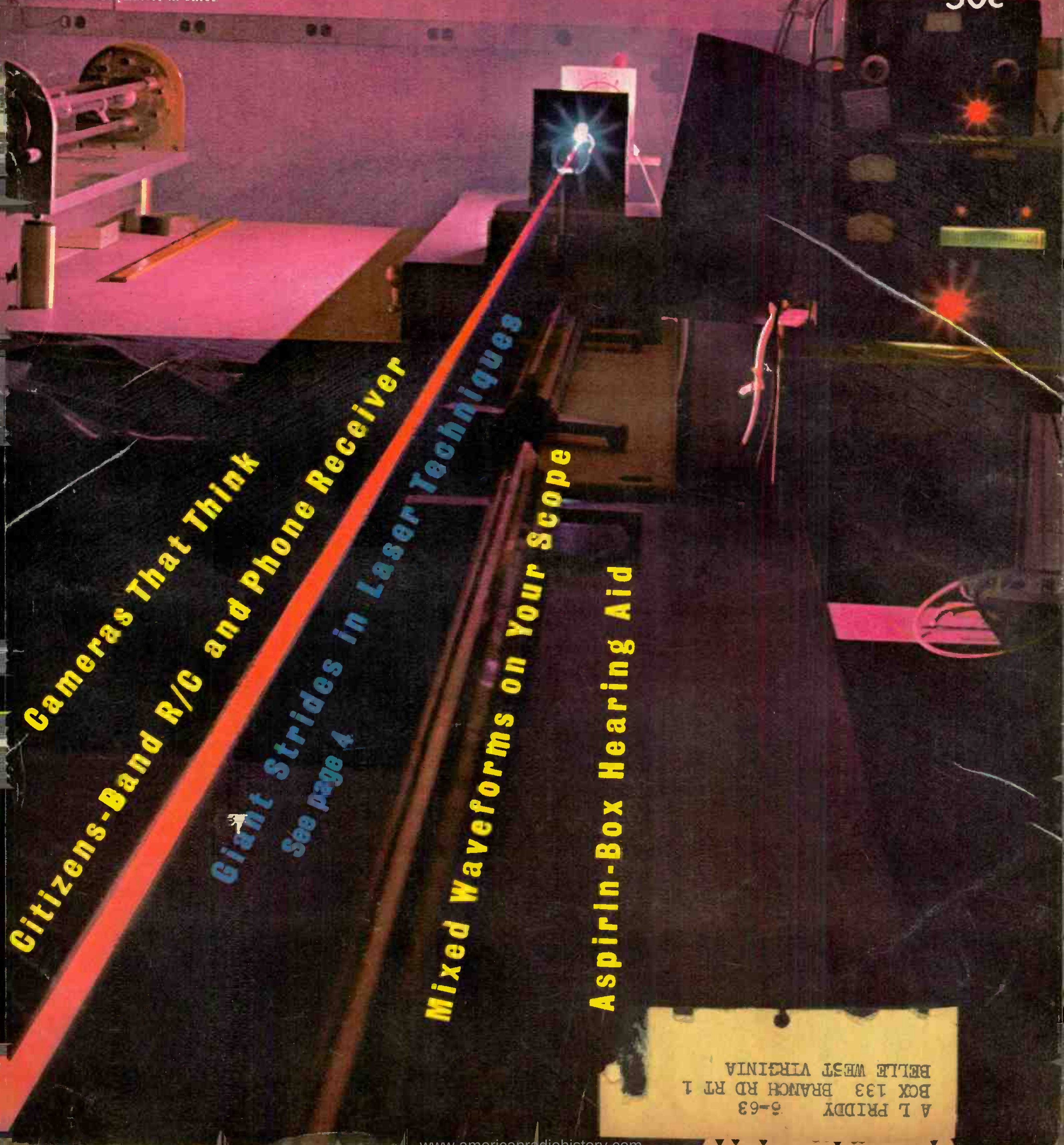
JANUARY

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief

50c



are you replacing top quality tubes with identical top quality tubes?

You can, now! You can carry the identical tubes that you find in most of the quality TV sets you're servicing. Chances are, you were not aware that these sets were designed around special Frame Grid tubes originated by Amperex.

For some time now designers have been using many Amperex Frame Grid tubes in their quality TV receivers and we can tell you now that even more Amperex tubes are being designed into the sets you'll be handling in the future.

Compare, if you will, the performance of Amperex Frame Grid tubes with conventional IF tubes: they provide 55% higher gain-bandwidth, increase TV set reliability by simplifying circuits and they make your servicing easier, faster and more profitable because their extraordinary uniformity virtually eliminates time-consuming realignment when you replace tubes. Technicians are finding Amperex THE line to carry.

Tubes introduced by Amperex and currently being used by major TV set makers include:

Frame Grid				*Others*	
2GK5	4GK5	6GK5	6EH7	6AL3	9A8
2ER5	4EH7	6ES8	6EJ7	6BL8	15CW5
3GK5	4EJ7	6ER5	6HG8	6BQ5	16AQ3
3EH7	4ES8	6FY5	7HG8	12AX7	27GB5

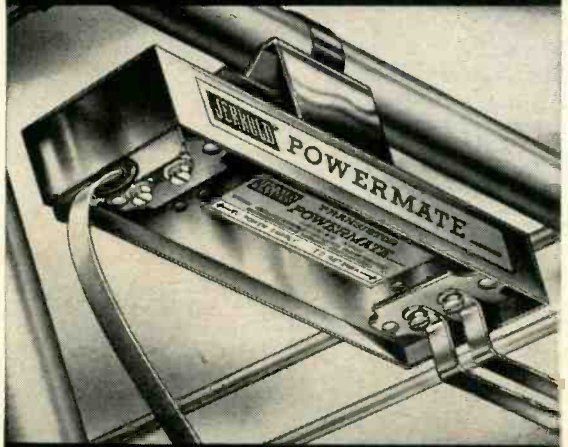
For optimum customer satisfaction and maximum profit operation for yourself, make room in your caddy right now for the identical, matchless-quality tubes designed into the original sets. Next time you visit your distributor look for the green-and-yellow box and ask about Frame Grid tubes for TV and other entertainment replacement applications. Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, L. I., N. Y. In Canada: Philips Electron Devices Ltd., 116 Vanderhoof Ave., Toronto 17.

POWERMATE

1 —rated No. 1

43
3
129

22
170
167
149
129
615



...the unquestioned leader in antenna-mounting preamplifiers

"Improved" models of other TV/FM antenna amplifiers may come and go, but Jerrold POWERMATE remains the one to beat.

Only POWERMATE delivers consistent high gain on both high and low bands—no "hills and valleys" to cause smearing and ghosting. And only POWERMATE offers the over-all reliability that cuts call-backs to the bone. Servicemen and viewers, even in deepest fringe areas, agree that POWERMATE outperforms them all . . . more customer satisfaction, more profit for you.

Are you getting your share of this POWERMATE-hungry market? See your Jerrold distributor today, or write Jerrold Electronics, Distributor Sales Division, Philadelphia 32, Pa.

JERROLD

A subsidiary of THE JERROLD CORPORATION

Radio-Electronics

JANUARY 1963
VOL. XXXIV No. 1

Formerly RADIO CRAFT—Incorporating SHORT WAVE CRAFT—TELEVISION NEWS—RADIO & TELEVISION*

—on the cover—

(Story on page 28)

Red shaft of laser's coherent light beam cuts across this month's cover and into the future of electronics. Its applications range from communications to cutting diamonds. Setting for the photo is General Telephone Labs (Sylvania) at Bayside, N.Y.

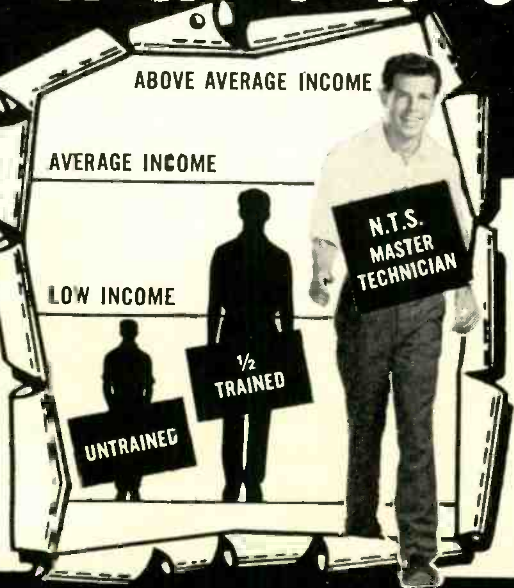
Color transparency by
William Noys

Gernsback Publications, Inc.
EXECUTIVE, EDITORIAL, ADVERTISING OFFICES
154 W. 14 St., New York 11, N.Y.
Telephone AL 5-7755

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

*Trademark registered U. S. Pat. Office

BREAK THROUGH TO HIGHER PAY *in* ELECTRONICS TV-RADIO



START NOW! Break through the Earning Barrier that stops half-trained men. N.T.S. "All-Phase" training prepares you — at home in spare time — for a high-paying CAREER in Electronics — TV — Radio as a MASTER TECHNICIAN. One Master Course at One Low Tuition trains you for unlimited opportunities in All Phases: *Servicing, Communications, Preparation F.C.C. License, Broadcasting, Manufacturing, Automation, Radar and Micro-Waves, Missile and Rocket Projects.*

A more rewarding job . . . a secure future . . . a richer, fuller life can be yours! As an **N. T. S. MASTER TECHNICIAN** you can go straight to the top in industry . . . or in your own profitable business.

SUCCEED IN MANY HIGH-PAYING JOBS LIKE THESE...

- TV-Radio Sales, Service and Repair
- Profitable Business of Your Own
- Communications Technician — F.C.C. License
- Hi-Fi, Stereo & Sound Recording Specialist
- TV-Radio Broadcasting Operator
- Technician in Computers & Missiles
- Electronics Field Engineer
- Specialist in Microwaves & Servomechanisms
- Expert Trouble Shooter
- All-Phase Master Technician

19 BIG KITS
YOURS TO KEEP

Free book gives you all the facts

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905
4000 SO. FIGUEROA ST., LOS ANGELES 37, CALIF., U. S. A.
Write Dept. RG-13

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shops, Labs, and Radio-TV Studios. Here you work with latest Electronic equipment — professionally installed—finest, most complete facilities offered by any school. Expert friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school—and part time job while you learn.

WRITE FOR SPECIAL RESIDENT SCHOOL CATALOG AND INFORMATION

ACCREDITED MEMBER
. . . the only nationally recognized accrediting agency for private home study schools.

N.T.S. Shop-Tested HOME TRAINING is **Better, More Complete, Lower Cost** . . . and it is your key to the most fascinating, opportunity-filled industry today!

YOU LEARN QUICKLY AND EASILY THE N.T.S. SHOP-TESTED WAY

You get lessons, manuals, job projects, unlimited consultation, graduate advisory service.
You build a Short Wave-Long Wave Superhet Receiver, plus a large-screen TV set from the ground up, with parts we send you at no additional cost. You also get a Professional Multitester for your practical job projects.

EARN AS YOU LEARN... WE SHOW YOU HOW!

Many students pay for entire tuition — and earn much more — with spare time work they perform while training. You can do the same . . . we show you how.

SEND FOR INFORMATION NOW... TODAY! IT COSTS YOU NOTHING TO INVESTIGATE.

N.T.S. HOME TRAINING is
- Classroom Developed
- Lab-Studio Planned
- Shop-Tested
- Industry-Approved
- Specifically Designed for Home Study

MAIL COUPON NOW for FREE BOOK and ACTUAL LESSON

NO OBLIGATION! NO SALESMAN WILL CALL

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

Mail Now To
National Technical Schools, Dept. RG-13
4000 S. Figueroa St., Los Angeles 37, Calif.

Please rush FREE Electronics-TV-Radio "Opportunity" Book and Actual Lesson. No Salesman will call.

Name__________ Age____
Address__________
City______ Zone____ State_____

☐ Check here if interested ONLY in Resident Training at Los Angeles.

VETERANS: Give date of discharge________

RADIO-ELECTRONICS published monthly at Concord, N. H., by Gernsback Publications Inc. Second-class postage paid at Concord, N. H. Copyright © 1963, by Gernsback Publications Inc. All rights reserved under Universal, International and Pan-American Copyright Conventions. SUBSCRIPTION RATES: US and possessions, Canada: $5 for 1, $9 for 2, $12 for 3 years. Pan-American countries: $6 for 1, $11 for 2, $15 for 3 years. Other countries: $6.50 for 1, $12 for 2, $16.50 for 3 years. Postmaster send form 3579 to 154 W. 14th St., New York 11, N. Y.

News Briefs

Radio Signals from Jupiter Due to Maser Action

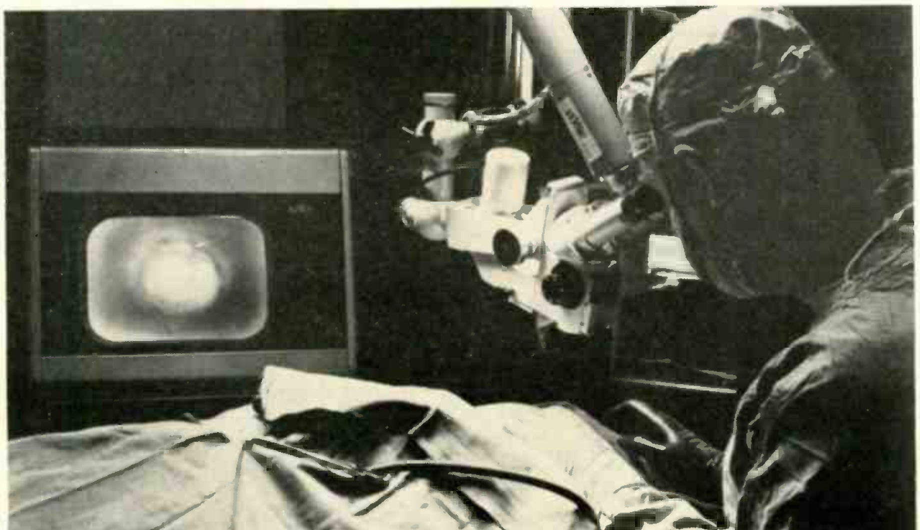
The mystery of the extremely powerful radio signals coming from Jupiter appears to have been solved by two New York physicists—Dr. Leon Landovitz and Dr. Leona Marshall. They believe that Jupiter is acting like a large gas maser, in which the electrons are raised to an excited state by solar radiation striking the planet's atmosphere and radiating waves a few meters long, as the electrons drop back to a lower energy state.

Jupiter emits radio waves in three ranges. The shorter wavelengths have been explained, but the so-called decimeter waves (in the order of 10 meters long), which were surprisingly powerful, could not be understood until the two physicists came forward with the explanation that Jupiter is a gigantic maser.

TV Plus Microscope To Train Surgeons

A breakthrough in microsurgery training was demonstrated by the New York Polyclinic Medical School and Hospital when they put on closed-circuit television what the surgeon himself saw through an operation microscope, as he performed highly delicate surgery in the middle ear. The surgeon was Dr. Alan Scheer of the Polyclinic Hospital, and the operation a stapedectomy—an operation in which one of the small bones of the middle ear is removed and replaced by a plastic tube. This permits signals to be transmitted again from the ear drum to the inner ear.

Previously, by using a double microscope, it was possible for one surgeon-in-training to watch the operation. By using a subminiature TV camera that can be mounted directly on the microscope, it is now possible for a large number of doctors to see what only one saw before. The camera, made by DuMont, weighs only 2 ounces, and is constructed in the form of a cylinder 1⅞ inches in diameter and 10 inches long. It has no lenses itself, all the optics being provided by the Zeiss operation microscope, on which it is mounted.



Subminiature TV camera mounted on Zeiss operation microscope. TV screen in rear shows size of magnified image.

Pictorial Computer Is New Navigation Aid

An airplane pilot can remain on course and know his exact position by watching an orange dot on a new navigation aid. The device, called "Flitefix" by its manufacturer, ACF Electronics, Inc., is designed for general aircraft already equipped to receive VORTAC ground stations. A chart with the nearest VORTAC station in the center is placed in the device, a scale selector turned to coincide with the chart scale, and the pilot is then able to watch his course across the chart as it is indicated by an orange luminescent dot which duplicates the aircraft flight through the charted area. The unit is priced in the $2,000 range.

The pilot, watching his position indicated by the dot in the upper right quadrant of the chart, is rotating the cursor disc, whose lines help him establish a heading.

WWVB and WWVL Improved

The National Bureau of Standards is taking steps to increase coverage of the standard-frequency and time transmissions on vlf. Stations WWVB (60 kc) and WWVL (20 kc) will have 50-kw transmitters and diamond-shaped antennas about 1,900-feet long. The new facilities are at a site near Fort Collins, Colo., and are expected to be operating by early 1963.

Higher accuracy is possible with very-low-frequency transmissions than over the regular frequen-

Advertising Representatives: Atlanta: J. Sidney Crane & Associates, 22 Eighth St. N.E., Tel. TRinity 2-6720. **California:** Husted-Coughlin Inc., 1830 W. 8 St., Los Angeles 57, Calif.; 444 Market St., San Francisco, Calif. **Florida:** Neff Associates, 15 Castle Harbor Isle, Fort Lauderdale, Fla. **United Kingdom:** Publishing & Distributing Co., Ltd., Mitre House, 177 Regent St., London, W. 1, England.
Foreign Agens: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, London E.C. 4.
Subscription Service Address form 3579 and correspondence to Radio-Eectronics, Subscriber Service, 154 West 14th St., New York 11, N.Y. When requesting a change of address please furnish an address label from a recent issue. Allow one month for change of address.

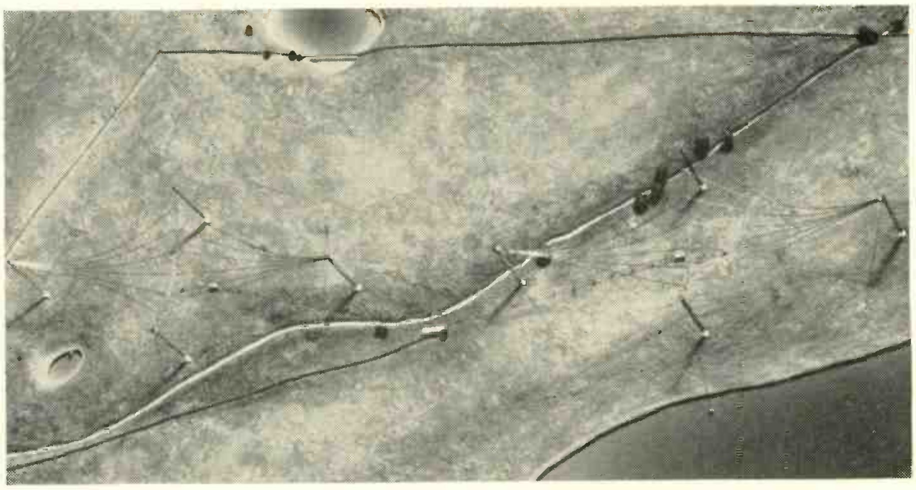
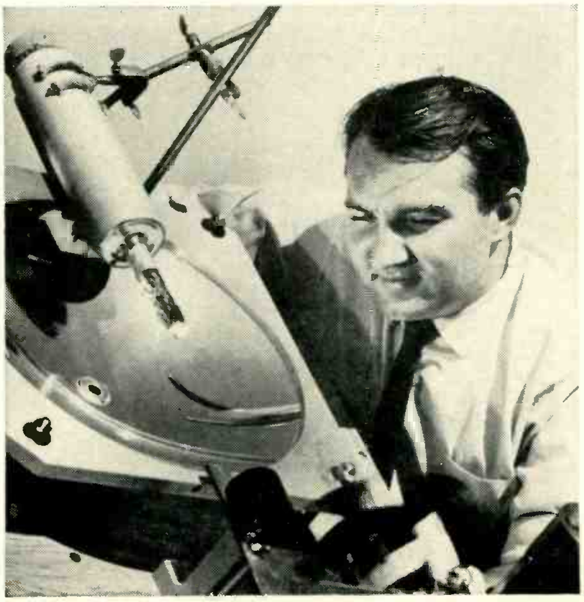


Table-model of diamond-shaped antennas planned for WWVB and WWVL. They cover a ground area of 200 acres.

cies of WWV. Transmission on 20 kc will offer a precision of 1 part in 10 billion or better over the whole earth, within an observing period of about 1 day. Within the same period, a 60-kc transmission will offer a precision of 5 parts in 100 billion within the continental United States. On the higher frequencies of WWB. a period of up to 30 days is required to achieve a precision of 1 part in 10 billion. The usual attainable precision is only about 1 part in 10 million—quite sufficient to meet the current needs of television and radio stations, electric power companies, amateurs, smaller businesses and the general public.

New Laser Is Solar-Powered

A new, sun-pumped laser has been developed by RCA, states Dr. James Hillier of the R.C.A. Laboratories. He said the apparatus includes a 12-inch hemispherical mirror for focusing the sunlight, a laser with a calcium fluoride crystal and a spectrometer for detecting the laser's output. The laser emits continuous radiation when exposed to about 50 watts of radiant power from the sun. Wavelength is 23,600 angstroms, which falls in the infrared portion of the spectrum. The laser operates in a bath of liquid neon for cooling.



Dr. Zoltan Kiss of RCA Labs and the new sun-pumped laser.

CALENDAR OF EVENTS

Millimeter and Submillimeter Conference, Jan. 8–10; Cherry Plaza Hotel, Orlando, Calif.

9th National Symposium on Reliability and Quality Control, Jan. 21–24; Sheraton Palace Hotel, San Francisco, Calif.

12th Southwestern Electronic Conference (SWELCON), Jan. 27–31; Baker Hotel, Dallas, Tex.

4th Winter Convention on Military Electronics, Jan. 30–Feb. 1; Ambassador Hotel, Los Angeles, Calif.

Pacific Electronic Trade Show; Conference, Feb. 4–10; Statler Hilton Hotel; **Show**, Feb. 7–10; Shrine Exposition Hall, Los Angeles, Calif.

6th International Exhibition of Electronic Components, Feb. 8-12; Paris (Porte de Versailles), France

3rd Quantum Electronics Congress, Feb. 10–15; Unesco House and Parc de Exposition, Paris, France

International Solid State Circuits Conference, Feb. 20–22; Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

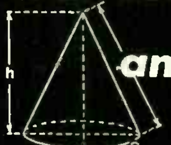
Kits Go Miniature

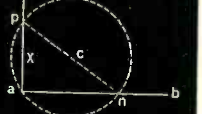
A kit introduced recently by General Electric uses components so small that the equivalent of a 200-

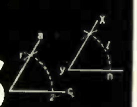
Now! Here's everything you need to master mathematics

$x^2 - 2x + 6 + 3x^4 = 2xdx - 2dx + 0 + 12x^3dx$ $\frac{5}{16} \times 8 = \frac{40}{16} = 2\frac{1}{2}''$

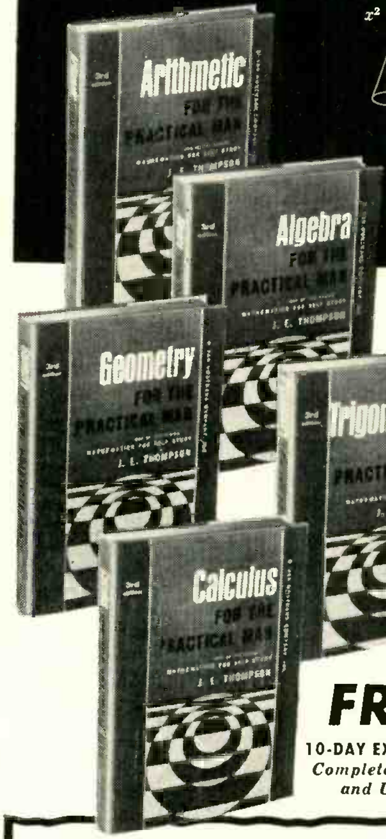
$x = \frac{-5 + \sqrt{25 + 48}}{6} = \frac{-5 + \sqrt{73}}{6}$







and "write your own ticket" to a higher-paying job



FREE

10-DAY EXAMINATION

Completely Revised and Updated

Learn at Home — in Only 10 Minutes a Day — With This Complete 5-Volume Self-Instruction Course

INDUSTRY today is 'crying' for men who know mathematics . . . to take advantage of the wonderful job opportunities in our fast-moving age of electronics, automation, and nuclear science.

Demand far exceeds supply for top-salaried superintendents, foremen, technicians, lab workers, designers, draftsmen, mathematicians, and engineers.

For example, the NASA recently announced 135 key jobs paying up to $21,000 per year. Hundreds of comparable positions go begging every day. Here is your chance to learn mathematics and get the basic training for this type of job . . . to help your country maintain its world leadership, and to earn the kind of money you deserve.

You can learn in 10 minutes a day

That's all it takes, with the aid of this simplified five-volume home-study course, to gain a complete knowledge of mathematics — which can lead to security, higher pay, self-confidence, and a better, more important job.

BRAND NEW
Binary Arithmetic, the method used in all computers today, with specific examples of all operations . . . addition, subtraction, multiplication . . . for whole numbers, decimals, fractions to meet all computer needs.

COMPLETELY REVISED AND UPDATED

This completely revised and updated course, based on easy-to-follow methods developed by Professor Thompson at Pratt Institute, shows you how to master every type of mathematical problem quickly and easily, right from the beginning. You start with a review of arithmetic (including dozens of new, time-saving short-cuts . . . and a special brand new section on *Boolean Algebra* — the algebra of logic and of switching). Then you proceed step-by-step, lesson-by-lesson, into every practical phase of higher mathematics.

BRAND NEW
Non-Euclidean Geometry, the basis for present-day developments in problems of space and electromagnetism. Makes relativity clearly understood.

Every minute pays big dividends

Without a working knowledge of algebra, trigonometry, and geometry, even the most capable man can be left behind . . . while men who know mathematics are quickly recognized, and forge ahead to bigger, higher-paying jobs.

The few minutes a day you spend learning this vital tool for most modern business and manufacturing and development processes can pay off in hard cash — bigger paychecks than you ever dreamed of.

So don't delay. These five volumes that can change your entire life would cost you $2.95 each if purchased individually, a total of $14.75. But if you order them now as a set, you will receive the entire course —all five volumes—for only $2.85 down and $3 a month for three months — *a substantial saving!* And then you will have all volumes on hand, should you need to look ahead for advance work that comes up on your job.

Send NO Money — Try Complete Course FREE

You don't have to send any money to find out how valuable this course can be! Just mail the coupon and we will rush you all five of these home-study books to examine *free*, in your own home, for 10 days. Unless you are absolutely convinced that this course in book form is exactly what you need to master mathematics, you may return the books and owe nothing. Otherwise keep them and send the easy payments indicated in the coupon. Take advantage of this opportunity today. Mail coupon *now* to **D. Van Nostrand Company, Inc., Dept. 181X, 120 Alexander St., Princeton, N. J.** *(Est. 1848.)*

MATHEMATICS FOR SELF STUDY

A complete course and reference library, by Prof. J. E. Thompson, B.S., in E.E., A.M., Pratt Institute, New York, N. Y.

ARITHMETIC. Clear, complete explanation of all basic principles. How to quickly figure fractions and decimals, ratio and proportion, powers and roots, series and progressions, percentages, dimensions, temperature, latitude and longitude. Many time-saving "short cuts" for calculating insurance premiums, loan rates, taxes, bank interest, charts and graphs. 293 pages.

ALGEBRA. How algebra can save you time and money with common everyday problems. Covers equations, logarithms, probabilities, slide rules, powers, roots, etc. Explains hundreds of applications involving machines, autos, engines, ships and planes. *Boolean Algebra* — how used in switching circuits and logic of computers. *Vector Algebra*, both 2 and 3 dimensional; how used in science and engineering. 320 pages.

GEOMETRY. Common-sense instructions on working with angles, cubes, spheres, planes, solids; figuring diameter and circumference; estimating materials needed for areas and solids; figuring volume, capacity, hundreds of other practical problems. 323 pages.

TRIGONOMETRY. How to solve virtually any problem in surveying, mechanics, astronomy, navigation. Trigonometric identities and relations between trigonometric functions. Finding heights of buildings, exact course of ship or plane; calculations involving construction of buildings, bridges, dams; cutting of gears — other uses that can improve your earning power. 239 pages.

CALCULUS. Computing speed, velocity, rate of increase or decrease, minimum and maximum limits, integral formulas, functions, derivatives, differentials, vector calculus. How to find the most efficient design for any mechanism, engine, moving vehicle; analyze sales figures, production charts; figure problems in statistics, insurance, physics, electricity, radio, much more. 358 pages.

COMPLETELY REVISED AND UPDATED

For the first time *Binary Arithmetic . . . Boolean Algebra . . . Non-Euclidean Geometry . . .* entirely new section on trigonometric identities . . . expanded section on partial derivatives and partial differentials. Completely revised and updated throughout.

FREE EXAMINATION COUPON

FREE IF YOU SEND COUPON NOW

Simplified Accounting — A 58-page book describing an easy way to start and to keep books; figure balances, adjustments, profit and loss, collections, debts, depreciation, interest, inventory, cost accounting, credit appraisals, etc. Contains 31 sample ledger sheets, forms, etc. List Price $1. Yours to keep — whether or not you keep MATHEMATICS FOR SELF STUDY.

D. Van Nostrand Company, Inc., Dept. 181X, 120 Alexander Street, Princeton, New Jersey

Send me Thompson's MATHEMATICS FOR SELF STUDY in 5 volumes. Within 10 days I will either return the books or send you $2.85 as first payment and $3.00 per month for three months until the total price of $11.85, plus a small shipping cost, is paid.

You are also to send me the book Simplified Accounting — and I may keep it free — whether or not I keep the other 5 Mathematics volumes.

Name..

Address..

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

☐ **SAVE!** Check box if enclosing $11.85 WITH this coupon. Then WE will pay all shipping costs. Same return privilege, refund guaranteed. In Canada: 25 Hollinger Road, Toronto 16, price slightly higher. (Foreign and A.P.O. — please send $11.85 with order.)

The General Electric TIMM (thermionic integrated micromodule) kit with heat-tolerant miniature electronic equipment.

tube computer can be built in the space taken up by a pack of cigarettes.

Not intended for the hobbyist, these kits sell for $95 and are designed to permit equipment manufacturers to design circuitry intended to operate at high temperatures. Each kit contains a quartz oven to attain the normal operating temperature of about 580°C, at which these micromodules are expected to perform.

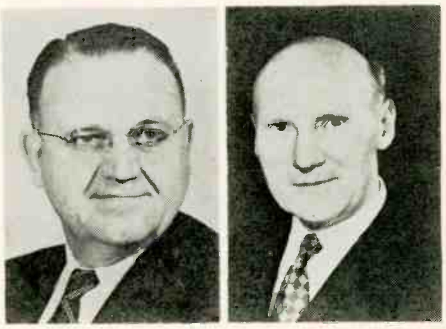
Chinese Typesetter Uses Fiber Optics

A new machine for setting type in Chinese is being developed by RCA under contract to the Army Quartermaster Research and Engineering Command. An electronic system using fiber optics and television techniques reproduces the characters very rapidly on film, and then transfers them to lithograph plates for offset printing.

The equipment will be capable of setting approximately 100 characters per minute—it has a storage bank of some 10,000 characters. This will be a tremendous speedup over the present method of setting printed material by hand from large cases, which may carry as many as 8,000 to 10,000 characters. Speed of such typesetting is limited by the pace of the man choosing the characters from the huge cases.

IEEE Elects Officers

Dr. Ernst Weber (right) has been elected president of the Institute of Electrical & Electronic Engineers, to be formed Jan. 1, 1963. Dr. Weber is president of Polytechnic Institute of Brooklyn. A Fellow of the AIEE, he was 1959 president of IRE. The Electrical Engineering Education Medal was awarded to him in 1960.



Dr. B. Richard Teare, Jr., (left) Dean of the College of Engineering and Science at Carnegie Institute and president of the American Institute of Electrical Engineers, has been elected vice president.

The IEEE, formed by a merger of the AIEE and the IRE, will have a world-wide membership of 160,000, with headquarters in New York.

(Continued on page 14)

R. G. Shashoua, RCA engineering leader, checks the optical tunnel of the new Chinese typesetting machine.

take these boosters

in this caddy/pak

on every service call

NEW BLONDER-TONGUE CADDY/PAK BOOSTS BOOSTER SALES

TV Technicians — here's a bright new profit idea from Blonder-Tongue. Called the CADDY/PAK, it holds two indoor TV/FM boosters—one a transistor model, the other tubed — and fits easily in your tube caddy. The boosters are: the new all-transistor, model IT-4 Quadra-booster; and the industry's most reliable tubed model, the B-24c.

This combination makes it easy for you to give your customer the right booster for any reception situation. Remember, transistor boosters provide higher gain and are more rugged, but they have one problem — overload (windshield wiper effect, loss or sync). If you use a transistor booster in an area with one or more strong TV or FM signals — you may be buying too much booster. On the other hand, tubed boosters perform very well in these areas.

With the Blonder-Tongue CADDY/PAK you can demonstrate both tubed and transistor models in a jiffy, by connecting them to the terminals of the set. Either way your customer gets the finest indoor booster — a Blonder-Tongue.

The CADDY/PAK fits in your tube caddy. It's imprinted with the profit-producing words — "WANT A SHARPER TV PICTURE? ASK ME." You can place it on the set you are servicing and let it sell for you. And it reminds you and all your technicians to mention boosters on every service call.

You just can't help selling more — having more satisfied customers too — because they have the right booster.

Today, see your Blonder-Tongue distributor and get details on how you can get a free CADDY/PAK booster demo kit—the sure-fire approach to boosting booster sales.

engineered and manufactured by

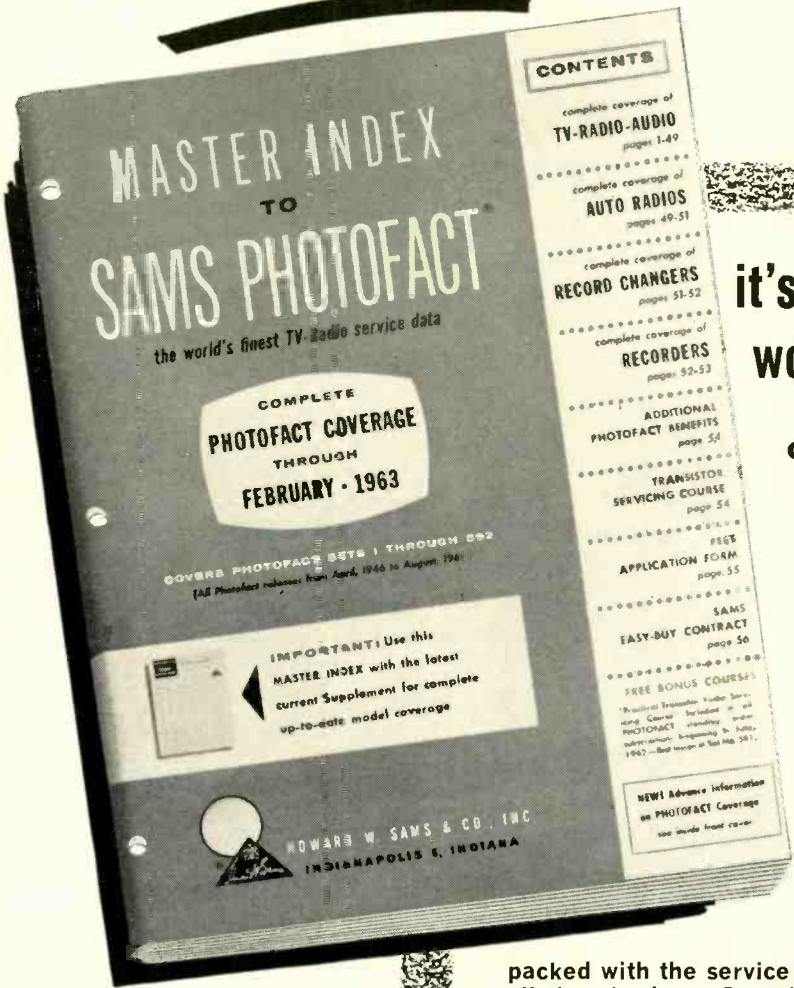
BLONDER-TONGUE

9 Alling St., Newark, 2 N. J.

Canadian Div.: Benco Television Assoc., Ltd., Tor., Ont.
Export: Rocke Int'l. Corp., N. Y. 16 - Cables ARLAB

Home TV Accessories • UHF Converters • Master TV Systems • CATV Systems • CCTV Systems

Free! send today for your LATEST INDEX TO PHOTOFACT®



it's your handy guide to the world's finest service data

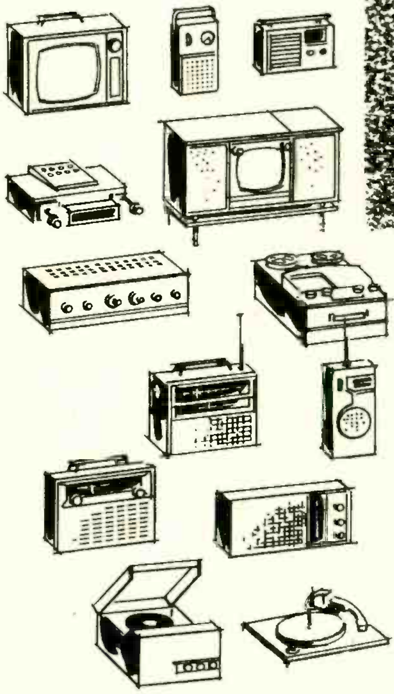
covering **54,000** listings

- TV RECEIVERS
- HOME & AUTO RADIOS
- RECORD CHANGERS
- TAPE RECORDERS
- CB RADIOS

Here is your valuable 68-page guide covering virtually every model of home-entertainment electronic equipment produced since 1946! Helps you locate the proper PHOTOFACT Folder to quickly solve any service problem in any model. PHOTOFACT provides *everything* you need in complete, uniform style for quick, effective repairs: Famous Standard Notation Schematics packed with the service details you need; Full Photo Coverage of all chassis views; Complete Replacement Parts Lists; Tube Placement Diagrams; Alignment Instructions; CircuiTrace® for printed boards; Disassembly Instructions; Dial Cord Diagrams; Changer and Recorder "Exploded Views"—plus dozens of other great features. Send for your FREE copy of the latest PHOTOFACT Index to the service data you need!

SEND FOR *FREE* INDEX

MAIL COUPON TODAY!



TAKE THE RIGHT STEP TO TIME-SAVING, PROFIT-BUILDING SERVICING....

See your Sams Distributor for details on an Easy-Buy PHOTOFACT Library or Standing Order Subscription.

HOWARD W. SAMS & CO., INC.

Howard W. Sams & Co., Inc., Dept. 6-A3
4300 W. 62nd St., Indianapolis 6, Ind.

☐ **Send FREE Photofact Index**

☐ I am a Service Technician: ____full time, ____part time

Other: (specify)__________

Shop Name__________

Attn:__________

Address__________

City________Zone____State____

(*Continued from page 10*)

Doppler Radar Navigators Fly Trans-Ocean Planes

Radar equipment (RADIO-ELECTRONICS, May 1962, page 8; August 1962, page 42) is now being used to fly Trans-World Airline jet planes in place of professional navigators. Settlement of an agreement to provide job protection for some 680 members of the Flight Engineers International Association, makes it possible to reduce crews on TWA planes from four to three members.

TWA is the first company to use the self-contained Doppler equipment as a primary navigation system over the Atlantic. The company believes it to be more reliable than any other for long-range navigation. Several other airlines have Doppler equipment, but carry navigators.

Music Ups Corn Yields?

George E. Smith, agronomist and corn breeder of Normal, Ill., reports that test plots of corn showed increases of yield from 6% to 10% when serenaded with radio programs or sound tones. The greatest increase, he says, was from a plot subjected to a 450-cycle note, though all types of sound or music produced greater yield than in controlled plots grown in comparative silence. The sound ran 24 hours a day, from mid-May until just before harvest time.

Agricultural colleges have commented rather negatively on Mr. Smith's work, but have not reported on any experiments which would tend to prove or disprove his results.

Sunspot Conditions May Bring Broadcast Dx

The drop in usable frequencies for long-distance transmission caused by the decrease in the number of sunspots is making new bands useful for trans-Atlantic dx. British stations have been getting excellent results with the 3.9-mc transmissions, and it is likely that the lower frequency bands in the 2-and 3-mc region will get out much farther than has been possible in the past. Under exceptionally favorable conditions, trans-Atlantic dx on the broadcast band is possible.

Stanley Leinwoll gives more details on low-frequency propagation conditions in his column on page 38.

$42,000,000 for Hi-Fi

Hi-fi enthusiasts, who spent less than $2,000,000 for components in 1950, invested more than $42,000,000 last year, according to the Electronic Industries Association (EIA). The audio enthusiast spent $15,000,000 for speakers alone, $14,000,000 for amplifiers, and about $13,000,000 for tuners.

(Continued from page 14)

Electronic Highlights of 1962

Space electronics was top dog in 1962. It backed up every missile, rocket and satellite launching. It put our astronauts into space, and brought them back again. It fired the rockets, kept them on course, reported on conditions inside the craft and gave second-by-second contact with the men aboard the manned flights. Telstar I is a perfect example of electronics in space. That little globe circling the earth is crammed full of electronic devices.

Computer electronics ran a very strong second. More and more reliance was placed by business on computers. They took care of inventory, billing, records and payroll. Airlines used computers to keep track of available seats. And your bank now uses computers to keep tabs on your checking account. (That's what that special number along the bottom of your checks is for.)

Medicine had an important year, too. Electronic devices to take the load off a weak heart and to restore proper operation to a fluttery one went into full-scale use. Computers showed up as diagnostic devices. Even the laser was introduces as a new tool for eye surgery.

In the home, developments were too numerous to describe. FM stereo brought sound in depth over the air waves to every home equipped to receive it. It is responsible for a tremendous growth in the number of FM stations and production of FM receivers. TV saw lighter-weight sets—even transistor portables that sit in the palm of a hand—and a general resurgence in small-screen portables. Remote-controlled TV was everywhere and almost everyone, it seems, bought a CB transceiver. Electronic refrigerators that have no moving parts appeared. Electroluminescent lighting became readily available. And much, much more.

All around us electronics has been on the move. The first communications satellite was launched and proved highly successful. Laser beams were being used for everything from communications to machining diamonds.

If electronics continue at its present rate—and there is no reason why it shouldn't—it will soon become the single most important factor in everyday life.

JANUARY

Laser in Surgery. Laser device called a retina coagulator was used to treat eye tumor. It produces for an instant a spot of precisely located intense heat which burns out tiny pieces of unwanted tissue. *(March, page 6)*

Atomic Weather Station. Atomic energy powers an automatic weather station, buried in the snow and ice of the Arctic, that reads barometric pressure and wind speed. Radio transmitters relay this data to manned stations in more accessible areas. *(May, page 6)*

FEBRUARY

Machine Reads Script. If the writer observes base and guide lines, uses no capitals and writes legibly, there are machines that will read his writing with 90% accuracy. *(April, page 6)*

Doctors Use Sniperscope. Not to see in the dark, but to see through a patient's cornea if it has become opaque. Normally, the patient can't see out and the doctor can't see in. *(April, page 12)*

MARCH

Secret Radio Transmission. You scramble the transmission with a discrete frequency synthesizer. With this device, both transmitter and receiver jump from frequency to frequency, apparently at random and always in step, rendering eavesdropping impossible. *(May, page 6)*

Radio Sounding Measures Ice. Thickness of Arctic glaciers can be measured with radio waves. The signals are beamed down through the ice, reflect off underlying soil and return to a receiver. As with radar, the time it takes for the signal to return indicates the thickness of the ice. *(May, page 6)*

APRIL

Satellite Earth Station. Andover, Me., is the site of the first Earth Station for handling communications traffic via satellites. A 340-ton rotatable antenna horn sits inside a protective radome, 16 stories tall. *(June, page 6)*

Human Electric Plants. Medical researchers suggest implanting piezoelectric crystals inside the human body, near muscles, to supply power for medical instruments normally implanted in the body—heart Pacemakers and nerve stimulators. *(June, page 6)*

Luminescent Decade Counter. Specially built luminescent panel replaces the familiar numeral display tube. *(June, page 12)*

MAY

Report Cards by Computer. At least one high school started using a computer to process report cards. Big time saver for teachers, although they still must supply the grades to the computer that makes out the cards. *(July, page 6)*

Conelrad on the Way Out. Present system called unnecessary by Defense Department. Will be replaced by a more effective arrangement. *(July, page 6)*

TV Pix Bounced Off Echo. First TV image to travel via satellite relay. Station doing the relaying was the reflective coating on the surface of Echo I, a passive space satellite. *(July, page 8)*

JUNE

Voiceprinting for Identification. Voice spectograms show that a voice pattern is a very individual thing. It may some day replace fingerprints as the major identification method. *(August, page 6)*

Electronic Refrigerator. No moving parts to wear out in this unit. Electric current is passed through thousands of semiconductor junctions. One side of the junction gets hot, the other side cold. You may not be seeing much more of that refrigerator repairman! Can also be used in air conditioners. *(August, page 8)*

JULY

Pay TV Test. First large-scale over-the-air test in Hartford, Conn. Picture and sound are electronically scrambled so only subscribers with proper converters can tune in programs. *(September, page 6)*

Light-weight TV Picture Tubes. New processes result in big weight savings. Thick, heavy safety glass replaced by thin, tough, lightweight laminated plastic. *(September, page 8)*

First Communications Satellite in Orbit. Makes intercontinental TV and radio a reality. Total of 30 to 40 satellites will be needed for full 24-hour world-wide communications. *(September, page 30)*

Uhf on All TV's. It became law when the President signed the bill requiring all new TV's to be equipped with uhf tuners. Actual effective date probably will be 1964. *(September, page 6)*

AUGUST

Gaseous Masers Announced. Five types, each using a different gas mixture and operating at different frequencies. They deliver coherent light output at frequencies ranging from visible light into the far infrared. *(October, page 6)*

Radar for Moon Landing. Velocity measuring device is accurate to 0.1 foot per second. This is vital since as little as a 40-foot-per-second decrease in velocity from 34,830 feet per second can mean never getting to the moon. Yet 90 feet a second too fast will cause the craft to overshoot the moon. *(October, page 8)*

SEPTEMBER

Magnetic Glass. Optically transparent, this glass reacts to a magnet like a piece of iron or steel. It should find many uses in thermomagnetic devices, transformer cores, laser modulation and space applications. *(November, page 6)*

Gallium Arsenide Laser. Direct conversion of electricity into narrow-band light is now possible. When an electric current is fed through a gallium arsenide diode, infrared light is emitted from the junction in the device. *(November, page 8)*

Nuclear-Powered Lamp. Used for railroad switch service it will run for 10 years. Has no bulbs, cables or batteries, and no electrical energy is produced or used. *(November, page 16)*

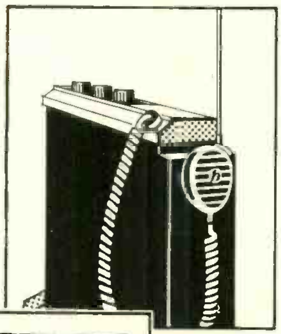
OCTOBER

Microscopic Microphone. A solid-state transducer that makes an excellent ultra-miniature microphone. Some versions are so small that they must be viewed under a microscope. *(December, page 6)*

Space Radio Blackouts Halted. Radio silencing during spacecraft re-entry from orbit may be circumvented by high-power millimeter-wave transmission. Such signals might be able to penetrate the heat-induced ion shield that forms during re-entry, blanking out normal radio transmitters. *(December, page 10)*

END

Nothing fits <u>all</u> your CB needs like Hallicrafters' versatile new transistorized CB-5



Wherever and however you use citizens band, no transceiver made gets around with the effortless efficiency and consistent high performance of the new CB-5.

A fraction over 3 inches high, 10 inches wide and 8 inches deep, its 18-transistor design solves all normal space problems in mobile or airborne use. It has no vibrator of course, and you can operate it all day with less battery drain than it takes to start your engine once.

A slim, matching pedestal will furnish AC power for base operation. And for carrying between "stations," it weighs just 6¾ pounds.

For occasional portable use, an inexpensive 12-volt battery works out fine; but we've also designed a highly-efficient rechargeable battery pak accessory, in case you're serious about it. (There'll be a tone-coded squelch accessory, too, in the near future.)

Specifications? Here are a few: 5 watts in; 100% modulation capability; 6 crystal-controlled channels; 1 µv sensitivity for 10 db. S/N ratio; 45 db. adj. channel rej.; PTT ceramic mike; 6 kc. selectivity at 6 db.; 18 transistors, 9 diodes, 3 instant-heat transmit tubes. Price: $199.95; accessories optional at extra cost. For full details, talk it over with your Hallicrafters dealer or drop us a line.

the new ideas in communications are born at . . . *hallicrafters*

5th & Kostner Aves., Chicago 24, Ill.

Overseas Sales: Contact Export Department, Hallicrafters. **Canada:** Gould Sales Co., Montreal, P. Q.

Correspondence

Improves Laurent Amplifier

Dear Editor:

I built the 40-watt stereo amplifier (20 watts per channel) that appeared on page 35 of the May 1961 issue. Once it was completed, I had some trouble with excessive hum. The first two of the following modifications eliminated the hum. The third item makes it possible to balance the output stages.

1. Insert a 2,000-ohm ½-watt pot across the 6.3-volt heater winding of

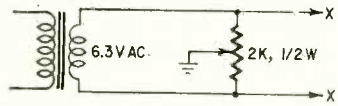


Fig.1

the power transformer, grounding the arm (Fig. 1).

2. Remove R1 (10 ohms, ½-watt) It causes a ground-hum feedback loop between the preamp and basic amplifier.

3. Change R16 from 150 ohms 5 watts to 125 ohms 5 watts and add a

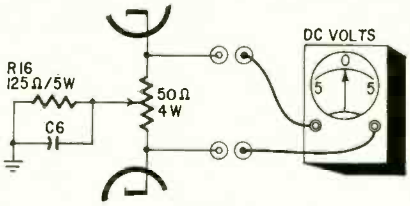


Fig.2

series 50-ohm 4-watt pot and two voltage jacks (Fig. 2).

VINCENT N. MCLAUGHLIN
Grosse Ile, Mich.

[Some of these changes may not improve all units. The 10-ohm resistor, for example, was intended to *reduce* possibility of hum.—*Editor*]

Conductors Opaque?

Dear Editor:

In your October issue's "Inventors of Radio" by Dexter S. Bartlett, he attributes to James Clerk Maxwell, the mathematical seer of radio, this statement:

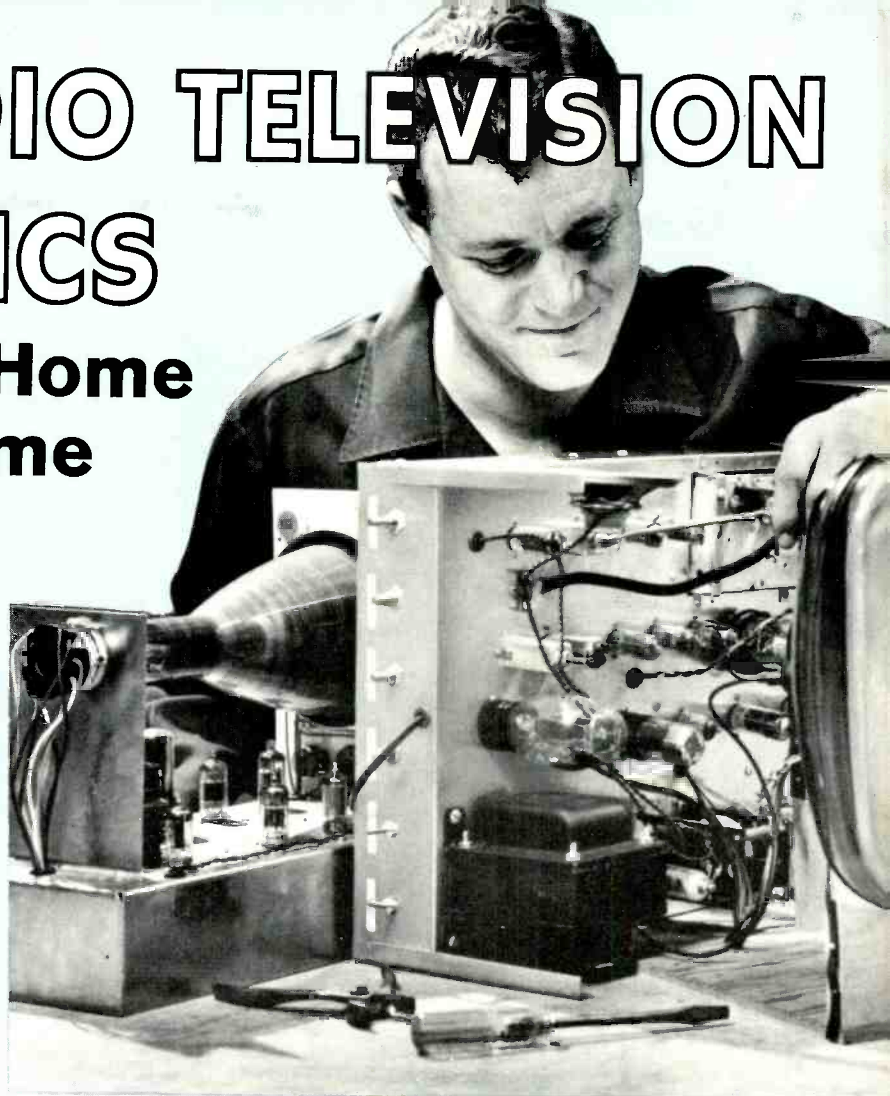
"Conductors of electricity must be opaque to light."

I do not recall whether or not Maxwell actually made such a statement, but it obviously does not hold water—or *for* water:

a. Salt water as well as acidulous solutions of it *are* transparent, yet they are conductors of elec-

Learn RADIO TELEVISION ELECTRONICS

by Practicing at Home in Your Spare Time



Electronics is the outstanding career field of the 1960's. There are more better-than-average opportunities in Electronics than in any other field—openings for which *you* could qualify through NRI training. Thousands of men like yourself have stepped up to good money in Industrial Electronics, Radio and TV Broadcasting and Radio and TV Servicing with NRI training.

