's grid. The phase is inverted and the amplified signal Δ(R − L) appears at the plate and across R6, the STEREO control. A portion of this voltage is tapped off and fed as R − L to the high end of section R7-a of the LOUDNESS control. Here it combines with the +2L signal from V1-a's plate to develop a sum (R + L) signal on V2-a's grid.

The R + L and R − L signals on the arms of the LOUDNESS control are amplified by V2-a and V2-b and passed through tone controls, a second audio amplifier and phase inverter to the grids of the push-pull 6BQ5 power amplifiers.

The matrix

The matrix network consists of the secondaries of output transformers T1

The Motorola model SK30 comes in mahogany, blond, and walnut finishes.

and T2. The secondary of T2, the difference amplifier's output transformer, is center-tapped and the tap is connected to the ungrounded end of T1's secondary.

The sum voltage developed across T1's secondary is in series-aiding with the voltage across one half of T2's secondary and in series-opposing with the voltage across the other half. Polarities are indicated on the diagram to show this relationship. As shown, the voltage from T1 is in series-aiding with the voltage between terminals 1 and 2 on T2 and we have $(L + R) + (L - R) = 2L$. This signal appears across the left speaker.

Similarly, T1's signal is in series-opposing with the voltage across terminals 2 and 3 so we have $(L + R) - (L - R) = 2R$ applied to the right speaker. These examples assume that the STEREO control is set for normal stereo so signals of equal amplitude are fed to the sum and difference amplifiers.

Recalling that the difference channel determines the spread or separation, we can control it by varying the signal fed to the difference amplifier. Assume that for extended stereo, the STEREO control is set so the output of the difference channel is twice that of the sum channel. Now, the signal in each half of T2's secondary is $2(L-R)$. The voltage across the lower half of T2 is in series-opposing with that developed in T1 so the signal applied to the right speaker is $(L+R) - 2(L-R)$ or $3R-L$. On the other hand, the voltage across the upper half of T2 is in series-aiding with that from T1 and the voltage on the left speaker is $(L+R) + 2(L-R)$ or $3L-R$. Thus, the spread of the stereo effect is determined by the magnitude of the out-of-phase components applied to the individual speakers.

3-channel stereo

Many manufacturers of stereo radio and phono packages are touting "three-channel" systems. Do not confuse these with the three- and four-channel systems that have been demonstrated with tape. In these three-channel systems, the third or center channel is obtained by mixing portions of the left and right signals of a conventional two-channel stereo source.

The third channel was introduced to eliminate or minimize the hole-in-the-middle effect that is heard when the right and left speakers are too far apart or when the system is not phased properly. Frequencies below around 350 cycles do not contribute as much to the stereo effect so most package manufacturers use those frequencies for the center channel while the stero effect is maintained by frequencies above 350 cycles from the right and left speakers. The third channel is obtained by electronic or acoustic mixing.

With acoustic mixing, the stereo system generally uses three-way speakers in the outputs of the left and right amplifiers. The woofers for the two channels are placed in the center of the cabinet while the mid-range speakers and tweeters are in the ends of the cabinet or in separate enclosures. This gives the effect of a "wall of sound" with the stereo effect maintained by the directional characteristics of frequencies above 350 cycles from the mid-range speakers and tweeters.

There are several ways of mixing the L and R signals electronically to obtain a center channel. The most common is

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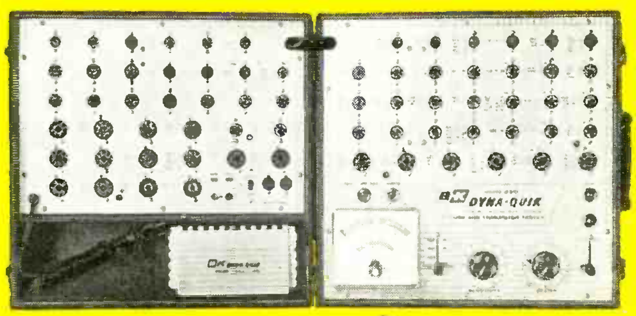

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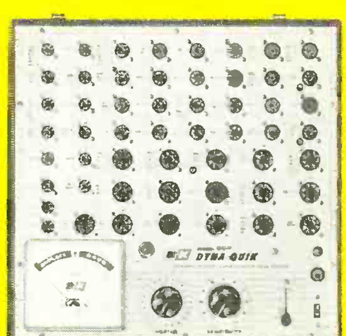

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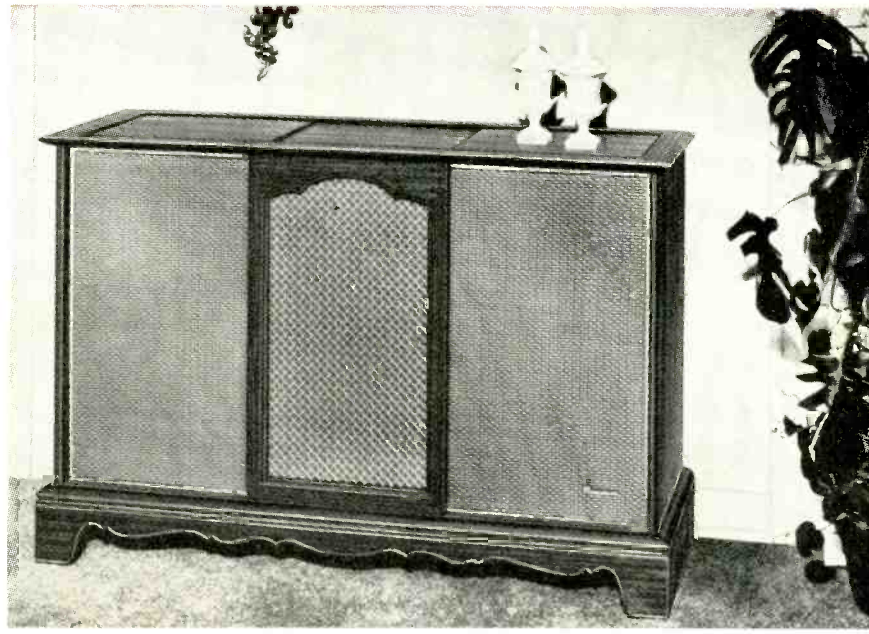
to bridge a woofer between taps on the output transformers of the left- and right-channel amplifiers. When multichannel speaker systems are used for the outside channels, the woofer is often bridged across the low-frequency outputs of the right- and left-channel cross-over networks.

Another method is to feed the sum of the left and right input signals to a third amplifier through a low-pass filter and feed the individual left- and right-channel signals to their respective amplifiers through high-pass networks.

Some of Motorola's phonographs and combinations feature a "three-channel" stereo system with a separate low-frequency (below 300 cycles) amplifier for the center channel. Fig. 2 shows the circuit of the HS-768 and HS-793 power amplifier chassis used in the SK28, SK29, SK30 and SK31 models. All models in this series have a 15-inch woofer in the center channel. The SK28 and SK30 have 8-inch dual-cone mid-range speakers and 5-inch tweeters in the right and left channels. The SK29 has 6 x 9-inch mid-range units and 5-inch tweeters. The SK31 is similar to the SK28 and has a pair of 5-inch tweeters in each of the outside channels.



The Magnavox model 1-ST215H.

The right- and left-channel signals from the preamplifier are applied directly to the inputs of the single-ended right- and left-channel amplifiers through two-section high-pass filters C1, R3, C4, R6 and C2, R4, C5, R7 respectively. The incoming signals from the preamp are mixed in R1 and R2 to produce a center-channel signal that is the sum of the signals in the right and left channels. The L+R signal is applied to the input of the bass (center-channel) amplifier through a 300-cycle low-pass filter composed of C3, R5 and C6. Signals below 300 cycles readily pass through the filter and on to the push-pull bass power amplifier and the 15-inch woofer.

When used on a monophonic source, the function switch on the preamplifier and control chassis (not shown) connects the right- and left-channel inputs. The system then functions as a twin-channel amplifier with electronic cross-over at 300 cycles.

The Magnavox circuit

Magnavox stereo units using the 182

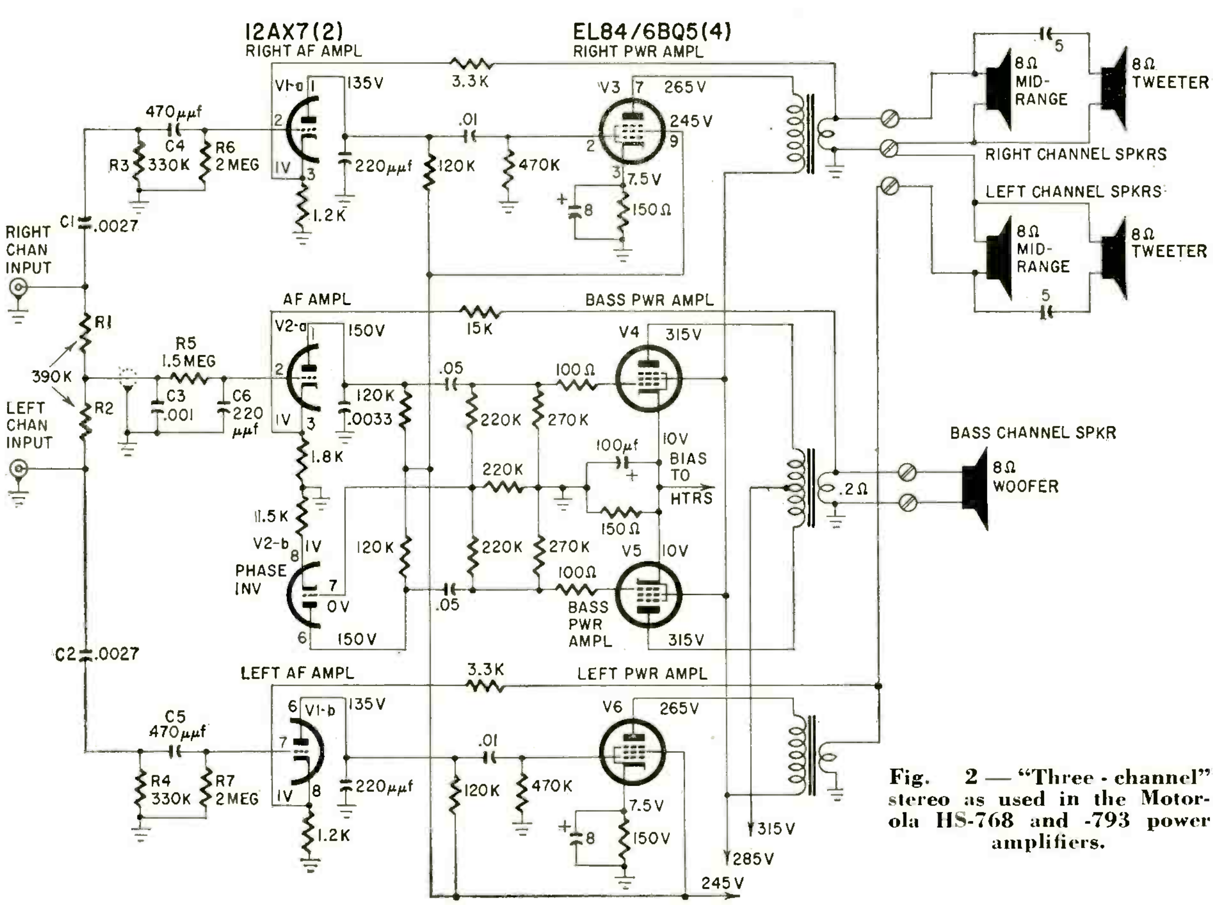


Fig. 2 — "Three-channel" stereo as used in the Motorola HS-768 and -793 power amplifiers.

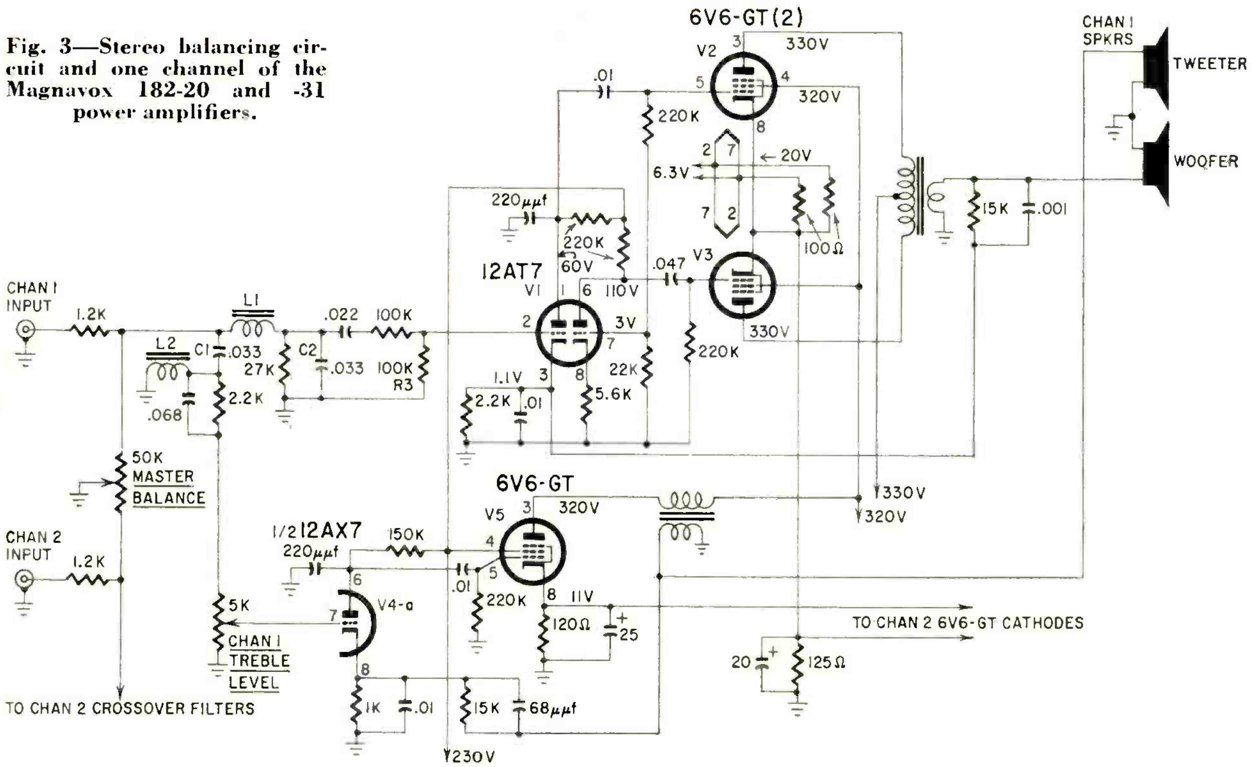


Fig. 3—Stereo balancing circuit and one channel of the Magnavox 182-20 and -31 power amplifiers.

series chassis have separate bass and treble amplifiers for each stereo channel. Each bass channel uses push-pull 6V6's delivering around 12 watts and the treble channels use single-ended 6V6's with 3 watts output. The schematic of one of the stereo channels is shown in Fig. 3.

The signal from one channel of the stereo source is fed to 1,000-cycle high- and low-pass filters in parallel. Signals below 1,000 cycles pass through the low-pass filter (L1, C2) to the 12AT7 voltage amplifier and phase inverter to the push-pull grids of the 6V6-GT power amplifier tubes. The high-pass filter (C1, L2) feeds signals above 1 kc to half of a 12AX7 treble voltage amplifier driving a single 6V6-GT. The bass and treble amplifiers have negative feedback from their respective speakers to the cathode of the input stage.

The stereo balancing circuits vary with different versions of the 182 chassis. In the 182-20 and -31 chassis, the bass amplifiers are carefully engineered for equal gain and output and a MASTER BALANCE control is connected across the inputs ahead of the crossover filters as in Fig. 3. Separate TREBLE LEVEL controls are connected in the grid circuits of the treble amplifiers. In the 182-00 and 182-10 versions, the bass balance control is between the low-pass filter and the input grid of the second channel. Here, the resistor corresponding to R3 in the second channel is a potentiometer with its arm connected to the input grid. END

NEXT MONTH

Reading Industrial Diagrams

Convert troublesome industrial drawings to electronic terms you are familiar with. Don't let the seemingly confused symbols and circuits throw you. Use the handy chart that shows industrial symbols and their communications counterparts. Find out how and where industrial symbols are used.

Better R-E Twin-Coupled Amplifier

The original R-E twin-coupled circuit is updated. More power, increased gain, improved bass response, voice-coil feedback, additional treble and bass controls make the twin-coupled circuit more useful and versatile than ever.

Dictionary of Color TV Controls

Don't know which color TV control does what? Here's a simple detailed chart that lists all the color TV controls a technician is likely to encounter. It tells what the control does, what it looks like, what it's called, where to find it and how to use it.

No-Parts Radio

Well practically none. Two-transistor matchbox radio has a total of six parts. Coupling capacitors and resistors are eliminated by using a novel direct-coupled design. Battery drain is low, size is small, cost is low.

SIGNAL VOLTAGES in the CHROMA MATRIX

The chroma matrix doesn't have to be a confusing area when you work on a color-TV receiver—here's proof

By **ROBERT G. MIDDLETON**

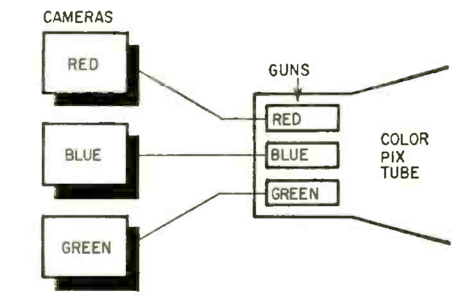


Fig. 1—The end result of matrix operation, no matter what the type of matrix or demodulator.

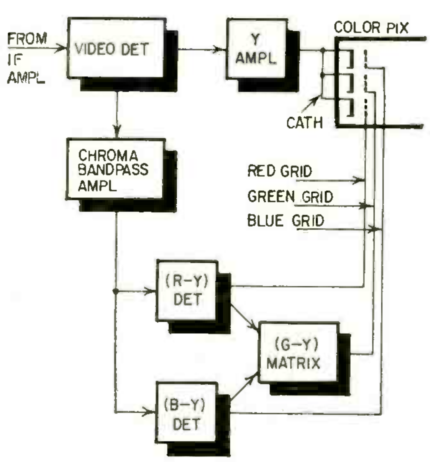


Fig. 2—Block diagram of G−Y matrix system.

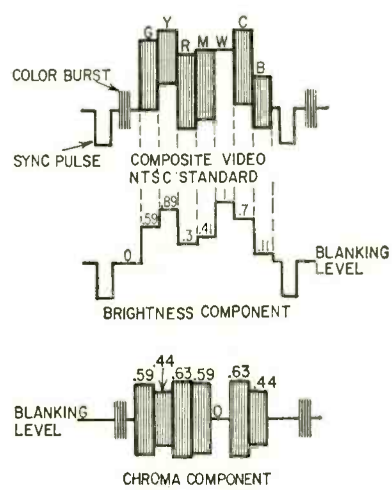


Fig. 4—A breakdown of the composite color signal.

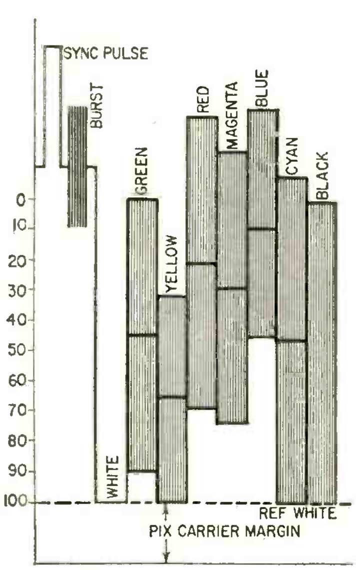


Fig. 3—The complete color signal.

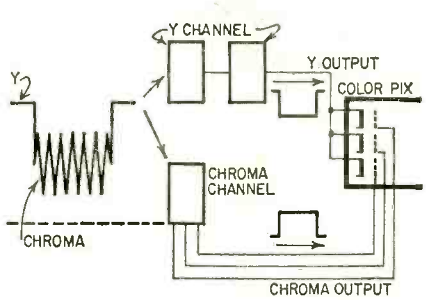
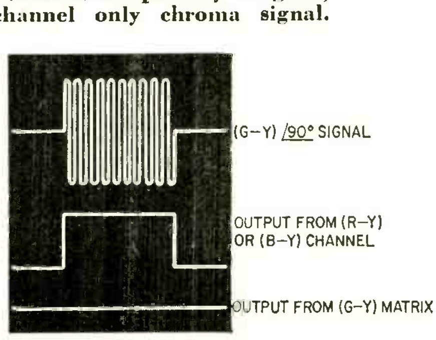


Fig. 5—Y channel accepts only Y signal; chroma channel only chroma signal.



VALUES and relations of signal voltages used in color TV matrices are important to the bench technician. He must know what should be present before he can determine what's wrong. Matrix circuits are used only in color receivers. One type recovers a chroma signal from a mixture of two other chroma signals. Another type obtains a primary color signal from a mixture of chroma and Y (luminance) signals.

A G − Y matrix is used in receivers with R − Y and B − Y demodulators. A B − Y matrix is used in receivers with R − Y and G − Y demodulators. Old-style receivers used R G B matrices, following I and Q demodulators. Still other matrices are used in receivers which demodulate R − Y and Q, and those which demodulate X and Z. The boostrap demodulator has a built-in G − Y matrix in the cathodes of the demodulator tubes.

To the beginner, the wide variety of matrices seems confusing. However, it helps to remember that the color pic-

(*Continued on page* 79)

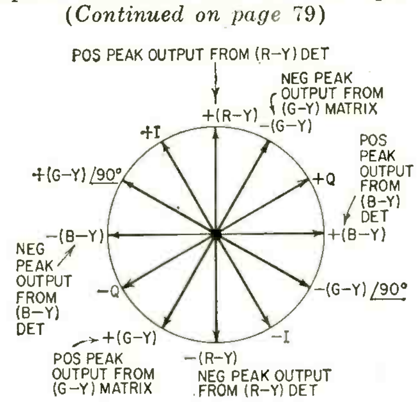
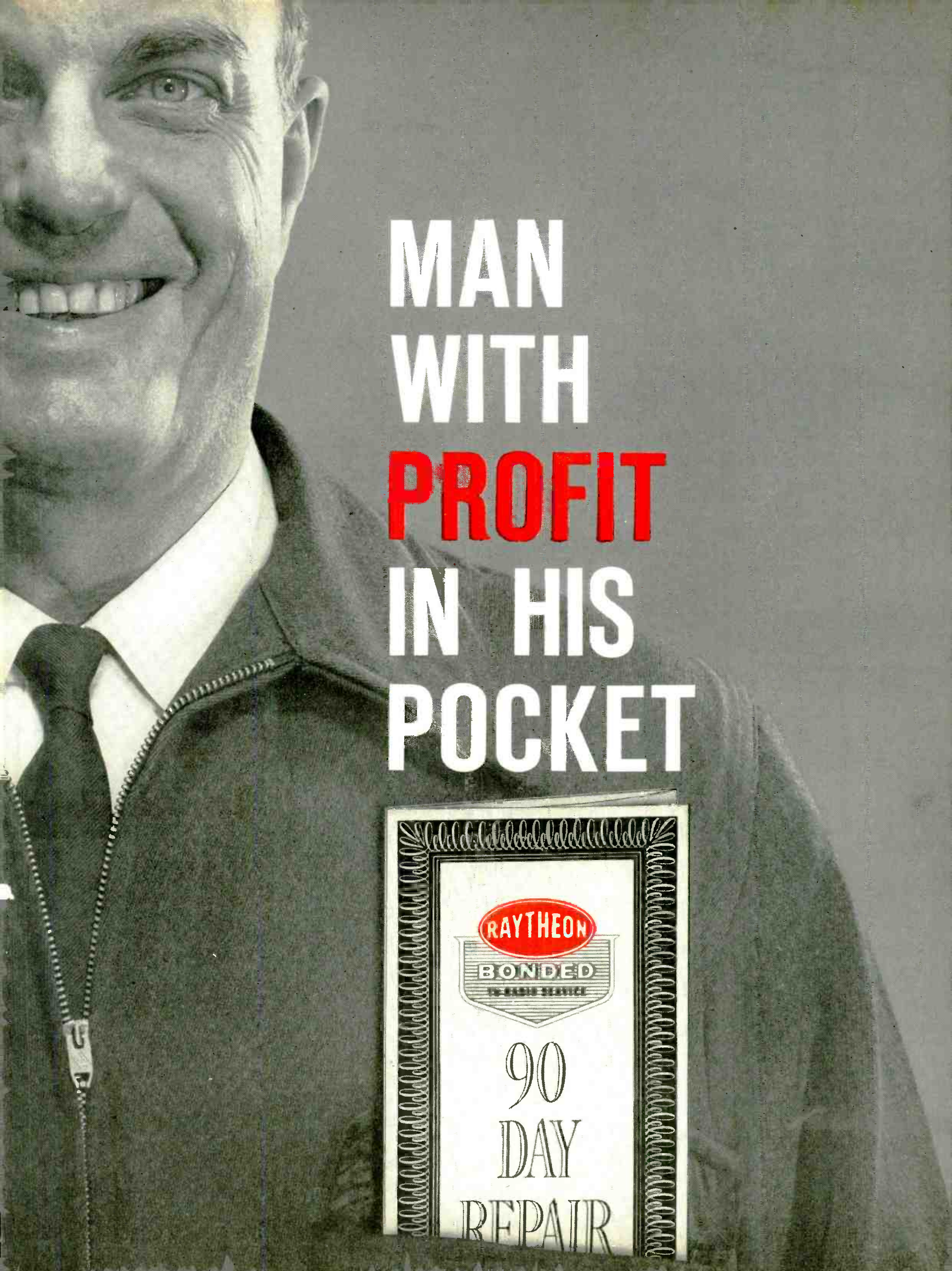


Fig. 6—G−Y matrix has peak outputs on ±(G−Y) chroma signal.