Make More Money Soon

If you decide to be a Radio-TV Service technician, NRI training can help you step up your income soon after you enroll. We show you how to apply your knowledge to make extra cash in spare time doing Electronic repairs or servicing radios and TV sets for friends and neighbors. If desired NRI assists you in job placement when you're ready. In short, whatever branch of Electronics you select, NRI is well qualified to help you grow in your new career . . . in usefulness, in prestige, in monetary gain.

Train With The Leader

NRI is America's oldest and largest home-study Radio-TV, Electronics training school. For nearly half a century NRI has maintained the confidence and respect of students, graduates and the Electronics Industry by constantly supplying practical, complete, up-to-date home-study training at a cost most everyone can afford. Read the capsule descriptions of NRI courses on the other side of this page. Then, mail the postage-free card today for the FREE NRI CATALOG. National Radio Institute, Washington 16, D. C.

NRI

Equipment You Get Makes Training Faster, Easier

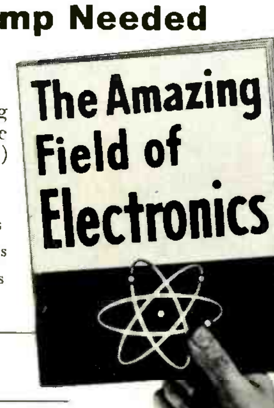
The NRI "train-by-doing" method, using special training equipment, is the time-proved way to assure advancement or to turn your hobby into a new and profitable career in the fast-growing field of Electronics. All NRI courses, except FCC License training, includes special equipment at *no extra cost*. You build circuits and work experiments. Theory you study comes to life in an interesting, easy-to-grasp manner. NRI catalog pictures and describes equipment you get. Mail the postage-free card for more facts about NRI training and opportunities awaiting you in Electronics, Radio-TV.

Turn Page For Facts On NRI Courses ➡

Cut Out and Mail—No Stamp Needed

NATIONAL RADIO INSTITUTE
WASHINGTON 16, D. C. RF

Please send me your Electronic, Radio-TV catalog without cost or obligation. I am interested in the course checked below. (No salesman will call. PLEASE PRINT.)



- ☐ Industrial Electronics
- ☐ Radio-TV Servicing
- ☐ Math for Electronics
- ☐ Communications (Complete)
- ☐ FCC License
- ☐ Mobile Communications
- ☐ Aircraft Communications
- ☐ Marine Communications

Name____________________ Age______

Address__________________________

City______________ Zone____ State______

ACCREDITED SCHOOL · NATIONAL HOME STUDY COUNCIL · NHSC

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

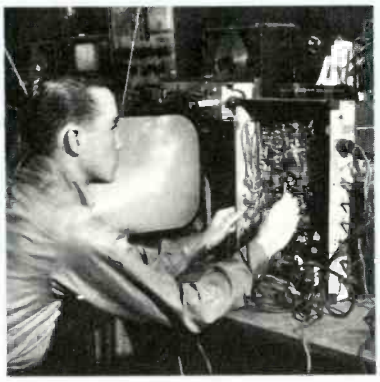
Approved for Veteran's under Korean GI Bill

PICK THE CAREER YOU WANT
IN THE WONDERFUL FIELD OF ELECTRONICS
TRAIN AT HOME WITH THE LEADER

INDUSTRIAL ELECTRONICS

Prepare for a career as an Electronic Technician in industry, business, government, the military, with this NRI course in Electronics—Principles, Practices, Maintenance. Computers, telemetry, automation, missiles, rockets all employ the same basic principles . . . and that is what this NRI course stresses with illustrated lessons, special training equipment.

TELEVISION-RADIO SERVICING
(INCLUDES COLOR TV)



NRI's time-tested course in Servicing not only trains you to fix radios, TV sets, hi-fi, etc., but also shows you how to earn spare-time money starting soon after enrolling. Fast growth in number of sets, color-TV, stereo, means money-making opportunities in your own spare-time or full-time business or working for someone else. Special training equipment included.

TV-RADIO COMMUNICATIONS

In the NRI Communications course you get *actual experience* as NRI prepares you for your choice of Communications fields and an FCC License. Commercial methods and techniques of Radio and TV Broadcasting; teletype; facsimile; microwave; radar; mobile and marine radio; navigation devices; FM stereo multiplexing are some of the subjects covered. You work with special training equipment.

FCC COMMERCIAL LICENSE

For men with Radio-TV experience who want to operate or service transmitting equipment used in broadcasting, aviation, marine, microwave, facsimile or mobile communications. A Service Technician is *required by law* to have an FCC License to work on C-Band, other transmitting equipment. From Simple Circuits to Broadcast Operation, this new NRI course trains you quickly for your Government exams.

ALSO: Special courses in Mobile Communications; Aircraft Communications and Guidance; Marine Communications; Math for Electronics.

SEE OTHER SIDE

Today, a career in Electronics offers unlimited opportunity. Job counselors advise, "For an interesting career, get into Electronics." The National Association of Manufacturers says, "There is no more interesting and challenging occupation in American industry."

When you train for a career in Electronics through NRI home-study methods your home becomes your classroom, and you the only student. You pick your own study hours, study when you want, as long as you want. No need to give up your job or go away to school. And there are no special requirements of previous Electronics experience or education. Train with the leader. Your NRI training is backed by nearly 50 years of success. Mail the postage-free card. **National Radio Institute, Washington 16, D.C.**

Mail Postage-Free Card

FIRST CLASS
PERMIT
NO. 20-R
(Sec. 34.9, P.L.&R.)
Washington, D.C.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

NRI **National Radio Institute**
3939 Wisconsin Avenue
Washington 16, D.C.

tricity; every automobile storage battery testifies, if mutely, to these facts.

b. Molten glass is also transparent and conductive.

c. Photoconductive cells could not operate unless they had both these characteristics.

B. F. MIESSNER

Miami Shores, Fla.

Crossup on the Crossover

Dear Editor:

Paul W. Klipsch's comments, in his letter in the November 1962 issue, on my article on crossover networks, are much appreciated. Mr. Klipsch apparently had in mind the simpler 6-db-per-octave network, whose phase shift is indeed 45° per channel, resulting in a 90° phase difference between the two outputs. In that case, speaker polarity will not matter since the two speakers can never be either in or out of phase. The network discussed in the article, however, was of the 12-db-per-octave type, which has a phase shift of 90° per channel, or a 180° phase difference between the two outputs.

Mr. Klipsch's point regarding the effect of acoustic path lengths on phasing is well taken. At 2,340 cycles a difference in path length of only 2.82 inches will result in a phase shift of 180°. Granted that the human ear cannot detect phase, it can detect amplitude and, therefore, cancellation due to out-phasing.

BASIL BARBEE

Nacogdoches, Tex.

We're Sorry

Dear Editor:

Mr. Barbee did me the honor of sending me a copy of his letter in answer to my criticism. I admit with regret that I did not do as much for him in mine.

Mr. Barbee points out that his network is clearly a 12 db per octave slope, and I criticized it on a basis of it being a 6 db network. Thus I have to admit I just didn't read it carefully—I skimmed rather than scanned.

[*The editors must confess at this point their own contribution to the confusion. On the cover of the August issue, the crossover was described as a 6 db per octave unit. This may have started the whole thing.*]

Further, what Mr. Barbee says of polarity reversal would be true for coaxial–coplanar speaker elements. In this, again, I was thinking of horns rather than direct radiators where horn lengths would differ and produce a delay difference.

Preference for 6-db networks has led me to their adoption for most applications, and here again I judged on a basis of what was most familiar to me rather than what I should have read critically.

Using 6-db networks and horns differing some 20 inches in length, polarity reversal does not produce a significant difference in sound, as judged by numerous observers.

PAUL W. KLIPSCH

Klipsch & Associates Inc.
Hope, Ark.

Modified Meter Saver

Dear Editor:

Tony Karp's meter saver (October 1962, page 34) is an excellent device for any shop, and its design is primarily suited to portable or separate equipment units.

Protection by shorting alone might result in damage elsewhere. The following modification may be handy in a built-in or meter panel unit.

Jack J at the left of the schematic on page 34 connects to the terminals of the meter it is intended to protect. All currents are fed to the vtvm or vom meter through its probe. Excessive currents trigger the 2N1213, closing the relay and shunting the meter. But, for added protection, I suggest using the unused relay contact to break the probe circuit. When not actuated, the relay would complete this circuit.

This will protect meter multipliers against burnout or changed values due to overloading. In a vtvm or vom, you could break the lead between the selector switch and the meter.

ERNEST LUKIS

Tyler Electronics Co.
Bronx, N. Y.

More Headphones

Dear Editor:

I have just read with avid interest the article by Joseph Marshall in the October issue. You are to be complimented on an excellent article covering the growing field of private-listening stereo program material. It was surely to our chagrin that we did not find our excellent headsets among those listed.

Since you may not be aware of our well recognized products in this field, I have attached our product literature on the wide-range flat-response stereo Dyna Twin and on the Stereo Twin, our latest product for the hi-fi listener. From the recognition it has received, we feel the Stereo Twin is fully competitive with the products which you did show in your article. For example, our Stereo Twin is one of three listed in the latest Heathkit catalog.

ROBERT L. SELL

Assistant Vice President
TELEX St. Paul 1, Minn.

[We regret the omission of the Telex stereo phones. Readers who wish a spec sheet on the Telex Dyna Twin and Stereo Twin phones may get a copy by writing to Telex at the address shown above.—*Editor*] END

New Eico Stereo FM Multiplex Tuner ST 97

Semi-Kit **$99.95** Wired **$149.95** Includes Metal Cover AND FET

BUILDING THE SEMI-KIT:
The two most critical sections, the front end and 4 IF's through to the detector, are entirely pre-wired and pre-aligned for best performance on weak signals (fringe area reception).

For the third most critical section, the heart of the stereo demodulator, you simply mount and solder the components on a high quality circuit board. Pre-aligned coils eliminate all adjustments. The rest is non-critical and easily accomplished with the clearest pictorial drawings and most thorough-going step-by-step procedure in the industry.

THE CIRCUIT
the front end Consistent and reliable printed circuit. Ultra-sensitive, stable, and low-noise. Wide-band design. Rugged plated steel housing for protection and shielding. Meets FCC radiation requirements. Precise temperature-compensation for freedom from drift without AFC. AFC provided with defeat for convenience. Indirect gear drive is backlash-free and eliminates possibility of microphony.

the IF strip Four IF amplifier-limiter stages (all that will do any good) and an ultra-wide-band ratio detector, all pre-wired and pre-aligned. Designed with the utmost practicality so that the simplest alignment is also the alignment for highest sensitivity and practically lowest distortion. (Important to you if a service alignment is ever required.) Output is flat to the limit of the composite stereo signal frequency spectrum to eliminate any need for roll-off compensation in the stereo demodulator.

the stereo demodulator Ten stages for unequalled performance capabilities. EICO's brilliantly-engineered zero phase-shift, filterless detection circuit (patents pending) eliminates loss of separation due to phase-shift in the stereo sub-channel before recovery. Complete rejection of storecasting interference. Cathode follower driven, sharp cut-off 15kc low pass filters in each output channel.

THE OPERATION
Two slide-rule dials in a line: one, a station frequency dial with the famous EICO "eye-tronic"® tuning-eye travelling along it to indicate the exact center of each broadcast channel; the other a logging dial with an automatic stereo indicator lamp travelling along it in tandem with the tuning-eye to indicate when the station tuned in is broadcasting stereo.

THE LOOK
Massive extruded aluminum panel and side rails, exquisitely brushed and anodized pale gold, with baked epoxy brown, perforated steel cover.

PERFORMANCE
Pre-production field tests brought back the report "Definitely a fringe-area stereo tuner," which is simply the meaning of our laboratory measurements. We know, for example, that full limiting is achieved at 10uV input signal, meaning that the low distortion and noise specifications (the full benefits of FM) will apply to all but the most distant and difficult-to-receive stations. The sharp selectivity you need when a tuner is that sensitive is here also (a strong local station and a low-power station 100 miles distant separated by only 0.4 mc, each had its own sharp tuning-in point on the dial). While signal levels as low as 2.5uV will produce phase-locking for full stereo separation, very strong local signals will produce no higher output from the FM detector than a 10uV signal and will not be degraded in quality by overloading the stereo demodulator. Distortion is very low, both in mono and stereo, so that the sound you hear has that sweetness, clarity, and freedom from grating harshness that results from absence of distortion. The stereo output signals are so clean that there is not a sign of the 19kc pilot carrier or the re-inserted 38kc sub-carrier visible on a scope presentation.

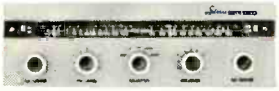
SPECIFICATIONS
Antenna Input: 300 ohms balanced. IHFM Usable Sensitivity: 3uV (30db quieting), 1.5uV for 20db quieting. Sensitivity for phase-locking (synchronization) in stereo: 2.5 uV. Full limiting sensitivity: 10uV. IF Bandwidth: 280kc at 6db points. Ratio Detector Bandwidth: 1 megacycle peak-to-peak separation. Audio Bandwidth at FM Detector: Flat to 53kc discounting pre-emphasis. IHFM Signal-to-Noise Ratio: –55db. IHFM Harmonic Distortion: 0.6%. Stereo Harmonic Distortion: less than 1.5%*. IHFM IM Distortion: 0.1%. Output Audio Frequency Response: ±1db 20cps-15kc. IHFM Capture Ratio: 3db. Channel Separation: 30db. Audio Output: 0.8 volt. Output Impedance: low impedance cathode followers. Controls: Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat. Tubes: 1-ECC85, 5-6AU6, 1-6AL5, 1-12AT7, 2-12AU7, 1-6D10 (triple triode), 1-DM70 (tuning-eye), 1-EZ80 rectifier, 6 signal diodes, 1 neon lamp. Power Source: 117V, 60cps; 60 watts drain; extractor post fuse. Size (HWD): 5⅛" x 15⅞" x 11⅜". Weight 17 lbs.

*Actual distortion meter reading of derived left or right channel output with a stereo FM signal fed to the antenna input terminals.

70-Watt Integrated Stereo Amplifier ST70
Kit: **$99.95** Wired: **$149.95**
Includes Metal Cover

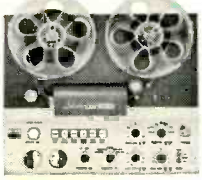
40-Watt Integrated Stereo Amplifier ST40
Kit: **$79.95** Wired: **$129.95**
Includes Metal Cover

Over 2 MILLION EICO instruments in use. Most EICO Dealers offer budget terms.



FM-AM Stereo Tuner ST96
Kit: **$89.95** Wired: **$129.95**
Includes Metal Cover and FET

FM Multiplex Autodaptor MX99 (Patent Pending)
Kit: **$39.95**
Wired: **$64.95**
Cover Optional $2.95



Transistorized Stereo/Mono 4-Track Tape Deck RP100 (Patents Pending)
Semikit: **$299.95**
Wired: **$399.95**
Carrying Case **$29.95**
Rack Mount **$9.95**

EICO, 3300 N. Blvd., L.I.C. 1, N.Y. C-1
☐ Send free 32-page catalog & dealer's name.
☐ Send new 36-page Guidebook to HI-FI for which I enclose 25¢ for postage & handling.
Name__________
Address__________
City_____ Zone____ State_____
Add 5% in West.

EICO®

3300 Northern Boulevard, L. I. C. 1, N. Y.

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M. • Export Dept., Roburn Agencies Inc., 431 Greenwich St., New York 13, N. Y.

TELEVISION AND SOUND

. . . Future TV Instrumentation Will Change Radically . . .

WHEN daily programmed broadcast TV first started on Aug. 13, 1928, it was done over a regulation radio broadcast station, WRNY (326 meters), and W2XAL (short wave 30.91 meters). These stations belonged to the writer's former publication *Radio News.* This was *"The first regular, daily, television broadcast service* the world has known," according to the September 1928 number of *Radio News.* The newspapers at that time—35 years ago—ran their first daily TV programs beginning August 21.

The New York Times of Aug. 13, 1928, heralded the new event with a front-page story, of which the following is a short excerpt:

> ". . . The television broadcasting scheduled to begin today will be made a part of WRNY's usual programs, Mr. Gernsback said. After a singer or other entertainer has finished, his or her face will be sent out over the air by television. Thus the schedule for the television will be the same as for the regular broadcasting of this station . . ."

Note particularly that in 1928 TV had no sound—it was completely soundless. The picture in motion was there—as large as a postage stamp—but it ran in majestic silence.

There are those critics today—and their number probably runs into the millions—who look back to those halcyon and nostalgic days of 1928 television, and perhaps wish that the later accompanying sound had never been invented! Indeed, full TV and simultaneous emissions over a broadcast station did not evolve until 1931.

It seems anachronistic to us that after 32 years of TV with sound, there has been so little improvement in the regulation modern TV receiver. For many years now we have had excellent high-fidelity reproduction, stereo and every audio improvement one could think of OUTSIDE of our TV receiver.

But most television receivers still to a large extent remain the "sound" stepchild of the industry! There are few commercial TV sets that have hi-fi equipment and stereo incorporated in a single cabinet.

It is only fair to state here that, up to now, the Federal Communication Commission has not allowed television stations to transmit stereo audio. It is mainly for that reason that TV receivers have rarely been equipped with stereo.

Last October, however, General Electric petitioned the FCC to allow stereo audio to be broadcast from TV stations. We hope the move succeeds.

It is conceivable that the industry could soon bring out TV receivers with the most up-to-date sound equipment. Admittedly, such high-grade musical instruments will not sell as readily as the present-day mass-produced "lame-ear" sets, but we honestly believe that there is a large and growing market for hi-fi, stereo TV today. We all agree that such sets will be expensive at first, but we are also sanguine that the public will buy them. If music lovers are avid for hi-fi and stereo equipment, why should they not welcome it combined with a TV set?

Admittedly, many attempts have been made in this direction. A few sets with multiple loudspeakers *simulate* hi-fi and stereo, but the experts tell us that they leave too much wanting. They also know that if the sound is a "live" broadcast the *quality,* and therefore the placement of the musical instruments, *must start at the TV station.*

One cannot receive a brilliant concert from a TV receiver if the brilliance does not originate at the transmitter. Hence it would be useless to build expensive sound receivers if the stations did not reform their transmissions first. This seems elementary, but it is not the whole story.

In our estimation we do not as yet possess the necessary instrument to judge scientifically the quality, the timbre, the brilliance, the sonority and the correct volume of the reproduced sound. Today, *"we play it by ear."* But most people's ears are far from perfect—hardly ever are both ears alike acoustically. Hence what is one music *connoisseur's* excellent reproduction is another's audio flatness.

With today's advances in audio electronics, it should not be too difficult to design at reasonable cost a *multi-audio-tester* that does for audio what a modern automatic light-exposure meter does for a luxury camera, when held 6 or 10 feet from the receiver. It is gratifying to note that steps in this direction have already been taken.

At the present time, most of our TV receivers still have fixed loudspeakers. We can visualize a future TV cabinet with removable and mobile speakers at both sides behind normally concealed doors. Such loudspeakers with attached flexible cords could be extended from the cabinet and placed in the best locations for maximum performance. At least one manufacturer has marketed a TV-FM radio-phono console with a similar arrangement.

Another future requirement for loudspeakers will be their *audio adjustability. Loudspeakers should be able to be adjusted to fit their environment.*

In the recently opened New York Philharmonic Hall, suspended from the ceiling are 214 six-cornered sound reflectors, *which can be raised or lowered to alter the sound characteristics of the hall.* Conversely, the loudspeakers of the *future high-performance TV receivers must be adjustable audio-electronically to the room's sound characteristics.*

No two rooms are alike audio-metrically. The ceiling, the walls, the floor, the furniture, the windows, the drapes, window shades, the placement of the receiver and loudspeakers, all are acoustic variables. For this reason, speakers must be placed and balanced for the optimum acoustic degree of the room. And this in turn requires a multi-audio-tester which we mentioned before.

This may all seem complex and difficult to attain. We assure you it is not, once the right instrumentalities have been evolved. Correct and efficient engineering has always overcome apparently impossible tasks—it will do so in this instance, too.

—H.G.

By DONALD L. STONER

Electronic circuit sets correct lens openings automatically

cameras that think

I, LIKE MANY OTHER AMATEUR PHOTOGraphers, have trouble with F-stops and focal lengths. Solving simultaneous equations seems simple compared to the intricacies of computing F-stops from an exposure meter.

Realizing that the camera is a mysterious and complex device to the layman, Kodak marketed a fully automatic still camera (called the Super Kodak 620) as early as 1938. It was an excellent piece of engineering, but had a price tag of $225. Actually the camera was 20 years ahead of its time.

Much later, in 1956, Bell & Howell scooped the industry with a battery-powered electric-eye 16-mm movie camera, their model 200-EE. It was the first automatic movie camera. Its wide acceptance led Bell & Howell to introduce, in 1957, the first fully automatic batteryless 8-mm camera (model 290), priced at $169.95. Its mechanical diaphragm was built to operate directly from the few microwatts supplied by a selenium photovoltaic cell.

This amazing device cracked open the home movie market. It was ideal for an average family who wanted movies without having to cope with exposure meters and F-stops.

Within a year of the introduction of the 290 almost every US movie camera maker had automatic or semi-automatic models on the market. One manufacturer, Elgeet Optical Co., brought out an accessory lens with an automatic diaphragm for converting standard movie cameras to automatic operation. A unique automatic attachment was also produced by the Polaroid Corp. for their "60-second" cameras, when using ASA 3000 film.

In 1958 simple automatic still cameras appeared, and again Bell & Howell was first with a camera in the $40 class, followed in 1959 by a mass-produced $29 camera called the Starmatic, produced by Kodak.

How it works

The simplest form of automatic-exposure camera can be thought of as a glorified exposure meter in which the needle controls the iris opening. In a typical exposure meter, a selenium photocell sits behind a plastic or glass lenticular lens and baffle assembly. Light striking the cell generates an electric current. The stronger the light, the greater the current. This current is fed to a moving-coil meter (Fig. 1). Passing through the coil, it creates a magnetic field which repels the field produced by the permanent magnet. The stronger the current, the higher the meter reading, as indicated by the pointer. The pointer is calibrated with a scale that indicates the correct F-setting for a particular film speed.

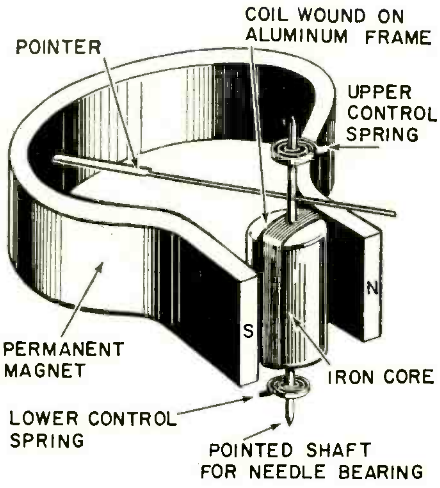


Fig. 1 — Current from photocell is passed through a moving-coil meter.

In the automatic camera the movement of the meter coil controls the diaphragm (Fig. 2). There are, of course, several varying mechanical designs but the method shown here is typical and

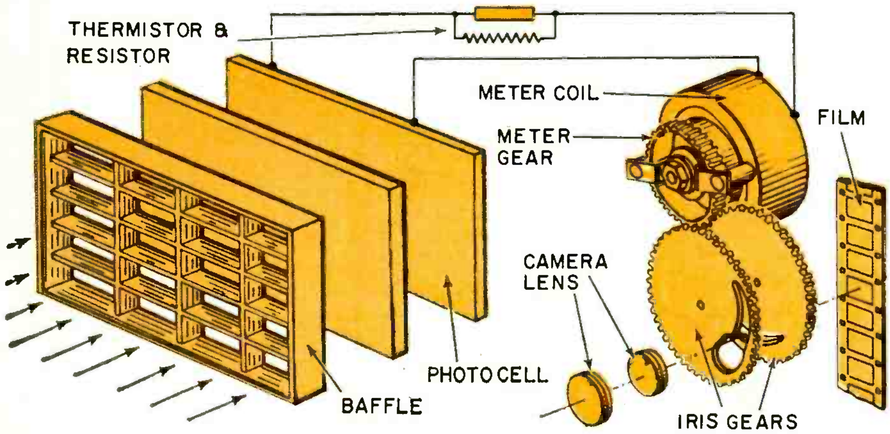


Fig. 2—Typical automatic exposure device. The meter gear drives both iris gears to control the opening.

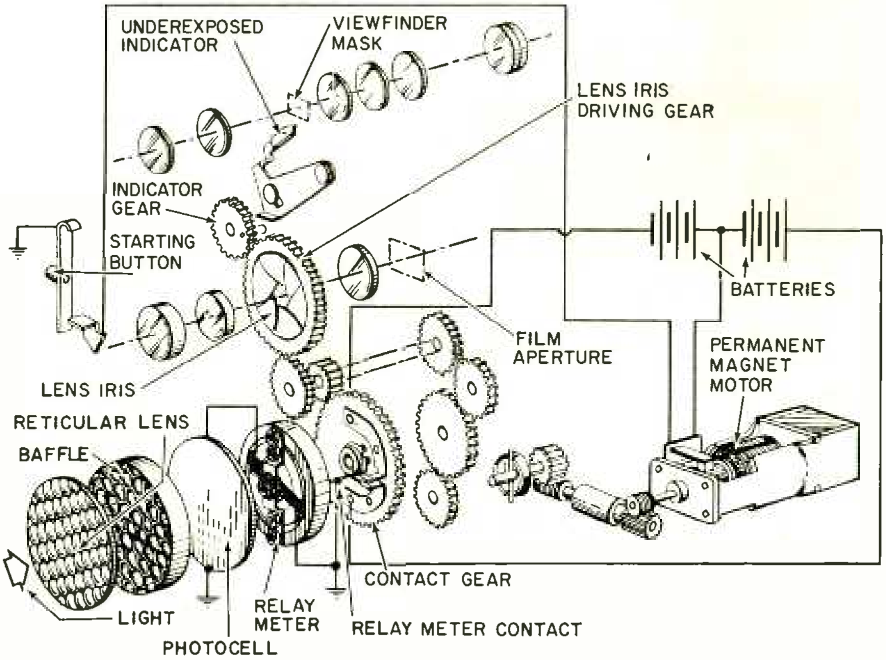


Fig. 3—Battery-powered motor adjusts the lens opening according to the amount of light falling on a photocell.

illustrates the general principle. Two iris gears with teardrop-shaped slots provide the variable lens opening. The gears are supported on small precision jeweled bearings and are coupled to a high-torque meter movement. Note that the gears rotate in the same direction.

The light entering the baffle hits the photocell, which generates an electric current in proportion to the light intensity. The current passes through a resistor and thermistor and the meter coil. The coil rotates according to the current strength to move the two iris gears, which allow just the right amount of light to strike the film. The inertia of the two gears is carefully matched to the meter for stability even though the camera may be moved during exposure. Without this feature, any camera movement would cause the iris opening to drift or change size, causing a variation in exposure. The resistor is used to calibrate and match the cell to the meter. The thermistor compensates for temperature changes and their effects on the cell and copper-wire meter coil. It thus maintains correct exposure over the wide range of temperatures encountered by outdoor photographers in winter and summer.

An automatic shutter

An interesting self-powered automatic-exposure device is produced by Polaroid as an attachment for its still cameras. An automatic shutter, it works on the principle of an air bellows. The rate of escape of the air controls the opening and closing speed. A selenium photocell actuates a vane which covers or uncovers (according to scene brightness) tiny holes through which the air escapes.

When one considers the tiny current generated by the photocell, it is truly amazing that the automatic-exposure cameras work so well. Their performance is even more outstanding when one looks at the range of illumination the camera must accommodate. The maximum scene illumination (bright sunlight) is approximately 10,000 foot-candles. The dimmest scene that can be photographed is determined by the maximum lens opening and the film speed. With typical movie cameras and average film speed, it may be approximately 20 foot-candles. Thus the photoelectric control system must be able to handle a range of illumination between 20 and 10,000 foot-candles.

Recent developments

The "second generation" 8-mm electric-eye cameras, produced by Bell & Howell, have battery-powered motors to rotate the iris discs. As shown in Fig. 3, the motor is connected in a form of servo system controlled by the light falling on a photocell. The lens iris is actuated through a gear train by a small battery-powered motor. Two electric circuits drive the motor in either of two directions, causing the lens iris to open or close. The control mechanism is the simple exposure meter mentioned earlier.

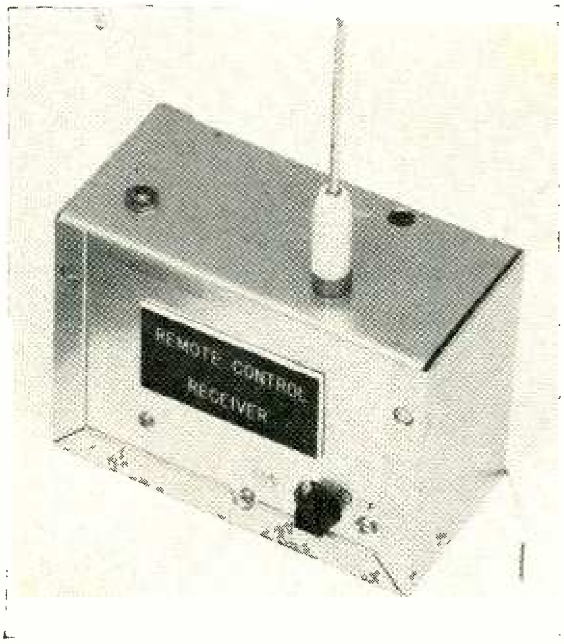
In this camera system, the needle moves to contact either of two platinum pins which act as a spdt switch to complete one or the other of the two motor circuits. The platinum contact pins are mounted on one of the gears used in the iris drive train so they straddle the control-mechanism needle. When the motor has driven the gear train and moved the lens iris to its correct aperture, the contact pins break contact with the control mechanism needle and the motor stops. This action takes place only when the starting button is actuated. In addition to controlling the camera mechanism, the starting button acts as a master switch for the motor circuits.

A third generation of electric-eye cameras is currently being marketed. These use the reflex principle—the scene is viewed through the lens opening. In addition, the cell which controls the iris setting "sees" this same scene. This eliminates the tendency of electric-eye cameras to adjust to overall illumination rather than the subject. Such a third-generation electric-eye camera is the new Bell & Howell Director Reflex. Since much lower illumination levels are involved, a cadmium sulfide cell is used to control the system. This type of cell does not generate electricity, but varies resistance in direct proportion to illumination. A typical cadmium sulfide cell might have a dark resistance of 1 megohm and at 10 foot-candles would drop to 2,000 ohms. A small mercury battery, connected in series with the cadmium sulfide cell provides power for the iris control system. The reflex technique makes it possible to incorporate zoom lenses in the automatic camera. Even though the field of view through the lens changes, as the lens zooms in or out, the cell is able to compensate for the changing illumination.

Photocell-controlled cameras are not without disadvantages but there is a mounting trend toward incorporating this automatic feature into even the lowest priced units. As the mechanism becomes more sophisticated, automatic-exposure devices will be used on highest priced professional cameras. END

Selenium photocells can be contoured to fit in any section of the camera.

International Rectifier Corp.



Completed unit includes an on–off switch not shown in schematic.

CB Receiver Opens Garage Door

5-transistor set is supersensitive

By JOHN H. PHELPS*

TO MEET THE VARIETY OF APPLICATIONS for a remote-control 27.255-mc Citizens-band receiver, three options are offered in the circuit design and printed-board layout: First, it can be built as a three-transistor Citizens-band phone receiver. Second, by adding two transistors, a relay can be closed by a tone-modulated signal. Third, a tuned circuit can be added to prevent phone stations and off-frequency tones from closing the relay when used as a remote-control receiver.

The heart of the receiver is a GE-M100 mesa transistor used as a super-regenerative detector (Fig. 1). Such a detector gives voltage gains in the order of 100,000 and rivals the best superhet receivers in sensitivity. Minimum discernible signal levels as low as 2 μv are not unusual, with 10 to 20 μv easily attainable. Unlike the superhet, selectivity is poor. This is the price paid for simplicity.

* Manager, Application Engineering Semiconductor Products Dept., General Electric Co., Syracuse, N. Y.

The transformer in the detector's collector circuit provides both impedance matching and quench removal. Its leakage reactance and the 0.2-μf capacitor across its secondary form a low-pass filter which attenuates the 40-80-kc sawtooth quench voltage. Following the detector are two temperature-stabilized 2N1694 audio amplifiers. Connect a single crystal earphone across V3's collector load for phone reception. Do not leave the phone in the circuit when relay operation is desired.

The relay driver stage consists of two direct-coupled 2N404 p-n-p transistors. The first transistor of the pair, V4, is not forward-biased and the pair are cut off when there is no audio signal. When a tone-modulated carrier is picked up, V4 conducts, causing V5 to conduct heavily and pull in the control relay. Capacitor C10 keeps V5 conducting during modulation negative half-cycles.

From V4's base to the positive supply bus a block marked Z is indicated. This network consists of a parallel .005-μf capacitor and a 5,600-ohm resistor

R1—2,000 ohms, 5%
R2—47,000 ohms
R3—15,000 to 47,000 ohms
R4, R8—10,000 ohms
R5, R9—68,000 ohms
R6, R10—1,200 ohms
R7, R11—5,600 ohms
R12—820 ohms
R13—33 ohms
R14—5,600 ohms
All resistors 1/10-watt 10% unless noted
C1—470 pf (μμf), ceramic
C2—5 to 10 pf, ceramic
C3—.01 μf, ceramic
C4, C7, C9—1-5 μf, miniature electrolytics
C5—0.2 μf, ceramic
C6, C8—25 μf, miniature electrolytics
C10—0.1 to 1.0 μf, miniature electrolytic
C11—.005 μf, ceramic
C12—.002 μf, ceramic
C13—2 pf, ceramic
All capacitors 6 volts or higher
BATT—4.5 volts (3 D-cells or equivalent)
J—phone jack
L1—21 turns No. 26 wire on Cambion phenolic coil for printed circuitry No. SPC2-D-2L. (11/16-inch winding length by 0.285-inch outside diameter). Tuning core X2172-D (3/16-inch diameter) for 20–50-mc range. Both coil form and core manufactured by Cambridge Thermionics Corp., 445 Concord Ave., Cambridge 38, Mass.
L2—750-μh unpotted toroid coil (Torotel, Inc., 5512 E. 110th, Kansas City 37, Mo. No. U50-21 will resonate at about 1,300 cycles with .02-μf capacitor. Price—$6.30.)
RFC—50 μh (National Co. R33-50)
RY—spdt GEM relay, 100-ohm coil (Jaidinger Co., Chicago, Ill.) Available at many hobby shops.
T—primary, 10,000 ohms; secondary 2,000 ohms (Telex T-42, Argonne TR-98, or equivalent)
V1—GE-M100 (G-E)
V2, V3—2N1694 (G-E)
V4, V5—2N404 (G-E)
Printed-circuit board
Antenna, 18-inch long wire
Miscellaneous hardware

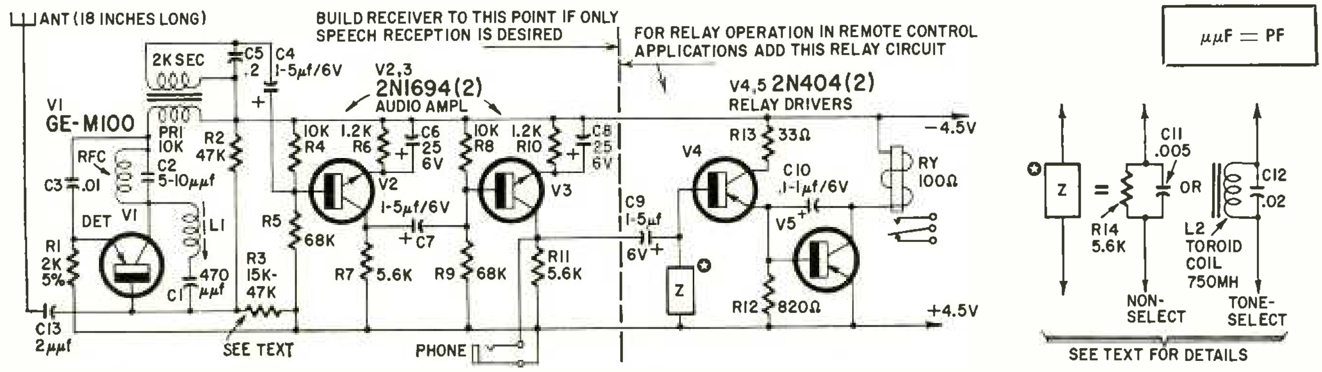
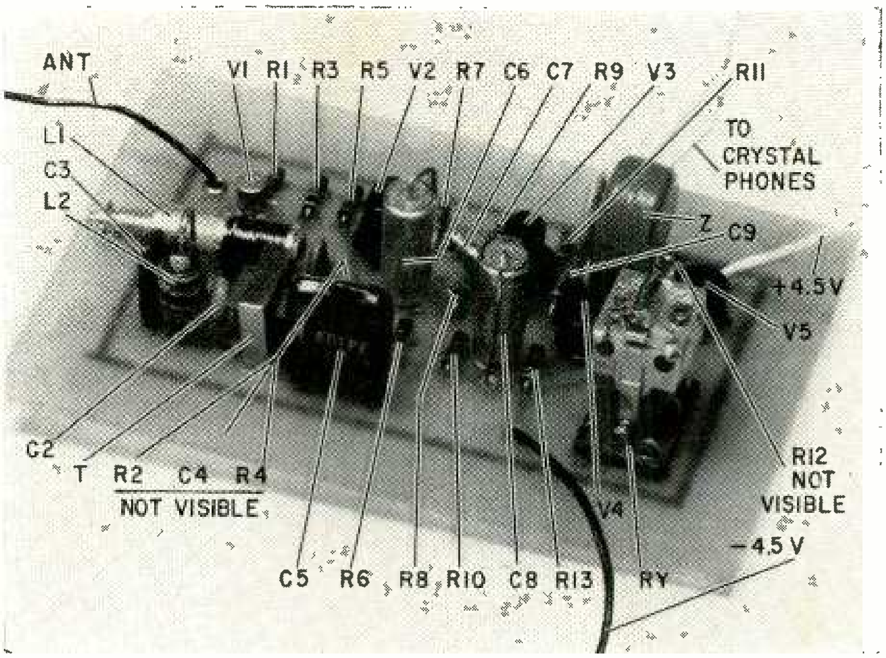


Fig. 1—Circuit of the 3-way unit.

when no audio frequency selectivity is desired. For selective tone operation, the network consists of a .02-μf capacitor shunting a toroidal inductance of 750 mh. This parallel combination resonates at approximately 1,200 cycles and audio tones appreciably removed from this frequency cannot close the relay.



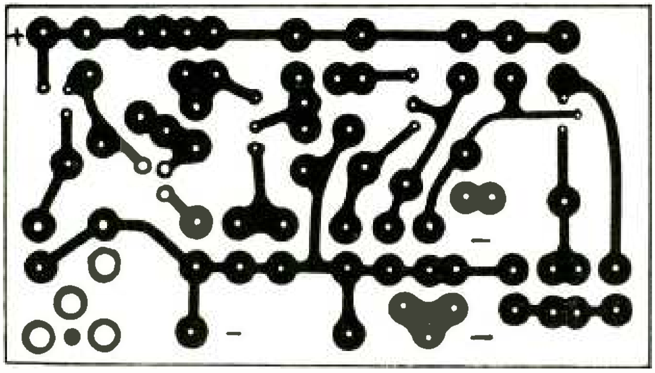
Top view of printed board showing location of all parts.

To build it

To facilitate construction a printed-circuit board layout is shown in Fig. 2. If you have never made your own printed circuits before, see "Photo-etched Circuits," by Richard Dorf, Radio-Electronics, December 1955 and January 1956; also "Making Printed Circuits Is Easy," by Tom Jaski, Radio-Electronics, September 1955.

Use a good rosin-core solder to solder components to the board. The low melting point solders are preferred. The lower melting point helps avoid damage to the conductors by overheating. During construction refer frequently to the schematic in Fig. 1 and the parts layout photograph. The parts location photo shows all components except R12, which is hidden by the toroid coil, and the 2-pf antenna capacitor mounted on the bottom of the board directly from V1's base to the antenna eyelet.

Fig. 2—Use this actual size pattern to make your printed circuit board.



Adjustments

Although some latitude is allowed for capacitor and resistor substitution in the audio and switch stages, the experimenter should stick to the transistor types shown and particularly the components specified for the superregenerator. If you cannot obtain RFC exactly as specified, C2 must be altered to preserve proper operation. The choke's distributed capacitance, as well as its inductance, is part of the feedback circuit. Inductance values ranging from 22 to 50 μh should work if a ceramic trimmer is used in place of C2, to establish proper operation. The trimmer should have a minimum capacitance of 5 and a maximum of 20 pf.

You can check proper operation best with a scope and a well shielded signal generator. If elaborate test equipment is not available, listen to the character of the superregenerative hiss in a crystal headphone. If it is ragged or absent, adjust the trimmer until you hear a smooth rushing noise.

Under certain circumstances the noise produced and amplified by the superregenerative detector will sporadically pull in the receiver relay. If this happens, reduce the value of C9. Values as low as .01 μf are acceptable. Select a transmitted tone above 1,000 cycles. Reducing the value of C9 also sharpens the selectivity of the toroidal filter by rapidly attenuating frequencies below resonance. Adjust the relay to pull in at about 20 ma and drop out at 10 ma.

Motorboating or low-frequency oscillation of the entire receiver is possible if the unit is powered by weak cells. For garage-door openers, three D-size flashlight cells should give approximately 1 year of operation. The readily available and inexpensive nickel-cadmium cell is ideal since it has very low internal resistance and a long recharge-cycle life. Use four such cells in series.

If motorboating persists, even with good cells, switch either the primary or secondary leads of transformer T.

The printed-circuit version of this receiver has been duplicated by a number of individuals without difficulty and with uniformly good results. When the receiver is used to actuate motor drives for opening garage doors, brush type (universal) motors can create very high rf interference levels which may keep the relay pulled in as long as the motor runs. This may or may not be objectionable, depending upon the type of power relay used in the mechanism and the nature of the limit and safety switches. Induction motors have caused no trouble and are recommended for use with this receiver. END

New Abbreviations

Radio-Electronics is adopting the modern abbreviation "pf" for "$\mu\mu$f". (The "p" in this case is short for pico, meaning "very small." Both the "p" and the "$\mu\mu$" represent 10^{-12}.) This abbreviation has been coming into more and more common use in the past year or two, and is especially handy for people who do not have the character "μ" on their typewriter keyboard.

We are also beginning to use "Q" instead of "V" to designate transistors. While usage has been split on this, "Q" is now used by the majority of American publications.

Since much material is already set up in type, readers will probably see both sets of abbreviations side by side in the magazine for a few months, but ultimately the newer ones will prevail.

COVER STORY

By JORDAN McQUAY

Here comes the LASER

What's new in the field of optical masers?

A MAJOR ADVANCE IN PHYSICAL SCIENCE is the generation of coherent light beams by a new electronic device: the optical maser, or laser. These newly developed electronic-optical devices promise to advance and revolutionize the extremely high-frequency fields of radio and electronics technology.

Potential uses of lasers are tremendous and breath-taking, with many bordering on science-fiction levels—but all are well within the realm of possibility in the next 5 years:

A light beam capable of handling 100 *million* telephone calls, or a million TV channels. A light beam that can power satellites and other spacecraft, or map areas of the moon. A light beam focused to an intensity brighter than the sun. A pulsed beam that enables radar to track objects *billions* of miles away in outer space. A concentrated light beam sufficiently intense to bore holes through metal—and even diamonds—in a few hundred microseconds.

These and other advanced techniques are possible with the laser—an acronym for *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation. Also called an optical maser, it is an extension of electronic techniques into the infrared and visible-light portions of the frequency spectrum (Fig. 1).

Both masers and lasers are essentially energy converters, operating on similar principles. The maser operates in the microwave region; the laser in the infrared and visible-light regions.

Both utilize the natural resonant frequency of electrons within an atom as a frequency standard. This means that they have very high stability insensitive to environment.

In both masers and lasers, random energy is converted by atomic action into a stimulated, coherent, highly directional beam. But of these two, lasers show greater promise for future applications—exploring for the first time the use of optical frequencies for communications and other electronic techniques.

The optical portion of the spectrum is a new and almost-unfamiliar region to those accustomed to thinking of frequency in terms of megacycles. Wavelengths are so short that the angstrom (1×10^{-10} meter) is used to define these waves.

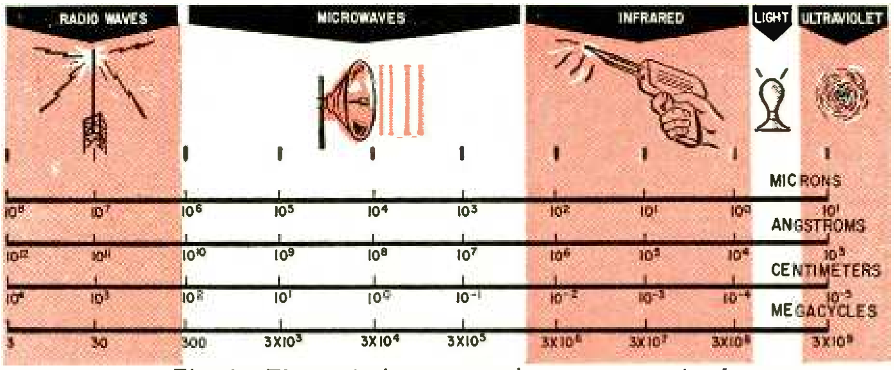


Fig. 1—The optical maser, or laser, operates in the boundary region between infrared and visible light.

In this region, a typical optical maser operates at about 6,330 angstroms, or 470 teracycles (10^{12} cycles). At longer wavelengths in the infrared region, typical lasers operate between 11,114 angstroms (268.3 teracycles) and about 21,189 angstroms (137.1 teracycles), depending on the type of *element* used in each device. At least one recent optical maser worked in the visible (red) light region.

Coherent waves

Although resonance in crystals and other materials is often encountered the most unusual characteristic of the laser is that oscillations are *controlled* and *stimulated*, by the device itself, so the output of light waves is *coherent*. This means the output is monochromatic, unipolarized and uniphased.

Light is produced whenever the atoms of certain substances are raised sufficiently in temperature. Such light—whether from incandescent lamps, fluorescent tubes or the sun itself—is *not* coherent. It is emitted in a random pattern, haphazardly in all directions. The many light waves interfere with each other and are diffused. As a result, the *potential* energy is dissipated to a large degree. But coherent light behaves differently.

Coherent light waves have traveling surfaces of constant phase moving in an extremely narrow beam. The amplitude and phase of coherent waves can be specified closely. The frequency depends upon the active laser element.

These coherent waves proceed in strict formation, closely obeying the ideal laws of optics.

Although laser outputs have an extremely narrow beam width, they can be focused to even tighter beams. Under such controlled conditions, a laser beam spreads less than 2 feet in 1 mile. In comparison, sunlight would disperse as much as 100 yards.

This permits wide-band communications where—at least in theory—a 1% bandwidth can handle over 100 million TV channels simultaneously. And with sufficiently high power, lasers will permit communication over phenomenal distances through outer space.

Much laser research is experimental. Only a few models are available for commercial use, and they are expensive. But some idea of the potential magnitude of lasers is indicated by the fact that over 500 Government-sponsored development contracts are now in existence in as many laboratories across the nation.

Despite their many advantages, these coherent light waves have some important limitations.

They cannot penetrate clouds, adverse weather or atmospheric conditions. They follow line-of-sight transmission paths—unless moved through optical type waveguides.

Atomic energy

Coherent optical waves are generated and produced by harnessing *and controlling* the illimitable power and inherent frequency of atomic energy.

Certain elements, such as uranium, lend themselves to the production of nuclear energy. And we know what *that* produces!

In more peaceful pursuits, any of a relatively small group of solid-state

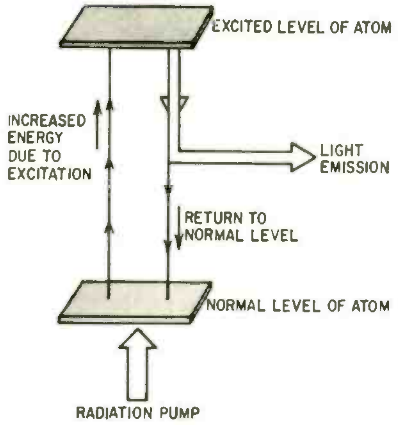


Fig. 2—Energy levels of one atom in typical laser.

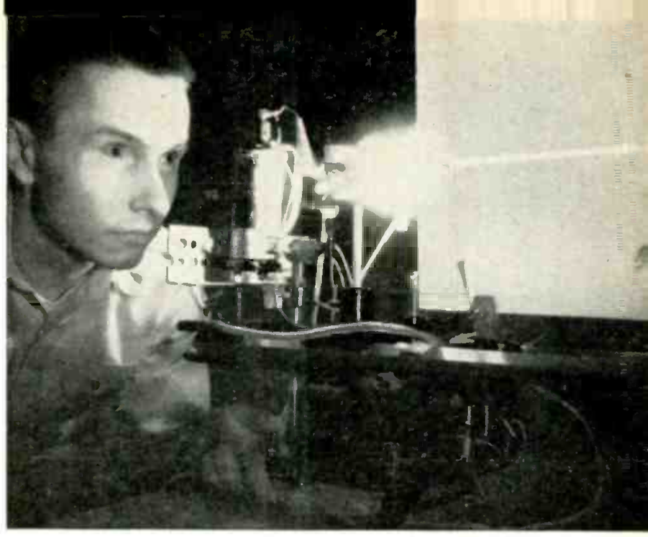


Fig. 5—Intense radiation beam from crystal laser.

Army Signal Corps

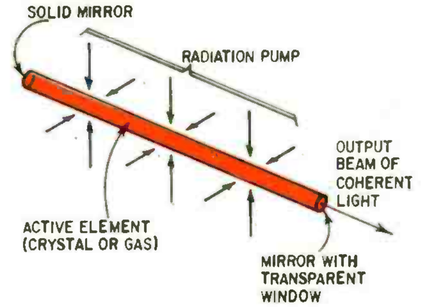


Fig. 3—Basic elements of typical laser.

crystals *or* certain gases are also suitable for producing a more beneficial and useful type of energy: optical waves.

The most successful crystalline substances have been the synthetic ruby —doped with any of several chemicals. Some of the gases are helium, neon, argon, krypton and xenon.

This is the way it works:

Every atom of such an active element has certain characteristic energy levels. The lowest of these is the normal —or "at rest" energy level, at which the atom remains relatively undisturbed (Fig. 2).

When stimulated by an external source of rf or light energy—called a *radiation pump*—the atoms of the element absorb some of the energy and jump quickly to a higher energy level, where they remain in an "excited" state.

This state is unstable and the atoms tend to return to their normal, "at rest" level. As they do so, they emit the absorbed energy in the form of light waves at a frequency depending upon the basic substance of the excited element. In a gas, these atoms collide with other atoms, causing further emission of light waves.

So far this light emission is random and *not* coherent.

But when this atomic process takes place in a resonant chamber or tube of critical dimensions and under carefully controlled conditions, the laser becomes a regenerative oscillator. Optical waves are stimulated and produce a magnified narrow-beam output.

Basic operation

In a typical arrangement (Fig. 3), the active element—whether crystal or gas—is contained within a tube.

A mirror over each end of the tube makes it a resonant cavity. One of these mirrors, however, has a small transparent "window," or may be very thin, so that a small portion of the light escapes through it.

The laser is pumped by either optical or electrical means. Then, as excited atoms return from higher energy levels to their normal or "at rest" level, light waves are produced.

Reflected by the end mirrors, the waves move back and forth within the cavity, each time colliding with other excited atoms, and stimulating or increasing the production of light waves. All these light waves are in phase, which results in a major intensification of these waves along the resonant tube. Output is through the mirror at one end of the cavity. [For a more detailed description of optical maser action, see "Communications on 450,000,000 Mc," Radio-Electronics, May 1961, page 57.] The *frequency* of these oscillations depends on the atomic structure of the active element.

There are two broad types of lasers: the *crystal* and the *gaseous.*

Crystal lasers

The active element of solid-state optical masers is a small crystal rod with silvered ends. It is *pumped* with white or green light from a spiral photoflash lamp surrounding the element.

The most common type of crystal laser (Fig. 4) uses a synthetic ruby crystal of aluminum oxide doped with chromium. Applying a green pumping light of the right frequency causes the chromium atoms to jump to a higher level of energy. Returning to their normal or "at rest" state, these atoms emit infrared light, which is trapped between the silvered ends of the ruby rod. By stimulating emission in the resonant cavity, intense radiation (Fig. 5) is developed along the length of the rod.

Work is continuing along several broad fronts by many research organizations. Notable among these are Hughes Aircraft Corp., Bell Telephone Laboratories, Raytheon Co., American Optical Co., Sylvania and many others.

The search for new active elements has led to exhaustive experiments with new crystal compounds. Prominent among the crystals successfully tested are calcium fluoride doped with dysprosium, samarium, thulium, neodymium, and even uranium. Also of potential merit are calcium tungstate doped with erbium, neodymium, holmium, thulium and other paramagnetic ions.

New methods of exciting the active element of a crystal laser have been developed. And Raytheon has offered one of the first pulsed crystal lasers on the commercial market.