Fig. 7—G−Y matrix nulls on ±(G − Y) <90° signal.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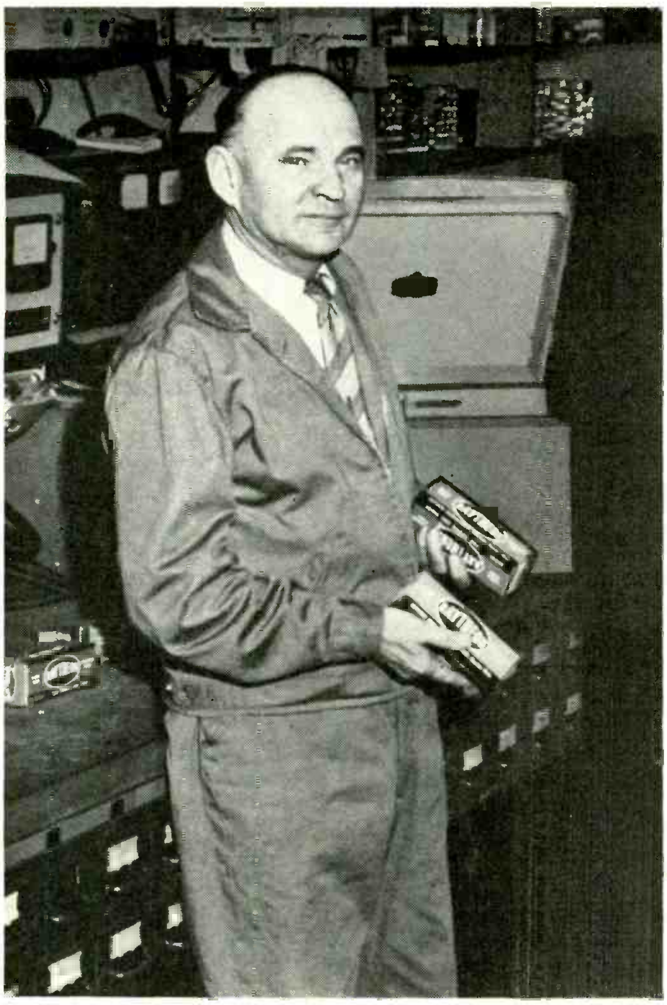

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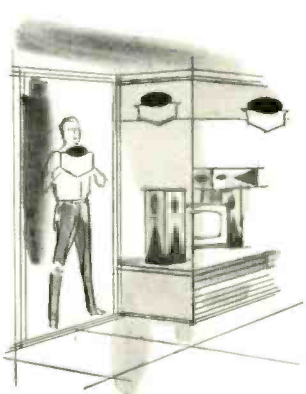

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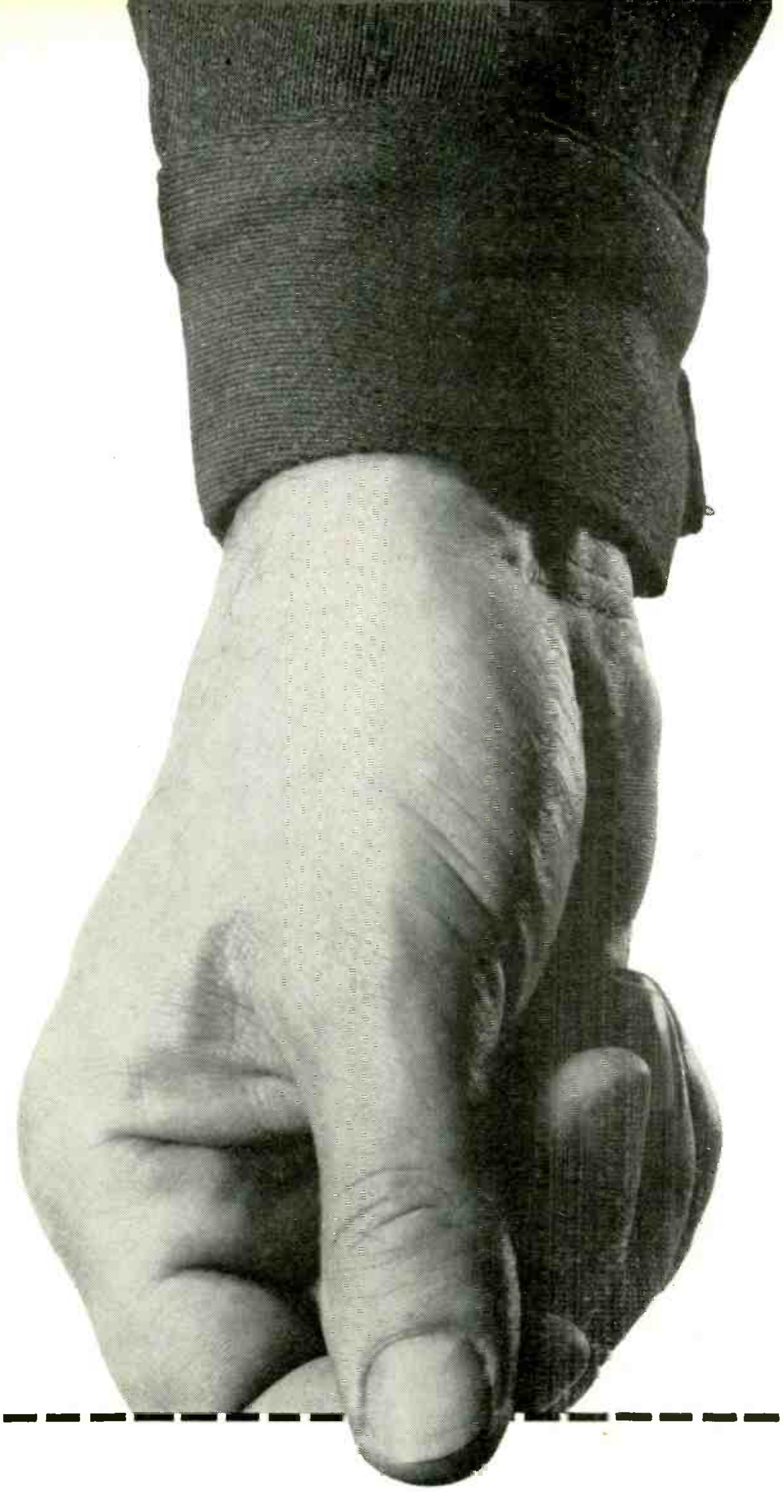

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(*Continued from page* 74)

ture always works with the *same* grid–cathode voltages. Hence, no matter what type of matrix is used, the end result at the picture tube is the same. This is shown in Fig. 1. The end result of matrix operation is always as if the output of the red camera were connected to the red gun in the color picture tube, the blue camera to the blue gun and the green camera to the green gun.

G — Y matrix

Many color receivers have used, and still use, the G — Y matrix system

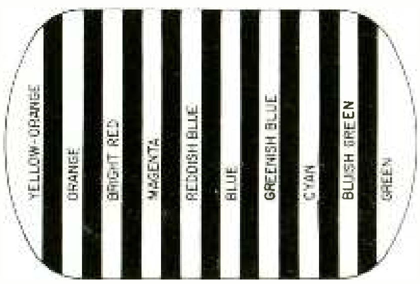


Fig. 8—Keyed rainbow generator display.

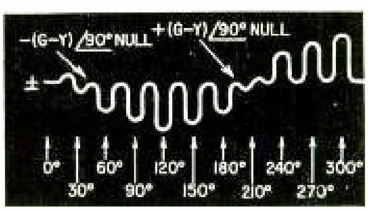


Fig. 9—First and seventh "pips" null if G − Y matrix is operating correctly

shown in Fig. 2. In this arrangement, the G — Y matrix follows the R — Y and B — Y chroma demodulators.

Let us see how a color signal is processed. Fig. 3 shows a complete color signal from the picture detector applied to the Y and chroma channels. This is a

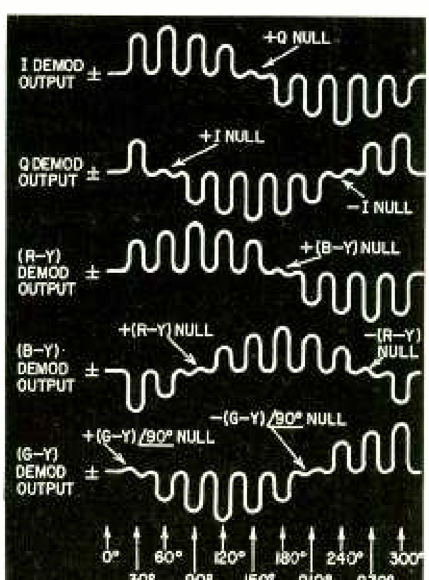


Fig. 10 — Correct nulls for I, Q, R − Y, B − Y and G − Y chroma channels.

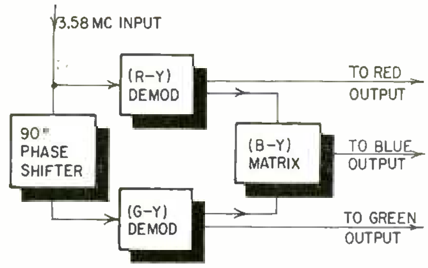


Fig. 11 — Some color receivers interchange the B − Y and G − Y demodulator and matrix positions in the chroma circuits.

color bar. It has a Y signal upon which the 3.58-mc chroma signal rides. These are broken down in Fig. 4. The Y signal passes through the Y amplifier to the picture-tube cathodes. The chroma signal is stopped by the Y amplifier. The chroma signal passes through the chroma channels. The Y signal is stopped by the chroma channels.

The chroma signal is demodulated in the chroma channel. It is applied as a square wave (envelope of the chroma signal) to the picture-tube grids, as seen in Fig. 5. A chroma signal always has a certain phase, as shown in Fig. 6. This diagram shows also that a G — Y matrix has peak outputs on a ±(G — Y) chroma signal.

We also see from Fig. 6 that R — Y and B — Y are separated 90° in phase. Or, we say that R — Y and B — Y are in quadrature. An R — Y demodulator has zero output (nulls) on a B — Y signal. Likewise, a B — Y demodulator nulls on an R — Y signal. Many color bar generators have a (G — Y) /90° signal—this is a chroma signal in quadrature with G — Y. Hence, a G — Y matrix nulls on a (G — Y)/90° signal, as in Fig. 7. Note that, as we expect, the R — Y and B — Y channels do *not* null on a (G — Y)/90° signal.

Many color bar generators are the keyed-rainbow type. They display color-difference stripes on the picture-tube screen as in Fig. 8. If we connect a scope at the G — Y matrix output, we see the pattern shown in Fig. 9. The first and seventh "pips" are ±(G — Y) /90°. Hence, we find the first and seventh pips nulling on the scope pattern, if the G — Y matrix is operating properly.

Similar tests can be made in any chroma channel with a keyed-rainbow signal, as shown in Fig. 10. It makes no difference whether the chroma channel is a demodulator circuit or a matrix circuit. A number of modern receivers interchange the B — Y demodulator and G — Y matrices, as in Fig. 11. However, the test results are the same in the R — Y, B — Y and G — Y channels. This is a very useful point to keep in mind.

A G — Y matrix operates as shown in Fig. 12. It combines −0.51 of R — Y with −0.19 of B — Y to make the G — Y signal. Note that the output from the B — Y demodulator is 78% higher than the output from the R — Y channel. This is done to obtain unadjusted chroma values. You will recall how an FM signal is pre-emphasized at the transmitter and de-emphasized at the receiver to get a better signal-to-noise ratio on high frequencies. In somewhat the same manner, the chroma signal is readjusted at the color TV transmitter to avoid overmodulation of the picture carrier. The chroma signal must then be readjusted at the color receiver to get true colors.

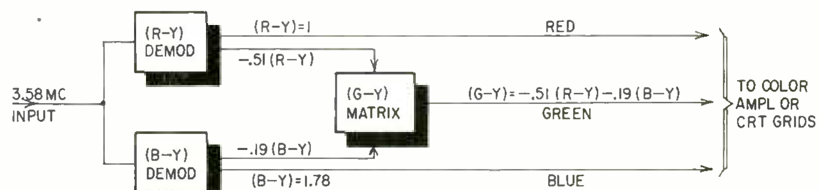


Fig. 12—G − Y matrix combines −0.51 of R − Y with −0.19 of B − Y to make G − Y.

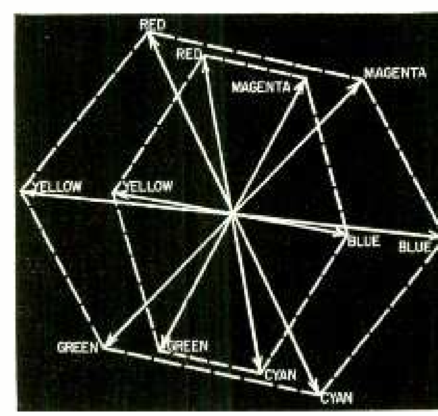


Fig. 13—Inner hexagon shows relative values of readjusted chrominance voltages. Outer hexagon shows relative unadjusted values.

In this readjustment, R — Y is reduced to 0.877 and B — Y to 0.493 of its initial value. Hence, the relations between the received signal and the signal as applied to the color picture tube are as illustrated in Fig. 13. B — Y is given 78% greater amplification than R — Y.

The circuit details for a typical G — Y matrix are seen in Fig. 14. Matrixing is handled by the three resistors connected to the grid of the G — Y matrix tube. The tube is merely a phase inverter and amplifier. The matrixing mixes the R — Y and B — Y signals in the three grid-circuit resis-

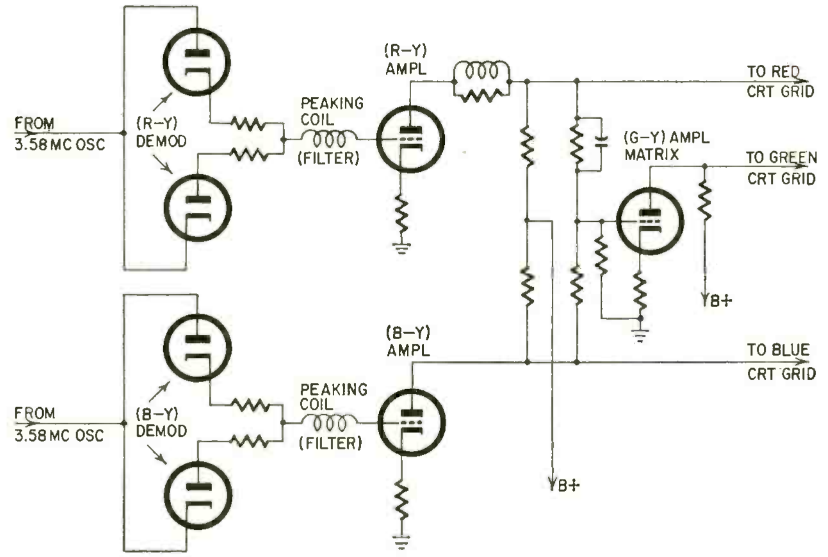


Fig. 14—Typical circuit of a G – Y matrix.

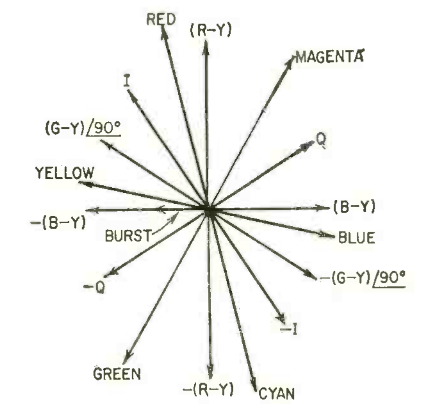


Fig. 15—Chrominance phase diagram shows each color in terms of phase angle with respect to burst phase.

tors. It is obvious that the resistors must have correct values to get normal matrix operation.

Fig. 15 is a chroma phase diagram, showing the primary and complementary colors, in addition to the basic color-difference signals. Note that red and R – Y have different phases. R – Y is not a pure red because a red signal has a 30% Y component. The Y component produces an output from all three guns. To display a pure red, we must cancel the output from the blue and green guns arising from the Y signal.

Hence, the red chroma signal has a phase which produces output only from the red gun, in spite of the fact that the three cathodes have a 30% Y signal present. The phase of the red chroma signal works as shown in Fig. 16. It gives a 70% grid signal to the red gun. This grid signal adds to the 30% Y signal to give 100% output from the red gun. The B – Y channel delivers a –30% output to the blue grid. This cancels the 30% Y signal on the blue-gun cathode. The G – Y matrix delivers a –30% output to the green grid. This cancels the 30% Y signal on the green-gun cathode.

When we sweep the chroma signal 360° around the chroma phase diagram, the outputs from the three chroma channels appear as in Fig. 17. This diagram shows that output is least from the G – Y matrix, next highest from the R – Y demodulator and highest from the B – Y demodulator. If we use a keyed or unkeyed rainbow signal, the curves shown in Fig. 17 can be checked with a scope, at the outputs of the color receiver's three chroma channels. END

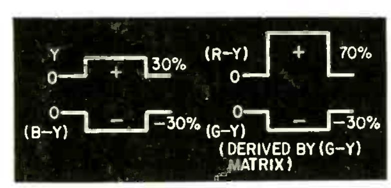


Fig. 16—When a color bar pattern is being transmitted, a saturated red bar develops the indicated square-wave voltages in the color receiver circuits.

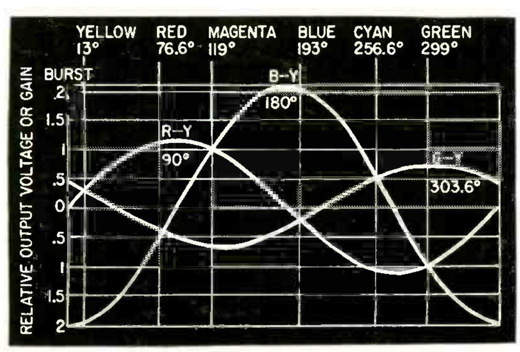


Fig. 17 — Relative outputs from the three chroma channels using a keyed or unkeyed rainbow signal.

CORONA on the AGC LINE

The Magnavox CT316 chassis showed symptoms of a simple agc defect—no picture on a strong signal, but a picture on a weak signal. The agc circuit was "simple" too. It consisted of an agc detector biased so that only the sync tips sticking up above the noise made the tube conduct.

The agc detector is followed by one stage of amplification and filtering, a clamp, and a bleed to the B-plus line to supply the tuner agc bias. When measured, agc voltage was too low for the scads of microvolts coming into the tuner. A finger across the antenna input terminals brought in a smeary picture and a *lower* agc voltage.

To add to the confusion, all the resistors, capacitors and other components in the detector and agc circuits checked out OK. A scope couldn't be used because of the if overload. The set would work with external agc bias, but what could be causing the trouble?

I decided to run a quick check of the overall response curve. It showed a nearly perfect response. A little tired and very disgusted, I doused the light and turned to leave. A passing glance at the scope pattern, as I reached out to turn it off, stopped me cold. In the dark room I could see a fence about ¾ inch high along the entire length of the response curve. I started to look for the high-voltage arc which usually causes this sort of display. There was a tiny blue corona around the nut that fastens the high-voltage filter capacitor to an insulating strip and the ground return. Two turns of the nut and the corona disappeared.

This could not cause the agc trouble, I thought, but by this time I was becoming a firm believer in ghosts and gremlins. On removing the alignment harness, what should appear but a perfect picture. By this time I was wondering what could have happened to cause this set of circumstances.

A little careful checking showed that the lead connected to the agc clamp tube was routed near the corona. The corona pickup was being rectified by the agc clamp tube and was bucking out the agc voltage generated by the sync pulses and causing the gain of the if strip to increase until the signal was blocked.

When I placed my finger across the antenna input terminals, I reduced the agc voltage but I also cut down the input signal to a point that the if was not completely overloaded, producing a smeary picture.—*F. L. H., Roanoke, Va.*

TV Service Clinic

conducted by

JACK DARR

WE get many letters wanting details about changing a metal-shell picture tube to a glass type. This is a comparatively easy conversion, and one which is sure to find favor with all technicians who will work on the set in the future.

The first step is to select a glass-bulb tube with electrical characteristics close to the original. For example, the popular (in its day) 21MP4 can be replaced by a 21YP4, with only physical changes, mounting, etc. The -YP4 is not quite an inch longer, but other dimensions are very close. (One note here: watch out for *faceplate curvature!* For example, if you tried to replace a 21MP4, which has a spherical faceplate, with a 21FP4, which has a "cylindrical" faceplate, the result would be a large gap at most places in the front mask.)

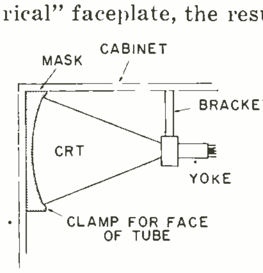


Fig. 1—Bracket supports yoke and rear of picture tube.

The most difficult part will be mounting the new tube. If the set is a console, the new tube can be mounted on the front of the cabinet, especially if the original tube was so affixed. The plastic mask is trimmed if necessary, to allow the new tube to fit snugly, and the original mountings are often easily converted to hold the new tube. This is especially true if they included a bracket to hold the yoke, which supports the back end of the tube (Fig. 1).

Many times original mountings consist only of a clamp around the face of the tube, leaving the yoke held up only by its leads! Yoke brackets can always be added, if necessary. Make them out of sheet-metal straps about an inch wide, or No. 16 or 18 gauge steel. These can be found in large quantities at your local sheet-metal shop or in the scrap bin. They can be bent to any shape needed, and fastened to the cabinet (wooden ones) with short wood screws.

The bracket can be fastened to the yoke in any one of several ways. Two methods are shown in Fig. 2. An alternate mounting is shown in Fig. 3. The bell of the tube is held in a "cradle" of heavy fabric straps against the front of the cabinet. These can be made out of luggage straps as sold in auto-supply stores, or any available material. They must be heavy enough to support the weight of the tube, at least 1 inch in width and very strong. Make some kind of a fastening like the gadget shown in the small detail of Fig. 3, so that the straps can be pulled very tight. This one consists of a small plate of metal, held down by screws, the strap is passed under it, pulled tight, then held in place by tightening the screws. Yoke brackets can also be added, if the finished rig looks flimsy.