An advanced type of optical maser, capable of continuous operation, has been developed by Bell Telephone Laboratories (Fig. 6). The active element of this laser consists of *two* substances grown together as one synthetic

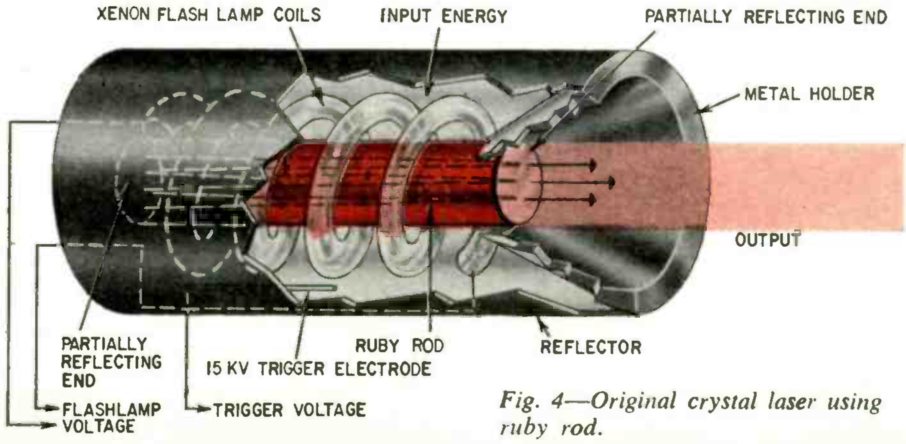
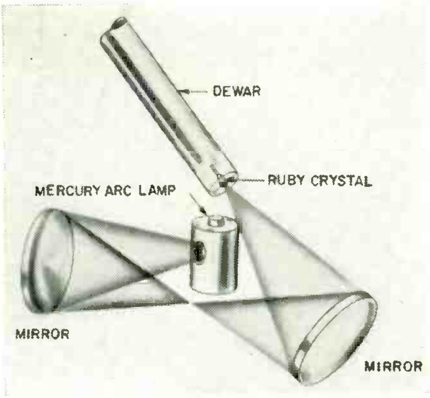
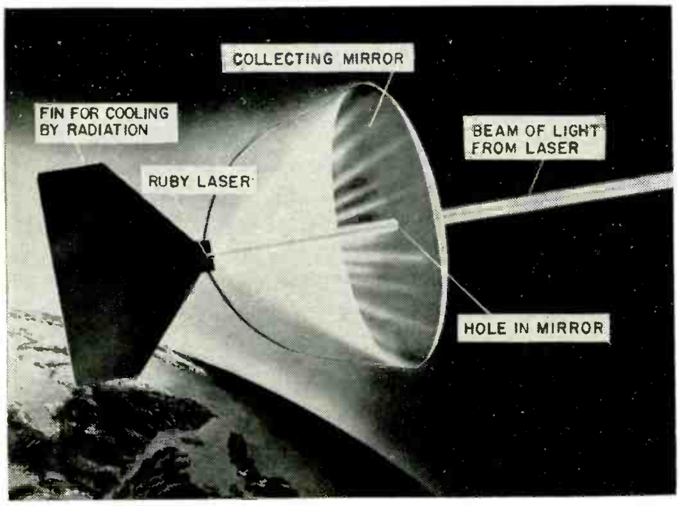


Fig. 4—Original crystal laser using ruby rod.



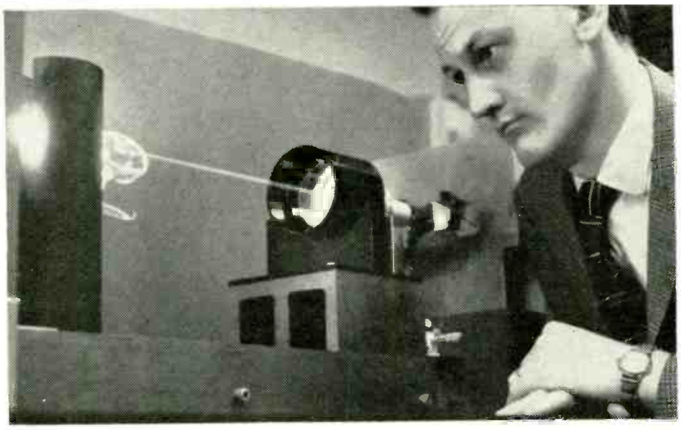
Bell Telephone Laboratories

Fig. 6—Crystal laser excited for continuous operation.



American Optical Co.

Fig. 7—Proposed sun-powered crystal laser.



Bell Telephone Labs

Fig. 8—Beam from typical helium-neon gas laser.

crystal. Shaped like a trumpet, the bell of the device is pure aluminum oxide (sometimes called *sapphire*) which receives the pumping radiation and then acts as a "condenser". The shank of the trumpet is synthetic ruby —aluminum oxide doped with chromium. Laser action takes place in the shank, producing an intense beam of infrared light. Output is about 4 mw.

Other advances in solid-state optical masers include increases in output power for crystal lasers plus new and diversified means of modulation.

One new technique which is reported to multiply output power by about 1,000 times, has been announced by General Dynamics Corp. The laser is surrounded by a strong nonuniform magnetic field, which forces the device to store up energy. When the field is removed, the laser releases the energy in a concentrate many more times powerful than for a nonmodulated discharge.

Another specialized application of the crystal laser is a sun-powered device, proposed by the American Optical Co., which would permit direct use of sunlight to power a system for communicating with satellites and other space vehicles (Fig. 7).

Gaseous lasers

Active element of most gaseous optical masers is a combination of inert gases—such as helium or neon—contained in a glass tube. This tube is pumped by a high-frequency signal of about 30 mc to change energy levels.

When the atoms of one gas are excited, they collide with atoms of the second gas. Energy is transferred in the form of infrared or visible light. In a resonant tube, the energy is stimulated to form a continuous high-energy beam of coherent light (Fig. 8).

Output frequency depends upon the active elements—the inert gases. Helium-neon combinations produce visible light of about 6,328 angstroms. Combinations of neon-oxygen as well as argon-oxygen produce light waves in the near infrared region of 8,450 angstroms.

Optical masers using a pure (noble) gas have also been developed by the Bell Telephone Laboratories. These produce a beam of coherent infrared radiation at more than a dozen wavelengths between 16,900 and 21,890 angstroms. Cesium has been used to generate beams of 71,180 angstroms.

An important characteristic of this type of optical maser is that the output beam is several hundred times *narrower* than the output of crystal lasers.

The two types—crystal and gaseous—tend to complement each other, since the gaseous laser is essentially a low-power device. The crystal laser, a high-power device, is particularly useful in pulsed applications—for radar and pulsed-code modulation (pcm) communication.

Communications

Using either pulse-code or continuous-modulated CW, optical masers are particularly adapted to long-range communication—particularly in outer space. But for interstellar and interplanetary communication, means and methods of modulation, which are now under development in research laboratories, are needed. General Telephone Laboratories at Bayside, N. Y. (formerly Sylvania Labs), announces, for example, a modulation method based on frequency change. This FM approach "allows the lasers to be 'tuned' rapidly like a home radio set" (Fig. 9).

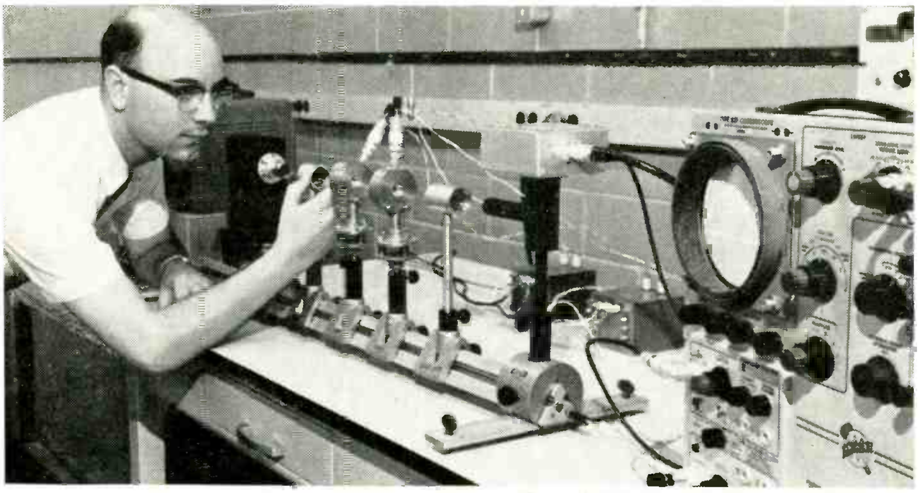
For pulse-code modulation transmission or reception, a "traveling-wave" crystal laser that can amplify or intensify light waves directly has been developed by Bell Telephone Laboratories.

An intensified image of a suitably illuminated object at the input is reproduced in the output. The laser type device consists essentially of two amplifying sections with an *isolator* of lead-oxide glass (flint glass) between them. This material is transparent to light waves over most of the optical range. The "isolator" tends to absorb backward traveling waves and to transmit forward traveling ones. This is done by a disc of polaroid type material. This apparatus provides a gain of about 13 db. But the amplifier has a bandwidth of about 100 kmc—as large as the *entire* spectrum of presently usable radio and microwave frequencies.

Not all optical masers need be large or ponderous. At least one lightweight though low-power crystal laser has been developed—by the Bell Telephone Laboratories. Weighing only a few pounds, it is used for short-range communications and demonstration (Fig. 10).

Radar applications

In radar—for long-range surveillance, acquisition and tracking, and for



General Telephone & Electronics Labs Inc.

Fig. 9—Setup for modulating the laser beam.

guidance and control of space vehicles, the optical maser is destined to shine the brightest.

Both crystal and gas lasers are extremely adaptable to most radar operations, because they can be pulsed to achieve extreme peak power. Outputs greater than 3 megawatts have been generated by the Army Signal Corps and other research laboratories.

One of the first laser radars was the Colidar (for *C*oherent *L*ight *De*tecting and *R*anging) developed by Hughes Aircraft Co. (Fig. 11). A crystal (ruby) laser provides light pulses, which are collimated by a lens and transmitted toward a distant target. Reflected light signals (echoes) are collected by a large telescope, amplified and processed to provide distance, elevation and other data.

On a larger scale, MIT scientists at Cambridge, Mass., during 1962, used a Raytheon pulsed crystal laser and precise timing equipment to bounce signals off the moon—an old stunt for microwave radar, but a scientific "first" for the optical maser. Using a 12-inch telescope, transmitted laser pulses illuminated a circle on the moon about 2 miles in diameter, and then returned to earth. Each round trip took 2 seconds and was received weakly—but positively.

Optical masers fit perfectly into the special requirements of space exploration and discovery—once the light waves penetrate the atmosphere of the earth. Supplementing conventional radar applications, lasers could well bridge the gap between a manned spacecraft and a target vehicle as they approach a rendezvous point in space.

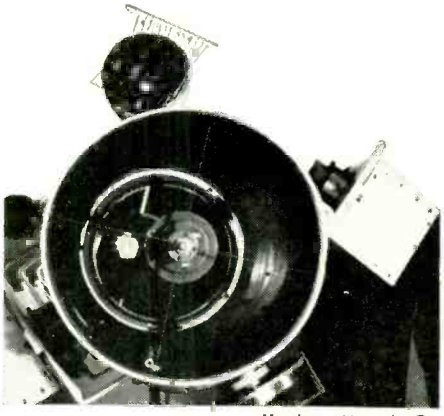
Although such an application may be a few years away, a suitable radar exists today—developed by the Martin Co. Called the "suitcase" laser, it transmits and receives radar pulses at ranges up to 10 miles. The equipment weighs about 30 pounds.

A military version of the same radar is the "laser ranger," also developed by the Martin Co. Designed for rugged field use, the operator simply aims the portable device toward a moving ground target, presses a button and reads the distance to the target on an indicator panel.

High-intensity beams

The ability of optical masers to produce coherent light beams of extremely high intensity is utilized in a number of ways.

Using laboratory lasers, the Air Force has welded pieces of titanium—

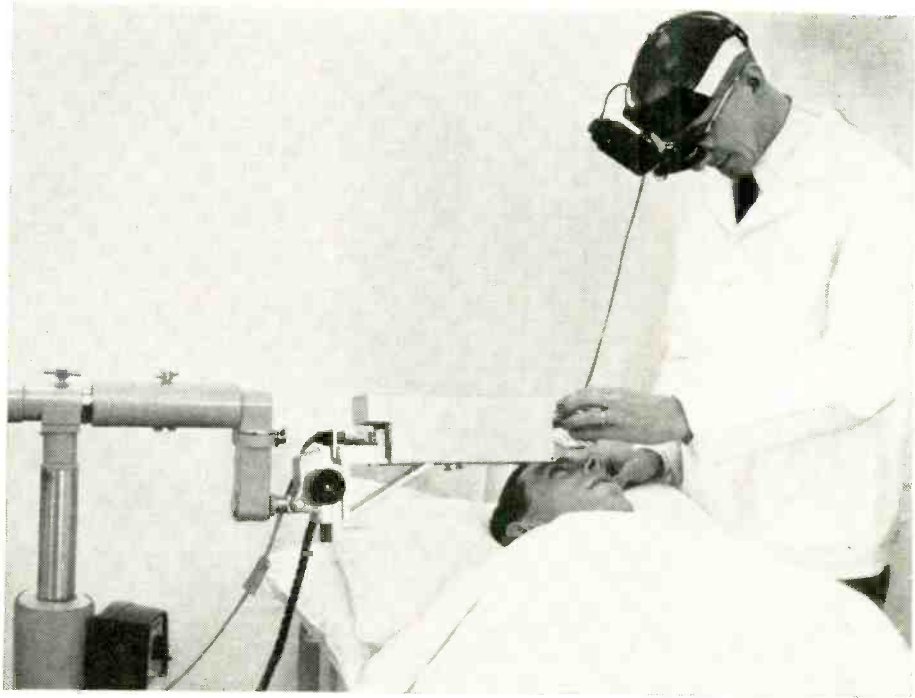


Hughes Aircraft Co.

Fig. 11—Coherent light beam radar. Transmitter is above; receiver (telescope) below.

Bell Telephone Labs

Fig. 10—Short-range laser can be hand-held.



American Optical Co.

Fig. 12—Laser is used in eye operation.

with no other source of power. And two pieces of hard-to-weld molybdenum and titanium have been fused by the American Optical Co. with a laser they developed.

Raytheon has demonstrated the tremendous power of their laboratory laser by burning holes through a stainless steel sheet 1/32 inch thick—in 2 milliseconds. The same coherent light beam can ignite paper at a distance of 15 feet. And a General Electric device can blast through diamonds with a temperature of about 10,000°F.

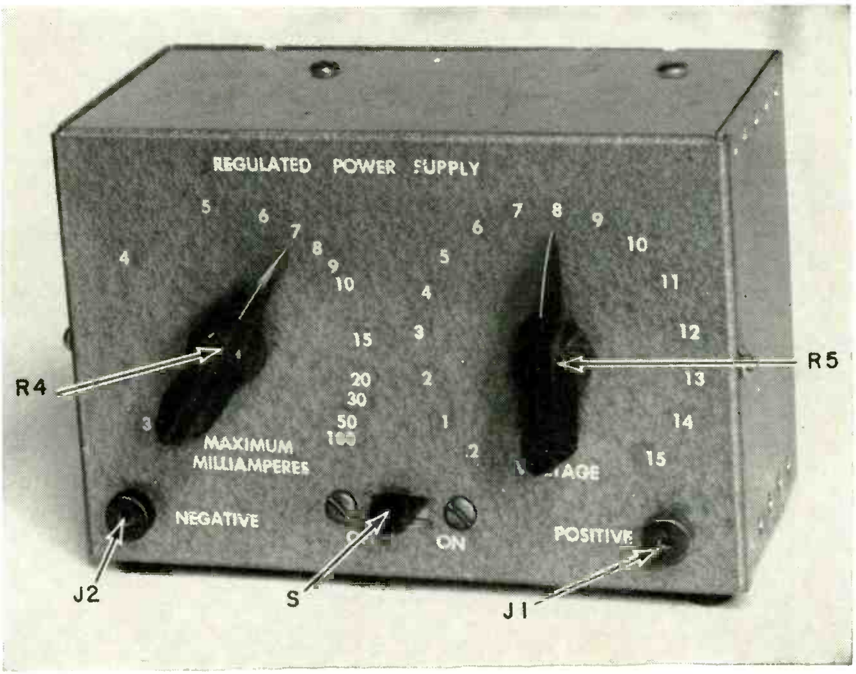
Already the laser has been adapted to the ophthalmologic area of medicine. Utilizing an intense laser beam, a new instrument called the laser retina coagulator is now successfully in use at the Presbyterian Hospital in New York. The beam is used to cauterize small areas and even kill individual cells of the retina without the dangerous and penetrating effects of X-rays and gamma rays (Fig. 12).

Martin Co.

"Suitcase" laser for short-range work.

Other applications of the coherent light beams of optical masers are proceeding in many laboratories. Under the cover of military secrecy, some of these experiments are concerned with developing a "death ray"—to divert enemy satellites in flight, or even to knock down intercontinental ballistic missiles.

Such applications—and the optical maser, itself—are in their infancy. And much can be expected in the future from the coherent light beams produced by lasers. END



Decals give the completed unit a professional look.

Transistor-safe POWER SUPPLY

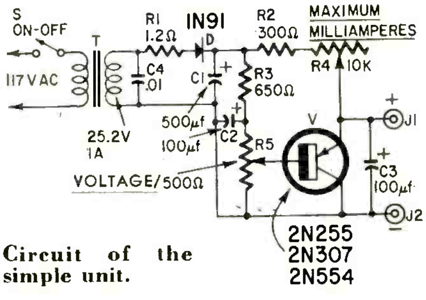
Limited-current supply makes it almost impossible to burn out a transistor circuit, even if it is shorted

By STANLEY E. BAMMEL

Here is a power supply with a continuously variable current limit. The output voltage is regulated up to the point of the current limit. If the limit is exceeded, output voltage drops very sharply. For example, the output drops from 10 volts to zero at a current overload of 30%, thus protecting the load (usually transistors) and the power supply. Note that the power supply cannot be damaged by any load. Also note that this supply is excellent for transistor circuits and comes in handy on the service technician's bench when working on transistor radios.

The current limit range is 3 to 100 ma. Very few transistors will be damaged by 3 ma, and 100 ma is adequate for almost any circuit.

The output voltage is continuously variable from 0.2 to 15 and is regulated within ½ volt or better, depending on voltage and current settings. The continuously variable voltage control is a great convenience over changing batteries to get a desired voltage. The regulation makes it unnecessary to use a meter. Just set it and forget it.



Circuit of the simple unit.

R1—1.2 ohms, ½ watt
R2—300 ohms, 5 watts, wirewound
R3—650 ohms, 1 watt (820 and 3,900 ohms in parallel)
R4—pot, 10,000 ohms, 2 watts, wirewound
R5—pot, 500 ohms, 2 watts, wirewound
All resistors 10%
C1—500 μf, 50 volts, electrolytics
C2, C3—100 μf, 15 volts, electrolytics
C4—.01 μf, ceramic disc
D—1N91
J1, J2—pin jacks
S—spst slide switch
T—filament transformer: primary, 117 volts; secondary, 25.2 volts, 1 ampere (Stancor P-6469 or equivalent)
V—2N255, 2N307, 2N554
Case, 3 x 4 x 6 inches
Miscellaneous hardware

The circuit

Transistor V shunt-regulates the output voltage. It is connected in a common-collector configuration that has a voltage gain of slightly less than one. For most practical purposes, the input voltage can be considered to be the output voltage. The current gain of the common-collector configuration is the beta of the transistor (common-emitter current gain) plus one.

The current drawn by V is the maximum output current. As the load is increased, less current flows through V and more flows through the load. The output current reaches a limit when all the current is transferred from V to the load.

By controlling the current through V, the maximum output current can be controlled. R4 is the current limit control. R2 limits the range of R4.

Since the output voltage equals the input, supplying the input (base) with a constant reference voltage will give an essentially constant voltage at the output (emitter). R3 and R5 form a voltage divider which provides the reference.

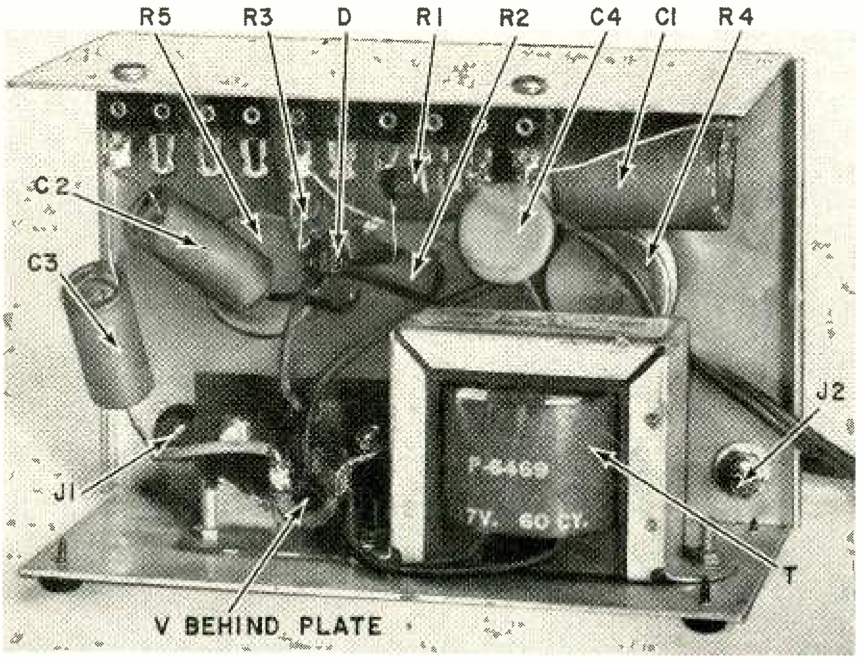
Also by supplying the base with a low-ripple source, we get a low-ripple output. C2 filters the base voltage and the ripple is 0.2% at 10 ma and 0.5% at 100 ma.

Since there is current gain, the reference-voltage source can be a relatively high impedance, for $Z = E/I$. Therefore, if I is relatively small, Z is relatively high since E is the same for both input and output. Also, since the input circuit is a relatively high impedance, a relatively small filter capacitor can be used to get a given amount of filtering.

Since the output voltage is dependent on an input reference voltage, the latter must be essentially constant for the output to be constant. Since the total current drawn by the whole circuit varies with the current control setting, the tendency of the main supply voltage is to drop when the current increases. The reference then drops in proportion. This tendency is bucked by using a very large value for C1.

Construction and calibration

I built my unit into a 3 x 4 x 6-inch box chassis. A somewhat smaller chassis can probably be used without difficulty. First drill the holes for and mount R4 and R5. Do the same for J1, J2 and S. Then mount T and the terminal strip. The transistor does not have to be mounted on a heat sink since dissipation at most is only 1.5 watts. Since the collector is grounded, it is simplest to mount it in the conventional manner. I mounted mine on an L-shaped bracket.



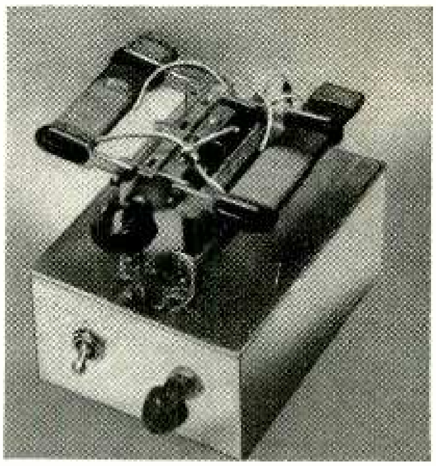
No crowding under the chassis makes for a neat and simple parts arrangement.

The unit can be calibrated easily with a vom. To calibrate the voltage, set the current control about midway and connect the voltmeter to the output terminals. Then mark the readings on the front panel as the voltage control is varied. To calibrate the current control, set the VOLTAGE control to 10 volts and insert a milliameter in series with R4. Then vary R4 and mark the current readings on the front panel. Inexpensive decals, which can be bought at many electronic supply houses, make about the neatest job.

To use the power supply, simply set the voltage and current controls to the desired figures. Then connect the power supply to the desired circuit and turn it on. Be sure to get the polarity right. It is as simple as that to operate. No meters to bother with, no batteries to buy or fumble with and fewer, many fewer, burned-out transistors. END

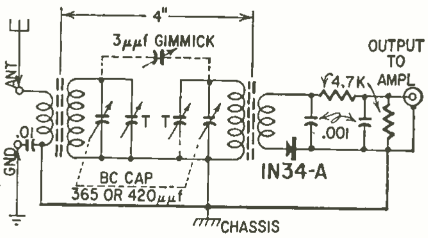
Bandpass Crystal Tuner

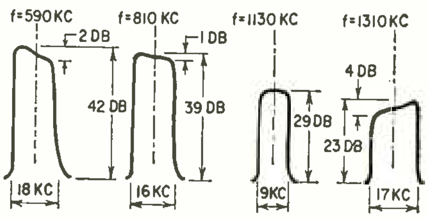
This crystal tuner was designed for local reception but has received stations up to 1,200 miles away. Its excellent performance made it useful as a signal source for demonstrating amplifiers at an audio exhibit. The curves show the



selectivity at various frequencies with the circuits peaked at 810 kc to favor a weak local station. With a 30–50-foot antenna and waterpipe ground, audio output was high enough to drive the average amplifier into distortion. Response is flat to 8 kc and then falls off rapidly, thus minimizing whistles and heterodynes.

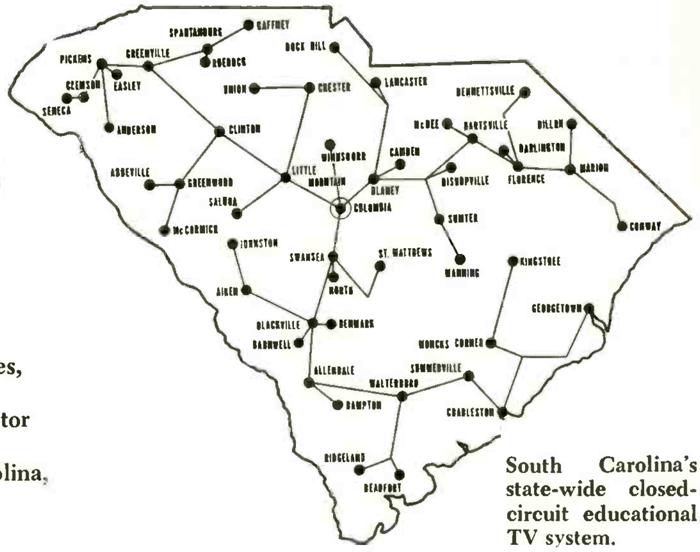
The transformers are flat ferrite-loop antennas with a Q of around 190 at 1 mc. They are mounted 4 inches





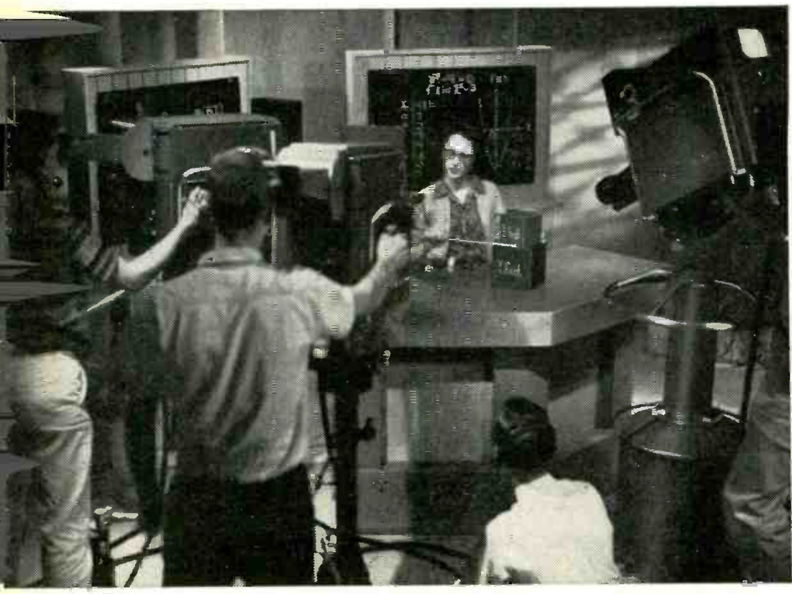
apart and at least 2 inches from the chassis to keep Q and selectivity high. The photo shows the coils and tuning capacitor mounted on an aluminum shield box. A three-stage transistor amplifier and battery were mounted in the box on this model.—*Leonard Geisler*

Educational TV in Action



South Carolina's state-wide closed-circuit educational TV system.

South Carolina has a state-wide closed-circuit educational TV system that now reaches 140 public schools, 3 denominational schools, 3 state colleges, 3 private colleges and 5 hospitals. According to Dr. Alvin C. Eurich, director of the Ford Foundation Fund for the Advancement of Education, "South Carolina, in our opinion, has the basis and blueprint for what educational TV needs to bring about a healthy revolution in American education systems."

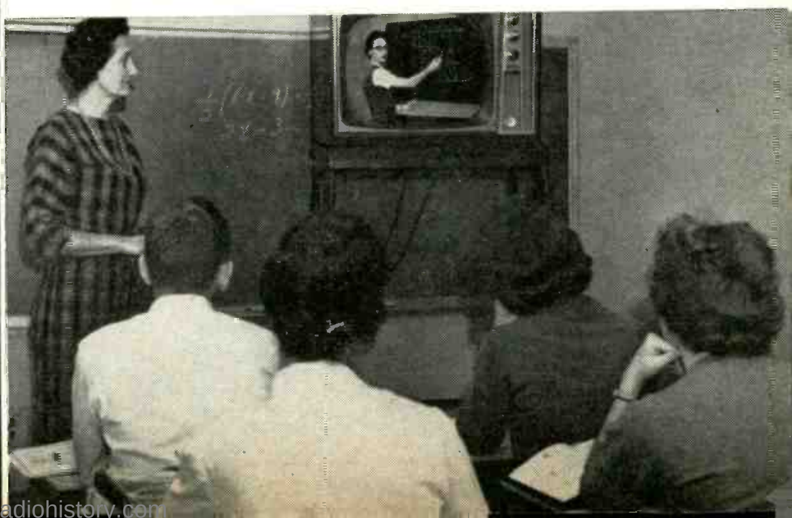


TV cameras come up close during taping of an algebra lesson. Most desirable views are selected and fed to the video tape recorder.

Skilled operator in the control room watches over monitors during a French class. He selects camera views and blends them, one after another, to put together a complete, continuous program.

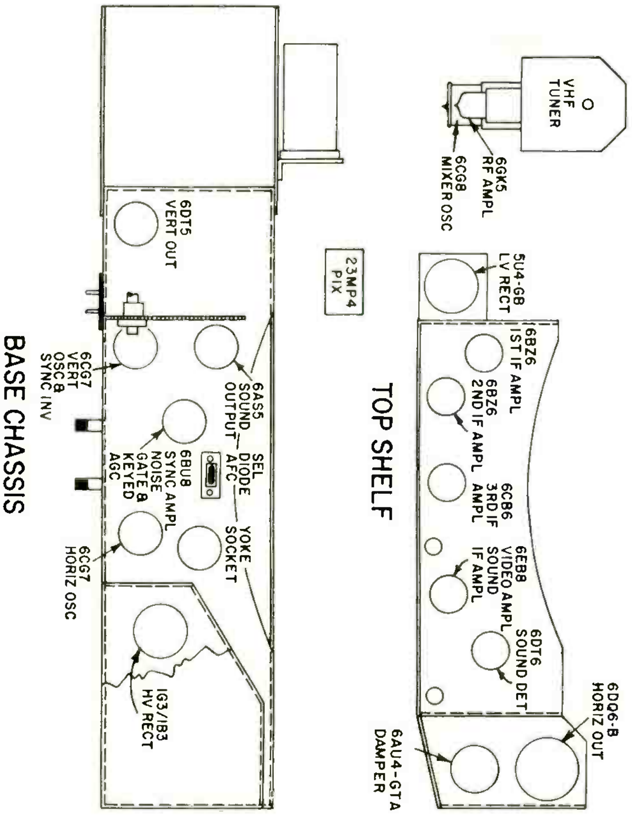
At class time, tape is played back and fed into closed-circuit system. Technicians monitor the program at all times.

Each class views the lecture. Additional instructors give further explanations and examples, as needed, to clarify questions raised by the students.



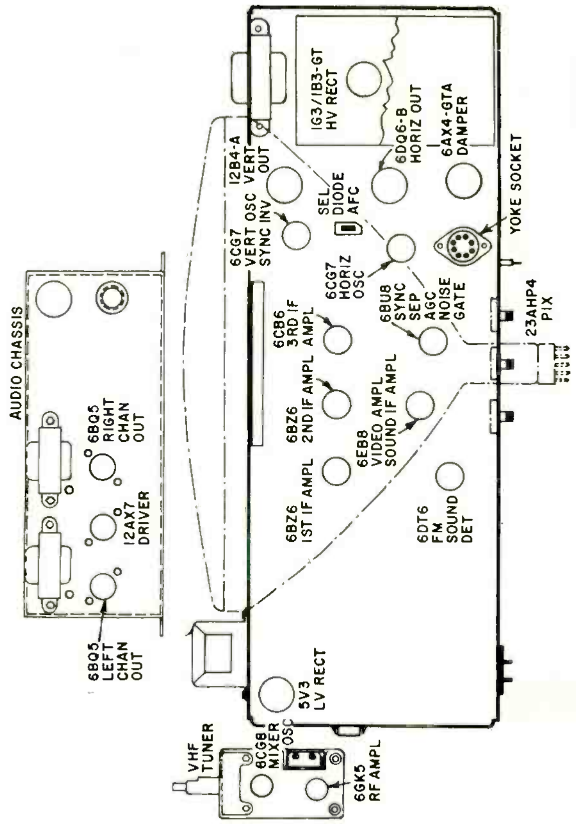
CUT HERE

5



MODEL 2DC3370

4

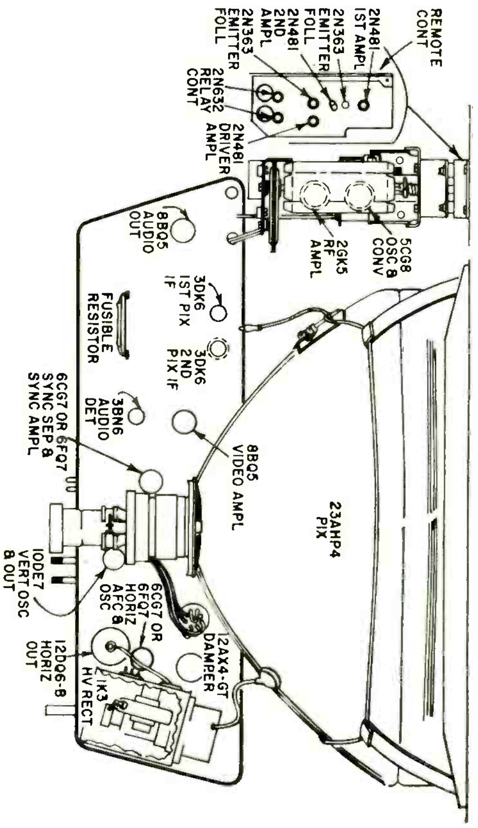


MODEL 2DC1350

CUT HERE

TRIM HERE AFTER FOLDING

MODEL 2DC1278A



8

Radio-Electronics

TUBE LAYOUTS

IN TV SETS

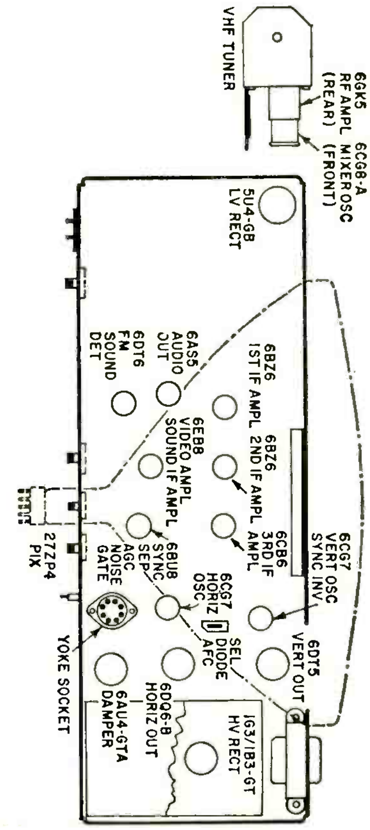
Compiled by Larry Steckler, Associate Editor

TRUETONE Western Auto Supply Co., 2107 Grand Ave., Kansas City 8, Mo.

HOW TO FOLD

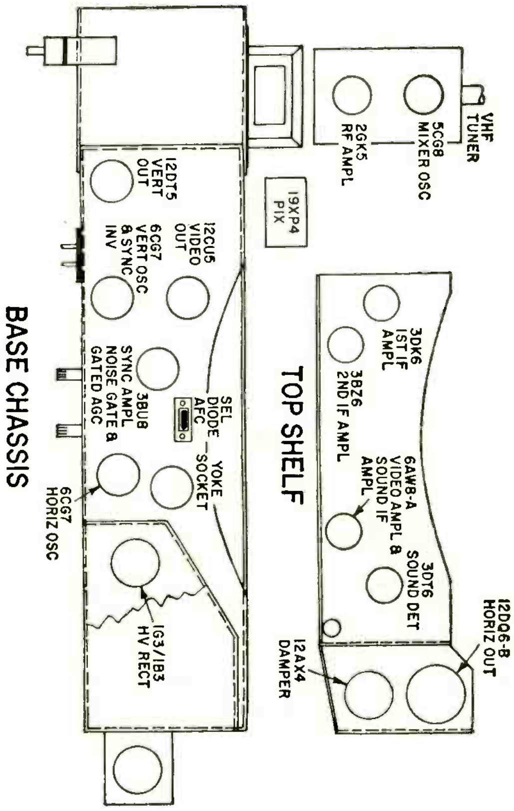
Fold the top down and back, keeping the cover facing you. Then trim the right and left edges. Now staple the booklet along the vertical center fold, about ¾ inch from the top and bottom. Now fold from left to right, keeping the cover facing you. Trim a fraction of an inch off the top and trim the bottom to size and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

3



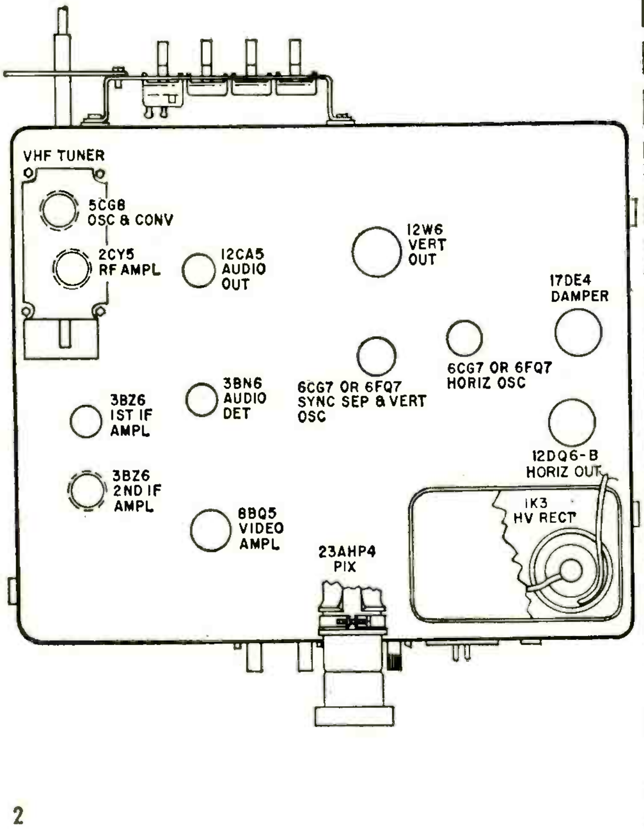
MODEL 2DC1340

9



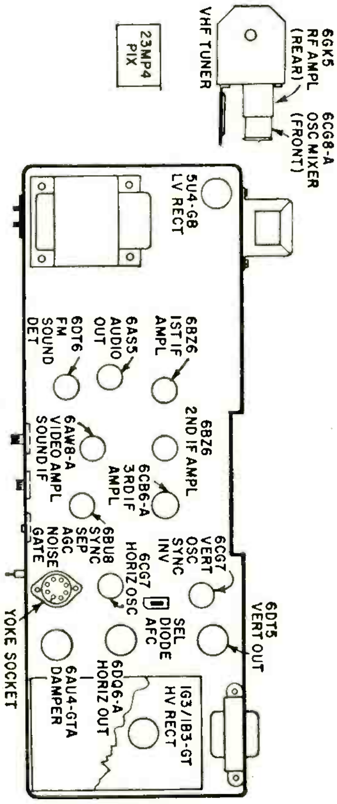
MODEL 2DC3330A

MODELS 2DC1200A, 2DC1202A

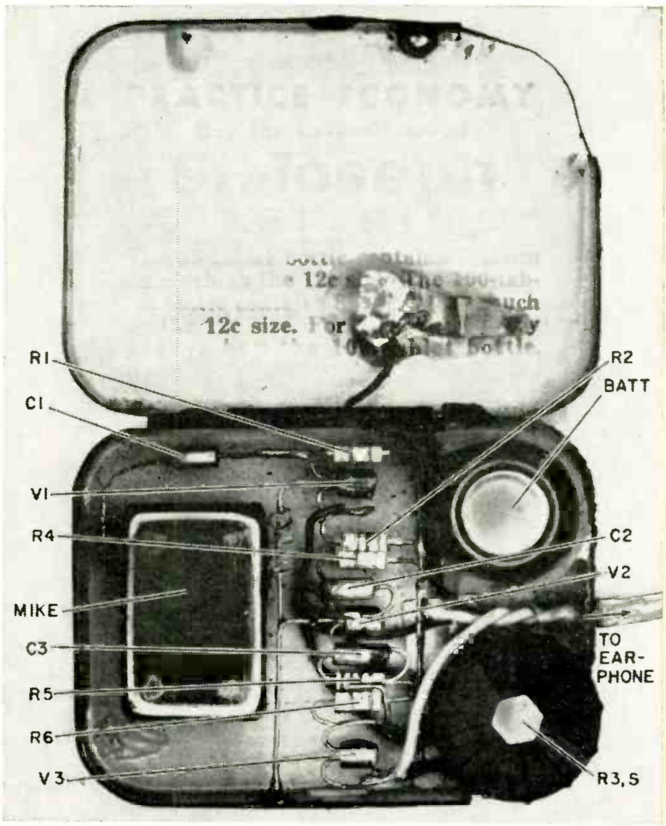


2

MODELS 2DC1210, 2DC1215



7



By PHILIP de la ROZA

Hearing Aid in an Aspirin Box!

It would be hard to make this 3-transistor unit any smaller

A look inside the case shows the parts layout that must be followed. The photo is approximately one and a half times actual size.

This tiny hearing aid is designed for the hard-of-hearing person who desires a small unit. It also is a good construction project for the electronics enthusiast interested in miniaturization. It will outperform most of the inexpensive hearing aids on the market. You can use larger components and build the unit into a cigarette case, if small size is not required.

Three very small high-beta transistors are used with a dynamic microphone. The volume control is a compact unit with a built-in switch. Life of the single mercury cell is long, as the entire circuit draws only 1 ma.

The amplifier is assembled outside the case and then slipped into place. Building such a compact unit requires a small soldering iron and a great deal of patience.

I used a 20-watt pencil iron and a small pair of side cutters with its sides ground away to allow it to fit into crowded spaces. In soldering, you will not have to be overly concerned about damage from heat because only a small amount of solder is used. When soldering the tantalum capacitors, however, grip the leads close to the body with pliers to prevent excess heat from popping them. Don't cut their leads shorter than 5/16 inch.

Put the circuit together

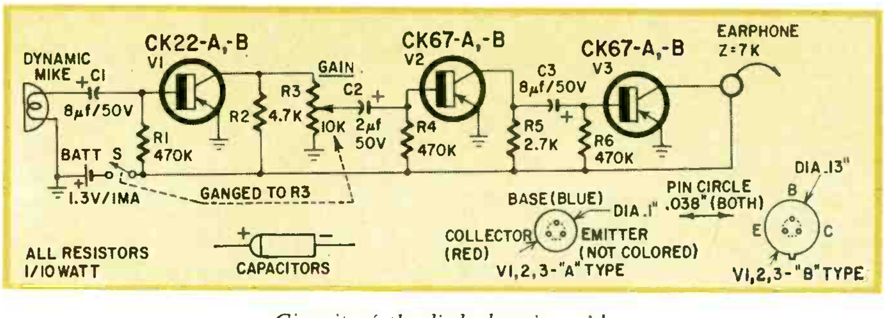
Start by cutting and bending the leads of C1 and R1. Next cut and position the base lead of transistor V1 and solder the three wires together as shown in the photo. It would be best to practice making these small solder joints with some thin wire to get the knack of it. With a little experience, you will be able to make tiny, neat connections by first positioning the leads close together and applying the iron and a little solder. Hold the iron in place only a second to allow the solder to form a neat bead. Excess solder can be snipped off with the dikes.

The rest of the components are wired as shown in the photo. Be sure to wire them close enough together to fit the space available.

Now the microphone, battery terminals and volume control are ready to be mounted in the aspirin box. But, first, cut away one corner of the box to allow the knob of the volume control to project slightly. Also cut a hole in the bottom of the box to correspond with the hole in the front of the microphone.

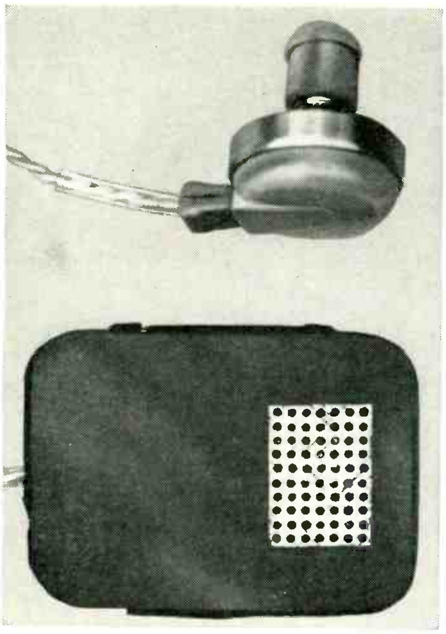
Shock-mount the mike on a thin piece of sponge rubber or strips cut from a wide rubber band. Cement several strips to the front of the microphone with any good rubber cement, and solder a ½-inch length of fine wire to each mike terminal. Then curl the wires to form the flexible leads needed to allow the microphone to move freely. Now cement the mike to the case.

A bead of solder inside the box



Circuit of the little hearing aid.

R1, R4, R6—470,000 ohms
R2—4,700 ohms
R3—pot, 10,000 ohms with spst switch (Centralab SM2-103-S or equivalent)
All fixed resistors 1/10-watt 10%
C1, C3—8 µf, 50 volts, miniature tantalum capacitor (Mallory TNT 805U050POB or equivalent)
C2—2 µf, 50 volts, miniature tantalum capacitor (Mallory TNT 205U050POA or equivalent)
The author used smaller capacitors which are no longer available. While those listed are somewhat larger, there is enough room in the case for them.
BATT—1.5 volts, mercury (Mallory RM675 or equivalent)
MIKE—Shure MC30J or equivalent
V1—CK22 -A, -B
V2, V3—CK67-A, -B
Aspirin box—12-tablet size
Miniature earphone, 7,000 ohms (Lafayette MS-260 or equivalent)
Miscellaneous hardware



Front view of the tiny hearing aid.

forms the positive battery terminal. Scrape the paint down to bright metal to insure good soldering. You may have to file down or build up the solder contact later for a perfect fit. The negative terminal is formed from a strip of thin sheet brass. Solder a 3-inch length of phono pickup-arm wire to one end of the strip and cement it in place on the lid. Epoxy cement works best for this. Place a small piece of paper between the terminal and the case for insulation. The other end of the wire will be connected to the switch later.

To mount the volume control, you will have to cut the switch terminal studs off flush with the bottom of the control. Now solder the switch and volume control leads and cement the control in place, again using a piece of paper to insulate the switch leads from the case.

After all major parts are mounted, you are ready to hook up the amplifier. When soldering the lead from the volume control to capacitor C2, remember to use pliers as a heat sink to protect the capacitor. Make sure the mike leads do not short to the microphone case.

When all wiring is complete, insert the battery with the positive side (outside of case) facing downward (see photo) and close the lid. If there is any tendency to motorboating at high volume settings, reduce amplifier gain by shunting resistor R2 with another resistor of lower value. You may require as little as 220 ohms.

To improve appearance, I cemented a small piece of speaker grille cloth to the front of the case, over the hole. A jewelry clip could also be soldered to the case. A coat of black crackle enamel paint completes the project. END

SW PROPAGATION FORECAST

Dec. 15—Jan. 15 **By STANLEY LIENWOLL***

The sharp drop in MUF's (Maximum Usable Frequencies) this winter has severely hampered the efforts of international broadcasters. Since the 6-mc band is the lowest allocated to international broadcasting, many broadcasters have found that, with MUF's running 4 and 5 mc over some circuits, their effectiveness has been severely limited, particularly over trans-Atlantic paths.

On the other hand, listeners and radio amateurs have found the 2-, 3- and 4-mc bands more active than at any time since the last period of sunspot minimum, in 1954. In addition, medium-wave dx enthusiasts have found that the upper part of the broadcast band has frequently opened over trans-Atlantic circuits.

Low nighttime MUF's are expected to continue the remainder of the winter, and be even lower next winter.

These tables are designed to serve primarily as a guide, since day-to-day variations in receiving conditions can be significant. At certain hours, propagation over some of the paths given may be extremely difficult or impossible. This will depend on the type of service, antenna characteristics, transmitter power, etc. The curves from which the data in the tables are derived are based on an effective radiated power of 10 kw. They are representative for the paths given. For example, the figures for the Eastern USA to Western Europe path are based on a circuit analysis curve drawn for the Washington, D.C. to Bern, Switzerland, circuit. On circuits farther north, e.g. New York to Brussels, Belgium, frequencies will be somewhat lower, while on more southerly circuits, frequencies 1 or 2 mc higher will be required.

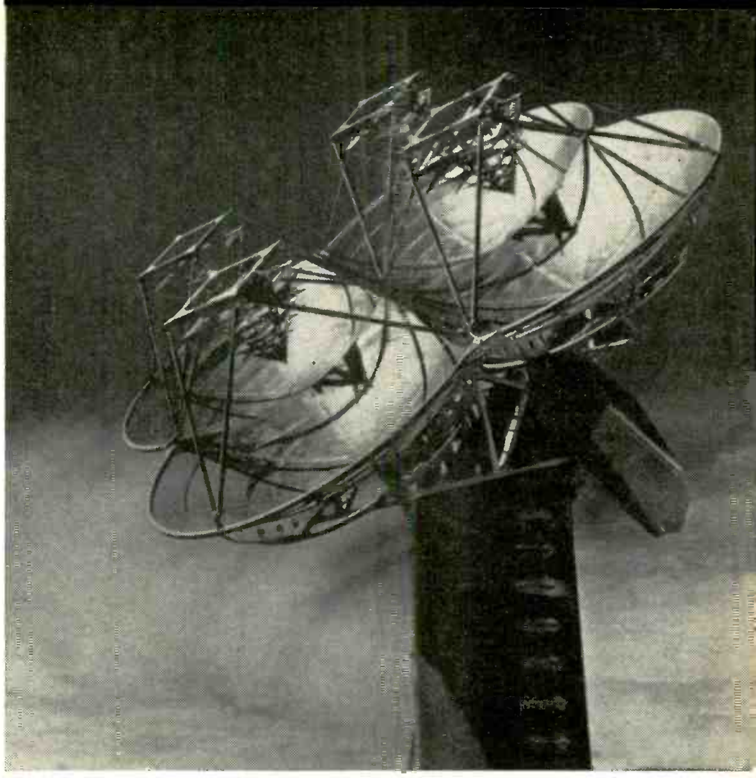
The tables show the optimum frequency in mc for propagation of short-wave signals between locations shown during time periods indicated.

Select the table most suitable for your location, read down the left side to the region in which you are interested, follow the line to the right until you are under the appropriate time. (Time is given in 2-hour intervals from midnight to 10 pm, in your local standard time.) This figure is the optimum working frequency, in mc. The best band is the one nearest the optimum working frequency.

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
EASTERN US to:												
West Europe	6	5	5	5	17	19	17	12	7	7	7	6
East Europe	5	4	7	5	17	16	10	6	5	5	5	5
Central America	11	10	9	14	22	22	23	25	25	20	12	11
South America	9	8	10	19	20	20	21	20	16	11	10	10
Near East	6	6	6	6	17	17	10	8	8	8	7	6
North Africa	6	6	6	8	20	20	16	10	8	8	7	6
South & Central Africa	9	9	8	13	20	21	20	19	15	9	8	8
Far East	7	7	8	7	7	8	8	8	7	10	9	7
Australia & New Zealand	8	9	10	8	10	11	14	18	19	18	12	9
CENTRAL US to:												
West Europe	5	6	6	6	16	16	9	6	5	6	6	5
East Europe	5	7	7	6	10	9	6	6	7	7	7	6
Central America	9	8	7	14	20	23	22	21	19	12	10	9
South America	9	8	14	20	20	22	22	22	18	12	9	9
Near East	7	8	8	6	10	9	7	8	8	8	7	6
North Africa	6	5	5	7	17	16	10	8	8	8	7	6
South & Central Africa	6	6	6	10	19	22	22	19	14	8	6	6
Far East	7	7	7	8	7	8	8	8	15	15	7	6
Australia & New Zealand	9	10	10	8	10	15	20	22	22	17	12	9
WESTERN US to:												
West Europe	5	7	7	6	16	12	6	5	5	5	5	5
East Europe	7	7	7	7	8	5	5	7	7	7	7	5
Central America	8	8	7	15	20	21	22	22	23	18	11	10
South America	9	10	8	15	19	21	22	22	17	11	9	9
North Africa	7	7	7	5	15	12	8	7	8	8	7	6
South & Central Africa	8	8	8	10	20	20	19	16	14	9	7	7
Far East	7	8	8	8	7	8	8	14	18	13	8	6
South Asia	6	6	7	5	6	9	8	7	10	13	7	6
Australia & New Zealand	8	8	8	5	11	17	22	23	24	16	10	8

* Radio-frequency and propagation manager, Radio Free Europe.

What's New

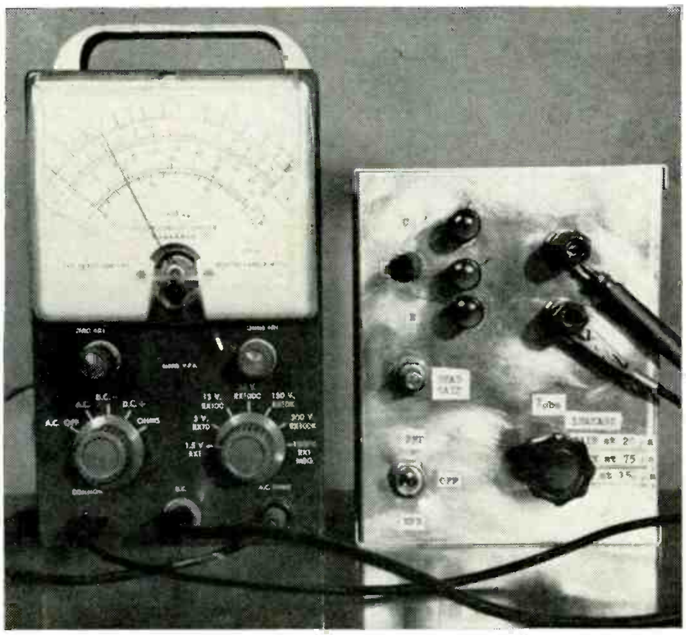


20-FOOT CLOVER LEAF is a new multi-purpose phase monopulse antenna system with a bandwidth of 200 to 2,300 megacycles. It consists of closely spaced reflectors, combined with individual log periodic feeds, which are interconnected to produce signal information for tracking purposes. The medium-gain system was developed by Radiation Inc., Orlando, Fla. Its wide bandwidth permits it to do the job of several antennas.