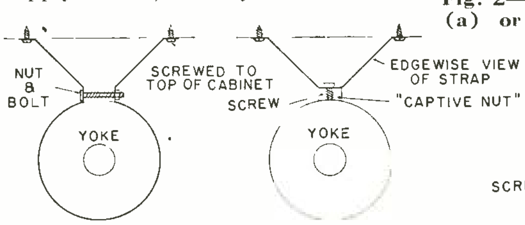


Fig. 2—Bracket may use nut and bolt (a) or screw and captive nut (b).

With a few exceptions, chassis-mounted tubes are always provided with yoke brackets. These are the easiest: the old tube is removed and the insulating ring adapted to fit the new tube by trimming it with a sharp pocketknife or tin shears. In some cases a pair of wooden blocks can be cut out and fastened to the front corners of the chassis to hold the tube (Fig. 4). These are usually cut to fit each individual set. Be sure to make them small enough to allow the set to go back into the cabinet without fouling on the back corners. The yoke can always be moved back to take up the extra inch, as these brackets are usually adjustable. (If not, they can be made so by drilling a couple of new holes here and there.)

If there are no yoke braces on the original chassis, they can be made up out of the helpful sheet-metal strap. Bend it to a right angle lengthwise, to give it greater rigidity and fasten it to an open place on the chassis or to the sides if there are no open places on the chassis. (Most of the sets upon which this job will be done are older models and there is usually some open space on the chassis.)

Regular conversion kits are available for quite a number of the older sets, like the Stewart-Warner 9300 series for example. These include all wooden blocks, straps, and screws needed to make the changeover. However, with a drill, saber saw, a few bolts and nuts and a bit of native ingenuity, the TV technician can make almost any tube fit any chassis he wants to, in just a short while.

Hum-bars in color TV

I have a Motorola TS 902 color TV, converted. There is a hum bar visible on the screen when there is no signal applied. It appears as a dark bar moving swiftly from bottom to top, and also appears on the scope as a pip moving left to right through the signal pattern. When a station is tuned in, this hum bar disappears, sometimes for quite a while, then returns, at times moving very slowly, usually from top to bottom. It seems to be coming to the picture tube through the video output tube. I disconnected the regular filament supply of the CRT, fed it with dc and still *got the hum bar. The 60-cycle signal seems to be strongest on the screen leads if I clip my probe on the insulation.—L. S. L., Englewood, Colo.*

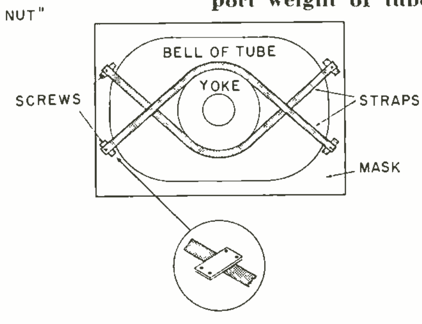


Fig. 3—Straps support weight of tube.

This would seem to be a case of our old friend "marginal electrolytics." You said before that you had shunted several of the filter capacitors without result. I believe, from the "timing" of the hum bar that you mention, that the trouble is going to be found somewhere in or around the vertical output stages.

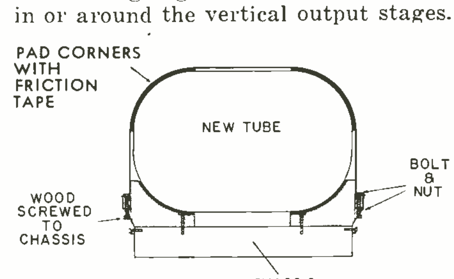


Fig. 4—Wood blocks hold front of tube.

Notice that the hum bar moves rapidly when there is no incoming signal (hence no sync) and disappears, then reappears, moving very slowly, with sync.

Electrolytics with a high power factor will often give misleading results on a shunt test because of the internal leakage (which is, after all, the main cause of the high power-factor condition). To get a reliable test, disconnect each suspected unit and replace it with a known good unit of the same or larger size. Trace your power supply lines with a direct probe (*not* a low-capacitance probe—it will attenuate the low-frequency ripple signals!) and see what kind of ripple you've got on them.

The most likely capacitors in this case would be those "nearest" to the screen leads to the CRT. If they are OK, then go back to the capacitors around the vertical output stage, as I said before. It is quite possible that some of the pulse voltage from this stage is leaking into the video.

You might also investigate the electrolytics in and around the vertical convergence circuits. A 60-cycle pulse is fed to these controls through the plug and cable connections, and filtered, etc., by three nonpolarized electrolytics, C15, C16 and C17. These are 100-μf units, connected at the three vertical convergence controls, R16, R18 and R20. If these are defective, they will give you trouble much like what you have.

Tricky horizontal hold

The horizontal hold control in an Admiral 18XP4BZ chassis is very sensitive. When the raster jumps out of sync, a sawtooth wave shows up vertically and the screen goes blank. I can lock it back in again with the hold control, but it does the same thing over again.—B. M., Delton, Mich.

This sounds as though you have a marginal defect in the horizontal oscillator. In other words, the oscillator is just barely working and the slightest disturbance throws it out of sync, making it stop completely. The collapse of the horizontal sweep is giving you the wavy vertical white line on the screen, as the vertical sweep is still running for a fraction of a second.

The trouble is probably due to a resistor having shifted in value. The most likely one would be the 470,000-ohm unit which feeds the horizontal oscillator. If it has increased in value, a common complaint, it would make the oscillator most unstable. Also, check the resistors in the grid circuit of the control section of the horizontal oscillator (Fig. 5). Some trouble was found with these if they drifted too far off tolerance. Replace with 5% resistors.

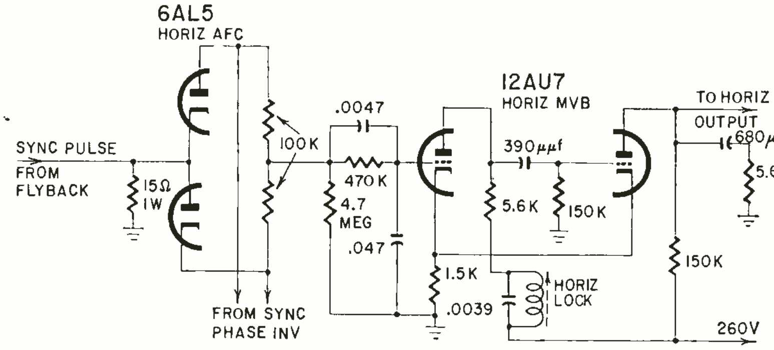


Fig. 5—Horizontal oscillator circuit in Admiral 18XP4BZ.

Transistor antenna booster

Do you have a diagram for a transistor single-channel antenna booster for a TV set? This one will be used on a single set, and I'd like to find one that wouldn't cost a fortune to build. —A. A., Rutland, S. D.

Transistor antenna boosters *are* being

made at present by Benco TV Associates of Canada and by some US manufacturers, but they are quite definitely out of your last category! The only ones now in production, to my knowledge, are broad-band types, designed for use with community antenna systems, and their cost is quite high.

At this time, I don't know of a design that would fit your requirements, I'm sorry to say. Try locating one of the old TACO 1628 single-channel antenna boosters. There should be plenty of them floating around, and they did an excellent job, although they are not used too much any more. I used one for several years on my own antenna, back when we could get only one channel, and that from a long way off.

Critical vertical hold

I'm working on a CBS 22C07M TV. The vertical hold control won't stop the picture until it is right at the grounded end, and then it's very critical.—A. W. A., Queens, N. Y.

If you have to run the vertical hold control all the way to the grounded end, you undoubtedly have too much resistance in the circuit. In other words, the 2.2-megohm resistor between the hold control and the oscillator grid has increased in value, or the hold control

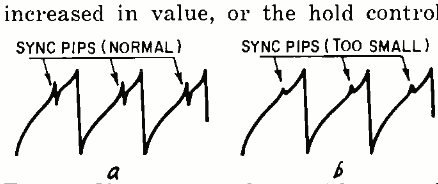


Fig. 6—Vertical waveform with normal (a) and too small (b) sync pulse.

itself has increased. Check *both* of them to be sure. While we normally don't think of trouble in controls, it is still very possible for one to increase in resistance, just as a standard carbon resistor does! Check the amplitude of your vertical sync pulse by applying a scope to the oscillator grid and rolling the picture slowly downward with the hold control. The sync pulse should be visible as a small pip on the waveform (Fig. 6).

If this is too small, it will not lock the oscillator as it should. Check sync amplifier and separator tubes, and the vertical integrator network.

Picture "bounce"

In a Sylvania 225MU TV set the picture bounces up and down whenever the sound is turned up to high levels. Turning the volume down below normal listening level steadies the picture, but bringing it back up makes it bounce. I have changed all the tubes in both vertical and sound circuits. What might be causing this problem?—P. B. G., Waldron, Ark.

This is caused by incorrect bias on either the vertical output tube or the sound output tube. Change the 0.1-μf capacitor in the grid circuit of the vertical output and the .005-μf input coupling capacitor in the sound output.

A slight leakage in either of these will alter the bias so that the sound output tube draws more than its normal plate current. When high sound peaks are encountered, the added current drain lowers the voltage on the vertical oscillator and output, making the picture shift position.

Vertical instability

Can you give the reason why an RCA KCS-124 TV will not stop rolling vertically? It does this on all channels. It can be held momentarily, then a change in the picture when a commercial comes on will start it again.—V. J. D., Washington, D. C.

This trouble is due to insufficient vertical sync amplitude. In the field, the most common cause is a weak 6CG7 tube. This is used as a sync amplifier and vertical oscillator. If a new tube doesn't cure the trouble, check the plate voltage on the sync section. It should be 65 volts on pin 1, the plate. The 6BU8 should have 185 volts on pin 8, the plate, and 110 volts on pin 9, the screen grid. The 6AW8 first sync separator should have 75 volts on pin 3, the plate. Changes of value of any of the plate load resistors would cause sync trouble.

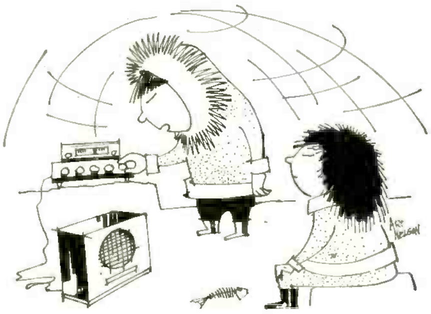
The .033-μf capacitor on the grid of the 6CG7 should be checked for leakage, also the .0056-μf capacitor on the grid of the vertical oscillator.

Incidentally, before taking any drastic steps, be sure that the vertical height and linearity controls are properly set. If they aren't, this may cause vertical instability.

Dim raster

We have a CBS TV which has only a dim raster, no control of brightness and no picture. I suspected the brightness control, but it checks out. Is it a bad picture tube?—A. M. F., Calif.

Watch this one, you've got a beautiful "double symptom" here! It *is* possible that you have a defective picture tube. Only testing with a reliable CRT checker will show it up. However, before doing this, change the sync-separator/video amplifier 6U8 tube. A short in the 6U8 will show exactly the symptoms described, which are the same as a heater–cathode short in the picture tube. The short removes bias and picture signals from the tube, leaving a low-brightness raster and no pix. END



"Takes a while to warm up."

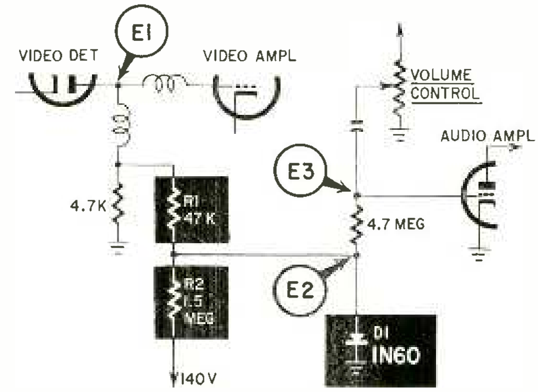
TELEVISION

IMPROVING the TV RECEIVER

Keyed-agc systems can cause warm-up buzz. Here's a simple way to get rid of this annoyance

By WILLIAM FEINGOLD

ALL television receivers have some sort of agc to help maintain a constant video detector output regardless of variations in the signal at the antenna. The simpler systems used in low-cost sets usually allow a three- or four-fold variation at the detector; the deluxe receivers generally hold the change to about 10%. This article deals with a strange performance complaint that is a byproduct of this better agc action.



Two resistors and a crystal diode are the only additional parts.

	DURING WARMUP	AFTER WARMUP
E1	−22 V	−2 V
E2	−16 V	+0.2 V
E3	−16 V	−0.7 V

These deluxe sets invariably use keyed agc. This circuit derives control bias for the set's rf and if stages by using a keying pulse supplied by the horizontal deflection system. Therefore, during warmup and prior to lock-in of the horizontal system, no control bias is applied to the rf and if stages. This lack of control voltage allows overloading, and intermodulation takes place between the video and the sound. The result is a raucous 60-cycle buzz blasting out of the speaker.

Although this situation is not new and has been more or less tolerated by the general public for a number of years, a simple innovation has pushed it into the aggravation stage in the last year. Many manufacturers are now incorporating preset volume controls with either push-pull or a push-push on–off switch. This leaves the volume set for normal listening during warmup instead of at the lower level that is generally used with the rotary on-off system.

Readers who would like to eliminate this annoying warmup buzz can easily make the necessary modification. Except for the three new elements—R1, R2, and D1—the diagram shows a conventional TV circuit.

Operating theory is straightforward. During warmup, the overloaded if strip puts an abnormally high signal voltage on the video detector which rectifies it, thereby deriving a high negative voltage. This negative voltage is used to bias the audio amplifier into cutoff during this period. The voltages in the diagram show that the warmup video voltage is −22. The values of R1 and R2 are selected so E2 is −16 volts during warmup and the audio amplifier is cut off. When the detector finally falls to its normal value of −2 volts, E2 goes a little positive, thereby restoring the audio tube. In the interest of audio quality, we preserve the negative contact voltage of E3 (−0.7 volt), so a germanium diode clamp is added to keep the value of E2 from going too far positive. END

WHEN THE CAT'S AWAY

An Indiana housewife blamed a neighbor's amateur operation for her distorted TV picture. She was not satisfied when an FCC field inquiry indicated that her receiver, rather than the ham, was at fault. So she wrote to President Eisenhower. However, a second visit by an engineer of the Chicago office showed that the disturbance had been eliminated. The method used was unique. On a day when the lady of the house (described by her husband as the "dominant member of the family") was away, the helpful amateur, with the consent of the woman's husband, but without her knowledge, installed a wavetrap and a line filter in her set to make up for its poor interference-rejection capabilities. — *Kilocycling With the FCC*

STREAMLINING the ONE-MAN SHOP

By HENRY J. MILLER

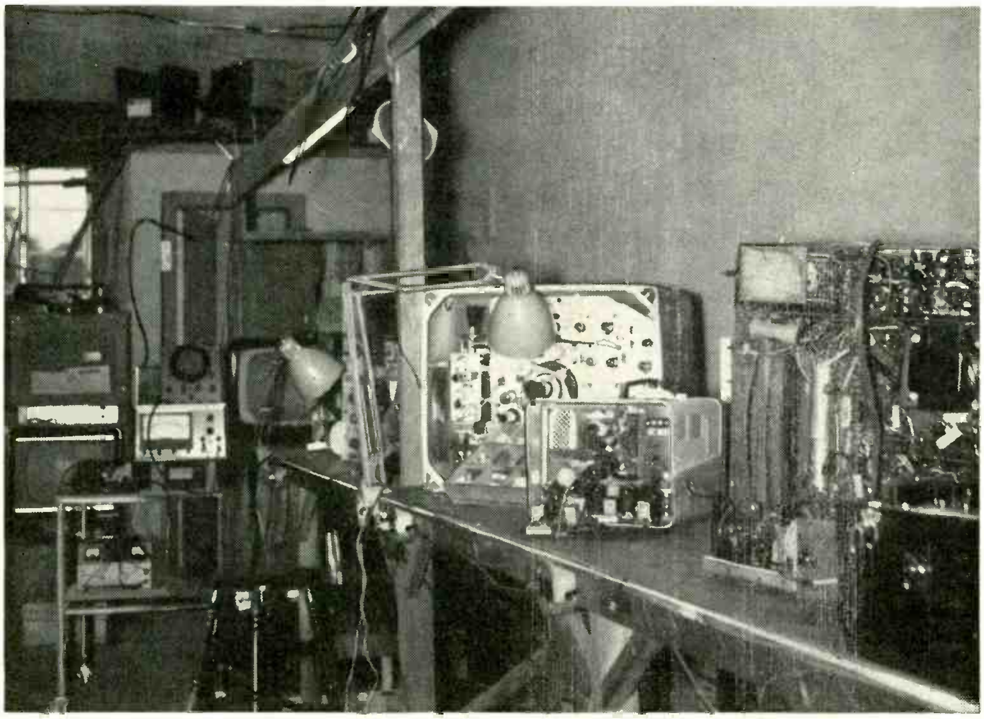
TEST equipment that rolls to where it's needed is one of the secrets of the unorthordox time-saving design of a busy one-man TV repair shop in Sarasota, Fla.

A technician's time is his prime commodity, and needless waste of it can mean the difference between profit and loss, especially in a one-man operation. With this in mind, Martin J. Stahl, Jr., revamped his Television Service Laboratory in an unusual manner for maximum efficiency.

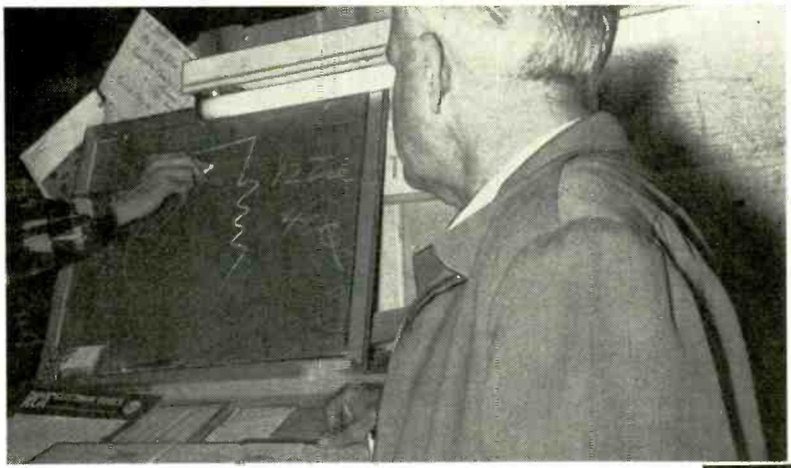
"It invariably happened that if I opened a TV set at one end of the bench, the test instruments I needed were at the other end," says Stahl. "And in between stood several sets in the process of repair or check, or being fixed. Often this meant time in moving equipment around to get at the instrument.

Not a single meter or piece of test equipment is mounted at a fixed location in Stahl's shop—all instruments are completely mobile. "To have a shelf with $2,000 worth of equipment laid out on it may be impressive to the customer, but it can mean the loss of a lot of money to the one-man shop owner," say Stahl. He achieved the mobility by mounting his test units on pipe frames with legs on large furniture casters.

Among his other efficiency innovations: "I count it a must to have a long workbench, and mine is 23 feet long." This means that when he yanks a chassis out of its cabinet, the case can be pushed back out of the way on the 50-inch tabletop, right behind the chassis. Thus seven sets are easily accommodated at one time on the long bench. If a hurry-up job comes in, it is placed in an unused space on the bench, the needed instruments rolled down to it and work begun at once.

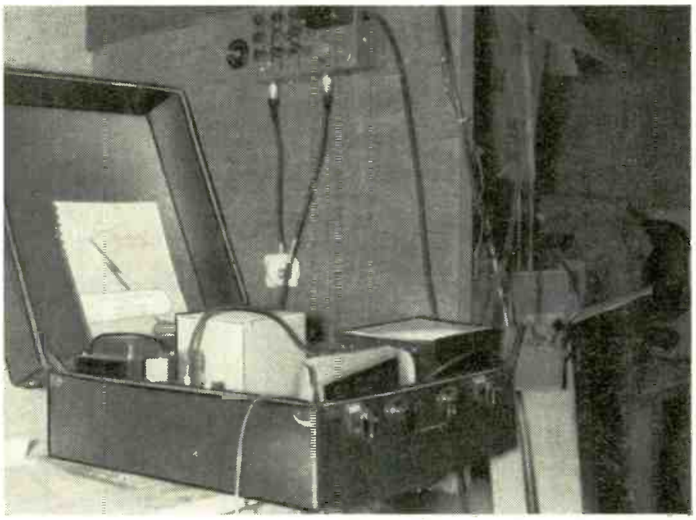


Stahl's lengthy bench eliminates needless handling of test equipment or receivers. "By the end of the day I'll often have half a dozen sets on the bench proving themselves," he explains. "If a part has to be ordered, I don't need to pick up or lift the chassis. It is simply pushed back out of the way toward the rear while awaiting the arrival of the component." Note the test instruments mounted on a castered rolling frame (at left). Another feature of the shop is the use of lighting designed to minimize glare and eyestrain.



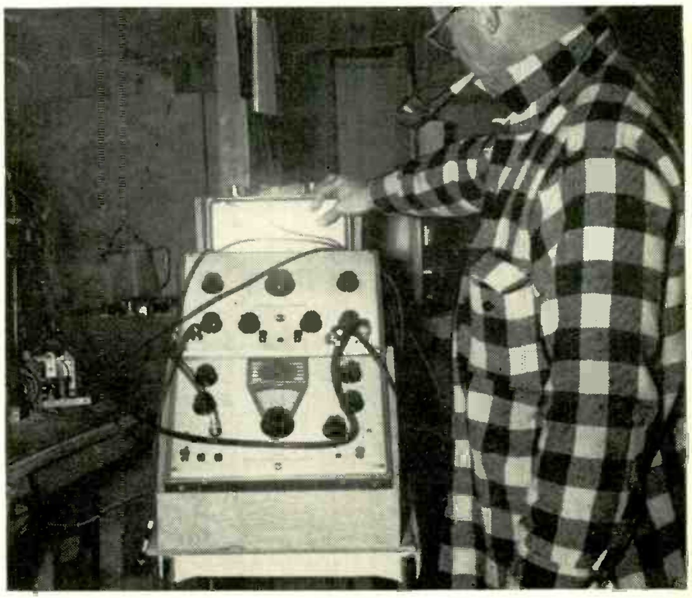
The shop owner finds a slate handy for reminders to himself and to make a graphic portrayal of ailments, costs and parts to an inquiring set owner. Stahl also keeps a pad for each set undergoing repairs. He marks the parts used and their cost as he installs them in the set, so when the job is ended only a fast calculation is required to total up the bill. If necessary, there's room for another man at his long bench, and "a glance at the pads enables you to see the progress of each job and what parts have been used up to the moment."

Important to the small shop is an adequate supply of parts to stave off needless trips to the supply house. Stahl keeps small parts in baby-food jars to insure maximum visibility and easy inventory keeping.



Stahl spent $300 for this Hickok video scanner and considers it an excellent investment as a time saver. It's connected to the antenna system so he can get a test pattern on every set. Thus he can quickly check the size, height and linearity of a picture at a glance; he also uses it to judge bandwidth of video if stages and for trouble-shooting sync circuits. "Its eliminates guesswork and saves time," he states, "which is the essence of a one-man shop."

Unlike Mohammed and the mountain, Stahl glides his rolling-stock test equipment to the jobs, eliminating the lugging of heavy sets to fixed instruments. This arrangement speeds service in the one-man shop.



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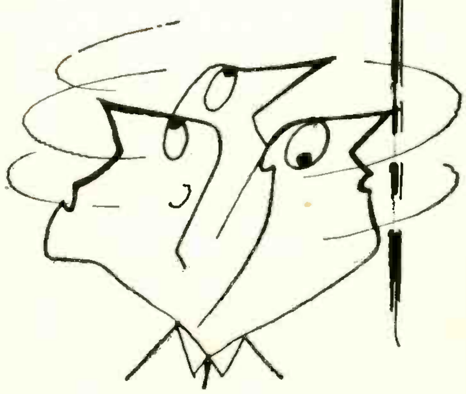
POOR MAN'S DIRECTION FINDER

Turn your portable receiver into a radio direction finder



By LEE CRAIG

IF you are a boating enthusiast and cannot afford a professional radio direction finder, you can find out where you are and where you are heading by using a pocket-size transistor radio as a direction finder. Some of them work very well for this purpose. And their cost starts at about $25 and runs all the way up the scale. Even the man with a rowboat can now have a radio direction finder!