INVISIBLE LIGHT carries confidential conversations between stations up to 10 miles apart. The portable communicator uses a pencil-thin infrared beam to set up the long-distance private line. For military uses, the Raytheon infrared communicator can convey commands or relay scout findings. For police uses, continuous contact is possible while radio silence is maintained.

HELMET RADIO and tiny hand-held transmitter may be standard equipment for the soldier of the future. This vhf unit, designed for short-range communication, is an experimental model made by Delco Radio Div. of General Motors for the Army Electronics Command at Fort Monmouth, N. J.

UNDERWATER ARTILLERY shoots telephone conversations across the bed of the Pacific Ocean. The "guns" are being assembled at ITT's Standard Telephones & Cables Ltd. plant in London. The submarine telephone repeaters will amplify telephone signals as they become weaker while traveling along a trans-Pacific telephone cable between Australia and Canada.



TEST Transistors with your vtvm

A vtvm and this little adapter, that is

By DANIEL J. HOROWITZ

This tester measures I_{CBO}, leakage (I_{CEO}) and gain (dc beta) at 20, 75 and 150 μa base current. If desired, other values of base current can be selected by using different resistor values. The vtvm is connected to terminals on the adapter, and set to its 1.5-volt dc scale. If the reading goes off this scale, switch the vtvm to its 5-volt dc scale.

The circuit is set up so that the transistor characteristics read off the vtvm scale are always multiples of the numbers on the 50- or 15-volt scales. The readout is as follows:

I_{CBO} test:
- vtvm on 1.5-vdc scale—read 0 to 15 μa
- vtvm on 5-vdc scale—read 0 to 50 μa

Leakage test:
- vtvm on 1.5-vdc scale—read 0 to 500 μa
- vtvm on 5-vdc scale—read 0 to 1500 μa

Gain tests:
- vtvm on 1.5-vdc scale—read 0 to 50 gain
- vtvm on 5-vdc scale—read 0 to 150 gain

Aside from offering two scales for each reading, the vtvm also has the advantage that when measuring gain it may be zeroed to cancel leakage. This is why there is a READ GAIN pushbutton on the adapter. When switching to one of the gain positions, zero the vtvm to cancel leakage. Then the READ GAIN pushbutton is pressed to apply base current. After going from the gain test to one of the other tests, turn the adapter off and zero the vtvm again.

A transistor socket is provided for transistors with short leads, and three binding posts for any others. A 9-volt battery provides the test voltages. The PNP–OFF–NPN switch, a double-pole double-throw switch with a center off position, reverses the polarity of the battery voltage so that both types of transistors can be tested. The vtvm must be switched from DC– to DC+ when switching from PNP to NPN.

Three values of base current are provided for gain measurement, so that gain can be compared under three conditions. In testing transistors, check the values obtained against those in a transistor manual. Also note that transistors are sensitive to heat and that holding a transistor in your fingers increases its leakage reading.

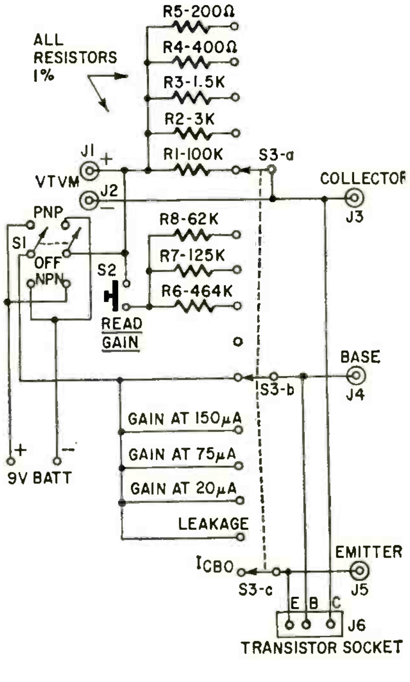
Transistor specifications normally list I_{CBO} and gain. Gain may be referred to as dc beta, h_{FE} or common-emitter dc transfer ratio. Leakage, though it may not be listed, indicates a defective transistor if excessive. It will be found that inexpensive experimenter's transistors generally have much higher leakage than standard types, and that their gain varies over an extremely wide range.

The transistor tester provides excellent accuracy if 1% tolerance resist-

Unit works exactly as described by author. Vtvm scales give clear, accurate, direct readings of leakage, gain and I_{CBO} (collector current). The large scales (6½ inches) on the tester's vtvm made it simple to read betas of 51, 52 and 53 without confusion.

Two minor disadvantages. First, binding posts are used in place of flexible leads with alligator clips. Use both if desired, but the flexible leads should take preference over binding posts. Second, you have to switch the meter, for p-n-p transistors, to its –dc volts range. This could be remedied by using an n-p-n—p-n-p selector switch with an additional set of dpdt contacts to reverse polarity in the tester rather than in the meter.

R1—100,000 ohms
R2—3,000 ohms
R3—1,500 ohms
R4—400 ohms
R5—200 ohms
R6—464,000 ohms
R7—125,000 ohms
R8—62,000 ohms
All resistors ½-watt.
Use 5% or 1% tolerence units depending upon the accuracy you need in the tester. Make up odd values by combining resistors in series or parallel.
BATT—Any 9-volt transistor radio battery
J1, J2—3-way binding posts
J3, J4, J5—binding posts
J6—transistor socket
S1—dpdt, center off, toggle switch
S2—spst momentary-contact pushbutton
S3—4-pole 5-position rotary, shorting (1 pole not used)
Chassis box, 6 x 5 x 4 inches
Miscellaneous hardware



Circuit of the adapter.

ors are used. However, 5% resistors are satisfactory if inexpensive precision resistors cannot be obtained.

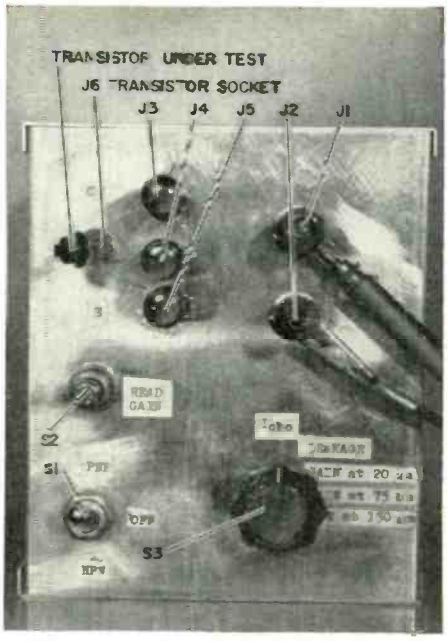
How it works

The vtvm measures voltages which are proportional to the currents through the transistor. These voltages are developed across resistors placed in the collector circuit. Since the voltages developed across these resistors are only a few volts in relation to the supply voltage of 9 volts, the change in collector voltage due to the drop across the resistor has negligible effect on the reading.

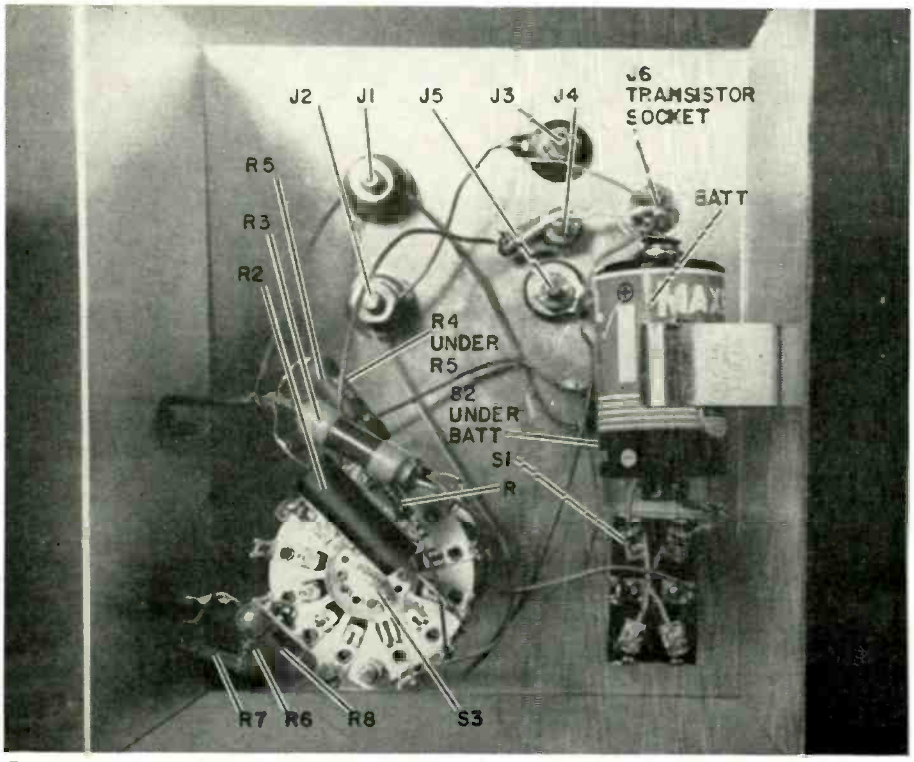
For measuring I_{bco}, the transistor's base is grounded, the emitter left open, and the collector connected to 9 volts through a 100,000-ohm current sampling resistor. This value is chosen so that a 15-μa current produces 1.5 volts.

To measure leakage, the transistor's base is left open, the emitter grounded and the collector connected to the battery through a current sampling resistor. The circuits for the gain tests are similar, except that, when the READ GAIN pushbutton is depressed, a fixed base current is applied. It is supplied to the base from the battery through a resistor whose value determines the current. The values of the base resistors are calculated assuming a battery voltage of 9.3, since a 9-volt battery is made up of six 1.55-volt sections connected in series.

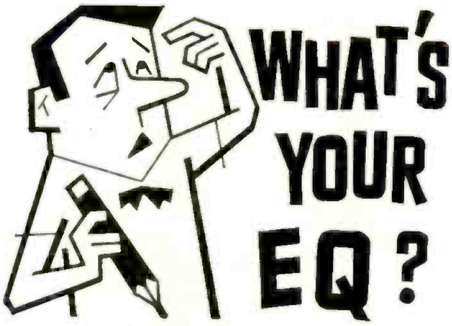
If desired, a minor modification allows testing for the beta cutoff frequency. To do this you will need a signal generator and scope as well as the adapter. Replace the five-position selector switch with a six-position switch and add a coaxial jack to the front panel. Wire the selector switch so that when it is set for the beta cutoff frequency test, the signal generator output is applied to the base of the transistor and a convenient collector load (5,000 ohms for example) is switched into the circuit. Connect the scope to the terminals marked VTVM. Use either an audio or rf signal generator as required. The frequency at which the scope display is reduced to half amplitude (over its low-frequency value) is the beta cutoff frequency. END



Closeup of the adapter's front panel.

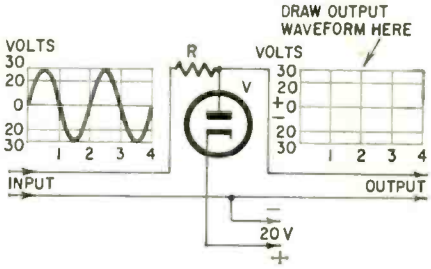


Components are few in number so space is no problem inside the adapter case.



DRAW THE WAVEFORM

The sine wave with a peak value of 30 volts, shown at the input of circuit, collided with a diode on its way to the output. As a result, the wave was



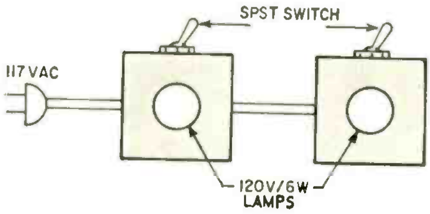
bent a bit. Draw in the space provided the shape of the wave at the output. Ignore the voltage drop across the diode.—*Cleveland Institute of Electronics.*

CAPACITOR CHARGE

Two 1-μf capacitors are connected in series with a 100-volt dc source. A shorting switch is connected across one of the capacitors. The capacitors are both good. The shorting switch is pressed, then released. What is the condition of the charge on the two capacitors *immediately* after the shorting switch is released?—*V. H. Laughter*

ANOTHER TWO-BOX LIGHT

Each of the boxes has an spst switch throw and a 120-volt 6-watt indicator lamp with jewel. The wires are shown in the diagram. The switch in each box operates the lamp in the opposite box. The boxes are a little larger than is necessary to enclose the single-pole single-throw switch and the 120-volt lamp and its socket. What is the circuit? What is in the boxes?—*Almon H. Clegg.*



Answers on page 57.

simple coax cable tester

By MELVIN S. LIEBERMAN

Make four checks with this single instrument

COAXIAL CABLES ARE IMPORTANT COMponents of many types of electronic production lines and electronic research projects. It is always best to check these cables thoroughly before putting them into use. Such testing should check for plug-to-plug shield continuity, plug-to-plug conductor continuity, absence of shield-to-conductor short, and high-voltage leakage resistance between shield and conductor. Normally, the first three checks are made with a simple low-voltage ohmmeter and the last check with a high-voltage megohmmeter (a megger).

A single instrument that makes both types of resistance measurements, performs all the switching functions automatically while doing so, has a minimum of parts for economy and is safe and simple to operate, is highly desirable. The unit described here does these things.

The two-ohmmeter circuits

Cable leakage resistance must be checked under high-voltage conditions. A 300-volt supply was rather easy to build, and a 100-μa meter was decided upon. A Weston model 301 meter was used. The basic high-resistance ohmmeter circuit is shown in Fig. 1.

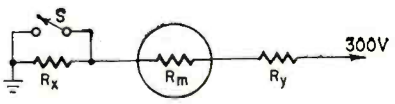


Fig. 1—Basic high-resistance ohmmeter circuit used in tester.

Since the meter resistance is 600 ohms, there is only .06 volt across it for full-scale deflection. Thus R_y will have 300 volts across it when the switch is closed. So when R_x is the unknown resistance, R_y is a known resistance, R_m is the meter resistance, I_1 is the current with the switch closed, I_2 is the current with the switch open:

$$R_y = \frac{E}{I} = \frac{300}{.0001} = 3 \text{ megohms}$$

The next thing to determine is the largest value of R_x which can be read on the 100-μa meter. Assume that the smallest division we can read on the 100-μa meter is the lowest point at which we can read our resistance. This smallest division is 2 μa. From the formula

$$R_x = (R_y + R_m)\,\frac{(I_1 - I_2)}{I_2},$$

we can omit R_m, since its 600 ohms is small compared to the 3 megohms of R_y.

$$R_x = 3 \times 10^6\left(\frac{.0001 - .000002}{.000002}\right)$$

$$R_x = 147 \text{ megohms}$$

We are interested in the useful range over which the high-resistance circuit will read. Assume a point on the scale corresponding to 97% of full scale, or 97 μa.

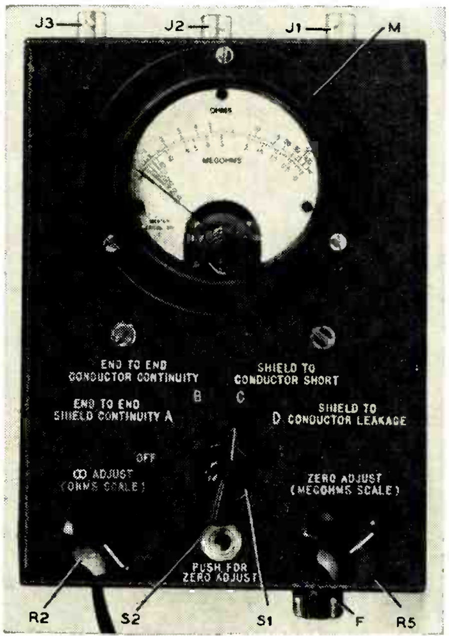
$$\text{Then } R_x = 3 \times 10^6 \left(\frac{.0001 - .000097}{.000097}\right)$$

$$R_x = 3 \times 10^6 \times .0309$$

$$R_x = 92{,}700 \text{ ohms}$$

Thus the approximate useful range of the high-resistance scale is from 100,000 ohms to 150 megohms.

To test for continuity, we must be able to read very low resistances. Low voltage and high current will do for low-resistance testing. I decided upon 10 ma for the full-scale deflection of the 100-μa meter, and a series resistance was used to drop the available 300 volts down to .06.



Front-panel view of the completed instrument.

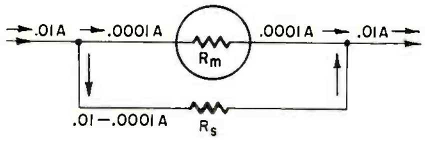


Fig. 2—How the meter shunt is determined.

The meter shunt is determined as shown in fig. 2:

$$E_{Mm} = E_{Rs} = 600 \times .0001 = .06 \text{ volt}$$

$$R_s = \frac{E_{Rs}}{I_{Rs}} = \frac{.06}{.01 - .0001} = 6.06 \text{ ohms}$$

where E_{Mm} = voltage across meter movement, E_{Rs} = voltage across shunt resistor, and R_s = shunt resistance.

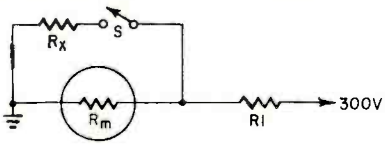


Fig. 3—Basic low-resistance ohmmeter circuit.

The basic low-resistance ohmmeter circuit is shown in Fig. 3. R1 is a current-limiting resistor. R_m is the shunted meter resistance (includes R_s above). R_x is the unknown resistance. I_1 is the current reading with the switch open and I_2 is the current reading with it closed.

The 10-ma current-limiting resistor

$$R1 = \frac{E}{I_m} = \frac{300}{.01} = 30{,}000 \text{ ohms.}$$

The next thing to do is determine the lowest value of R_x that can positively be read on the 10-ma meter scale. Assume that the smallest division we can read on the basic 100-μa (now 10-ma full-scale) meter is the lowest point at which we can read our resistance. This smallest division is 0.2 ma. The formula is:

$$R_x = R_m \left(\frac{I_2}{I_1 - I_2}\right).$$

Since .06 is small in R_m = 6.06 ohms, it may be omitted.

$$R_x = 6\left(\frac{.0002}{.01 - .0002}\right)$$

$$R_x = 0.12 \text{ ohm}$$

Of interest to us is the maximum range over which the low-resistance circuit will approximately read. Assume a point on the scale corresponding to 95% of full scale, or 9.5 ma.

Then:

$$R_x = 6\left(\frac{.0095}{.01 - .0095}\right)$$

$$R_x = 114 \text{ ohms}$$

Thus the approximate useful range of the low-resistance scale is from 0.1 to 100 ohms.

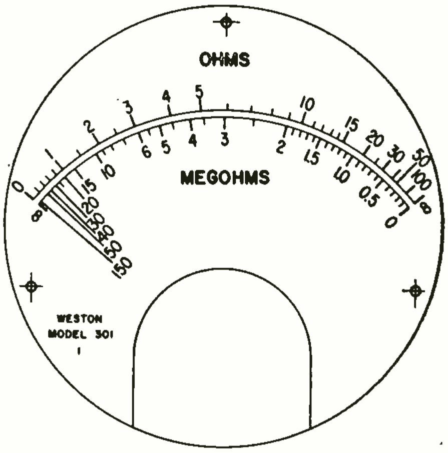
In the final design of this tester (Fig. 4) transformer T provides 250 volts rms, which is rectified for the ohmmeter circuits. Fuse F is in the primary, along with the on–off switch S1-h. In secondary is a IN561 rectifier, which is selected for its high peak inverse voltage rating. R6 is the surge-limiting resistor. The 6.3-volt filament winding on the transformer is not used. The 12-μf capacitor provides more than enough filtering.

The low-resistance ohmmeter circuit requires 10 ma, and is connected so its current string (R1, R2, R3) acts as a constant bleeder across the 300-volt supply. This of course improves power supply regulation.

R2 is the ∞ ADJUST for the low-ohms scale. It sets the meter and shunt current to 10 ma. The meter shunt is R3, and, whenever the low-resistance function is chosen, the meter is connected across it, making the basic 100-μa meter a 10-ma meter. The shunt was computed to be 6.06 ohms. It can be made in three ways: with small-gage copper wire, with resistance wire or by paralleling two low-ohmage resistors. I chose the third method and paralleled two standard 12-ohm ½-watt resistors. The two resistors were selected units, slightly low in resistance. After being paralleled, they were heated with a soldering iron until their resistance, as measured with a resistance bridge, rose to 6.06 ohms. If the resistors are not checked with a bridge, use 5% resistors. The low-resistance scale should be accurate enough. Any unknown small resistance is measured by its additional shunt effect across the meter.

The high-resistance ohmmeter circuit has R4 and R5 for its current-limiting string. R5 is the ZERO ADJUST (full scale) for the megohm scale, and it limits the meter current to 100 μa. Any unknown high resistance is measured by its effect in series with the meter.

Both short and long cables can be checked. Short cables are checked by connecting the ends to J1 and J2, labeled DOUBLE-END TEST. Long cables are checked by connecting either end to J3, labeled SINGLE-END TEST, or connecting both ends to J1 and J2.



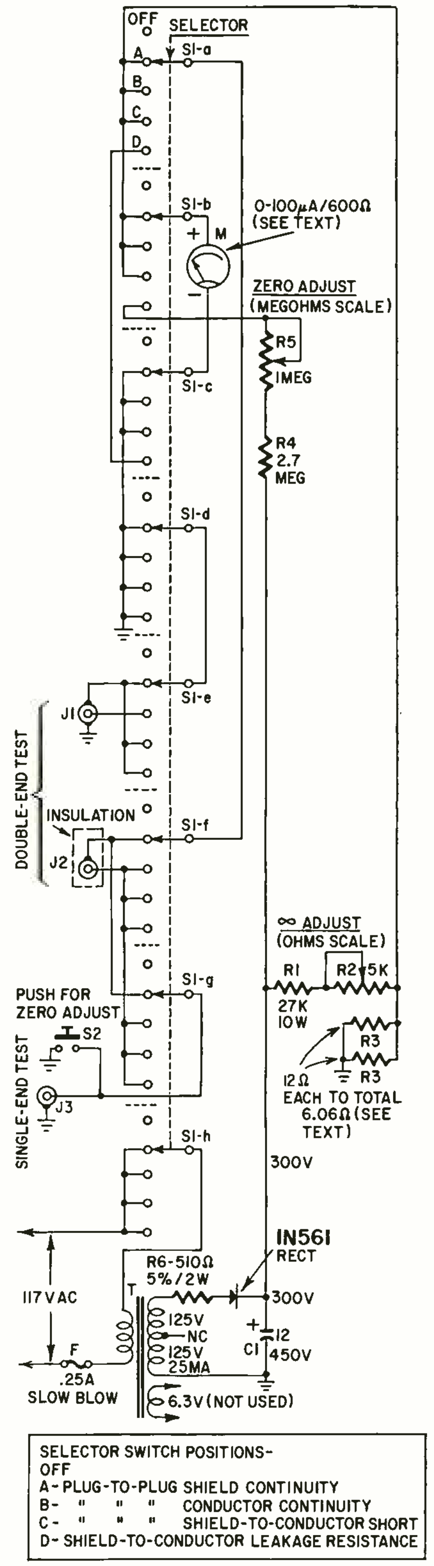
Details of the meter face.

S1-b and S1-c connect the basic 100-μa meter as a low-resistance ohmmeter in positions A, B and C. In position D, the microammeter is connected as a high-resistance ohmmeter. S1-e and S1-f connect the cable via J1 and J2 (under the double-end test) to the ohmmeter so that position A checks plug-to-plug shield continuity, position B plug-to-plug conductor continuity, position C plug-to-plug shield-to-conductor short, and position D shield-to-conductor leakage resistance. S1-g connects the cable via J3 (under single-end test) to the ohmmeter in the same fashion. Tests in positions A, B and C are made at 60 mv, while position D tests are made at 300 volts dc. S1-a and S1-d interconnect the ohmmeter function switches S1-b and S1-c to the external-circuit selection switches S1-e, S1-f and S1-g. S1-h is the power on–off switch. S2 is a momentary-contact pushbutton type. It must be depressed to zero-set the high-resistance scale, which is in use in position D. When S2 is depressed while the selector switch is in position A, B or C, the low-resistance scale's zero can be checked. The low-resistance scale's zero is the meter's mechanical zero.

Note that J2 is insulated from ground. This prevents shorting the 60 mv across the meter while using the low-resistance scale on position A of the ohmmeter.

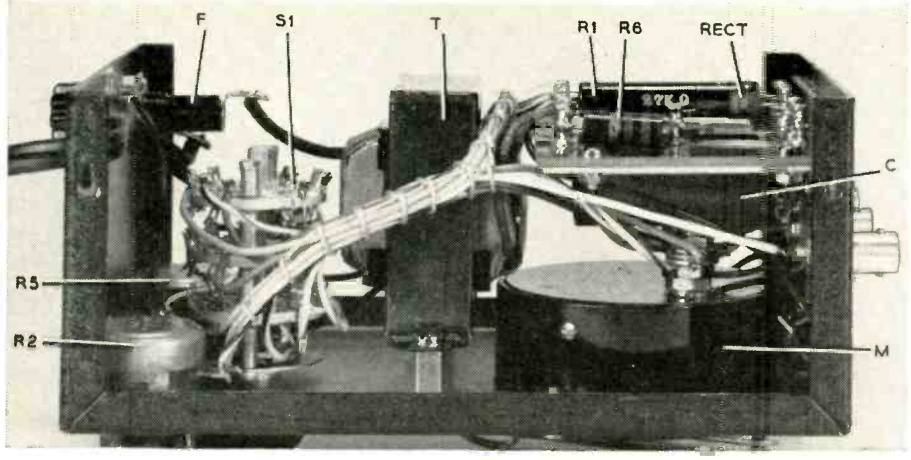
Construction

There is nothing critical about the layout of this circuit, and anyone can build to suit himself, or he can follow

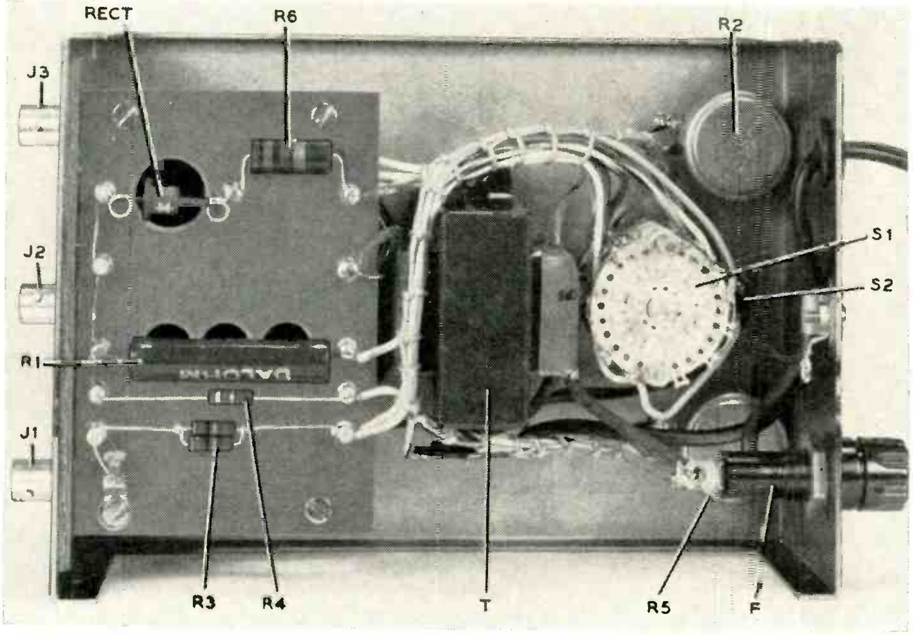


R1—27,000 ohms, 10 watts
R2—pot, 5,000 ohms, linear taper
R3—6.06 ohms (see text)
R4—2.7 megohms, ½ watt
R5—pot, 1 megohm, linear taper
R6—510 ohms, 2 watts, 5%
C—12 μf, 450 volts, electrolytic
F—0.25 amp, slow-blow
J1, J2, J3—BNC jacks, or coax connectors
M—0–100 μa, 600 ohm (Weston 301 or equivalent. See text)
RECT—1N561
S1—8-pole 5-position rotary nonshorting switch (three sections of Centralab PA-5 and a PA-3000 switch assembly)
S2—spst pushbutton
T—power transformer: primary, 117 volts; secondary; 250 volts, ct, 25 ma; 6.3 volts, 1 amp (Thordarson 22R39 or equivalent)
Case, 3 x 5 x 7 inches
Miscellaneous hardware

Fig. 4—Complete coax cable tester.



Side view inside case shows components under phenolic board.



Neat construction gives the tester a simple look.

the layout shown in the photographs. The meter scale may be cut out and cemented to the back of the 100-μa meter scale plate. Be careful to align the three marked screw holes with the clearance holes of the meter scale plate.

All parts are standard, including the chassis and meter. Since nothing has to be specially made, no one should have any difficulty in constructing this unit. Wire potentiometers R2 and R5 so that clockwise rotation decreases resistance. For convenience prewire the switch assembly.

Use the checker

Before putting the meter to work, set the mechanical zero. This can be done in two ways: either adjust the mechanical zero before the unit is turned on or, if it is turned on, set the selector switch to position A, B or C, press S2 and make the mechanical-zero adjustment. With the unit turned on, the meter should read full scale for selector position A, B or C. If it doesn't, set the ∞ ADJUST control (ohms scale) for full-scale deflection. The low-resistance ohmmeter scale is now calibrated. With the selector switch in position D, press S2 and set the ZERO ADJUST (megohms scale) for zero, which also is a full-scale deflection. This completes the calibration, and the unit is ready for use.

Although my unit is made with BNC connectors, adapters may be used, so that all types of cables may be tested. For short-cable testing, connect the cable ends to plugs J1 and J2. Now rotate the selector switch slowly through positions A, B, C and D. Positions A, B and C indicate shield continuity, conductor continuity and shield-to-conductor short, respectively. Good cables will read zero for positions A and B and infinity for position C. These will be readings on the ohms scale. Position D applies 300 volts to the cable, and leakage resistance is read on the megohms scale.

For long cables with only one end available, connect the available end to plug J3. Selector position C will detect shield-to-conductor shorts, while D will detect leakage resistance. If it is desirable to test long cables for continuity, all you have to do is short the far end while making the low-resistance test on position C. If both ends of the cable can be brought to the tester, then the double-end test is preferable. However, some low value of resistance will be read on positions A and B due to cable length. Remember, position D applies 300 volts to the conductor of the cable.

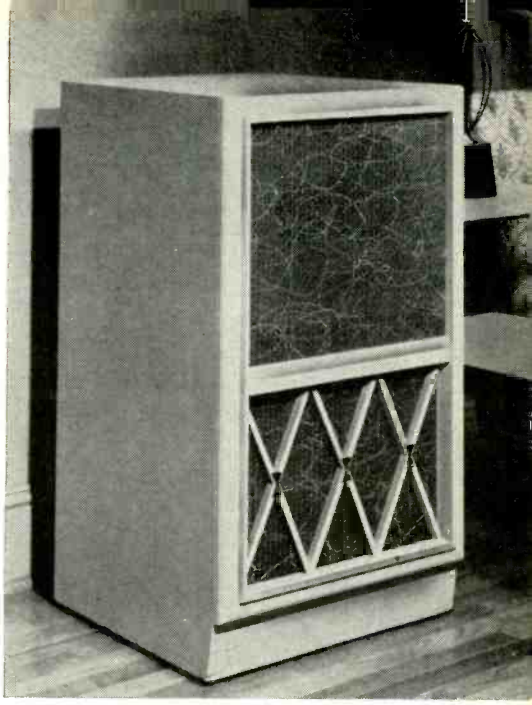
I use this unit every day. It has been a dependable and valuable tool. The assurance that cables being put to use are good is well worth the time taken to design and construct this unit.

[The 600-ohm, 100-μa model 301 Weston meter used in this tester has been replaced by a later model 301 with a much higher internal resistance. A meter with a resistance that is appreciably higher makes it necessary to calculate new resistor values and recalibrate the scale.

[The 301 meter used in this instrument can be obtained from A & M Instrument Co., 48-01 31st Ave., Long Island City 3, N. Y. When ordering, specify the meter by range and internal resistance. The old 301, 100-μa meter costs about twice as much as the current model.—*Editor*] END

By M. E. WEST

Hi-Fi Enclosure from your old TV



Some old-time cabinets make excellent speaker housings

TV IS NOW ABOUT 15 YEARS OLD. THE average useful life of a television set is probably 6 to 8 years before it is traded for a new one. Many stores never go to the trouble of rejuvenating these older models, and they are sold as junk usually at $3 to $10.

Some of these early small-screen sets had expensive, well built cabinets which lend themselves well to hi-fi speaker enclosures. An example of what can be done with one of these cabinets is shown in the photo and drawings. The cabinet was originally a General Electric model 817. It was a well constructed cabinet with ½-inch plywood throughout. Other features were the fairly good 12-inch speaker and the fact that the cabinet was on casters—easy to move.

The main point of interest in this example may be the construction of the tunnel and bass ports. The original TV chassis mounting floor was used as the bottom of the tunnel. This floor had two sets of slots used to ventilate the bottom of the TV chassis. The front set was covered by a piece of ¼-inch plywood, and the rear set left open so sound could enter the tunnel. The two bass ports were cut into the speaker baffle board as shown. The top of the tunnel is a ½-inch piece of plywood cut to size.

All the new pieces of plywood are glued and fastened with wood screws for solid construction. The 12-inch speaker enclosure (the lower portion of the cabinet) is lined with Fiberglas, except for the top. New grille cloth to match the cabinet finish is installed on the top and lower speaker baffles.

A conventional crossover network is used between the 12-inch and the mid-range speakers, with a capacitor between it and the tweeter. A three-way network would no doubt be even better.

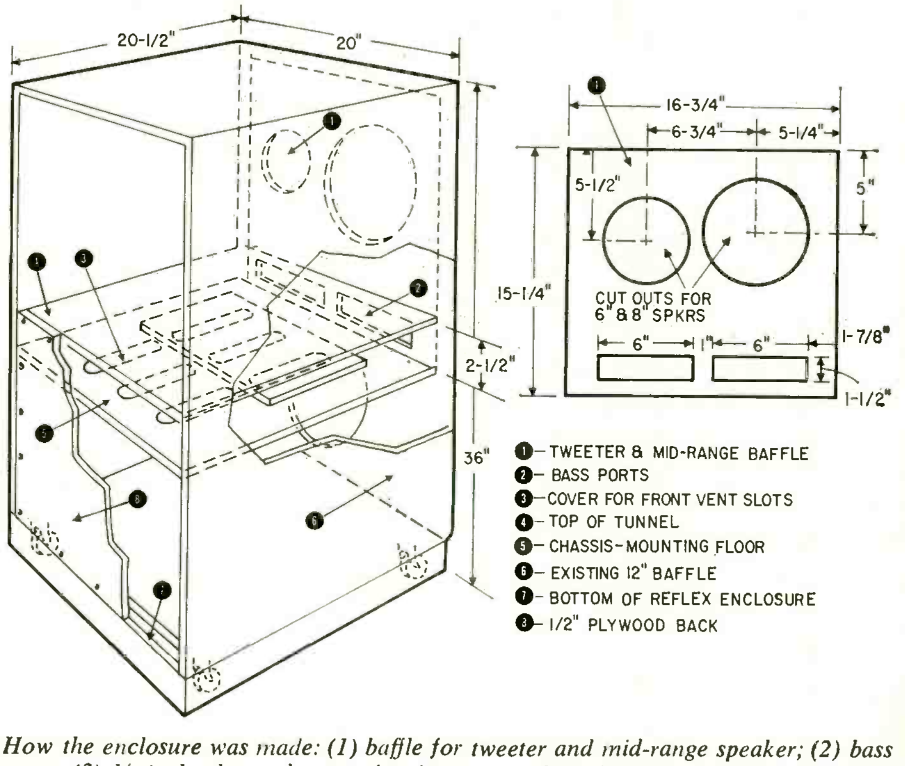
The situation will of course be different for each make and model of TV cabinet used, but some ideas that may prove helpful to the economy minded hi-fi enthusiast should be mentioned. When choosing a cabinet for a speaker enclosure, always choose the heaviest one, built with ½ inch plywood or better. Many cabinets are of ¼ inch plywood on a wood frame. These are not desirable.

No attempt was made to figure the mathematically correct size (for speaker diameter and bass response) of the example shown. The author is one of many who believe that listening is the best and final test in good audio reproduction, and this converted cabinet sounds very good, with plenty of bass.

The whole back of the cabinet can be covered with plywood to improve the low-frequency response. This was not done in the author's case, because a 25-watt amplifier was installed in the open portion of the cabinet.

The person just getting into stereo will find the converted TV cabinet an easy, economical way to obtain the second speaker enclosure needed for stereo.

In any case, some very good results can be obtained, for the small amount of money and time involved, if a little care is used in converting the old cabinet to a hi-fi speaker enclosure. END



How the enclosure was made: (1) baffle for tweeter and mid-range speaker; (2) bass ports; (3) ¼-inch plywood cover for front vent slots; (4) ½-inch plywood top of tunnel; (5) old floor for TV chassis; (6) existing baffle for woofer; (7) floor for bass enclosure; (8) ½-inch plywood back for 12-inch speaker enclosure.

At right, detail of new ½-inch panel for mid- and high-range speakers and bass ports.

mixed waveforms and your scope

How to spot trouble in a mixed waveform and know where it may be originating

By ROBERT G. MIDDLETON

MIXED WAVEFORMS ARE OFTEN FOUND IN electronic circuits. The composite video signal (Fig. 1) is a mixed waveform. It has three chief components: horizontal sync pulses, vertical sync pulses and the video signal. It also has minor components: equalizing pulses and the dc component.

Sync-pulse generators have an output waveform with square corners and a fast rise time. The leading and trailing edges are invisible on a scope screen (Fig. 2). The photo depicts two horizontal sync pulses, with five gating pulses inserted at black level (for insertion of a bar pattern). Compare this pulse with that shown in Fig. 3.

We see from Fig. 3 that the rise time of a sync pulse from a TV receiver is comparatively slow. The sides of the pulse shape with that shown in Fig. 3 results from passage through the transmitter network and the receiver circuits. The higher harmonics in the waveform are attenuated or lost. If the bandwidth of the receiver circuits (or of the scope) is excessively narrow, sync pulses are rounded off (Fig. 4).

The waveform in Fig. 4 is displayed on 7,875-cycle sawtooth deflection. If the deflection rate is reduced to 30 cycles, we see the waveform in Fig. 5. Here, narrow bandwidth has reduced the peak voltage of the horizontal sync pulses without greatly affecting the vertical sync pulse. Equalizing pulses have been practically eliminated by the narrow circuit bandwidth.

A 60-cycle hum is sometimes an undesired component in a mixed waveform. We see hum voltage in Fig. 5. Hum can result from heater–cathode leakage in a tube, faulty power-supply filtering or from stray-field pickup by high-impedance circuits (Fig. 6).

V1's grid circuit has high impedance at 60 cycles. Accordingly, the normal waveform at point X (Fig. 6) shows appreciable stray-field pickup (Fig. 7-a). If the .01-μf capacitor opens, the grid-circuit impedance becomes still higher and more stray-field voltage appears in the mixed waveform (Fig. 7-b).

Note that hum voltage appears as a sine-wave outline in a mixed waveform displayed on 30-cycle deflection (Fig. 8). On the other hand, hum voltage *thickens* a pattern displayed on 7,875-cycle deflection (Fig. 9). The experienced technician soon learns to

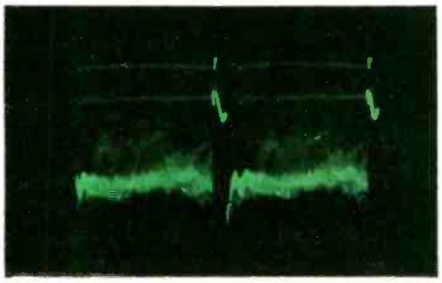


Fig. 1—The composite video signal is a mixed waveform.

Fig. 2—Horizontal sync pulses viewed at output of sync generator.

Fig. 3—Horizontal sync pulse at output of video amplifier in receiver.

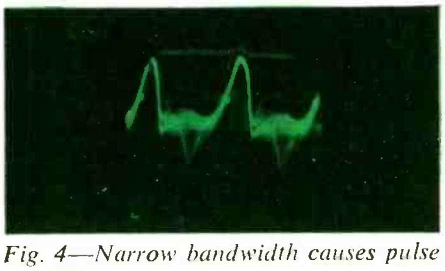


Fig. 4—Narrow bandwidth causes pulse rounding.

Fig. 5—Narrow bandwidth attenuates horizontal pulses before vertical.

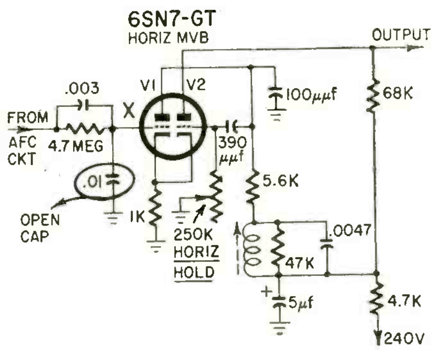


Fig. 6—V1's grid circuit has high impedance at 60 cycles.

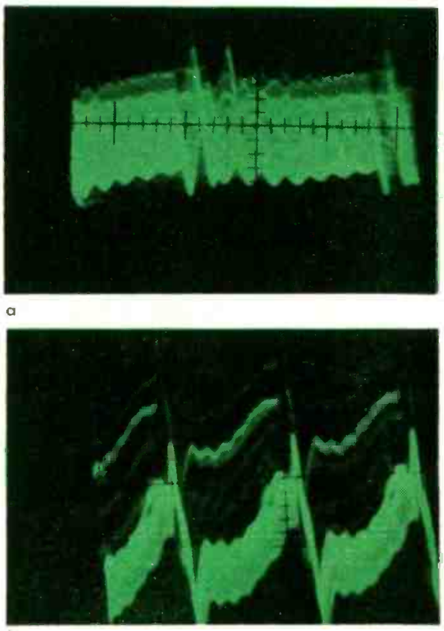


Fig. 7—The 60-cycle stray-field voltage at point X in Fig. 6 (a) increases (b) when the .01-μ capacitor is open.

Fig. 8—Outline of 60-cycle hum voltage is evident in this pattern.

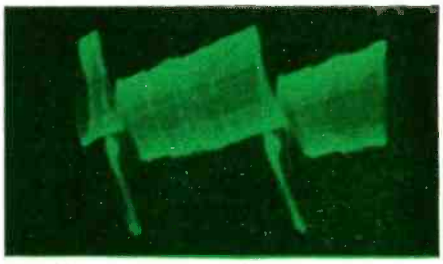


Fig. 9—At higher deflection rates, hum voltage thickens pattern.

recognize hum voltage in a pattern displayed at any chosen deflection frequency.

Mixed waveforms in some electronic circuits consist chiefly of various phases of a single frequency. For ex-

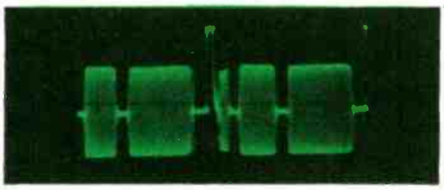


Fig. 10—Color signal is mixed waveform that consists chiefly of same signal frequency in different phases.

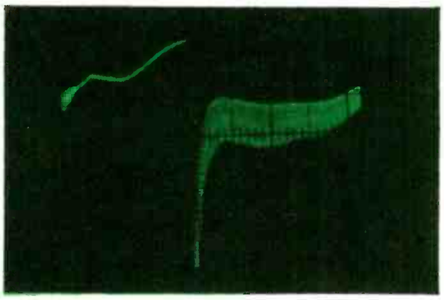


Fig. 11—Noise voltage thickens output waveform from thyratron pulse generator.

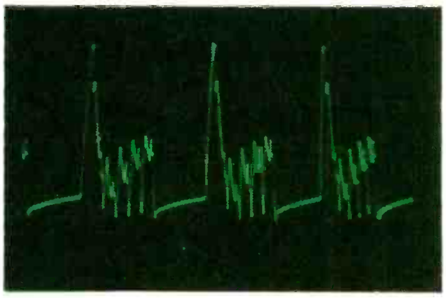


Fig. 12—Geometrical waveform with fundamental frequency of 15,750 cycles.

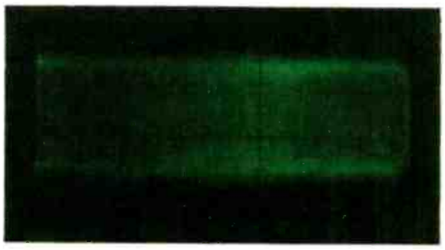


Fig. 13—Random noise voltages contain all frequencies within bandwidth of circuit under test.

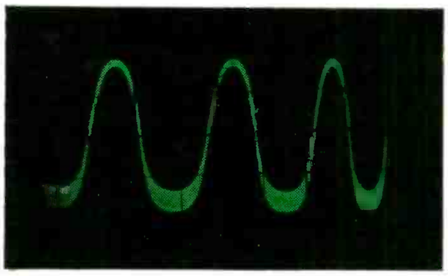


Fig. 14—This mixed waveform shows positive-peak compression.

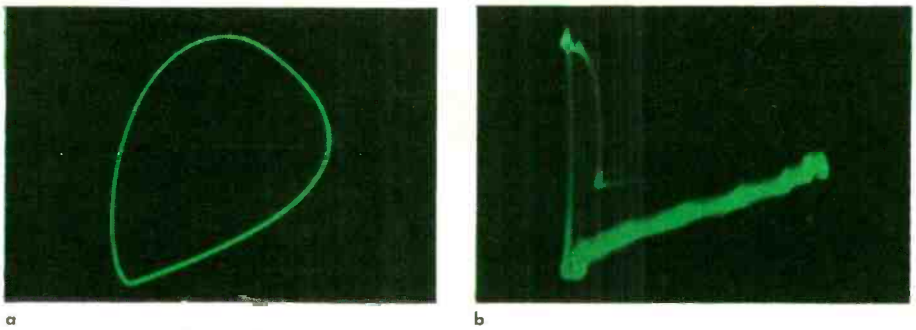


Fig. 15—Simple cyclogram pattern. b—Cyclogram with a mixed waveform.

ample, the color-difference signal in Fig. 10 consists of an (R−Y) bar, a (B−Y) bar, and a burst pulse. These three signals all have the same frequency (3.579545 mc), but each has a distinctive phase. Of course, there is also a 15,750-cycle sync pulse in the mixed waveform.

Circuit noise is sometimes a prominent component of low-level mixed waveforms. Fig. 11 shows an output waveform from a thyratron pulse generator. The right excursion of the waveform is greatly thickened by circuit noise. Note that noise voltages have *all* frequencies within the passband of the circuit. In this respect, a noise pattern differs from a geometrical pattern.

Thus, the geometrical waveform in Fig. 12 has a fundamental frequency (15,750 cycles), a second harmonic, third harmonic, etc., up to the bandwidth limit of the circuit. On the other hand, the random circuit-noise waveform in Fig. 13 has all frequencies from zero (dc) to the bandwidth limit of the circuit. Hence, there is a fundamental difference between man-made waveforms and naturally occurring "noise" patterns.

Mixed waveforms can be considered from two viewpoints. For example, a combination of horizontal and vertical sync pulses gives a composite sync signal. We usually regard it as a mixture of two separate waveforms. On this basis, the horizontal sync pulse has a fundamental frequency of 15,750 cycles, plus even and odd harmonics. In addition, the vertical sync pulse has a fundamental frequency of 60 cycles, plus even and odd harmonics of that frequency.

However, we can equally well consider the composite sync signal as the output from a single generator, instead of the mixed output from two generators. Then, we regard the composite sync signal as having a fundamental frequency of 30 cycles, plus even and odd harmonics of this frequency up to the bandwidth limit of the circuit. The fundamental frequency of the composite sync signal is 30 cycles, because the waveform returns to its starting point each 1/30 second.

Mixed waveforms often provide an indication of amplifier linearity. Fig. 14 shows a low-frequency waveform mixed with a high-frequency one after it is passed through a nonlinear amplifier. We can see that the high-frequency component is attenuated at the positive peaks of the waveform. This indicates

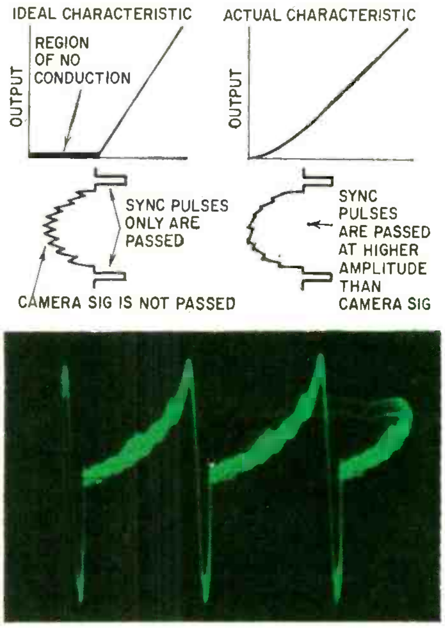


Fig. 16—Because a sync-separator tube does not have an ideally sharp cutoff, we expect to see residual camera signal in the afc waveform.

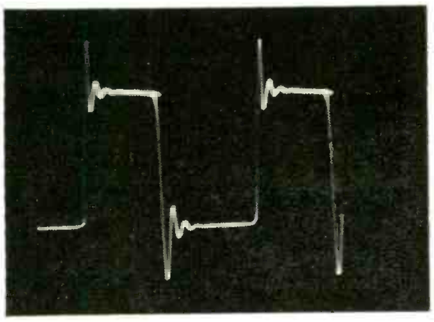
that the amplifier is compressing the signal on positive peaks.

Similar mixed waveforms of low- and high-frequency sine waves are often used to test audio amplifiers for intermodulation distortion. Whenever an amplifier compresses a signal, more or less heterodyne action is present. In turn, the two signal frequencies heterodyne to form sum-and-difference frequencies (new frequencies) which are measured at the amplifier output. Intermodulation distortion is expressed as a percentage of distortion products with respect to the total output signal.

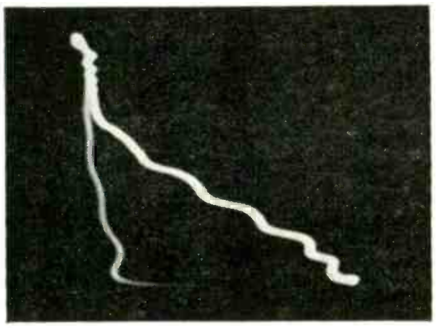
Mixed waveforms appear in cyclograms, as well as in conventional displays. Fig. 15 shows a simple cyclogram pattern, compared with a mixed waveform type. The thickened portion of the mixed waveform results from residual video signal, which gains entry into the sync circuits as in Fig. 16.

Electronic circuits can develop undesired mixed waveforms when high-Q resonant branches are present. In such cases, ringing patterns distort the waveform. Fig. 17 shows how spurious ringing components appear in conventional and cyclogram displays. Transient oscillation can be suppressed by reducing the Q of tuned-circuit branches.

When a voltage waveform rings,

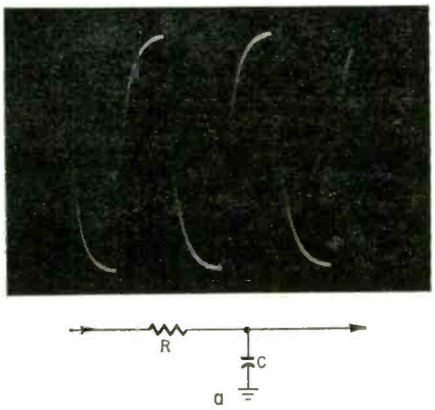


a



b

Fig. 17—Ringing pattern (a) in square wave; (b) in cyclogram.



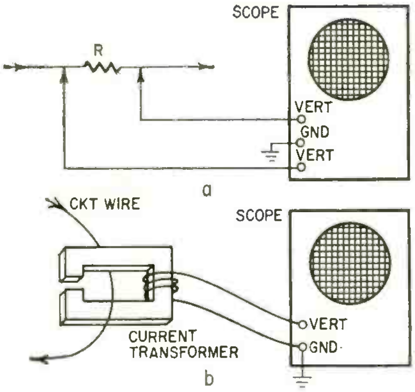


Fig. 18-a—Current waveform obtained across series resistor. b—Current waveform obtained with current probe.

the current waveform also rings. There are two methods of displaying current waveforms (Fig. 18). In the first, the scope's vertical input terminals are connected across a series resistor in the circuit. Since the voltage drop across a resistor is directly proportional to the current flow through the resistor, we see the current waveform on the scope screen.

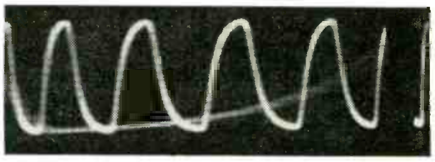
In the second method a current transformer can be used as a probe to display current waveforms. A small horseshoe-shaped ferrite core is used. A coil that connects to the scope input terminals is wound on it. The core is inserted around a wire in the circuit under test. Thus, the wire acts as a primary winding. The current waveform in the wire is induced in the coil, and the stepped-up voltage is fed to the scope.

The more turns in the coil, the higher its output voltage. On the other hand, the distributed capacitances can cause spurious resonances in the winding that produce overshoot and ringing in the reproduced waveform. It is sometimes helpful to shunt resistance across the coil winding to dampen the Q of spurious resonant configurations.

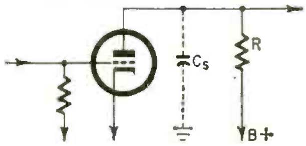
Fig. 19—(left) Integrated square wave and a simple integrating circuit. (across bottom of page) Some of the many types of square-wave distortion in electronic service work.