These portable transistor sets are powered by a self-contained battery. Most are superheterodyne receivers. Two of the imported types I tested proved very sensitive and their built-in loop antennas have extremely good directional qualities. One of them has directional characteristics superior to those of a radio direction finder costing more than six times as much.

A radio direction finder consists of a radio receiver with a loop antenna. Practically every AM broadcast receiver on the market has one built in. Since the suitability of an ordinary radio receiver as a direction finder depends upon the directional characteristics of its antenna, not all radio sets make useful direction finders.

A loop antenna provides strongest reception when its edge is pointed in the direction from which the signal is coming (Figs. 1-a and -b). When the loop is turned (in the case of built-in loops, the whole set is turned) so its open end faces the incoming signal, reception is poorest. The antenna's maximum-signal position is very broad while the minimum-signal position or "null" is quite narrow. There are two maximum-signal positions and two nulls (Fig. 1-c). This is true because the loop has two sides. Since the nulls are much sharper, they are used for determining direction.

The two nulls are supposed to be 180° apart. But, in practical loops there is some error. They may be a few degrees removed from 180°, so some error in taking bearings is to be expected. In professional direction finders (DF), special care is taken to minimize this error. This is done by balancing the loop with respect to ground. Fig. 2 shows why unbalance occurs and Fig. 3 shows various means for correcting un-

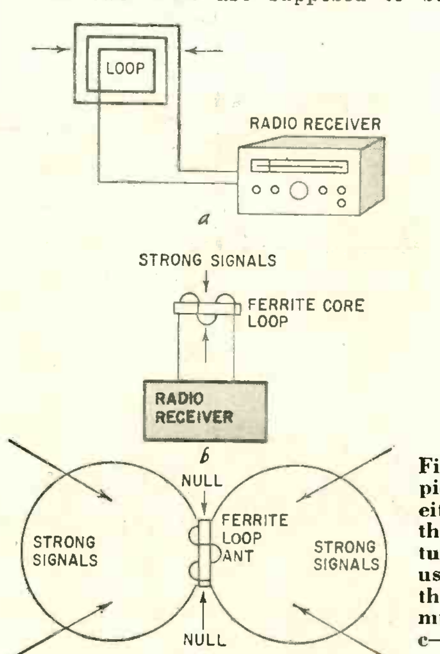


Fig. 1-a—A conventional loop antenna picks up the strongest signals when either edge of the coil is pointed toward the station being received. b—In miniature portables, a ferrite core loop is used. Maximum signal is picked up by the broad side of the loop while minimum signal is picked up by the ends. c—The approximate directional pattern of a midget ferrite core loop.

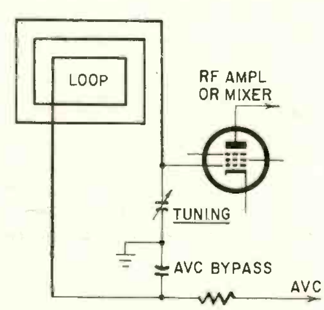


Fig. 2—Unbalanced antenna causes poor symmetry in antenna's directivity pattern.

balance as used in professional DF units.

It is easy to determine the suitability of a small transistor radio as a direction finder. Merely take an accurate map and note your location. Then take bearings on various radio stations whose transmitter locations are known. These bearings (nulls) should conform with lines drawn on the map from your location to the radio stations. By reversing the set 180° to use the opposite null position, you can quickly check the loop's balance. One of the low-priced sets had only a 1° error compared to a professional direction finder which had a front-to-back error of 6°. Both units were tested at the same location.

Professional direction finders and portable radios give two nulls, so the

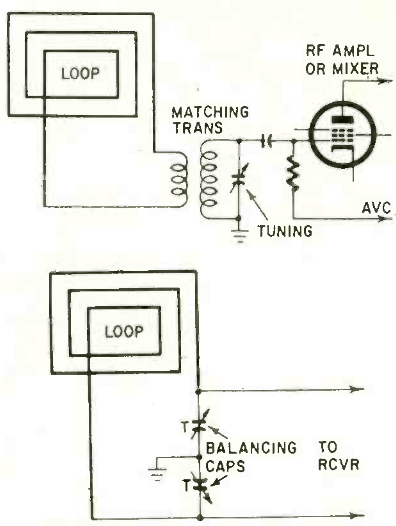


Fig. 3—Two ways of improving an antenna's directivity pattern.

navigator has to determine which of the two directions is the correct one. For instance, if he knows he is south of the station on which he has taken a bearing, he knows that the bearing to the north is not the one to use. Some professional DF units have a sense antenna which eliminates this guesswork. The operator rotates the loop to get a maximum-signal indication first. When a sense antenna is used, one of the maximum-signal positions is much stronger than the other one because the sense antenna adds to the signal in one direction and bucks the signal in the other one. Then, after determining general direction, he takes a null bearing to get an accurate reading.

By using two transistor radios, you can take bearings on two stations at the same time. This will yield directional information quickly. A fix is made by taking the two bearings and drawing lines on a chart or map. The ship is located at the point where the two lines join.

While you can merely lay one of the little transistor radios on top of a map to get rough bearings, a jig on which to mount the radio will give more

(*Continued on page* 98)

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

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

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms • **DECIBELS**—10 db to + 18 db, + 10 db to + 38 db + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77—VACUUM TUBE VOLTMETER ...Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.......... **$42.50 NET**

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER. *Plus* CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS. *Also Tests* SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Specifications

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

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

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

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Model 79—SUPER-METER . . . Total Price $38.50—Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months if satisfactory. Otherwise return, no explanation necessary!

Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads..........only **$38.50 NET**

GENOMETER

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- 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

Model TV-50A—Genometer. Total price—$47.50—Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary!

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peak wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency).

THE MODEL TV-50A comes absolutely complete with shielded leads and operating instructions.

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES: Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a handsome portable saddle-stitched Texon Case. Only **$47.50**

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert tube into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

SPECIFICATIONS

- Tests over 600 tube types
- Tests OZ4 and other gas-filled tubes
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence
- Dual Scale meter permits testing of low current tubes
- 7 and 9 pin straighteners mounted on panel
- All sections of multi-element tubes tested simultaneously
  Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms

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

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

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS AND REJUVENATES ALL PICTURE TUBES

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

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types —from 8" to 30" types.

ALL COLOR TUBES

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

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

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

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

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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-746, 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.

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- □ Model 79................Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- □ Model TV-50A........Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- □ Model TW-11.........Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- □ Model 82A.............Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- □ Model 83................Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.

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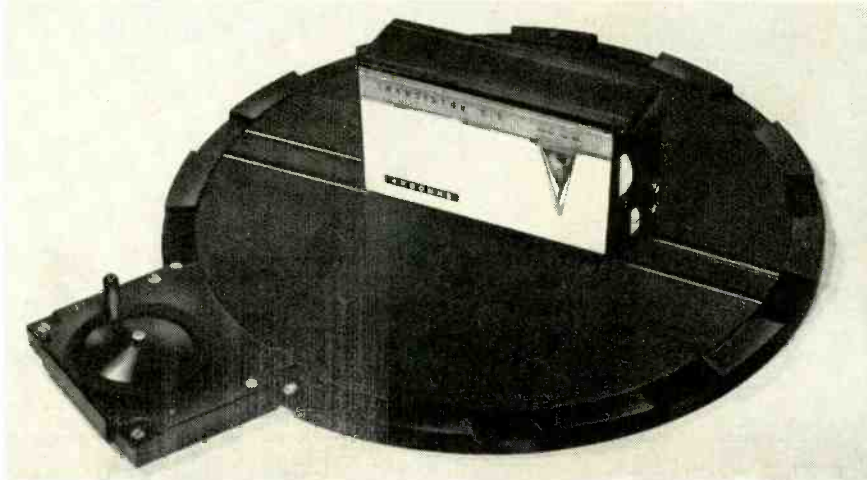
Address..

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

All prices net, F.O.B., N. Y. C.

Export Division: Rocke International Corp., 13 East 40th St., New York 16, N.Y.



An HO gauge model-railroad turntable makes a handy lazy Susan for rotating a tiny transistor radio used as a direction finder.

(*Continued from page* 95)

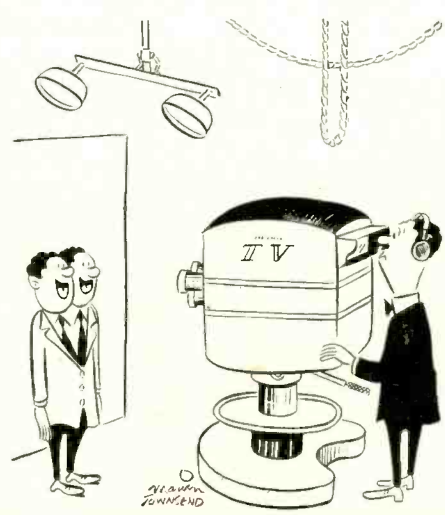
accurate results. A turntable designed for HO model-train setups can be used. The set is merely placed on top of the turntable between and parallel with the HO rails. The outer rim of the stationary part of the turntable can be marked in degrees so that it will serve as an azimuth scale. A crank is generally a built-in feature of these turntables and can be used for rotating the radio. A pointer marked on the rotating disc of the turntable is used as an indicator.

For even better results, buy a surplus pelorus with which visual bearings are made. A clamp can be fabricated for holding the radio set to the pelorus. The advantage of the pelorus is that it can be locked in place at the desired position. Furthermore, it can be used for calibrating the improvised DF against a visual object.

The weekend sailor who rents a boat, even a rowboat, can enjoy the safety and feeling of security afforded by a DF by taking along a miniature transistor radio. At home, it is used for entertainment. While afloat, it can be for entertainment as well as for direction finding. If he is lost, he can set the radio on one of the seats so that the null side of its built-in loop antenna points straight forward. By steering the boat for minimum signal strength, which is usually the point where the background noise is highest, he can "home" on the station to which he is listening.

And, if he is really critical, he can take along a dc milliammeter (0–5- or 0–10-ma range) or a volt-ohmmeter. When connected in series with the transistor radio battery, it can be used as a visual null indicator. When the signal is weakest, current indication is lowest. This is true only of transistor radios. More precise null indications can be measured when using a visual indicator since the human ear cannot accurately detect minute variations in sound level.

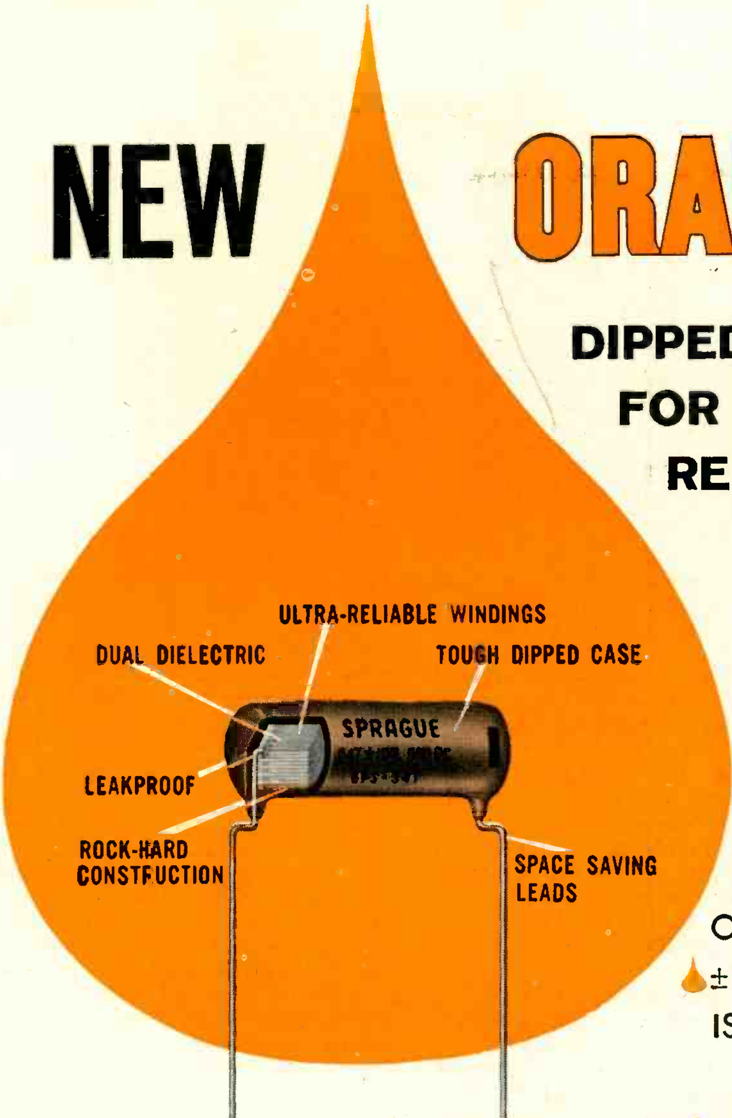
Because it is so easy to use a portable radio as a substitute for a DF, there is little excuse for anyone who sails out of sight of known landmarks to sail blind. Even a modern-day Tom Sawyer and Huck Finn wouldn't venture out on a raft without some sort of DF. With the good ferrite loop antennas now on the market, one can even build a crystal set which can be used as a direction finder when fairly close to a broadcasting station. END



Friends, do you see a double image on your TV Screens? Call EQ 0-0001 for expert TV repair.

NEW ORANGE-DROP®

DIPPED DIFILM® CAPACITORS FOR EXACT ORIGINAL REPLACEMENT



THIS NEW . . . MINIATURE . . . DIFILM CAPACITOR OUTPERFORMS ALL OTHER DIPPED TUBULAR CAPACITORS! ±10% CAPACITANCE TOLERANCE IS STANDARD.

SPRAGUE DIFILM *does it again!* First to give you at regular prices the finest molded tubular capacitor made—the DIFILM BLACK BEAUTY . . . and now the newest DIFILM capacitor—the ORANGE-DROP dipped capacitor.

SPRAGUE ORANGE-DROP CAPACITORS are especially made for easy installation in tight spots . . . where only an exact replacement will fit. They are the exact same dipped capacitors used by leading manufacturers in many TV sets.

WHY ORANGE-DROPS BEAT HEAT AND HUMIDITY

Sprague Orange-Drop Mylar*-Paper Dipped Capacitors combine the proven long life of paper capacitors with the effective moisture resistance of film capacitors. Their duplex dielectric of kraft paper and polyester film is impregnated with HCX®, Sprague's exclusive hydrocarbon material which saturates the paper and fills voids and pinholes in the film before the HCX polymerizes. The result is a solid, rock-hard capacitor section which is then double-dipped in bright orange epoxy resin for moisture protection. Leads are neatly crimped for easy installation on printed wiring boards.

SPRAGUE ORANGE-DROP CAPACITORS are a natural teammate for the molded Difilm Black Beauty®. Black Beauties, born out of engineering to tough missile standards, are still far and away the best replacement capacitors—better than any other molded or dipped . . . paper, film, or film-paper combination . . . capacitor made for entertainment electronics.

Where a dipped capacitor is called for, no other dipped unit can match the ORANGE-DROP. Your distributor is stocked with all popular ratings in 200, 400, 600, and 1000 volts in handy Sprague Kleer-Paks. Order some today.

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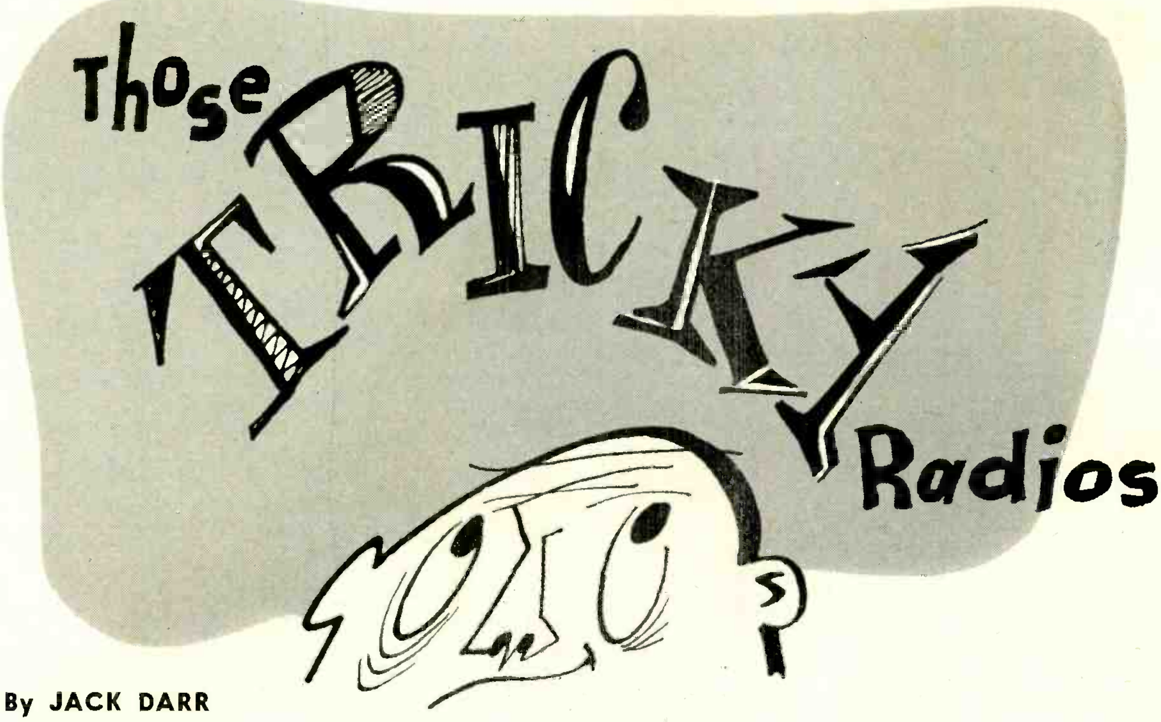
don't be vague—insist on

SPRAGUE® the mark of reliability

ANOTHER TESTED RELIABLE PRODUCT BY THE WORLD'S LARGEST CAPACITOR MANUFACTURER

The Old-Timer shows the Young Ham how to solve some of the radio woes that give technicians bald heads

Those TRICKY Radios



By JACK DARR

THE Old-Timer came in through the shop's back door, a smug expression on his face. He jingled a small stack of dimes in his hand and he whistled softly. The Young Ham was piled up on his end of the bench, with his face buried in a copy of *Mad* magazine. Despite the presumably hilarious nature of his reading material, he looked very unhappy. On the bench completely disassembled, a small radio lay.

"Well, Junior, what's *your* trouble?" asked the Old-Timer jovially. "You look a wee bit sour!"

"You'd be sour, too, if you had *this* little stinker!" said the Young Ham bitterly. "All it'll do is squeal and squall. There ain't a thing wrong with it, but it just won't work!"

"Well, now," soothed the Old-Timer, pocketing his dimes," lessee what goes on." He bent over the little set, turning it on. As it warmed up, sure enough, all he could get was an assortment of birdies, squeals and whistles. "Hmm," he said, turning the signal generator on. He clipped the output lead to the loop frame, and tuned the generator back and forth, moving the radio dial once in a while. The Young Ham watched him sourly. "That's *all* you're gonna get!" he growled.

"Well, now, I wouldn't say that." The Old Timer grinned. "Come on, I'll buy the coffee with some of this money I just won off Doc and Max. Had to sink a long putt on the seventh to do it, too!" He grabbed the copy of *Mad* out of the Young Ham's hands, and dropped it in the wastebasket as they shot out the back door and across the alley to the drugstore. Settled there with their coffee, the Young Ham said, "All right, quit looking so smug. You didn't find out what was the matter with that set that quick!"

The Old-Timer merely grinned knowingly and stirred another spoonful of sugar into his coffee. "All right, then, what's wrong with it? I give up!"

"Well," said the Old Timer, "you gotta remember that I was fixin' them things when you were just a gleam in your father's eye! I've seen a lot of troubles an' I've done just what *you* did m'self quite a few times! Tell me, have you aligned that set?"

"Yeah," said the Young Ham, "I touched it up some. Didn't seem to help though. Just squealed worse! I can't get anything on the lower half of the dial."

"Thought so. Well, I'll show you when we git back to th' shop, but I can tell you now. Your if on that set is neatly peaked at around 650 kc!"

"650!" cried the Young Ham. "How can that be? An' how can that cause all that oscillation?"

"Well, when you keep on 'aligning' a set by hand, without usin' a signal generator, you unconsciously get farther an' farther away from the right frequency," explained the Old-Timer. "Can't help it. First thing you know, the if's away off. When it gets up into the broadcast band, like this one, you begin to get beats between the set oscillator, the signal an' everything else, an' your whole set goes kapoot. Bein' so far off frequency, you get outside the bandpass of th' if transformers and your gain goes away down, so th' set is weak." He paid for the coffee out of his stack of dimes and they returned to the shop. There he turned the little set on again and called the Young Ham. "Looky here now. I've showed you this before, but you seem to need it ag'in, so c'mere."

The Young Ham surreptitiously retrieved his new *Mad* from the wastebasket and peered over the Old-Timer's shoulder. "See here now. I'm feedin' an if signal into th' set by coupling into th' loop." He turned the generator dial back and forth. "I am? Well! Let's try this then." Turning the set over, he connected the generator to the grid of the if amplifier tube. Moving the generator dial, he finally found the signal. "Now look there. 640 kc. Not too close to 455 kc, is it?" The Young Ham gaped in amazement.

Don't fiddle with alignment

"How did the thing get so far off?" he asked.

"Fiddlin' with it!" snapped the Old-Timer. "Tryin' to align the if's on a broadcast signal! It just 'cain't be did'! Even I can't do it, smart as I am! Calibration, yes. You can set th' oscillator trimmer right on a signal, but you just can't align the if that way. Now, see here." He connected a vtvm to the avc network, near the volume control, set the signal generator to 455 kc, and proceeded to adjust the transformer for a peak reading. Several times he was forced to stop and turn down the signal generator level until at last he was satisfied. Moving the generator lead to the mixer grid lead, on the top of the tuning capacitor, he repeated

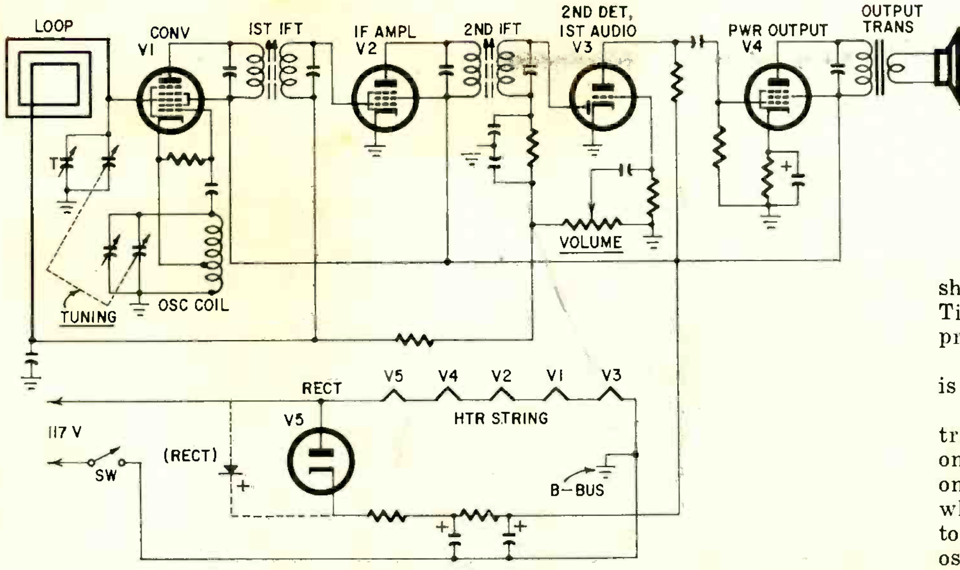


Fig. 1—Circuit of a typical ac–dc radio.

the process for the input if transformer. Removing the signal generator lead, he ran the dial back and forth. Several stations came in fairly well.