Causes of waveform distortion

Next, let us look into some of the basic causes of waveform distortion. Once they are understood, we can look at a distorted waveform and tell what



a

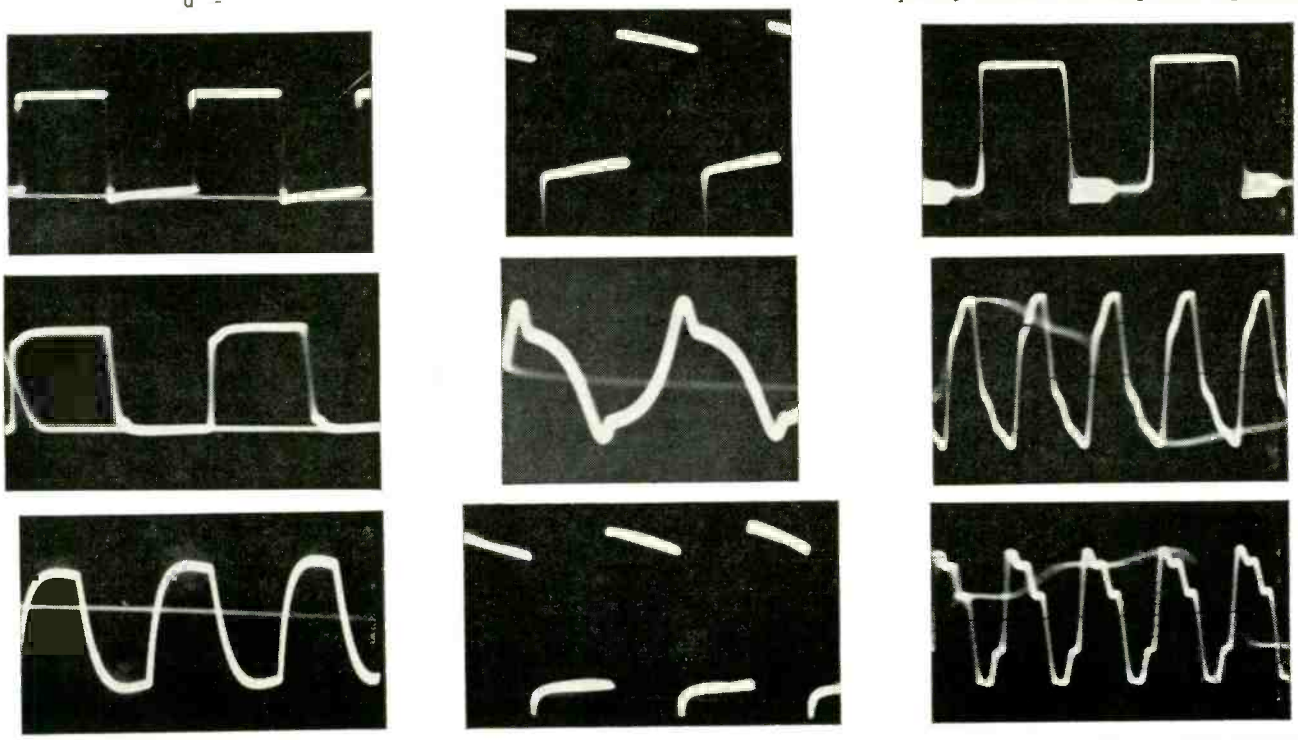


b

Fig. 20-a—Square wave integrated in passage through amplifier. b—Stray capacitance C_s forms integrating circuit with R that distorts square wave.

circuit fault has occurred. First, consider Fig. 19-a. Series resistance working into shunt capacitance integrates a square-wave, sync-pulse or other rectangular waveform. This is one of the basic distortions met in practical work. Other types of square-wave distortion are illustrated across the bottom of this page.

For example, we find integration in a simple resistance-coupled amplifier (Fig. 20) when the square-wave frequency exceeds the amplifier capability.



Here the shunt capacitance is invisible. It is stray capacitance and consists of the capacitance of circuit wiring to ground, plus the tube's interlectrode capacitance. How can we minimize this integrative distortion? A lower value

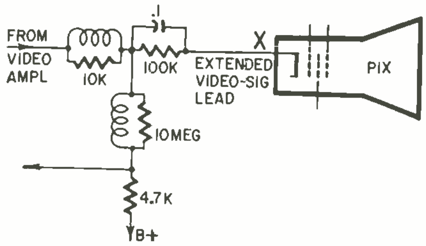


Fig. 21—Scope test at X shows integrative distortion when an extended picture-tube lead is used.

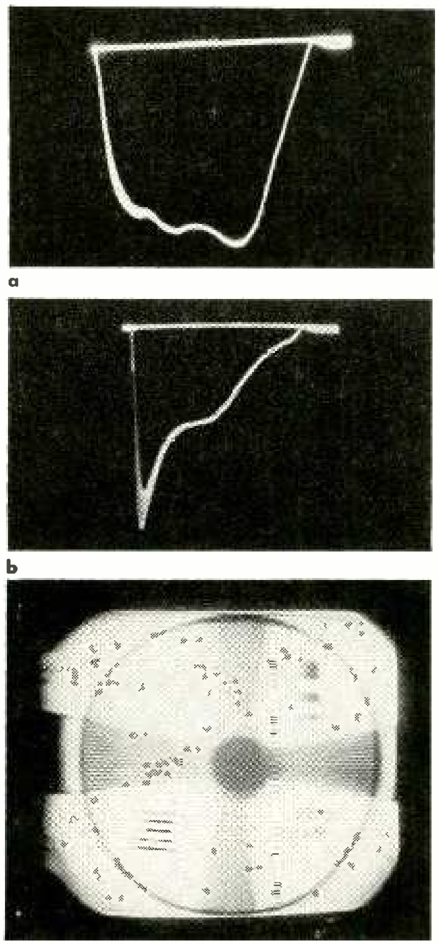


Fig. 22-a—Normal video amplifier response curve. b—High-frequency attenuation caused by excessively long lead to picture tube. c—Test pattern showing blurring as result of high-frequency attenuation.

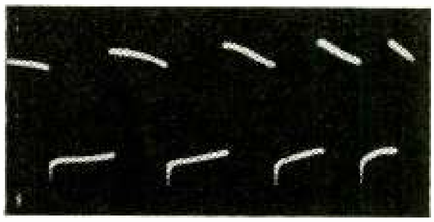


Fig. 23—Compression at right side of pattern is caused by nonlinearity in scope's horizontal amplifier.

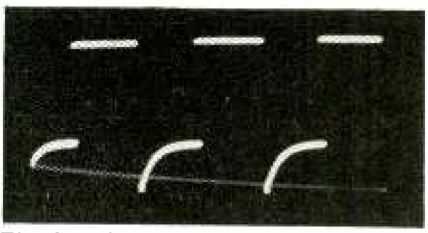


Fig. 24—Square-wave distortion caused by a leaky grid-coupling capacitor with reduced effective capacitance.

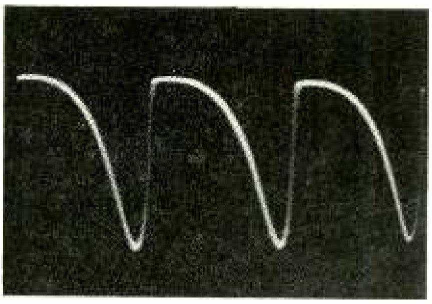


Fig. 25—A faulty grid-coupling circuit causes nonlinearity in the sawtooth waveform.

of plate-load resistance must be used. The amplifier gain drops, but we get improved frequency response.

Stray capacitance increases when lead length is increased. Suppose we lengthen the video-signal lead to a picture tube (Fig. 21). We find that the picture quality deteriorates as the stray capacitance increases. As shown in Fig. 22, detail is lost and the image appears fuzzy. If the amplifier is swept, the frequency-response curve shows high-frequency attenuation because of excess stray capacitance.

We must not confuse scope distortion with receiver distortion. Fig. 23 shows a distorted reproduction of a square wave. The pattern is cramped at the right-hand end. This is not a receiver fault, but a scope defect. The horizontal amplifier is nonlinear. Nonlinearity can be caused by weak tubes, low plate-supply voltage or a defective grid-coupling capacitor.

Coupling capacitors become defective in different ways. Sometimes a capacitor opens completely or partially. Again, the capacitor often becomes leaky or shorts. The capacitance of a leaky capacitor frequently drops, too. Fig. 24 shows how a square wave becomes distorted when a grid-coupling capacitor becomes leaky and its effective capacitance is reduced. The lower portion of the waveform is differentiated because of the reduced time constant in the grid circuit. The top of the waveform is clipped, because leakage shifts the dc grid bias in a positive direction. This causes diode action, and clips the positive peaks of incoming signals.

With a sawtooth driving wave, curvature is introduced as in Fig. 25—the wave becomes nonlinear. In turn, the scope pattern becomes progressively cramped toward the right-hand end. We see that adequately large time constants and correct operating points are

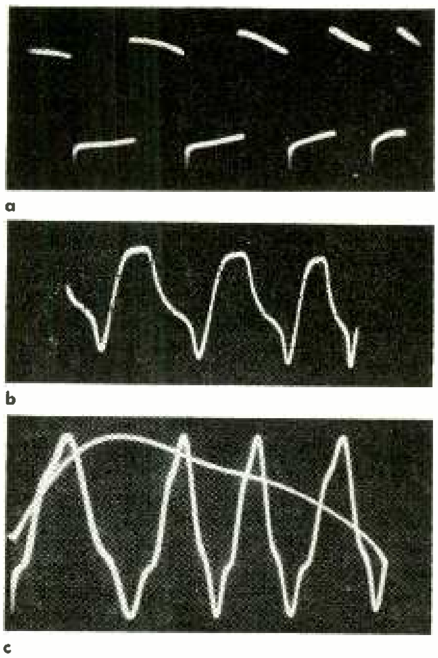


Fig. 26—Three kinds of nonlinearity: a—pattern cramped at right. b—Pattern cramped at left. c—Pattern cramped in middle.

essential in scope amplifiers. Three types of horizontal nonlinearity are found (Fig. 26).

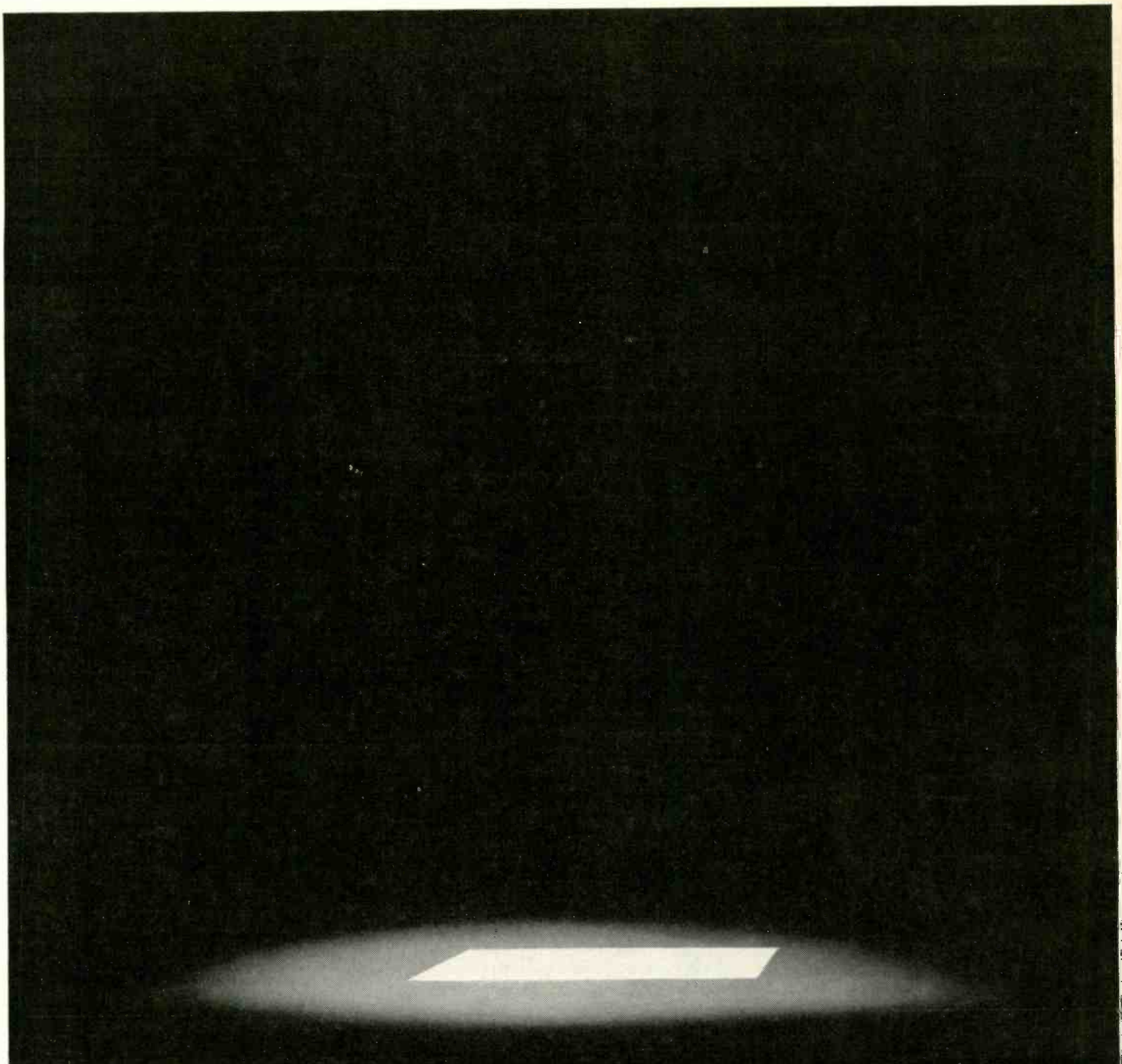
Thus, when the basic causes of waveform distortion are recognized, it becomes much easier to interpret scope patterns. The patterns are like a foreign language, which must be learned. For this reason, practical experience is the only way we can become proficient in reading "waveform language." END

British TVers Like Rental

Half the TV watchers in Britain rent their sets instead of buying them, according to a recent statement in *Time*. Of the new sets being installed, 80% are rentals. One advantage to the consumer is the speed of repair or replacement—at no charge. Larger firms maintain mobile repair vans with parts, test benches and generators and a large company may handle 30,000 service calls a week. One firm offers 32 models at monthly rentals from $4.20 to $8.40, with used sets at lower prices. Charges are reduced every 6 months, and discounts are given for advance payment.

Largest of the firms is Radio Rentals, Ltd. Thirty-two years ago it started renting radios at 35¢ a week. Now it has 750,000 subscribers, and manufactures its own sets as Baird Television, Ltd. Profits last year were $4.612,000.

It's catching on here, too. Hertz, renting home sets in New York since December 1961, reports triple the volume it anticipated.



How 6½ sq. ft. can speed up your picture-tube service:

10 versatile "Universal" picture-tube types from Sylvania's SILVER SCREEN 85 line may be all you need to fill 52% of your renewal needs! This fact, verified by a recent industry survey, stems from a remarkable streamlining of the Sylvania line—making fewer, more versatile types that can be used as replacements for many others. Already 54 types can replace 217.

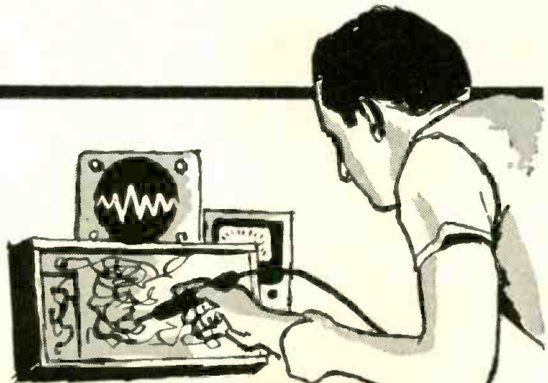
Think what the versatility of these "Universal" tubes can mean. An in-shop inventory of a few popular types can help you quickly take care of most of your renewal calls. Ordering is simplified...and distributor calls for special tubes can be cut way down.

Start profiting now from Sylvania's SILVER SCREEN 85 picture tubes. Call your Distributor and put an inventory in your own shop—where it can enhance your reputation for fast service and quality replacements.

SILVER SCREEN 85 Picture Tubes are made only from new parts and materials except for the envelopes which, prior to reuse, are inspected and tested to the same standards as new envelopes.


85
SYLVANIA
PICTURE TUBE


SILVER SCREEN 85



SERVICE CLINIC

By JACK DARR
SERVICE EDITOR

> This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.
> We've changed our target a little and are no longer restricted to TV, Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it

THE VALUE OF ANY PIECE OF TEST equipment is determined by what it can do that the rest of your test equipment *can't*. Or if it does duplicate, how much faster or more accurately does it operate? The scope falls right in the middle of that category. It can do one job very well—look at the *waveshape* of a signal. Also, it does this very rapidly, if we use it correctly. Let's look at a few examples.

Is the horizontal oscillator working? Dc voltmeters and even ac voltmeters can give you some information, but nothing absolutely definite. Negative voltage on the grid of the horizontal output tube could be signal-developed bias or a fixed bias from somewhere else. Only a scope can answer this one. Simply touch a low-capacitance probe to the grid and there's your answer.

Another use: Is the signal on frequency? If the horizontal oscillator is running but is way off frequency, the screen may be dark because the excitation is so far off frequency that the flyback won't deliver any high voltage.

Fig. 1—Two cycles of horizontal sync on the scope screen.

How is this measured with the scope? By comparison. The scope is basicially a comparison instrument. If you remember the Lissajous patterns found in every book on scope theory, they show a *comparison* between a known (standard) and an unknown frequency. We need a standard horizontal-frequency signal too compare with what we see on the output tube grid. Where? Try the horizontal sync pulses in the video signal. Is that accurate enough? Touch the low-capacitance probe to the video output plate, and set the scope's horizontal sweep to 7,850 cycles to produce 2 or 3 cycles on the screen. You can use more or less if you like, but 2 or 3 give a good usable display (Fig. 1).

Now, leave the horizontal sweep alone, and touch the probe to the output tube grid again. If you see the same number of cycles, the oscillator is *definitely* on frequency and you can look elsewhere for the trouble. You can set it exactly on frequency with the horizontal hold control, to simplify further troubleshooting. Just adjust for the same number of cycles in the pattern (Fig. 2).

Suppose there is something wrong with this set so that I can't get a video signal? Simple. Take the comparison waveforms from *another* set in operating condition. Same signal in all of them!

This same trick can be used for vertical sweeps. For instance, if the picture is rolling so fast that you can't tell whether it's going up or down, set up the scope on the video again, but this time on the vertical sync frequency (Fig. 3). Now, back to the vertical oscillator grid and repeat the process we just used on the horizontal oscillator. If you see only a half-cycle or less, the oscillator is too fast (Fig. 4). Several more cycles (Fig. 5) and you know it's too slow.

Fig. 3—Two cycles of video at 30-cycle sweep. Look for the vertical sync pulses.

Sync troubles? Sure. Big problem in cases of vertical instability—weak sync or oscillator troubles? Set up the scope for 2 cycles of vertical sweep or 30-cycle sweep, connect it through a low-capacitance probe to the sync in-

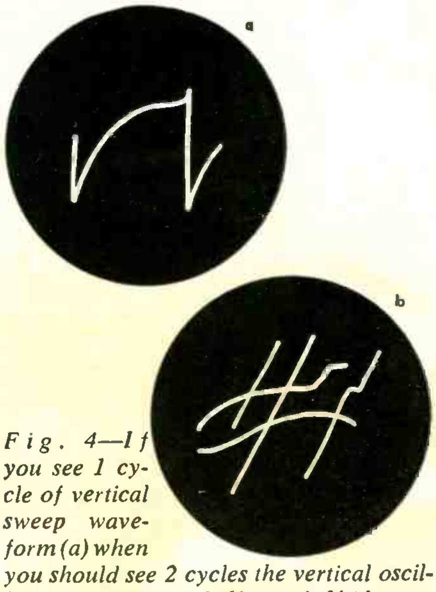


Fig. 4—If you see 1 cycle of vertical sweep waveform (a) when you should see 2 cycles the vertical oscillator is running at half speed. If it's very slow you may see a mess as in b.

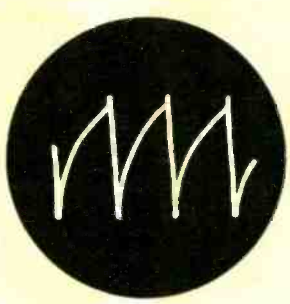


Fig. 5—Three cycles of vertical sweep when there should be only two indicates the oscillator is running slow.

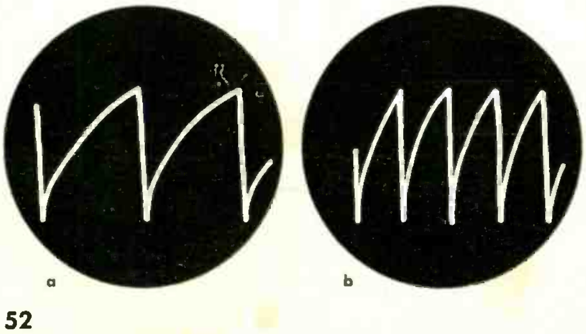
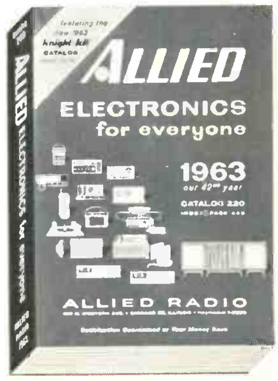


Fig. 2—Horizontal output tube grid waveforms. a—Two cycles on screen show horizontal oscillator is on frequency. b—Four cycles on screen show that horizontal oscillator is too slow.

mail now

Free SEND CARD TODAY FOR YOUR 464-PAGE ALLIED 1963 CATALOG

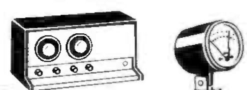


WORLD'S LARGEST • BIGGEST SELECTION • BIGGEST SAVINGS

NEW

1963 *knight-kits*®

Over 100 great do-it-yourself kits: Hi-Fi, Hobby, Intercom, Amateur, Citizens Band, Instrument—savings up to 50%.



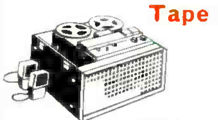
NEW

Stereo Hi-Fi

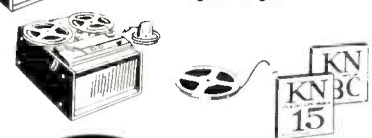
Complete selection of components and systems; latest All-Transistor equipment and Stereo Multiplex FM.

NEW

Tape Recorders



Complete recorders, tape decks, recording and pre-recorded tapes at big savings.



NEW

Citizens Band Radios

Latest 2-way radio—no exam required—complete selection of top-value CB equipment, including Walkie-Talkies.

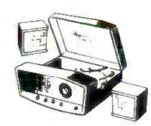
NEW

Transistor, FM-AM Radios

Best buys in all types of compact transistor radios, including quality FM-AM portables.

NEW

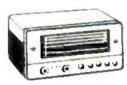
Phonographs & Records



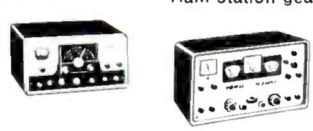
Big values in phonographs; latest stereo portables; famous-brand records at amazing discounts.

NEW

Ham Station Equipment

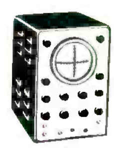


Largest selection of receivers, transmitters, antennas—everything in Ham station gear.

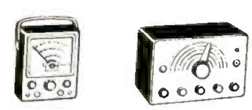


NEW

Test Equipment



Save on every type of instrument for home or professional use—all leading makes available.



PLUS • PA Systems & Intercoms • Top values in Power Tools, Soldering Guns, Hardware • Biggest selection of TV Tubes, Antennas; Parts, Tubes, Transistors, Books

satisfaction guaranteed or your money back

NO MONEY DOWN: Now! More Buying Power with Your Allied Credit Fund Plan!

mail now

Free MAIL CARD TODAY FOR YOUR 1963 ALLIED CATAL—

AND GIVE THIS CARD TO A FRIEND

TO:
ALLIED RADIO
100 N. WESTERN AVE.
CHICAGO 80, ILL.

PLACE STAMP HERE

TO:
ALLIED RADIO
100 N. WESTERN AVE.
CHICAGO 80, ILL.

PLACE STAMP HERE

put of the vertical oscillator, and kill the sweep temporarily. Pull a tube, in parallel-filament sets, or ground the output tube grid, in series-string sets. Now, check the sync amplitude. How? Once again, by comparison with a known voltage amplitude. As an average, if there is less than 4 or 5 volts of sync, you've got troubles.

Where to get known voltage? Best way, from a voltage calibrator made for the purpose. Some scopes have built-in peak-to-peak voltages on the front panel. If you haven't any of these, use the filament voltage from your tube tester. For example, the 1.4-volt filament is stated in rms values so the peak-to-peak value is 2.8 times this, or 3.92 volts. Set the scope's vertical gain so it covers a known distance on the calibrated screen. I always used 2 major divisions or 10 small divisions. It makes no difference as long as you remember where it is set. If you don't have a calibrated graticule, mark the ends of the waveform on the screen with a grease pencil. Now go ahead and measure the peak-to-peak amplitude of your sync. Same trick can be used for horizontal sync, video or any other signal to find the peak-to-peak value. To make it simpler, turn the scope's horizontal sweep off while calibrating, leaving only a thin vertical line. Easier to judge distances.

There are a lot of quick-checks such as this that you can make with a scope once you get into the habit of using it regularly. They'll speed up your service work tremendously. Of course, you won't need it on every job, nor even on the majority of jobs. Good old statistics keep telling us that a very large percentage of service jobs require only the replacement of one tube, and this is true, as you've found out. But on the jobs where we *need* this kind of help, the scope is the only place we can get it. The scope can trace signals, and show you what is happening to them at any point in the circuit, something that no other piece of test equipment can do.

Video short

A Tele-King K73 has developed a short. Raster is present; no video. The sound is nothing but a low growl. The two 1,200-ohm resistors connected in parallel coming off a peaking coil in the video amplifier circuit are burning up. B-plus voltages are correct.—L. K., New York, N.Y.

This set has been tampered with. The two 1,200-ohm resistors in the video amplifier circuit are wrong. This would give you a total plate load of only 600 ohms. Someone has misread the color code. This resistor should be 5,600 or 6,200 ohms. This is about normal plate load resistance for this circuit.

As to the short, there is a remote possibility that the low resistance is causing the tube to draw so much plate current that the resistors are overloaded. Not too much chance of this, though, because of the tube type used. Unless it is shorted, a 6CB6 probably wouldn't

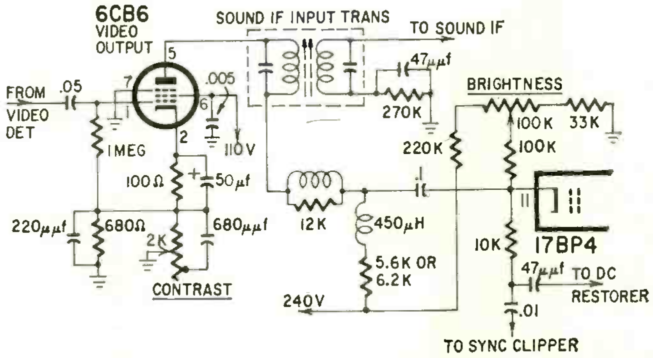


Fig. 6—Video output circuit in a Tele-King K73.

carry enough current to burn up two resistors in parallel. Check to see if the 100-ohm resistor in the cathode circuit is burned. It or the contrast control would probably be damaged, too, if the tube were defective.

The most likely cause for this would be a direct short to ground in the wiring, one of the peaking coils or the primary of the sound i.f. input transformer (Fig. 6). Unsolder parts and trace it out with an ohmmeter.

Picture pulling

I have an RCA KCS-72 chassis with severe picture pulling. I can't get the contrast high enough without weaving, by adjusting the agc control. Also, the height of the sync pulses goes down when the weave shows up. Is 8 volts too much negative bias on the i.f. grids?—J. H. M., Detroit, Mich.

All of your troubles are tied together. Eight volts is quite a bit too much negative bias for the video i.f. Because of this, you can't get enough gain in these stages to give you proper contrast. Check the i.f. tubes. Even with the high bias, one of them may be gassy or have grid emission, resulting in plate saturation and the sync clipping.

Also, from the symptoms, it would be a very good idea to align the i.f. stages. Sweep them carefully and watch out for a droop in the high-frequency end of the curve.

Finally, bridge the electrolytics in and around the B-plus supply lines to the video amplifier and sync separator stages. Pulling is often caused by weak electrolytics.

Vertical growing

We have a Sylvania 537-3 chassis in the shop that is pretty mysterious. The vertical sweep expands about 40% during the first 5 minutes of warmup! The vertical output tube plate current increases about the same amount, but the waveform on the plate seems to expand only about 5%. All voltages seem to be pretty stable.—D. H., White Rock, B.C., Canada

Since, as you say, you've changed all components in the vertical circuits, I'd look elsewhere. Try replacing the damper tube, since it could be altering the boost voltage. Check the horizontal output tube for grid current or grid leakage, also the 10DE7 vertical output tube. I'd say that this trouble is probably due to grid current or grid leakage in one of the tubes named (except the *damper*, of course!) since this seems to be at the bottom of almost all mysterious difficulties like this.

I remember a case not long ago in which a small leakage in the grid of the horizontal output tube caused a very similar symptom. The only explanation we could find was that it was altering boost voltage.

Horizontal lock range

In an old Stewart-Warner 9126, I can't get the horizontal hold control to work right. Although I can short out the afc grid and hold a picture for a long time, when I put the afc back on, it is very unstable.

When I turn the hold control (the slug in the ringing coil) clockwise to bring the picture into sync, it flops on past out of sync the other way. If I back up to it I can get it to lock, but sometimes I get it locked on a split picture and can't get it off without throwing it out of sync again and sneaking up on it. I've checked or changed every part in the horizontal avc, and I seem to have plenty of sawtooth pulse at the right peak-to-peak amplitudes.—J. C., Atlanta, Ga.

Although this looks like a standard stabilized-multivibrator dual-diode afc circuit, it can be pretty tricky. Check the circled parts in Fig. 7. Each one has been known to cause this peculiar symptom. Probably the most likely is the 3,900-ohm oscillator plate load resistor. Even though this resistor *in most circuits is not* critical as far as frequency is concerned, in this one it is. You'll probably find it has increased to 8,000 or 10,000 ohms. Also check the grid bypass capacitor and the pulse coupling capacitors, both .05 μf, for leakage. The grid is a very high-impedance circuit, more than 5 megohms from ground, and any dc leakage in the bypass capacitor upsets control action.

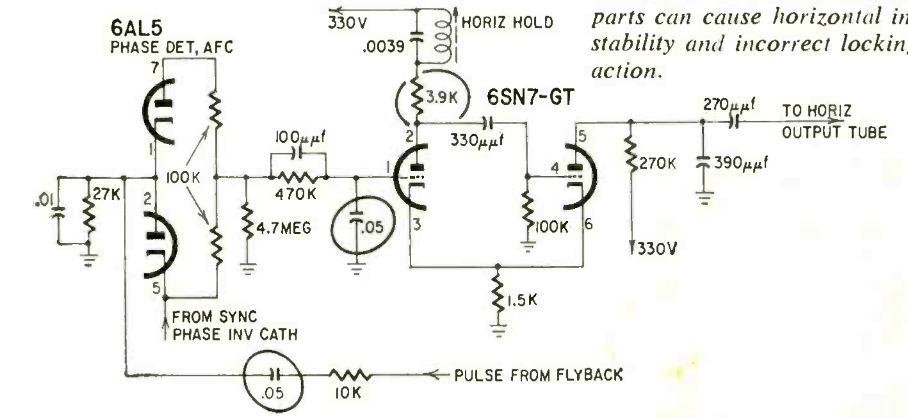


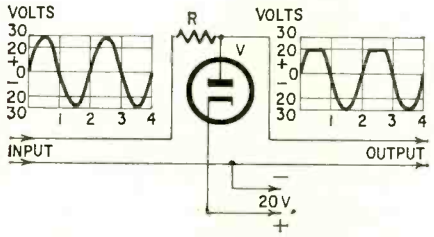
Fig. 7—Partial circuit of Stewart-Warner 9126. Circled parts can cause horizontal instability and incorrect locking action.

WHAT'S YOUR EQ?

These are the answers! The puzzles are on page 41.

Draw the Waveform

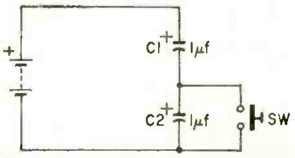
As long as the input signal is less than +20 volts, the diode cannot conduct and the output signal is the same as



the input signal. When the input voltage reaches 20, the tube acts as a short, keeping the voltage from rising any higher.

Capacitor Charge

Since the two capacitors are in series, the 100-volt charge will divide, charging each to 50 volts. When the shorting switch is pressed, the non-shorted capacitor (C1) will be charged to 100 volts. When the switch is released, one end of C2 is connected to the negative side of the battery and the other end to the negatively charged end of C1. Thus, you will have a 100-volt charge on one capacitor and zero charge on the other. (This statement does not consider the residual charge left in the shorted unit.) Due to leakages, the charges will gradually even up, resulting in a final charge of 50 volts on each capacitor.



Another Two-Box Problem

As you have probably guessed, this is also done with rectifiers, and the difference between it and the earlier problems is in the switching. The diagram below shows the circuit. The lamps are 120 volts 6 watts, as stated in the problem, and the rectifiers should be rated at 100 ma or more. END

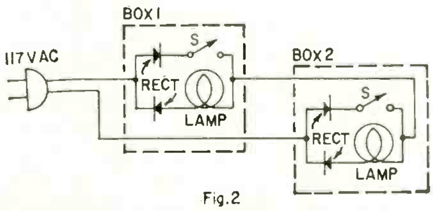


Fig.2


HERE'S PROOF:
CHANNEL 1
CHANNEL 2
LEVEL
BASS
TREBLE
ATTENUATE
BOOST
CHANNEL 3
CHANNEL 4
CHANNEL 6
LEVEL
SPEECH FILTER
OUT IN
OFF
FULL
COMPRESSION
MIC
TAPE HD
PRECEDENCE
POWER

HARMAN-KARDON GALAXY SERIES handles more sound jobs, large or small, easier and at less cost than any other packaged public address amplifier!

■ You select exactly the number of channels, types of inputs and the power you require to fit each job! **You buy only what you need, use what you buy . . . never any waste!**

■ Expand or modify a system, anytime, with simple modules that install in minutes. Regardless of whether it's channels, inputs or power! **System never obsoletes!**

■ Apply compression or full limiting to any desired channel, on any kind of program source. Or, alternately, apply limiting action to the entire program mix. **Eliminate complaints about sound being too loud or too low; reduce the number of microphones and channels needed to achieve group coverage; prevents sound output exceeding point of feedback howl.**

■ Introduce beep, warble or continuous tones—all three if you wish—to signal time periods, fire, forced or unauthorized entry, occurrence of any disaster or emergency . . . even to signal rain, temperature, water level or other possibly significant conditions. And you can introduce these signals manually, or remotely and automatically . . . even if the amplifier is turned off! **Now a sound system can more than earn its keep by doubling as an operation and safety aid.**

■ Employ "precedence" mode of operation, with local manual switch or remotely and automatically; complete cut-out of unwanted signal or any blend of the normal and precedence signals. **Now you can have all-call, emergency messages, tone signals, periodic sales messages, etc. . . . as an integral part of the regular sound system.**

■ Monitor headset jack and monitor volume control . . . plus space and facilities on the front panel for plug-in monitor speaker or VU meter. **Takes the guesswork out of system adjustments; detects and isolates program problems quickly.**

■ Complete remote control facilities are provided . . . for control of program levels, putting the system on "standby" or turning the system on and off. **Place the equipment where it ought to be, control the system from where it's most convenient.**

■ **Professional performance, quality and construction throughout.** Power ratings are given at 1% T.H.D.—the industry practice for packaged amplifiers is **twice** this distortion. Power band-width, hum and noise level and regulation are exceptional . . . as good as you might expect from "high fidelity" amplifiers. Parts are conservatively operated; tubes are run well within manufacturers' tolerances for greatest reliability and life.

■ **Plus many other special operating and installation advantages, such as:** output to a tape recorder, independent of tone and master volume controls; four position Lo Cut Filter; bridging In-Out connections; on-chassis sockets for plug-in low impedance mike and line input transformers, phono and tape equalizers; both balanced and unbalanced 25V and 70V constant voltage outputs; choice of flush-panel, cage or rack-mounting facilities . . . and numerous other features.

PREAMPLIFIER-MIXER—accommodates up to 8 channels; includes VU Meter, line amplifier and power supply.

POWER BOOSTERS—available covering the range from 40 to 200 watt performance.

REAR VIEW 40-50 WATT GALAXY—note modular construction and arrangements of inputs. Other models: 75-85 watt and 150-200 watt output power.

HK-92

AND DOLLARS-PER-WATT PRICES THAT DEFY COMPETITION! No matter how small or how big the sound system you contemplate, you owe it to yourself to investigate the Harman-Kardon GALAXY Series before you buy. Use the coupon to get Free "Sound Headquarters" Decal that helps identify you as a source of quality sound equipment . . . plus all the facts on GALAXY!

HARMAN-KARDON INC. Commercial Sound Division
55 Ames Court, Plainview, L.I., N.Y. DESK F-1

Please send literature on the GALAXY Series immediately.

name____________________

address____________________

city__________ state__________

harman kardon

Electronic switching

Switching circuits for oscilloscope or oscillograph

By F. J. G. VAN DEN BOSCH

IN ELECTRONICS IT IS OFTEN DESIRABLE to compare two or more waveforms, either in relation to each other or to a fixed standard. Electronic switching and an oscilloscope make this possible.

There is a fundamental loss of information when we use an electronic switch—we lose whatever data would have appeared during the switching intervals. This loss is kept as small as possible by selecting a switching frequency that makes all useful or desired information available. This depends upon how much loss of information can be tolerated, or inversely by the minimum amount of data judged adequate.

In studying biophysical waveforms, for example, the switching frequency should be at least five times that of the waveform to be observed. When the two waveforms to be observed have a great frequency difference, the switching frequency should be based upon the highest frequency.

Fig. 1 shows two electronic switch circuits. In Fig. 1-a, V1 is arranged as a standard multivibrator. Switching pulses are injected into the supressor grid of the 6AU6's. Varying screen grid potentials with potentiometers R1 and R2 varies the relative position of each of the switched beams. The switch's outputs can be connected directly to a scope or to the driver stage shown in Fig. 2.

Fig. 1-b is slightly different. Here, multivibrator V1's output is fed to V2, a driver for V3 and V4. V2's cathodes are directly connected to the cathodes of V3 and V4. Again the output of these last tubes can be connected directly to the scope or to the driver stage shown in Fig. 2.

With the values shown, both circuits in Fig. 1 will operate equally well.

However, note the separate feed of the screen grid potentials in Fig. 1-a. This is done to avoid interference between the two beams. If you want to display more than two waveforms simultaneously (for example, six signals), use three multivibrators and six independent 6AU6 output tubes. The driver stage shown in Fig. 2 increases sensitivity and is optional.

Fig. 3 shows a valuable addition for blanking. It is primarily a mixer for the two incoming signals from the switches. V2's plates are connected via a capacitor (not shown) to the grid of CRT. One control grid of V2 receives the mixed signals from V1 and the other control grid receives a pulse from the scope's sweep circuit. The net result is sync with the line time base and a suppressed retrace.

There is another approach to this problem. When dealing with a biophysical phenomenon, it might be more economical to use separate preamps fed by an electronic switch to power a final amplifier. This final might then be connected to a scope (if the signal is to be visually observed), or to recording equipment.

Fig. 4 shows the circuit of an electronic switch for two inputs. V1 and V2 are both multivibrators. V3 allows phase adjustments before output stage V4. Variable capacitors C1, C2, C3 and C4 adjust the switching frequency for the waveforms shown at A and B. Both these outputs then connect to the input terminal of the preamps and in parallel with the incoming signals. This way only one final amplifier is required. For example, electroencephalographs usually contain six to eight separate circuits for each hemisphere of the brain to be examined. By using three switches like the one in Fig. 4 and interconnecting them for sync with capacitors of the type shown in the cir-

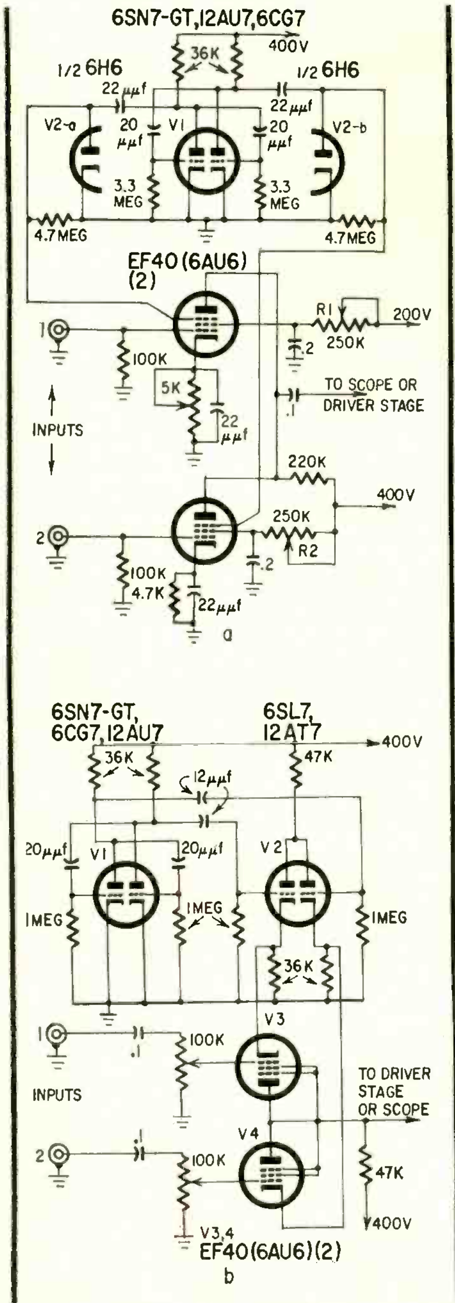
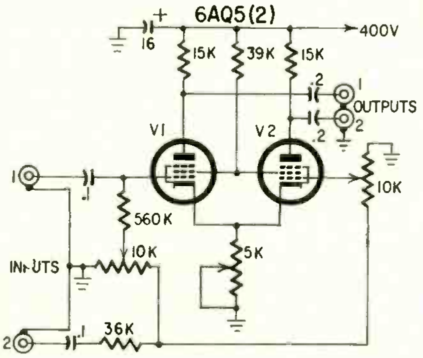


Fig. 1—Two basic switching circuits.

Fig. 2—Driver stage amplifies output of circuits of Fig. 1.



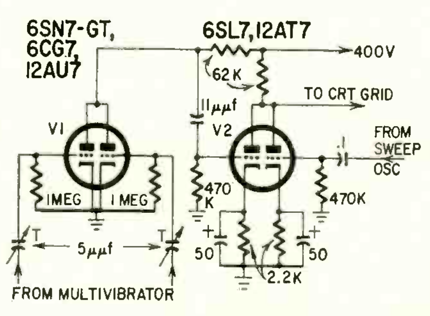
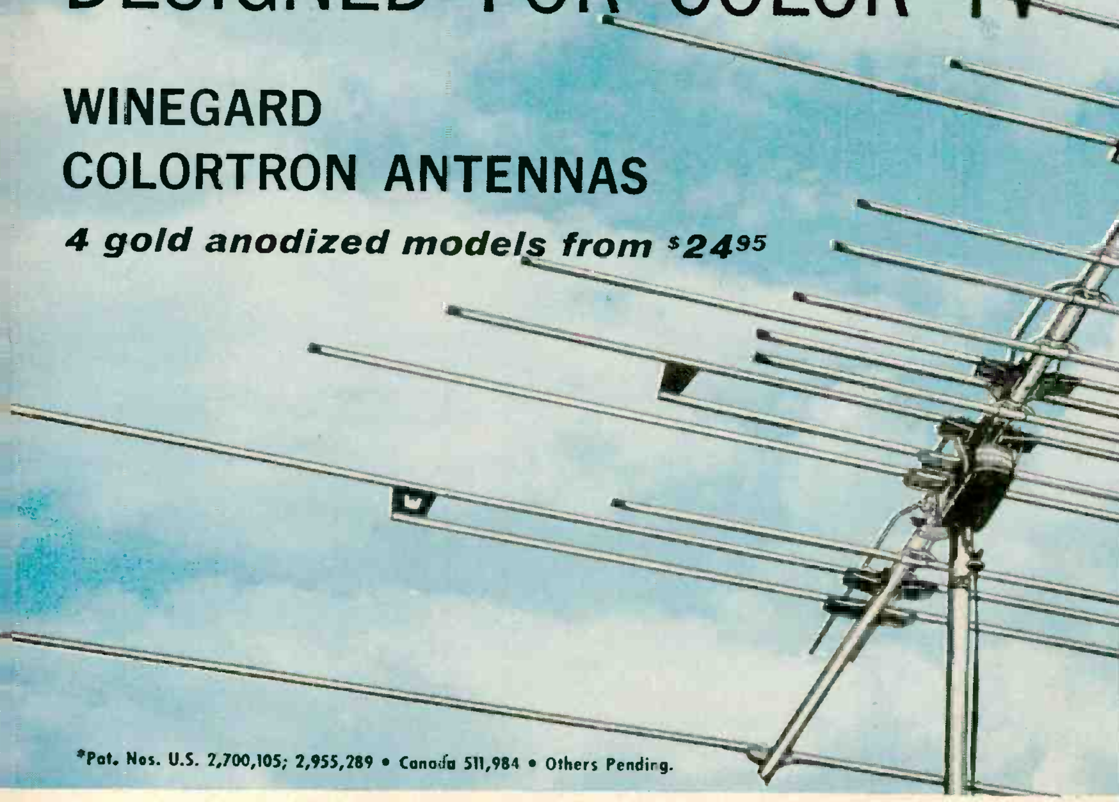


Fig. 3—Retrace blanker is also a mixer.

DESIGNED FOR COLOR TV

WINEGARD COLORTRON ANTENNAS

4 gold anodized models from $24.95



*Pat. Nos. U.S. 2,700,105; 2,955,289 • Canada 511,984 • Others Pending.

AVAILABLE WITH REVOLUTIONARY NUVISTOR COLORTRON AMPLIFIER...

Now, through continuous Winegard research, a new, improved Electro-Lens yagi has been developed—the NEW WINEGARD COLORTRON—PERFECT ANTENNA FOR COLOR TV!

Colortrons have a flat frequency response (plus or minus ½ DB across any 6 MC channel), no "suck-outs" or "roll-off" on end of bands . . . accurate 300 ohm match (VSWR 1.5 to 1 or better) . . . unilobe directivity for maximum ghost and interference rejection. They deliver today's finest color reception, give a new picture quality to black and white. Colortrons are the only outside antennas that carry a WRITTEN FACTORY GUARANTEE OF PERFORMANCE.

And Colortrons are built to last. High tensile aluminum tubing for rigidity and stability, insulators with triple moisture barrier, GOLD ANODIZED for complete corrosion-proofing.

There are 4 Colortron models to cover every reception need, from suburbs to distant fringe areas . . . $24.95 to $64.95 list.

New Winegard Colortron twin-nuvistor amplifier perfectly matches Colortron antennas. Gives added gain and sensitivity on both color and black and white. Ultra-low noise, high gain Colortron Nuvistor Amplifier can easily drive 6 or more TV sets.

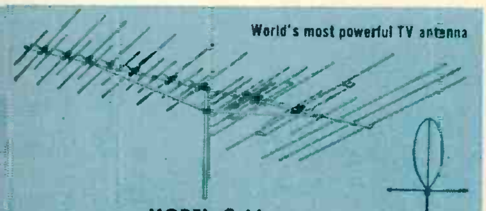
With revolutionary twin-nuvistor circuit, Colortron amplifiers can handle up to 400,000 micro-volts of signal without overloading. *This is 20 times better than any single transistor amplifier.* The Colortron Amplifier will bring the weakest signals up out of the snow, yet strong local TV & FM signals will not overload it. A special life saver circuit gives the two nuvistors a life of 5 to 8 years.

This amplifier is completely trouble free and the finest performing antenna amplifier you can own.

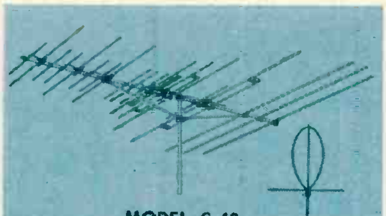
Completely weather sealed, nothing is exposed to corrode and cause trouble . . . has all AC power supply with 2 set coupler. (Model No. AP-220N, $39.95 list). Twin transistor model also available up to 80,000 micro-volts input. *New type circuit protects transistor from static electricity built up in lightning flashes.* (Model No. AP-220T, $39.95 list).

Colortron Amplifier can be added to any good TV antenna for sharper, clearer TV reception.

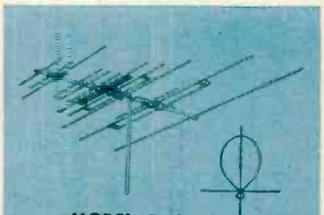
Ask your distributor or write for technical bulletin.



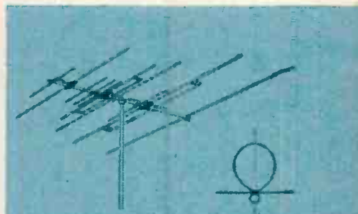
MODEL C-44
GOLD ANODIZED $64.95



MODEL C-43
GOLD ANODIZED $51.90



MODEL C-42
GOLD ANODIZED $34.95



MODEL C-41
GOLD ANODIZED $24.95

Winegard ANTENNA SYSTEMS

There's an extra bonus of quality and performance in every Winegard product.

3013-1 Kirkwood • Burlington, Iowa

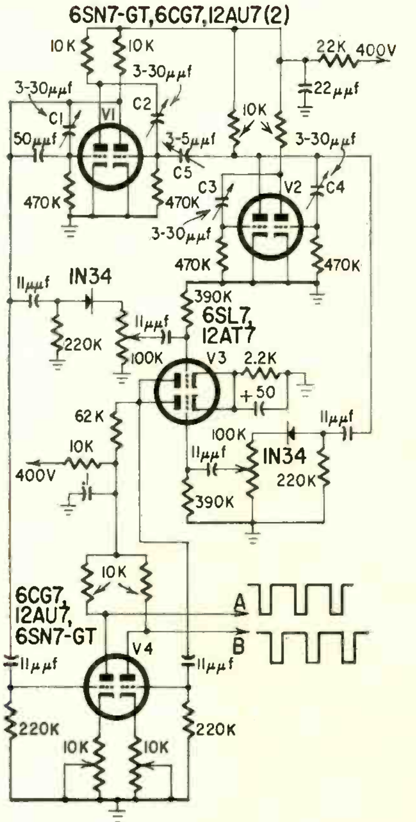


Fig. 4—A practical electronic switch.

cuit as C5, it is possible to use six preamps, each controlled by the electronic switches as shown. These preamps are then connected to *one* final amplifier which in turn will use only *one* recording pen. The various channels recorded following simply in the sequence determined by the electronic switches.

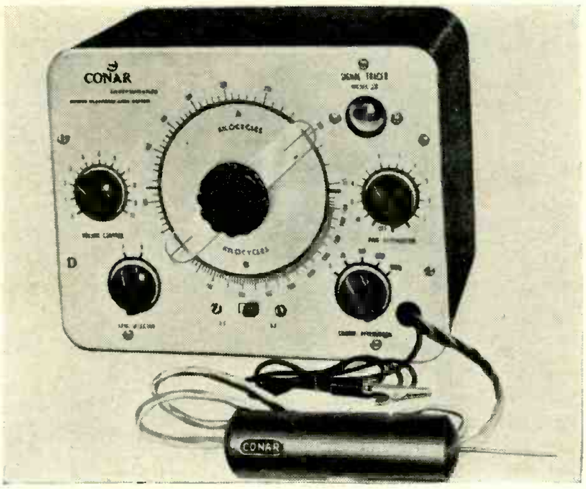
In this way, both hemispheres can be recorded with only two pens. If a visual display on a scope screen is desired, simply connect the output to the scope input. However, make sure the switching frequency you select is fast enough to give a linear display of the six channels during one line sweep. Using electronic switching for these purposes will simplify equipment and lower the cost of experimental apparatus for the laboratory. END

Simpler Closed-Circuit TV

An industrial closed-circuit, high-resolution color TV system that uses a single vidicon camera with a color wheel and a three-gun color tube in the receiver is reported by Mitsubishi of Japan. Previous systems using a single vidicon in the camera have needed color wheels synchronized on both camera and receiver. Those systems that used a three-gun color tube in the receiver have used a three-vidicon camera. The new camera combines the two approaches to make a simpler system. The equipment has a bandwidth of 10 mc.

EQUIPMENT REPORT

Metro-Tel Shorted-Turn Indicator



Conar 230 Tuned Signal Tracer

By WAYNE LEMONS

Ever want to check the oscillator or oscillator frequency of a tube or transistor radio? Ever want to make a quick diagnosis as to whether the radio trouble is in the i.f. or af stages? Like to know if the loop antenna is tuning to the correct frequency? These are only a few of the things you can do with a TUNED signal tracer that you can't do or can't do as well with an untuned one.