"Now, Junior." He grinned. "We can use broadcast stations for a signal generator at this point. Here's a station at 1200 kc, KLCO. How far away is Poteau, anyhow? 60 miles? That's about right. Don't want to use th' local station, he's too strong. So, we know he's on exactly 1200 kc, within 4 or 5 cycles if th' chief engineer's on his toes. So, we set th' dial on 12 and adjust the oscillator and antenna trimmers for maximum avc readings an' then we got it." He ran the tuning back and forth. Now several stations came in loud and clear without a sign of a whistle or oscillation.

"Now," continued the Old-Timer, "let's try the low end. Lucky this one's oscillator coil has a tunable core. Some of 'em haven't, and there's not much you can do with 'em. But on this one, just pick up a station near 600 kc, set the dial to the station's right frequency, and adjust the slug till you get the loudest signal." Making the adjustment as he spoke, he quickly ran the dial back to 1200 kc, retuned the oscillator trimmer slightly, tuned back across the low-end station, and grunted with satisfaction.

"So there you are," he said, leaning back. "Now you see how it's gotta be done. Always remember, young squirt, that there's a difference between 'calibration' and 'alignment'. There ain't but one right way to align a radio and that's the way I just did it. If it's far enough off, start at the last if transformer an' work your way back toward the antenna. You know how to find an unknown intermediate frequency?"

"You showed me once," said the Young Ham. "Lemme see now—"

"I showed you several times!" said the Old-Timer. "Looky here," and he coupled the signal generator to the radio again, by clipping the lead to the loop frame. "Here, I got a signal. Is it the correct if or is it a beat that's comin' in through the front end? How do you tell the difference?" The Young Ham looked blank. "Like this." And the Old-Timer moved the tuning dial of the radio. The signal tone disappeared. "See? We can tune this signal in and out, so it ain't the if. Now, if I set the generator on the right frequency, we can still hear it." He set the generator to 455 kc. "But! Notice that the setting of the tuning dial on the set doesn't have any effect on it!" He demonstrated. As he moved the pointer back and forth the signal still came through. "So that signal's going through the if stages only, it's not coming in through the front end. The first one I had there was some kind of a harmonic or something that you could hear, but it wasn't the if. You can always tell. If you can't tune a signal with th' set dial it's goin' through th' if."

The Young Ham's face took on a look of comprehension. "I see now," he cried. "You're going through the mixer stage, but you're just using it as an amplifier. The oscillator doesn't have anything to do with it at that point."

"Right!" agreed the Old-Timer. "Now you're beginning to get th' point. Remember, your if stages are a fixed-tuned bandpass amplifier an' you can't align them properly without usin' an accurate signal source. Best method, look up th' correct intermediate frequency for that particular set in the service data file. Although most of th' sets nowadays, outside of th' transistor models, use 455-kc if's, still you never can tell when somebody'll try to throw you a curve. Better be safe an' look it up. Only takes a minute and then you're sure."

Lightning strikes twice

The next day the Old-Timer came into the shop only to find the Young Ham in the identical attitude he had been in the day before. Another small radio lay on the bench before him. This time he was simply glaring at it. The new *Mad* lay in the far corner of the shop where he had flung it. The Old-Timer grinned at the woebegone expression on the youth's round face.

"Oh, no!" he said. "Not again! What is it this time?"

The Young Ham snarled at him. "I tried everything you told me yesterday on this and it's worse than the other one! I aligned it real careful! Just when I get it right up to where it ought to peak, the blasted thing goes into oscillation! The only way I can stop it is to detune one of the if transformers! *Now* what's the matter? I thought I had 'em pretty well down, but now I don't think I'll *ever* learn anything about 'em!"

The Old-Timer laughed sympathetically. "Well now, don't be a defeatist! Let's see what's wrong. Seems to me I've had the same kind of troubles in the past. Fact, I've had a lot of 'em! Lessee here," and he turned the set on. In truth, it did oscillate wildly. Turning it over, he carefully touched the tip of a finger to several points, then picked up an electrolytic capacitor from a drawer. He carefully bridged it across the filter capacitor in the set. The oscillations stopped and the set played sweetly. The Young Ham's jaw dropped.

"You mean the thing had a bad filter capacitor?" he howled. "Why, that dirty -|||||- ⓞ ⊖ ≠ ∿∿ ⊥ I thought about that once. Never occurred to me to shunt it. Didn't have too much hum, I thought."

"Well, sir, you don't always have to have a loud hum to have a bad filter capacitor," replied the Old-Timer. "Lemme show you something. Where's that 'typical radio schematic' I was always making you draw me a while back?"

"Right here somewhere," said the Young Ham, scrabbling in the litter at the back of the bench. He emerged with a small battered notebook and opened it. "Here (Fig. 1)."

"Yeah, that's it," said the Old-Timer. "However, I'd much rather have this schematic here," giving the Young Ham's crew-cut head a brisk Dutch rub, "than in here," tapping the notebook. "Now, looky here. *All* radios are built like this. Don't make a dern what kind they are, tube or transistor, you got these same parts in 'em. Just like all cars got four wheels and a motor, you got these parts in radios. Kind of a irreducible minimum, might say. So look at the return paths from all of the rf and if stages. All go back to the power supply and that output filter capacitor has to bypass all that mess

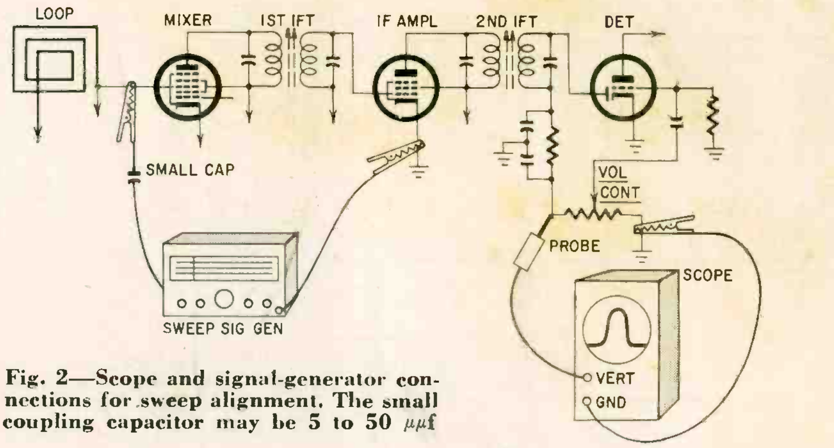


Fig. 2—Scope and signal-generator connections for sweep alignment. The small coupling capacitor may be 5 to 50 $\mu\mu f$

of assorted frequencies to ground or B-minus if you want to be correct about it. So it gets a little off, and don't have the filtering efficiency it oughta have. Then, when you're aligning a set you wind up building up a large signal in the return paths back to th' power supply, an' th' first thing you know, it finds a feedback path somewhere, and th' set goes into oscillation. Like I said before, y' don't necessarily have to have the customary loud hum. This capacitor's just got too high a power factor; in other words, it has resistance as well as capacitance, that's all."

"Well!" marveled the Young Ham. "I sure didn't think of that."

"Well, if you can kinda keep that schematic in mind, an' make a logical deduction about just what's happenin', you won't have too much trouble," said the Old-Timer. "Experience is a great help, too! Every time you run into some characteristic trouble like this, make a note of it, an' pretty soon you'll have a mental file of dang near all of 'em."

"How can you remember *all* of the darn things?" asked the Young Ham.

Try this one

"I got news for you. You *can't!* The Old Timer grinned. "However, if you got a good groundin' in the basic facts about a radio an' you remember how it works, you can get pretty close most of th' time. Say, by the way, I got one for you; almost like this, only worse. Came in this mornin' while you were in school an' I saved it for you." Ignoring the very sarcastic "Thank you!" from the Young Ham, he went to his end of the bench and brought back another small radio. "Here, try this out and see what you think of it. Gimme a tentative diagnosis on it. I gotta run across the street a minute."

When he returned, he found the little radio playing sweetly on the local station. The Young Ham beamed up at him. "Hey, Dad-O! Listen to that! I realigned it like you said, and listen. Stations all over the place!" He ran up and down the dial, demonstrating.

"Like way out, man!" agreed the Old-Timer. "Only one little thing an' that's what I wanted you to find. Notice anything out of th' ordinary?"

"Well, not too much," said the Young Ham. "Kinda seems like it whistles a little too much when you tune it across a station."

"That's it!" said the Old Timer, delighted. "That's what I wanted you to find! Congratulations! Now what'll we do about it?"

Twiddling the if's helps

"There you got me, man. Seems like I can help it a little by twiddlin' the if adjustments, though," replied the Young Ham.

"That's right. That's where it is. Now lemme show you an easier way," said the Old-Timer, turning the sweep generator and oscilloscope on and hooking them up to the set (Fig. 2). He set up the generator to produce a pattern on the screen (Fig. 3). "Now, there's a response curve of the if stages. See, I hooked the generator to th' mixer grid an' the scope to the detector output, right here at the top of the volume control. Now, by settin' th' signal generator up to produce an FM signal, swept about 30 kc at the if, I got an idea of what the if stage response looks like. See that funny-shaped pattern (Fig. 3-a)? That don't look right, does it?"

"Shouldn't it be more symmetrical, more rounded, instead of havin' that sharp point?" asked the Young Ham.

"Right, Junior. You're sharp as a tack today!" said the Old-Timer. "That 'point' indicates that the thing is just on th' verge of bustin' into oscillation! See those little 'squiggles' on th' base line there? Those are always a good clue. That an' th' sharp point and th' general one-sidedness of the pattern. Now, let's adjust the if transformers until we git this thing a bit more symmetrical, huh?" Suiting action to words, he retuned the if adjustments. As he worked, the pattern gradually assumed the rounded shape of Fig. 3-b. "Now then," he said, disconnecting the instruments, "lessee what she sounds like now." Sure enough, the annoying whistle was gone and the radio played sweetly from one end of the dial to the other.

"Hey, that's a lot better," said the Young Ham. "Now, just what was causing that?"

"Well, that's a leetle hard to say, precisely," said the Old-Timer, honestly. "Might have been darn near anything: too hot if tubes, some stray coupling in the wiring, filter capacitor just right on th' verge of bein' too high in power factor, not enough shielding or even a fault of the design of the set! This you usually find in th' cheaper sets. Poor ol' designer tryin' to get more out of it than he put in, an' drivin' his if stages too hard! Used to find a lot of that right after th' war. Not so bad now, thank goodness. Anyhow, the basic fault was a kind of incipient oscillation, caused by a little-bitty feedback path *somewhere* in th' set. You coulda tracked it down other ways, but this is a heck of a lot easier! Of course, if you do try this on some set and you *can't* get th' pattern to come up like it oughta, then you start lookin' for other troubles: temporarily replace the filter capacitors; shield the if tubes; check th' lead dress on plate and grid wires; check th' avc bypass capacitors, and all of the other things you could do to eliminate feedback paths in both plate and grid return circuits. If you'll do this while you watch your scope pattern, it'll tell you right away whether what you just did really helped or not."

"This is a kinda old signal generator, isn't it?" asked the Young Ham. "Do they make them any more? Seems as if I haven't seen any like that for quite a while, in the ads."

"Nope," said the Old -Timer, "guess not. Hickok made this old 188 'way back in 1941. Since then it's been superseded by a new job. They call it the 288X. There used to be a lot of 'em, an' there may be more one of these days. Seems like sweep alignment is comin' back, by golly. Tell you another thing this'll do. Tell me what you have to have to align one of these little AM/FM/hi-fi tuners that are gettin' to be so popular nowadays?"

"Some way to make the thing pass a wide band of frequencies, up to 15,000 cycles, haven't you?"

"Right! At least, you ought to, if you're gonna call the thing hi-fi," answered the Old-Timer. "Now, suppose you wanted to align the if stages on one of them, on AM f'rinstance. Would you just peak it like you did this one? Or would you like to find some way to flat-top th' if response curve so's it would pass all those frequencies. Remember, the standard bandpass for a regular if is only 10 kc and most of 'em a lot less'n that!"

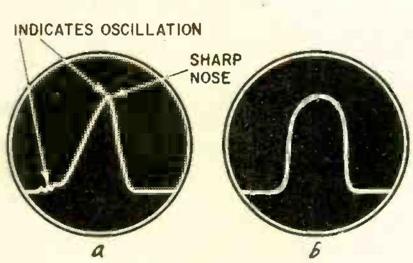


Fig. 3—Incorrect (a) and correct (b) scope patterns.

The JUNE issue of RADIO-ELECTRONICS will be on sale May 26
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"Why, it would be much better if you could flat-top it," said the Young Ham. "But how would you do it?"

"Well, it'd be a leetle rough tryin' to do it with just an output meter and a standard signal generator," said the Old-Timer. "But you could put this sweep generator on it, on AM, like we just did, and adjust the if trimmers to give you a flat-topped response curve like this (Fig. 4). If you wanted the FM if's to be the same, like they oughta be, all you gotta do is sweep them at their correct if, 10.7 mc ain't it? Set your sweep width a little more, 'cause your FM signals cover a wider band than AM: 150–200 kc, but you can get the same nice wide flat-top

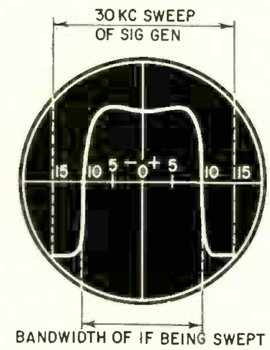

Fig. 4—Flat-top alignment for wide-band AM tuners for hi-fi radio reception.

response that you need. That'll give you a tuner with pretty poor selectivity, on AM anyhow, but that don't seem to bother much. Seems like most of th' hi-fi bugs don't go in for dx'in' any more. They confine their hi-fi listenin' to the local stations an' the broad tunin' don't make any difference. Of course, if they want, you can set the response any way they need it. If they want distant stations, set 'er up for a narrower bandpass, say about 8 kc, and the selectivity will be fine! So, you can make 'em do anything you want, if you go about it in the right way."

"Say, that's right," admitted the Young Ham. "Never thought of it before." He turned the little radio on and a burst of rock 'n' roll music came out from the local station's late afternoon Teen-time show. The Old-Timer got a faintly nauseated expression. "Junior" he inquired, "did I ever tell you about the article I read a while ago? An engineer down in th' jungles was havin' trouble with th' leopards eatin' his native workers? Know what he did?"

"No," said the Young Ham, with a suspicious look.

"Hooked up a PA system on a jeep and ran up and down th' roads playin' rock 'n' roll records so loud you could hear it for a mile! Them leopards took off for th' high lonesome and ain't been seen since! And, y' know what? It kinda affects me th' same way!" And he grabbed his battered cap and a list of service calls and beat a hasty retreat before the Young Ham could come up with a rebuttal. END

Dependability is a built-in feature of all Delco Radio Service Parts!

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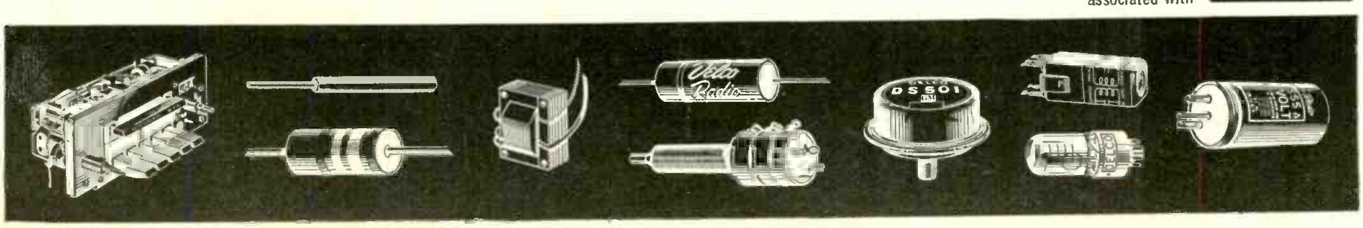


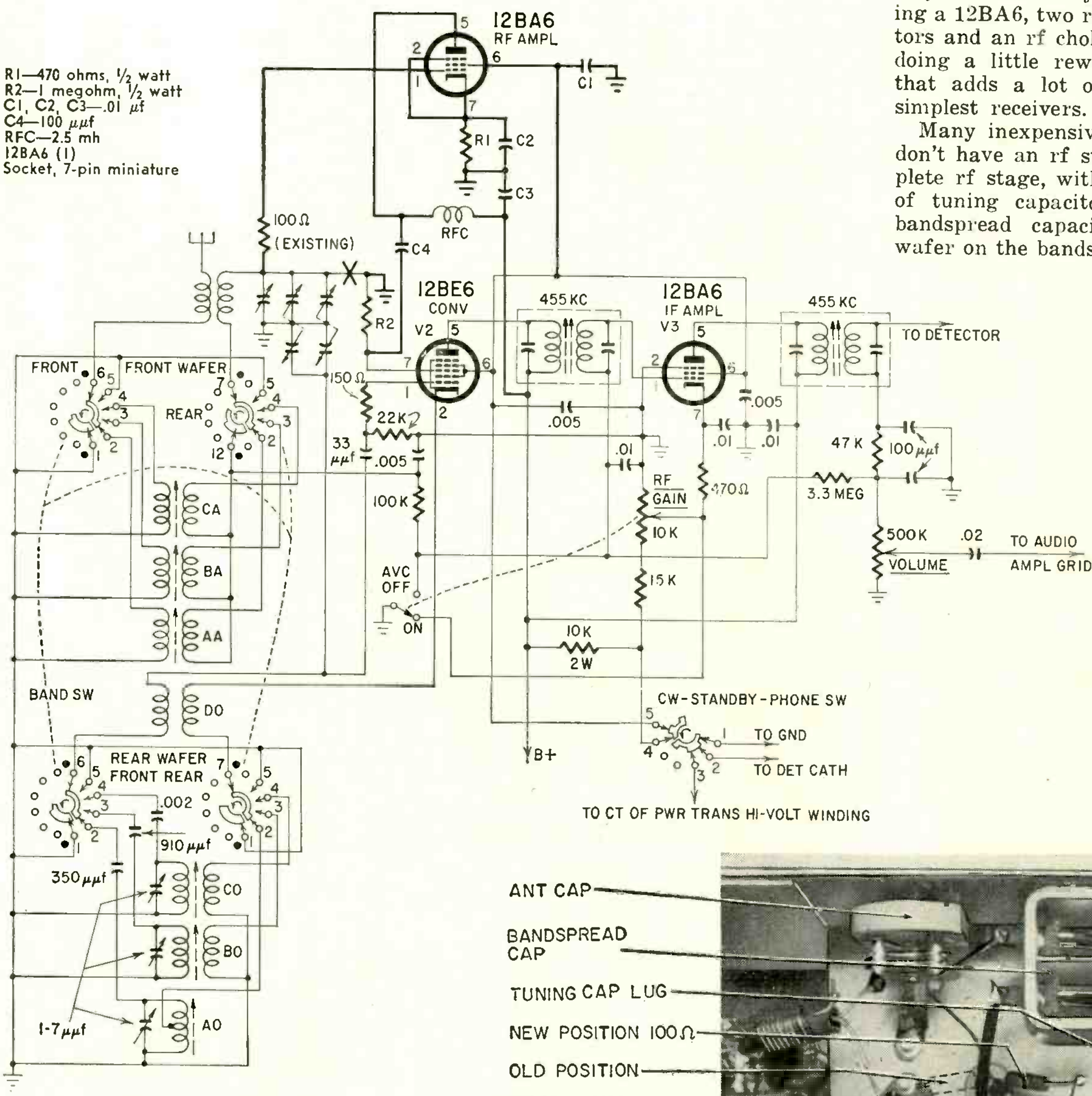
Souping up that OLD RECEIVER

For more sensitivity add a tuned rf stage that uses the coils already in the all-wave receiver

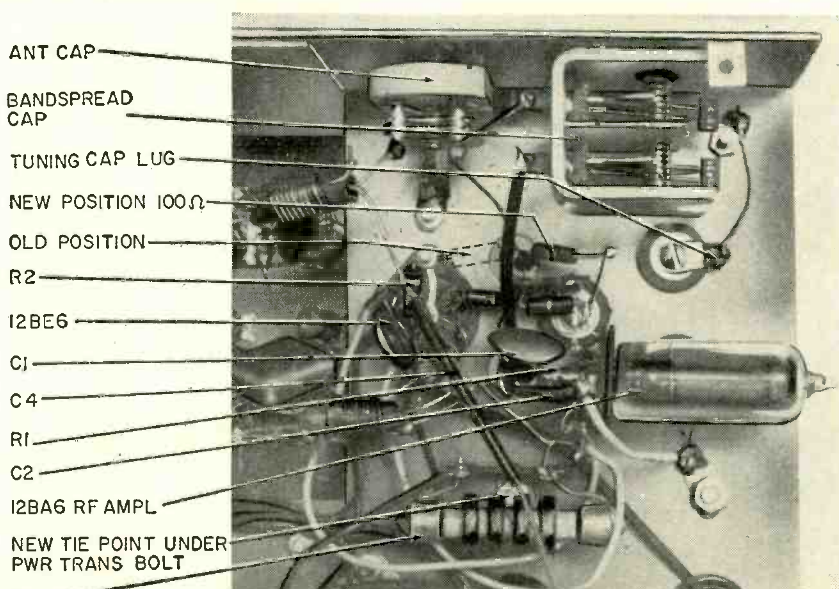
By J. H. THOMAS

IF you like to listen to foreign stations and amateurs, and your receiver is an inexpensive shortwave unit, here's how you can pull in European stations you never knew existed, as well as many amateurs inaudible up to now. The whole job won't cost much, nor will it take more than about 20 minutes of your time. It's just a matter of adding a 12BA6, two resistors, four capacitors and an rf choke to the circuit and doing a little rewiring. A simple job that adds a lot of sensitivity to the simplest receivers.

Many inexpensive all-wave receivers don't have an rf stage. To add a complete rf stage, with coils, third section of tuning capacitor, third section of bandspread capacitor and additional wafer on the bandswitch *could* be done,



Circuit of inexpensive all-wave receiver showing added rf stage.



Under the chassis, this is how the modification looks.

but would be relatively costly and difficult to fit into the receiver. It is simpler to add a tuned rf stage using all the present coils (and no more) and make the converter an untuned stage. In this way, you will not detract from the selectivity (as you would with an untuned rf stage); you will, at least, maintain the signal to noise ratio and you will gain a great deal in sensitivity.

Here's how I did the job on my Heath AR-3. The modified circuit is shown in the diagram and photo. The connections to pin 7 of the 12BE6 are unsoldered, and the entire group of coils is then connected to the 12BA6 as shown. The plate of the 12BA6 is fed through an rf choke and a 100-$\mu\mu$f capacitor couples it to the grid of the 12BE6. Keep the connections to the grids short, and well away from the heater leads. The receiver should be realigned, paying particular attention to the rf section. Oscillator action should not have been affected by the change. The socket for the 12BA6 needs no sheet-metal work and no separate support, if you use solid No. 20 for the connecting wires. The socket gets enough support from the short wires (unless you intend to ship your receiver somewhere).

For the broadcast band, the extra rf amplification was not really needed and, if you feel you want to be able to do without it there, the new amplifier connections can be switched in and out so you can switch back to the original circuit at once. This switch should be a three-pole two-position unit at least, one section to switch the connections to the 12BA6 grid, a second to switch the connections to the 12BE6 grid and the third to parallel a small trimmer with the rf section of the tuning capacitor, which needs a little more capacitance with the 12BA6 in the circuit. A 3–15-$\mu\mu$f trimmer should be adequate. The selectivity of the AR-3 is normally quite good, except for strong interfering signals on the short-wave bands. For this reason, Heath has put out the Q multiplier, which is a feedback type of amplifier giving tremendous selectivity but no additional sensitivity. With this modification, which does not affect the use of the Q multiplier, you can have the additional sensitivity as well. The performance of the whole assembly, if carefully aligned, comes much closer to that of the more expensive receivers, particularly on the 10–30-mc band.