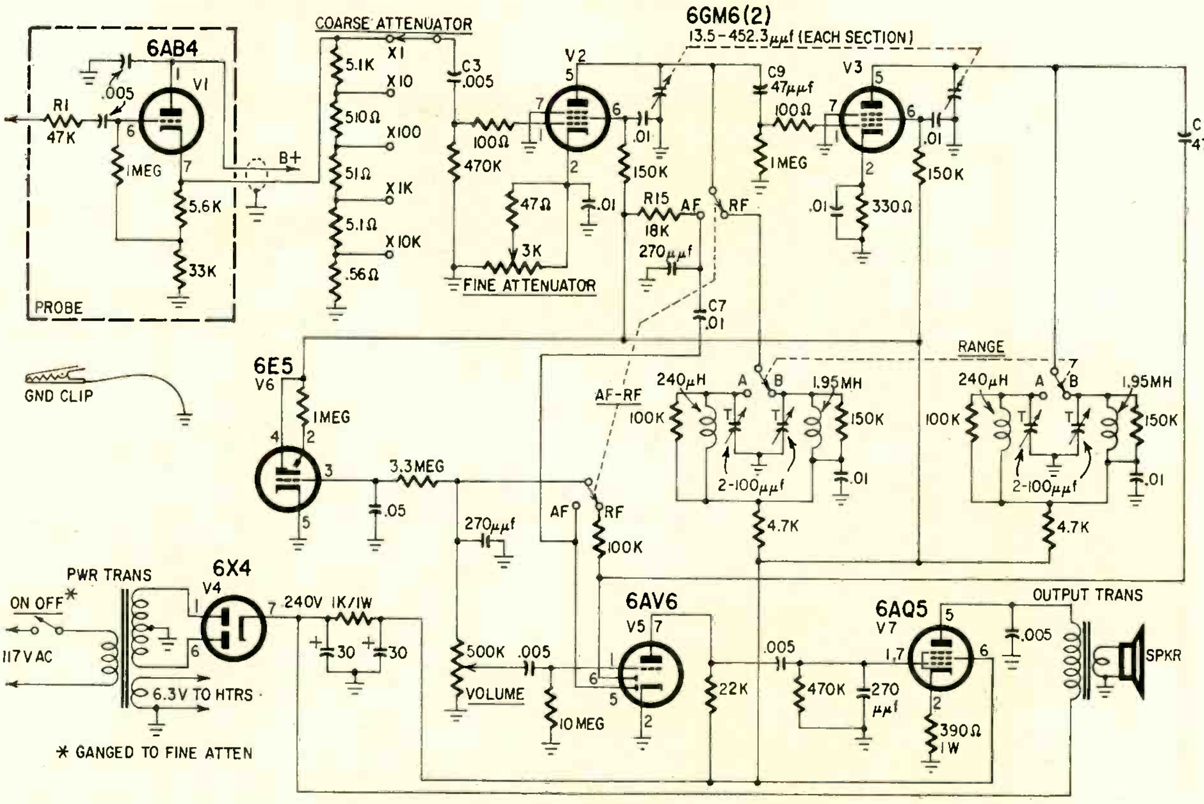
Back in the Thirties no shop was considered complete without at least one tuned signal tracer on the service bench. Later, the untuned tracer virtually replaced the tuned variety, because they were then less expenseive and less complicated.

The tuned tracer is better than the untuned both in circuit loading where it usually has much less effect on the circuit it is checking, and in signal identification where the tuned tracer tells you whether the signal you are measuring is rf, i.f. or oscillator and at what frequency.

The bugaboos of both price and complication have been neatly sidestepped on a new tuned tracer made by Conar, a division of the National Radio Institute. It is both simple and inexpensive.

Looking at the schematic, note that the probe houses a cathode follower (6AB4). This gives it high input impedance and low input capacitance. The 47,000-ohm resistor (R1) further isolates the input capacitance from the circuit to be tested.

The output of the 6AB4 is fed through the probe cable to a COARSE



Circuit of an unusual type of signal tracer.

ATTENUATOR step switch inside the main housing. This switch attenuates the input signal, either rf or af, in multiples of 10. The output of the attenuator is fed through a .005-μf capacitor (C3) to the grid of a 6GM6 rf–af amplifier. A 3,000-ohm pot in the cathode of this tube is used as a FINE ATTENUATOR. In the rf position, the plate load of the 6GM6 is an rf coil. Its frequency is determined by the range switch and the tracer tuning capacitor (A range—170 to 500 kc, B range—500 to 1,500 kc). The rf is then coupled through a 47-μμf capacitor (C9) to the grid of a second 6GM6 rf amplifier that also uses rf coils in its plate circuit. The output of this second rf stage is fed through another 47-μμf capacitor (C13) to one of the diode plates of the 6AV6. This diode rectifies (detects) the rf, and the resultant dc is filtered and fed to the grid of the 6E5 tuning-eye tube. The detected signal is also fed to the audio amplifier through the volume control. Eye closure indicates the strength of the rf signal.

For af tracing, the same probe is used as well as the coarse and fine attenuators. In the af position, though, only the first 6GM6 is used. The rf plate-coil is switched out and an 18,000-ohm resistor (R15) switched in instead. The af is then fed through a .01-μf capacitor (C7) to the other diode plate of the 6AV6. The rectified af voltage is fed to the grid of the 6E5 tuning eye. It is also fed to the audio amplifier through the tracer volume control so the operator can hear the signals through the built-in speaker.

Using the tracer

Either tube or transistor radios can be checked with the 230; however, since transistor radios are not discussed as often as tube types, we will confine ourselves to the transistor radio only.

1. Dead radio

Turn on the radio and make sure it is drawing current. Tune the signal tracer to the i.f. (usually 455 kc) and hold the probe near the last i.f. transistor, touch it to the transistor case or to the slug inside the transformer. Turn the tracer to near full gain and tune the radio dial. If you hear stations, the circuits are working up to this point and you should suspect the audio circuits. If you hear no signals, then you know the trouble is ahead of the last i.f.

To trace the audio stages, switch the tracer to af. A convenient point to start is at the top of the volume control. If there is audio here, move on to the driver base, driver collector, audio output bases, audio output collectors and the speaker voice coil, until you find where the signal stops.

For tracing i.f. and rf signals, switch the tracer to rf, start at the antenna and work up to the volume control—base and collector of each stage. Remember that in a transistor radio, unlike a tube radio, you will have a loss through the i.f. transformer. The only time you won't have a loss is if the transistor input circuit is open so that there is no load on the secondary winding. If you find a set that has little or no loss, look for a broken printed circuit or an open transistor. When tracing rf or i.f. circuits, set the tracer dial to the correct frequency to get maximum gain.

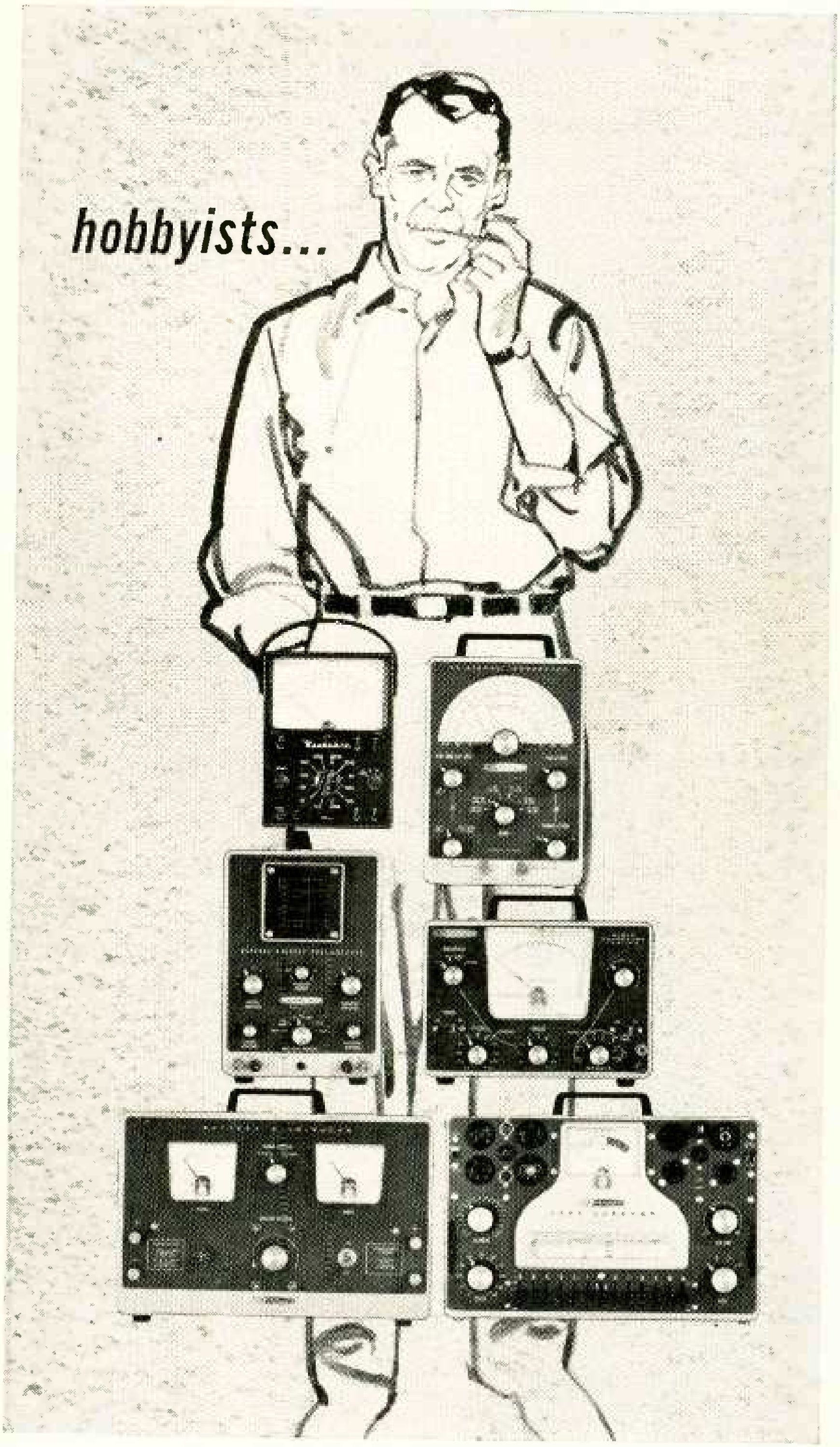
2. Testing the oscillator

The oscillator circuit is a frequent cause of trouble in transistor radios. With the model 230 you can tell not only whether the oscillator is working but also if it is at the correct frequency. Just hold the tracer probe near the oscillator circuit and tune the tracer on band B for maximum eye closure. Increase attentuation if the eye shadow overlaps. Read the oscillator frequency directly from the 230 dial. *Note: Since the tracer's top frequency is 1,500 kc, the radio diao should be set to* below *1,000 kc so that the radio's oscillator frequency will not be out of the tracer's range. (The oscillator is normally the intermediate frequency* above *the station frequency.)*

3. Checking gain

One of the most important aspects of signal tracing is in checking the gain of a radio. A set that is weak is nearly always harder to troubleshoot than a dead one. With the 230 you can check gain accurately since the tracer does not load the circuits appreciably. The

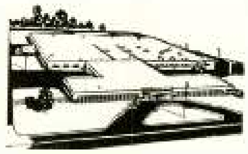
(*Continued on page 66*)



economy stacks up best

Hobbyists of all kinds find Heathkit test equipment invaluable for pursuing their hobbies with refined techniques. Audiophiles, amateur radio operators, kit builders of all kinds use these Heathkits in their workshops: IO-21, General Purpose 3″ Oscilloscope, $49.95 . . . MM-1, Sensitive Volt-Ohm-Milliammeter for all-purpose measurements, $29.95 . . . IT-21, Tube Checker for fast tests of tubes of all types, $44.95 . . . IG-102, Radio Frequency Signal Generator, $27.95 . . . IG-72, Audio Signal Generator, $41.95 . . . IP-12, Low Ripple Battery Eliminator, $47.50.

Who is Heathkit?



Heathkit is the pioneer and world's largest manufacturer devoted exclusively to the design and manufacture of do-it-yourself electronic kits. All our efforts are aimed at creating more kits, better kits, easier-to-build kits.

What are Heathkits?

Heathkits are electronic equipment in un-assembled form. All parts are packaged in convenient groups and complete, easy-to-read, well-illustrated instruction manual tells you how to put them together. Heath offers over 250 kits from simple portable radios to big analog computers.

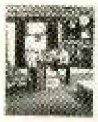
Who builds Heathkits?

Millions build Heathkits. People with absolutely no mechanical ability or knowledge of electronics as well as skilled electronic experts—all find value, economy, fun, relaxation, and pride of accomplishment in Heathkits. You can too.

Money Back Guarantee

Heath Company unconditionally guarantees that each Heathkit® product assembled in accordance with our easy-to-understand instruction manual must meet our published specifications for performance or your purchase price will be cheerfully refunded.

The famous Heathkit guarantee—This money back guarantee stands behind every Heathkit. It guarantees that you are getting equipment of the highest quality that will provide years of use and pleasure. Equipment second to none. Heathkit—world pioneer in the exciting hobby of kit building.



FREE 1963 Heathkit Catalog. Send for your free copy of this new Heathkit Catalog . . . it describes and illustrates the complete Heathkit Test Instrument line . . . units for every purpose . . . units of highest quality at lowest cost.

HEATHKIT® by Daystrom

HEATH COMPANY
Benton Harbor 20,
Michigan

☐ Please send my free 1963 Heathkit catalog

NAME____________________

ADDRESS____________________

CITY________________ ZONE________

STATE____________________

(*Continued from page 63*)
best way to check gain is to first check several radios that are performing normally. This gives you some idea of what to expect. This is your standard of performance and, when a radio deviates substantially from it, you have a good indication of where to look for trouble. *Note: Only strong stations will give you any indication at the antenna transformer secondary. There is very little signal voltage at this point.*

4. Checking audio

You can check the audio stages both for gain and distortion. Start at the top of the volume control and work right on through to the speaker. For more accurate af gain checks, use an af generator with the tracer.

For distortion, a station signal is best. Follow the af until you can localize the stage originating the distortion.

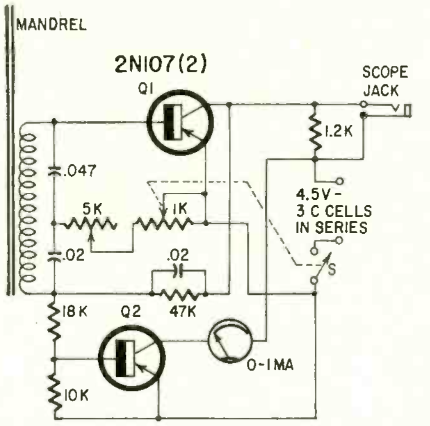
The calibrated attenuators work both for rf and af and control the amount of signal fed to the tuning eye and to the audio amplifier. On the other hand, the volume control has no effect on the eye. It controls the audio going to the speaker.

The Conar tracer fills a definite niche as an inexpensive, simple-to-operate, tuned signal tracer that should be an invaluable aid for any technician servicing broadcast radios.

Metro-Tel Shorted-Turn Indicator

This handy little device checks coils for shorts and excessive leakage rapidly and easily. You simply drop the coil being checked over the mandrel projecting out of the front panel and watch the meter. If the needle doesn't move, the coil is not shorted. If the needle moves to the left (down scale), there's a shorted turn somewhere in that coil.

The circuit used is a peak-tuned two-transistor oscillator powered by four 1.5-volt C-cells. The oscillator coil core extends through the instrument's front panel. If a shorted or very leaky coil is placed over this core (mandrel), it reduces the Q of the oscillator circuit. This cuts back the oscillator output or stops the oscillator, causing a lower meter reading. The arrangement is so sensitive that it will detect even one shorted turn in a coil of No. 44 wire.



Simple two-transistor circuit picks out shorted coils accurately.

One thing to watch out for: Normal leakage in coils with 5,000 turns or more can cause a shift in oscillator frequency and a reduction in the meter reading. (A scope can be plugged in to detect frequency shift.) So when checking large thousand-turn coils, set up a standard meter reading with a known good coil and use it to detect any defective ones.

While the coil is being checked for shorts, it can be checked for continuity. Simply short the coil leads. Continuity is indicated by the meter needle moving downscale.

Different size mandrels are for particular applications and are available on special order.

INTERNATIONAL MODEL 100 A EXECUTIVE TRANSCEIVER

International's new Model 100 A is the latest in the outstanding line of Executive transceivers. The advanced design Executive features a *transistor power supply, new perforated metal cabinet,* and a *new rugged microphone* . . . all of which contribute to a more reliable mobile operation.

The Model 100 A . . . the finest of its kind, also features: • Crystal filter for improved receiving • Twelve crystal controlled transmit positions • Two crystal controlled receive positions • Dual conversion superheterodyne receiver tuning 23 channels • Built-in calibration circuit • N R squelch • Provision for connecting external speaker and s/meter • Push-to-talk operation • Transistor power supply operates from 6/12 vdc or 115 vac

Model 100 A, complete with 1 transmit crystal, 1 receive crystal, and microphone....... $199.50

External Speaker and S/Meter

The perfect companion for the International Executive Model 100. Utilizes a high impedance vacuum tube volt meter circuit. Connects to socket on rear of transceiver. S/meter reads in three ranges. Brown cabinet, brown and silver panel matches Executive transceiver.

Complete with interconnecting cable....... $49.50

Executive Speech Clipper/Filter Amplifier

A microphone amplifier designed to increase average modulation . . . limits modulations peaks . . . filters audio frequencies above 2500 cycles. Permits arms-length microphone operation. Power requirements: 12 vac or 12 vdc.

Complete with interconnecting cable....... $36.50

12.6 VAC, 2 Ampere Power Unit

Base station power unit for Speech Clipper/Amplifier. Operates from 115 vac. Provides 12.6 vac at 2 amperes.

Complete with mounting chassis, power cord, fuse, switch....... $12.50

Citizens Band licensees with International equipped stations know the unquestioned superiority and advantages of Executive transceivers and their system engineered accessories.

See your authorized International dealer today.

INTERNATIONAL
CRYSTAL MANUFACTURING CO., INC.
18 NORTH LEE • OKLAHOMA CITY, OKLA.

FM STEREO the EASY way

Headphones cut cost, time and amount of equipment

By **ERIC LESLIE**

The hard-core stereo enthusiast insists that the only way you can get true stereo is by listening with headphones. Loudspeaker stereo does add that third dimension of direction to the sound, but the direction is limited by the speakers. The sound has to come either from one or the other, or from some point ahead of you on a plane directly between the two speakers. But, as Joe Marshall says: "Headphones put you right among the instruments."

To me, headphone stereo had one other advantage. It made it possible for me to add stereo to my present setup with a minimum of cost and trouble. A small multiplex adapter, a pair of stereo headphones and two output transformers were, roughly speaking, all I needed. The transformers for this application are not critical, but should be matched. Mine were 2,000 ohms primary to 3 to 6 ohms secondary, for use in the cathode-follower output of the Heath multiplex adapter. A higher primary impedance might work better with adapters having plate output circuits. An otherwise identical 7,000-ohm type was tried both with the cathode-follower output and with a transistor-type multiplex adapter. In both cases, output dropped 50%. Since no dc flows in the windings, large transformers are not required.

The output transformers were enclosed in a box with a pair of fuses (not really necessary for this type of headphone stereo, but useful in case I ever want to use the phones on the output of a power amplifier) and the necessary input and output jacks. The hookup is shown in Fig. 1, and is self-explanatory. All that is necessary is to connect it to the multiplex output of your FM tuner. My FM tuner did not have a multiplex output, so the problem was not quite as simple, but still not difficult.

The audio output of an FM tuner follows a *de-emphasis network*—a sort of tone control that compensates for the fact that the high frequencies are deliberately emphasized before being transmitted. This pre-emphasis and de-emphasis is one of the factors that give FM its excellent signal-to-noise characteristics. For FM stereo, we have to tap in ahead of this de-emphasis network, which is a resistor in series with the output and a capacitor across it.

Our multiplex output has to be taken off ahead of this final resistor. Fig. 2 makes this clear. The convenient thing would be to add a jack for the multiplex output. I simply soldered a short piece of low-capacitance coax directly to the discriminator output.

Some practice may be needed in adjusting the separation control to get the best stereo effect. Unfortunately the tones broadcast to help you make this adjustment are usually short, but if you can try to use them, not only will the right and left tones tell you when you are getting separation, but there is an unmistakable maximum of sound in both headphones—when both tones appear at the same time and the separation adjustment is correct—that cannot be heard on monophonic music or speech.

Another thing to watch is that the two channels are *in phase*. Reverse the connections to one of the output transformers while listening.

The headphone effect is, of course,

Output transformers (see text) (2)
Fuses, 1/2-ampere (2)
Fuse holders (2)
Pair of low-ohmage stereo headphones (Knight KN845 or equivalent)
EIA input jacks (2)
3-conductor jack, for phones (1)
Case and panel to suit
Miscellaneous hardware

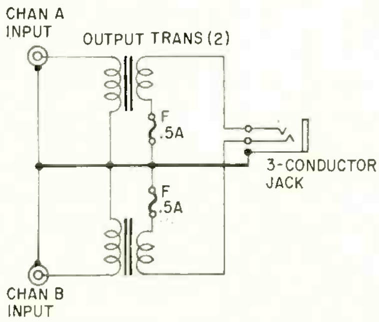


Fig. 1—Schematic of the unit.

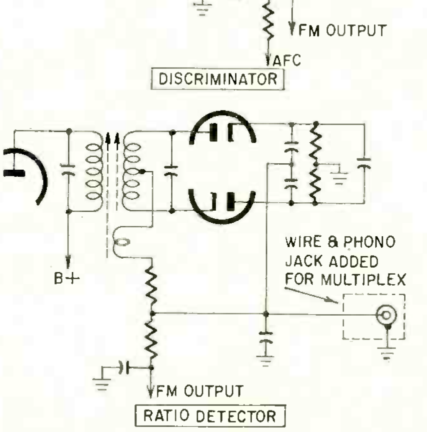
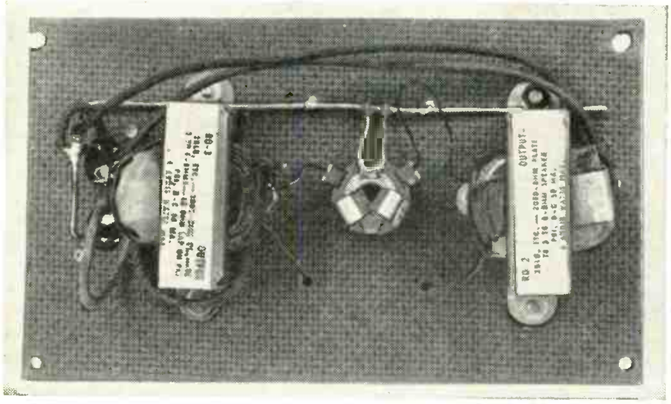


Fig. 2—How to add multiplex output to discriminator or ratio detector.



This is what's inside the box.

binaural rather than the *stereophonic* effect you get with loudspeakers. In most recordings, it is binaural reception of material recorded stereophonically. See Marshall's article in the October 1962 issue.

And, if you have a second amplifier, all you have to do for loudspeaker stereo is to pull the output leads of the multiplex adapter off the phone box and plug them into the inputs of your two amplifiers. It is a second's job to change from headphones to speaker or back again. [My own job uses the old (de-emphasized) output to the mono amplifier, so I have mono FM on speaker and stereo on headphones.]

END

why settle for a routine job in electronics while others move ahead?

Read how CREI graduate Roy S. Reichert has advanced from maintenance work to the design of electronic equipment at one of the world's leading laboratories.

CREI GRAD ROY S. REICHERT *makes an adjustment on the prototype of a programmable power supply which he designed and built in his capacity as Senior Technical Aide, Bell Telephone Laboratories, Murray Hill, New Jersey.*

JUST A FEW YEARS AGO Roy S. Reichert had a routine job maintaining electronic equipment. He realized that progress to a responsible, well-paying position in modern electronics was impossible without practical and up-to-date knowledge of advanced electronic engineering technology. Determined to prepare himself to meet industry requirements for career opportunities, he enrolled in a CREI Home Study Program. Today, he helps design complex test equipment used in the development of transistors in the Semiconductor Device Lab of Bell Telephone Laboratories.

YOU HAVE THE SAME OPPORTUNITY. CREI offers you, for study at home, a complete program in electronic engineering technology designed to equip you with the practical knowledge of electronic developments required for well-paying positions and put you on the level of specialization where men are most in demand.

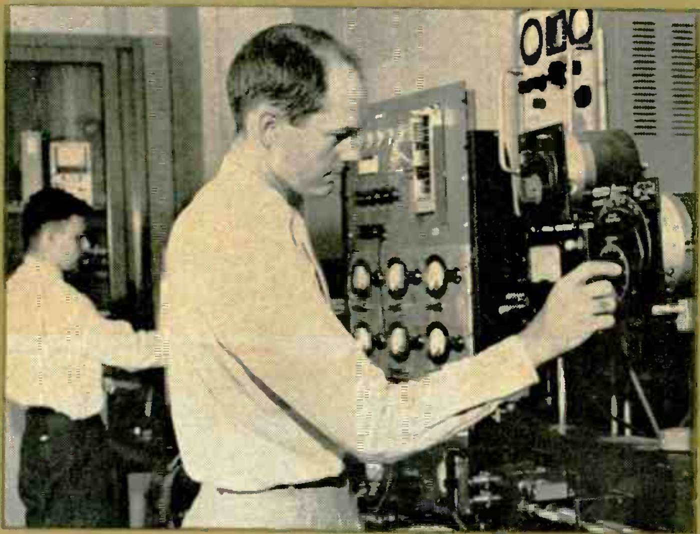
YOU WILL FOLLOW THE FOOTSTEPS of the thousands of CREI men who hold positions as associate engineers, engineering aides, field engineers, project engineers and technical representatives. They work in every area of electronics from manufacturing to research in the aero-space program.

YOU CHOOSE FROM PROGRAMS covering every important field of electronics:

SERVOMECHANISMS • INSTRUMENTATION • RADAR • COMPUTERS • AERONAUTICAL AND NAVIGATIONAL • COMMUNICATIONS • AERO-SPACE • TELEVISION • AUTOMATION AND INDUSTRIAL ENGINEERING TECHNOLOGY • NUCLEAR ENGINEERING TECHNOLOGY

A CREI PROGRAM *has helped Reichert earn respect for his creative abilities. Here he discusses the design for an automatic transistor test set with John E. Iwersen, supervisor of the transistor development group of Bell Telephone Laboratories.*

THE HIGH LEVEL *of Reichert's knowledge of electronics is shown by his ability to contribute substantially to the design of, and to build the prototype of this automatic transistor test set, which measures the device characteristics of transistors under development.*



REICHERT ENJOYS *the satisfaction and rewards of contributing to the development of semiconductor devices at Bell Telephone Labs. He was doing routine electronic maintenance work at the time he enrolled in a CREI Home Study Program.*

PROMOTIONS MERITED *with the help of CREI Home Study have brought Reichert to an income where he is able to provide a comfortable, suburban way-of-life for his wife, Dawn, and his son, Alan. The motor scooter supplements the family car.*

YOU ARE GUIDED and assisted with personal attention from CREI's staff of experienced instructors. You study courses to which a number of leading engineers and scientists have made substantial contributions.

CREI EDUCATION IS RECOGNIZED by such large corporations as Pan American Airways, Federal Electric Corp., The Martin Co., Canadian Broadcasting Co. and Mackay Radio. They pay all or part of CREI tuition for their employees.

CREI HAS 35 YEARS OF EXPERIENCE in advanced technical education through home study. CREI has developed electronics courses for the Army Signal Corps, special radio technician courses for the Navy and group training programs for leading aviation and electronics companies. CREI also maintains a Residence School in Washington, D. C. and invites inquiries from high school graduates.

YOU CAN QUALIFY for a CREI Correspondence Program, if you have basic knowledge of radio or electronics and are a high school graduate or the equivalent. If you meet these qualifications, send for the FREE 1963 edition of our 58-page book describing CREI Programs and career opportunities in electronics. Use coupon provided, or write to:

CREI *FOUNDED 1927*
THE CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 1401-A 3224 Sixteenth St., N. W.
Washington 10, D. C.

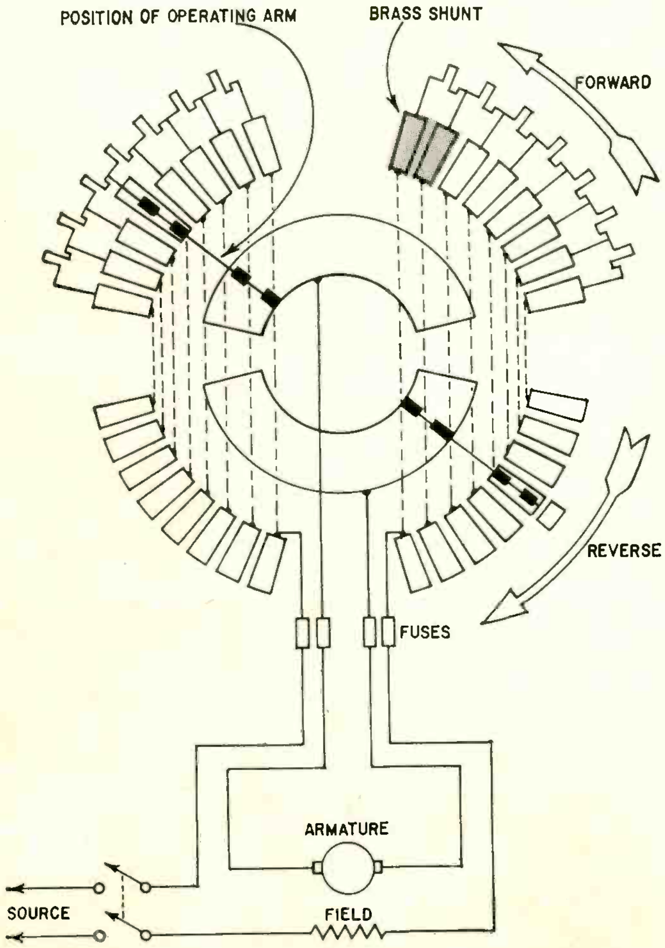
#35

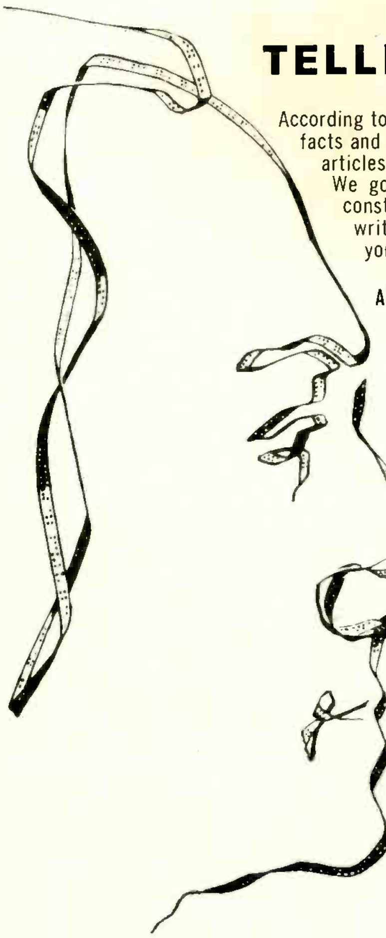
Industrial emergency repairs

ALTHOUGH THE DIAL TYPE DC CONTROLLER IS FAST DISAPPEARing, there are still enough around to keep the maintenance section worrying over the shortcomings inherent in the design. Repairing the nichrome-steel wire in the resistance coils mounted in the hollow cast-iron base is both tedious and viciously hot work that should be best delayed until weekend shutdowns make the work more convenient and leisurely. The innermost tier of coils is the first to fail, because of the entrapped heat. By the same token, it is the most difficult to get at for repairs.

The severe arcing at the contact segments as a resistance coil opens provides a way to make an emergency repair that will hold until normal shutdown can be arranged. Remove the two arcing plates (segments) and insert two thicknesses of brass shim stock large enough to cover the dual spot in one solid piece (see diagram). By drilling proper screw holes in the shim stock, you can replace the segments, place over the shims and secure them with the usual screws. Now the brass shims bridge the gap in the defective resistance coil and service is restored in a matter of minutes (if you have the shunts cut and perforated beforehand).

The slightly increased elevation of the shunted segments offers practically no obstruction to the passage of the carbon brushes on the rotating arms, since the rounded edges of segment and brush provide smooth motion. We have had as many as three shim shunts in place on as many old dc cranes, awaiting an opportune time to dismantle the interior of the hollow cast-iron base to replace those troublesome resistance coils.—*Paul C. Ziemke*





EACH TUBE ATTRACTIVELY BOXED & BRANDED RAD-TEL

Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
___0Z4	.79	___6AU8	.87	___6K6	.63	___12CU5	.58
___1AX2	.62	___6AV6	.41	___6S4	.52	___12CU6	1.06
___1B3	.79	___6AW8	.90	___6SA7GT	.99	___12CX6	.54
___1DN5	.55	___6AX4	.66	___6SH7	1.02	___12D4	.69
___1G3	.79	___6AX5	.74	___6SJ7	.88	___12DE8	.83
___1J3	.79	___6BA6	.50	___6SK7GT	.95	___12DL8	.88
___1K3	.79	___6BC5	.61	___6SL7GT	.84	___12DQ6	1.04
___1R5	.77	___6BC8	1.04	___6SN7	.65	___12DS7	.84
___1S5	.75	___6BE6	.55	___6SQ7GT	.94	___12DT5	.76
___1T4	.72	___6BF5	.90	___6T4	.99	___12DT7	.79
___1U5	.65	___6BF6	.44	___6T8	.85	___12DT8	.78
___1X2B	.82	___6BG6	1.70	___6U8	.83	___12DW8	.89
___2AF4	.96	___6BH8	.98	___6V6GT	.54	___12DZ6	.62
___3AL5	.46	___6BJ6	.65	___6W4	.61	___12ED5	.62
___3AU6	.54	___6BJ7	.79	___6W6	.71	___12EG6	.62
___3AV6	.42	___6BK7	.85	___6X4	.41	___12EK6	.62
___3BC5	.63	___6BL7	1.09	___6X8	.80	___12EL6	.50
___3BN6	.75	___6BN6	.74	___7A8	.68	___12EZ6	.57
___3BU8	.78	___6BQ6	1.12	___7AU7	.65	___12F8	.66
___3BY6	.58	___6BQ7	1.00	___7EY6	.75	___12FA6	.79
___3BZ6	.56	___6BU8	.70	___7Y4	.69	___12FM6	.50
___3CB6	.56	___6BX7	1.11	___8AU8	.90	___12FR8	.97
___3CS6	.58	___6BZ6	.55	___8AW8	.93	___12FX8	.90
___3DG4	.85	___6BZ7	1.03	___8BQ5	.60	___12GC6	1.06
___3DK6	.60	___6C4	.45	___8CG7	.63	___12J8	.84
___3DT6	.54	___6CB6	.55	___8CM7	.70	___12K5	.75
___3GK5	.99	___6CD6	1.51	___8CN7	.97	___12L6	.73
___3Q4	.63	___6CG7	.61	___8CS7	.74	___12SF7	.69
___3S4	.75	___6CG8	.80	___8EB8	.94	___12SK7GT	.95
___3V4	.63	___6CL8	.79	___8FQ7	.56	___12SL7	.80
___4BQ7	1.01	___6CM7	.69	___9CL8	.79	___12SN7	.67
___4CS6	.61	___6CN7	.70	___11CY7	.75	___12SQ7GT	.91
___4DT6	.55	___6CQ8	.92	___12A4	.60	___12U7	.62
___4GM6	.60	___6CR6	.60	___12AB5	.60	___12V6	.63
___5AM8	.79	___6CS6	.57	___12AC6	.55	___12W6	.71
___5AN8	.90	___6CS7	.69	___12AD6	.57	___12X4	.47

RAD-TEL TUBE CO. NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
___5AQ5	.54	___6CU5	.58	___12AE6	.50	___17AX4	.67
___5AT8	.83	___6CU6	1.08	___12AE7	.94	___17DQ6	1.06
___5BK7	.86	___6CY5	.70	___12AF3	.73	___18FW6	.49
___5BQ7	1.01	___6CY7	.71	___12AF6	.67	___18FX6	.53
___5BR8	.83	___6DA4	.68	___12AJ6	.62	___18FY6	.50
___5CG8	.81	___6DE6	.61	___12AL5	.47	___19AU4	.87
___5CL8	.76	___6DG6	.62	___12AL8	.95	___19BG6	1.39
___5CQ8	.84	___6DJ8	1.21	___12AQ5	.60	___19EA8	.79
___5EA8	.80	___6DK6	.59	___12AT6	.50	___19T8	.85
___5EU8	.80	___6DN6	1.55	___12AT7	.76	___21EX6	1.49
___5J6	.72	___6DQ6	1.10	___12AU6	.51	___25AX4	.70
___5T8	.86	___6DT5	.81	___12AU7	.61	___25C5	.53
___5U4	.60	___6DT6	.53	___12AV6	.41	___25CA5	.59
___5U8	.84	___6DT8	.94	___12AV7	.82	___25CD6	1.52
___5V6	.56	___6EA8	.79	___12AX4	.67	___25CU6	1.11
___5X8	.82	___6EB5	.73	___12AX7	.63	___25DN6	1.42
___5Y3	.46	___6EB8	.94	___12AY7	1.44	___25EH5	.55
___6AB4	.46	___6EM5	.77	___12AZ7	.86	___25L6	.57
___6AC7	.96	___6EM7	.82	___12B4	.68	___25W4	.68
___6AF4	1.01	___6EU8	.79	___12BD6	.50	___32ET5	.55
___6AG5	.70	___6EV5	.75	___12BE6	.53	___35C5	.51
___6AH4	.81	___6EW6	.57	___12BF6	.60	___35L6	.60
___6AH6	1.10	___6EY6	.75	___12BH7	.77	___35W4	.42
___6AK5	.95	___6FG7	.69	___12BK5	1.00	___35Z5	.60
___6AL5	.47	___6FV8	.79	___12BL6	.56	___36AM3	.36
___6AM8	.78	___6GH8	.80	___12BQ6	1.16	___50B5	.69
___6AQ5	.53	___6GK5	.61	___12BR7	.74	___50C5	.53
___6AS5	.60	___6GK6	.79	___12BV7	.76	___50EH5	.55
___6AT6	.49	___6GN8	.94	___12BY7	.77	___50L6	.61
___6AT8	.86	___6H6	.58	___12BZ7	.86	___70L7	.97
___6AU4	.85	___6J5GT	.51	___12CN5	.56	___117Z3	.85
___6AU6	.52	___6J6	.71	___12CR6	.67	___807	.75

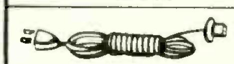
• FREE! Send For New Tube & Parts Catalog • Send For Trouble Shooting Guide

Be your own **TELEVISION REPAIRMAN**

The Original NOW YOU CAN FIX YOUR OWN TV SET BOOK

You can fix your own TV if you have TV Fixit Book . . . because 80% of troubles are caused by tubes. This book explains, illustrates trouble and what tubes cause this trouble. Pinpoints in over 3000 layouts by model number, position and type tube causing trouble.

No. 170 .... **$1.00**



CHEATER CORD 6 ft., No. 154 .... **29¢ ea.** Lots of 3—25¢ ea.

Easy to work on set while panel is off.

RAD-TEL TUBE CO. TV, RADIO AND HI-FI

DEPT. RE-1 55 CHAMBERS STREET, NEWARK 5, NEW JERSEY

TERMS: 25% deposit must accompany all orders, balance C.O.D. Orders under $5: add $1 handling charge plus postage. Orders over $5: plus postage. Approx. 8 tubes per 1 lb. Subject to prior sale. No C.O.D.'s outside continental U.S.A.

---------ORDER FORM ● MAIL TODAY---------

RAD-TEL Tube Co.
Dept. RE-1
55 Chambers Street
Newark 5, New Jersey

Total Tubes $________
Total Part(s) $________
Postage $________
Grand Total $________

ENCLOSED IS $________________ Please rush order.

SEND: _____Book(s) Be Your Own TV Repairman @ $1.00 ea. #170
_____Cheater Cord 29c ea. Lots of 3 - 25c ea. #154

Orders under $5.00 - Add $1.00 handling charge - plus postage.

FREE! ☐ Send FREE Tube and Parts Catalog
☐ Send FREE Trouble Shooting Guide

NAME ....

ADDRESS ....

CITY .... ZONE .... STATE ....

Guide to Semiconductor Terms

By Sylvania Semiconductor Div.

(Concluded)

Nonosecond—A thousandth of a microsecond (10^{-9} second).

N-p-n Transistor—A device consisting of a p-type central section with two n-type semiconductor end sections.

N-Type—A semiconductor crystal with a surplus of electrons, or negatively charged particles.

Parameter—A derived or measured value which expresses performance for use in calculations.

P-Type—A semiconductor crystal with a surplus of holes or positively charged particles.

P-n Junction—The region of transition between n-type and p-type parts of a piece of semiconductor material.

P-n-p Transistor—A device consisting of an n-type central section with two p-type end sections of semiconductor material.

Resistivity—A property of material that determines its ability to conduct electricity. The amount and kind of impurity (dopant) in semiconductor material determines conductivity and whether the material is p- or n-type.

Reverse Bias—An external voltage applied to a p-n junction with a polarity such that very little current flows across the junction. Changing polarity will give forward bias and a large current will flow. (See Diode) Reverse bias widens the depletion region.

Saturation (Leakage) Current—The current flow between the base and collector measured with the emitter lead open, or between the emitter and collector with the base lead open. Most frequently, this current refers to the leakage between the base and collector.

Saturation Voltage—In a switching transistor, voltage drop across transistor when it is fully turned on. A perfect switch has negligible voltage drop.

Semiconductor—A conductor, whose resistivity is between that of metals and insulators, in which electrical charge carrier concentration increases with increasing temperature over a specific temperature range.

Solid-State Devices—Any elements that can control current without moving parts, heated filaments or vacuum gaps. All semiconductors are solid-state devices, but some solid-state devices are not semiconductors.

Storage Time—That part of the total switching time of a transistor required to sweep current carriers out of the collector region when the switch is turned off.

Transistor—A semiconductor device capable of transferring a signal from one circuit to another and producing amplification.

Varactor—A semiconductor junction device designed to utilize the nonlinear variation of junction capacitance with change in applied voltage. END

NEW LITERATURE

CATALOGS • BOOKLETS • CHARTS

LEVER-TYPE SWITCHES shown in 6-page *Catalog S-302.* Engineering drawings, specs and operating features of Lev-R, Lever-Lock and Telever switches. Full page explains prouct applications. —**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

TRANSVERTER POWERS MOBILE GEAR, reprint of September 1962 R-E article by Oliver Williams and Edmund P. Kelly, Jr. Tells how to build a universal transistorized transverter for mobile electronic equipment. Unit provides 12-vdc or 117-vac power for equipment requiring up to 280 vdc at 150 ma.—**Stancor Electronics, Inc.**, 3501 W. Addison St., Chicago 18, Ill.

CATALOG SHEET offers audio books *High Fidelity Systems*, by Roy F. Allison, and *Reproduction of Sound* by Edgar Villchur, plus needle force gage.—**Acoustic Research, Inc.**, 24 Thorndike St., Cambridge 41, Mass.

MATHEMATICAL PUZZLES, 33 of them supplied in new version of *Problematical Recreations.* Solutions in back of booklet.—**Litton Industries**, 336 N. Foothill Rd., Beverly Hills, Calif.

FOR THE LANGUAGE LABORATORY, 4-page illustrated leaflet, describes microphones, headsets, combinations for classroom use. Photo and specs of eight models.—**Turner Microphone Co.**, Audio-Visual Products Div., 909 17 St. N.E., Cedar Rapids, Iowa.

AMATEUR AND SHORT-WAVE RECEIVERS offered in 12-page 8½ x 11-inch brochure. Includes complete line, gives description and specs on each receiver.—**National Radio Co., Inc.**, Dept. P, Melrose 76, Mass.

OMINIDIRECTIONAL ANTENNAS described in 2-page *Bulletin No. 621.* Details high-gain colinear-array omnidirectional base-station antennas for 2-way service in 150– 450–mc ranges. Contains charts with typical vswr curves, gain of colinear arrays, diagrams of mounting details. Selection chart includes prices. Explains how new construction isolates antennas from weather effects. —**Mark Products Div., Dynascan Corp.**, 5439 W. Fargo Ave., Skokie, Ill.

PUSHBUTTON SWITCHES. 6-page *Catalog S-301* features new series 970 Tiny-Frame direct-acting pushbutton switch for space-saving applications. Also illustrates manufacturer's Littel Switches, Button Switches, Cord Switches, T Switches and others. Lists engineering data, design features, dimensional drawings, full page of application ideas.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

COLOR BAR GEN, model 661 Chrom-Aligner, described in 4-page brochure. Defines and illustrates NTSC standard signal plus standards for white-dot and cross-hatch patterns. Outlines setup procedure to operate model 661.—**Hickok Electrical Instrument Co.**, 10514 Dupont Ave., Cleveland 8, Ohio.

POWER RESISTORS listed in 8-page *Catalog D-130.* Describes manufacturer's line of stock Vitrohm vitreous enamel wirewound power type resistors for electronic and industrial application. Stock listing, prices, dimensions given for axial-lead, fixed, adjustable, strip, disc, plaque, noninductive and intermittent-duty types. Mounting hardware data included.—**Ward Leonard Electric Co.**, Electronic Distributor Div., Mt. Vernon, N. Y.

HI-FI COMPONENTS offered in 6-page illustrated foldup leaflet. 15 items include amplifiers, tuners, receivers, multiplex–stereo adaptors. Photos and specs of all units.—**Grommes**, Div. Precision Electronics Inc., 9101 King St., Franklin Park, Ill.

ELECTRONIC COMPONENTS pictured in 4-page leaflet. Products include tube testers, converters, circuit analyzer, tester adapter, cables. Photos and technical data on all models, plus extension-cable selector guide.—**Antronic Corp.**, 2712 W. Montrose, Chicago 18, Ill.

INDUSTRIAL ELECTRONIC PARTS shown in enlarged 1963 *Catalog 73.* Lists over 70,000 items from 500 manufacturers; includes products for industrial, defense and broadcast use. 60 pages of semiconductor devices with numerical listing by JEDEC number. Many illustrations, full specs.—**Newark Electronic Corp.**, 223 W. Madison St., Chicago 6, Ill.

BASIC COMPONENT HOLDERS described and illustrated in 2-page *Bulletin B2.* Offers stainless-steel pliers, tweezers and other small tools in standard and unique shapes.—**Techni-Tool, Inc.**, 1216 Arch St., Philadelphia 7, Pa.

TERMINALS, TERMINAL BOARDS, CHASSIS HARDWARE offered in two 4-page and one 8-page catalog. Included are mil specs covering materials and finishes on handles, screws, spacers, standoffs, bushings, brackets. Materials and plating for terminals, plus multiple sizes in single, double, triple turrets, tubulars, split-type double-end and threaded. All sizes and dimensions of standard, modular and special Proto type terminal boards.—**Sales Dept., Concord Electronics Corp.**, 37 Great Jones St., New York 12, N. Y.

TEST EQUIPMENT offered in 20-page catalog. Illustrations, specifications, special features and prices of milliammeters; vtvm's; tube, transistor, crystal diode testers; signal, sweep, audio and color gens; resistance and capacitance decades; scopes; capacitor testers; power supplies; signal tracers.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N. Y.

ELECTRICAL SPECIALTIES. 100-page 1962–63 catalog illustrates over 1,500 electrical wiring devices, switches, receptacles, transformers, extension and cord sets, fuses, wall plates, push buttons and lamps. New items include ac switch in competitive grades, blister-packed and poly-bagged supplies. All products grouped in categories and completely cross-indexed.—**Eagle Electric Mfg. Co., Inc.**, 23-10 Bridge Plaza South, Long Island City 1, N. Y.

PRECISION POWER RESISTORS presented in 16-page illustrated catalog. Contains specs and standard ranges/tolerances/resistances of silicone-coated resistors for power requirements in advanced-circuitry and high temperature applications, metal-clad resistors for high-power heat-sink applications. Also includes recap of CAL-R's production and quality-control methods.—**California Resistor Corp.**, 1631 Colorado Ave., Santa Monica, Calif.

AUDIO EXCHANGE BOOKLET, 10-page *Trader's Handbook.* Describes nationwide trading systems, including service department, custom installations and design, mail-order service, trade-in and trade-back of new and used equipment.—**Audio Exchange**, 153-21 Hillside Ave., Jamaica, N. Y.

ELECTRONIC COMPONENTS of some hundreds of manufacturers catalogued in 2,200-page *Electronic Engineers Master, 1962-63* (EEM) purchasing guide of the electronic industry. Sections include: product finder (who makes what); catalog section (1,325 pages of photos and specs in 51 product sections); manufacturers and sales offices directory; trade names directory; cross-section index. Available free to engineers and purchasing agents, others $15. Available on microfilm.—**Tech Publishers, Inc.**, 60 Madison Ave., Hempstead, N. Y.

LOUDSPEAKER BROCHURE *Catalog 165-H.* 24-page booklet covers all technical and styling details of hi-fi, loudspeaker, headphone equipment. Discusses slim vs bookshelf speakers, headphone accessories, remote control devices.—**Jensen Manufacturing Co.**, 6601 S. Laramie Ave., Chicago 28, Ill.

END

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.

TECHNICIANS' NEWS

Color TV Course

Pasadena, Calif.—A 12-week course on practical color TV service, sponsored by the California State Electronics Association–Pasadena, and co-sponsored by the San Gabriel and Whittiers chapters, is underway. The cost of the course is $25, and includes all texts and work materials. Classes are held every Thursday evening. The course is limited to service operators and their employees. It assumes practical knowledge and experience in black-and-white TV service. The course covers theory, but emphasizes practical color TV servicing. Diplomas will be issued to technicians completing the course.

Tri-State Council Events

Gloucester, N. J.—A color school is scheduled for 20 technicians of the Allied Electronic Technicians Association Inc. of New Jersey. Attendance is limited to 20 because of the way the course is given, and reports from TSDA (Delaware County) members who have attended it say "it is the most."

Wilmington, Del.—All members who successfully completed the recent color school sponsored by the Television Service Dealers Association of Delaware received their color school certificates. The association thanks the RCA instructor and Ty Yonker of Raymond Rosen & Co. for the course.

Trenton, N. J.—Members voted to adopt licensing, as presented by the Tri-State Council. Certificates will be issued, as well as identification cards. An advertising program will get underway in the near future. The group (Radio Servicemen's Association of Trenton, N. J.) also took on a group life insurance program, which will go into effect as soon as plans are finished with other Tri-State members.

Around Wisconsin

Green Bay—The regular meeting of the local TESA group was held at the Wisconsin Public Service Building. Attendance was considered exceptionally good. The main point of discussion was the NATESA convention in Chicago.

Milwaukee—At a recent meeting, communications from Senator Proxmire and Congressmen Zablocki and Reuss were read. They expressed delight to have heard from TESA–Milwaukee, urging support of the Quality Stabiliza-

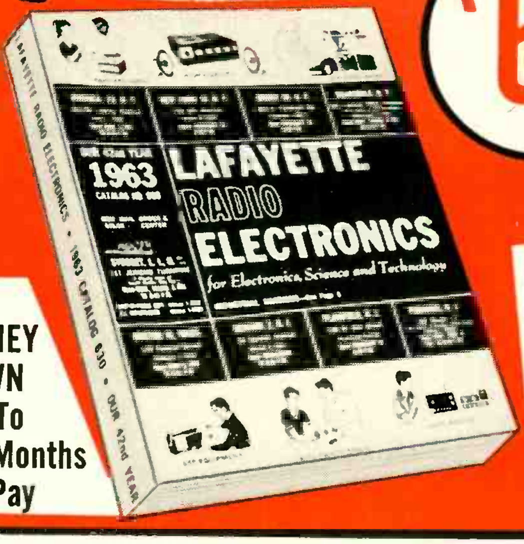
FREE! FOR '63

LAFAYETTE RADIO ELECTRONICS

1963 CATALOG NO. 630

388 GIANT-SIZE PAGES —

The Largest Catalog in Our 42-Year History



NO MONEY DOWN Up To 24 Months To Pay

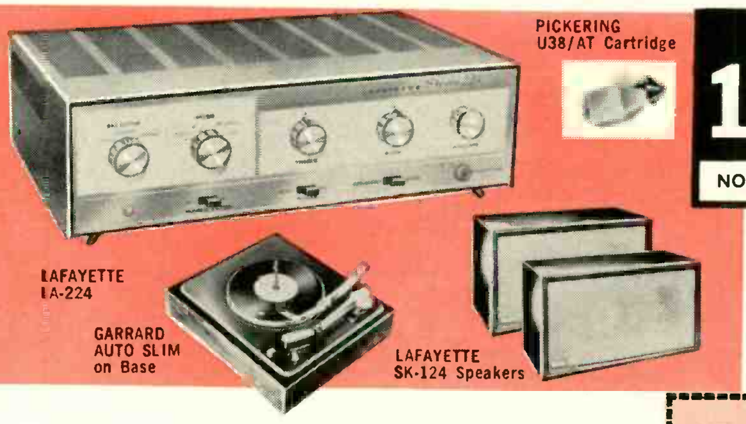
from the "WORLD'S HI-FI & ELECTRONICS SHOPPING CENTER"

WHEN YOU BUY AT LAFAYETTE, YOU GET THESE EXCLUSIVE BENEFITS

- OUTSTANDING LAFAYETTE KITS
- LOWEST PRICES
- 24-HOUR SERVICE

- **SATISFACTION GUARANTEED OR MONEY REFUNDED.** Use Lafayette's 30-Day FREE Home Trial.
- **LARGEST STOCK SELECTION.** If it's in Hi-Fi or Electronics, it's in the Lafayette Catalog.
- **NO MONEY DOWN.** Buy on time with Lafayette's Easy Pay Credit Plan, up to 24 months to pay.

TRUE, CUSTOM-MATCHED STEREO NEED NOT BE EXPENSIVE —*and isn't at Lafayette!*



ONLY **129.50**

NO MONEY DOWN

YOU SAVE 49.30

A COMPLETE 24-WATT STEREO PHONO SYSTEM

Only at Lafayette could you find an outstanding, custom-matched stereo system at such an amazing low price. Compare components, compare performance, compare price—you'll choose Lafayette.

LS-225WXM Specify: Pickering Cartridge; wood base finish; Speaker System finish. Shpg. wt., 64 lbs. Net **129.50**

YOU GET THESE SYSTEM MATCHED COMPONENTS

Lafayette LA-224 24-Watt Stereo Amplifier	49.95
Garrard Autoslim 4-Speed Record Changer	39.50
Wood Base (Specify Walnut, Mhg. or Blonde)	3.95
Pickering U38/AT Diamond Needle Cartridge	46.50
2 Lafayette SK-124 2-Way Speaker Systems (Specify walnut or mahogany) @ 19.95 each	38.90
Regular Catalog Price	~~178.80~~

LAFAYETTE'S MAIL ORDER and SALES CENTER

SYOSSET, L. I., NEW YORK
111 Jericho Turnpike

OTHER LOCATIONS

NEW YORK, NEW YORK 100 6th Avenue	SCARSDALE, NEW YORK 691 Central (Park) Ave.	PARAMUS, NEW JERSEY 182 Route 17
JAMAICA, NEW YORK 165-08 Liberty Avenue	PLAINFIELD, NEW JERSEY 139 W. 2nd Street	BOSTON, MASS. 110 Federal Street
BRONX, NEW YORK 542 E. Fordham Rd.	NEWARK, NEW JERSEY 24 Central Avenue	NATICK, MASS. 1400 Worcester Street

MAIL THIS COUPON TODAY for YOUR FREE LAFAYETTE 630 CATALOG

Get One for a Friend Too

LAFAYETTE RADIO ELECTRONICS
Dept. JA-3, P.O. Box 10, Syosset, L.I., N.Y.

☐ Rush my FREE 388-page giant-size Lafayette Catalog

☐ Send me #......................, Shipping charges collect.

I am enclosing ....

Name..

Address..

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

Friend's Name..

Address..

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

tion Act. G. Hall reported that he and several members attended a meeting at Stevens Point, where a new tri-county chapter may soon be organized.

Sheboygan County—The annual picnic was held at Kalks Place, close to Plymouth, Wis., with almost 100% participation. L. N. Mathieu was chef. Roy Van Sluys, vice president, was his chief assistant.

Check Those Postcards

If your service-shop housekeeping isn't all it should be, take a look around. You may be harboring a treasure. Hanging on the back of repaired radios and TV sets or lying on service-shop shelves may be some of General Electric's old 2-cent advertising postcards. In 1958, when the postage rate rose to 3 cents, the Chicago post office overprinted many of these 2-cent cards. G-E sent some to customers, and some ended up hanging on the back of receivers. Now they're collector's items, and have sold for as much as $20. Don't write G-E, they don't have any more!

Lemons on the Road

Wayne Lemons, popular RADIO-ELECTRONICS author, heads Sencore's new traveling technical clinic. His coast-to-coast tour includes over 200 towns and cities, where he will tell service technicians about "Short Cuts That Speed Up Servicing of Color and Monochrome TV and Transistor Circuits."

Lemons (center) discusses the new time-saving clinic with Sencore president Herb Bowden (right) and chief engineer Bob Baum (left).

The clinics are sponsored by local electronic parts distributors, who can inform interested technicians when and where they will be held.

Lemons, owner of two radio-TV service shops, was named G-E Serviceman of the Year in 1958.

Ethics Code Ok'd

San Diego, Calif.—The majority of electronic repair firms have agreed to comply with newly established service standards and a Code of Ethics set up by the San Diego County Bureau of Home Appliances in cooperation with the local Better Business Bureau. The code includes features of many similar codes already existing in other cities. Individual service technicians, service assocation representatives, suppliers and other segments of the industry were

HOW TO BE SURE OF GOOD TV SERVICE...

1. Beware the Service "Bargain." If you shop around for cut-rate prices or extra-liberal service contracts, you're *asking* for trouble. A "something-for-nothing" offer usually means cut-rate parts and substandard service methods. The *reputable service dealer* spends years in study and training—thousands of dollars on test equipment, tools, and service manuals—countless hours in keeping up-to-date on new developments and service techniques. Because of this heavy investment, he can't *afford* to offer "bargains."

2. Rely on a Fully Qualified Independent Service Dealer. Well known and highly regarded by your friends and neighbors, his professional training and experience have made him a real technical expert. He takes pride in his work. He wants to stay in business. And he stakes his reputation and his future on satisfying *you*. So he'll use only component parts of the highest quality and latest design—plus his thorough knowledge and keen skills—to do the job right. Depend on him; he can't *afford* to let you down!

Your TV set provides you with a wealth of entertainment. Keep it in the best repair . . . at lowest cost . . . by calling your local TV-RADIO Service Dealer at the first sign of trouble!

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,
DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS FOR . . .

YOUR INDEPENDENT TV-RADIO SERVICE DEALER

6S-342 R1

consulted before the standards and code were drawn up.

TV Service Seminar

New York, N. Y.—Service and engineering pointers on the 1963 Westinghouse television sets were highlighted at a TV service seminar held by Westinghouse at the National Design Center. Service technicians and dealers from the metropolitan New York and New Jersey area attended. The Westinghouse color-coded chassis, instant-on mobile sound and the company's warranty program were covered fully in talks given by J. H. Fooks, K. H. Brown, H. J. Horstmann, J. J. Eagan and G. E. Bouton, all from Westinghouse.

Roly Poly Boosts Business

A boost for the independent service dealer is offered by General Electric in the form of an inflatable plastic "Roly Poly" toy. Bearing the name "Independent TV Service Dealer", this 28-inch inflatable toy can be used as a store display or in consumer sales promotion. It is made of heavy-gauge

white vinyl, colorfully decorated in blue-gray, red-orange and black. It is available to service dealers, as G-E part No. ETR-3261, for $1.65, deflated and packed in individual mailing boxes. It can be obtained from authorized General Electric tube distributors.

Yellow-Page Fight Rages

Sacramento, Calif.—The fight to regulate yellow-page TV service advertising is still going strong. Chapters throughout the state are getting more and more cooperation from the telephone company, and hope that the battle will soon be over. What the California State Electronics Association is after is that every firm advertising in the yellow pages be required to have an address and a place of business. Experience has shown that the greatest source of customer complaints has stemmed from firms advertising only phone numbers. In some instances, the same phone number has appeared in several ads with different firm names. The association has suggested that any service dealer in the state that knows and has proof of irregularities should put them in writing and send them to the state office in Sacramento.

Promotion to Boost Trade

Treasure-Hunt Promotion: Place an article or merchandise somewhere in your store. Give clues—and the finder gets the prize.

Post Card Mailings: Each postcard has a number. Recipient is invited to bring a card to the store and check to see if this number is listed. Lucky numbers receive prizes.

Prize When Bell Rings: Ring a bell in the store at irregular intervals. Those in the store at the time receive a few items of merchandise, or a 5% discount on purchases.

End-of-Month Drawing: At the end of each month a "drawing" is held of purchase slips deposited in a special box each day. Those holding lucky slips get full refund.

Sale-A-Thon: Conduct a dawn-to midnight contest—once a month. Offer unusual discounts on selected merchandise items.

END

In-Circuit Capacitor Testing

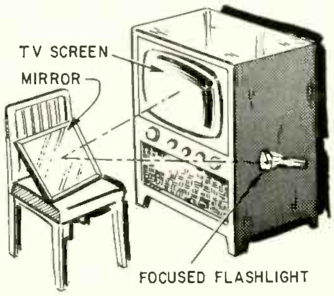
The statement is often made that an ordinary bridge circuit will not measure capacitance in-circuit! But I find that my EICO 950B will check capacitors for value in-circuit, if the shunting resistance is not too low. These values are roughly as follows:

.001 μf	10 megohms
.01 μf	3.3 megohms
.1 μf	220,000 ohms
.2 μf	68,000 ohms
5 μf	10,000 ohms
10 μf	2,000 ohms
100 μf	100 ohms

I have tried the "comparator" range for in-circuit testing, using a capacitor and variable resistor as the "standard". The results were not conclusive, as the bridge would not balance at several points on the dial—*Charles Andrews*

TV Viewing Mirror Setup

Have a headache setting up your mirror so you can watch the TV screen while making rear-chassis adjustments? Well, here's a way to avoid the headache. Set up a flashlight at a convenient viewing point—the place your head will be when you look at the mirror.



Turn on the light. Now place the mirror on a chair in front of the set. Move it around till the flashlight beam hits the center of the mirror. Now angle the mirror until the light beam is reflected onto the center of the TV screen. That's all there is to it.—*David T. Geiser*

Soft Tips for Earpieces

Perhaps some readers have tried the new low-priced "Stethoscope" earphones offered by many distributors recently—both dynamic and crystal—and

When you order merchandise by mail...

- Be sure to include your address with postal zone number (if you have one).
- Type or print if you can—if not, write clearly.
- Don't send cash—use checks or money orders.
- Include allowances for postage charges if you know the weight of what you're ordering. (Parcel post rates are not affected by the new postal rate increases.)

have found them very satisfactory. From a lightweight performance standpoint, they are a welcome relief from the old-fashioned heavy "cans". However, the hard, small plastic tips quickly become uncomfortable in the ears. This can be easily remedied by inexpensive "slip-on" pencil erasers, in which a small hole has been drilled, placed over the hard tips. Shape the end of the eraser with sandpaper. For sanitation, each earphone wearer can have his own erasers.—*F. Bodine*

Cup-Hook Cable Standoffs

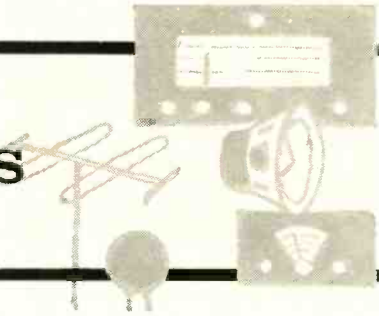
Need some standoff insulators for an electric cable or heavy-gage wire? Im-

provise your own standoffs by snapping rubber grommets into the eyes of cup hooks as shown.—*John Comstock*

Better Grip Tool Handles

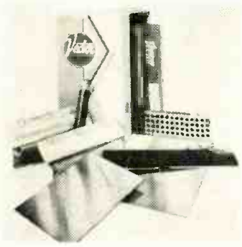
When using screwdrivers and nut drivers with plastic handles I raised more than one blister trying to tighten or loosen a tough screw or nut. To get around this problem, I got a piece of large-diameter Alphlex shrinkable tubing and fitted it over the tool handle. A little heat applied with a soldering iron shrinks the tubing to a tight fit over the plastic handle. The next time I had need for the driver there were no more blistered hands, and the resilient surface of the tubing let me get a better grip on the tool, making the job easier.—*Warren Roy* END

"He's waiting for the man next door to turn his hi-fi on."



NEW PRODUCTS

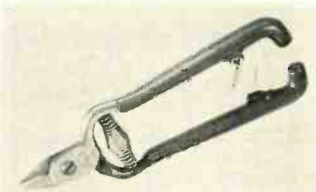
ETCHED-CIRCUIT KIT, *model 27X.* Simple etched circuits. 2 pieces 4½ x 6½ x 1/16-in. thick phenolic, clad one side with 2-oz copper, perforated with overall grid of .062-in. holes on 0.2-in. centers. Unperforated area ½-in. on one edge for etching connector fingers. 1 sheet tape-resist circles. 1 sheet tape-resist strips; 2 bags dry etchant chemical; 1 ballpoint etch-resist pen; 2 sheets grid layout paper; complete instructions.—**Vector Electronic Co.,** 1100 Flower St., Glendale 1, Calif.



TRANSISTOR IGNITION KIT, *GD-212,* for 12-volt negative-ground ignition systems. Voltage-protected transistors, adjustable for optimum current. Two 2N1546 transistors, two 56-volt 1-watt Zener diodes; adjustable 1-ohm 100-watt ballast resistor; Mallory F-12T coil, current meter.—**Heath Co.,** Benton Harbor, Mich.

MICA TRANSMITTER TYPE CAPACITORS. Epoxy-encapsulated elements, no wax or thermoplastic filling. Rectangular blocks or two end plates; interchangeable with Mil styles CM65 and CM70, but operate to 125°C. Also single endplate. Used at full current ratings to maximum operating temperature, without derating.—**Sprague Electric Co.,** 81 Marshall St., North Adams, Mass.

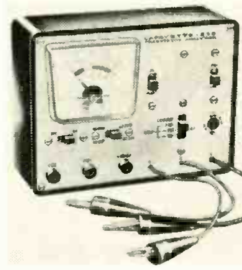
LONG POINTED BLADES, ELECTRONIC SNIPS, *In-Dus-Tronic No. P4.* Shear action of serrated long-pointed blades cuts filament, fine wire, other electronic materials. Spring return keeps blades open. Polished head, factory-mounted cushion-grip handles.—**H. Boker & Co., Inc.,** 101 Duane St., New York 7, N. Y.



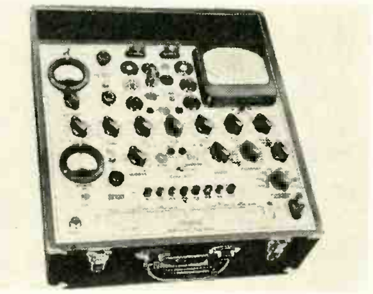
TRANSMITTER TESTER, *model 1A89.* For rf output tests, audio output tests and tuning adjustments on transmitters for radio-controlled garage-door operators.—**Perma-Power Co.,** 3100 N. Elston Ave., Chicago 18, Ill.

ELECTRICAL CIRCUIT TESTER, *model BZ5 Chek-It.* Tests continuity, fuses, switches, buzzers, push buttons, chimes, appliances, motors, auto ignition voltage regulators.—**Workman Electronic Products, Inc.,** Box 5397, Sarasota, Fla.

TRANSISTOR ANALYZER KIT, *KT-223.* Tests all transistors including power types. In- and out-of-circuit transistor checker, diode and rectifier checker, signal generator, battery tester, voltmeter, milliammeter. Out-of-circuit check for leakage, also beta gain in 3 ranges to 200. 5-kc test signal with harmonics for checking rf, if and af circuits. Voltmeter measures up to 12 vdc, milliameter checks current drain to 80 ma.—**Lafayette Radio Electronics Corp.,** 111 Jerico Turnpike, Syosset, N. Y.



PORTABLE TUBE TESTER, *model 539C.* Tests VR tubes, low-power thyratrons, 4-digit industrial types, compactrons, Novars, nuvistors, 10-pin types. No elements paralleled; evaluate voltage regulator tubes under actual operating conditions. Separate monitoring of plate current through panel



(Continued on page 92)

The Electronic Catalog of the Year
BY POPULAR DEMAND!

over 1,000,000 new friends— amateurs, pros, hi-fi devotees, hams— have already sent for it!

EASY TIME PAYMENT TERMS take up to 2 years to pay

YOU CAN STILL GET RADIO SHACK'S

GREAT NEW 1963 Electronic CATALOG

FREE

For you and 2 Friends
MAIL CARD TODAY

284 PAGES
OVER 10,000 ITEMS

Partial list of products in our New 1963 Catalog

• Amateur Radio	• Public Address
• Antennas	• Radios
• Batteries	• Resistors
• Books	• Tape Recorders
• Capacitors	• Test Equipment
• Controls	• Tools
• Hi Fi	• Transformers
• Microphones	• Transistors
• Needles	• Tubes
• Phonographs	• Wire

Yes, over 1,000,000 brand new friends have been added to the millions who shop regularly from Radio Shack's big catalog but we want everyone interested in electronics to have this great money saving shopping guide so we've printed 500,000 more for you and your friends. Mail the card opposite today and get your share of the newer and better things in electronics in this fine new book.

Whether you are a music devotee, a radio ham, a professional operator, or just interested in the great world of communications as a hobby, you'll be excited and delighted with the vast assortment of precision-built, high-quality, guaranteed products in Radio Shack's famous catalog. And you'll save too as you never saved before. Our easy credit terms make it convenient and simple to buy what you want when you want it and pay later. Mail the card opposite now!

RADIO SHACK CORPORATION 730 Commonwealth Ave. BOSTON 17, MASS.

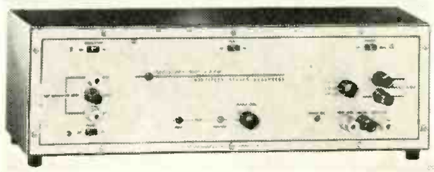
(Continued from page 87)

terminals to aid matching or balancing tubes. Built-in switch for measurements under fixed or self-bias conditions. Nonstandard tests aided by plate terminals giving access to grid, plate, cathode and heater circuits. Six ranges, 600–60,000 μmhos. Metered line and grid voltage, dual tube leakage readings directly on meter or by neon short indicator.—**Hickok Electrical Instrument Co.,** 10514 Dupont Ave., Cleveland 8, Ohio.

SELF-SERVICE TUBE TESTER, *model 202-LB.* Tests Nuvistors, novars, compactrons, 10-pin types, plus 6- and 12-volt vibrators, fuses, pilot lights. 63 phosphor-bronze beryllium sockets, will

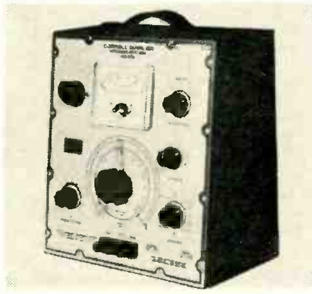
accommodate new tube types to come. Sliding drawers, tube dividers, drawer sheets for automatic inventory control. Flip tube charts list more than 1,200 tube types, new charts available periodically. 16 in. high x 20 in. wide x 19½ in. deep.—**Mercury Electronics Corp.,** 111 Roosevelt Ave., Mineola, N. Y.

STEREO MULTIPLEX SIG GEN, *model E-490.* For rapid alignment, complete testing of multiplex circuitry in FM stereo receivers and adapters. Measures and adjusts channel separation, channel balance, sync pull-in and hold-in range.



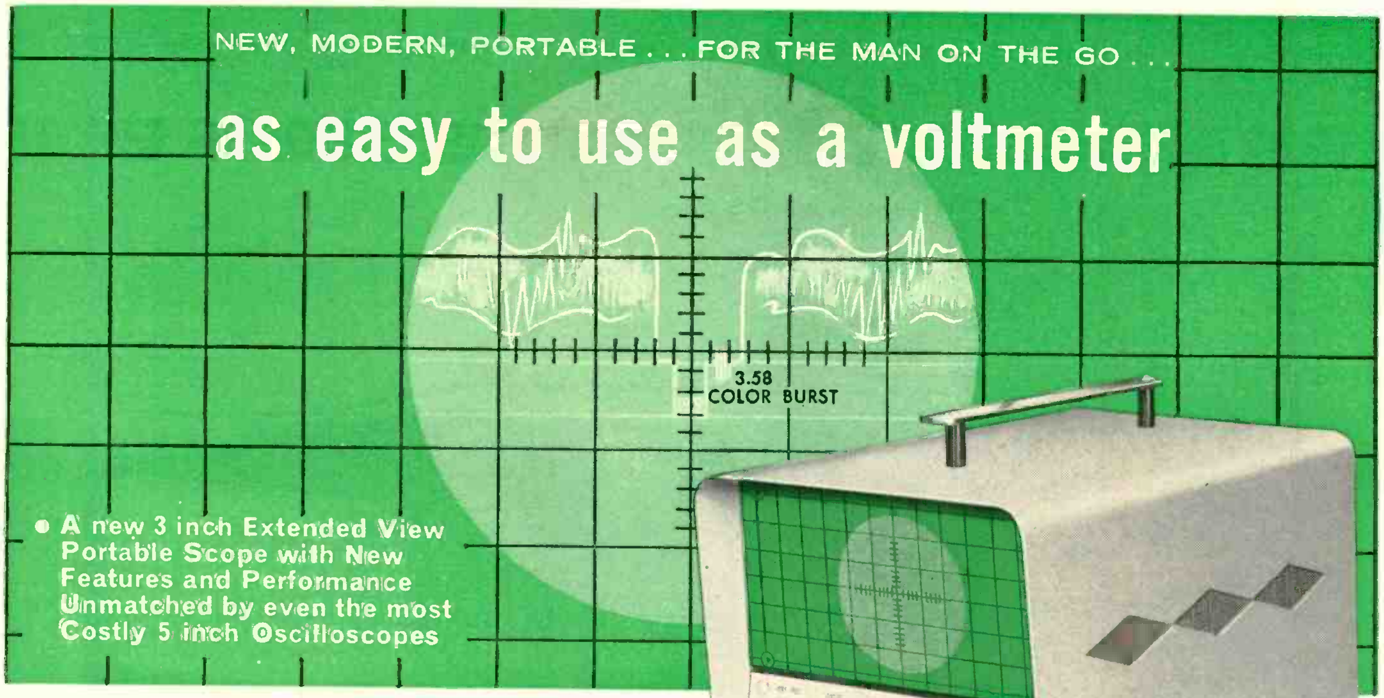
Self-contained 1-kc audio oscillator or external audio generator switchable to generate left only, right only, sum or difference signals. Pilot signal switches on or off.—**Precision Apparatus Co., Inc.,** 70-31 84 St., Glendale 27, N. Y.

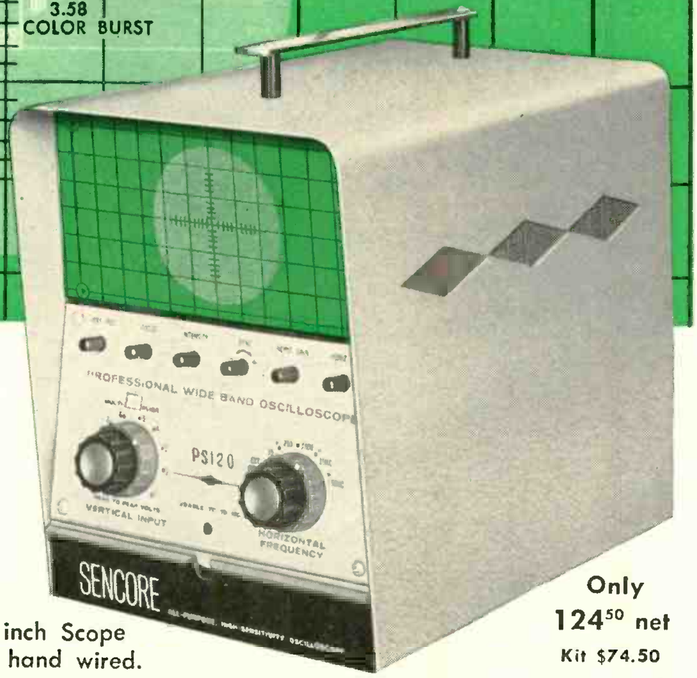
CAPACITOR ANALYZER, *model BF-71.* Tests unit with ratings of 1–500 volts. Measures 10-pf to 2,000-μf capacitors. Resistance measurement range 2.5 ohms–29 megs; current measurement, 2 μa–100 ma. Measures power factors to



50%. Internal power supply 0–500 vdc at 35 ma maximum for capacitance leakage tests. Checks leakage currents on tantalum capacitors plus aluminum foil types.—**Cornell-Dubilier Electronics Div.,** Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

DC VOLTAGE REFERENCE SUPPLY FOR SCOPES, *Scope-O-Trol type PS-39590.* Opposing potential cancels dc increment of circuit being checked, so ac and dc steady-state and transient voltage changes seen in true form. 115-volt 60-cycle circuit. Regulation ±.005% for ±15% line change.





NEW

SENCORE PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

Lowest priced Wide Band 3 inch Scope anywhere. All hand wired.

Only 124^{50} net
Kit $74.50

Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job.

• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectedly. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down —3 DB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 DB from 45 to 330 KC, flat within —6 DB from 20 to 500 KC.

HIGH DEFLECTION SENSITIVITY:

	RMS	P/P
Vertical Amplifier—Vert. input cable	.035V/IN.	0.1V/IN.
Aux. vert. jack	.035V/IN.	0.1V/IN.
Through hi-imped. probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—	.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 85 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 20 MMF
Through hi-imped. probe	27 Meg. shunted by 8.6 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC usable to 12 MC

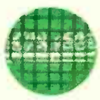
MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— Aux. vert. jack—	1000 VPP (in presence of 600 VDC)
Hi-imped. probe— Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts Stby. pos. 10 watts

SIZE: 7" wide x 9" high x 11¼" deep—weight 12 lbs.

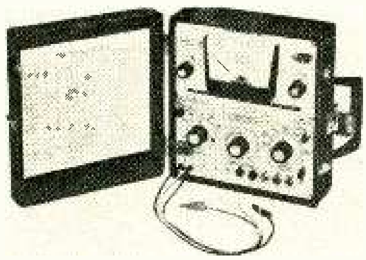


The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE
ADDISON 2, ILLINOIS

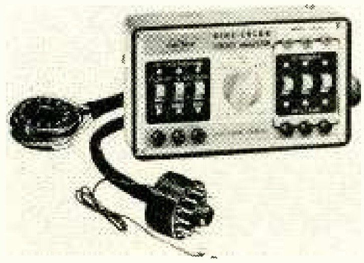
Output adjustable 0 to 52 volts dc, stabilized at selected voltage. Coarse adjustment in 6 overlapping 10-volt steps, fine-adjustment potentiometer selective at 2 mv per degree or rotation. Ripple .002% peak to peak. Output voltage stability within ±.015% per hour after 15-minute warmup.—**Acme Electric Corp.**, Cuba, N. Y.

TRANSISTOR/TUNNEL DIODE ANALYZER, *model 250.* Reads collector-to-base and collector-to-emitter leakage currents, tests tunnel and Zener diodes. Checks transistors in or out of circuit. Indicates transistor leakage and gain, tun-



nel-diode negative resistance characteristics, diode forward conductance and reverse current leakage. Identifiees n-p-n and p-n-p transistors, matches transistors of similar type by ac dynamic test or dc analysis, operates as sine-wave and harmonic signal generator or comprehensive circuit analyzer. AC power or battery-powered.—**Seco Electronics, Inc.,** 1201 S. Clover Dr., Minneapolis 20, Minn.

CIRCUIT ANALYZER, *Anchor model CA 378 Kine-Color.* Complete analysis of color picture tube and related circuits under operating conditions. With volt-ohm-milliammeter, measures operating voltages in circuits supplying power to elements in color tube. Tests color guns, indicates

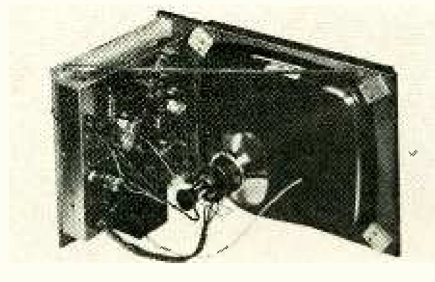


results of adjustments. Built-in method of disabling one or more CRT guns during purity adjustments and convergence procedures. With scope, checks signals at CRT. Switching arrangement for testing any gun and related circuits without disturbing others.—**Antronic Corp.,** 2712 W. Montrose, Chicago 18, Ill.

INDUSTRIAL-AMATEUR TV CAMERA, *AL-DEE.* Dual tetrode video amplifiers, built-in

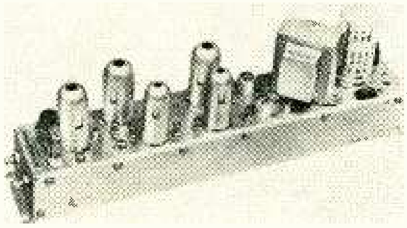
intercarrier 4.5-mc sound system. Complete audio-visual closed-circuit transmitter. 2-inch electrostatic Vidicon and F 1.9 48-mm lens of standard Leica/-Cannon camera. Output adjustable to vhf channels 2–6.—**Denson Electronics Corp.,** Longview St., Rockville, Conn.

23-INCH CUSTOM TV KIT, *model GR-22.* 17-tube, 5-diode circuit with uhf. Turret type Standard-Kollsman nuvistor tuner. 4 preassembled and aligned subassemblies including optional uhf.



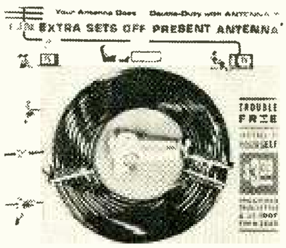
Transformer-operated power supply with tube rectifier. Line thermistor, circuit breaker and B-plus fuse, gated agc and noise canceller, vertical and horizontal retrace blanking. Picture power 20,000 volts. Cathode follower output; 8-ohm 2-watt output for integrated speaker. Wide-band, high-gain, 3-stage prealigned i.f. strip with 5 built-in interference traps. Dc restorer. Video response 3.5 mc. Audio output impedance 8 ohms.—**Heath Co.,** Benton Harbor, Mich.

AUDIO MASTER, *model AM.* Adds complete sound channels to master antenna and community antenna TV systems. Receiver on line reproduces



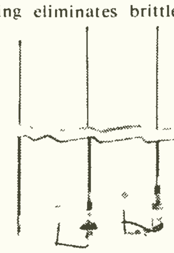
FM or AM music, tapes, hi-fi recordings, public address. No extra distribution materials, cables or cabinets; mounted into same housing with other equipment.—**Blonder-Tongue Labs, Inc.,** 9 Alling St., Newark, N. J.

HOUSEHOLD COUPLER PACKAGE, *Antenna +.* Inductive set coupler, 25 feet of Twin-lead. Connects any number additional sets to exist-



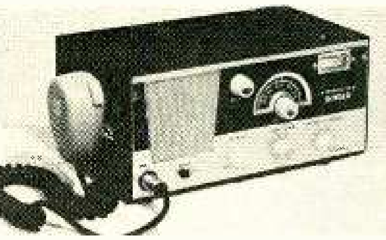
ing antenna line with snap-on installation. Isolation factor between final set and any auxiliary 12 db; 24 db between auxiliary sets. Loss due to placement on line ½ db for low-frequency channels, ¼ db for highs.—**Aerogap Corp.,** 1680 N. Vine St., Los Angeles 28, Calif.

CB ANTENNA, *Black Beauty.* Solid black Fiberglas sleeving eliminates brittleness, cracking,



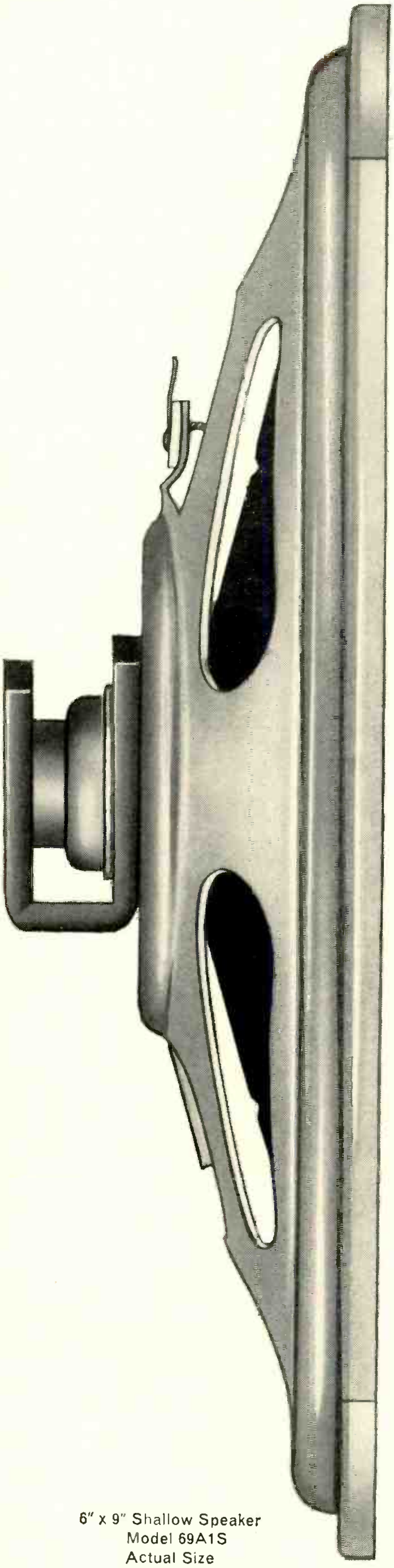
mottling and graying. Center-loaded, 48 inches. Cowl, deck, fender or truck mount.—**Antenna Specialists Co.,** 12435 Euclid Ave., Cleveland, Ohio

6-CHANNEL CB TRANSCEIVER, *model R-1050.* Nuvistor front end, push-to-talk ceramic mike, adjustable squelch, series type noise limiter. Ceramic mike, 1 transmitting and 1 receiving crys-



tal, universal type mobile mounting bracket.—**De-Wald Radio,** Div. United Scientific Labs, 35-15 37th Ave., Long Island City 1, N. Y.

2-WAY MOBILE RADIO, *Comco model 700 μh-AM.* For military airport vehicles communicating with control towers and planes. Transmitter/receiver/power supply chassis, remote control head, speaker-assembly military type microphone, antenna, hardware and cabling for vehicle installation. Single-frequency crystal-controlled operation in military range 225–400 mc. Interchange on ve-



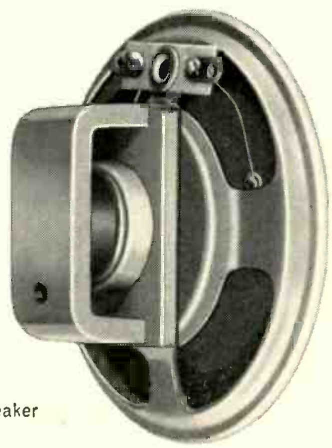
6" x 9" Shallow Speaker
Model 69A1S
Actual Size

For those special applications choose a Quam speaker

When you need a 2¼" unit for a transistor radio—or a shallow 6" x 9" for a Thunderbird replacement—Quam has it!

When you need a special voice coil impedance or special field resistance—Quam has it!

Quam gives you the widest selection and the highest quality in the entire speaker industry! Ask for Quam, the Quality line, for all your speaker needs.



2¼" Transistor Radio Speaker
Model 22A06Z8
Actual Size

QUAM

QUAM-NICHOLS COMPANY
234 East Marquette Road
Chicago 37, Illinois

SPECIAL LOW COST SUBSCRIPTION RATES

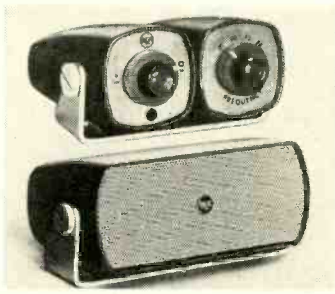
to RADIO-ELECTRONICS available to clubs, associations and other groups. *Write*: G. Aliquo, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N. Y.

hicles with 6-, 12- or 24-volt battery systems. Hand-carried case available to operate from 6-, 12-, 24-vdc or 117-vac power source, or for rack-mounting as control-tower transceiver.—**Communications Co., Inc.,** 300 Greco Ave., Coral Gables, Fla.

TONE SQUELCH, *kit models GD-162A* (ac), *GD-162D* (dc). 4-position selective call kit eliminates unwanted conversations on CB channels. Switch selection of 4 tone signals, all-tone monitor position, built-in power supply, relay contacts for

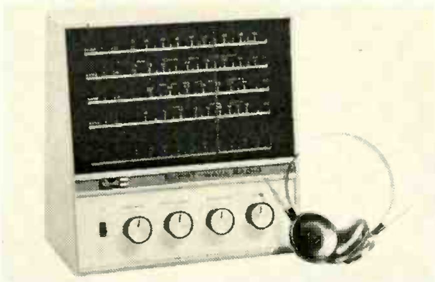
connecting external alarm device. Defeat switch for normal operation. Connected to CB transceiver, operates as speaker switch controlled by resonant-reed relay. Receiver speaker disconnected until actuated by selected tone.—**Heath Co.,** Benton Harbor, Mich.

2-WAY CAR RADIO, *Super-Carfone.* 30- and 60-watt models. All-transistor receiver and power supply circuits, maximum transistorization in transmitter. Transmitter instantly goes from "off" to



full-power transmit when mike removed from clip. Audio output transistors in speaker assembly. Provision for addition of companion units for multiple frequency and selective dial calling control.—**RCA Mobile Communication Products,** Meadow Lands, Pa.

SHORT-WAVE RADIO KIT, *model Y-8000.* Professional dual headphones. Standard AM broadcast band, 3 short-wave bands to 18 mc. 2-transis-



tor regenerative detector with single audio stage. Controls: professional type slide-rule tuning, electrical bandspread, regeneration, antenna tuning. Operates on 9-volt transistor radio battery.—**Revell, Inc.,** 4223 Glencoe Ave., Venice, Calif.

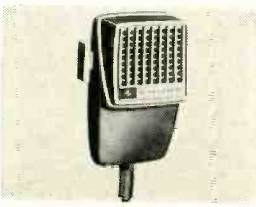
CB TRANSCEIVER, *Globe-Master.* Transmitter section: 11 crystal-controlled channels. Maximum plate power input 5 watts. 100% plate-modulated using push-pull class-AB1 modulator. Adjustable modulation level. Speech clipping adjustable to 22 db. Speech filtering limits audio response to 350-3,000 cycles. Receiver section: Dual conversion superhet, choice of 11 crystal-controlled channels or

tunable over all 22. Selectivity 6-db point at 6 kc. 60-db point at 25 kc. Image rejection 50 db. Series gate noise limiter. external speaker jack.—**GC Electronics Co.**, 400 S. Wyman St., Rockford, Ill.

HIGH OUTPUT MICROPHONE, *Big Mike*. Transistorized. variable mike for mobile or base CB and amateur transceivers. Built-in transistor

amplifier with adjustable controls, squeeze-to-talk bar, magnetic hang-up. Optional permanent magnet allows unit to be hung on any metal surface. 4½ x 1½ in.—**Instruments & Communications, Inc.**, 33 Danbury Rd.. Wilton. Conn.

PALM MICROPHONES, *series 201-401*. Shaped voice reponse, omnidirectional polar pattern. Model *201*. ceramic cartridge, high impedance, output level —55.5 db. *Model 401A*, controlled mag-



netic, high impedance. output level —49 db. *Model 401B*, controlled magnetic. low impedance. for PA applications. output level —48 db.—**Shure Bros., Inc.**, 222 Hartrey Ave., Evanston, Ill.

RECORD CHANGER, *Studiomatic*. Replacement unit or for custom installation. Turntable, almost 12-in. diameter, balanced and cushioned to minimize rumble. Plays all sizes of records. inter-

mixed in any sequence. Manual operation allows single play without interfering with automatic mechanism. Optional accessories: 45-rpm spindle, mounting board, base.—**RCA Sales Corp.**, 600 N. Sherman Dr., Indianapolis, Ind.

AUTOMATIC RECORD CHANGER, *model PK-750*. Plays all 4 speeds automatically or manually, intermixes 1-in. stacks of 7-, 10- and 12-in. records. Built-in antiskate device, pop filter to elim-

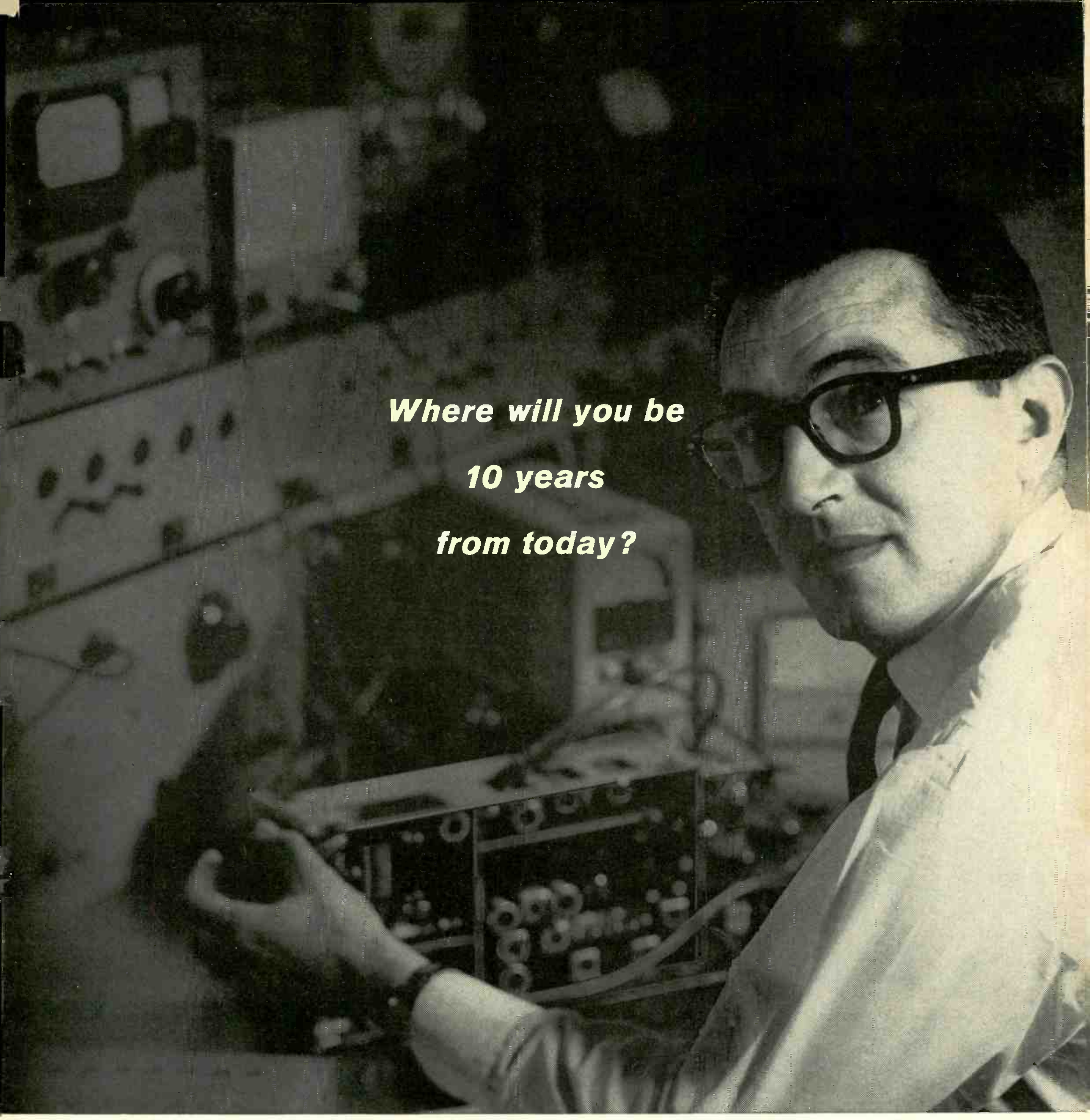
inate sounds between cycles. One-piece, die-cast aluminum tone arm, turnover stereo cartridge. Motor dynamically balanced, isolated by rubber mounts.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

TAPE RECORD/PLAYBACK, *Truvox model PD-96*. 4-track stereo. Built-in record and playback preamps. 7½, 3¾ and 1⅞ ips. Separate motor for each reel plus squirrel-cage motor for driving cap-

(Continued on page 102)

SELLING an idea, product or service?

You can reach more than 155,000 prospects economically with classified advertising in RADIO-ELECTRONICS.


Where will you be
10 years
from today?

RCA CLASSROOM TRAINING
IN NEW YORK CITY AND LOS ANGELES

INDUSTRY DESIGNATED JOB TITLES	THIS IS THE RCA TRAINING THAT WILL HELP YOU GET IT!	QUALIFICATION
Engineering Aide, Lab Technician, Field Service Engineer, Test Engineer, Technical Instructor	Electronics Technology (T-3)	High School Grad with Algebra, Physics or Science
Electronic Technician, Field Technician, Computer Technician, Broadcasting Technician, Customer Service Engineer, Instrument Technician	Industrial and Communications Electronics (V-7)	2 yrs. High School with Algebra, Physics or Science
TV Serviceman, Electronic Tester	Electronics and Television Receivers (V-3)	2 yrs. High School with Algebra, Physics or Science
Transistor Circuits Specialist	Transistors	Radio background
Junior & Senior Detail Draftsman	Electronic Drafting (V-11, V-12)	2 yrs. High School with Algebra, Physics or Science
Color TV Service Technician	Color Television	Television background
Hi-Fi Service Technician	Audio Hi-Fidelity	Radio background
Technical Writer	Technical Writing	Electronics background
Cameraman, TV Film Editor, Video Technician, Director	TV Studio Production (S-1)	High School Grad
Console Operator, Junior Programmer	Computer Programming (C-1)	College Grad or Industry sponsored
Radio Code Technician	Radio Code	8th Grade
Preparatory	Preparatory Math & Physics (P-1)	1 yr. High School
Preparatory	Preparatory Mathematics (P-OA)	1 yr. High School

• **Free Placement Service.** RCA Institutes graduates are now employed in important jobs at military installations such as Cape Canaveral, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, and in radio and TV stations all over the country. Many have opened their own businesses. A recent New York Resident School class had 93% of the graduates who used the FREE placement service accepted by important electronics companies, and had their jobs waiting for them on the day they graduated!

Note: 3 additional locations. RCA Technical Institutes offers a limited selection of basic resident school courses in Electronics in Chicago, Philadelphia, and Cherry Hill, N. J. (near Camden). For complete information write the name of the city of your choice on the attached postcard.

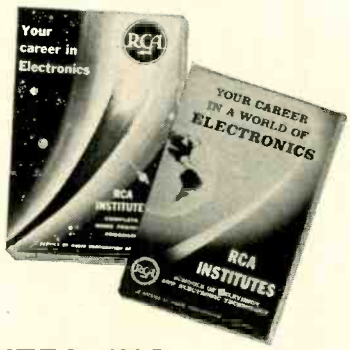
RCA HOME TRAINING

INDUSTRY DESIGNATED JOB TITLES	THIS IS THE RCA TRAINING THAT WILL HELP YOU GET IT!	QUALIFICATION
Radio aligner, Repairman, Tester	Radio-Electronic Fundamentals	8th Grade
Black & White TV Service Technician	Television Servicing	Radio Background
Color TV Service Technician	Color Television	Black & White Television
Automation Technician	Automation Electronics	Radio or Electronics Fundamentals
Transistor Circuits Specialist	Transistors	Radio or Electronics Fundamentals
Transmitter Technician, Communications Specialist	Communications Electronics	Radio or Electronics Fundamentals
Junior Draftsman	Electronic Drafting	8th Grade
Coder, Programmer, Analyst	Computer Programming	High School Grad plus 1-year business experience

• **Voluntary Tuition Plan for Home Training Courses.** This plan affords you the most economical possible method of home study training. You pay for lessons only as you order them. If, for any reason, you wish to interrupt your training, you can do so and not owe one cent. No other obligations! No installment payments required!

• **You get Prime Quality Equipment.** All kits furnished with home-training courses are complete in every respect and the equipment is top grade. You keep all the equipment furnished to you for actual use on the job, and you never have to take apart one piece to build another!

SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY! SPECIFY HOME STUDY OR NEW YORK OR LOS ANGELES RESIDENT SCHOOL



RCA INSTITUTES, INC. Dept. ZRE-13
A Service of the Radio Corporation of America,
350 West 4th St., New York 14, N. Y.
Pacific Electric Bldg., 610 S. Main St., Los Angeles 14, Calif.

RCA®

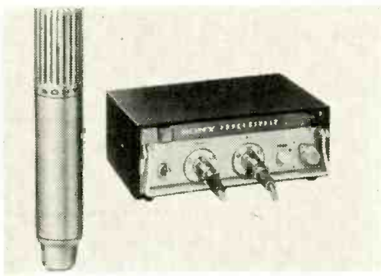
The Most Trusted Name In Electronics

(Continued from page 97)

stan. Independent VU meter each channel. Separate gain controls each channel and each input. Off-the-tape monitoring, cue button, digital counter, automatic shutoff. Permanently lubricated capstan and flywheel bearings. 7-inch reels. Bias frequency 95 kc. Mike inputs: high-impedance (2 megs) sensitivity: 1.0 mv. Radio/phono inputs: 0.5 meg, sensitivity 150 mv. Output: approximately 1 volt, low impedance. At 7½ ips, wow and flutter 0.12%,

frequency response 30-20,000 cycles. Signal-to-noise ratio 50 db, channel separation 55 db.—**Benjamin Electronic Sound Corp.,** 80 Swalm St., Westbury, N. Y.

MINIATURE CONDENSER MIKE, *model C-17B.* Cardioid pattern with 25-db front-to-back sensitivity. Frequency response ±2 db–15,000



cycles. Power supply included; low-frequency 4-position step attenuation and high-frequency cutoff. ⅝ in. diam × 3¾ in. long.—Sony unit. available from **Superscope Inc.,** 8150 Vineland Ave., Sun Valley, Calif.

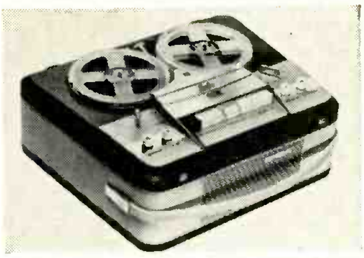
STEREO HEADPHONES, *model HA-8.* Frequency response 20–15,000 cycles, maximum input power 2 watts. Impedance 8 ohms per phone. Attenuation of ambient noise 20 db at 1,000 cycles. Lateral pressure about 2 lb over 8-sq-in. area. 6-ft

conductor cord with strain relief, ¼-in. diameter 3-circuit phone plug. Cord connects for right or left cup. Y-cords also available. Headphones with special impedances can be ordered.—**Sharpe Instruments Inc.,** 965 Maryvale Dr., Buffalo 25, N. Y.

STEREO AMPLIFIER KIT, *model SA-210.* Power output 8 watts per channel. Peak power output 16 watts per channel. Frequency response

20–18,000 cycles. Dual inputs: magnetic phono and tape, tuner, crystal.—**Merrell Electronics Inc.,** 519 Hendrix St., Brooklyn 7, N. Y.

4-TRACK STEREO TAPE RECORD/PLAYER, *Continental 401.* 7½, 3¾, 1⅞ plus 15/16 ips for 32 recording hours on 7-inch reel. Self-contained. Records stereo and mono, plays back stereo or mono tapes through unit or external hi-fi sys-



tem. Inputs for recording from mike, tuner and phono, facilities for mixing and multiplay. Foot-switch control, for monitoring with stereo headphones. 2 power amps, 2 loudspeakers, 2 preamps using 4 transistors. At 7½ ips, frequency response 60–16,000 cycles ±3 db. wow and flutter 0.14%. Signal-to-noise ratio –48 db. Input sensitivity: microphone 1 mv; radio/phono 150 mv.—**North American Philips Co., Inc.,** High Fidelity Products Div., 230 Duffy Ave., Hicksville, N. Y.

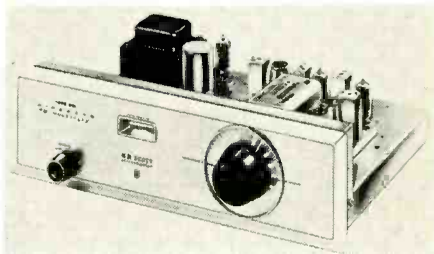
30-WATT FM–AM STEREO RECEIVER, *model RP230.* Frequency response ±1 db, 20–20,000 cycles. FM sensitivity 0.85 μv for 20-db quieting.

Stereo-Minder indicator, electronic-eye tuning, tape recorder filter.—**Bogen Communications Div.,** PO Box 500, Paramus, N. J.

STEREO PHONO CARTRIDGE, *Stanton 481A.* For manual tone arms. Recommended tracking force 2–5 grams. Dc resistance 3,200 ohms, inductance 640 mh, load resistance 47,000 ohms. Nominal output 1 mv/cm/sec, channel separation

35 db. Frequency response 1½ db down at 20 kc, channel balance 1 db. Mumetal shielding.—**Pickering & Co.,** Sinnyside Blvd., Plainview, N. Y.

FM STEREO TUNER, *model 370.* Time-switching multiplex circuitry. *Sonic Monitor* stereo signal. 3-gang tuning capacitor with tuned rf stage. Planetary-drive tuning, wide-band detector. Sepa-



rate level controls. IHFM sensitivity, 3.5 μv. Capture ratio 6 db, selectivity 32 db, separation over 30 db, signal-to-noise ratio 55 db.—**H. H. Scott, Inc.** Dept. P, 111 Powdermill Rd., Maynard, Mass.

DISK-WHISK KIT. Cleans records while they play. Brush sweeps grooves, cylinder pad deposits coating of anti-static fluid. Device clips to arm of any record changer or turntable. Replacement kit,

model ESK-8, contains roller and fluid.—**Robins Industries Corp.,** 15-58 127th St., Flushing 56, N. Y.

All specifications are from manufacturers' data

A Bold Departure in Paging Speakers!

Look carefully at the new Electro-Voice PA7 paging speaker. The speaker that defies tradition to give you more value than any other paging unit on the market!

Even the horn is new! Molded of tough, unbreakable Cycolac* plastic, it outlasts metal yet doesn't "ring" like ordinary bells. And the color is molded in. Fading, peeling, rusting problems are gone forever!

Inside, a brand new ring-type diaphragm of fiberglass-reinforced Acoustalloy® provides the authoritative voice of the PA7. Unusually high efficiency is coupled with smoothly rising response and low distortion. Test it with voice—even music! This is crisp, commanding sound that puts even larger speakers to shame!

Although the PA7 is light in weight, the ingenious swivel mounting is strictly heavy-duty for quick, absolute positioning anywhere . . . mobile or fixed!

Every detail of design and performance of the PA7 reflects the refreshing, new ideas that have made E-V PA speakers the finest in the industry! Ideas that mean highest quality and reliability for you and your customers!

Measure this remarkable new paging speaker against your personal yardstick of quality. No matter how critically you judge the Electro-Voice PA7, you'll find it's better than you expected. Except the price. That's much better!

* T.M. Borg-Warner

SPECIFICATIONS: Frequency Response 400-13,000 cps, Sound Pressure Level 119 db (at 4′ on axis, 7.5 watts input, 2-4 kc), Power Handling Capacity 7.5 watts, Impedance 8 ohms, Dispersion 120°, Size 6¾″ diameter x 6″ deep, Weight 2 lbs.

$28.35 LIST
(Normal trade discounts apply)

ELECTRO-VOICE, INC.
Commercial Products Div., Dept. 136E,
Buchanan, Michigan

. . . THE SMART MOVE IS TO ELECTRO-VOICE!

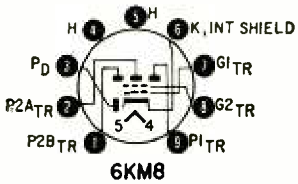
Electro-Voice®

NEW SEMI CONDUCTORS & TUBES

DESPITE THE NAME OF THIS COLUMN, we're starting off with a combination tetrode with three plates and a diode in the same miniature envelope. Further on, you'll find some controlled rectifiers, a *nor* gate in a semiconductor package and a triode-pentode for TV vhf tuner applications.

6KM8

Here's a fascinating tube—a multi-unit 9-pin miniature that houses a diode and a sharp-cutoff tetrode that has three plates. It is specially designed for use in an electronic organ where the 6KM8 can provide three independent readout or output-signal voltages. The diode unit can be used as a key in a vibrator circuit.