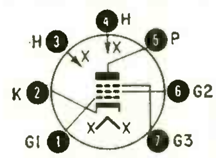
Sputniks can now be heard, when they are around. Try it out. If you decide you don't like the result, you can take it all out with a soldering iron in a minute. I'll bet you keep it in! END

NEW TUBES and SEMI-CONDUCTORS

TUBES rule this month. There is a power-output audio type, a high-gain twin triode for cascode amplifier service, a couple of pentodes for if amplifier use and a full-wave rectifier. Protecting the interests of the semiconductor field are a couple of vhf silicon transistors and a line of Zener diodes.

6EW6, 4EW6

These tubes are miniature high-transconductance sharp-cutoff pentodes designed for service as if amplifiers. The 4-volt version has a controlled heater warmup time for series-string



6EW6,4EW6

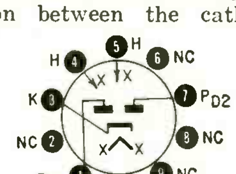
operation. The tubes are identical except for heater ratings. The 6EW6 has a 6.3-volt 400-ma and the 4EW6 a 4.2-volt 600-ma heater.

Typical operating characteristics of these Sylvania tubes as a class-A1 amplifier are:

V_P	125
G3	tied to cathode
V_{G2}	125
$R_{K\,bias}$ (ohms)	56
I_P (ma)	11
I_{G2} (ma)	3.2
gm (μmhos)	14,000
R_P (approx) (k ohms)	200

6CA4

A full-wave vacuum rectifier tube in a 9-pin miniature envelope intended for use in high-fidelity equipment. The tube has a unipotential cathode with a 6.3-volt heater and has high-voltage insulation between the cathode and



6CA4

heater. The 6.3-volt heater eliminates the need for a separate heater winding on the power transformer.

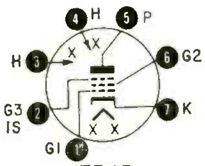
Maximum design-center ratings of

the RCA 6CA4 in rectifier service are:

V_P (peak inverse)	1,000
V_P (ac supply, rms voltage per plate)	350
I_P (peak per plate) (ma)	450
I_{output} (ma)	150

7543

A sharp-cutoff pentode in a 7-pin miniature envelope intended for use in high-gain resistance-coupled amplifiers where low hum and minimum microphonics are essential.



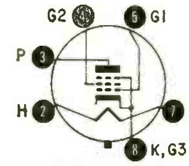
7543

Characteristics of the RCA 7543 as a class-A1 amplifier are:

V_P	100	250	250
V_{G3}	connected to cathode at socket		
V_{G2}	100	125	150
R_K (ohms)	150	100	68
R_P (megohms)	0.5	1.5	1
gm (μmhos)	3,900	4,500	5,200
I_P (ma)	5	7.6	10.6
I_{G2} (ma)	2.1	3	4.3

6FE5, 50FE5

A series of beam-power tubes of the octal type designed for use in the audio-output stages of stereo or mono phonographs. As the tubes have high power sensitivity at low supply voltages and can deliver relatively high power output at low plate-load resistance, they make possible compact, low-cost 3-tube stereo systems. The 6FE5's heater is rated at 6.3 volts, 1.2 amps. The 50FE5's heater is rated at 50 volts, 150 ma.



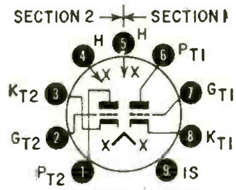
6FE5,50FE5

Typical operating characteristics of the RCA 'FE5 (two tubes in cathode-bias operation) are:

V_P	130	145
V_{G2}	130	145
R_K (ohms)	75	75
I_P (zero sig ma)	150	160
(max sig ma)	154	172
I_{G2} (zero sig ma)	7.2	8
(mag sig ma)	17	20
HM (%)	6	6
P_{total} (max watts)	7	8.5
R_P (ohms)		1,000

ECC88/6DJ8

A high-gain twin-triode with frame-grid construction in a 9-pin miniature envelope. The tube offers high reliability for instrumentation, industrial controls, nuclear electronics, communication and broadcast equipment and TV tuners. The tube is especially useful



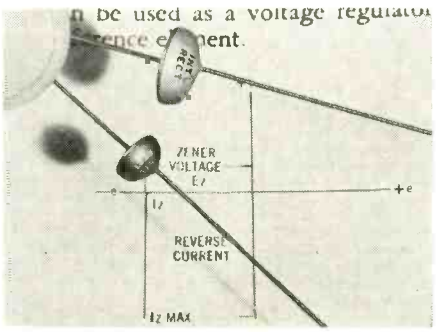
ECC88/6DJ8

in cascode amplifier service where it provides low-noise performance.

Characteristics (each section) of the CBS ECC88/6DJ8 are:

V_P	90
V_G	−1.3
I_P (ma)	15
g_m (μmhos)	12,500
μ	33

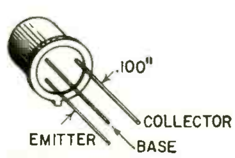
International Rectifier offers an economy line of silicon Zener diodes. These units feature low Zener impedance val-



ues and very sharp Zener knees. They are available in 50-mw and 1-watt rated series and standard EIA voltage steps from 5.6 to 27 volts.

2N715, 2N716

A pair of n-p-n double-diffused mesa



2N715,2N716

silicon transistors designed for use as vhf oscillators and amplifiers at frequencies up to 200 mc.

Maximum ratings of these Texas Instruments transistors are:

	2N715	2N716
V_{CB}	50	70
V_{CE}	35	40
V_{EB}	5	5
P_T (mw)	500	500

Typical characteristics at 25°C are:

		2N715	2N716
Oscillator output power $V_{CB}=30$, $I_C=25$ ma, f=70 mc)	(mw)	250	450
Amplifier power output ($V_{CB}=30$, $I_C=25$ ma, P_{in} (ac)=120 mw, f=70 (mc)	(mw)	400	600
h_{FE} ($V_{CE}=10$, $I_C=15$ ma)	(min)	10	10
	(max)	50	50

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 May, 1910, *Modern Electronics*

Bellini-Tosi Station at Boulogne, by A. C. Marlowe.
Directive Aerials, by George F. Worts.
De Forest Radio Telephone Experiments.
Auxiliary Loose-Coupled Tuner, by Walter E. Keever.
100 Mile Wireless Station Using the Duplex Aerial, by Richard H. Foster.
New Detector.
Transmitting Pictures.
New Electrolytic Detector.
Wireless on Airship.
Experimental Wireless Telephone, by Moore Stuart.
Wireless Registry.
Directive Aerials, by Bernadotte Anderson.
Simple Helix.
Duplex Aerial.

TRY THIS ONE

BATTERY REPLACEMENT

Some years ago a complete line of transistor batteries labeled the VS series appeared on the market. Among them was a 4-volt unit called the VS308. Many experimenters used this battery in their radios and other equipment. Unfortunately, it was discontinued some months ago. If you cannot find a suitable replacement, try this:

Obtain an Eveready battery No. 226 (a 9-volt unit with 6 cells that is roughly twice the length of a VS308 and has about the same diameter). Pry off the metal envelope and split the stack in half to get two 4.5-volt batteries. At the split you will note black, carbony surfaces.

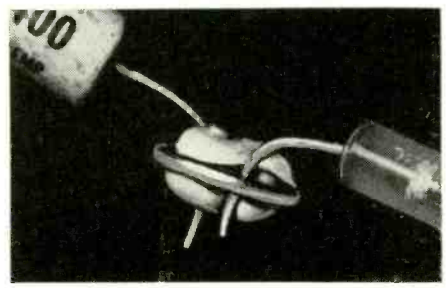
To complete the new batteries, rip apart an old VS308, salvaging the terminal plates and cardboard pieces (one red and one black to indicate polarity). Add one terminal plate and cardboard disc to each 4.5-volt stack at its open surface. Use a rubber band to hold everything under pressure and you have two new batteries, each about the same size as a VS308.

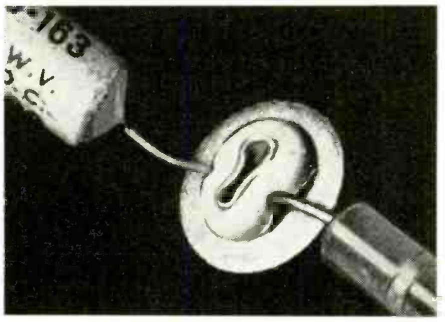
The catalogs list P6M (Burgess) and VS300A (RCA) as equivalent to the Eveready 226.—*I. Queen*

SOLDERLESS CONNECTORS

Several solderless connectors which allow rapid substitution of parts in experimental circuits are available. However, most of these connectors are expensive. After a great deal of experimenting, a solderless connector which I call a "connect-em" was developed to permit parts to be changed quickly and without damage. And best of all, each connect-em costs only a few pennies!

To make the construction of experimental circuits a pleasure at a minimum of cost, you can assemble a supply





of these solderless connectors from washers and grommets available in most radio supply houses. Obtain some ⅝-inch diameter metal washers with a ¼-inch hole, and an equal quantity of soft gum-rubber grommets to fit a 5/16-inch mounting hole. The extra 1/16-inch makes a tight fit when the grommets are inserted in the washers.

To use a connect-em, simply insert the leads of transistors, resistors and capacitors between the grommet and the inside edge of the washer. To use tube sockets, potentiometers and parts which do not have leads, solder a length of solid wire to each terminal so they maye be used with this connector.—*Roscoe Siceloff*

DROP-CLOTH POCKETS

Have your wife sew a pocket into each corner of your drop cloth. Use them to store a set of dusting cloths, sponges and other cleaning items. This is an especially good idea if your caddy or toolkit happens to be a bit overcrowded. Snap fasteners on the pockets will keep the contents from falling out. —*Joe C. Allen*

SHARPENING A PUNCH

Eventually a chassis punch looses its keen edge and doesn't cut as efficiently as it should. If you have a dull punch resharpen it by laying the punch and die ring on an oil stone and slowly rotating them with a circular motion, using moderate pressure. Don't rock the punch up on edge while sharpening or you will get an uneven cutting edge.

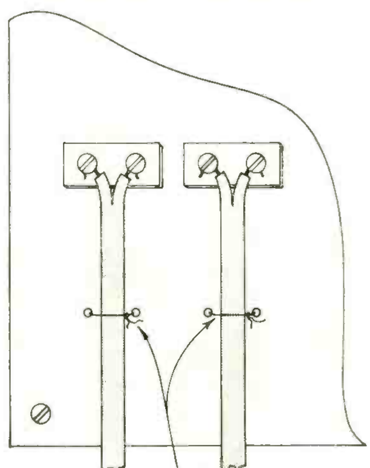
If you don't have an oil stone, a piece of very fine sandpaper tacked to a perfectly flat surface will do the job nicely.—*John A. Comstock*

TAPE PROTECTS CHEMICALS

If you've ever opened your toolkit and discovered a tube of service cement, lubricant or weatherproofing compound punctured, you probably wished there were some way to keep this from happening again. Fortunately, there is a way. Just wrap each tube with overlapped strips of electrician's plastic tape. Leave enough of each tube unwrapped to identify its contents.—*Scott Mack*

REDUCE NUISANCE CALLS

Quite often I make a house call to find nothing wrong except that the antenna leads have been pulled off the back of the set. This is common on sets which can be swiveled, since the leads are moved each time the set is turned.



TIE ANTENNA LEADS TO BACK COVER WITH STRING

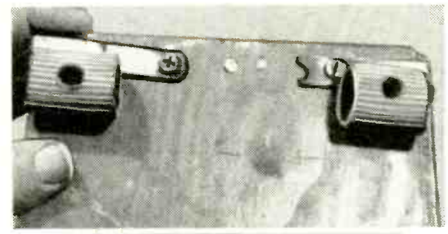
I solve this problem by tying each antenna lead to the back cover with string a few inches below the antenna terminals. This keeps the leads from breaking at the antenna terminals. Holes seldom have to be drilled as most back covers are perforated for ventilation.—*Albert J. Krukowski*

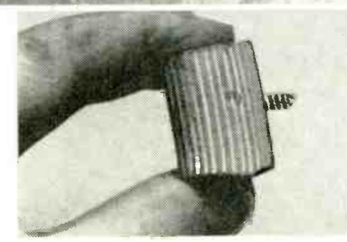
EARPIECE REPAIR

Some of the transistor radio earpieces have rubber ear inserts. After being used for a while, the ear insert gets sticky and the rubber eventually "rots" away. When this happens you have to get a new insert. You can make your own by simply obtaining a plastic cap like those on the plastic squeeze bottles that glue comes in. I used a cap from a 2-ounce bottle of Fuller's all-purpose adhesive. Drill a 5/32-inch hole in the small end of the cap. Then slip it over the earpiece knob. If the cap slides off the knob, sand the knob lightly and apply a small amount of glue.—*Les Leap*

SHOCK ABSORBERS

Shock-absorbing pads for delicate electronic instruments, record changers, motors, etc. can be made from ordinary discarded garden hose. Cut a section of the hose into small pieces. Drill or punch a small hole through the center of each section as shown in the photos. These holes are for the attaching screws





or bolts. If more convenient, the pads can be permanently fastened to small wooden blocks that are attached to the equipment. In addition to stopping vibration, these pads will keep a motor (for example) from creeping on a smooth surface.—*Glen F. Stillwell*

DOUBLE-DUTY ALLEN WRENCH

To get at Phillips-head screws in cramped quarters, grind one end of an Allen wrench to fit the screw slots. Pocket-sized, such a screwdriver will loosen the most stubborn screw, and its unaltered end can be used for the regular Allen setscrews.—*S. Clark* END

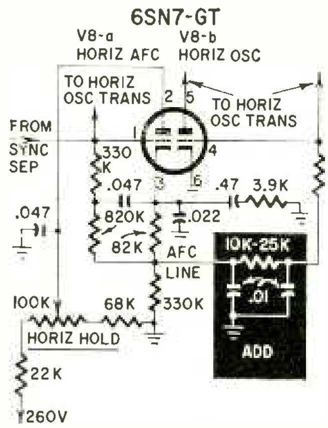
Technotes

AIR-CONDITIONER FAN MOTORS

Experience in our shop has shown that many RCA air-conditioner fan motors, which appear defective because of open windings, actually have a cold-solder joint where the motor winding connects to the built-in thermal overload. The next time you run into a fan motor that doesn't run when power is applied, disconnect the fan motor leads from the switch and check resistance with an ohmmeter. If no resistance is read between the black and white wires, but you get a reading between green and white a cold-solder joint may be causing the trouble. To check, remove the motor from the air conditioner, remove the bolts holding the end covers in place, remove the cover opposite the side the leads come out. Then carefully cut the tape holding down the black lead and withdraw the thermal overload. Check the joint between the overload and the enameled wire. If defective, resolder and reassemble the unit, and you have saved your customer a motor replacement.—*W. C. Warren*

CBS U3T616

There was a bend in the picture at the top of the screen. A check of the circuit revealed hash on the afc line to the horizontal oscillator. I couldn't locate any bad components, so I had to get the hash off the afc line. To do so, I broke the line and installed an 18,000-ohm resistor (any unit rated between 10,000 and 25,000 ohms will



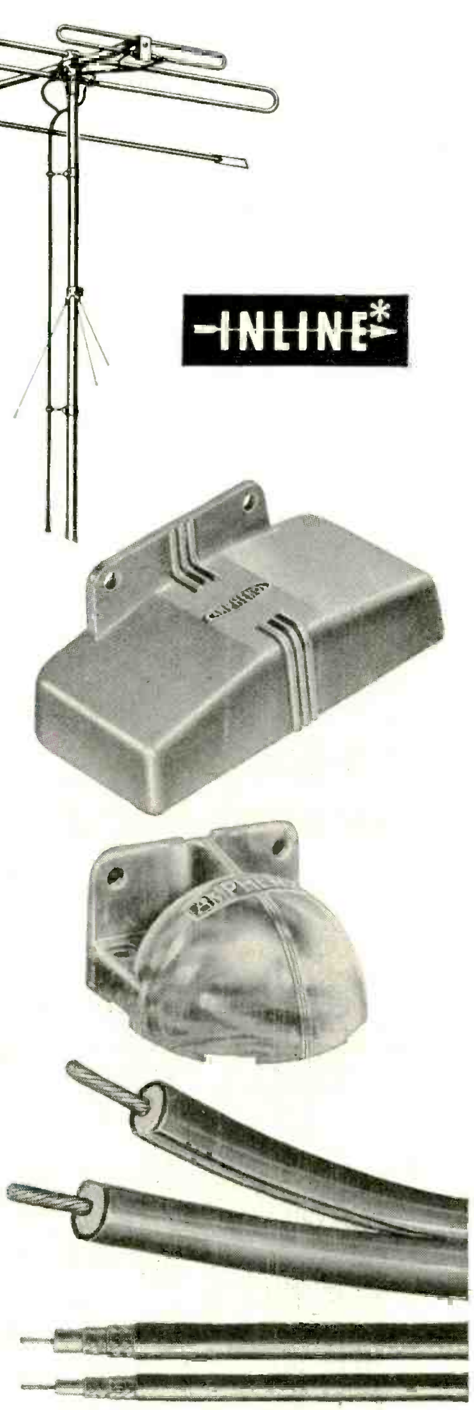
work). Then I bypassed both sides to ground with a couple of .01-μf capacitors. This filtered out the hash and restored normal operation.—*W. G. Eslick*

BENDIX CHASSIS T-19

One of these sets came into the shop with a complaint of hum pickup. Normal methods could not stop the hum. Finally, we discovered that the hum was being picked up by the filament wiring of V11, 12, 7 and 9 from the green lead coming from pin 1 of V11. The solution was to dress the filament wiring as far as possible from the green lead.—*Larry Steckler*

FREEING IF COIL SLUGS

Quite often trying to touch up the if alignment of an auto radio becomes a major job because one or two slugs refuse to budge. Usually, this is caused



by wax the manufacturer drops into the core to keep vibration from affecting the receiver's alignment. Trying to force the slug may damage it, the coil or the alignment tool.

Most auto radio if slugs require a hex alignment tool and, as these tools are nonmetallic, they cannot be used to apply heat to the slug. Placing the receiver under a heat lamp will eventually soften the wax, but this needlessly subjects many parts to extreme temperatures.

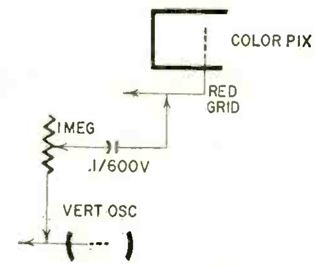
I find that an easy way to soften the wax holding an if slug is to heat an Allen wrench of the proper size with a soldering iron and insert it into the slug opening. This not only provides maximum transfer of heat but also provides a means of starting the slug. —*Albert J. Krukowski*

OUT-OF-SYNC COLOR ON PURPOSE

Classroom instructors and shop supervisors can make highly effective demonstrations of out-of-sync color patterns by using this stabilizing method:

Feed the voltage from the red gun back to the grid of the vertical sweep oscillator through a 0.1-μf blocking capacitor and a 1-megohm pot. Lock the pattern with the pot.

To make the demonstration, display a color bar or rainbow pattern on the



screen of the picture tube. Next, throw the burst afc off balance, so the pattern loses color sync. Finally, adjust the 1-megohm pot to lock the out-of-sync pattern.

By holding the pattern still on the screen, the instructor can point out its details to much better advantage. Students can also study the pattern more effectively when it is not moving on the screen.

The effect of high or low off-frequency operation of the color subcarrier oscillator can be shown by turning the burst afc one way or the other, by greater or lesser amounts.—*Robert G. Middleton*

FORD 74BF, 75BF

Transistors used in the audio output circuits of hybrid auto radios are a hardy breed, but they can be damaged by excessive heat. To guard against this they are mounted on the outside of the set and, as an additional precaution, usually in a heat sink. Under certain conditions this is not enough protection.

After a severe heat wave last summer I had to replace the transistor in half a dozen Ford hybrids (models 74BF and 75BF) that had weak or no sound. No other faulty component or circuit defect could be found in any of these sets to account for the sudden epidemic of transistor failures. Each of these cars must have been parked in hot sunshine with their windows closed long enough to bake the transistor, increasing its conduction to the point where it was permanently damaged. —*Chase Bass*

DON'T FORGET TUBE SHIELDS

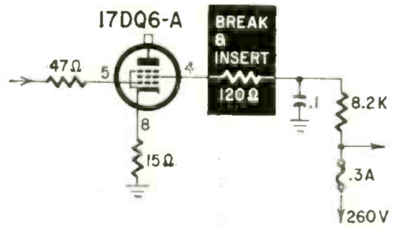
Forgetting to replace tube shields can cause a lot of trouble. Interference beats in the picture, if oscillation, degraded picture, distorted sound and critical fine tuning can result. Proper placement of tube shields in the tuner, pix if strip and audio if are especially important. Check grounding springs for good contact between tube shields and chassis.—*W. C. Warren*

MARK GRID-CAP LEADS

Many older radios in use now have grid-cap leads. When servicing these sets, it is best to mark the grid-cap leads. Two same-sized (but different type or application) tubes close together can have the same color and length grid-cap leads. These leads come from same hole in chassis. Or the lead from the top of one if can may reach any one of three tubes. To identify these (after removing from tubes) mark two squares of adhesive tape with the letter A. Put one on the tube and the other on the matching wire. Do the same for other tube, using a different letter of course.—*A. von Zook*

RCA 800 SERIES PORTABLES

The set came in with a jagged vertical line on the right side of the picture which we properly analyzed as parasitic oscillations in the horizontal out-



put stage. The solution was simple: we inserted a 120-ohm ½-watt resistor in the screen grid of the horizontal output tube, a 17DQ6-A.—*C. S. Lawrence*

ELECTROSTATIC-FOCUS CRT'S

These picture tubes are designed to be self-focusing despite variations in the voltage applied to the focus electrode of the tube. However, focus can sometimes be improved by trying the various voltages found throughout the chassis on the focus electrode.—*Larry Steckler*

END

TECHNICIANS' NEWS

WORTH JOINING

According to *TESA News of Wisconsin*, the average income of a TESA member is about $1,000 more a year than non-members, or about $6,000 as compared with $5,000. Lack of management skills is the main cause of the lower income. An example of this is unprofitable pricing schedules. The article also says that white shirts are good for business. The members say that the shirts give them more prestige, respect and customer confidence.

WHY AREN'T YOU ON THE LIST?

RADIO-ELECTRONICS is publishing a list of *known* service associations in North America. Every now and then some association will write in and ask us why they have not been listed. We can only list you *if we know about you*. Associations in certain states seem reluctant to announce their presence. These include Arkansas, Connecticut, Florida, Minnesota, New Hampshire, Oklahoma, Rhode Island and Texas. Your organization can be most effective if its existence is made known.

If your association or any you know of have not been listed, *let us know about it*. Send a postcard with the name and address of the president or secretary to: Associations Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

MISSOURI

TESA-CENTRAL MISSOURI
Vernon Towner, Secretary
710 Jefferson St.
Jefferson City

THE ELECTRONIC ASSOCIATION OF MISSOURI (TEAM)
John V. Glass, Membership Committee Chairman
4134 Easton Ave.
St. Louis

KANSAS CITY CHAPTER (TEAM)
Joe E. White, Chairman
5367 Independence Ave.
Kansas City 24

TELEVISION SERVICE ENGINEERS-KANSAS CITY (TSE)
J. Alex Earp, Secretary
7504 Troost
Kansas City

MISSOURI-KANSAS GROUP
J. B. Welch
12900 Elm St.
Lenexa, Kans.

TESA OF THE OZARKS
Benton Linder, Secretary
854 S. Glenstone Ave.
Springfield

TESA-SOUTH CENTRAL MISSOURI
Bill Pryor, Secretary
Mountain Grove

TESA-SOUTH WEST MISSOURI
George Scott, Secretary
306 College
Greenfield

TESA-ST. LOUIS
Eugene Love, Secretary
6909 Glenmore Ave.
Pine Lawn 20

An addition is reported from OHIO:

TESA OF MANSFIELD AREA
Saul Hersch, Secretary
P. O. Box 667
Mansfield, Ohio

G-E SERVICE POLICY

"Television receiver servicing traditionally has been done primarily by independent servicers and this fact is recognized by the newly issued company-wide policy statement."

These words from Steven R. Mihalic, product service manager for G-E's TV receiver department, sum up G-E's present attitude toward TV repairs.

The actual policy statement says that the company believes "that its participation in product service activity is a natural, desirable and essential part of producing and marketing its products . . . There are many competent and efficient independent service organizations engaging in this activity as a profitable business . . . Both the company and its customers depend on such organizations to keep many kinds of equipment in good operating condition. Service manuals and service parts are made available to qualified independent service organizations in this work."

NEW OFFICERS

The Electronic Service Dealers Association (ESDA) of Cowlitz County (Wash.) has elected Les Eddy president; Forrest Duvall, vice president; Ansel V. Heckman, secretary-treasurer, and Rollie Mietzke and George Gorans, directors. Their program for the year includes a motion to join NATESA.

ANTI-LICENSE INJUNCTION

The Kansas City Chapter of TEAM (Mo.), has secured a temporary injunction against enforcement of the license ordinance in their city. W. C. Pecht, editor of *Team News*, says they can carry the case to the Supreme Court if necessary to remove the ordinance from the books.

TESA MILWAUKEE ELECTS

TESA of Milwaukee, Wis., has elected officers for the coming year. They are Larry Dorst, president; Arthur Nelsen, vice president; Daniel Smith, secretary; Lee Cowen, treasurer; Ed Bruning, NATESA director.

NEW LOCAL

Technicians in the Mansfield, Ohio, region have formed the TESA of Mansfield Area. Officers for the NATESA-affiliated group are: Fred Plew, president; Berny Welker, vice president; Saul Hersch, secretary; Walter Brandt, treasurer; Don Queen, chairman, board of directors. The group has about 50 members at present.

OHIO OFFICERS

TESA of Ohio has elected Marvin A. Miller president; Robert Allen, vice president; Wade Campbell, secretary, and Adolph Stamguts, treasurer.

TRI-STATE CONVENTION

The fourth annual Servicing Industry Telerama (1960) will be held in Atlantic City, June 24, 25 and 26. The Shelburne Hotel, located on the boardwalk, and its connecting motel, the Empress, were selected to play host.

Manufacturers will be invited to display their products and services to the delegates.

Room assignments will be made with preferential accommodations going to the earliest requests. If you are interested and have not received a reservation form, write to the Tri-State Council of Television Service Associations, 4616 Westfield Avenue, Camden, New Jersey.

PASADENA ELECTION

The Pasadena Chapter of the Radio Television Technicians Association of California has elected Virgil Gaither president. Other officers elected are: Ken Mendes, first vice president; Dave Wyman, second vice president; Bob Kealey, secretary; Chester W. Shepherd, treasurer. Directors are Stan Gilkinson; Richard B. Hartwell and Wayne B. Hartwell.

POSSIBLE LEGISLATION

Legislation, sponsored by Senator Joseph F. Periconi of the Bronx and Assemblyman Francis P. McCloskey of Wantagh, that would require licensing of TV service technicians and service dealers was sent to committees in both the N. Y. State Senate and House. A written test for a license would be required of any technician who does not have at least 4,000 hours of service experience (or equivalent) or 2,000 hours of experience and completion of an approved course of study. Licenses would run for a period of 2 years.

TESA MEETING

TESA of Missouri elected new officers: Earl Steffers, president; Wm. Frasure, secretary; Carl Adcock, treasurer; Ed Engel, chairman of the board. Benton Linder, Harry Robbins, Earl Bess, Troy Braustetter, Ken Cleaton, Wm. Reagon, Fred Reichman and Albert Hawn were elected area vice presidents.

ESFETA FOR BILL

The Empire State Federation of Electronic Technicinas Associations reviewed the New York State license bill at a recent meeting. It was ESFETA's unanimous opinion, according to Melvin Cohen, secretary, that the bill "is favorable to public welfare and safety and will also protect the consumer from incompetents and TV repair frauds."

Officers will be elected at the next meeting, which will be held on May 1 in Binghamton. For more information on time and place, write to Melvin Cohen, R. D. 1, Hudson Falls, N.Y.

TECHS BUY PARTS

A group of service shops in the Minneapolis area have incorporated a parts-supply house, according to John W. Hemak of Minnesota Television Service Engineers, Inc. (MINTSE). The move was made because of unsatisfactory relations with local parts jobbers. END

EDITORIAL *(Continued from page 31)*

1072. STATIC POWER SUPPLY.—A simplified system for cutting of conduction (gaining control) of the controlled silicon rectifier for dc-to-dc converter circuits and dc-to-ac inverters. The system should not be affected by changes in load, input voltage and temperature.

1073. IONICALLY CONDUCTIVE MATERIAL (ANION).—Ionically conductive material with the following characteristics: (1) strength sufficient to permit the casting of thin films practically impermeable to gases such as hydrogen, oxygen, etc., (2) very high capacity (in the thin film form) for the acceptance of hydrogen (OH) ions at the film or membrane surfaces, (3) high mobility of hydroxyl ions within the materials so that films or membranes of the materials will have very low electrolytical resistance, (4) high concentration of anion acceptor groups throughout the material, (5) hydrophyllic, (6) high stability in alkaline solutions, (7) very low electronic conductivity.

1074. SELF-ACTIVATING SPARE ELECTRONIC COMPONENTS.—Need exists for methods and devices capable of activating a spare component immediately upon failure or malfunction of the original component. The electron tube, amplifier or other device may incorporate multiple self-activating channels or else spare components may be employed which become active when needed. Simplicity, small size and dependable operation are necessary.

1075. FREQUENCY-CONVERSION DEVICE.—A small lightweight static device for increasing the frequency of single-phase, 60-cycle power to frequencies up to 5 kilocycles square wave or sine wave. 2-kw output, efficiency 90% or better.

1076. PHASE-MULTIPLICATION DEVICE.—A small lightweight, static device for converting single-phase 60- or 400-cycle power to balanced 3-phase power. 2-kw output with efficiency up to 90% or better.

1077. TRANSISTORS.—Transistor capable of operation at ambient temperatures well in excess of 250° C.

1078. TRANSISTORS. — Transistors whose characteristics change considerably less with temperature than present units.

1087. WIDE-BAND ANTENNA WITH MEDIUM GAIN, UNDIRECTIONAL.—A wide-band antenna of 10-to-1 frequency range which must maintain a single lobe pattern and be circularly polarized and also capable of receiving linearly polarized signals. This antenna should have medium gain on the order of 10 db above a reference dipole. A system of three antennas would cover the frequency range of 10–100, 100–1,000, 1,000–10,000 mc.

1097. IMPROVED COMMUNICATION TECHNIQUES.—There is need for improvement of today's communication techniques or the invention of a new technique which is simple, accurate and usable for the transmission and reception of intelligible signals over a long global range.

Today's techniques of long-range global communication by utilizing radio frequencies of approximately 0.1 through 5,000 mc is limited in range. Thus, today's communication techniques are not usable for the guidance of long-range missiles, i.e. are not sufficient for guiding a missile accurately to a distant target. The effort to overcome present shortcomings was limited to existing communication techniques in general and resulted in the construction and use of costly and complex systems.

1100. SIMPLE MISSILE GUIDANCE SYSTEM.—There is a need for a novel design of missile-guidance system of marked simplicity. Such a guidance system is assumed to be producible at low cost, require less space and maintenance and result in increased missile reliability.

The complexity of missile-guidance systems is high at the present. Real progress in increasing the reliability of missile systems and in making missiles a dependable tactical weapon, is dependent mainly upon a simplification of the guidance system. While the simplification of guidance components has shown some progress (such as the use of printed circuits), the guidance system as such has increased in complexity as a result from increased requirements on their functions.

1101. RADIO-NOISE ELIMINATION.—A need exists for a method to eliminate radio noise, without distortion of the intelligible signal.

All types of radio receivers are interfered by noise (man-made and nature-made). In transmitting speech, intelligible sound, frequencies or pulses; and straight continuous waves, interfering noise results in distortion of the received message. Thus, the guidance of missile systems and the accuracy of telemetered data are severely affected by noise. Today's techniques of eliminating radio noise in receivers only limit or dampen the noise, or eliminate both the noise and the intelligible portion (during occurrence of noise) of the signal.

1103. **ANALOG COMPUTER.**—A requirement exists for an analog computer which will give an output representing the distribution of a function of a number of variables, each having its own distribution, to be used as inputs.

1138. **EMERGENCY UTILIZATION OF TV TRANSMITTERS FOR ANTI-AIR DETECTION.**—Feasibility study and operational plans should be prepared to utilize certain military radar components in conjunction with existing TV stations to provide anti-air detection in times of urgency.

1139. **FIELD PORTABLE DIGITAL RADAR.**—Since most data transmission systems today employ digital techniques, it appears reasonable that digitally compatible radars be designed for use with such data transmission systems. The radars output will be purely digital for the functions of trigger video antenna position, etc.

1140. **DEVELOPMENT OF A WIDE-ANGLE, COLD-CATHODE, HIGH-RESOLUTION CATHODE-RAY TUBE.**—To accommodate new military electronic systems, it is necessary to develop a high-resolution (in the order of 500 lines per inch), cold-cathode, cathode-ray tube. Such a device would have a wide application in military data display systems.

1141. **DEVELOPMENT OF A LARGE-SCREEN, HIGH-RESOLUTION, MULTICOLOR SYSTEM FOR RADAR AND ALPHA-NUMERIC DATA DISPLAY.**—This display system should be capable of displaying radar data in real time, at a resolution of at least 1,250 lines an inch and with a minimum of three colors. It should also be capable of accepting alphanumeric characters for simultaneous display with the radar.

1142. **"SAFE AREA" DESTRUCTION OF MISSILES ENTERING DEFENSE AREAS.**—A technique should be developed to correlate long-range tracking radar capability and a high-speed frequency scan directional radio with combinations of times and frequencies for the purpose of either causing self-destruction of a missile in a "safe area" or changing the flight path.

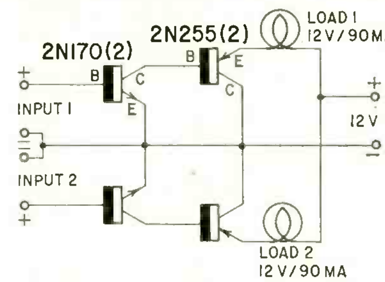
1252. **INSTRUMENTATION TO STUDY THE REACTIONS OF ACTIVE HUMAN TEST SUBJECTS WHEN SUBJECTED TO ENVIRONMENTAL STRESS.**—Skin thermocouples and rectal thermometers have been developed which can be worn by active clothed test subjects. These sensors, together with their associated instrumentation are reliable, convenient and do not cause discomfort to the subject. More recently, a telemetering system for measuring pulse rates consisting of a sensor and a small transistorized radio transmitter has been designed which can continuously measure heart beats and is now ready for user tests. Similar telemetering devices are required for measuring other physiological factors such as blood flow, cardiac output, oxygen consumption, tidal volume, breathing rate and chemical makeup of the breath. END

"This must be the place."

NOTEWORTHY CIRCUITS

TWO LIGHT-CONTROL CIRCUITS

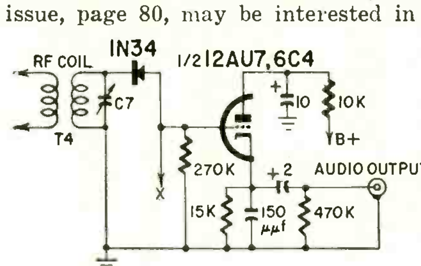
I was interested and surprised to see the circuit presented by Rufus P. Turner in the November, 1959, issue (page 99) for controlling a light bulb. I have been using a similar circuit for several months. The circuit I use employs



the same transistors selected by Mr. Turner. The difference is that I put the light bulb in the emitter circuit. I do this because my circuit controls two separate bulbs powered by separate input signals. If the bulbs had been in the collector circuit, I would have had to isolate the transistors' cases from the chassis to keep their outputs separate. I work with 12 volts and use bulbs that draw about 90 ma at 12 volts.—*Christopher W. Farrell*

IMPROVED DETECTOR

Readers who built the unique AM tuner described in the December, 1956, issue, page 80, may be interested in a

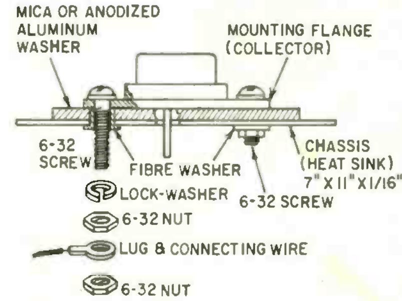


change in the detector circuit which I have tried. It increases sensitivity with no reduction, and a possible improvement in fidelity. The avc can be taken off at point X.—*Frederick Butterfield*

MOUNTING POWER TRANSISTORS

In many circuits using power transistors, the transistor's case must be fastened to a heat sink (usually the chassis) to allow for heat dissipation. However, in some circuits, particularly push-pull arrangements or any other where the chassis may be connected to

the positive end of the power supply, the p-n-p power transistor must be insulated from the chassis. The reason is simple: the transistor's collector is connected to its case and must be at a



negative potential. So naturally it can't be connected to a positive chassis.

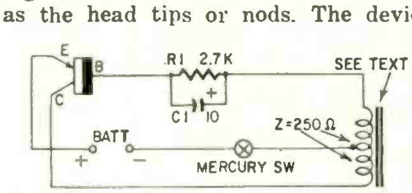
This brings up an unusual problem. A good thermal connection to the chassis is needed for heat dissipation, yet the case of the transistor must be insulated from the chassis.

Two solutions to this problem, currently used in auto radios, are described in RCA *Application Note* AN-171. You can use anodized aluminum washers or mica washers. The mica is a natural insulator and the anodizing process coats the aluminum washer with aluminum oxide making it a good insulator without destroying its heat dissipating properties.

The diagram shows how to mount the power transistor using either the anodized aluminum or the mica insulating washer. Be sure you don't forget the fiber insulating washer between the mounting bolt and the chassis. If you use the aluminum washer, make sure that all burrs have been removed from the holes in the chassis. If this isn't done, they may scrape away the anodized layer and short the washer to the chassis.

SLEEP ALARM

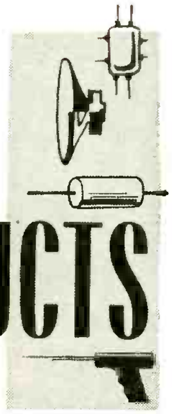
The Driver-Larm is a new device to prevent long-distance drivers, night watchmen and others with lonely boresome jobs from falling asleep, by sounding a loud buzz in their ear as soon as the head tips or nods. The device,



a product of Driver-Larm, Inc., of Kansas City, Mo., consists of a transistor oscillator and earpiece suspended on a lightweight headband.

The earpiece—a center-tapped 500-ohm dynamic type—is the inductor in a Hartley oscillator. The oscillator is controlled by a carefully balanced mercury switch that is open when level and closed when tilted. When the wearer's head begins to roll or nod from fatigue or boredom, the switch tips and turns on the oscillator. This produces a buzz or audio tone loud enough to startle the wearer awake. END

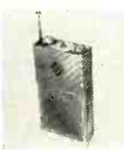
new PRODUCTS



TRANSCEIVERS for Citizens band use, either kit or wired form. *Model 760* (*K* if kit), 117 volts ac, has superheterodyne receiver with rf stage, 5-watt

transmitter. Pi output network matches most antennas. Models available for 6 to 12 volts dc. **Electronic Instrument Co., Inc.,** 3300 Northern Blvd., Long Island City, N. Y.

TRANSCEIVER SET. Completely transistorized *Duo-Com 100* operates in 27-mc Citizens



band. Receiver—double-conversion superheterodyne, dual crystal-controlled, glass-B audio amplifier. Transmitter—crystal-controlled, 100-mw input. Uses 8 penlight cells. 20 ounces.—**Osborne Electronics Corp.,** 13105 S. Crenshaw, Hawthorne, Calif.

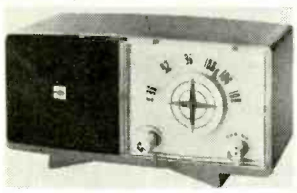
TRANSCEIVER KIT has 5-watt power input to rf output stage, 2½-watt audio power output. *Models G-110* (117 volts ac), *G-12* (12 volts dc), *G-6* (6

volts dc) with Astatic microphone, crystal and tubes. Superregenerative receiver.—**Grove Electronic Mfg. Co.,** 4103 W. Belmont Ave., Chicago 41, Ill.

NOISE SUPPRESSOR *model GNS-1,* high-Q parallel-tuned circuit to be connected in series

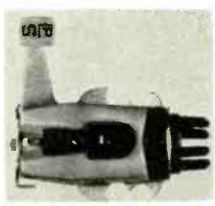
with car's generator. Reduces generator noise in 14–30-mc range. Can be used with mobile amateur and Citizens-band equipment.—**Globe Electronics,** 22-30 S. 34 St., Council Bluffs, Iowa.

FM RADIO has 6 tubes plus selenium rectifier. *Model RA-340* tunes 88 to 108 mc. Jack for external speaker. 2 controls, vol-



ume and tuning. For 117 volts ac–dc.—**Olson Radio Corp.,** 260 S. Forge St., Akron, Ohio.

STEREO CARTRIDGE *model 53.* Peak response to 25,000

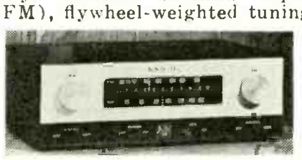


cycles, low of 16 cycles. Ceramic. Channel separation of 24 db at 1,000 cycles. 4 output leads to avoid energy crossover through common lead.—**Jensen Industries,** Forest Park, Ill.

STEREO TUNER KIT, completely prealigned, needs no ad-

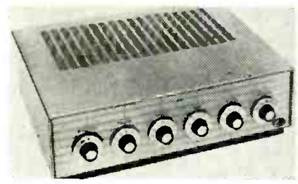
ditional minor alignment or front-end tracking adjustments. *Model ST-45PA* has 10-kc whistle filter in AM section, FM sensitivity 2 μv for 30-db quieting. Flywheel tuning, afc, AM trf stage, FM grounded-grid rf stage. 13 tubes.—**PACO Electronics Co., Inc.,** 70-31 84th St., Glendale 27, N. Y.

STEREO TUNER *model KN-135* for stereo, AM only or FM only. 50-ohm antenna input (FM), flywheel-weighted tuning



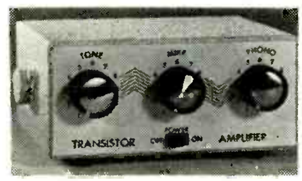
controls. FM sensitivity 4 μv for 20-db quieting, AM sensitivity 10 μv for 20-db signal-to-noise ratio. FM response 20 to 20,000 cycles within 0.5 db. Supplied with two 36-inch audio cables, AM and FM antennas.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

STEREO AMPLIFIER *model AM-147*, built-in preamp, 15 watts output each channel, response 20 to 30,000 cycles within ½ db at 1 watt. 8 tubes. 6



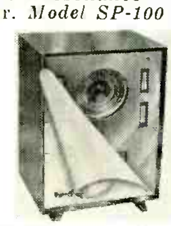
front-panel controls; 4-, 8- and 16-ohm outputs each channel. 5 inputs per channel.—**Olson Radio Corp.**, 260 S. Forge St., Akron, Ohio.

TRANSISTOR AMPLIFIER has 6-watt output, works on 6 volts dc. *Model 1-A* has 8 transistors, inputs for microphone;



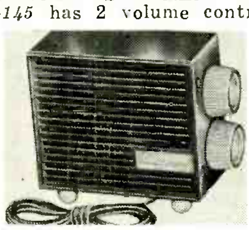
magnetic, ceramic and crystal phono. 4-, 8- and 16-ohm outputs.—**Transonic Enterprises, Inc.**, P. O. Box 1995, Miami 1, Fla.

SPEAKER SYSTEM with 4 matched electrostatic elements and low-resonance voice-coil speaker. *Model SP-100* response



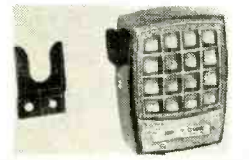
35 to 25,000 cycles. Walnut cabinet features duct system designed for voice-coil speaker.—**Monarch International, Inc.**, 7035 Laurel Canyon Blvd., N. Hollywood, Calif.

REMOTE SPEAKER *model SK-145* has 2 volume controls,



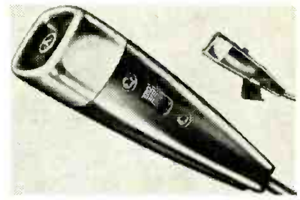
one for speaker itself, second for volume of TV-set or radio speaker. — **Lafayette Radio Corp.**, 165-08 Liberty Ave., Jamaica 33, N.Y.

COMMUNICATIONS MICROPHONE *model 715* comes with hang-up bracket. Ceramic ele-



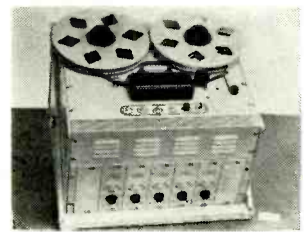
ment, response 60 to 7,000 cycles.—**Electro-Voice, Inc.**, Buchanan, Mich.

MICROPHONES in the *330* series. *Model 335H*, dynamic high impedance, response 50 to 12,000



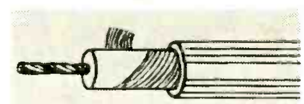
cycles at —56 db. *Model 335L*, low impedance, same as *335H*, except output is —57 db. *Model 333*, ceramic, high impedance with response 30 to 12,000 cycles at —58 db. *Model 331* (illustrated), ceramic, high impedance, 300 to 5,000 cycles at —56 db. for Citizens-band use. —**Astatic Corp.**, Conneaut, Ohio.

7-CHANNEL RECORDER *model 1855R* operates for 4¼ hours on a single 4,800-foot ½-inch reel of tape. Tape speed 3.75 ips. Rewind time less than 2 minutes. Modular plug-in amplifiers. Response 300 to



3,000 cycles within 2 db.—**Telectro Industries Corp.**, 35-17 37th St., Long Island, N.Y.

AUDIO CABLE for stereo and monaural use. *No. 8421* has spiral tinned-copper shield, cel-



lular polyethylene insulation for lower capacitance and loss. —**Belden Manufacturing Co.**, 4647 W. Van Buren St., Chicago, Ill.

4-WAY POCKET TOOL *model 600* serves as ¼- and 7/16-inch nut driver, 3/16-inch screwdriver and No. 1 Phillips driver. Patented spring holds the double-

end blade firmly in socket.—**Xcelite, Inc.**, Orchard Park, N.Y.

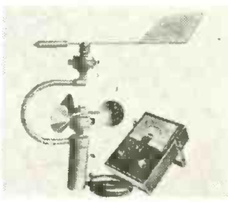
RECHARGEABLE BATTERY can be recharged hundreds of times. Nickel-cadmium cells charged by unscrewing cap and plugging unit into 117-volt ac

outlet. *Model FC-3* fits any flashlight using 2 D-cells, provides power for (3 hours) about twice the duration of the company's Model FC-2 consumer cartridge. —**Sonotone Corp.**, Elmsford, N.Y.

GAIN CONTROL for master TV antenna system. *Model MAC*

provides automatic signal regulation for any amplifier with over 16-db gain and an output between 0.6 and 2.5 volts. Control maintains level within 1 db for 10-db signal variation.—**Blonder-Tongue Labs., Inc.,** 9 Alling St., Newark 2, N. J.

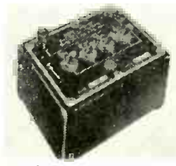
WIND-VELOCITY INDICATOR also shows wind direction. *Model F-507* has 3 scales: direc-



tion, velocity 0 to 25 mph and 0 to 100 mph. Power supplied by built-in battery, no power drain except when reading direction. Transmitter assembly fits 1¼-inch pipe or mast.—**Lafayette Radio Corp.,** 165-08 Liberty Ave., Jamaica 33, N. Y.