6KM8

Maximum ratings of the triode section of the RCA 6KM8 in frequency-divider and complex-wave generator service are:

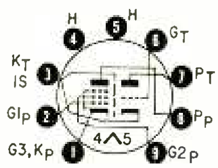
V_P (plate 1)	330
(plate 2A)	330
(plate 2B)	330
V_{G2}	330
V_{G1} (neg bias value)	50
(pos bias value)	0
G_2 input (watts)	0.65
P_P (plate 1, watts)	1
(plate 2A, watts)	1
(plate 2B, watts)	1

Diode section rating:

Maximum plate current	1 ma

5HG8

A triode-frame-grid pentode, in a 9-pm miniature envelope, designed for use in the mixer stage of vhf television tuners. This tube has a 5.3-volt 450-ma heater with an 11-second controlled warmup time.



5HG8

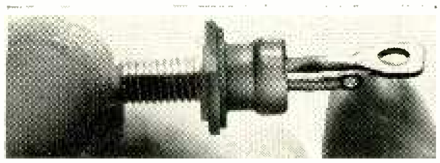
Typical operating characteristics of this Sylvania tube are:

	Triode	Pentode
V_P	100	170
V_{G2}	—	150
V_{G1}	—3	—1.2
I_P (ma)	14	10
I_{G2} (ma)	—	3.3
g_m (μmhos)	5,500	12,000
μ	17	70
R_P (k ohms)	3.1	350

2N1842-A through 2N1849-A

A series of controlled rectifiers, rated at 16 amps rms forward current. Typical applications for these 4-layer 3-terminal devices are in proportional control systems, such as heating controls, and residential light-dimming controls.

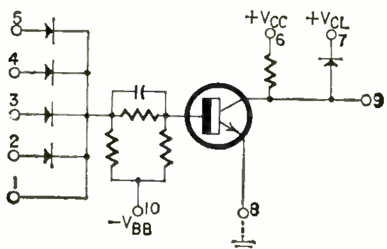
The units can withstand a 125°C

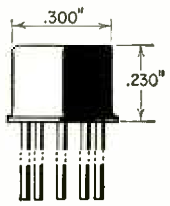


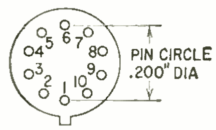
junction temperature and can carry an average current of 10 amps at a 180° conduction angle. One-cycle peak current rating is 125 amps and the maximum forward current drop is 1.6 volts at 10 amps. Forward blocking voltage ratings are 25 through 400 volts and repetitive peak reverse voltage ratings are 30 to 480.

NC-10

This digital *nor* gate can operate at speeds up to 15 mc. It features a clamped output to define the output







NC-IO

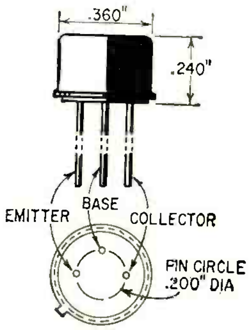
level and is widely used in digital logic systems, instrumentation and general switching service. The unit incorporates planar epitaxial microtransistors and microdiodes as well as planar resistors. The NC-10 Nanocircuit can replace many conventional packaged inverters.

Specifications for the General Instrument NC-10 silicon Nanocircuit:

V_{CC}	8	12
V_{C1}	3.2	4.2
V_{BB}	—3	—3
Logic levels (volts)	0.3 and 4	0.3 and 5
Max. output drive available	3.5 ma at 4 v	6.5 ma at 5 v
Max. power dissituation (mw)	80	170
Max. repetition rate (mc)	15	15
Output rising slope nsecs)	25	22
Output falling slope (nsecs)	12	12

2N1893

A high-voltage n-p-n silicon planar transistor, suitable for high-frequency, medium-power applications.



2N1893

Maximum ratings of the General Instrument 2N1893 are:

V_{CBO}	120
V_{EBO}	7
V_{CER} (pulsed)	100
V_{CEO}	80
P_{Total} (mw)	800

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
Practical Electrics	1921
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 January, 1913 *Modern Electronics*

Frog-Leg Wireless.

The Wireless Amateur and the Wireless Law, by C. A. LeQuesne, Jr. (Part Two).

Electrolytic Interrupters, by H. Winfield Secor.

International Wireless Signal Code, by Stanley E. Hyde.

Wireless Club Directory.

Rotary Spark Gap, by Charles S. Ballantine.

A Detector of Merit, by Paul Horton.

Compact Receiving Outfit, by Wyly Dewey Nelson.

Portable Sending Set, by Charles Keevil.

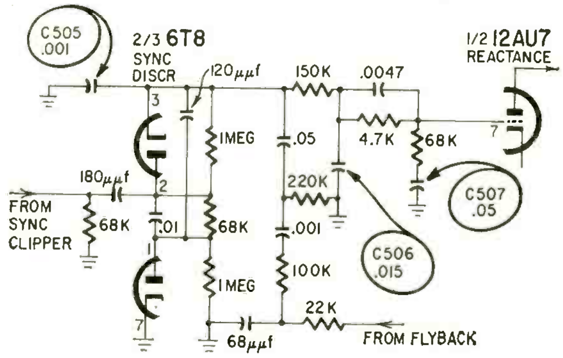
ENGINEERS, TECHNICIANS, EXPERIMENTERS WANTED

to write articles for RADIO-ELECTRONICS. Ask for an authors guide. FRED SHUNAMAN, RADIO-ELECTRONICS, 154 West 14th Street, New York, New York.

Technotes

G-E 24C101

The set was brought into the shop with a complaint of intermittent ripples in the center of the screen. Later the condition was analyzed as piecrusting. As in other cases of the piecrust effect, the trouble was insufficient filtering of the error signal in the horizontal afc. Shunting capacitors in this circuit (C505, C506 and C507) with known good units cured



the trouble. If the bad unit had been shorting, shunt caps wouldn't have helped and we would have had to check by replacement. Removing the shunts one at a time showed that C506 was causing the trouble. We replaced it with a new unit and the piecrust was gone.—*Warren Roy*

I Turned Off the Trouble

I had a call on a TV set that had no sound and no picture, but the raster was on. The room was dark, and I asked the owner for some light. He pointed to a switch in the back of the room. There were two adjacent switches side by side, and since I didn't know which was the right one I turned them both on. Then I returned to the set, changed both tuner tubes and turned the set on. Strangely enough, none of the tubes lit up. I checked the line cord and plug, but to no avail. I couldn't figure out what had happened. (The set had a power transformer.)

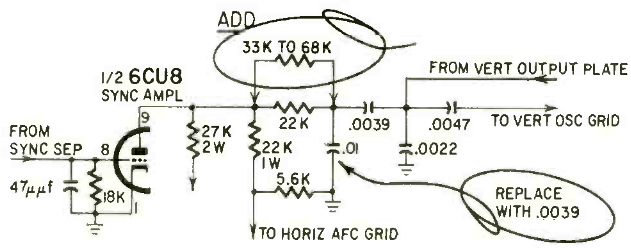
After taking the set to the shop, I checked the entire power supply, finding nothing wrong. I plugged in the set, and curiously enough it went on. I left it on for a whole day, hoping something would show up. Everything was normal, however.

I returned the set to the owner, and again it wouldn't work. I asked the owner if his outlets were ok, and he said yes, but that he had a switch to turn them off.

On my first visit, when I turned on the lights, I turned off the outlet!—*Saul Burah*

POOR SYNC, RCA KCS120

When poor sync is the problem with this model in weak signal areas, try adding a resistor (33,000–68,000



ohms) across the 22,000-ohm resistor in the plate circuit of the sync amplifier, a 6CU8. Replacing the .01-μf capacitor that is connected to one end of this resistor with a .0039-μf unit may also help.—*M. L. Leonard*

Metz 604

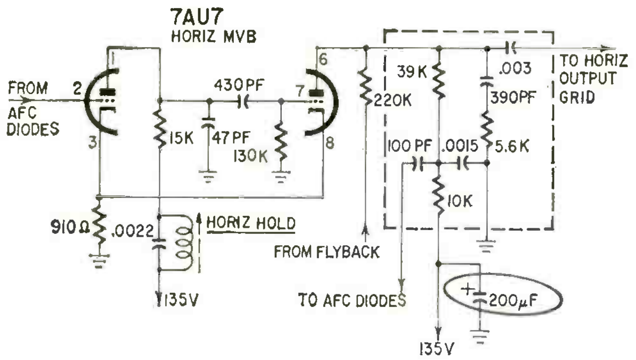
On this model the AM and FM tuning drives are engaged by a clutch assembly. It is a rubber-tired wheel that engages either the AM or FM tuning drive assembly. The tire (actually a rubber cover) eventually disintegrates and is hard to replace as sources of exact replacements are few and far between.

It can be repaired by buying a rubber finger—sold in drug stores—cutting it into three strips or sections 5/8 inch wide and placing these, one over the other, on the wheel.

This repair takes about an hour because both dial cords must be loosened and the entire assembly removed. When replacing the dial cords be sure you reinstall them exactly as they were. In fact, before loosening them, use small pieces of masking tape over all pulleys to hold the string in place.—*Juan F. Trujillo*

Philco E2004F

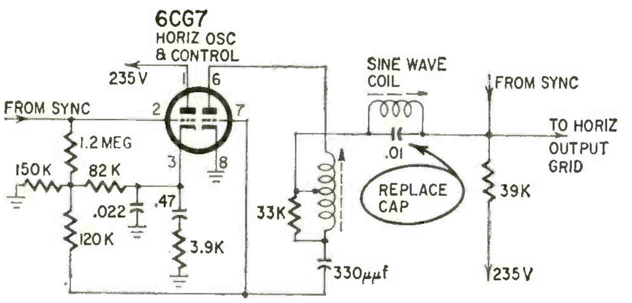
There was no raster and a squeal in the sound. Voltage checks at the horizontal multivibrator were within reason. Applying a 15,750-cycle signal at pin 6 of the 7AU7 (plate) restored the raster and cleared up the sound. I changed vari-



ous components in the horizontal circuit without results, finally found the trouble in the 200-μf filter on the 135-volt line that supplies the multivibrator plate through 39,000- and 10,000-ohm resistors. Replacing the capacitor cured the trouble. We used a higher-voltage replacement to insure against a recurrence of the same trouble.—*Lloyd S. Lemons*

RCA 14S7052 (KCS 102B)

Horizontal pull, poor vertical and horizontal sync: Change the .01-μf capacitor across the sine-wave coil in the horizontal oscillator (see diagram). Set slug, watching the scope for proper waveform, then change the .033-μf capacitor from the video amplifier plate network to the triode



section of 6AW8 (first sync amplifier). This set ran for hours outside the cabinet, but failed in 20 to 30 minutes inside the cabinet. A heat lamp was used on chassis to make the part break down.—*W. G. Esick*

END

THIS SALE IS "NISHT GEFUNFIT" (THE Real McCoy)

"DOLLAR BUYS" that would be bargains even at FIVE DOLLARS—made possible by our TREMENDOUS Buying Power* ... Money back guarantee ... Same day delivery!

10% OFF & FREE GIFT—ON PURCHASE OF $10 OR OVER

- ☐ 1—EMERGENCY AUTO LAMP Red dome, blinker, including batteries $1
- ☐ $15.00 RADIO PARTS "JACKPOT" handy assortment $1
- ☐ 1—5'' PM SPEAKER alnico #5 magnet $1
- ☐ 1—4'' PM SPEAKER alnico #5 magnet $1
- ☐ 1—4" TWEETER SPEAKER for HI-FI $1
- ☐ 3—SPEAKER CABINETS (3") Modern plastic in ebony $1
- ☐ 1—3'' PM SPEAKER Perfect fit for above cabinet ... $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 50L6 type $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 6K6 or 6V6 type .. $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 3Q4, 3Q5, 3S4 .... $1
- ☐ 3—I.F. COIL TRANSFORMERS 456kc, most popular type $1
- ☐ 15—RADIO OSCILLATOR COILS standard 456kc $1
- ☐ 3—I.F. COIL TRANSFORMERS 10.7mc for FM $1
- ☐ 2—G.E. #RTL-143 I.F. COIL TRNSFRMRS 456kc w/flange . $1
- ☐ 3—I.F. COIL TRANSFORMERS 262kc for Auto Radios ... $1
- ☐ 4—OVAL LOOP ANTENNAS assorted popular sizes $1
- ☐ 3—LOOPSTICK ANTENNAS hi-gain, ferrite, adjustable .. $1
- ☐ 3—½ MEG VOLUME CONTROLS with switch, 3" shaft . $1
- ☐ 5—ASST. 4 WATT WIREWOUND CONTROLS $1
- ☐ 10—ASSORTED VOLUME CONTROLS less switch $1
- ☐ 5—ASSORTED VOLUME CONTROLS with switch $1
- ☐ 5—50K VOLUME CONTROLS less switch $1
- ☐ 10—SURE-GRIP ALLIGATOR CLIPS 2" plated $1
- ☐ 10—SETS PHONO PLUGS & PIN JACKS RCA type $1
- ☐ 20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc. $1
- ☐ 20—PILOT LIGHT SOCKETS bayonet type, wired $1
- ☐ 50—ASSORTED TERMINAL STRIPS 1, 2, 3, 4 lugs $1
- ☐ 100'—FINEST NYLON DIAL CORD best size, .028 gauge .. $1
- ☐ 50—ASST. RADIO KNOBS screw and push-on types $1
- ☐ 25—ASST. CLOCK RADIO KNOBS in colors $1
- ☐ 25—ASSORTED PRINTED CIRCUIT SOCKETS best types .. $1
- ☐ 30—INSTRUMENT POINTER KNOBS popular screw type .. $1
- ☐ 10—SPRAGUE CONDENSERS 100/100/10—75 volts $1
- ☐ 1—LB SPOOL ROSIN-CORE SOLDER 40/60 .... $1
- ☐ 20—BALL POINT PENS Retractable, assorted colors ... $1

- ☐ 100—ASSORTED ½ WATT RESISTORS some in 5% $1
- ☐ 70 — ASSORTED 1 WATT RESISTORS some in 5% $1
- ☐ 35 — ASSORTED 2 WATT RESISTORS some in 5% $1
- ☐ 40—ASST. PRECISION RESISTORS in 1 percenters $1
- ☐ 20 — ASS'TED WIREWOUND RESISTORS 5, 10, 20 watt .. $1
- ☐ 10 — ASST. RADIO ELECTROLYTIC CONDENSERS ... $1
- ☐ 5—ASST. TV ELECTROLYTIC CONDENSERS $1
- ☐ 2 — ELECTROLYTIC CONDENSERS 40/40-450v $1
- ☐ 4 — ELECTROLYTIC CONDENSERS 20/20—450v $1
- ☐ 300—ASST. ½ W RESISTORS AB, IRC, Short leads, excellent $1
- ☐ 10—6' ELECTRIC LINE CORDS with plug $1
- ☐ 4—50' SPOOLS HOOK-UP WIRE 4 different colors $1
- ☐ 50—STRIPS ASSORTED SPAGHETTI handy sizes $1
- ☐ 100 — ASSORTED RUBBER GROMMETS best sizes $1
- ☐ 200'—BUSS WIRE #20 tinned for hookups, special circuits, etc. $1
- ☐ 250—ASST. SOLDERING LUGS best types and sizes $1
- ☐ 1000—ASST. HARDWARE KIT screws, nuts, washers, rivets, etc. $1
- ☐ 250—ASST. SELF TAPPING SCREWS #6, #8, etc. $1
- ☐ 150—ASST. 6/32 SCREWS and 150 6/32 HEX NUTS $1
- ☐ 150—ASST. 8/32 SCREWS and 150—8/32 HEX NUTS .. $1
- ☐ 150—6/32 HEX NUTS and 150—8/32 HEX NUTS ... $1
- ☐ 8—ASST. LUCITE CASES hinged cover, handy for parts $1
- ☐ 4—TOGGLE SWITCHES SPST, SPDT, DPST, DPDT $1
- ☐ 100—ASST RUBBER & FELT FEET FOR CABINETS best sizes $1
- ☐ 50—100K ½ WATT RESISTORS 10% $1
- ☐ 50—470K ½ WATT RESISTORS 10% $1
- ☐ 50—220K ½ WATT RESISTORS 10% $1
- ☐ 50—ASST. MICA CONDENSERS some in 5% $1
- ☐ 35—ASST. DISC CERAMIC CONDENSERS popular numbers $1
- ☐ 25—ASSORTED MICA TRIMMER CONDENSERS $1
- ☐ 3—ELECTROLYTIC CONDENSERS 50/30-150v $1
- ☐ 5—ELECTROLYTIC CONDENSERS 25-50v. $1
- ☐ 3—SELENIUM RECTIFIERS 2—65ma and 1—75ma $1
- ☐ 2—SELENIUM RECTIFIERS 1—100 ma and 1—250 ma .. $1
- ☐ 2—SELENIUM RECTIFIERS 1—65ma and 1—450ma $1

- ☐ $15.00 TELEVISION PARTS "JACKPOT" best buy ever .. $1
- ☐ 50—ASSORTED TV COILS I.F. video, sound ratio, etc. .. $1
- ☐ 1—$10 INDOOR TV ANTENNA hi-gain, 3 section, tiltproof $1
- ☐ 5—TV CHEATER CORDS with both plugs $1
- ☐ 3—ELECTROLYTIC CONDENSERS 50/30-150v $1
- ☐ 100'—TWIN TV LEAD-IN WIRE 300 ohm, heavy duty .. $1
- ☐ 50' — FLAT 4-CONDUCTOR WIRE many purposes $1
- ☐ 40—ASSORTED TV KNOBS ESCUTCHEONS etc. $20 value $1
- ☐ 6—ASSORTED STANDARD TUNER UHF STRIPS $1
- ☐ 1—70° FLYBACK TRANSFORMER Incl. Schematic Diagram .. $1
- ☐ 100—ASST. CERAMIC CONDENSERS some in 5% $1
- ☐ 2—TV VERTICAL OUTPUT TRANSFORMERS 16 to 1 ratio $1
- ☐ 2—RATIO DETECTOR COILS 4.5mc or 10.7mc $1
- ☐ 2—TV SOUND I. F. COILS 4.5mc or 21.25 mc $1
- ☐ 2—SOUND DISCRIMINATOR COILS 4.5mc or 10.7mc $1
- ☐ 50—ASSORTED TV PEAKING COILS all popular types $1
- ☐ 4—ASST. TV ION TRAPS for all type TV Receivers $1
- ☐ 4—TV CENTERING RINGS fits on neck of picture tube ... $1
- ☐ 10—TV PICTURE TUBE SOCKETS wired with 20" leads $1
- ☐ 5—TV HI-VOLT ANODE LEADS 20" length $1
- ☐ 20—ASSORTED GRID CAPS for 1B3, 1X2, 6BG6, 6BQ6, etc. $1
- ☐ 10—DIODE CRYSTALS 1N34 . $1
- ☐ 10—ASST. DIODE CRYSTALS 5—1N60 and 5—1N64 ...... $1
- ☐ 2—SILICON RECTIFIERS 750ma, 400 PIV $1
- ☐ 3—SILICON RECTIFIERS Top Hat 500ma-400 PIV $1
- ☐ 25'—INSULATED SHIELDED WIRE #20 braided metal jacket $1
- ☐ 32'—TEST PROD WIRE deluxe quality, red or black .. $1
- ☐ 50'—HI-VOLTAGE WIRE for TV, special circuits, etc.... $1
- ☐ 6—ASST. SLIDE SWITCHES SPST, DPDT, etc. $1
- ☐ 35—MICA CONDENSERS 20—470mmf and 15—680mmf $1
- ☐ 35—MICA CONDENSERS 20—2000mmf & 15—2500mmf $1
- ☐ 35—CERAMIC CONDENSERS 20—250mmf & 15—470mmf . $1
- ☐ STANDARD BRAND TUBES 0Z4, 1B3, 1X2, 5U4, 5Y3, 6AC7, 6AU6, 6AX4, 6CB6, 6CG7, 6J6, 6K6, 6SN7, 6U8, 6X8, 12AT7, 12AU7, 12AX4, 50L6 .... Each Tube $1

MARKET SCOOP COLUMN

- ☐ 1 ROSCOE PORTABLE RADIO some complete—including Cabinet, Spkr., 4 Tubes (as is, potluck) $1
- ☐ 10—ASSORTED TUBES Radio, Television and Industrial $1
- ☐ 6—TRANS. RADIO BATTERIES 9 volt, same as Eveready #216 $1
- ☐ 20—ASST. ROTARY SWITCHES all popular types over $20 value $1
- ☐ 20—ASST. DIODE CRYSTALS fine assortment. Latest types .. $1
- ☐ 500' CHOICE HOOKUP WIRE asst colors cut in handy lengths some stripped & tinned $1
- ☐ 100—CERAMIC CONDENSERS 300 mmf, 500 volts $1
- ☐ 2—WIRE STRIPPERS/CUTTERS adjust to all insulation sizes ... $1
- ☐ 1—SQ. YARD GRILLE CLOTH most popular brown & gold design $1
- ☐ 50—RCA PHONO PLUGS Standard for phonos, male $1
- ☐ 10—SILICON RECTIFIERS Top hat, 350 ma, 200 piv $1
- ☐ 3—3" RECORDER TAPES Quality acetate, 150 feet $1
- ☐ 20—G-E #NE-2 TUBES Neon Glow Lamp for 101 uses $1
- ☐ 10—KENRAD 6SH7 TUBES $1
- ☐ 10—½ MEG VOL CONTROLS $1
- ☐ 6—TV ALIGNMENT TOOLS $1
- ☐ 10—RCA #12L8 TUBES $1
- ☐ 10—RCA #954 TUBES $1
- ☐ 10—ROGERS #2X2 TUBES $1
- ☐ 3—SYLVANIA 35W4 TUBES $1
- ☐ 10—AMPERITE #3-38 TUBES most popular Ballast Tube .. $1
- ☐ 5—RCA #1U4 TUBES also serves as a 1T4 Tube .. $1
- ☐ 6—I.F. COIL TRANSFORMERS 456 kc. latest 3/4" x 3/4" type $1
- ☐ 1—90° FLYBACK TRANSFORMER including schematic diagram $1
- ☐ 1—HEARING AID AMPLIFIER incl 3 Tubes, Mike, Etc (as is) $1
- ☐ 100—ASSORTED SOCKETS all type 7 pin, 8 pin, 9 pin ... $1
- ☐ 100—ASSORTED FUSES 3AG and other popular sizes ... $1
- ☐ 100—ASSORTED TUBULAR CONDENSERS .001 to .47 up to 600v $1
- ☐ 20—STANDARD CONDENSERS .047-600v 85° top quality $1
- ☐ 10—C-D TUBULAR CONDENSERS 50mfd—150 volts lists at $1 $1
- ☐ 1—4 SPEED PHONO ARM with sapphire flipover Cartridge $2
- ☐ 100'—RG/59-U CO-AX Standard 72 ohm type $3

* In order to SELL, we must first BUY and that we do on a BIG SCALE. If you have any TUBES, CONDENSERS, RESISTORS or any other PARTS in quantity and new that you wish to sell . . . please send us samples . . . We pay SPOT CASH.

HANDY WAY TO ORDER—Simply pencil mark items wanted (X in square is sufficient), enclose with money order or check. You will receive a new copy of these offers for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess refunded. **LARGER ORDERS** shipped express charges collect.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N. Y. TELEPHONE COrtland 7-2359

NOTEWORTHY CIRCUITS

Regulated Heater Voltage Supply

A regulated heater voltage supply is often specified for precision oscillators and dc amplifiers. These circuits from *Hoffman Semiconductor Application Notes* show how Zener diodes can be used for this purpose. The circuits in Fig. 1 are for 6.3-volt 300-ma

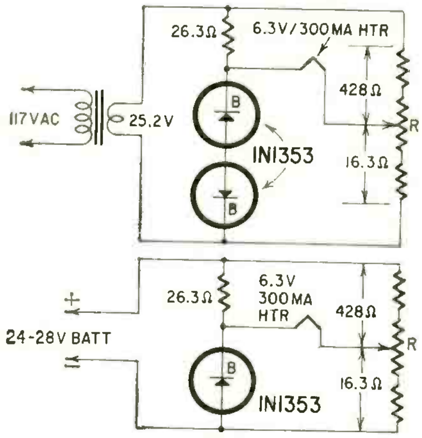


Fig. 1

heaters and those in Fig. 2 are for 12.6-volt 150-ma circuits.

When adjusted for optimum regulation, a 13% change in the voltage applied to the bridge causes a heater voltage variation not exceeding .04%. Trimmer resistor R should have a maxi-

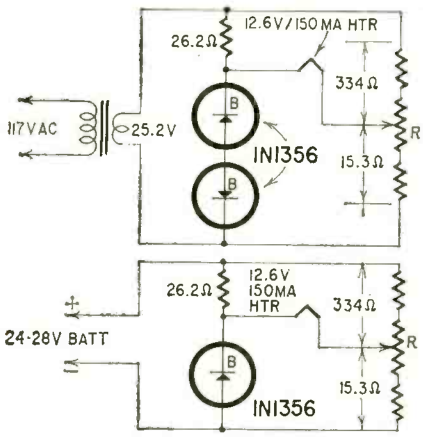


Fig. 2

mum value of about 20% of the total value of the lower variable arm of the bridge. The fixed resistor should be about 10% less than the value shown. A 3- to 4-ohm pot should do in the circuits in Figs. 1 and 2.

Fig. 3 is a test circuit for adjusting the voltage regulator bridge. Set the pot for minimum heater voltage variations with changes in supply voltage.

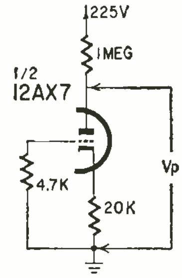


Fig.3

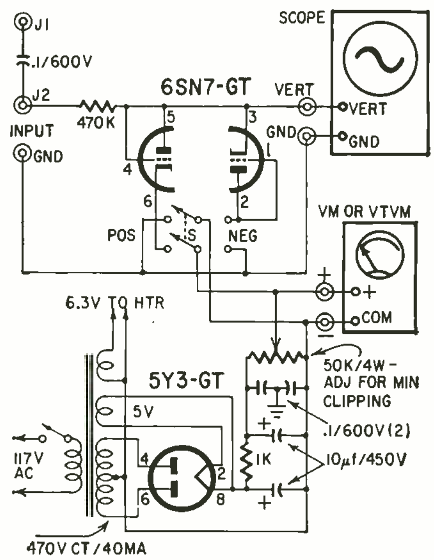
Using a precision null type vtvm with sensitivity better than .05%, it is possible to set the pot so there is no discernible change in plate voltage (V_P) when line voltage varies from 100 to 150.

Peak-Voltage Indicator

This instrument measures the negative and positive peak values of a waveform displayed on a scope. Peak voltage values are read directly on your vom or vtvm.

Connect the scope and vtvm or vom as shown in the diagram. Adjust the spot for maximum reading on the voltmeter. Place switch S in the positive or negative position to read the desired peak voltage polarity. Connect the voltage to be measured between J1 and ground if it has a dc component or between J2 and ground if it is straight ac.

Synchronize the scope for a stationary pattern and adjust the vertical



gain control for maximum height without discernible distortion. Set the vertical centering control so the desired negative or positive peak is centered on the scope screen. Now, back off the pot until clipping or flattening of the waveform is barely perceptible. At this point, the voltage read on the meter is very nearly equal to the peak voltage of the waveform. Throw the switch to the other side and recenter the waveform to measure peaks of opposite polarity.

Caution: Be very careful if your

meter has its common jack connected to its metal case. Don't let it touch the scope or the indicator chassis. And, above all, don't touch the meter and scope at the same time. You may get a serious shock. The variable bias supply in the indicator is above ground and the meter's case will not be at ground potential.—L. M. Dilley

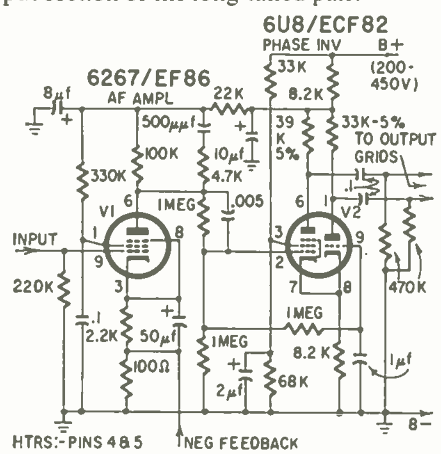
New Phase Inverter

Instability in many high-fidelity amplifiers with wide-band output transformers has been traced to poor high-frequency response in the phase-inverter or phase-splitter circuit. When negative feedback is applied around the phase inverter, the drop in response at high frequencies causes a lagging phase shift that approaches 90°. If the total phase shift is 180° at some high frequency, feedback becomes positive and the amplifier oscillates.

This kind of instability can be minimized by increasing the high-frequency response so the frequency where phase shift becomes intolerable is close to or above the upper limit of the output transformer.

In *Wireless World*, A. R. Bailey describes an improved version of the popular long-tailed-pair phase inverter. In the original circuit, the high-frequency response is limited by Miller effect in the input triode. When a 12AX7 long-tailed pair is fed from a 100,000-ohm impedance, the reflected Miller capacitance causes the response to drop around 3 db at 25 kc.

The new circuit practically eliminates Miller effect degradation by using a pentode instead of a triode in the input section of the long-tailed pair.



The diagram shows the front end of a power amplifier with the long-tailed pair. The pentode and triode sections of a 6U8/ECF82 are used. The plate load resistor in the pentode section is slightly larger than the one in the triode stage, for balanced output. Coupling between the input stage and the phase inverter is direct. This eliminates the coupling capacitor, which could make the amplifier unstable at low frequencies when large amounts of feedback are used. END

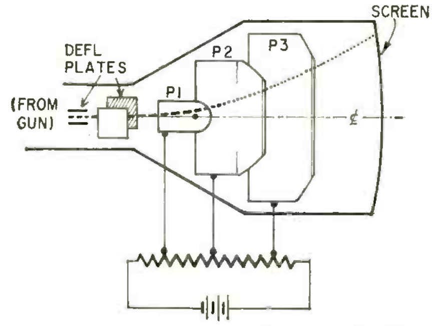
new PATENTS

Sensitive CRT

PATENT NO. 3,042,832

Harvey M. Owren, Livermore, Calif. (assigned to Abtronics, Inc., Livermore)

This novel deflector-accelerator adds sensitivity without distortion. Three curved electrodes, P1, P2, and P3, are energized from taps on a voltage divider. A thin film of secondary-emission material is placed in front of P1. Each electron striking P1



(dashed line) causes *several* electrons (dotted line) to be emitted. These are further deflected and accelerated by P2, then by P3, to provide a larger, more brilliant trace on the screen. A sensitivity gain of 10 is claimed when the radii of P3: P1 are in the ratio of 5:1.

The drawing shows a CRT with electrostatic deflection, but electromagnetic deflection can be used.

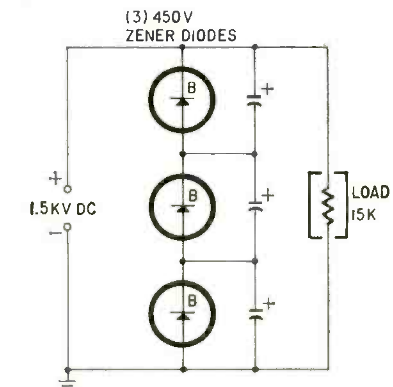
High-Voltage Operation of Electrolytic Capacitors

Patent No. 3,041,501

Samuel P. Willits, Mt. Prospect, Ill., (Assigned to Chicago Aerial Industries, Inc., Melrose Park, Ill.)

Electrolytic capacitors are compact and inexpensive, but are normally limited to circuits handling 500 volts or less. This patent shows how to connect electrolytics in series (without equalizing resistors which waste power) to withstand higher voltages.

In the diagram the load may be a photoflash lamp. Each capacitor is rated at 500 volts, and



each diode is a 450-volt Zener. The diodes protect the capacitors against overload during operation. Also, they protect against reverse voltage that may appear across an electrolytic during discharge, due to distributed capacitance and inductance.

Meter Protection

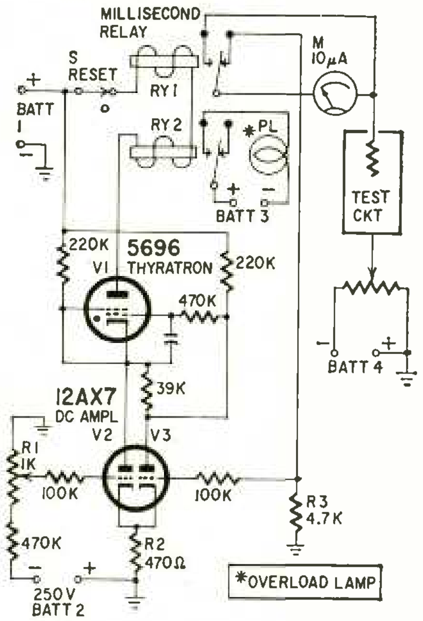
PATENT NO. 3,042,865

Grant F. Stetzler, Temple, Pa. (Assigned to Western Electric Co., Inc., New York, N.Y.)

This circuit removes an overload even before the meter needle can deflect appreciably. As meter current rises (through R3) it *adds* to V3's bias.

Also, since R2 passes less current, V2's bias is *reduced* at the same time. This results in a potential dfference between the tube's anodes.

When meter current reaches the danger point, the output from V2 and V3 is high enough to



fire the thyratron and energize the relays it controls. Then RY1 contacts short out the meter and RY2 contacts switch on the overload indicator.

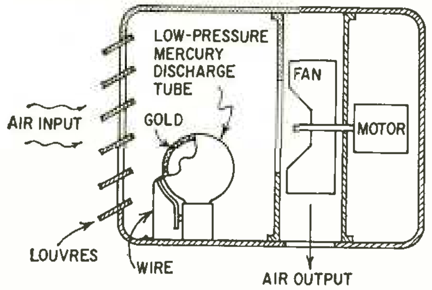
R1 is adjusted so that thyratron V1 fires at the predetermined overload value. S resets the circuit. RY1 and RY2 should be fast-acting relays, such as mercury types.

Negative Ion Generator

PATENT NO. 3,043,977

Harold J. Morowitz, Orange, Conn.
(assigned to Puritron Corp., New Haven, Conn.)

Negative ions are used in therapeutic work and to purify air. This generator uses a mercury tube within an enclosure. A thin layer of gold (or other metal) is deposited on the inner shell of this tube.



The gold absorbs ultraviolet light from the tube, and emits photoelectrons.

A fan sucks in air through the louvres and expels it through the side. The photoelectrons or ions move along with the air into the room.

A ground wire to the metallic layer replenishes the supply of negative charges as they are emitted.

END

"Sure glad you showed up. There's a program in a couple minutes I don't want to miss."

R-E Classified ADS

Rates—55¢ per word (including name, address and initials). Minimum ad 10 words. Payment must accompany all ads except those placed by accredited advertising agencies. Three or more consecutive issues—50¢ per word. Misleading or objectionable ads not accepted. Copy for March issue must reach us before Jan. 10, 1963.
RADIO-ELECTRONICS, 154 West 14 St., New York 11, N. Y.

WANTED

INVESTIGATE ACCIDENTS. Earn $750 to $1,000 monthly. Men urgently needed. Car furnished. Business expenses paid. No selling. No college education necessary. Pick own job location. Investigate full time, or earn $6.44 hour spare time. Write for Free Book. No obligation. **UNIVERSAL**, CER-1, 6801 Hillcrest, Dallas 5, Tex.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special purpose, Magnetrons, Klystrons, broadcast types, etc. Want military & commercial lab/test and communications equipment such as G.R., H.P. AN/UPM prefix. Also want commercial receivers and transmitters. For a fair deal write **BARRY,** 512 Broadway, New York 12, N.Y. WAlker 5-7000.

PLATINUM electronic scrap bought. **NOBLE METALS CO.,** Box 543, Los Angeles 9, Calif.

ELECTRONICS MANUFACTURER offers engineering and/or production facilities. Tax exemption permits tremendous savings. **MILLES ENGINEERING,** Las Marias, P. R.

EDUCATION/ INSTRUCTION

LEARN WHILE ASLEEP, Hypnotize with your recorder, phonograph or amazing new Electronic Educator endless tape recorder. Catalog, details free. **SLEEP-LEARNING ASSOCIATION,** Box 24-RD, Olympia, Wash.

NEW CONCEPT OF LEARNING SELF-HYPNOSIS! Now on tape or record! Free Literature. **McKINLEY-SMITH CO.,** Dept. T5, Box 3038, San Bernardino, Calif.

FCC LICENSE in 6 weeks, First Class Radio Telephone. Results Guaranteed. **ELKINS RADIO SCHOOL,** 2603E Inwood, Dallas, Tex.

JOB-SEEKING TECHNIQUE, $1.00. **WALTER KAZAKS,** 234 E. 58th St., New York 22, N. Y.

SLIDE RULE—SELF TEACHING METHOD. Genuine bamboo 8-inch rule; manual with step-by-step illustrative problems, practice exercises and answers. Only $3.95. postpaid; Cash, check or money order. **ALSYNCO,** Dept. RE-1, 171 So. Main, Natick, Mass.

LEARN ELECTRONIC ORGAN SERVICING. New Home Study courses covering all makes electronic organ including transistors. Experimental kits — schematics — troubleshooting. Accredited NHSC-GI Approved. Write for free booklet. **NILES BRYANT SCHOOL,** 3631 Stockton Blvd., Dept. F. Sacramento 20, Calif.

HIGH-PAY Jobs in electronics waiting for you! Be an electronics technician, missileman, automation expert, computer specialist, radio-TV-hi-fi serviceman. Massey home study training pays for itself in spare-time earnings—accredited course with 7 kits. Write for Free home study or residence catalog. **MASSEY TECHNICAL INSTITUTE,** Dept. RE-1, Jacksonville, Fla.

LEARN HYPNOSIS. Free illustrated catalogue. Write: **HYPNOTIST,** 8721 Sunset, Los Angeles 69RE, Calif.

SERVICES

METER REPAIRS. Average $2.50 by **BIGELOW ELECTRONICS,** Bluffton, Ohio. Free Mailing Pack.

TRANSISTORIZED products dealers catalog, $1. **INTERMARKET,** CPO 1717, Tokyo, Japan.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. New and used instruments bought, sold, exchanged. **HAZELTON INSTRUMENT CO.,** 128 Liberty St., New York, N.Y.

SPEAKER RECONING. Satisfaction Guaranteed. **C & M RECONE CO.,** 255 Tioga St., Trenton, N.J.

TV Tuners—rebuilt or exchanged, $9.95. Fast, Guaranteed. Complete crystal control alignment. **VALLEY TUNER SERVICE,** 18530 Parthenia, Northridge, Calif.

MULTIMETER REPAIRS. Average $7.00 by, **BIGELOW ELECTRONICS,** Bluffton, Ohio. FREE Catalog.

JAPAN DIRECTORY. 145 manufacturing exporters. Japan and Hongkong trade Journal information. Asia opportunities. Send $1.00. **NIPPON SHOGYO.** Box 739, Seattle 11, Wash.

G-R, H-P, L&N, etc., Tubes, manuals, military electronics. **ENGINEERING ASSOCIATES,** 434 Patterson Road, Dayton 19, Ohio.

FOR SALE

General

TRANSISTORIZED PRODUCTS replacement parts catalog $1.00 money order. Custom orders for transistorized equipment or components. Write **TECHSERVICES,** C.P.O. Box 849, Tokyo, Japan.

BEFORE You Buy Receiving Tubes, Test Equipment, Hi-Fi Components, Kits, Parts, etc. . . . send for your Giant Free Zalytron Current Catalog, featuring all STANDARD BRAND TUBES all Brand New Premium Individually Boxed, One Year Guarantee—all at BIGGEST DISCOUNTS in America! We serve professional servicemen, hobbyists, exprimenters, engineers, technicians, WHY PAY MORE? **ZALYTRON TUBE CORP.,** 461 Jericho Turnpike, Mineola, N. Y.

FREE CATALOG—name-brand tubes 65% discount, phono needles 80% or more discount, phono cartridges, picture tubes 75¢ inch, parts, parts kits, silicon and selenium rectifiers, transmitting tubes, 7" TV test tube $6.99, imported batteries, tube testers etc. Want to swap or sell tube inventory? Send us your offering. **ARCTURUS ELECTRONICS CORP.**—Dept. R.E., 502 22nd St. Union City, N. J.

100 NEW INSULATED CARBON RESISTORS $1.00 postpaid. Free Catalog. **BIGELOW ELECTRONICS,** Bluffton, Ohio.

APPLIANCE-AUTOMOTIVE Lamp-Vacuum parts. Free wholesale bargain lists. **SECO,** 112 So. 20th St., Birmingham 3, Ala.

Electronics

DISC CERAMIC CAPACITORS. New, unused. Leading manufacturer. Most popular capacitance. Assortment of 30 capacitors for only $1.00. **ROCK DISTRIBUTING CO.,** 902 Corwin Rd., Rochester 10, N.Y.

SAVE DOLLARS on radio, TV tubes, parts at less than manufacturer's cost. 100% guaranteed! No rebrand, pulls. Request Bargain Bulletin. **UNITED RADIO,** 1000-R, Newark, N.J.

DIAGRAMS for TV, $2.00; for radio, $1.00. **HIETT DIAGRAMS,** Box 816, Laredo, Tex.

TRANSISTOR IGNITION COIL—Instructions. SPECIAL—$8.50. **ANDERSON ENGINEERING,** 16 Williams, Wrentham, Mass.

PROFESSIONAL ELECTRONICS PROJECTS—Organs, Timers, Computers, etc.—$1 each. List free. **PARKS,** Box 1665, Lake City, Seattle 55, Wash.

SUPERSENSITIVE DIRECTIONAL MICOPHONE picks up faint sounds at 300 feet. Detects sound through ordinary walls. Easily built for $7.00. No electronic experience necessary. Illustrated plans, $2.00. **DEE CO.,** Box 7263-A, Houston 8, Tex.

TRANSFIRE IGNITION. Transistor electronic. Save gas, tune-ups. Points, plugs last 50,000-100,000 miles. Improved cold-starting high-speed performance. Parts, complete conversions, kits from $34.95. **PALMER ELECTRONICS,** RE-1, Carlisle, Mass.

GOVERNMENT SURPLUS. Voltmeters—$1.05, Freq meters—$4.37, Transmitters—$6.18, Receivers—$5.65, Oscilloscopes, Multimeters, walkie-talkies. Typical surplus prices. Exciting details FREE. Write: **N. Y. ENTERPRISES,** Box 402-F14, Jamaica 30, N. Y.

CONVERT ANY TELEVISION TO SENSITIVE, Big-screen oscilloscope. Only minor changes necessary. Plans $1.95. **RELCO,** Box 10563, Houston 18, Tex.

PRECISION RESISTORS, carbon-deposit. Guaranteed 1% accuracy. Millions in stock. ½ watt, 8¢. 1-watt, 12¢. 2- watt, 15¢. Leading manufacturers. **ROCK DISTRIBUTING CO.,** 902 Corwin Rd., Rochester 10, N.Y.

DIAGRAMS FOR REPAIRING RADIOS, $1; television $2. Give make and model. **DIAGRAM SERVICE,** Box 672 RE, Hartford 1, Conn.

VIDICON FOCUS AND DEFLECTION COIL KIT, coils and all parts included $15.95—also available assembled. Coming soon vidicon camera kit—under $200. **KENCOL ELECTRONICS,** 2816 E. Norwich, Fresno, Calif.

CONFIDENTIAL BARGAIN Electronic Parts catalog, lowest prices in USA. Guaranteed. Send 20¢ coin only. **KNAPP,** 3174 8th Ave. SW, Largo, Fla.

WEBSTER ELECTRIC INTERCOM! Amateur Equipment! Marine Electronics! Select Bargains! 10¢ Any list! **SUPPLIERS,** 187 Miraloma, Miraloma, Calif.

ELECTRONICS, Radios, Amplifiers, Recorders. Everything Japanese. **UNITA,** 545 Fifth Ave., New York 17, N.Y.

BEGINNER'S CRYSTAL-TRANSISTOR giant catalog. **LABORATORIES,** 1131-B Valota, Redwood City, Calif.

Audio—Hi-fi

WRITE for our low quotation on components, recorders. FREE catalog. **HI-FIDELITY SUPPLY,** 2817-XC, Third Ave., New York City 55.

TAPE recorders, Hi-Fi components, Sleep-learning equipment, Tapes, Unusual values. Free catalog. **DRESSNER,** 1523 Jericho Turnpike, New Hyde Park 5, N.Y.

RENT STEREO TAPES—over 2,500 different—all major labels—free catalog. **STEREO-PARTI,** 811-RE, Centinela Ave., Inglewood 3, Calif.

SALE ITEMS — tapes — recorders — component quotes. **BAYLA,** Box 131-RE, Wantagh, N. Y.

KARLSON SPEAKER ENCLOSURES. Systems and Kits. Wholesale-Retail. (Dealers, Salesmen wanted; Western States, Hawaii.) **PARASONIC LABORATORIES,** Orcutt, Calif.

ATTENTION: A THRILLING FIND: We have just uncovered a collection of original antique Edison Cylinder Phonographs, released from 50 years of storage. Each in perfect working order and shape. Each complete with outside concert horn with stand and 12 original cylinders. Each $70.00, extra cylinders $1.00 each. **TRACY STORAGE CO.,** 114 State, Brewer, Me.

4/TR STEREO TAPES—bought, sold, rented, traded! bargain closeouts! Catalog. **COLUMBIA** 9651 Foxbury, Rivera, Calif.

STEREO TAPES FOR RENT. Write **NATIONAL TAPES,** 71 Dey St., New York 7, N.Y.

VIBRATION MICROPHONE, many uses. Instructions, Sample, $1.00. **IGWTE,** Williamsburg, N. M.

MISCELLANEOUS

$100 WEEKLY POSSIBLE. Compile mailing lists and address envelopes for advertisers. Home-spare time. Particulars free. **NATIONAL SERVICE,** 81 Knickerbocker Station, New York, N. Y.

MAKE $25-$50 WEEK CLIPPING newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. **NATIONAL,** 81 Knickerbocker Station, New York N. Y.

EXOTIC EARRINGS! Details Free. Pair, $1.00. **OHGA,** RA-415, Sigakenkusatu, Japan.

BUSINESS AIDS

BUSINESS CARDS, LABELS, RUBBER STAMPS. Send for free descriptive literature, **HEIGHTS INDUSTRIES,** 6121 C Street, Capitol Heights 27, Md.

250 BOND 8½x11 letterheads, 250 Envelopes Printed $5.50. **ACADEMY PRESS,** Enterprise, Kan.

1,000 BUSINESS CARDS $3.95. Many other bargains. List Free. **ALCO,** Box 244-R, Urbana, Ill.

new BOOKS

ELECTRONIC DRAFTING, by George Shiers. *Prentice-Hall Inc., Englewood Cliffs, N. J. 6 x 9 in. 556 pp. $11.50.*

A complete text, aimed at the electronics technician who may be a beginner in drafting. Covers workshop practices as well as drawing techniques.

MODERN INFRARED TECHNOLOGY, by Barron Kemp. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 255 pp. $4.95.*

Infrared generation and detection, and its applications in measurement, communication and viewing.

ELECTRICITY AND ELECTRONICS FOR AEROSPACE VEHICLES, Northrop Institute of Technology staff. *McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N. Y. 8½ x 11 in. 392 pp. Cloth, $13.95.*

Excellent background material for the electronic technician who would like to get into repair, maintainance or assembly of equipment for aircraft or space vehicles.

AMATEUR RADIO ANTENNA HANDBOOK, by Harry D. Hooton, W6TYH. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 160 pp. $2.95.*

Charts and practical data on towers, lines, antennas and couplers.

REPRODUCTION OF SOUND, by Edgar Villchur. *Acoustic Research Inc., 24 Thorndike St., Cambridge 41, Mass. 6 x 9 in. 93 pp. Paper, $2. Direct from publisher only.*

A nonmathematical analysis of the nature of sound and of how reproducing components work. A reprint and revision of the author's excellent course in the fundamentals of sound and high fidelity that appeared some years ago in the magazine *Audio.*

PHOTOELECTRIC CONTROL, by Harvey Pollack. *John F. Rider Publisher Inc., 116 W. 14 St., New York, N. Y. 5½ x 8½ in. 136 pp. $3.50.*

A modern education, at technical school level, covering tubes, measurements and controls.

PERMANENT MAGNETS AND THEIR APPLICATION, by Rollin J. Parker and Robert J. Studders. *John Wiley & Sons Inc., 440 Park Ave. South, New York 16, N. Y. 5¾ x 9 in. Cloth, 406 pp. $16.*

Magnetic charts and calculations for engineers and designers.

TV TUBE SYMPTOMS & TROUBLES, by Robert G. Middleton. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in. 96 pp. $1.95.*

A great deal of information in a small amount of space. A large number of photographic reproductions of TV screens.

RADIO-WAVE PROPAGATION IN THE TROPOSPHERE, edited by J. A. Saxton. *American Elsevier Publishing Co. Inc., 52 Vanderbilt Ave., New York 17, N. Y. 6 x 9 in. 199 pp. Cloth, $8.75.*

Proceedings of Commission II on radio and troposphere during the XIII General Assembly of URSI, London, September 1960.

School Directory

ELECTRONICS IS HIGHER INCOME!

Prepare NOW! EARN YOUR A. S. DEGREE IN 24 MOS.

DEMAND FOR ELECTRONIC ENGINEERING TECHNOLOGISTS EXCEEDS SUPPLY! Enroll with a nationally-recognized *leader* in electronics education. ECPD Accredited Technical Institute curricula in Electronic Engineering Technology and Commercial Broadcast Technology. Complete career preparation for booming fields of ELECTRONICS—COMMUNICATIONS — BROADCASTING — COMPUTER TECHNOLOGY — COMPUTER PROGRAMMING. College level resident and home-study courses. Coeducational. Up-to-date laboratories feature IBM, BENDIX and UNIVAC electronic computers and data processing equipment. SEND COUPON FOR COMPLETE CATALOG.

CENTRAL TECHNICAL INSTITUTE 1644 Wyandotte, Kansas City 8, Mo. RE013

Name ________ Age ____

Address ________

City ________ Zone ____ State ____

CHECK INTEREST: ☐ Resident ☐ Home Study

ENGINEERING DEGREES

E. E. Option Electronics, Mechanical, Also in Liberal Arts earned by

HOME STUDY

Resident Classes Also Available if Desired
Specify course preferred

PACIFIC INTERNATIONAL C. A. S.

PACIFIC INTERNATIONAL COLLEGE OF ARTS & SCIENCES

Primarily a correspondence school
Chartered 1935

5719-M Santa Monica Blvd. Hollywood 38, Calif.

ENGINEERING SCIENCE MATH — B.S. DEGREE IN 36 MOS.

U.S. NEEDS 50.000 NEW ENGINEERS A YEAR! EARN ACCREDITED B.S. DEGREE in Science or Engineering in 36 months—year-round program optional. 27-month engineering diploma also available. Classes start January, March, June, September. QUALITY EDUCATION. Graduates employed throughout the U. S. and foreign countries. Government approved for veteran training. Students from 50 states. 40 countries. 20 buildings; dorms, gym. Campus. New library and laboratories. Employment help provided. SAVE TIME AND MONEY. Write for catalog and full information.

1616 E. Washington Blvd., Fort Wayne 2, Indiana

INDIANA TECHNICAL COLLEGE

ENGINEERING EDUCATION for the Space Age

NORTHROP INSTITUTE of Technology is a privately endowed, nonprofit college of engineering offering a complete Bachelor of Science Degree Program and TWO-YEAR accredited technical institute curricula. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics, and space technology. Write today for catalog—no obligation.

NORTHROP INSTITUTE OF TECHNOLOGY
1181 West Arbor Vitae Street, Inglewood 1, California

ETI

Engineering Technician
A.S. Degree—2 Years
Electronics Engineer
B.S. Degree
Evening Courses Available

ELECTRONIC TECHNICAL INSTITUTE
970 W. Manchester Ave., Inglewood, Calif.
4863 El Cajon Blvd., San Diego, Calif.

GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic & advanced courses in theory & laboratory. Electronic Engineering Technology, an ECPD accredited Technical Institute curriculum. Assoc. degree in 29 mos. B.S. also obtainable. G.I. approved. Graduates in all branches of electronics with major companies. Start Feb., Sept. Dorms, campus. High school graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
Department C, Valparaiso, Indiana

ENGINEERING

ENGINEERING DEGREE IN 27 MONTHS

You know the advantages college graduates have in industry . . . more income, rapid advancement. Important firms like Tri-State graduates . . . regularly interview seniors on campus. Become an Electronics Engineer. Bachelor of Science Degree in 27 Months in Electrical, Mechanical, Chemical, Aeronautical, Civil Engineering. IN 36 MONTHS B. S. in Business Administration (General Business, Accounting, Motor Transport Management majors). For earnest, capable students. Small classes. More professional class hours. Beautiful campus. Well-equipped labs, modernized buildings, new dorms. Year-round operation. Enter Mar., June, Sept., Jan. Founded 1884. Write J. G. McCarthy, Director Admissions, for Catalog and "Your career in Engineering and Commerce" Book.

TRI-STATE COLLEGE
2413 College Avenue • Angola, Indiana

EARN Electronics Engineering DEGREE

You can earn an A.S.E.E. degree at home. College level HOME STUDY courses taught so you can understand them. Continue your education, earn more in the highly paid electronics industry. Missiles, computers, transistors, automation, complete electronics. Over 27,000 graduates now employed. Resident school available at our Chicago campus—Founded 1934. Send for free catalog.

American Institute of Engineering & Technology
1139 West Fullerton Parkway, Chicago 14, Ill.

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below

Printed in USA.

THE FINEST STEREO HEADPHONES YOU'VE EVER HEARD

Jensen MANUFACTURING COMPANY
Division of The Muter Co.

Jensen's new HS-1 Stereo Headphones are ready for you. We think you will agree with the experts who say they are the finest ever. Reasons? They cover the frequency range with extra smoothness because they have new **fluid-damped** transducers developed by Jensen. And they are good to look at, easy to adjust, comfortable to wear. Cord comes out one side . . . you don't get tangled up. Impedance 8 ohms. Complete with Jackbox for connecting to any stereo amplifier. Write for Brochure MH.

HS-1 With 3 conductor plug and accessory jack box.......... Net **$24.95**
HS-1L With 4 spade lug terminals.......................... Net **22.50**

Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill. / Canada: Radio Speakers of Canada, Ltd., Toronto