TRANSISTOR TESTER *model K & K* checks units in oscillator circuit. Determines if transistor is open, shorted, noisy or has high leakage value. Checks power and general-purpose, p-n-p or n-p-n types. Powered by two 6-volt batteries.—**Kierulff & Co.,** 6303 Corsair St., Los Angeles 22, Calif.

SUBSTITUTION BOX for electrolytic capacitors. 15 capaci-



tance combinations from 10 to 150 μf at 450 wvdc. 2 or more *model CDE* units may be connected in parallel for unlimited capacitance range.—**Cornell-Dubilier Electric Corp.,** S. Plainfield, N. J.

AC VTVM *834X608* has automatic motor-driven range selector. Panel lights indicate range in use. Motor unit capable of driving selector switch through

11 ranges from .003 to 300 volts in 2½ seconds. Can be used as preamp for other test equipment. Panel switch allows locking on any range.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

VTVM *model VT-10* has 6-inch 100-amp meter. Twisting tip of

multi-probe allows it to function as either ac, dc, rf or locap probe. Amplifier–rectifier circuit has frequency-compensated attenuator. — **Century Electronics Co., Inc.**, 111 Roosevelt Ave., Mineola, N. Y.

TUNING INDICATOR *model TM-1*. Built-in meter shows when transmitter is radiating maximum power. Can be used as relative field-strength meter

or to indicate when antenna is properly matched. Tenna-meter can be used with Citizens-band or amateur gear.—**Globe Electronics**, 22-30 S. 34 St., Council Bluffs, Iowa.

PULSE GENERATOR for troubleshooting if, rf and audio circuits. Self-contained transistorized units in probe form. Os-

cillator frequency about 1,000 cycles. Output audible in audio circuits. When Noy-Z-Ject is applied to if–rf circuits, its pulse waveform excites any resonant circuit into oscillation which acts as carrier for 1,000-cycle signal of the *Model D-800*.—**Doss Electronic Research, Inc.**, 820 Baltimore, Kansas City 5, Mo.

TRANSCEIVER for 27-mc Citizens band has built-in 12-volt dc power supply. Trans-

mitter output 5 watts. *Model G-11* has adjustable squelch control, simple push-to-talk operation, 117-volt ac supply available.—**Gonset Div.**, 801 S. Main St., Burbank, Calif. END

All specifications on these pages are from manufacturer's data.

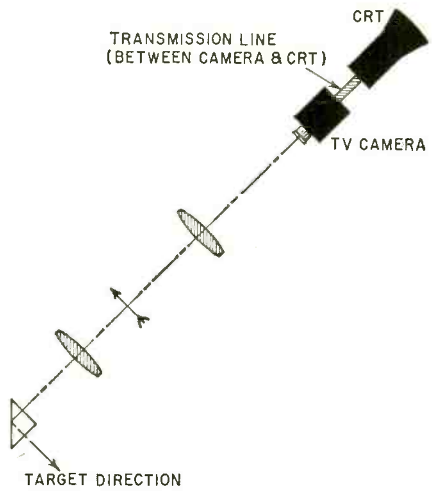
new PATENTS

REMOTE VIEWER

Patent No. 2,912,494

Edward F. Flint, Rochester, N. Y. (Assigned to Eastman Kodak Co., Rochester)

This invention combines optics and electronics for viewing an image from a remote point. The basic arrangement shows, from left to right: a scanning prism, objective, formed image



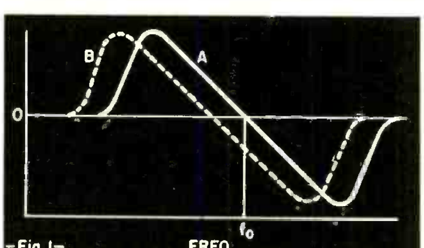
(represented by an upright arrow), relay objective, TV camera, transmission cable, crt. The advantages of this arrangement are that the image may be viewed in comfort and may be magnified as desired: the viewer is not limited to an eyepiece, difficult to maneuver.

SELF-TUNED FM DETECTOR

Patent No. 2,915,631

Ole Kristian Nilssen, Collingswood, N. J. (Assigned to Radio Corp. of America)

For minimum distortion the passband of an FM detector should accept equal sweeps about the center frequency. Fig. 1 shows f_o correctly

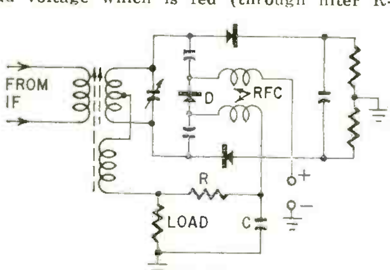


–Fig.1–

centered along the response curve A. The average load voltage will be zero.

Fig. 2 shows a typical ratio detector, with reverse-biased diode D added for automatic tuning. D has capacitance which increases with reduced bias.

Due to drift or mistuning, the response curve may shift, for example to curve B (Fig. 1). Equal sweeps about f_o now produce a negative load voltage which is fed (through filter R-C)



–Fig.2–

OPPORTUNITY ADLETS

Rates—50c per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for July issue must reach us before May 15, 1960.

RADIO-ELECTRONICS,
154 West 14 St., New York 11, N. Y.

(*Continued on page* 131)

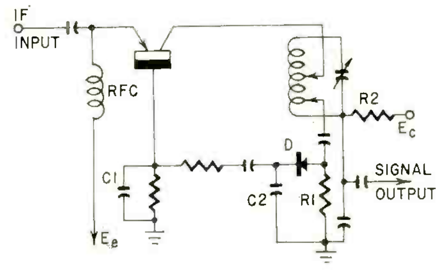
to the anode of D. This increases the reverse bias and thus lowers the diode capacitance. The stage is now tuned to a higher frequency to restore the original passband, curve A.

REFLEX STAGE

Patent No. 2,916,616

Archie F. Boscia, Rochester, N. Y. (Assigned to General Dynamics Corp., Rochester, N. Y.)

This reflex stage amplifies rf and audio. The modulated rf signal is fed to the emitter, detected audio is fed to the base. Good filtering prevents the rf from feeding back into the stage.



D detects the modulated carrier, and the af is developed across load R1, and rf bypasses C2. The audio is impressed at the base, bypassed for rf by C1. The tank impedance is high for rf and very low for audio. R2 is the audio load. Audio is fed to the next stage through a capacitor. The emitter is suitably biased through RFC.

POWER-LINE ALARM

Patent No. 2,906,897

Arthur Laudel, Jr., Kansas City, Mo. (Assigned to USA as represented by Office of Civil and Defense Mobilization)

Civilian defense or other emergencies can be announced in several ways. Sirens are used, and Conelrad procedure is well known. Here is a new method, simple yet effective because the power line is the signaling medium.

The line frequency is generally controlled very closely. To signal, second or fourth order *harmonics* may be injected into the line. Note that the voltage is maintained to within 1% or so of normal, so that ordinary power functions are not interfered with. The patent does not include means to detect the audio harmonics, but such methods are known. The harmonics may be used to set off an alarm, turn on a radio, etc. END

CORRECTIONS

There is an error in the specifications for the driver transformer (T4) in the "Transistor Auto Radio" on page 40 of the March issue. Parts list and diagram show T4's secondary impedance as 8,000 ohms. The correct impedance is 8 ohms. Thanks to Ronald Stephens of Chicago and A/2c Orval A. Bair, Jr., of Forbes AFB, Kansas, for this correction.

In the "TV Service Clinic" of the February issue drawings A and B of Fig. 6 (page 78) were inadvertently reversed. Thanks to Gilbert H. Prier, Moses Lake, Wash., for reporting this obvious error.

Re: Davidson's "Transistube Pocket Radio," page 70 of the December, 1959, issue.

Mr. Malcolm Snow of West Scarboro, Me., points out that when the switch is OFF, the positive end of BATT 2 is 13.5 volts above ground and this battery will tend to discharge through the emitter-collector circuits of the transistors. Longer B-battery life is insured by using a standard dpst switch instead of the spst type used by the author. The added switch section should be installed so it disconnects the positive side of the 15-volt battery from the line to the emitters of V1 and V2.

BUSINESS and PEOPLE

General Electric Receiving Tube Dept., Owensboro, Ky., launched a new national advertising and sales promotion campaign to back up service technician sales on its Black-Daylite line of TV picture tubes. Commercials on the Today network TV show will highlight

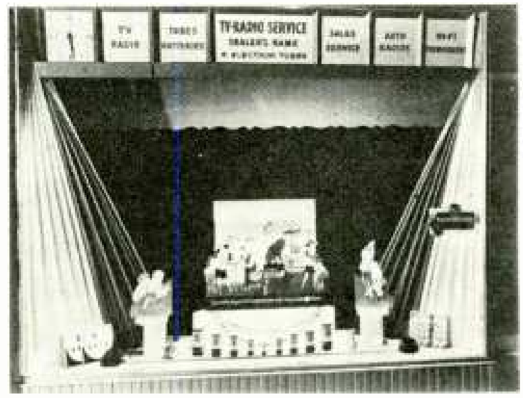
the program. Dave Garroway, MC of the Today show, and Gordon E. Burns, G-E's distributor sales manager (right), show one of the banners to be used during the promotion, as Fred J. Nataly, G-E manager of distributor advertising, looks on.

Electro-Voice, Buchanan, Mich., reports that its dynamic transistor microphones are being used in all United Air Lines DC-8 and Boeing 720 jetliners. Here stewardess Joan Chettero demonstrates the E-V No. 625 handset.

Sencore, Addison, Ill., released a new complete Substitution Service Lab, which contains the Handy 36 for direct capacitor and resistor substitution, the Electro Sub for electrolytic capacitor substitution and the RS 106 Rectifier Troubleshooter for selenium and silicon rectifier substitution, all conveniently packed in a handy dsiplay-carrying case.

OPPORTUNITY ADLETS *(Continued from p. 130)*

RCA Electron Tube Div., Harrison, N. J., introduced a new store-improvement program for independent TV service technicians. It consists of more than 35 business and service aids designed to make the service shop a more powerful selling tool. Professional window displays, practical bench units and attractive sales area layouts are all part of the plan.



Standard Coil Products Co., Inc., Melrose Park, Ill., is underway on a new ad campaign to introduce its complete TV tuner repair and replacement program. Distributors will stock specially designed shipping cartons which will be instantaneously recognizable as tuner repair jobs and then given immediate attention. A special service department has been established by Standard Coil to give 48-hour in-plant repair service. James O. Burke (center), Standard Coil president, and A. H. (Buzz) Forbes (right), distributor poles manager, discuss the ad program with Joe H. Morin, vice president of Burton Browne Advertising, the agency which handles the account.

Perma-Power Co., Chicago, orbited a new spring promotion on its Vu-Brite TV tube brighteners — offering an unbreakable flashlight free with the purchase of 12 Vu-Brites.

L. Berkley Davis (left) was elected a vice president of General Electric Co. General manager of the Electronic Components Div., Owensboro, Ky. He started as an engineer with the former Ken-Rad Tube & Lamp Corp., in 1934, and was an executive with that company when it was acquired by G-E in 1945. **Louis M. Robb** was appointed to the new position of manager of market development. He had been administrator of distributor sales.

Harry A. Gilbert was appointed to the new position of vice president of Blonder-Tongue Laboratories, Newark, N. J. He had previously been controller of the company.

Ed Claffey joined Glaser-Steers Corp., Newark, N. J., as merchandise manager, consumer products. He is well known in hi-fi dealer circles and in the distributor phase of the business.

Arlie J. Holmes was promoted to the new post of distributor sales manager of Xcelite, Inc., Orchard Park, N. Y. Holmes had previously held the position of assistant sales manager.

George Elliot was promoted to manager, distributor sales, of Amperex Electronic Corp., Hicksville, N. Y. He had been in charge of export sales, sales to other tube manufacturers, and sales of Valvo tubes. END

new LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

COLORED INSULATORS of high-dielectric vinyl are shown in *Sheet No. 232*. The new insulators are available in white, yellow, green and blue as well as red and black for the manufacturer's line of clips.—**Mueller Electric Co.**, 1567Y E. 31 St., Cleveland 14, Ohio.

GLASS DIODES conforming to military specifications are listed in *Bulletin 11-108*. The sheet shows the characteristics of these seven silicon diodes: 1N457; 1N458; 1N459; 1N463; 1N658; 1N662 and 1N663.—**Silicon Transistor Corp.**, Carle Place, N. Y.

GENERATOR REGULATORS are described in a 4-page *Bulletin 3200*. The regulators are of the magnetic-amplifier type, with selenium or silicon rectifiers. They control generator field current to regulate the output voltage.—**Fidelity Instrument Corp.**, 1000 E. Boundary Ave., York, Pa.

INSULATING MATERIALS are described in *Bulletin GET-2929A*. This 12-page catalog gives technical data and information on the uses of mica-mat, built-up mica, coated materials, varnishes, paints, enamels, thinners, etc. Also included are short notes on how the products are manufactured.—**General Electric Co.**, Schenectady 5, N. Y.

SUBMINIATURE CONNECTORS made by Cannon Electric are listed in a 2-color, 4-page folder. *The K/D Guide* gives detailed information on the miniature K and the subminiature D lines.—**Schweber Electronics**, 60 Herricks Road, Mineola, N. Y.

RESISTORS and *Trimmer Potentiometers* are the titles of two booklets. The first discusses resistor construction and defines resistor terms. The second covers the construction and testing of "T-pots".—**Dale Products, Inc.**, Columbus, Neb. 50c each

RADIO CONTROL parts, kits and assembled equipment are described and priced in the *1960 Radio Control Cata-*

log. Includes escapements, relays, servos, receivers, transmitters and components and accessories for radio-control modeleers. Many of the smaller components listed can be used in transistor circuits.—**Gyro Electronics Co.,** 36 Walker St., New York 13, N. Y.

FOREIGN-TUBE interchangeability directory lists approximately 450 foreign tube types and their exact or similar replacements. This 4-page directory, *1CE-197,* is available from distributors or the manufacturer.—**Comercial Engineering, Electron Tube Div., RCA,** Harrison, N. J.

TUBE-SUBSTITUTION *Guide* lists 416 tubes and their appropriate substitutes. Included in the listing are more than 100 foreign tube types. An 8-page booklet, 5½ x 8½ inches, it can be obtained from distributors or the manufacturer. —**Vis-U-All Products Co.,** 640 Eastern Ave., S. E., Grand Rapids 6, Mich.

TRANSISTORS and diodes are listed in the second issue of *Semi-Conductor Directory.* All major manufacturers and types are listed in numerical order with specifications, applications and prices. The directory is punched for loose-leaf insertion.—**Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33, N. Y.

RADIO FUNDAMENTALS, a 2-page bulletin with covering letter, written by M. N. Beitman, briefly reviews two radio servicing books.—**Supreme Publications,** 1760 Balsam Road, Highland Park, Ill.

TRANSFORMER CATALOG lists more than 750 transformers for industrial, communications and radio and TV applications. Besides audio and power transformers, the catalog lists chokes, yokes, flybacks and transistor transformers. Copies may be obtained from distributors or the manufacturer.—**Chicago Standard Transformer Corp.,** 3501 W. Addison, Chicago 18, Ill.

ZENER DIODES are cataloged in *Bulletin SR-260.* This 6-page folder lists 152 standard types and instructions on selecting diodes from 1,584 standard and special-voltage-tolerance types.—**International Rectifier Corp.,** El Segundo, Calif.

KNOBS and components are described in a 4-page catalog *Control Knobs and Mechanical Components.* Specification drawings are shown for knobs, test jacks and binding posts, pull handles and captive hardware.—**William H. Weed, Mechanical Components Dept., Industrial Apparatus Div., Raytheon Co.,** 100 River St., Waltham 54, Mass.

SHORT HAM COURSE to help potential amateur radio operators get their Novice license has questions and answers, Morse code and abbreviations in common usage. The four-page *Short Course for the Novice License* can be used by itself or in conjunction with other material.—**Electronic Instrument Co., Inc.,** 33-00 Northern Blvd., Long Island City, N. Y. END

new BOOKS

MAGNETIC AND ELECTRICAL FUNDAMENTALS by Alexander Efron. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 124 pp. $2.50

This book emphasizes fundamental magnetic and electrical facts and theories. It teaches about charges at rest and in motion, generation of emf, measurements, circuits and Ohm's law. Common everyday things like lightning, the permanent magnet, exposure meter, compass, etc., are explained by basic theory. It makes a fine first book on the subject.—*IQ*

TOPICS IN ELECTROMAGNETIC THEORY, by Dean A. Watkins. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 5¾ x 8¾ in. 118 pp. $6.50.

A graduate course in microwave engineering is based on this book. Its author is the inventor of a low-noise traveling-wave tube, and some of the information is presented in book form for the first time.

Among the selected topics are: transmission system, propagation along wire helix, coupling modes, amplifiers using waves and beam, and ferrites. The book ends with problems.—*IQ*

ENCYCLOPEDIC DICTIONARY OF ELECTRONICS AND NUCLEAR ENGINEERING, by Robert I. Sarbacher. Prentice-Hall Co., Englewood Cliffs, N. J. 7½ x 10 in. 1426 pp. $35

This work will be an indispensable tool for design engineers, patent attorneys, missile men, laboratories, libraries, schools, technical writers and research workers. It has exact definitions of modern terms, systems, components and elements in the electronics and nuclear engineering fields, including recently declassified information. There are about 14,000 entries and 1,400 illustrations. Cross-references are extensive. Under the word "antenna" for example, there are 206 entries and 92 illustrations. Graphs and schematics are liberally scattered throughout the book.—*MG*

HOW TO USE GRID-DIP OSCILLATORS, by Rufus P. Turner. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 103 pp. $2.50

The grid-dip oscillator is a device for indicating resonance, so it can measure capacitance, inductance, etc. This book shows practical setups for receiver, transmitter, antenna and other measurements. All are clearly explained and illustrated. Nearly all agree with the latest in lab procedures. Commercial instruments are described and illustrated in the last chapter. —*IQ*

TRIPLE PINDEX. RCA, Commercial Engineering Dept., Electron Tube Div., Harrison, N. J. 5¼ x 8¼ in. $1.75

With this guide you can concentrate on three things at once. Over 1,500 tube basings are triply presented—you can view three basings at the same time.

Also listed are more than 400 picture tube basings, over 200 industrial receiving types and more than 200 foreign types.—*IQ*

101 WAYS TO USE AUDIO TEST EQUIPMENT by Robert G. Middleton. Howard W. Sams & Co., Inc., 1726 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 136 pp. $2

Know-how is an important ingredient in making tests and measurements. This book, by an authority, shows the best setup and procedure for tests on equipment, amplifiers, components, sys-

LAFAYETTE

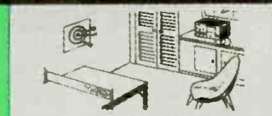
NEW! **LAFAYETTE HE-15**

CITIZENS BAND 11 METER SUPERHETERODYNE TRANSCEIVER

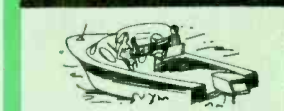
MADE IN U.S.A.

COMPLETELY WIRED
NOT A KIT!

Not Superregenerative but SUPERHET!



Use in the Home



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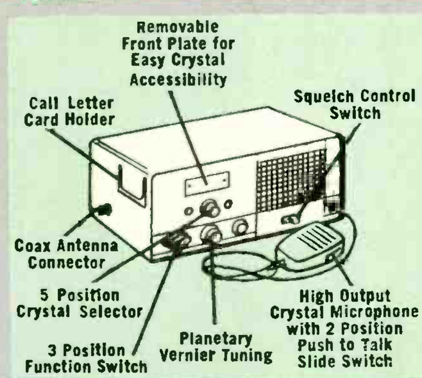

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ADVANCED MAGNETISM AND ELECTRO MAGNETISM. Edited by Alexander Schure. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 96 pp. $2.50.

This book teaches with the aid of algebraic equations and numerical examples. Ferromagnetism, inductance, hysteresis are among the topics. The basic laws of Faraday, Lenz, Ampere and Biot are developed and explained. Modern applications like the cyclotron, spectrograph and betatron are discussed.

This book offers a good foundation for more serious study in this field.—*IQ*

HOW TO GET THE MOST OUT OF TAPE RECORDING, by Lee and Sheridan. Robins Industries Corp., Flushing 54, N.Y. 6 x 9 in., 128 pp. $1.

A better title for this comprehensive little book would be "All About Tape Recorders and How to Use Them." For beginners, not for people who've used tape recorders for any length of time.

A TECHNICAL WRITER'S HANDBOOK by Margaret Norgaard. Harper & Bro., 49 E. 33 St., New York, N. Y. 6 x 8½ in. 241 pp. $3.75.

One of the best practical guides for the technical writer ever to appear. It points out clearly and simply what to do and what not to do, shows how to prepare a manuscript and goes into grammar, punctuation, abbreviations, style and types of technical writing. If you are getting ready to write a technical manuscript for the first time, this book can help you make your try a good one.—*LS*

RADIO TELEMETRY, by Marvin Tepper. John F. Rider, Publisher, Inc., 116 W. 14th St., N. Y. 11, N. Y. 6 x 9 in. 116 pp. $2.95.

This branch of engineering grows more important each year. Here the reader will find a complete and up-to-date account of pulse methods, multiplexing, digital techniques and data processing methods. Various transducers, receivers, antennas, transmitters, are discussed and compared. No previous knowledge of the subject by the reader is presumed.

Much attention is given to satellite telemetry. Schematics, diagrams and actual photos appear often. A bibliography is included.—*IQ*

INTERFERENCE BETWEEN POWER SYSTEMS AND TELECOMMUNICATION LINES, by H. R. J. Klewe. St. Martin's Press, Inc., 103 Park Ave., New York 17, N. Y. 7 x 9½ in. 256 pp. $12.50.

This theoretical book concerns the specialist who deals with lines that carry power or communication signals. It shows how the interference is caused and how to reduce it. It includes much useful data such as charts and formulas for calculating mutual inductance, measurement of noise, calculation of interference, star-delta and other transformations, acoustic and electric shock effects, etc.—*IQ*

TV SERVICING HANDBOOK, by Gordon J. King. Odhams Press, Ltd. 96 Long Acre, London, England. 5¾ x 8¾ in. 280 pp. 30 shillings net.

A troubleshooter's book that also discusses antennas, test equipment and alignment. Although British TV standards differ in some respects from our own, the fundamentals of servicing remain the same. This is a practical book that covers its ground systematically and clearly.

Chapters carry headings like "No Raster, Normal Sound" and so on. A chart then lists circuits likely to cause the defect and the text suggests methods for localizing same. Sync, sweep and agc networks receive special attention.

This book can help beginners as well as experienced technicians.—*IQ*

RADIO-PHONO SERVICE GUIDE 1957–1959 (Vol. II). General Electric, Radio Receiver Dept., Technical Publications, 869 Broad St., Utica, N. Y. 8½ x 5½ in. 114 pp. $1.

A handy guide that presents complete schematics and parts lists of all G-E radios and phonographs from 1957–1959. It also includes a picture guide section to help the technician identify the model number of any set. END

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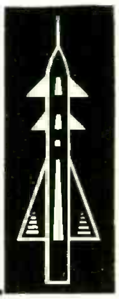

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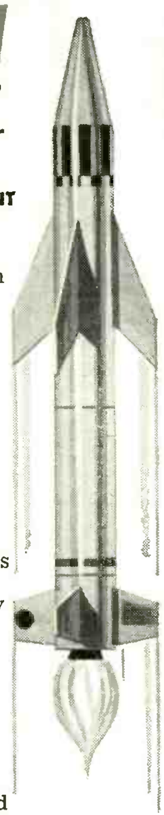

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335L	Dynamic	-57 db	50-12,000	Low		23.50

NOTE: Model 331 has momentary-on, spring-return switch, is furnished with hang-up bracket. Cable provides for audio and relay connections. All other models have slide switch with "lock-on" position, are complete with lavalier and stand adaptor with ⅝"-27 thread.

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